ASAP Service and Maintenance Manual

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Charging Air Force

Introduction

The ASAP has two batteries, one battery is located under the hood. This battery is for the Polaris Ranger functions. This battery starts the engine, runs the ignition system, headlights, turn signals, power steering system and Aux. cooling fan. This battery is for all Polaris chassis related items.

The other battery is located under the driver's seat (this can be accessed by pulling up on the front edge of the seat, lifting in the areas of between the driver's legs and the passenger legs).
This battery is the deep cycle battery; it runs all emergency lighting, dome lights, windshield wipers, generator starter, A\C control panel, 12 volt outlet in rear patent compartment.

Polaris Battery:

The Polaris battery is charged two ways:

1. Polaris engine
2. Onboard battery charger

If the Polaris engine is running the engine charges the battery.
If the shoreline is plugged in, the onboard battery charger charges the battery.
If the generator is running the onboard battery charger charges the battery.

Any time the generator is running, the onboard battery charger is on and charging batteries

The only time the onboard charger is **not** charging the Polaris battery is if the ignition key is in the **"on"** position or the Polaris engine is running. This is to prevent double charging.

Note: There is a solenoid that only allows one device to charge the Polaris battery at one time. By turning the ignition key to the "**on"** position, the solenoid breaks the connection from the onboard battery charger to the Polaris battery.
(This creates a red blinking light on the onboard battery charger).

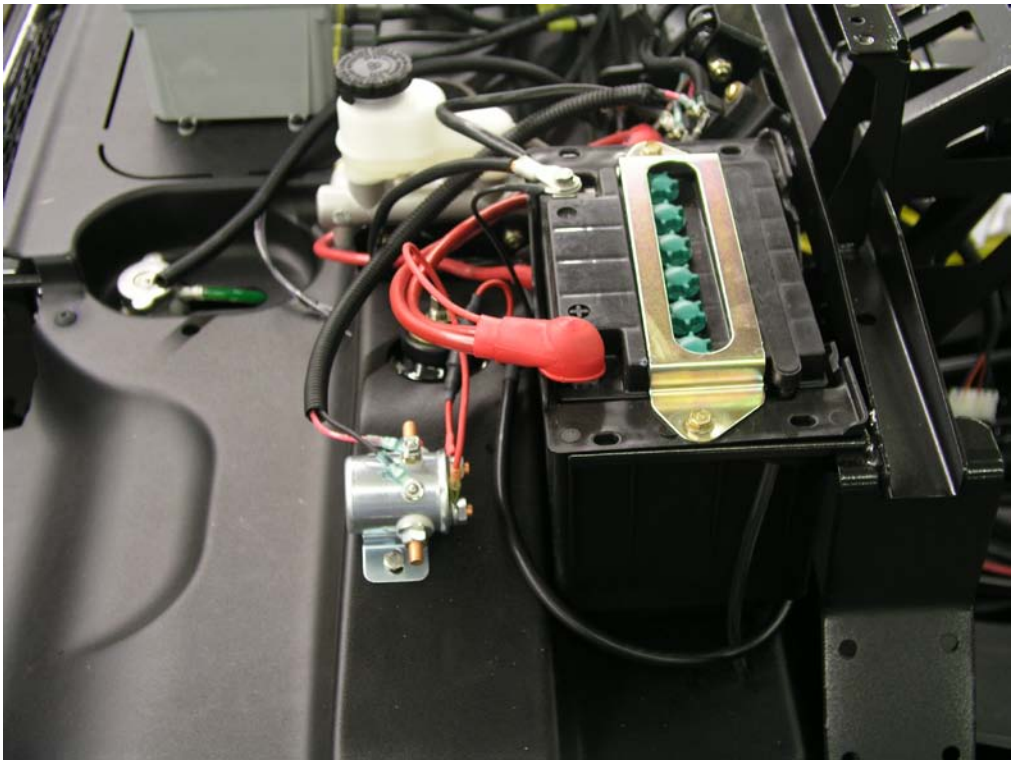
As a safety measure, this solenoid does not allow current from the battery charger to enter the system when the Polaris engine is running. The engine stator is charging the battery when the engine is running.

Q. When would you find yourself on this type of situation?
A. If you were driving the ASAP and running the generator.

Q. Is it okay to drive the ASAP with the generator running?
A. Yes

Q. Is it okay to have the shoreline plugged in all the time?
A. Yes, anytime the ASAP is stationary and you have access to 110 volt outlet, it should be plugged in. The battery charger will automatically shut off when your batteries are full.

The Polaris battery is located under the hood and the steel solenoid is located near this battery. This battery size is considered a **CB30L-B**. Always replace it with one that is equivalent.



Deep Cycle Battery:

The deep cycle battery is charged only one way:

1. Onboard battery charger

If the shoreline is plugged in, the onboard battery charger charges the battery.
If the generator is running the onboard battery charger charges the battery.

Any time the generator is running the onboard battery charger is on and charging the deep cycle battery.

Q. Is it okay to drive the ASAP with the generator running?
A. Yes

Q. Is it okay to have the shoreline plugged in all the time?
A. Yes, anytime the ASAP is stationary and you have access to a 110 volt outlet, it should be plugged in. The battery charger will automatically shut off when your batteries are full.

The deep cycle battery is located under the driver. Its size is considered a **group 27**. When replacing this battery always replace it with a Group 27 Deep Cycle battery.

This battery needs to be charged daily to prevent discharge.

If the deep cycle battery gets discharged completely (less than 2 volts), the onboard battery charger will not start charging the battery.
You will need to hook up an external battery charger like one you would put on your car or attach a pair of jumper cables from another vehicle for a couple of minutes.

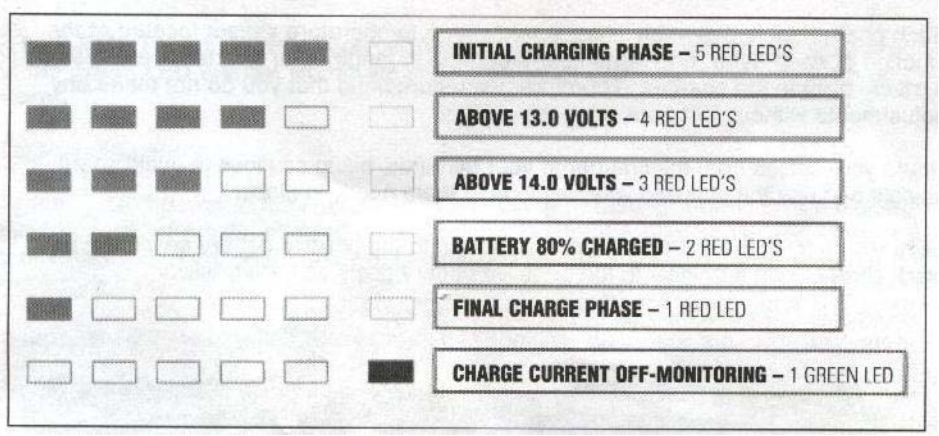
If using an external charger it will need to be used for approximately one half hour. This will put enough charge into the battery to allow the onboard charger to start charging the battery.

Note: The onboard battery charger will not start charging a battery that is completely dead. The charger thinks that that battery may have a shorted cell in it and prevents the charging process from starting for safety reasons.

Start Charging the Batteries

To start charging the batteries you can do it one of two ways. You can simply plug in an extension cord into the shoreline receptacle located near the driver's door. Or you can start the generator. After you do one or the other, locate the onboard battery charger. It will be located under the dash on earlier models and under the hood on newer models.
Observe the red L.E.D bar graph. The more red lights you have the more the battery is discharged. As the battery charges up the lights will one by one go out resulting in just one red light. It then will turn green, indicating the battery is fully charged. The charger has two indivual battery chargers within the one case, so they are completely separate from each other. So you may have one green light on one battery and red lights showing on the other battery.

The following picture shows the charging status.



Notice that even with three red lights on, the battery has 14.0 volts in it. That's still a pretty good battery.

If the battery was completely dead, it will take at least 8 hours to recharge the deep cycle battery up to a full charge status.

Shoreline Location:

The shoreline is located near the driver's door.

Charging System with Battery Brain and No Generator

Introduction

The ASAP has two batteries, one battery is located under the hood. This battery is for the Polaris Ranger functions. This battery starts the engine, run's the ignition system, headlights, turn signals, power steering system and (optional) aux. cooling fan. This battery is for all Polaris chassis related items.

The other battery is located under the driver's seat (this can be accessed by pulling up on the front edge of the seat, lifting in the areas of between the driver's legs and the passenger legs). This battery is the deep cycle battery; it runs all emergency lighting, dome lights, windshield wipers, A\C control panel, and 12 volt outlet in patent compartment.

Polaris Battery:

The Polaris battery is charged two ways:

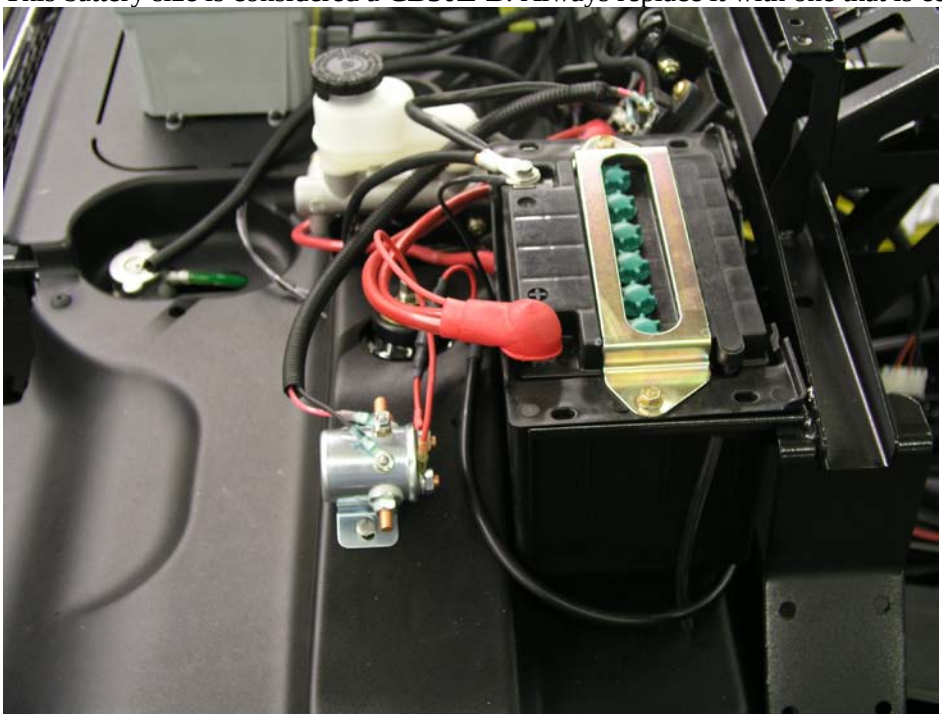
1. Polaris engine
2. Onboard battery charger

If the Polaris engine is running the engine charges the battery.
If the shoreline is plugged in, the onboard battery charger charges the battery.

Q. Is it okay to have the shoreline plugged in all the time?

A. Yes, anytime the ASAP is stationary and you have access to 110 volt outlet, it should be plugged in. The battery charger will automatically shut off when your batteries are full.

The Polaris battery is located under the hood.
This battery size is considered a **CB30L-B**. Always replace it with one that is equivalent.



Deep Cycle Battery:

The deep cycle battery is charged only one way:

1. Onboard battery charger

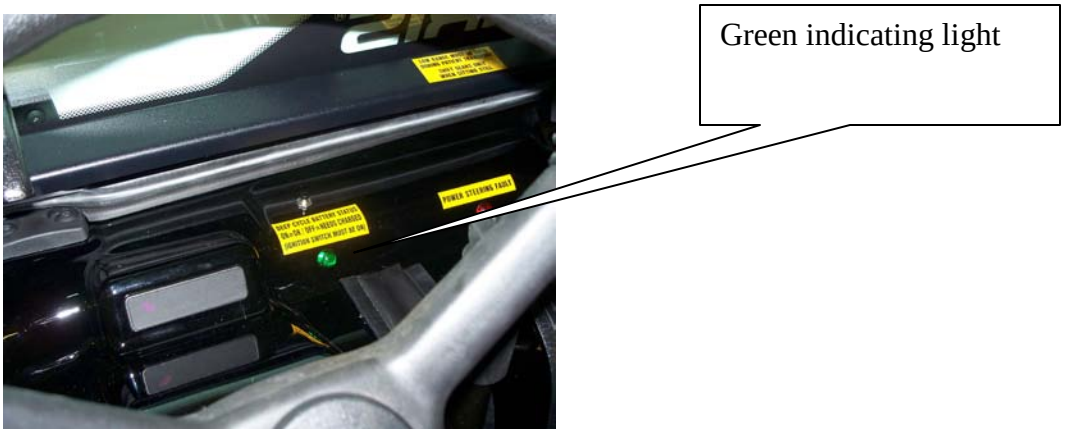
If the shoreline is plugged in, the onboard battery charger charges the battery.

The deep cycle battery is located under the driver. Its size is considered a **group 27**.
When replacing this battery always replace it with a Group 27 Deep Cycle battery.

This battery needs to be charged daily to prevent discharge.

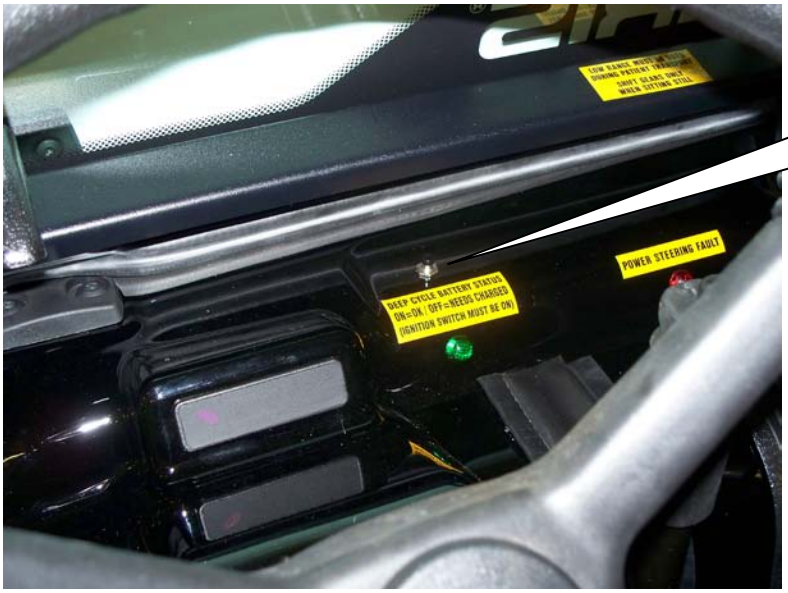
The deep cycle battery has a load manager device that monitors the battery voltage at all times. As long as the battery voltage is above 10.5 volts the green light is illuminated on the dash indicating the battery is in an okay status.

If the voltage drops below 10.5 volts the green light will go out, indicating the battery needs charging. (The green light will only work if the ignition key is in the on position)



If you find yourself in an emergency situation and your deep cycle battery drops below the 10.5 volts which will cut or turn off all auxiliary power you can push the push button on the dash near the windshield to regain 12 volt battery power.

At that point you are running on only the remaining battery voltage and you will run the battery dead. **This is to be done only if absolutely necessary**.



Over ride button for the battery brain

Start Charging the Batteries

To start charging the batteries you simply plug an extension cord into the shoreline receptacle located near the driver's door.

Observe the red L.E.D light on the battery charger located under the hood. It will turn green, indicating the batteries are fully charged. The charger has two indivual battery chargers within the one case, so they are completely separate from each other and the battery charger is completely waterproof. (Refer to the battery charger manual for further information).

It will take at least 8 hours to recharge the deep cycle battery up to a full charge status if it was completely down

Shoreline Location:

The shoreline is located near the driver's door.

Charging System with Battery Brain and Generator without Push Button

Introduction

The ASAP has two batteries, one battery is located under the hood. This battery is for the Polaris Ranger functions. This battery starts the engine, runs the ignition system, headlights, turn signals, power steering system and the optional auxiliary cooling fan.

This battery is for all Polaris chassis related items.

The other battery is located under the driver's seat (this can be accessed by pulling up on the front edge of the seat, lifting in the areas between the driver's legs and the passenger legs).

This battery is the deep cycle battery; it runs all emergency lighting, dome lights, windshield wipers, generator starter, A\C control panel, 12 volt outlet in the patent compartment. And any other optional equipment that may be on the unit

The ignition switch and master switch do not have to be "ON" in order to charge batteries

Polaris Battery:

The Polaris battery is charged two ways:

1. By the Polaris engine
2. By the onboard battery charger

If the Polaris engine is running the engine charges this battery.
If the shoreline is plugged in, the onboard battery charger charges the battery.
If the generator is running the onboard battery charger charges the battery.

Any time the generator is running the onboard battery charger is on and charging batteries

The only time the onboard charger is **not** charging the Polaris battery is if the ignition key is in the **"ON"** position or the Polaris engine is running. This is to prevent double charging.

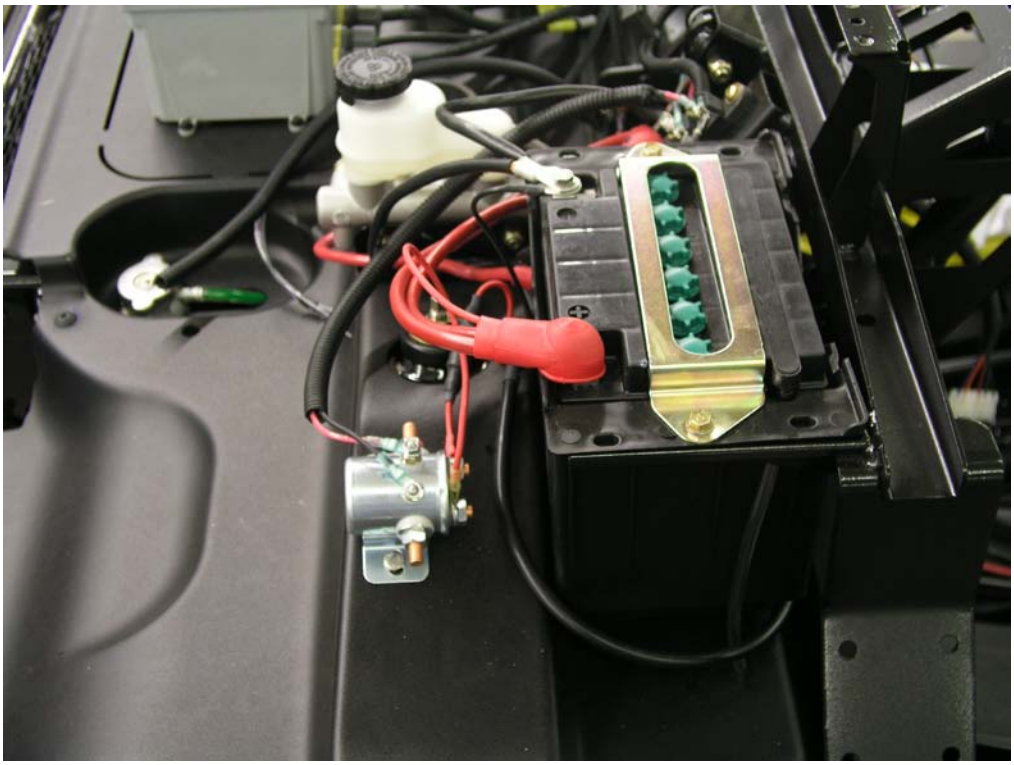
Note: There is a solenoid that only allows one device to charge the Polaris battery at one time. By turning the ignition key to the "**on"** position, a solenoid breaks the connection from the onboard battery charger to the Polaris battery.
As a safety measure this solenoid does not allow current from the battery charger to enter the system when the Polaris engine is running. The engine stator charges the battery when the engine is running.

Q. When would you find yourself in this type of situation?
A. If you were driving the ASAP and running the generator.

Q. Is it okay to drive the ASAP with the generator running?
A. Yes

Q. Is it okay to have the shoreline plugged in all the time?
A. Yes, anytime the ASAP is stationary and you have access to 110 volt outlet, it should be plugged in. The battery charger will automatically shut off when your batteries are full.

The Polaris battery is located under the hood and the steel solenoid is located near this battery. This battery size is considered a **CB30L-B**. Always replace it with one that is equivalent.



Deep Cycle Battery:

The deep cycle battery is charged only one way:

1. By the onboard battery charger

If the shoreline is plugged in, the onboard battery charger charges the battery.
If the generator is running the onboard battery charger charges the battery.

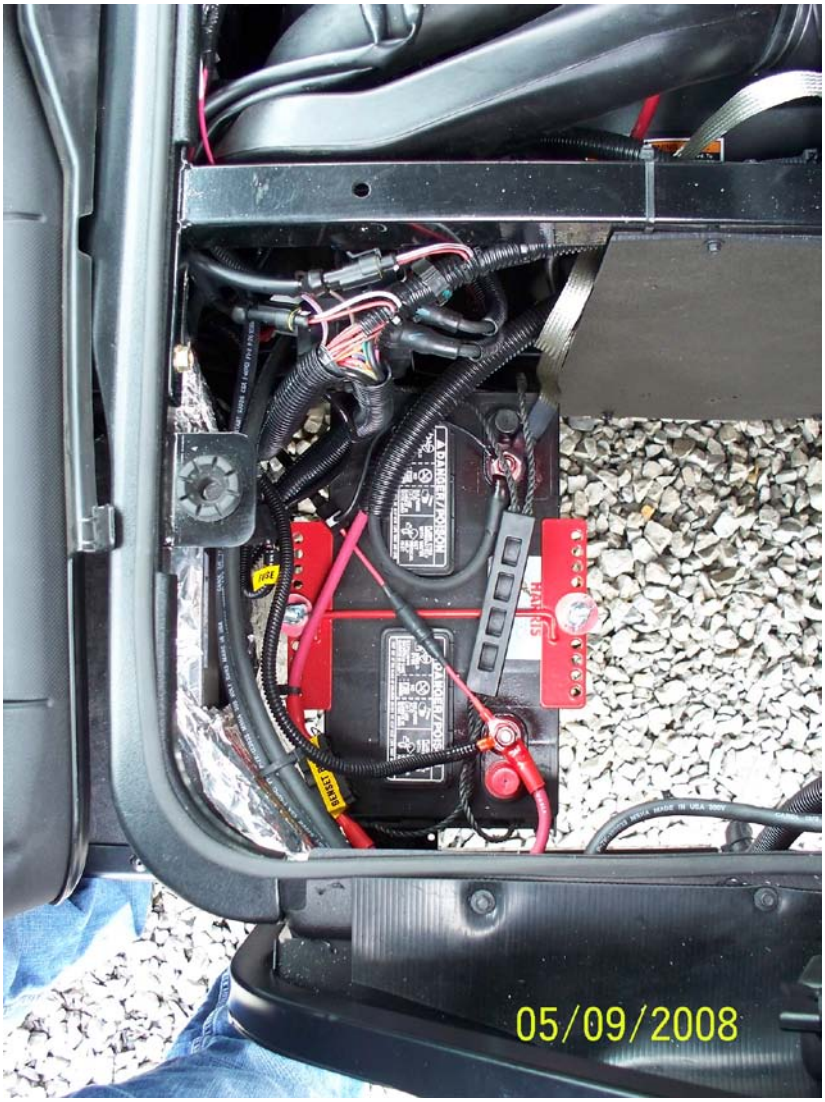
Any time the generator is running the onboard battery charger is on and charging the deep cycle battery.

Since the deep cycle battery can only be charged via the onboard battery charger it is good practice to keep the shoreline plugged in often or run the generator.

This is only needed of course if you have been running any of the accessories that are connected to the deep cycle battery.

A quick way to determine what is connected to the deep cycle battery is to turn off the master switch that is located between the driver's legs. This switch runs everything that is connected to the deep cycle battery. So if you're not sure, turn that item in question "on" and then turn the master switch off. If the item in question turns off then is run off the deep cycle battery.
If it stays on then it is run off the Polaris battery and the factory electrical system.

The deep cycle battery is located under the driver. Its size is considered a **group 27**. When replacing this battery always replace it with a Group 27 Deep Cycle battery.



This battery needs to be charged daily to prevent discharge.

The deep cycle battery has a load manager device that monitors the battery voltage at all times. As long as the battery voltage is above 10.5 volts the green light is illuminated on the dash indicating the battery voltage is in an okay status.

If the voltage drops below 10.5 volts the green light will go out indicating the battery needs charging. When the green light goes out the battery voltage is below 10.5 volts. This condition will make the load manager device shut down all deep cycle battery functions.

The green light only works if the ignition key is in the "ON" position

Start Charging the Batteries

To start charging the batteries you can do it one of two ways.

1. You can simply plug an extension cord into the shoreline receptacle located near the driver's door.

Or

2. You can start the generator.

After you do one or the other, locate the onboard battery charger. It is located under the hood.

Observe the red L.E.D light. It will turn green, indicating the batteries are fully charged. The charger has two separate battery chargers within the one case, so they are completely separate from each other. Refer to the battery charger manual for further information.

It will take at least 8 hours to recharge the deep cycle battery up to a full charge status if it was completely down to 10.5 volts

Shoreline Location:

The shoreline is located near the driver's door.

Charging System with Battery Brain and Generator

Introduction

The ASAP has two batteries, one battery is located under the hood. This battery is for the Polaris Ranger functions. This battery starts the engine, runs the ignition system, headlights, turn signals, power steering system and (optional) aux. cooling fan.
This battery is for all Polaris chassis related items.

The other battery is located under the driver's seat (this can be accessed by pulling up on the front edge of the seat, lifting in the areas of between the driver's legs and the passenger legs). This battery is the deep cycle battery; it runs all emergency lighting, dome lights, windshield wipers, generator starter, A\C control panel, 12 volt outlet in patent compartment.

(The ignition switch and master switch do not have to be "ON" in order to charge batteries)

Polaris Battery:

The Polaris battery is charged two ways:
1. Polaris engine
2. Onboard battery charger

If the Polaris engine is running the engine charges the battery.
If the shoreline is plugged in, the onboard battery charger charges the battery.
If the generator is running the onboard battery charger charges the battery.

Any time the generator is running the onboard battery charger is on and charging batteries

The only time the onboard charger is **not** charging the Polaris battery is if the ignition key is in the **"on"** position or the Polaris engine is running. This is to prevent double charging.

Note: There is a solenoid that only allows one device to charge the Polaris battery at one time. By turning the ignition key to the "**on"** position, the solenoid breaks the connection from the onboard battery charger to the Polaris battery.

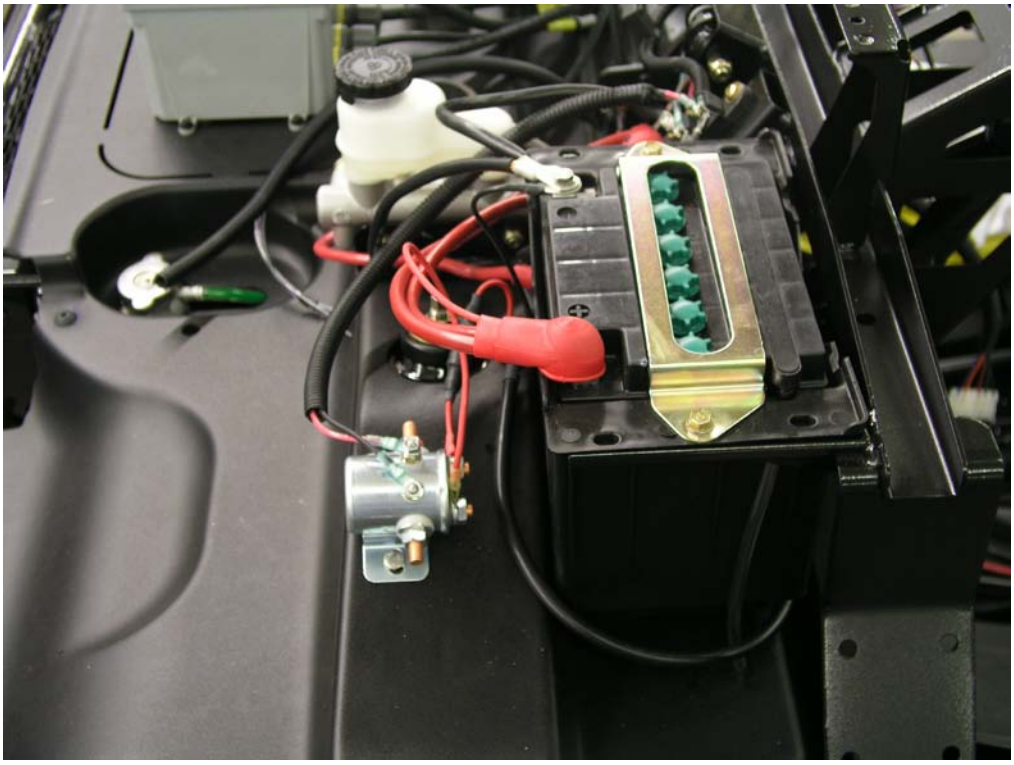
As a safety measure this solenoid does not allow current from the battery charger to enter the system when the Polaris engine is running, as the engine stator is charging the battery when the engine is running.

Q. When would you find yourself on this type of situation?
A. If you were driving the ASAP and running the generator.

Q. Is it okay to drive the ASAP with the generator running?
A. Yes

Q. Is it okay to have the shoreline plugged in all the time?
A. Yes, anytime the ASAP is stationary and you have access to 110 volt outlet, it should be plugged in. The battery charger will automatically shut off when your batteries are full.

The Polaris battery is located under the hood and the steel solenoid is located near this battery. This battery size is considered a **CB30L-B**. Always replace it with one that is equivalent.



Deep Cycle Battery:

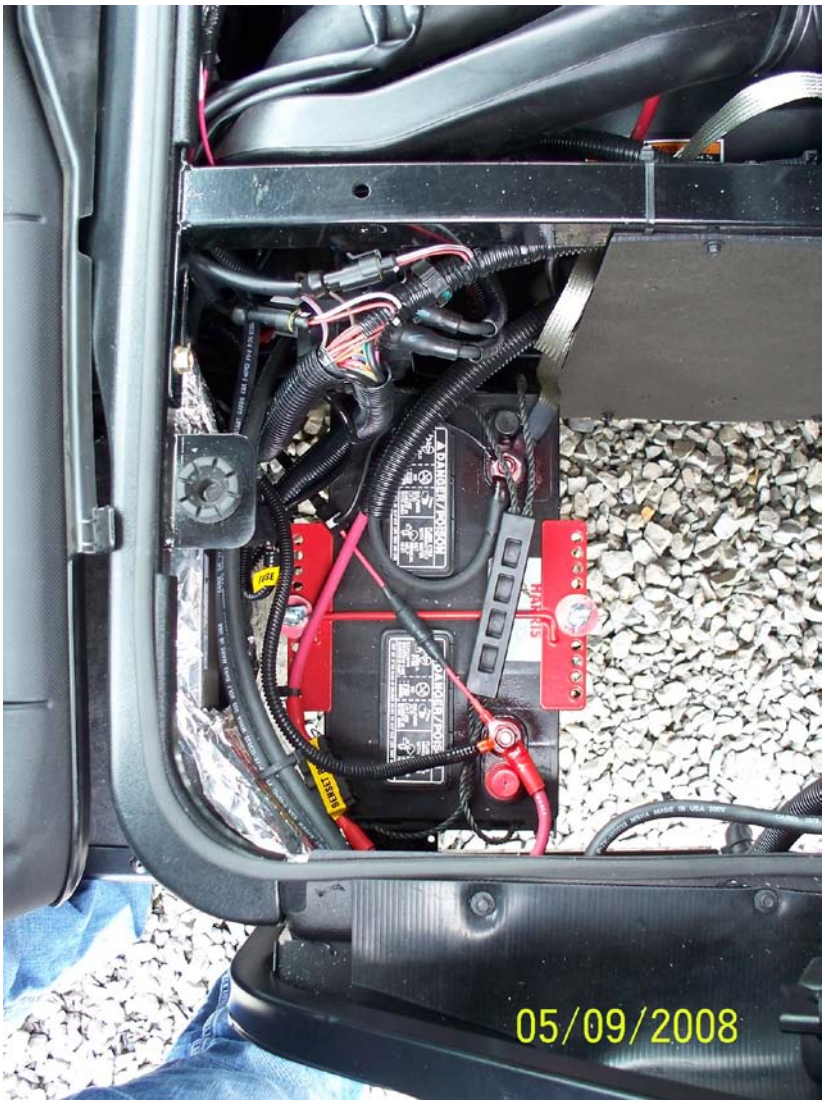
The deep cycle battery is charged only one way:

1. Onboard battery charger

If the shoreline is plugged in, the onboard battery charger charges the battery.
If the generator is running the onboard battery charger charges the battery.

Any time the generator is running the onboard battery charger is on and charging the deep cycle battery.

The deep cycle battery is located under the driver. Its size is considered a **group 27**. When replacing this battery always replace it with a Group 27 Deep Cycle battery.



This battery needs to be charged daily to prevent discharge.

The deep cycle battery has a load manager device that monitors the battery voltage at all times. As long as the battery voltage is above 10.5 volts the green light is illuminated on the dash indicating the battery voltage is in an okay status.

If the voltage drops below 10.5 volts the green light will go out indicating the battery needs charging. When the green light goes out the battery voltage is below 10.5 volts. This condition will make the load manager device shut down all deep cycle battery functions.

(The green light will only work if the ignition key is in the on position)

If you find yourself in an emergency situation and your deep cycle battery drops below the 10.5 volts which will cut or turn off all auxiliary power, you can push the push button on the dash near the windshield to regain 12 volt battery power. At that point you are running on only the remaining battery voltage and you will run the battery dead. This is to be done only if absolutely

necessary. It would be better to start the generator which would turn on the on board battery charger.

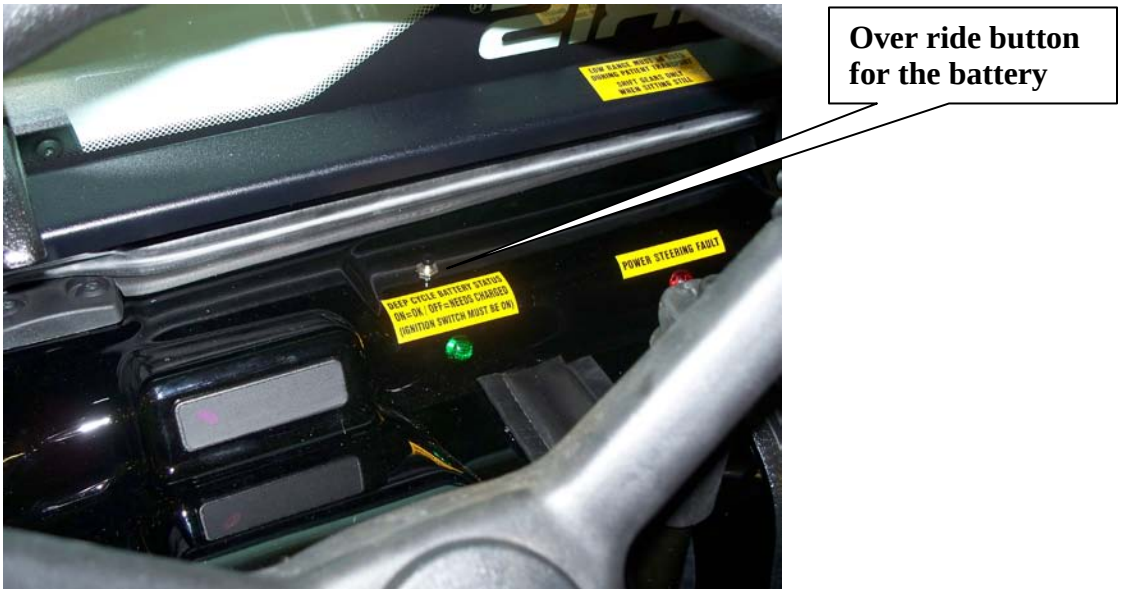
NOTE:
You might find yourself in a situation where you have the master switch in the on position, the ignition key in the on position and the green light is not on but you know that the deep cycle battery is up in charge.

Hold the Over ride button for two seconds until you here the load manager "click".

Sometimes the load manger may see a condition where it kicks itself off or someone may accidently push the over ride button by mistake. Either of these conditions will result in having no deep cycle battery functions even though the battery is up.

So just remember if you happen to have lost auxiliary power for no apparent reason. You first need to hold the over ride button in for a couple of seconds to reset the load manager.

You will either get power back or the load manger will kick back out. If it kicks out your battery is low.



Start Charging the Batteries

To start charging the batteries you can do it one of two ways. You can simply plug in an extension cord into the shoreline receptacle located near the driver's door. Or you can start the generator. After you do one or the other, locate the onboard battery charger. It is located under the hood.
Observe the red L.E.D light. It will turn green, indicating the batteries are fully charged. The charger has two separate battery chargers within the one case, so they are completely separate from each other. Refer to the battery charger manual for further information.

It will take at least 8 hours to recharge the deep cycle battery up to a full charge status if it was completely down

Shoreline Location:

The shoreline is located near the driver's door.

Charging System without Load Manager

Introduction

The ASAP has two batteries, one battery is located under the hood. This battery is for the Polaris Ranger functions. This battery starts the engine, runs the ignition system, headlights, turn signals, power steering system and Aux. cooling fan. This battery is for all Polaris chassis related items.

The other battery is located under the driver's seat (this can be accessed by pulling up on the front edge of the seat, lifting in the areas of between the driver's legs and the passenger legs).
This battery is the deep cycle battery; it runs all emergency lighting, dome lights, windshield wipers, generator starter, A\C control panel, 12 volt outlet in rear patent compartment.

Polaris Battery:

The Polaris battery is charged two ways:

1. Polaris engine
2. Onboard battery charger

If the Polaris engine is running the engine charges the battery.
If the shoreline is plugged in, the onboard battery charger charges the battery.
If the generator is running the onboard battery charger charges the battery.

Any time the generator is running, the onboard battery charger is on and charging batteries

The only time the onboard charger is **not** charging the Polaris battery is if the ignition key is in the **"on"** position or the Polaris engine is running. This is to prevent double charging.

Note: There is a solenoid that only allows one device to charge the Polaris battery at one time. By turning the ignition key to the "**on"** position, the solenoid breaks the connection from the onboard battery charger to the Polaris battery.
(This creates a red blinking light on the onboard battery charger).

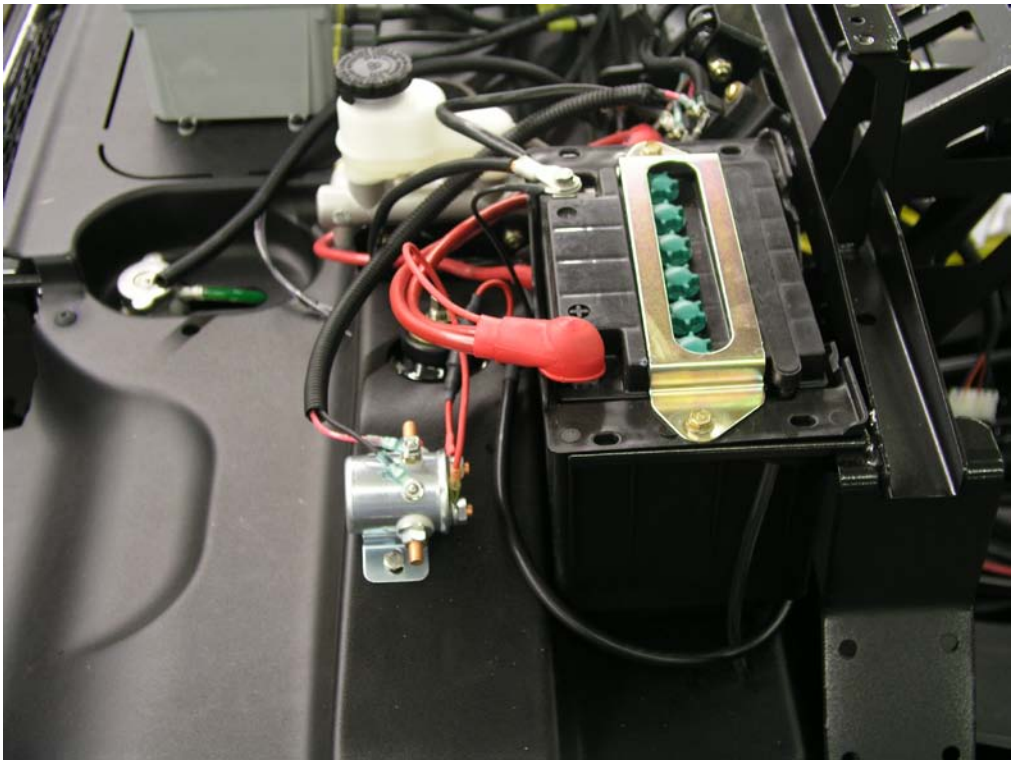
As a safety measure, this solenoid does not allow current from the battery charger to enter the system when the Polaris engine is running. The engine stator is charging the battery when the engine is running.

Q. When would you find yourself on this type of situation?
A. If you were driving the ASAP and running the generator.

Q. Is it okay to drive the ASAP with the generator running?
A. Yes

Q. Is it okay to have the shoreline plugged in all the time?
A. Yes, anytime the ASAP is stationary and you have access to 110 volt outlet, it should be plugged in. The battery charger will automatically shut off when your batteries are full.

The Polaris battery is located under the hood and the steel solenoid is located near this battery. This battery size is considered a **CB30L-B**. Always replace it with one that is equivalent.



Deep Cycle Battery:

The deep cycle battery is charged only one way:

1. Onboard battery charger

If the shoreline is plugged in, the onboard battery charger charges the battery.
If the generator is running the onboard battery charger charges the battery.

Any time the generator is running the onboard battery charger is on and charging the deep cycle battery.

Q. Is it okay to drive the ASAP with the generator running?
A. Yes

Q. Is it okay to have the shoreline plugged in all the time?
A. Yes, anytime the ASAP is stationary and you have access to a 110 volt outlet, it should be plugged in. The battery charger will automatically shut off when your batteries are full.

The deep cycle battery is located under the driver. Its size is considered a **group 27**. When replacing this battery always replace it with a Group 27 Deep Cycle battery.

This battery needs to be charged daily to prevent discharge.

If the deep cycle battery gets discharged completely (less than 2 volts), the onboard battery charger will not start charging the battery.
You will need to hook up an external battery charger like one you would put on your car or attach a pair of jumper cables from another vehicle for a couple of minutes.

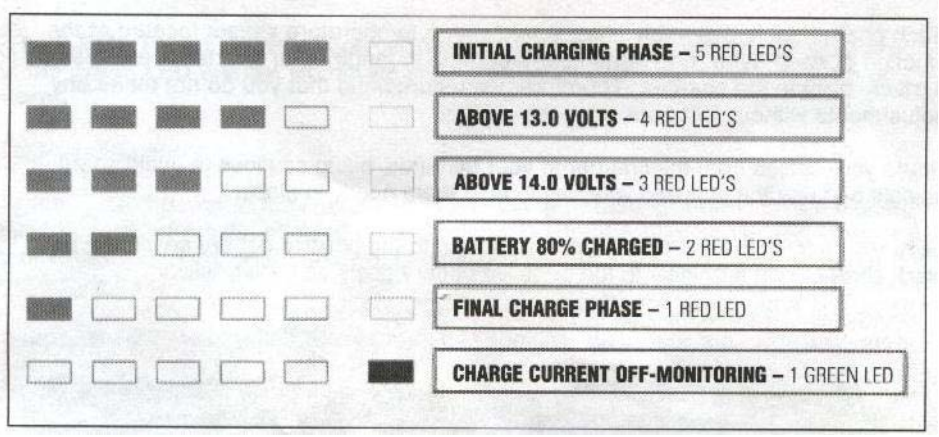
If using an external charger it will need to be used for approximately one half hour. This will put enough charge into the battery to allow the onboard charger to start charging the battery.

Note: The onboard battery charger will not start charging a battery that is completely dead. The charger thinks that that battery may have a shorted cell in it and prevents the charging process from starting for safety reasons.

Start Charging the Batteries

To start charging the batteries you can do it one of two ways. You can simply plug in an extension cord into the shoreline receptacle located near the driver's door. Or you can start the generator. After you do one or the other, locate the onboard battery charger. It will be located under the dash on earlier models and under the hood on newer models.
Observe the red L.E.D bar graph. The more red lights you have the more the battery is discharged. As the battery charges up the lights will one by one go out resulting in just one red light. It then will turn green, indicating the battery is fully charged. The charger has two indivual battery chargers within the one case, so they are completely separate from each other. So you may have one green light on one battery and red lights showing on the other battery.

The following picture shows the charging status.



Notice that even with three red lights on, the battery has 14.0 volts in it. That's still a pretty good battery.

If the battery was completely dead, it will take at least 8 hours to recharge the deep cycle battery up to a full charge status.

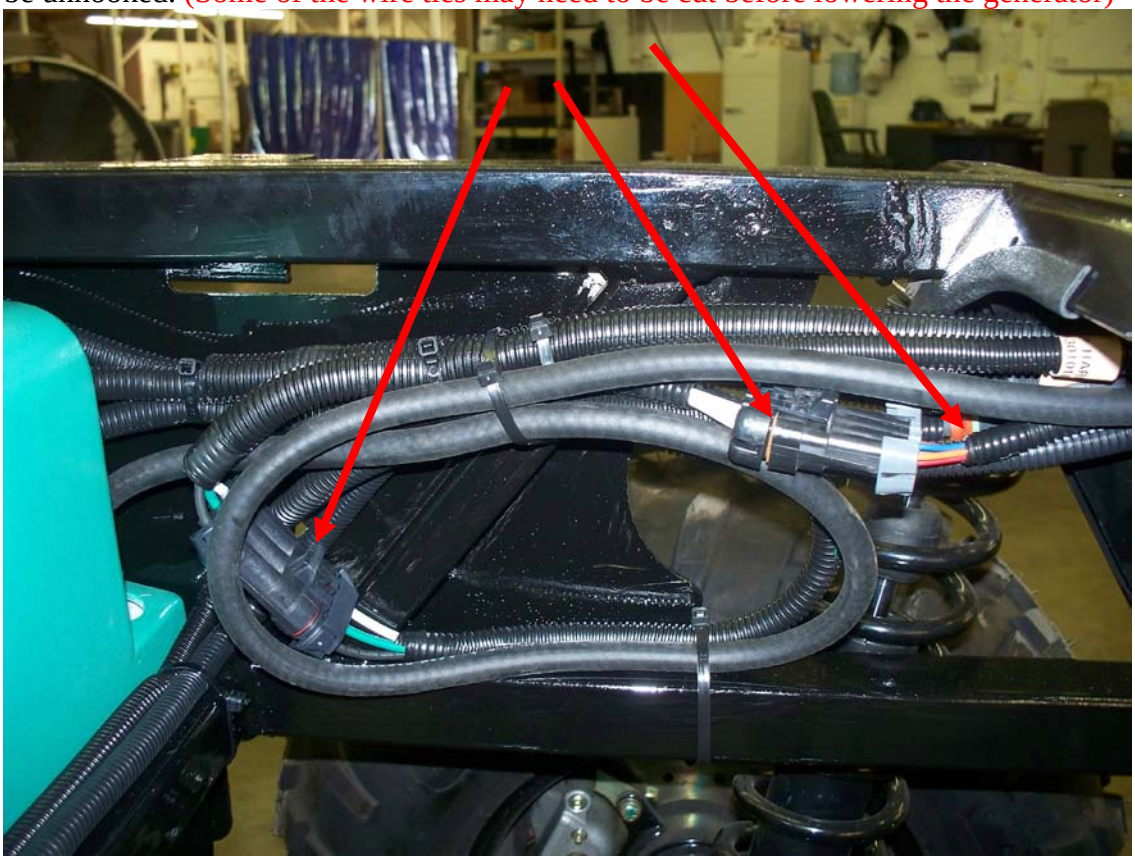
Shoreline Location:

The shoreline is located near the driver's door.

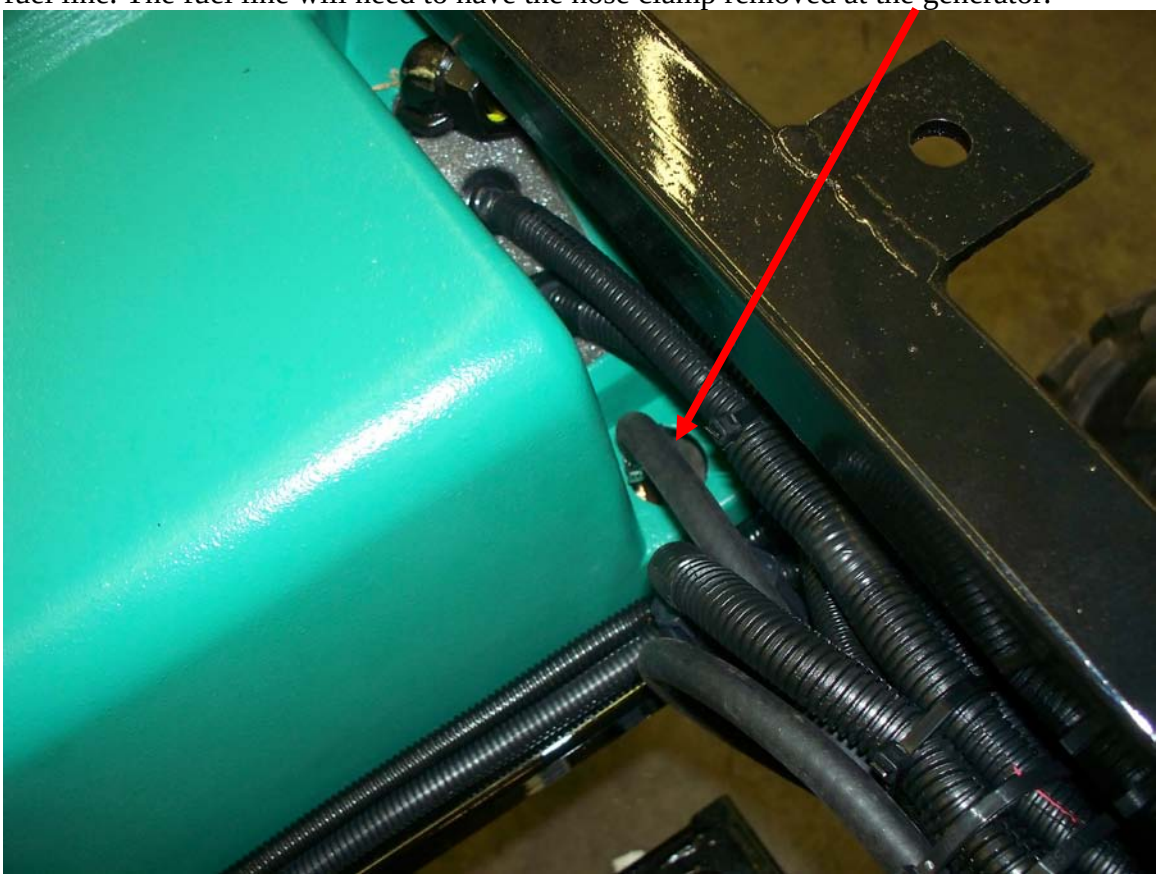
Dropping the generator

1. Place jack under generator
2. Remove the four bolts holding the generator to the frame.

3. There are a bundle of cables located in the top of the frame. They are looped so that the generator can be lowered down some what in order for the connections to the generator to be unhooked. (Some of the wire ties may need to be cut before lowering the generator)



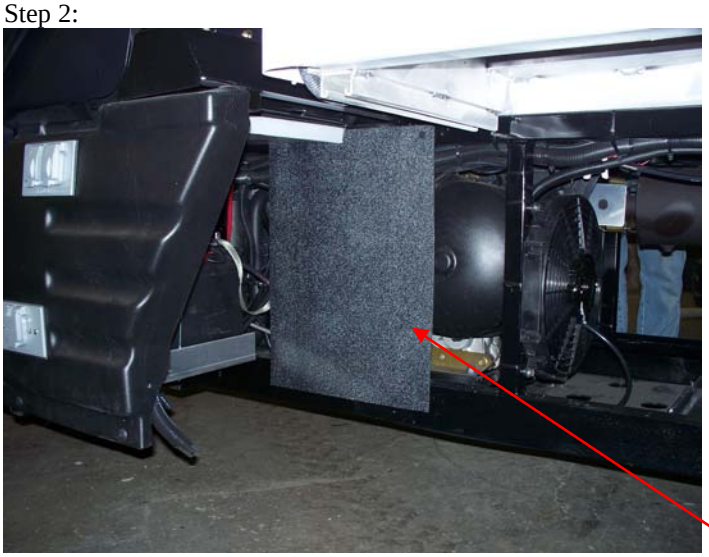
4. There will be three plugs that will need to be unplugged (see above) along with the fuel line. The fuel line will need to have the hose clamp removed at the generator.



Step 1:

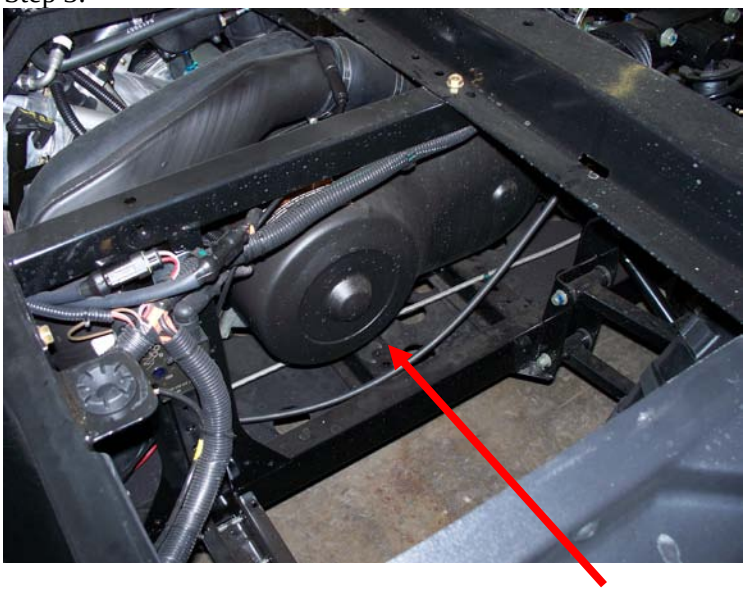
Open the driver's side lower storage compartment and loosen the six bolts that are in the top of the box. Then pull the compartment towards you. It will slide out and come completely off the unit. (Some of the earlier units may require you to remove the six bolts completely in order to remove the storage box)

Step 2:

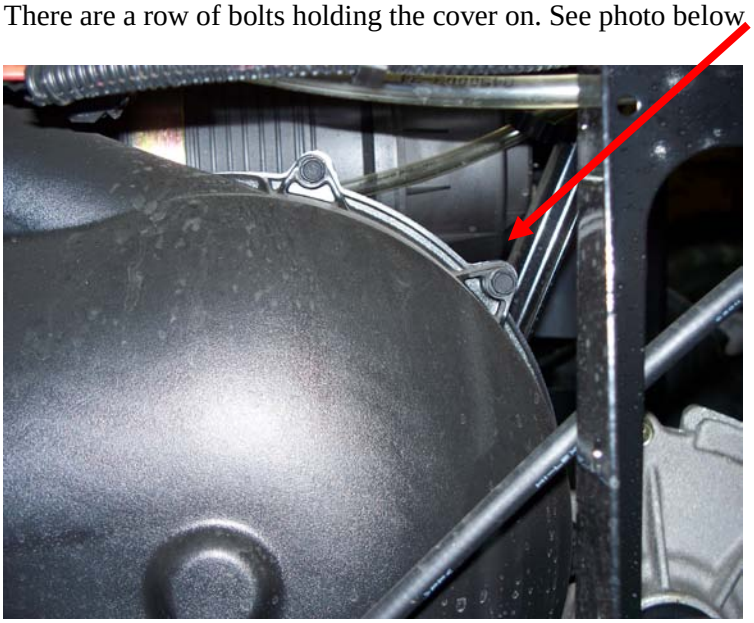


Now remove the black plastic panel that is beside the deep cycle battery.
It takes a 7mm socket to remove the four screws

Step 3:



The drive belt is located behind the cover shown here in this photo.
There are a row of bolts holding the cover on. See photo below

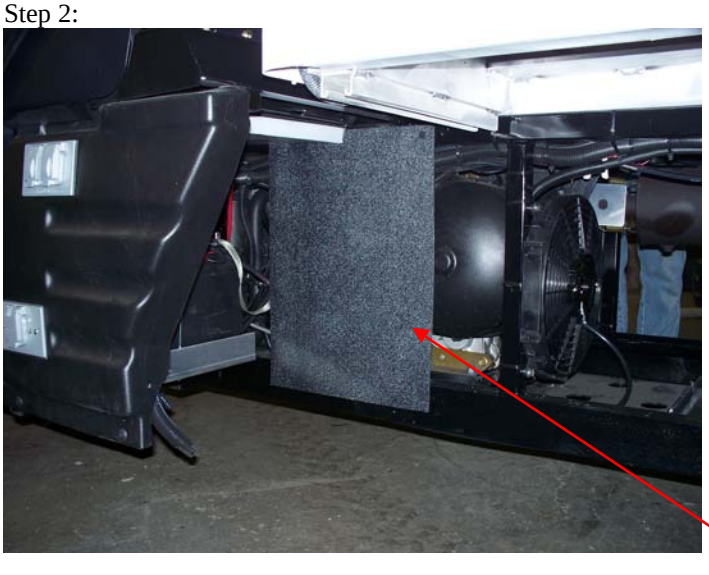


Remove all of the bolts and pull the cover off the reveal the drive belt.

Step 1:

Open the driver's side lower storage compartment and remove the six bolts that are in the top of the box. Then pull the compartment out and completely off the unit.

Step 2:



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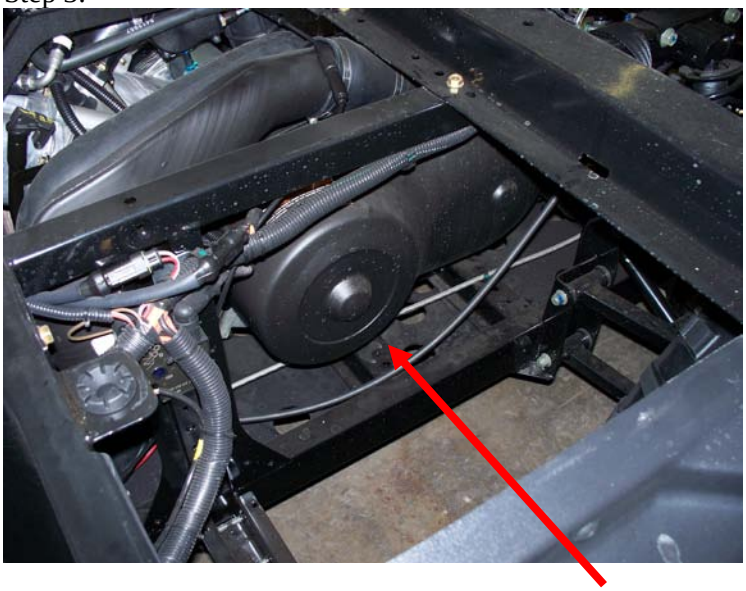

The drive belt is located behind the cover shown here in this photo.
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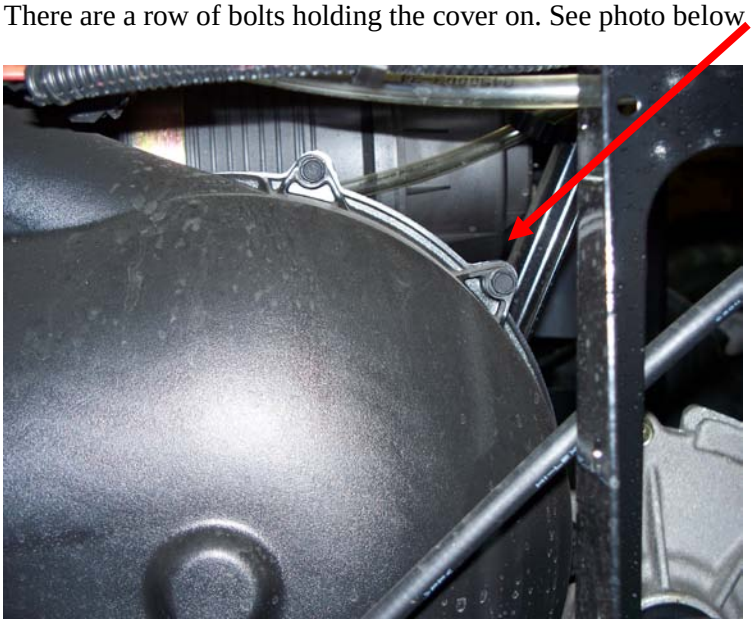
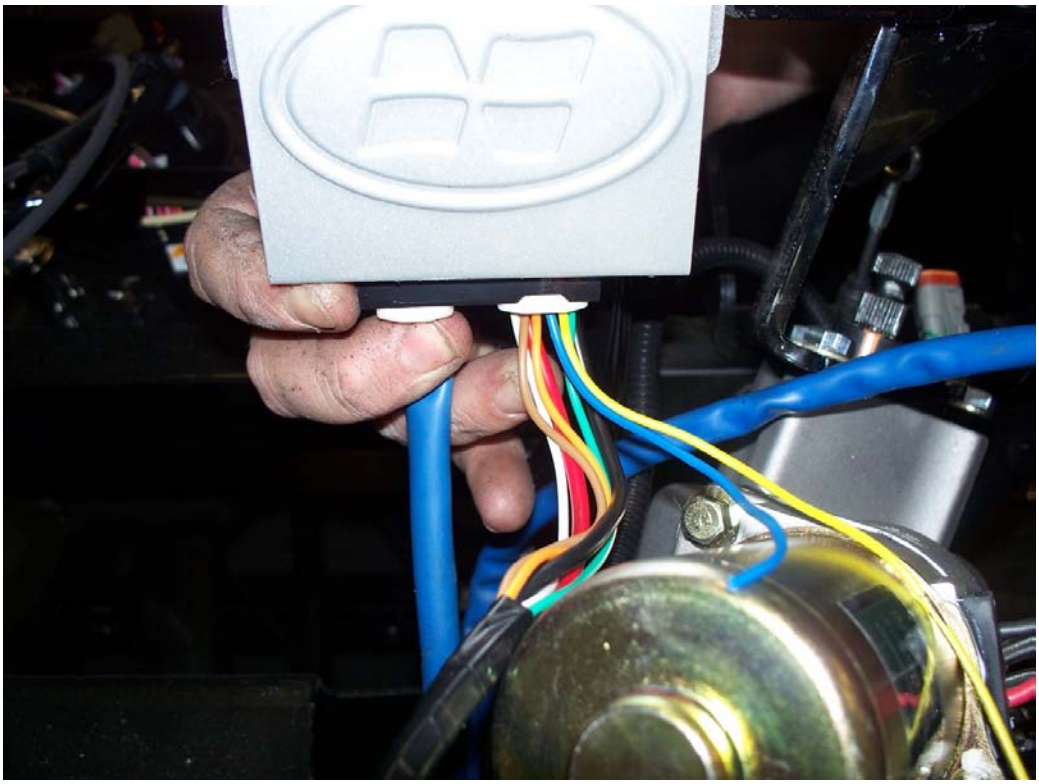


Remove all of the bolts and pull the cover off the reveal the drive belt.

Your unit has a high performance drive belt and clutch installed in it. It is NOT the standard factory Polaris parts.
So if the drive belt needs replaced the following is what is needed
to be reinstalled.

Manufacture: **EPI Performance**
Belt Part number: **WE262020**
Clutch Part Number: **WE436658**

You will need to switch out the power steering module. After you switch them out, there is a blue wire coming out of the module. If the blue wire is only 4-5 inches long like in the photo below that is good.
If the blue wire continues on you will need to proceed with this procedure.



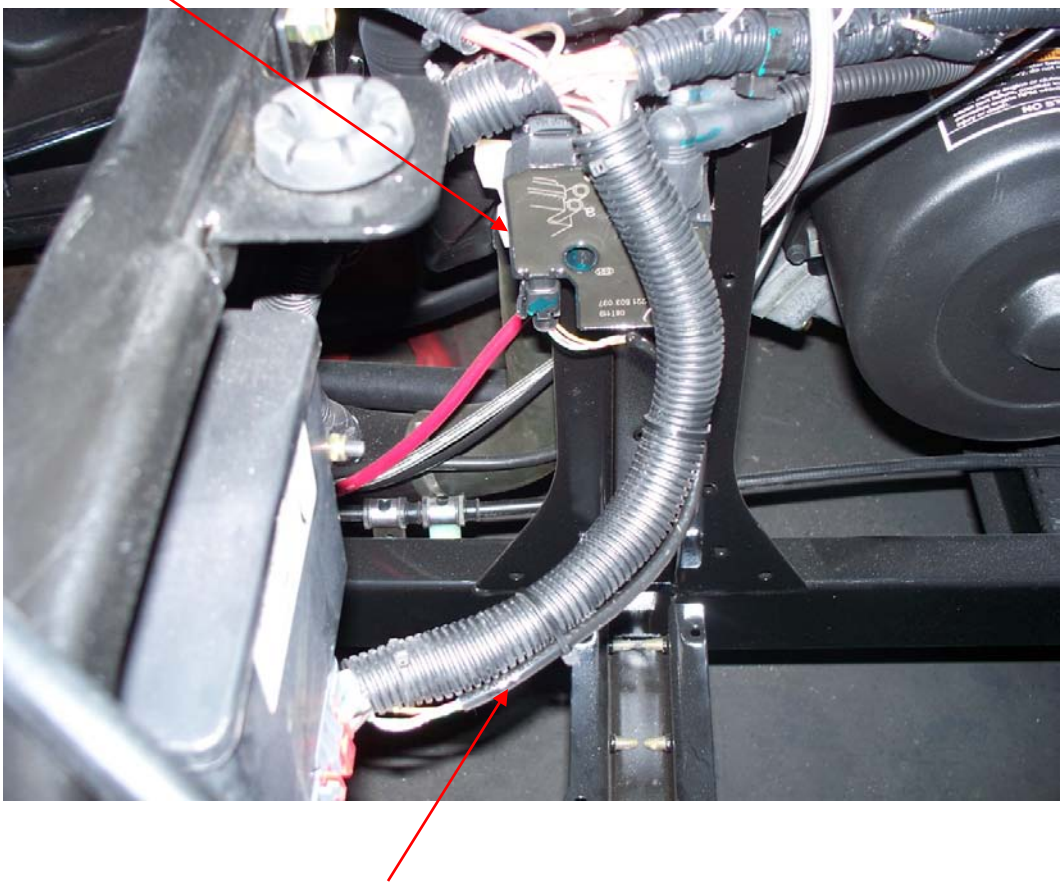
Go back an inch or two and cut the blue wire. Then tape both ends of the wire.

The older power steering units needed a tach signal to operate. When the Polaris engine is at a lower RPM the steering gives you more assist and at a higher RPM the steering gave you less assist.
In line of this blue wire between the power steering module and the ignition coil there are a couple of resisters that proven to be fragile and has given us some problems.

(In order to remove is blue wire you need to switch out the module to the new style.)

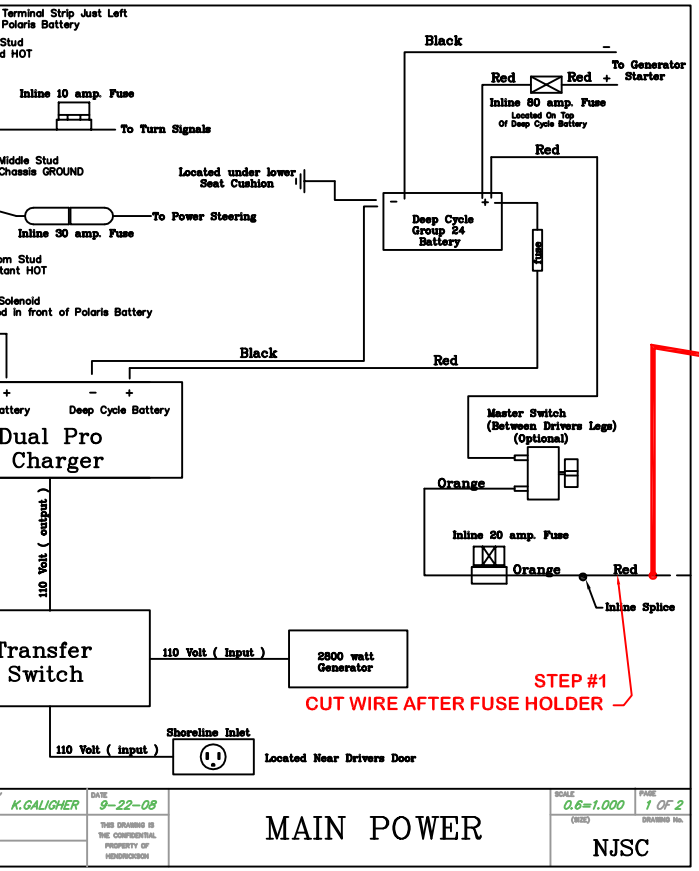
Next I would like for you to lift up the front seat bottom cushion. Under the drivers butt, on the frame you will find the coil pack for the engine.

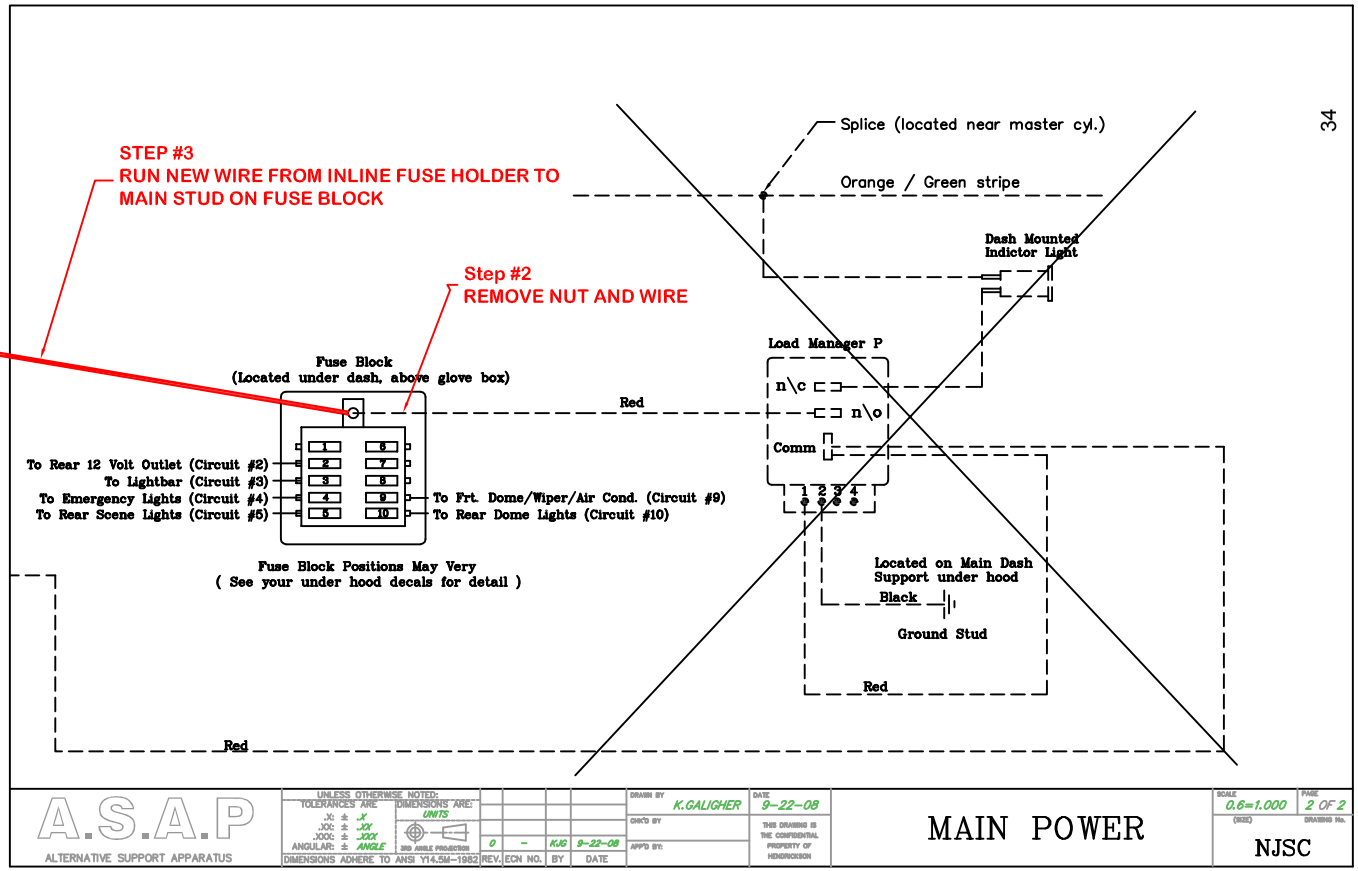
Coil Pack



The other end of the blue wire is tapped into the green\white wire coming out of the coil pack. I would like for you to cut the wire here also and retape the green\white wire. By doing this, it will eliminate any corruption that the coil may be seeing in that line that was running up to the power steering unit.

Basically we are removing the blue wire from the green\white wire of the coil


Terminal Strip Just Left
Polaris Battery
Stud
d HOT
Inline 10 amp. Fuse
To Turn Signals
Middle Stud
Chassis GROUND
Located under lower
Seat Cushion
To Power Steering
Inline 30 amp. Fuse
m Stud
tant HOT
Solenoid
d in front of Polaris Battery
Black
To Generator
Starter
Red
Red
Inline 80 amp. Fuse
Located On Top
Of Deep Cycle Battery
Red
Deep Cycle
Group 24
Battery
Fuse
Black
Red
attery
Deep Cycle Battery
Dual Pro
Charger
Master Switch
(Between Drivers Legs)
(Optional)
Orange
Inline 20 amp. Fuse
Orange
Red
Inline Splice
110 Volt (output)
Transfer
Switch
110 Volt (Input)
2800 watt
Generator
110 Volt (input)
Shoreline Inlet
Located Near Drivers Door
STEP #1
CUT WIRE AFTER FUSE HOLDER


STEP #3
RUN NEW WIRE FROM INLINE FUSE HOLDER TO
MAIN STUD ON FUSE BLOCK
Step #2
REMOVE NUT AND WIRE
Fuse Block
(Located under dash, above glove box)
Red
To Rear 12 Volt Outlet (Circuit #2)
To Lightbar (Circuit #3)
To Emergency Lights (Circuit #4)
To Rear Scene Lights (Circuit #5)
To Frt. Dome/Wiper/Air Cond. (Circuit #9)
To Rear Dome Lights (Circuit #10)
Fuse Block Positions May Very
(See your under hood decals for detail)
Splice (located near master cyl.)
Orange / Green stripe
Dash Mounted
Indictor Light
Load Manager P
n\c
n\o
Comm
1 2 3 4
Located on Main Dash
Support under hood
Black
Ground Stud
Red
Red
34

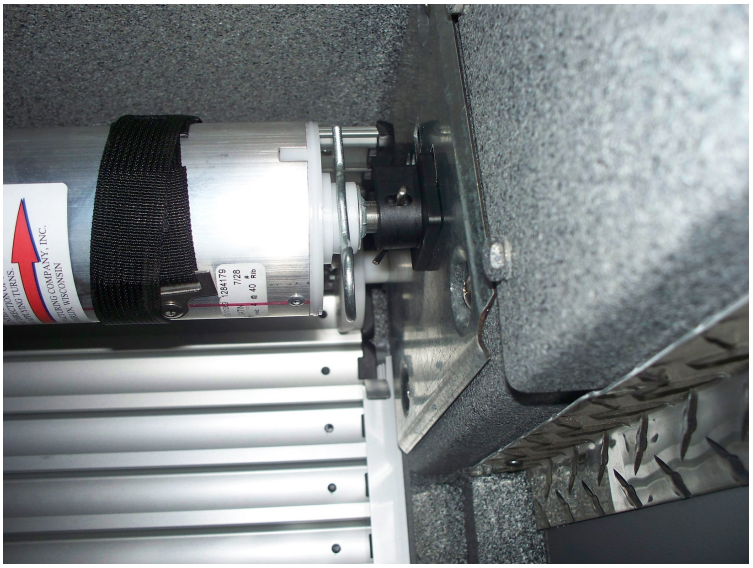
Rewinding the rear roll up door barrel

Find the decal on the barrel that indicates the number of factory preset turns of the barrel. Then find the box that indicates the number that the barrel can be turned additionally.

(This one in the photo can be turned a total of 16 times.)

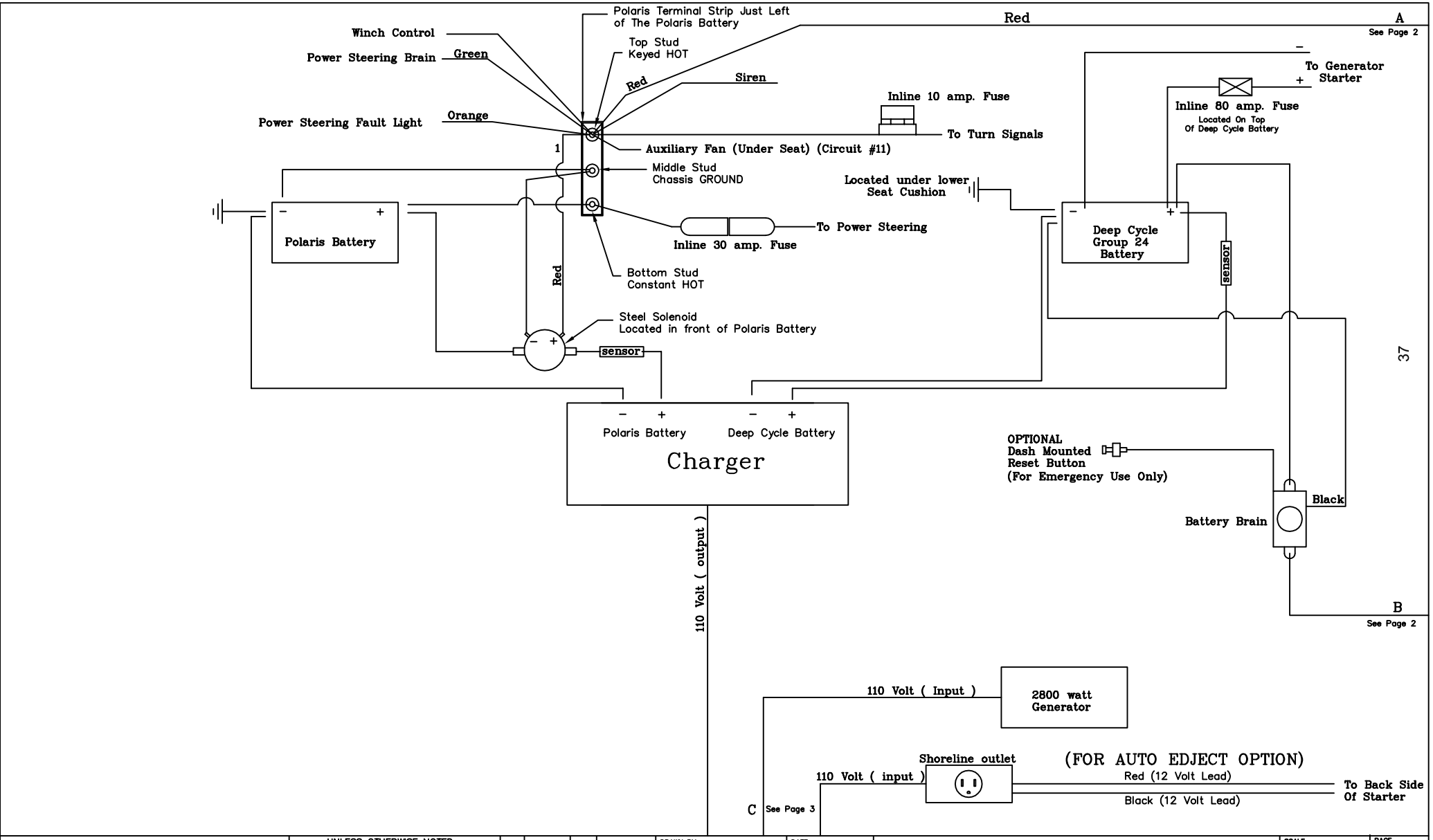
Find your numbers and add them up. Get someone to help you and turn the barrel that many times. Be sure to turn the barrel in the direction of the arrow on the sticker.

After the barrel has been turned to it's max amount of turns, while holding it insert a nail or clevis pin into the hole at the end of the barrel. (Look for the white plastic end cap near the big sticker).
This will hold the barrel's tension while you hook the straps two the door. If your replacing the straps now is the time to do that.



Once you have hooked the straps to the door, grab a hold of the barrel, twist it a little bit to take the tension off the holding pin and remove pin. (Hold onto the barrel until the straps tighten up).

The door should now work. This procedure using the clevis pin or nail also works if you need to work on the door but do not want to lose the tension in the barrel. You would insert the pin first then remove the door straps. This would allow the door to be removed for serving.



A.S.A.P

ALTERNATIVE SUPPORT APPARATUS

UNLESS OTHERWISE NOTED:
TOLERANCES ARE
.X: ± .X
.XX: ± .XX
.XXX: ± .XXX
ANGULAR: ± ANGLE
DIMENSIONS ARE: UNITS
3RD ANGLE PROJECTION
DIMENSIONS ADHERE TO ANSI Y14.5M–1982

REV.	ECN NO.	BY	DATE
0	–	KJG	9-22-08

DRAWN BY: K.GALIGHER
DATE: 9-22-08
CHK'D BY:
APP'D BY:

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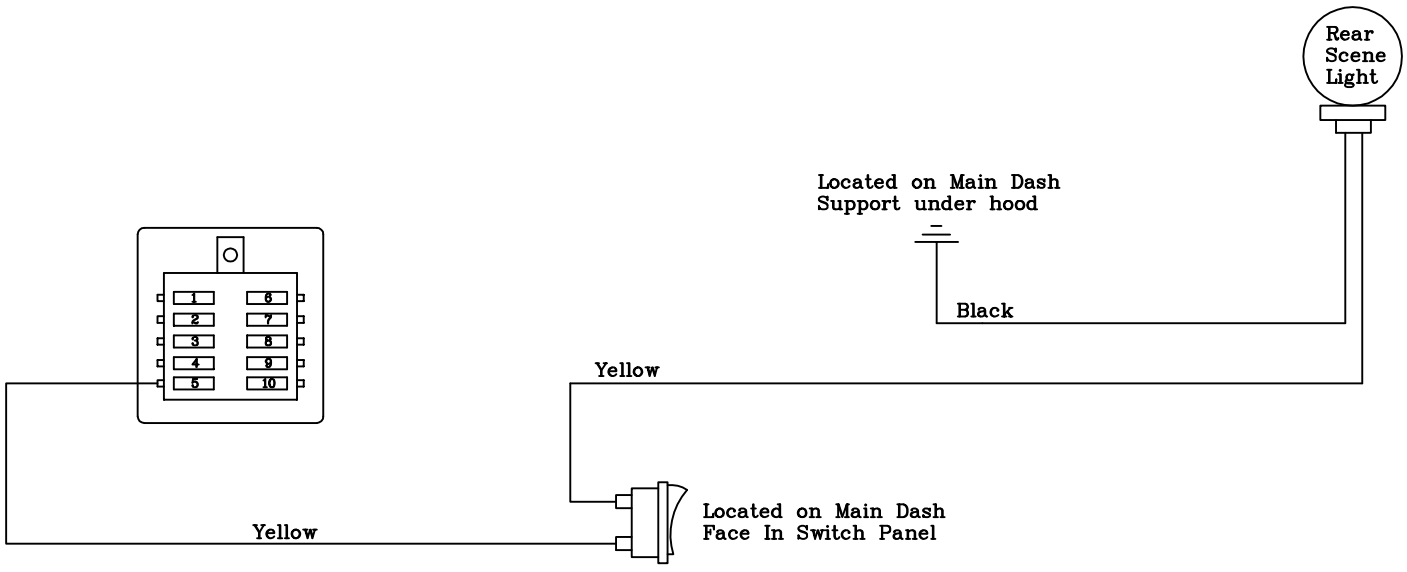
BATTERY BRAIN

WITH GREEN LIGHT AND AUX. FANS

SCALE: 0.6=1.000 (SIZE)
PAGE: 1 OF12
DRAWING No.: BB



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DIMENSIONS ADHERE TO ANSI Y14.5M–1982

REV.	ECN NO.	BY	DATE
0	–	KJG	9-22-08

DRAWN BY: K.GALIGHER
DATE: 9-22-08
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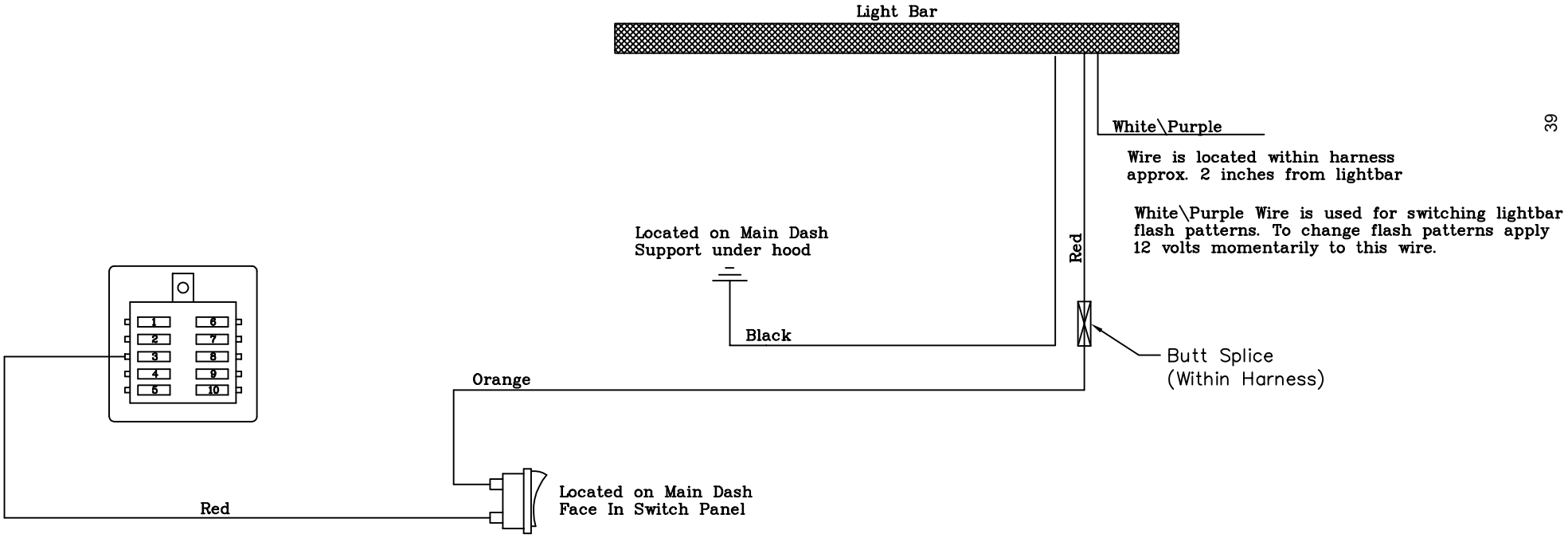
Rear Scene Light Circuit #5

SCALE: 0.6=1.000 (SIZE)
PAGE: 10 OF 12
DRAWING No.: BB



A.S.A.P
ALTERNATIVE SUPPORT APPARATUS

UNLESS OTHERWISE NOTED:
TOLERANCES ARE
.X: ± .X
.XX: ± .XX
.XXX: ± .XXX
ANGULAR: ± ANGLE
DIMENSIONS ARE: UNITS
3RD ANGLE PROJECTION
DIMENSIONS ADHERE TO ANSI Y14.5M–1982

REV.	ECN NO.	BY	DATE
0	–	KJG	9-22-08

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DATE: 9-22-08
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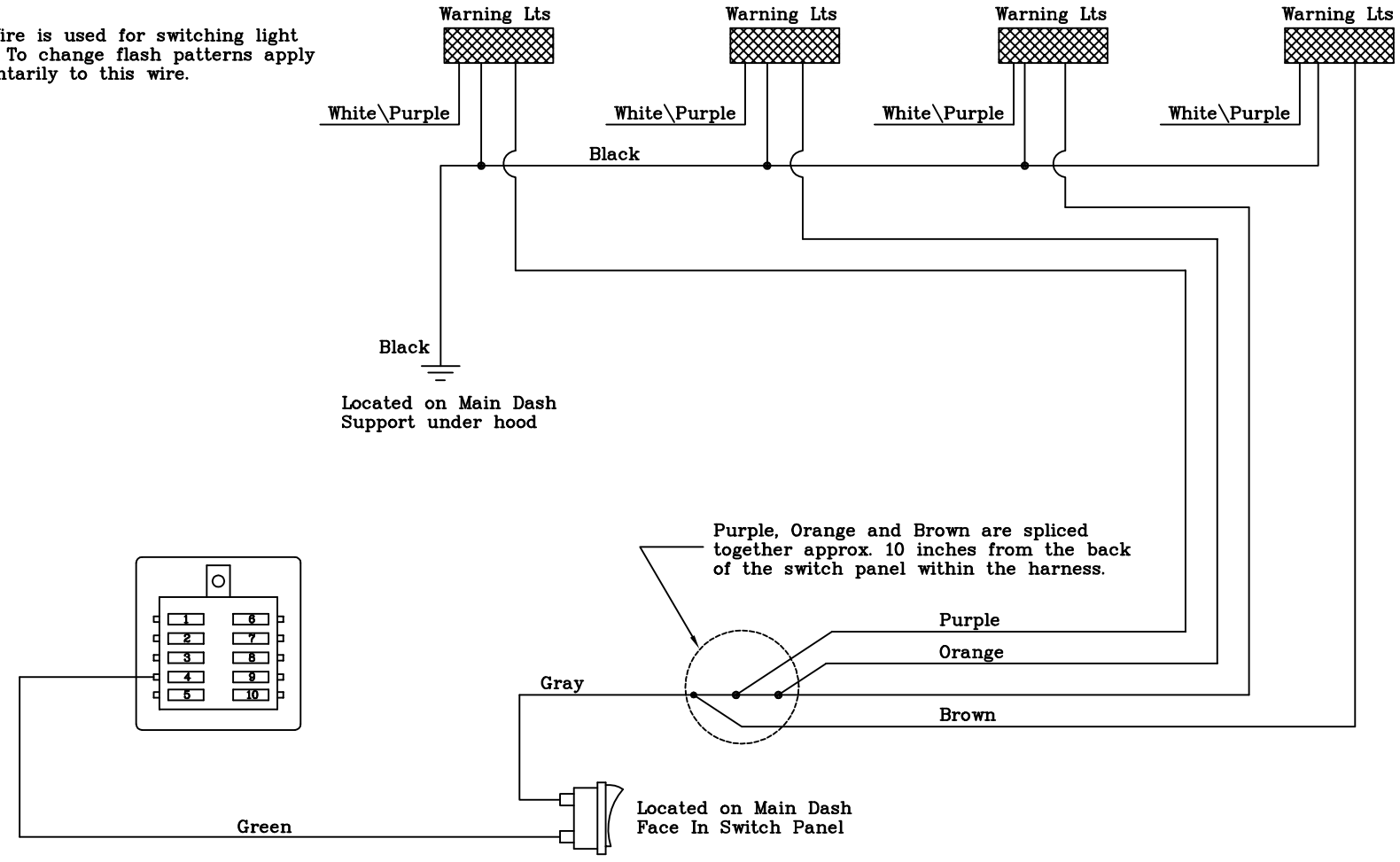
Light Bar Circuit #3

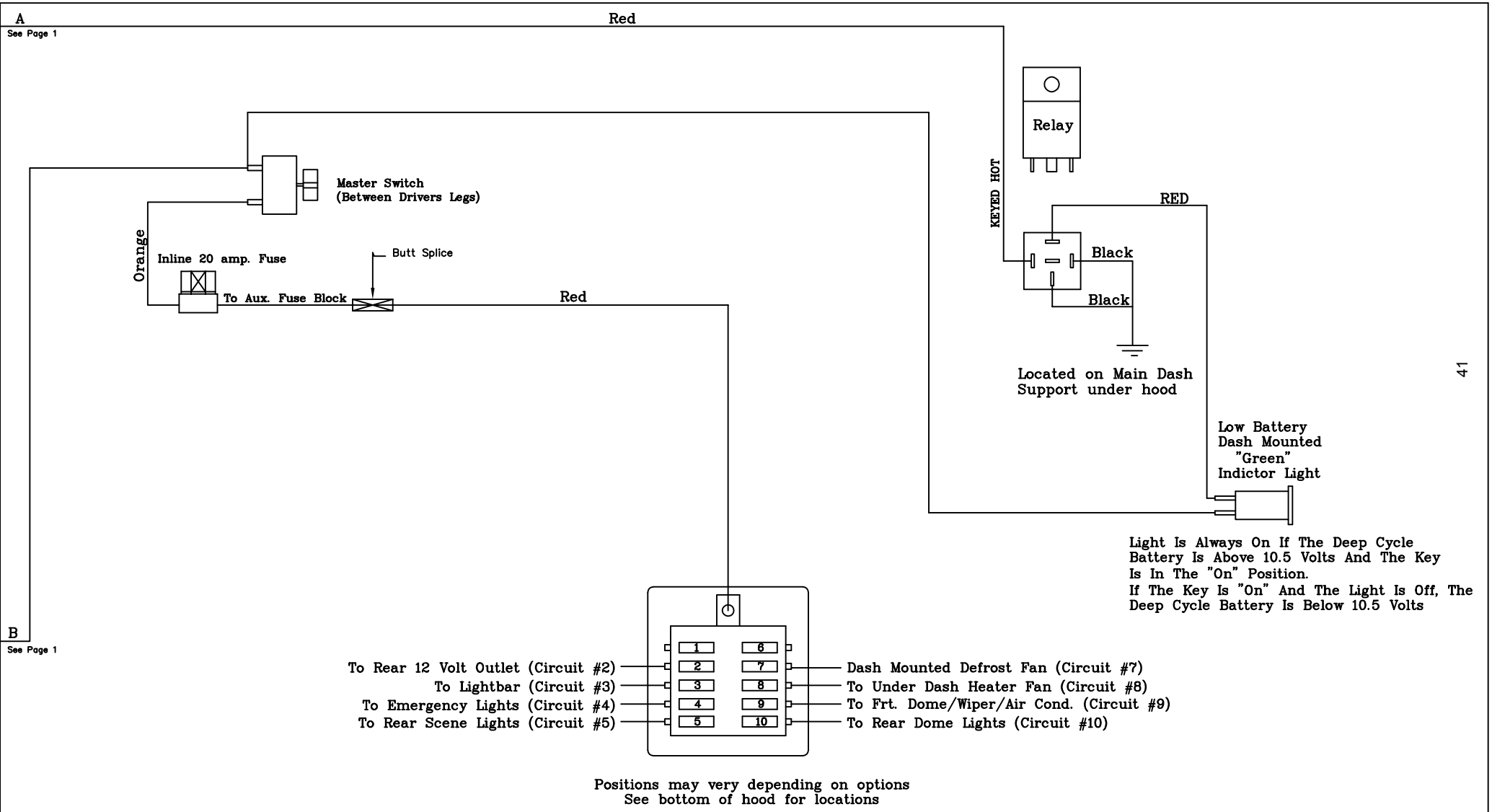
SCALE: 0.6=1.000 (SIZE)
PAGE: 11 OF 12
DRAWING No.: BB

White\Purple Wire is used for switching light flash patterns. To change flash patterns apply 12 volts momentarily to this wire.



40

A.S.A.P ALTERNATIVE SUPPORT APPARATUS	UNLESS OTHERWISE NOTED: TOLERANCES ARE .X: ± .X, .XX: ± .XX, .XXX: ± .XXX, ANGULAR: ± ANGLE DIMENSIONS ARE: UNITS 3RD ANGLE PROJECTION DIMENSIONS ADHERE TO ANSI Y14.5M–1982					DRAWN BY: K.GALIGHER	DATE: 9–22–08	Emergancy Lights Circuit #4	SCALE: 0.6=1.000 (SIZE)
						CHK'D BY	THIS DRAWING IS THE CONFIDENTIAL PROPERTY OF HENDRICKSON		PAGE: 12 OF 12
						APP'D BY:			DRAWING No. BB
		0	–	KJG	9–22–08				
		REV.	ECN NO.	BY	DATE				



A.S.A.P
ALTERNATIVE SUPPORT APPARATUS

UNLESS OTHERWISE NOTED:
TOLERANCES ARE: .X: ± .X, .XX: ± .XX, .XXX: ± .XXX, ANGULAR: ± ANGLE
DIMENSIONS ARE: UNITS
3RD ANGLE PROJECTION
DIMENSIONS ADHERE TO ANSI Y14.5M–1982

REV.	ECN NO.	BY	DATE
0	–	KJG	9-22-08

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DATE: 9-22-08
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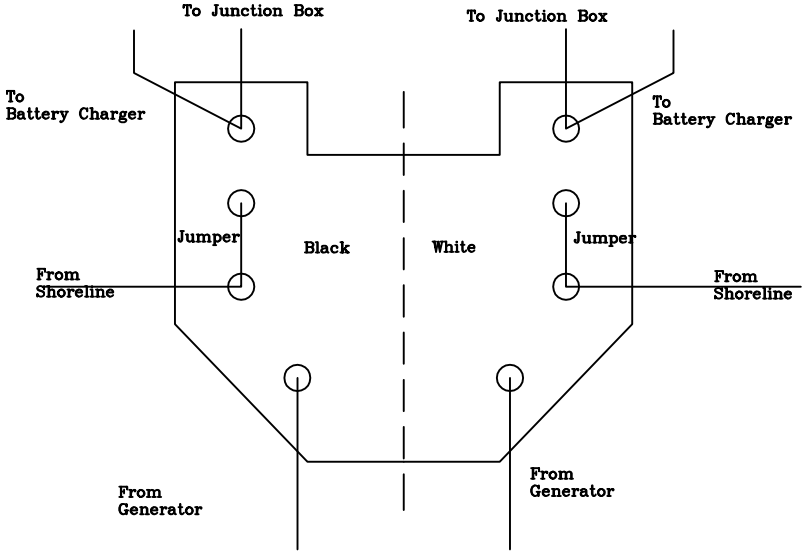
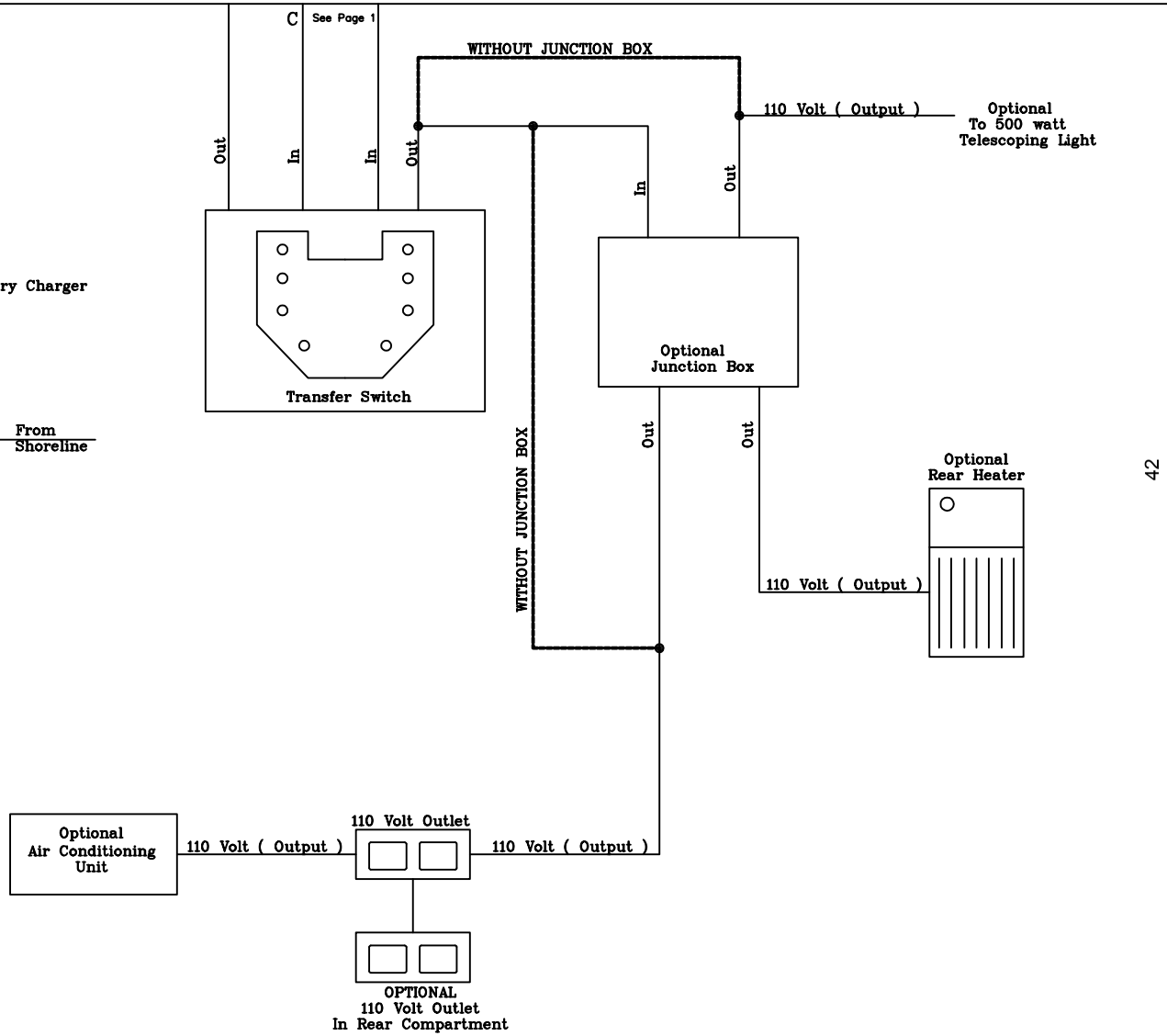
BATTERY BRAIN
WITH GREEN LIGHT AND AUX. FANS

SCALE: 0.6=1.000 (SIZE)
PAGE: 2 OF12
DRAWING No.: BB



Transfer Switch



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ALTERNATIVE SUPPORT APPARATUS

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DIMENSIONS ARE: UNITS
3RD ANGLE PROJECTION
DIMENSIONS ADHERE TO ANSI Y14.5M–1982

REV.	ECN NO.	BY	DATE
0	–	KJG	9-22-08

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DATE: 9-22-08
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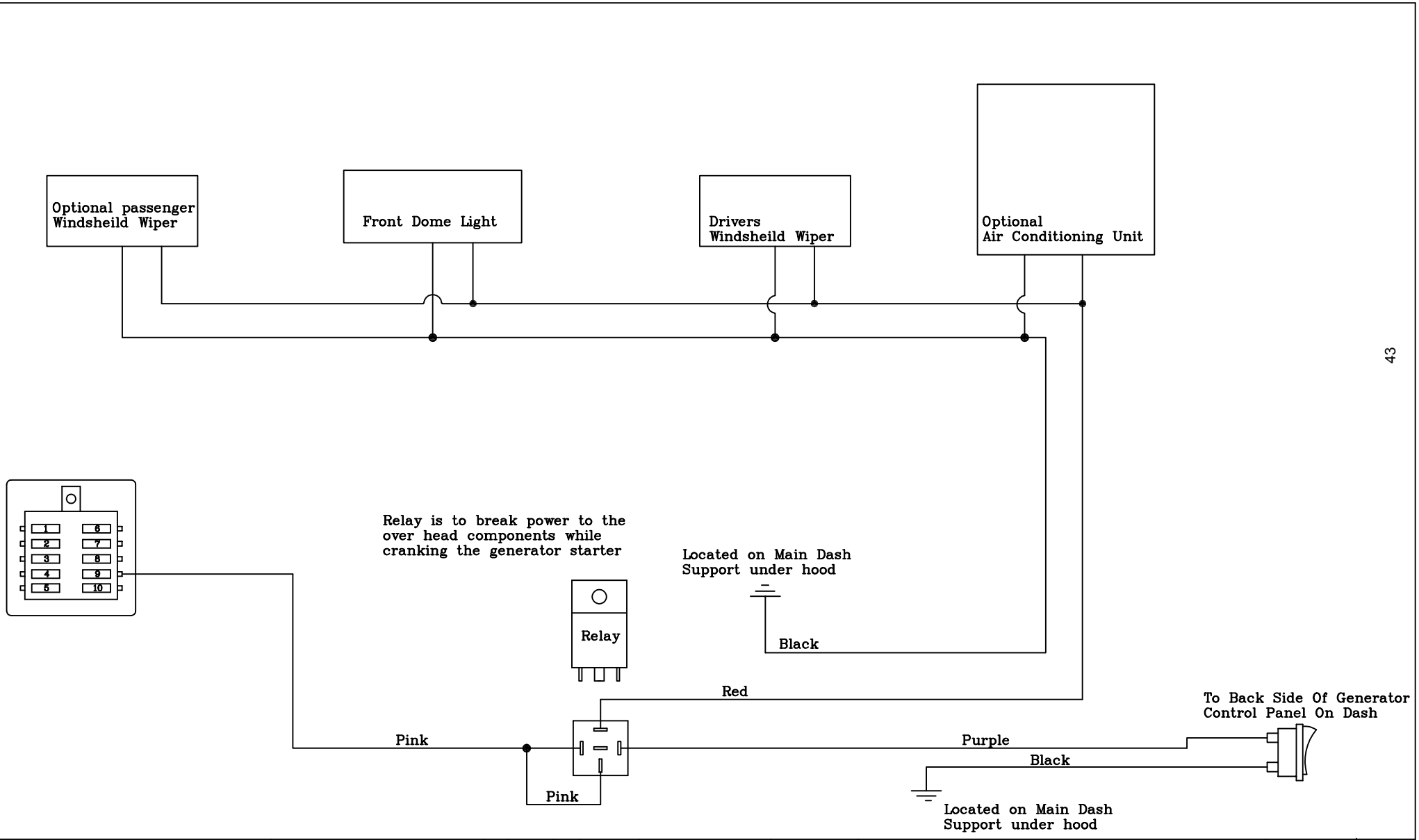
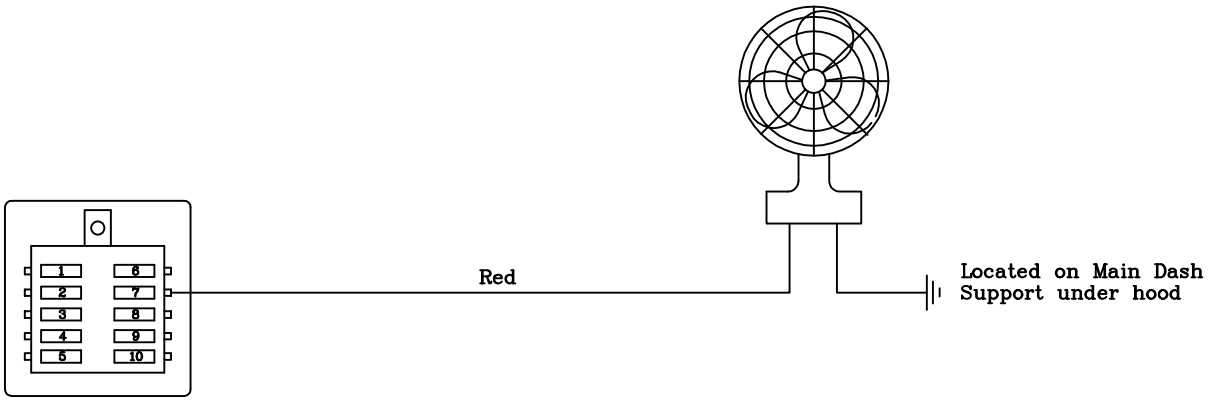
BATTERY BRAIN
WITH GREEN LIGHT AND AUX. FANS

SCALE: 0.6=1.000 (SIZE)
PAGE: 3 OF12
DRAWING No.: BB



43

A.S.A.P ALTERNATIVE SUPPORT APPARATUS	UNLESS OTHERWISE NOTED: TOLERANCES ARE: .X: ± .X, .XX: ± .XX, .XXX: ± .XXX, ANGULAR: ± ANGLE DIMENSIONS ARE: UNITS 3RD ANGLE PROJECTION DIMENSIONS ADHERE TO ANSI Y14.5M–1982	REV.	ECN NO.	BY	DATE	DRAWN BY: K.GALIGHER CHK'D BY APP'D BY:	DATE: 9–22–08 THIS DRAWING IS THE CONFIDENTIAL PROPERTY OF HENDRICKSON	Over Head Circuit #9	SCALE: 0.6=1.000 (SIZE) PAGE: 4 OF12 DRAWING No.: BB
		0	–	KJG	9–22–08				



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ALTERNATIVE SUPPORT APPARATUS

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.X: ± .X
.XX: ± .XX
.XXX: ± .XXX
ANGULAR: ± ANGLE
DIMENSIONS ARE: UNITS
3RD ANGLE PROJECTION
DIMENSIONS ADHERE TO ANSI Y14.5M-1982

REV.	ECN NO.	BY	DATE
0	-	KJG	9-22-08

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DATE: 9-22-08
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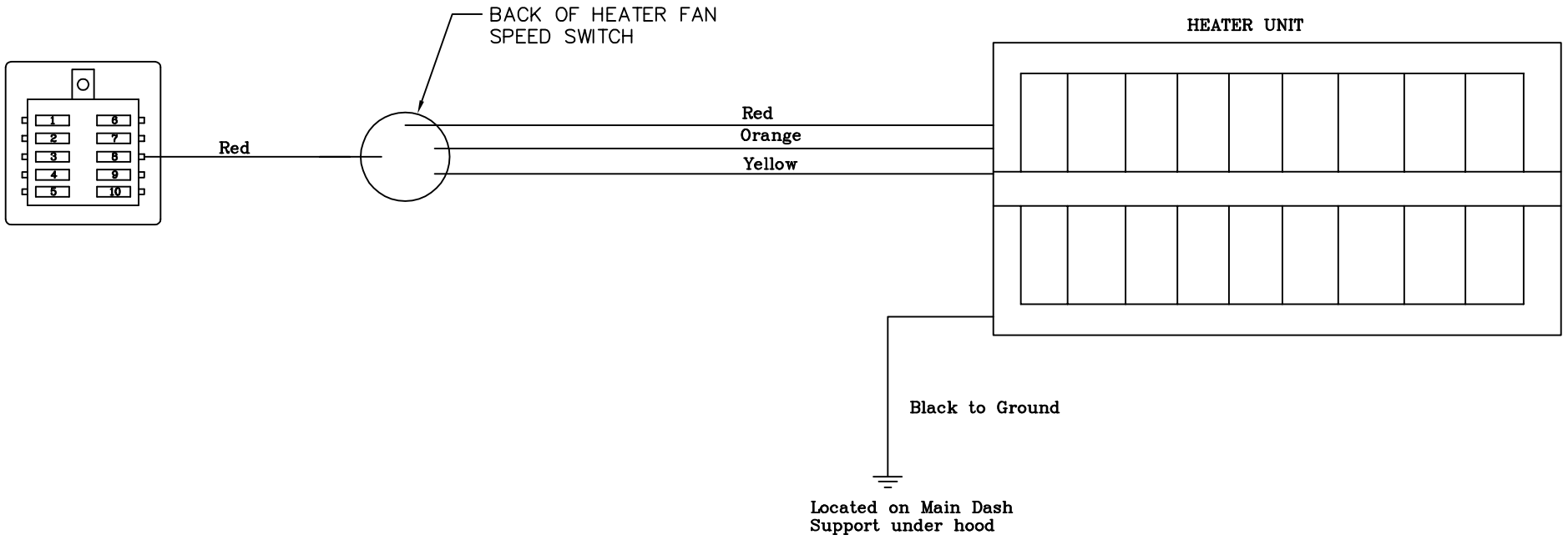
Dash Mounted Defrost Fan Circuit #7

SCALE: 0.6=1.000 (SIZE)
PAGE: 5 OF12
DRAWING No.: BB



45

A.S.A.P

ALTERNATIVE SUPPORT APPARATUS

UNLESS OTHERWISE NOTED:
TOLERANCES ARE
.X: ± .X
.XX: ± .XX
.XXX: ± .XXX
ANGULAR: ± ANGLE
DIMENSIONS ARE: UNITS
3RD ANGLE PROJECTION
DIMENSIONS ADHERE TO ANSI Y14.5M–1982

REV.	ECN NO.	BY	DATE
0	–	KJG	9-22-08

DRAWN BY: K.GALIGHER
DATE: 9-22-08
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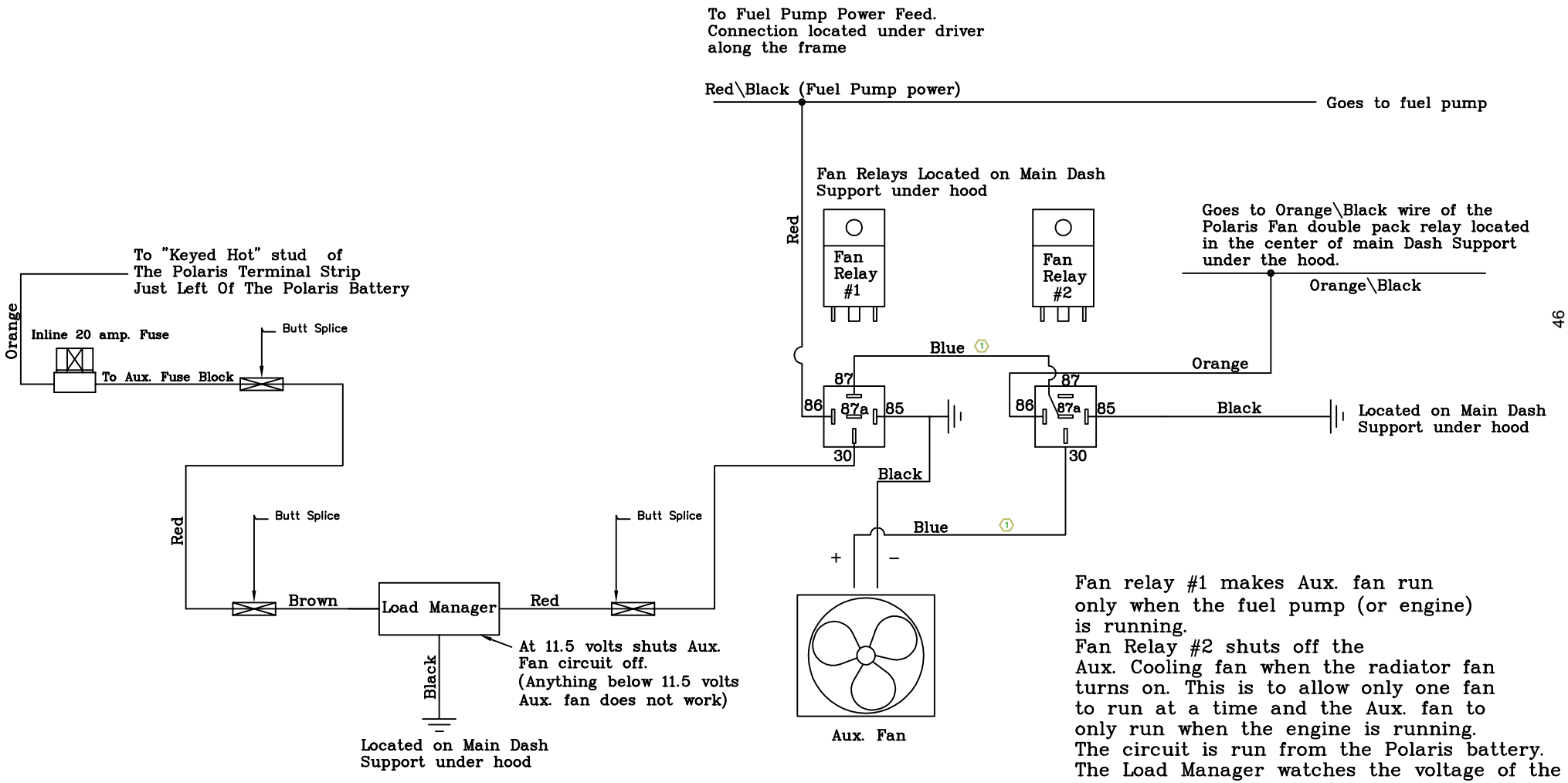
Under Dash Heater Fan Circuit #8

SCALE: 0.6=1.000 (SIZE)
PAGE: 6 OF12
DRAWING No.: BB



Fan relay #1 makes Aux. fan run only when the fuel pump (or engine) is running.
Fan Relay #2 shuts off the Aux. Cooling fan when the radiator fan turns on. This is to allow only one fan to run at a time and the Aux. fan to only run when the engine is running.
The circuit is run from the Polaris battery. The Load Manager watches the voltage of the battery. If the voltage drops below 11.5 volts the Aux. fan circuit gets shut down

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A.S.A.P
ALTERNATIVE SUPPORT APPARATUS

UNLESS OTHERWISE NOTED:
TOLERANCES ARE: .X: ± .X, .XX: ± .XX, .XXX: ± .XXX, ANGULAR: ± ANGLE
DIMENSIONS ARE: UNITS
3RD ANGLE PROJECTION
DIMENSIONS ADHERE TO ANSI Y14.5M–1982

REV.	ECN NO.	BY	DATE
1	–	KJG	10–12–09
0	–	KJG	9–22–08

DRAWN BY: K.GALIGHER
DATE: 9–22–08
CHK'D BY:
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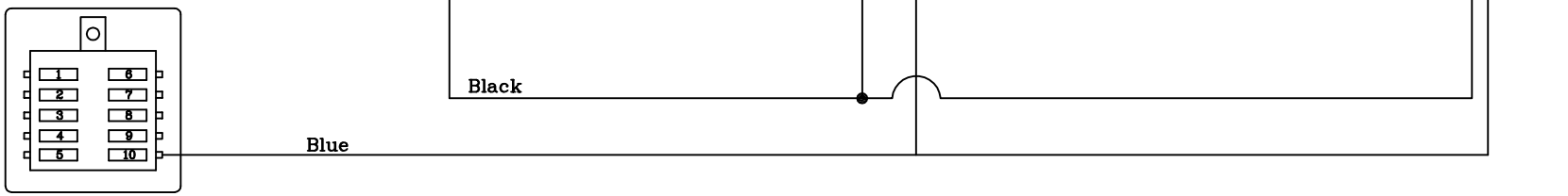
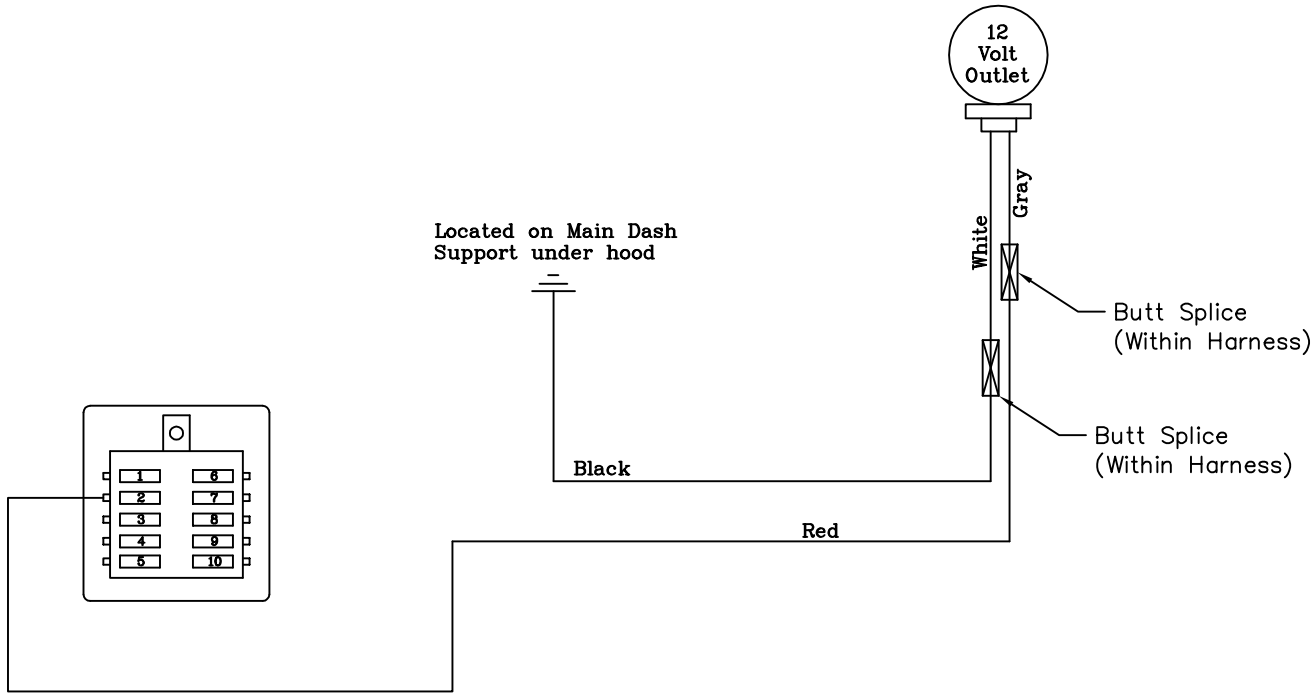
Aux. Fan Circuit #11

SCALE: 0.6=1.000 (SIZE)
PAGE: 7 OF12
DRAWING No.: BB



47

A.S.A.P ALTERNATIVE SUPPORT APPARATUS	UNLESS OTHERWISE NOTED: TOLERANCES ARE .X: ± .X .XX: ± .XX .XXX: ± .XXX ANGULAR: ± ANGLE DIMENSIONS ARE: UNITS 3RD ANGLE PROJECTION DIMENSIONS ADHERE TO ANSI Y14.5M–1982					DRAWN BY: K.GALIGHER	DATE: 9–22–08	Rear Dome Lights Circuit #10	SCALE: 0.6=1.000 (SIZE) PAGE: 8 OF12 DRAWING No.: BB
						CHK'D BY:	THIS DRAWING IS THE CONFIDENTIAL PROPERTY OF HENDRICKSON		
						APP'D BY:			
		0	–	KJG	9–22–08				
		REV.	ECN NO.	BY	DATE				



48

A.S.A.P ALTERNATIVE SUPPORT APPARATUS	UNLESS OTHERWISE NOTED: TOLERANCES ARE .X: ± .X .XX: ± .XX .XXX: ± .XXX ANGULAR: ± ANGLE DIMENSIONS ARE: UNITS 3RD ANGLE PROJECTION DIMENSIONS ADHERE TO ANSI Y14.5M–1982	REV.	ECN NO.	BY	DATE	DRAWN BY K.GALIGHER	DATE 9–22–08	Rear 12 Volt Outlet Circuit #2	SCALE 0.6=1.000 (SIZE) BB PAGE 9 OF12 DRAWING No.
		0	–	KJG	9–22–08	CHK'D BY APP'D BY:	THIS DRAWING IS THE CONFIDENTIAL PROPERTY OF HENDRICKSON		

Installation Instructions

BATTERYBRAIN

Battery Brain is an innovative accessory that easily installs to any battery. Using unique micro-electronic technology it continually monitors the battery power. When Battery Brain detects power falling below the level required to start your engine, it automatically isolates the battery from the electrical system. This will ensure you always have enough power to start your engine and keep moving!

*Type III & IV also have the ability to disconnect the battery from the electrical system to act as an anti-theft device.

*Type IV RV is designed to extend battery life by protecting utility/house/coach batteries rather than the vehicle battery.

Updates to installation instructions will be posted on **www.smgy.net**.

Technical Specifications

DIMENSIONS

Base 1 5/8” (4cm) x 2 1/4” (5.5cm), Height (including removable protective cap)

2 1/2” (6cm), Brackets 1 1/4” (3.5cm) x 5/8” (1.5cm) x 1/8” (3mm).

WEIGHT

Battery Brain 175gm, Accessories 280gm, Packaging 3gm;

Total weight 408gm (1lb).

CURRENT SPECIFICATIONS

Operational Current Consumption for type II & III After disconnect: 3.8 Milliamps.

Operational Current Consumption for type I & IV After disconnect: 0 Milliamps

Maximum Peak Amperage: 1100 Amps, for 15 consecutive seconds.

Continuous Amperage Capacity: 250 Amps.

Disconnect Voltage Threshold: 11.8V

Disconnect Voltage Threshold for type IV RV: 10.5V

OPERATIONAL TEMPERATURE RANGE

-60°F (-51°C) to 200°F (90°C).

Battery Brain is made of non-combustible materials.

BATTERY SAFETY WARNING!

When working with lead acid batteries and accessories, caution must be employed:

- Shield eyes. Do not open vent caps or puncture battery casing in any way.
- Sulfuric acid can cause blindness and severe burns.
- Rinse hands and flush eyes with water immediately.
- Avoid sparks, flames and smoking.

PROPOSITION 65 WARNING

Battery posts, terminals, and related accessories contain lead and lead compounds. Chemicals known to the State of California to cause cancer and reproductive harm. Wash hands after handling.

Battery Brain

GENERAL

The Battery Brain is installed on the positive (+) battery post with the post clamp provided. The clip end of the black ground wire is fastened to the negative (–) post clamp bolt.

HELPFUL HINT

The positive (+) bracket on the Battery Brain for the positive (+) post clamp is on the same side of the Battery Brain unit with “12V+” printed on it.

TOOLS REQUIRED

Tools required may vary based on your vehicle. The most common tools are; Open-end 5/16”, 9/16”, 10mm, 12mm,14mm, or adjustable wrench. Standard and Phillips screwdrivers.

REMOTE CONTROL USERS

Save a copy of the identification number on the back of your remote control. You will need it to order a replacement if lost.

IMPORTANT NOTE

Before beginning installation, be sure your battery is holding the proper charge. If your battery does not hold a minimum charge, it may be at the end of its lifecycle. The Battery Brain is designed to protect a properly functioning or new battery. It cannot restore or repair a damaged battery. If your vehicles battery shows any signs of physical damage such as swelling, leaking or cracking, replace the battery prior to installing Battery Brain.

IMPORTANT NOTE

Unless you are fully familiar with your vehicles electrical system it is recommended that installation of this product is performed by a certified technician.

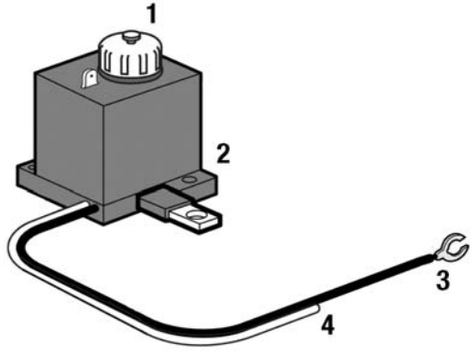
IMPORTANT NOTE

This product is not intended for Marine use and should not be submerged in water. Units specifically designed for Marine use are available, see **www.smgy.net/batterybrain** for more information.

Battery Brain Kit includes

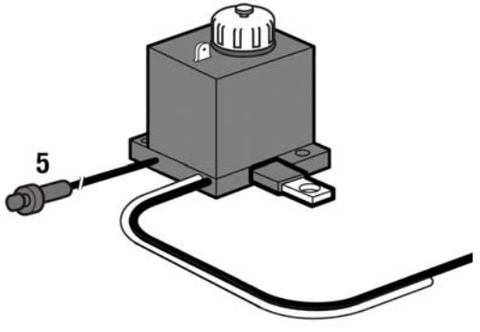
BATTERY BRAIN UNIT:

1. Manual “ON/OFF” Reset Control Knob under removable protective cap
2. Positive (+) side of Battery Brain (side with writing) with Butterfly Connector
3. Black Ground Wire, attached to unit
4. White Antenna Wire, attached to unit (type II & III only)



Type IV Only-This unit has the same remote capacities as the type III, but uses a push button (5) instead of a remote control to change the setting of the Battery Brain with the press of the button. The button can be mounted/concealed anywhere in the vehicle and is connected to the Battery Brain unit via a wire.

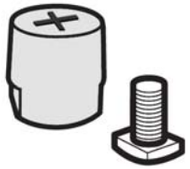
Type IV RV looks like the type IV model but is designed to be connected to the utility/house/coach batteries in order to avoid the deep cycling of full discharge and charging that can prematurely end a batteries life.



Do not press the button while the engine is running. Mount the push button in the desired location by tightening the nut provided.

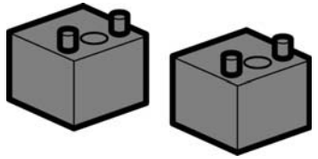
Aluminum Positive Post with Butterfly Connector with Bolt and Lock Washer

Aluminum Positive Post with Bolt and Lock Washer

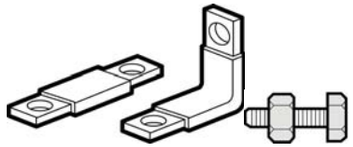


Side Mount Bolt

Chassis Mounting Blocks



L-Bracket & Straight Mounting Brackets

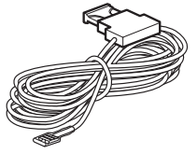


Remote Control (Type II & III Models Only)

Remote Control Frequency: TX433.92 Mhz

Battery Type: 12 V 27 A (The batteries are already installed)

Red Accessory Bypass Wire with Fuse Holder

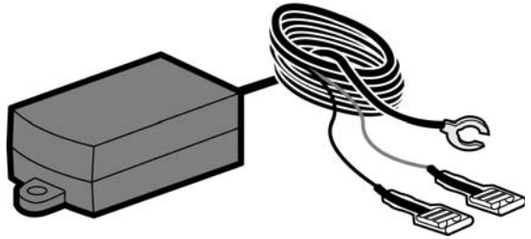


Black Engine On Wire

Optional:

Vibration Sensor - Available separately, can be used in place of the Engine On Wire

*(See your retailer for details)



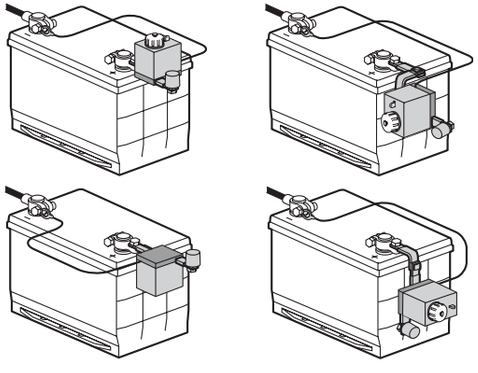
Installation Instructions

NOTE: Battery location and position differ in vehicles. With the supplied accessories you can mount the Battery Brain on the vehicle using the Top Mount, Side Mount or Chassis Mount positions.

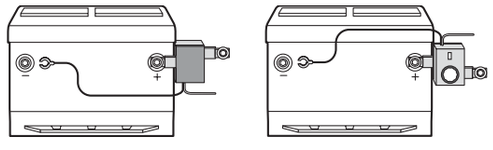
NOTE: After installation ensure all connections are tight. Ensure manual reset control knob under the protective cap is in the on position. Press down on the knob to establish connection.

Sample Configuration Options

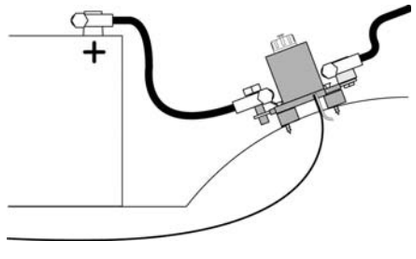
Top Mounting Options



Side Mounting Options



Chassis Mounting Option



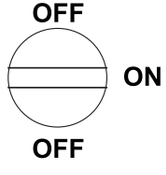
STEP 1: Disconnecting Battery Cables:

A) Disconnect the black/negative (–) cable from the negative (–) battery post/bolt on the battery.

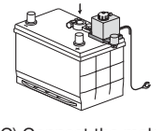
B) Disconnect the red/positive (+) cable from the positive (+) battery post/bolt on the battery

STEP 2: Connecting the Battery Brain:

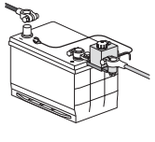
A) Unscrew removable protective cap on the top off the unit and turn the “ON/OFF” manual reset control knob to the “ON” position.



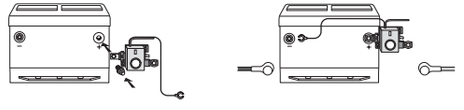
B) Connect the Aluminum Positive Clamp with butterfly connector to the Positvie side (the side with 12V+ printed) of the battery brain. Then connect the Aluminum Positive Clamp to the positive terminal on the battery.



C) Connect the male post to the other side of the Battery Brain. Connect the red positive battery cable to the male post.



D) Side mount only: Connect the positive side of the Battery Brain (with the sign 12V +) to the positive post on the battery using the provided side mount screw. Then connect the red positive battery cable to the other side of the Battery Brain.



NOTE: The positive battery post is tapered. Verify that the cable is mounted correctly.

STEP 3: Connecting Battery Brain to Ground:

A) Connect the black/negative (–) battery cable to the negative (–) post/bolt on the battery.

B) Connect the clip end of the black ground wire to the clamp bolt on the negative (–) battery post/nut or ground to chassis with a metal screw.

CHASSIS MOUNTING

A) Connect the positive (+) side of the Battery Brain to the positive (+) side of the battery with a separate red positive battery cable (must be purchased).

B) Connect the original red positive (+) cable of the car to other side of the Battery Brain.

C) Connect the black ground wire of the Battery Brain to the chassis or directly to the negative post of the battery.

STEP 4: Install Black Engine On Wire.

Installation of the Engine On wire will prevent the Battery Brain from disconnecting the battery while the engine is running. This will also prevent the Battery Brain from disconnecting the battery if the voltage level drops below 11.8V as could be the case with accessories that briefly reduce the voltage below the threshold level or in the case of problems with the vehicle electrical components. i.e.: bad alternator.

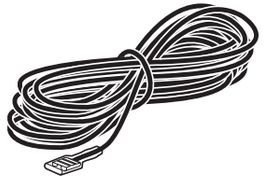
This wire must be installed to ensure the Battery Brain will not activate while the engine is running.

*Not required if optional Vibration Sensor is used. (Purchased separately).

A) Locate a wire or fuse that has 12V when the ignition switch is in the “ON” or “RUN” position and is 0V when the ignition switch is in the “OFF” position.

B) Slide the connector end of the black engine on wire onto the single connector on the Battery Brain that is labeled with “ACC”.

C) Attach the other end of the supplied black engine on wire to the selected wire or fuse as located in step A above. This may require running a wire to the interior of the vehicle. A fuse-tap or wire-tap connection may be required.



STEP 5: Red Accessory Bypass Wire Installation [Optional]

Installation of the red accessory bypass wire will provide you with continuous 12V power to an accessory or accessories bypassing the Battery Brain designed to allow you to save presets or memory settings.

NOTE:

Use of this feature will bypass the Battery Brain and may allow the battery voltage to drop below the minimum charge needed to start your vehicle.

NOTE:

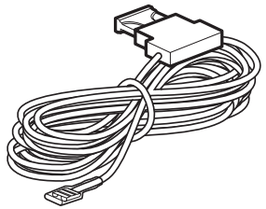
Exact location of the fuse & fuse panel will differ by manufacturer; consult your owner’s manual or wiring schematic for the vehicle to locate fuses for the accessories. Amperage for the bypassed accessory must not exceed 7.5Amps.

A) Locate the fuse that provides power only to the accessory that you wish to have it active at all times.

B) Attach the exposed end of the red bypass wire to the fuse or device you wish to have active on the non active side of the fuse. A fuse tap connection may be required.

C) Carefully route the wire from the fuse to the Battery Brain. A fuse-tap or wire-tap connection may be required.

D) Attach the connector end of the red bypass wire onto the butterfly connector on the female positive post of the Battery Brain.



MULTI BATTERY INSTALLATION

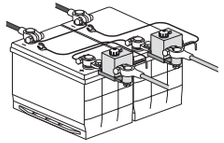
If your vehicle has a multi-battery configuration, Battery Brain can be mounted to any battery configuration. However, any primary live positive battery post must have its own Battery Brain. Consult a certified technician if you require assistance.

If the two or more batteries are connected in series, to one primary red positive cable, then only one Battery Brain is required. Follow the installation instructions as previously stated.

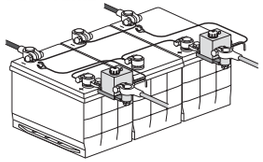
If two or more batteries are connected in parallel, two primary red positive cables, then you will require two Battery Brains, to ensure that the batteries are effectively isolated from the electrical system once the disconnection threshold is reached. Mount both Battery Brains at the primary positive posts connected to the Starter, Alternator, ECM or any accessory device that requires electrical power.

Installation Tip: Remote Location: If you wish to mount the Battery Brain in a remote location due to space limitations, or if desired, use proper battery cable. (Additional cable not supplied)

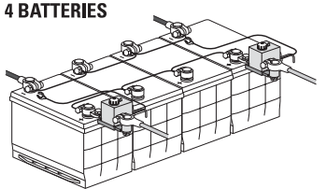
2 BATTERIES



3 BATTERIES



4 BATTERIES



Series configuration options shown for example purposes only.

INSTALLATION COMPLETE:

THE MANUAL RESET CONTROL KNOB ON THE BATTERY BRAIN UNIT SHOULD BE TURNED TO THE “ON” POSITION.

THEN PRESS DOWN ON THE MANUAL RESET CONTROL KNOB TO ESTABLISH CONTACT.

Testing the Installation

A) TO TEST FOR SUCCESSFUL INSTALLATION:

Start the engine after installation is complete. If the engine starts properly proceed to the next step. If not, review the installation instruction or consult a certified technician.

B) TO TEST BATTERY BRAIN OPERATION:

With the Manual Reset Control Knob in the “ON” position turn the engine off and turn on as many electrical accessories (i.e. lights, radio,) as possible and leave them on. The Battery Brain will cut power from the battery automatically – confirming the Battery Brain is working. This may take some time, depending on the battery’s age and state of charge.

C) TO TEST THE MANUAL RESET CONTROL FUNCTION:

Ensure that the Manual Reset Control Knob is in the “ON” position and press it down after the Battery Brain has disconnected the power (to reset). The unit should reestablish power to the electrical accessories and enable you to start the engine.

D) TO TEST THE REMOTE CONTROL UNIT / WIRED REMOTE BUTTON UNIT (BATTERY BRAIN III & IV):

The remote control unit supplied with Battery Brain Type III and the wired remote button supplied with the Battery Brain IV can be used to disconnect and reconnect power by choice (as an anti-theft device), as well as reestablishing power after draining. Press and hold for 4 consecutive seconds either the remote control button or mounted switch to disconnect, reconnect or reestablish power to electrical accessories and to start the engine.

If problems occur with any of the test procedures, please refer to Trouble Shooting Instructions or consult Battery Brain technical support.

Trouble Shooting

AFTER INSTALLATION, THE BATTERY BRAIN DOESN’T SEEM TO BE WORKING.

WHAT TO DO:

1. Be sure your battery is holding the proper charge.
2. Make sure the positive side of the Battery Brain (the side with the writing) is attached to the positive (+) post of the battery.
3. Check that the Manual Reset Control Knob is pointing to the “ON” position.
4. Check that the black ground wire is securely attached to the negative (-) post on the battery.

AFTER THE BATTERY BRAIN HAS DISCONNECTED POWER, THE REMOTE CONTROL DOES NOT RESET THE POWER.

WHAT TO DO

1. Make sure that the light on the Remote Control is lit when you press the button down. If the light does not come on, open the Remote Control and replace the battery.
2. Hold the Remote Control button down for five seconds to activate Battery Brain.
3. Turn the Manual Reset Control Knob to “ON”.
4. Check that the black ground wire is securely attached to the negative (-) post on the battery.

BATTERY BRAIN IS FREQUENTLY DISCONNECTING POWER FOR NO APPARENT REASON.

WHAT TO DO

1. Your car battery may be low in power due to Alternator function. If it cannot hold a charge, it may be at the end of its life cycle.
2. The electrical system might have an unknown short. Consult a certified technician.
3. Make sure all lights are off.
4. Disconnect all accessory electronics (radio, phone charger, DVD player, etc.) and check again.

YOU CANNOT DETERMINE A BATTERY BRAIN INSTALLATION CONFIGURATION FOR YOUR VEHICLE OR LOCATE BATTERY CONNECTIONS.

WHAT TO DO

1. Consult a certified technician.

IMPORTANT NOTE:

If a warning light for NO CHARGE or BATTERY WARNING illuminates on your dashboard, stop your vehicle at a safe area and TURN THE MANUAL RESET CONTROL KNOB (located under the removable protective cover on the Battery Brain unit itself) TO THE “OFF” POSITION. Your vehicle will experience a complete loss of power unless the “No Charge” problem is repaired immediately! This problem is unrelated to the Battery Brain and requires assistance from a qualified technician.

Limited Warranty

Your Battery Brain™ is covered by a conditional, limited warranty to the original purchaser.

This unit is guaranteed to the original retail purchaser against defects in quality or workmanship for a period of two years from the date of original purchase. If this unit fails because of a manufacturing defect within 30 days of purchase, return the unit, with your receipt, to the retailer. After 30 days of purchase, but within the warranty period, if the unit was purchased within the continental United States, return it, freight prepaid, to Smart Energy Solutions, Inc. for repair or replacement. If the unit was purchased outside the continental United States, return the unit to the place of purchase.

This warranty does not cover damage due to operation other than the use of the correct Battery Brain model on the specified battery voltage. This warranty does not extend to any defect, malfunction, or failure caused by accidents, misuse, abuse, improper installation (including disassembly of Battery Brain, use of the product with equipment for which it was not intended, or unauthorized alterations or repairs.

All implied warranties are hereby limited in duration to the period of two years from the date of original retail purchase. Incidental or consequential damages arising from a breach of either express or implied warranties are hereby disclaimed and excluded. Some states do not allow the exclusion of limitation of incidental or consequential damages, so this limitation or exclusion may not apply to you.

Neither Smart Energy Solutions, Inc. nor retailers selling Battery Brain are responsible for indirect, incidental, special, punitive or consequential damages arising from improper installation, the use of or inability to use Battery Brain. Except for this limited warranty, Smart Energy Solutions, Inc. has not made, and specifically disclaims any warranty or representation of any kind, express or implied, direct or indirect, of product fitness for a particular purpose.

Assembled in China for Smart Energy Solutions, Inc.

Battery Brain is an innovative accessory that easily installs to any battery. Using unique micro-electronic technology it continually monitors the battery power. When Battery Brain detects power falling below the level required to start your engine, it automatically isolates the battery from the electrical system. This will ensure you always have enough power to start your engine and keep moving!

BATTERYBRAIN

SMGY

SMART ENERGY SOLUTIONS

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Telephone: 973-248-8008
Fax: 973-248-8088
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sales@smgy.net
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NASDAQ OTCBB:SMGY.OB

For more information and other products go to
www.smgy.net/batterybrain/

CE Version: 200702

Douglas Enterprises

3326 Limebank Road, Unit 6
Ottawa, Ontario, Canada K1V 1H2
Phone: (613)521-0297 ☎ Fax: (613)526-5905

Blizzard Wizard®

Foam Mixer Kit

for

Portable/Fixed Fire Pumps

Operating Instructions

The Model BB Foam Mixer Kit consists of the following items:

- p/n 1015 Variable Round-the-Pump Foam Mixer c/w Pick Up Tube;
- p/n 1010 2" Suction Tee Adaptor (5);
- p/n 1011 (NHT) **or** 1012 (NPSH) 1½" Discharge Tee Adaptor (7).

Mount the Mixer to the Pump in the following manner:

- Attach the 2" Adaptor (5) to the suction port of the pump with the Female GHF (6) pointing up, then attach the suction hose;
- Attach the 1½" adaptor (7) to the discharge port of the pump, do not tighten at this time;
- Connect the Male GHF (2) located under the Mixer to the Female GHF on the 2" adaptor (6);
- Connect the ¾" Female GHF Hose of the Model BB Mixer (1) to the ¾" Male GHF of the Discharge Tee Adaptor. (8) (Remove the knurled Aluminum Cap);
- Connect the Pick Up Hose to the ¾" Male GHF (3) on the top side of the Model BB.

NOTE: There is a tendency for Pump vibration to cause these connections to loosen, thereby causing loss of prime. We recommend that they be tightened finger tight, and then further tightened ⅓ to ⅔ of a turn with slip joint plyers.

To make water/foam Solution, proceed as follows:

Step 1 - Ensure that the Metering Valve on the Model BB (4) is CLOSED.
Step 2 - Ensure that the ball valve of the Foam Sampling Nozzle (9) is CLOSED.
Step 3 - With the Pump running at pressure and the Hose line Nozzles OPEN, open the Metering Valve (4) wide (about 1 full turn) until the Pick Up Tube fills with foam liquid, then close the Metering Valve (4). Aim the Foam Sample Nozzle (10) away from Personnel and the Pumps Water Supply and open the Sample Nozzle ball valve (9). As soon as clear water flows from the Foam Sample Nozzle (9), slowly open the Metering Valve (4) until Foam of the desired consistency is produced, then close the Foam Sample Nozzle ball valve (9). If the 1½" Tee is not equipped with a Sampling Nozzle, observe the discharge from the Hoseline Nozzle.

Step 4 - Take note of the Metering Valve (4) setting and check periodically while pumping to ensure the setting has not changed.

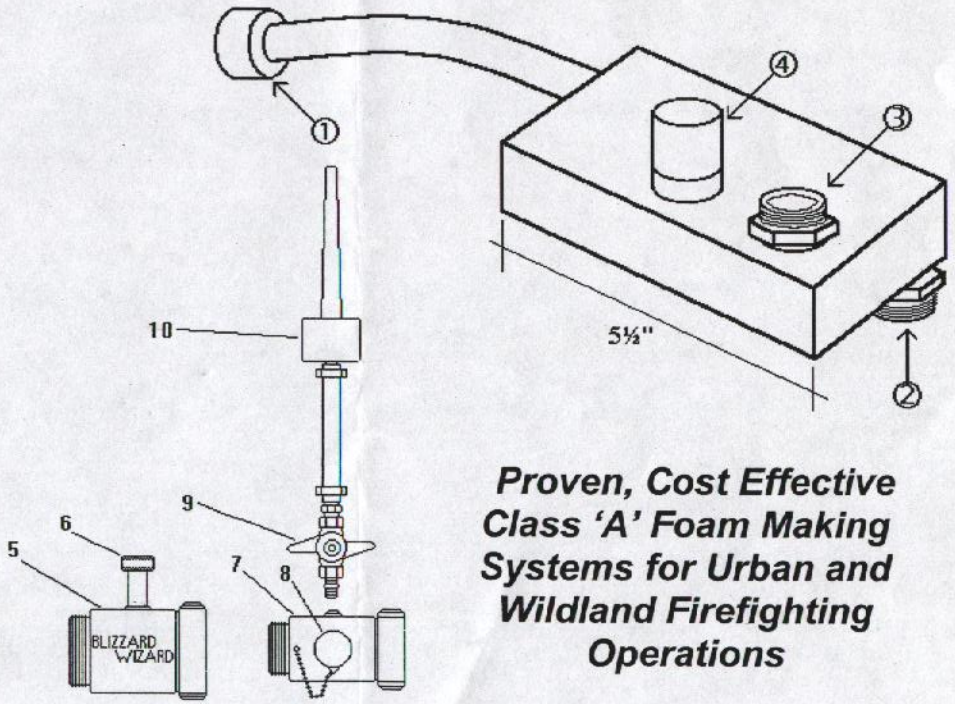
NOTE: With experience, the concentration setting can be determined qualitatively via the Foam Sample Nozzle (10) as described above. The required setting can also be determined by using the Model BB Flow Tables. Use of the Tables requires that the operator is able to determine the total flow in the hoseline. Total Flow can be determined by adding the flows of all nozzles connected. (For details, see the Model BB Flow Tables).

After use, flush the Model BB and the Pick Up Tube **THOROUGHLY** with clean water. While flushing, open the Metering Valve (4) fully. After flushing, return the Metering Valve (4) to the fully closed position for storage. The Foam Mixing Kit can be left on the Pump or removed for storage.

Trouble Shooting

If, after performing Steps 1, 2, & 3, foam liquid is not being picked up, check the following:

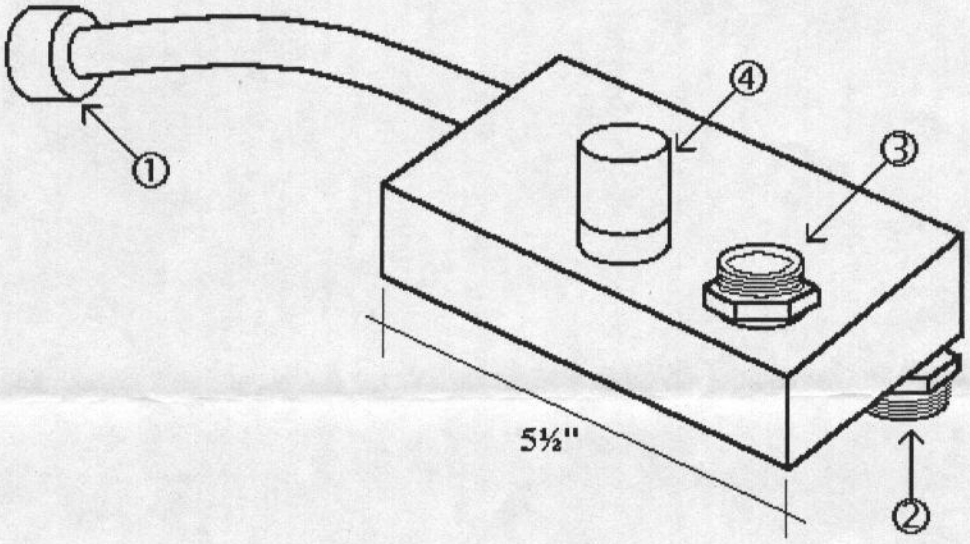
- Open the Metering Valve (4) fully to flush out any dirt which may be lodged in the Valve seat.
- Ensure that water is flowing through the Model BB. This can be determined by removing the unit, closing the Metering Valve (4), and blowing through the ¾" Male GHF on the underside (2). Only slight resistance to flow should be felt.
- Ensure that the internal pick up Check Valve is free by opening the Metering Valve (4), and blowing through the pick up Male GHF (3). If the Check Valve is stuck closed, connect a garden hose to the pick up Male GHF (3) and run water under pressure (200 PSI Max.) through the Metering Valve. NOTE: this connection will require a double Female GHF or a hose with a Female GHF on either end such as an automatic clothes washer hose.



Proven, Cost Effective Class 'A' Foam Making Systems for Urban and Wildland Firefighting Operations

Douglas Enterprises

3326 Limebank Road, Unit 6, Ottawa Ontario Canada K1V 1H2
Tel (613)521-0297 * Fax (613)526-5905



Pt. No. 1015

To install a Blizzard Wizard® Model BB Foam Mixer to any pump, proceed as follows:

(a) Connect the 9" long hose ① to the discharge side of the pump. The hose is fitted with a 3/4" female garden hose coupling. If this is not practical, removing the hose will leave a 3/8" female pipe thread. Schedule 40 pipe and fittings can then be used to connect the unit to the discharge side of the pump.

(b) Connect the 3/4" male garden hose fitting ② to the suction side of the pump (ie: into the suction line from the water tank to the pump) as close to the pump as possible but, in any case, on the pump side of the tank valve. As in **(a)** above, the garden hose fitting may be removed, leaving a 3/8" female pipe thread.

(c) The pick-up hose attaches to ③ and then into the concentrate pail or tank.

(d) The control Knob ④ adjusts the amount of foam concentrate which is injected into the water, or may be shut off completely without affecting the normal operation of the pump.

Note: If the mixer is attached to the discharge side of the pump on the hose side of the discharge control valve, it will be necessary to install another shut-off valve in the mixer pipe line somewhere between the *discharge* side connection and the *suction* side otherwise, it will not be possible to to prime the pump when going to draft.

Blizzard Wizard®

Douglas Enterprises

3326 Limebank Road, Unit 6, Ottawa, Ontario, Canada K1V 1H2
Phone: (613)521-0297 ☎ Fax: (613)526-5905

Calculating Pick-Up Settings for the Model BB Mixer

Nozzle Model Number	Nozzle Capacity (gpm US)	Nozzle Capacity (l/min)
LF-8	11	43
MF-16	23	87
HF-32	34	129
SF-50	50	189
SF-60	60	225

Table 1 - Nozzle Flow Rates @ 100 psi (690 KPa)

Concen-tration (% by Vol)	Flow Factor	
	US	Metric
0.2	0.256	2
0.3	0.384	3
0.5	0.64	5
1.0	1.28	10
3.0	3.84	30

Table 2 - Flow Factors

Pick-Up Setting	Pick-Up Rate	
	Ozs/min	ml/min
A	1.3	39
B	8.4	248
C	23.5	695
D	44.7	1322
E	61	1804
Full Scale	72.1	2132

Table 3 - Pick-Up Rates

To determine the setting required:

① Calculate **Total Water Flow** through pump (Sum of Capacities of all Nozzles connected from ***Table 1.***

② Multiply **Total Water Flow** by the appropriate Concentrate **Flow Factor** from ***Table 2*** to calculate required **Concentrate Flow.**

③ Select appropriate setting for **Model BB Control Knob** from ***Table 3.***

Example:
2 x **MF-16** Nozzles @ 23 gpm US.

Total Water Flow = 2 x 23 gpm = 46 gpm

Assume: Required **Concentration** is 0.5%

∴ **Flow Factor** is 0.64 *(Table 2),* and,

Concentrate Flow = 46 gpm x 0.64
= 29.44 oz/min.

∴ Set **Model BB Control Knob** between **C and D.**

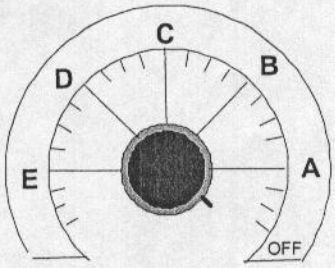


Fig. 1 Model BB Label

Conversions
1 Liter = 1000 mL
1 US gal = 3.785 Liters
1 US gal = 128 ounces
1 ounce = 29.6 mL

DOUGLAS ENTERPRISES

3326 Limebank Road, Unit 6, Ottawa Ontario Canada K1V 1H2
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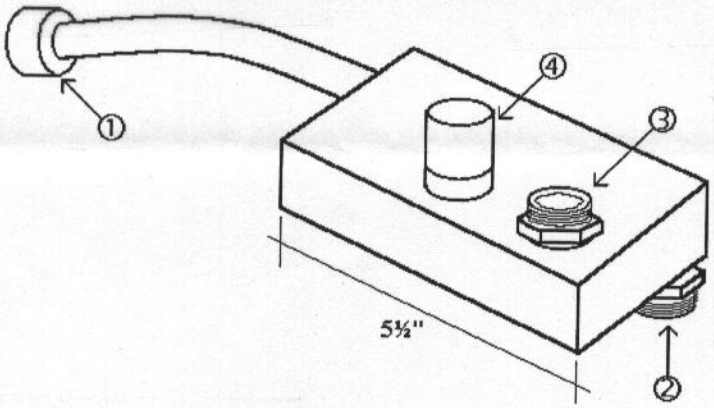
Blizzard Wizard® Model BB Foam Mixer - Cleaning and Storage Instructions

Any piece of firefighting equipment which comes into contact with foam solution or concentrate should be thoroughly flushed with clean water after use. The Model BB Foam Mixer is no exception.

The BB Mixer has only two moving parts, namely: a) the metering valve (4), and b) the ball check (internal-not shown). Both of these parts come into direct contact with the undiluted concentrate when foam is being produced. If clean water is not flushed through the concentrate inlet (3) by (upon completion of firefighting operations) placing the pick-up hose into a clean water supply with the unit in operation and the control knob (4) fully open, the residual concentrate will dry inside the unit and literally glue the ball closed in the Ball Check. In this condition, the unit will either not pick-up concentrate at all, or will do so at a rate well below the calibrated range. This situation may arise from time to time, since it is not always possible to execute thorough cleaning in the field. If a unit will not pick-up concentrate, first ensure that the pick-up hose has a good washer installed and that it is connected tightly (hand tight is sufficient) to the concentrate inlet (3). Next, ensure the metering valve (4) is **not** in the closed position. If these two conditions are met and pick-up still cannot be achieved, proceed as follows:



1. Obtain a double female garden hose adaptor. A readily available source is a hose from an automatic washer. (They have a female swivel on both ends.)

2. Connect this hose to a domestic water supply (appx. 40-60 psi), preferably warm water, then connect the other end to the concentrate inlet (3).

3. Start with the metering valve (4) wide open. Turn on the warm water and once it starts flowing through the mixer, fully close and then re-open the metering valve (4) once or twice. Water should be discharging from both the inlet hose (1) and the discharge fitting (2). Allow the water to flow through at full pressure for at least a minute. This should flush all the internal surfaces clean. If necessary, repeat the procedure.

4. Store the unit with the metering valve (4) in the OFF (fully clockwise) position.

This procedure is also recommended when preparing a BB Mixer for an extended period of storage.

Blizzard Wizard®

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CAB INSTALLATION INSTRUCTIONS

POLARIS RANGER/UTV CAB KIT (p/n 2874660)

To install this cab kit (p/n 2874660), you will need mount kit p/n 2874689.

Available optional kits:
Vinyl Doors (p/n 2874693); Hard Rear Panel (p/n 2859091).

The contents of this envelope are the property of the owner.
Be sure to leave with the owner when installation is complete.

(optional accessories shown: work lights, strobe light, antenna, and second wiper motor)

WARNING ***Exposure to Carbon Monoxide can Cause illness, serious injury or death.***
Never operate vehicle if suspicious of Carbon Monoxide. Inspect exhaust system for leaks monthly. Leaks can result from loose connections, corrosion, cracks or other damage to the exhaust manifold. If leaks are found, repair or replace exhaust system. Do not use vehicle until repair or replacement is complete.

ADDED WEIGHT **NOTICE**

Curtis Cabs, blades and general accessories add additional weight to the base vehicle. All Curtis accessory weights are listed in product brochures. Deduct the accessories total weight from the vehicles rated capacity and never exceed the vehicles rated capacity including driver and passenger.

CAB INSTALLATION

BEFORE YOU START

HELPFUL REMINDERS:

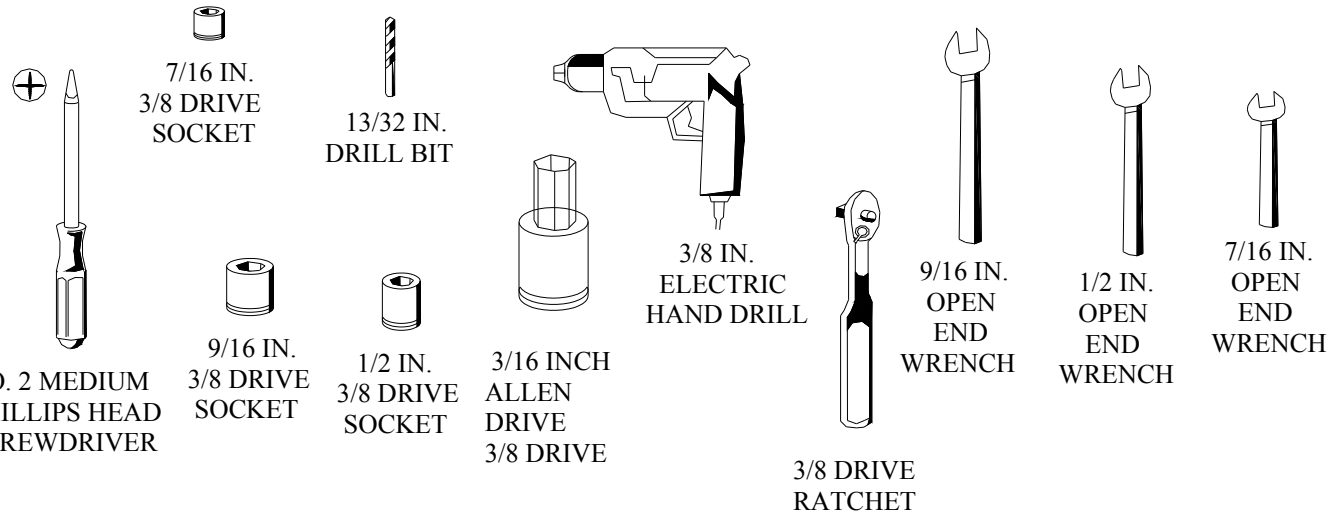
A. Leave all bolts loose for later adjustment unless otherwise specified.

B. Read and understand all instructions before beginning.

C. Plastic washers have been supplied to provide a weather seal around all exterior fasteners. The plastic washer should be installed under each bolt head directly against the outside cab surface. Care should be taken not to over tighten the fasteners and damage the plastic washer. Also use metal washers as required.

D. Apply a clear silicone sealant to seal any minor gaps that may occur due to vehicle variances. For example, windshield cowl to unitized frames.

TOOLS REQUIRED:



MODEL: POLARIS RANGER CAB KIT INSTALLATION INSTRUCTIONS

1. VEHICLE PREP.

1.1 Remove the roll bar from the vehicle so the vehicle appears as shown in figure 1.1.

1.2 Remove the seat back (the actual back portion of the seat) from the roll bar tubing as shown in fig. 1.2. Save these eight (8) bolts for reuse in step 3.1.

1.3 Remove and save the six (6) button head, self-tapping screws (3 per side) that are in the floorboard as shown in fig. 1.3 (left, driver's side shown).

Fig. 1.1 Roll bar removed

2. SIDE FRAME (left side)

2.1 Open the hood of the vehicle.

2.2 Install the left side frame to the vehicle by tucking the middle front section in behind the plastic hood as shown in fig. 2.2. Using three (3) of the button head screws previously removed in step 1.3, attach the lower portion of the side frame to the floorboard. Using two (2) 5/16" x 3/4" hex. head bolts, steel washers, and locknuts, attach the front middle section of the side frame to the matching mounting surface on the vehicle as shown in fig. 2.2.

3. REAR PANEL

3.1 (NOTE: If installing the optional hard rear window, install window clips before installing seat back to rear panel.) Attach the seat back to the rear panel as shown in fig. 3.1 using the eight (8) bolts that were previously removed in step 1.2. (NOTE: the relief in the middle edge of the seat should be down towards the bulb rubber side of the rear panel.)

3.2 Attach the mounting brackets to the rear panel with one (1) 5/16" x 3/4" button head screw as shown in fig. 3.2. (NOTE: visually line up the outer edge and the two (2) slots before tightening the bolt.)

Fig. 1.2 Back seat section

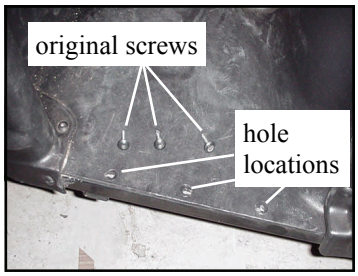


Fig. 1.3 Reuse floorboard bolts

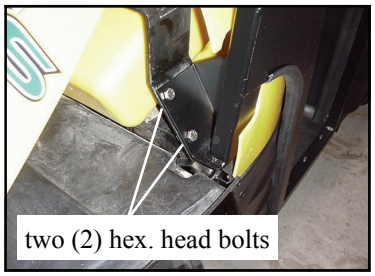


Fig. 2.2 Side frame (front middle section)

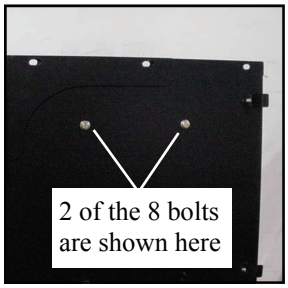


Fig. 3.1 Rear Panel assembly

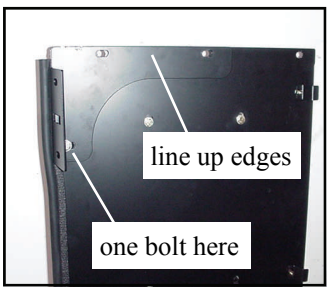


Fig. 3.2 Attach mounting brackets

REV. J

3. REAR PANEL (cont'd.)

3.3 Place the rear panel assembly on the vehicle as shown in fig. 3.3. (NOTE: the bottom of the rear panel is to remain in front of the four (4) welded tubes as shown in fig. 3.3.1) (NOTE: a cut will need to be made in the flat rubber filler where the seat belt comes through.)

3.4 Secure the rear panel assembly to the back side of the side frames using six (6) 5/16" x 1" button head screws, steel washers, and plastic washers as shown in fig. 3.4 (3 bolts per side frame). (NOTE: two of the three bolts will go through the slots in the mounting brackets.)

Fig. 3.3 Rear panel assembly installed

4. SIDE FRAME (right side)

4.1 Install the right side frame (passenger's side) similar to the left side frame. Secure the bottom of the side frame to the floorboard using the remaining three (3) button head screws previously removed in step 1.3. Using two (2) 5/16" x 3/4" hex. head bolts, steel washers, and locknuts, attach the front middle section of the side frame to the matching mounting surface located inside the plastic hood.

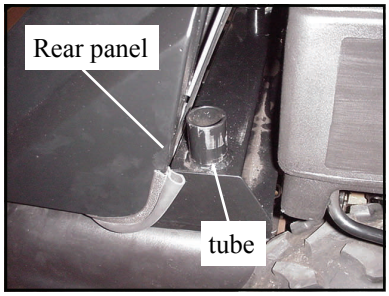


Fig. 3.3.1 Rear panel location

5. REAR CROSS BRACE

5.1 Install the rear cross brace as shown in fig. 5.1. Use one (1) 5/16" x 1" button head screw, steel washer, and plastic washer, per side, in the back side of each of the side frames. (NOTE: the top slot is to remain open until the roof is installed.)

6. COWL

6.1 Install the cowl using two (2) 5/16" x 1" button head screws, steel washers, and plastic washers, per side, as shown in fig. 6.1, with the flap of bulb rubber extended toward the front. Push cowl fully down and tighten bolts.

7. WINDSHIELD SUPPORT

7.1 With assistance, install the windshield support with the bent flange down. Use one (1) 5/16" x 1" button head screw, steel washer, and plastic washer, per side, as shown in fig. 7.1. (NOTE: the top holes will get fasteners once the roof is installed.)

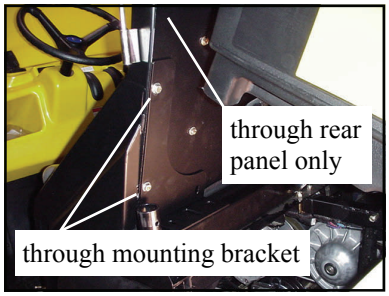


Fig. 3.4 Rear panel to side frame

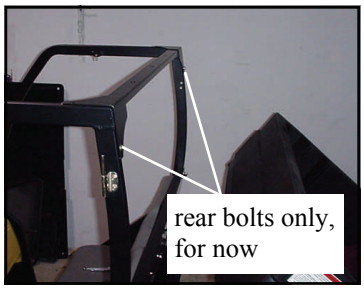


Fig. 5.1 Rear cross brace

Fig. 6.1 Cowl installation

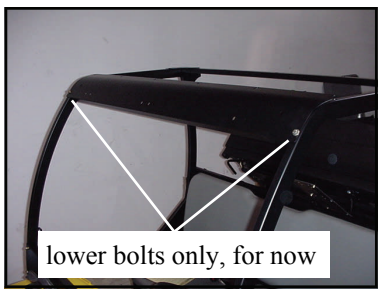


Fig. 7.1 Windshield support

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8. WINDSHIELD

8.1 With assistance, install the windshield to the windshield support (see figure 8.1). Use six (6) 5/16 x 1 3/4" long flat head screws and 3/4" thick plastic spacer blocks (placed between the plastic hinge and the windshield support as shown in fig. 8.1.1). Do not tighten.

8.2 To install windshield bottom latches into the cowl brackets, open windshield slightly. Grasp and squeeze the spring-loaded tabs and cradle latches into cowl brackets, aligning tab bosses with their respective mounting holes (see Fig. 8.2)

8.3 To close, grasp the windshield bottom edge and lift slightly while pushing closed. Fully close latches. Align sides of windshield with side frames and tighten hinges. HINGES ARE PLASTIC COMPONENTS. DO NOT OVER TIGHTEN. TORQUE TO 7 FT./LBS. MAX.

Fig. 8.1 Install windshield

9. ROOF

9.1 With assistance, place the roof on top of the side frames as shown in fig. 9.1.

9.2 Fasten the roof in place. Use seven (7) 5/16" x 1" long button head screws, steel washers, and plastic washers on the three sides of the roof that attach to the tubing (via threaded inserts in the tubes). Use four (4) 5/16" x 1" long button head screws, steel washers, plastic washers, and locknuts in the remaining openings in the front of the roof (to bolt the roof and windshield support together).

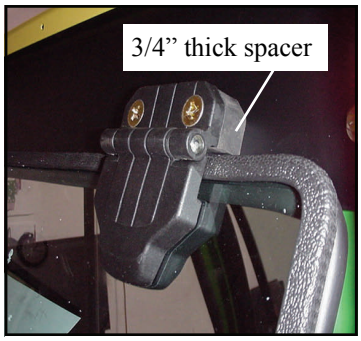

Fig. 8.1.1 Spacer Block

10. REAR CURTAIN (soft)

NOTE: a Hard Rear Panel (p/n 2859091) is available as an option.

10.1 Apply self adhesive hook velcro, as needed, along the rear side frames and rear panel. (NOTE: adhesive backed velcro should be applied to a clean, dry surface at room temperature.) (wipe down areas where velcro is to be applied with iso propyl alcohol)

10.2 Install the rear curtain by snapping to the inside back vertical edge of the roof.

10.3 Adhere three sides of the rear curtain to the newly applied velcro strips.

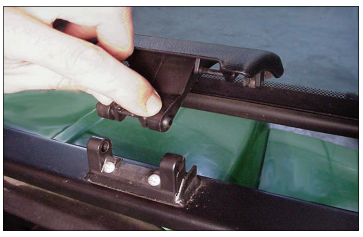

Fig. 8.2 Squeeze tabs

Fig. 9.1 Install roof

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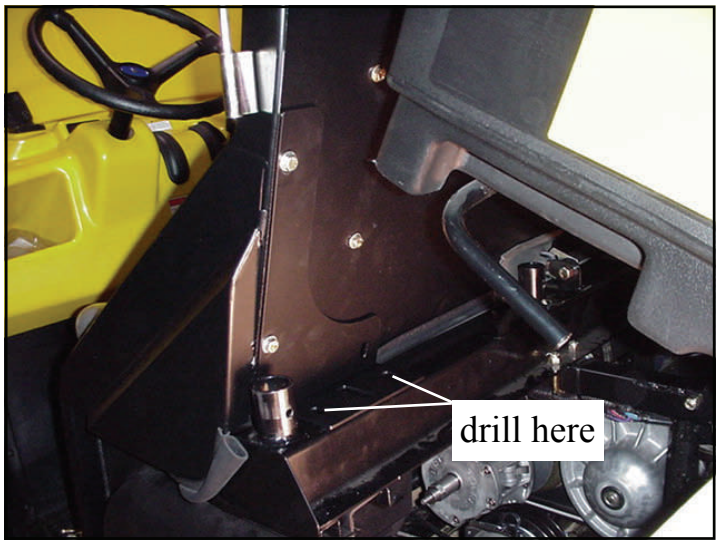
11. MOUNTING BRACKET

11.1 Lift the dump bed.
11.2 Using a 13/32" drill bit, and using the approximate center of the mounting bracket slots as a guide, drill four (4) holes through the sheet metal on the vehicle as shown in the enlarged view below (fig. 11.2).
11.3 Use four (4) 3/8" x 1" hex. head bolts, steel washers, and locknuts to secure the mounting brackets to the vehicle (2 per side).

12. FINISHING TOUCHES

12.1 Install wiper motor per instructions included with the kit.
12.2 Install 5/16" plastic nut covers on all interior 5/16" locknuts.
12.3 At this point, to install doors, follow the instructions included in the vinyl door kit (p/n 2874693).

Fig. 11.2
Drill 4 holes
(2 per side)



CARE AND MAINTENANCE

Check and tighten hardware after 40 hours of operation.
Periodically inspect and tighten hardware for the remainder of the unit's life.

Wash the painted surfaces of the unit with commercial automotive cleaning products.

Clean windows with glass cleaner.

Vinyl components should be washed with a mild solution of warm soapy water.
Clear vinyl can be easily scratched. Be careful cleaning frost or snow from windows.
Do not roll curtains in cold weather. The windows become stiff and may crack. Keep windows clean.

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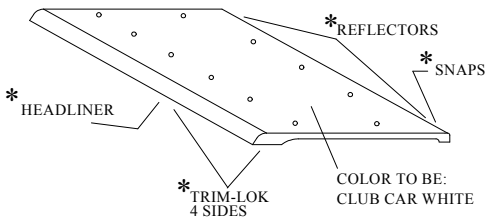
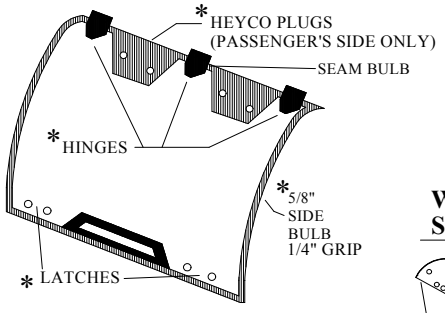
POLARIS MAIN CAB BODY - RANGER / UTV (p/n 2874660)

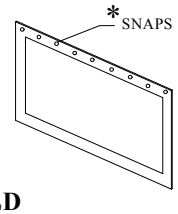
ROOF QTY. 1 P/N UTV-01



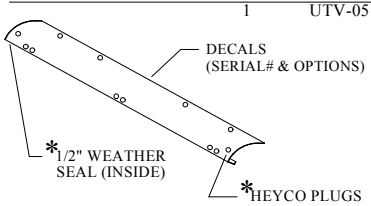
WINDSHIELD QTY. 1 P/N UTV-02



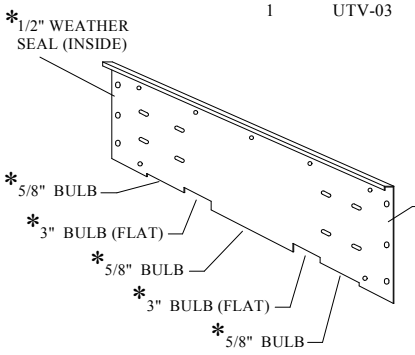
REAR CURAIN QTY. 1 P/N UTV-06



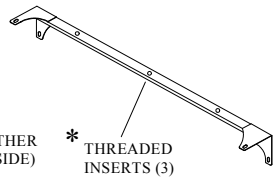
WINDSHIELD SUPPORT QTY. 1 P/N UTV-05



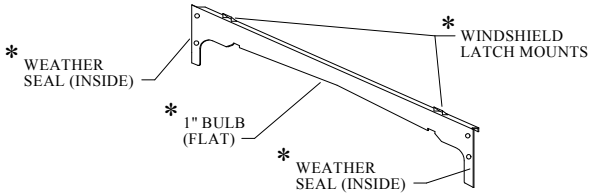
LOWER REAR PANEL QTY. 1 P/N UTV-03



REAR BRACE QTY. 1 P/N UTV-04



WINDSHIELD COWL QTY. 1 P/N UTV-08



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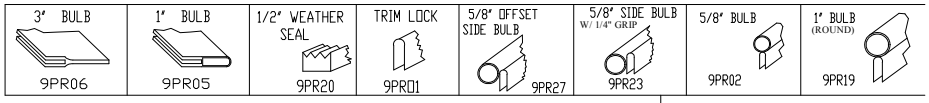
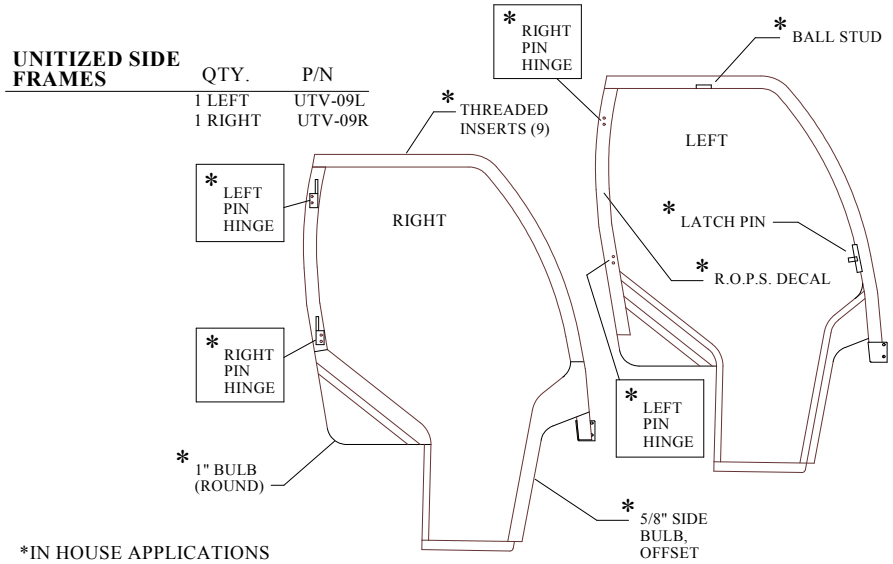


UNITIZED SIDE FRAMES QTY. 1 LEFT 1 RIGHT P/N UTV-09L UTV-09R



*IN HOUSE APPLICATIONS

ADDITIONAL SERVICE PARTS

QTY/UNIT	P/N	DESCRIPTION
1	9GL-32 x 55	MOLDED WINDSHIELD KIT
3	9PH007 & 9BLK01	POP OUT WSHIELD HINGE KIT-SINGLE
2	9WL01	POP OUT WSHIELD LATCH KIT-SINGLE
1	9PH006	UNITIZED FRAME HINGE KIT-LH
1	9PH005	UNITIZED FRAME HINGE KIT-RH
1	UTV-HWK	HARDWARE KIT

REV. J

DOOR INSTALLATION INSTRUCTIONS

POLARIS RANGER/UTV
STEEL DOORS (p/n 2875941-067)

The contents of this envelope are the property of the owner.
Be sure to leave with the owner when installation is complete.

WARNING ***Exposure to Carbon Monoxide can Cause illness, serious injury or death.***
Never operate vehicle if suspicious of Carbon Monoxide. Inspect exhaust system for leaks monthly. Leaks can result from loose connections, corrosion, cracks or other damage to the exhaust manifold. If leaks are found, repair or replace exhaust system. Do not use vehicle until repair or replacement is complete.

ADDED WEIGHT NOTICE

Curtis Cabs, blades and general accessories add additional weight to the base vehicle. All Curtis accessory weights are listed in product brochures. Deduct the accessories total weight from the vehicles rated capacity and never exceed the vehicles rated capacity including driver and passenger.

POLARIS RANGER/UTV DOOR KIT (STEEL DOORS)
INSTALLATION INSTRUCTIONS

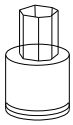
TOOLS REQUIRED:

7/16 IN. 3/8 DRIVE SOCKET

7/16 IN. OPEN END WRENCH

1/2 IN. OPEN END WRENCH

3/4 IN. OPEN END WRENCH


3/16 INCH ALLEN DRIVE 3/8 DRIVE

3/8 DRIVE RATCHET

1. REAR MOUNTS

1.1 Remove existing rear mounts (part number 2874689) from the cab rear panel and install left and right mounts from this kit in their place as shown in figure 1.1.

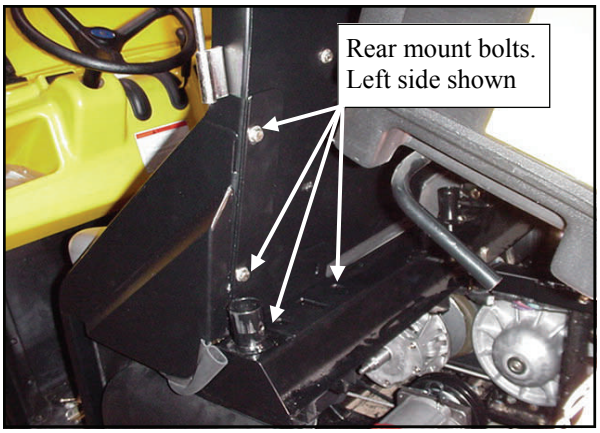


FIG. 1.1

2. DOORS

2.1 Install doors onto hinges. Work the doors back and forth until the hinges are completely seated. (NOTE: the hinges, and striker bolt can all be adjusted for proper engagement.)

2.2 Tighten all remaining bolts.

2.3 Install gas springs onto ball studs with the piston side toward the door.

CAUTION: FOR SAFE OPERATION, DO NOT DRIVE WITH DOORS OPEN. MAKE SURE DOORS ARE CLOSED AND PROPERLY LATCHED WHEN DRIVING.

CARE AND MAINTENANCE

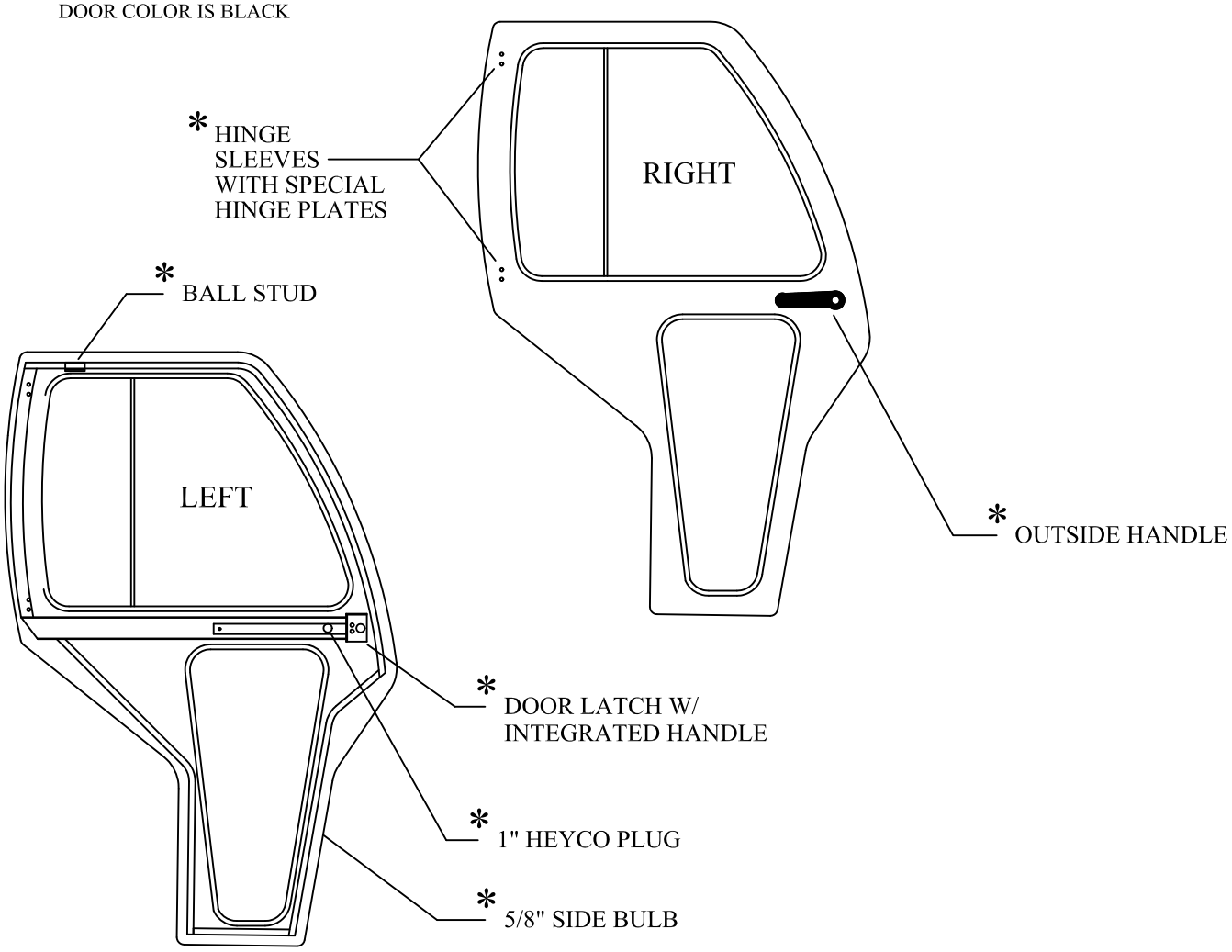
Check and tighten hardware after 40 hours of operation.
Periodically inspect and tighten hardware for the remainder of the unit's life.
Wash the painted surfaces of the unit with commercial automotive cleaning products.
Clean windows with glass cleaner.

POLARIS RANGER HARD SIDED DOOR KIT
p/n 2875941-067

DOORS

QTY.	P/N
1 LEFT	2875941-067LD
1 RIGHT	2875941-067RD

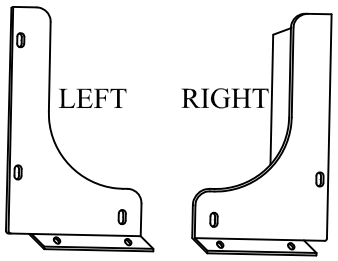
REFERENCE:
DOOR COLOR IS BLACK



REAR MOUNTS

QTY.	P/N
1 LEFT	2875941-067LRM
1 RIGHT	2875941-067RRM

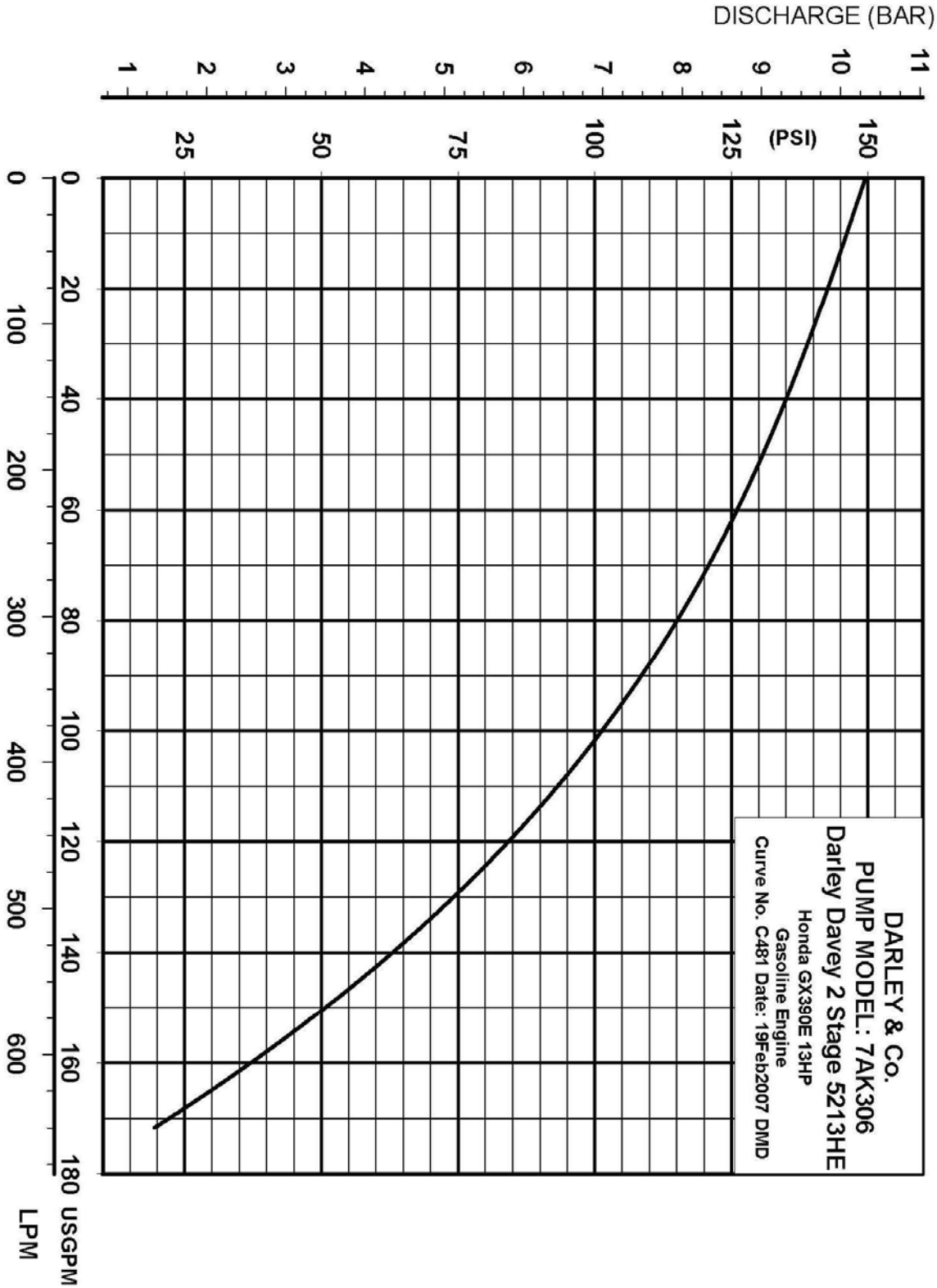
*IN HOUSE APPLICATIONS



ADDITIONAL SERVICE PARTS

P/N	DESCRIPTION
9PH006	UNITIZED FRAME HINGE KIT-LH
9PH005	UNITIZED FRAME HINGE KIT-RH
9SW-PL	LEFT DOOR SLIDER ASSEMBLY
9SW-PR	RIGHT DOOR SLIDER ASSEMBLY
9DL03A	ROTARY DOOR LATCH W/ HANDLE -LH (SHORT)
9DL03B	ROTARY DOOR LATCH W/ HANDLE -RH (SHORT)
9DL01C	OUTSIDE R-LATCH HANDLE W/KEY
9GS02	GAS SHOCK (DOOR) (SINGLE)
9PH008HP3	HINGE PLATE (POLARIS ROPS HARD SIDED DOOR)

7AK306/5213HE/NPT **2 Stage**
13 HP Honda



TWIN IMPELLER "FIREFIGHTER®"

Model Numbers: 5290BE, 5290HE, 5213BE & 5213HE

DEPEND ON DAVEY

WATER PRODUCTS

SELF PRIMING PUMPS

PRODUCT DESCRIPTION

Rugged, economical, twin impeller, self priming pump. These units are driven by either a 9 or 13hp Briggs & Stratton "Vanguard" engine or a 9 or 13hp Honda GX/E engine, fitted with an electric start.

APPLICATIONS

- Firefighting
- Tanker to tanker water transfer
- High head general water transfer
- Sheep jetting
- Irrigation
- Boom spraying
- Travelling irrigators

FEATURES & BENEFITS

Heavy duty wide vane impeller for longer life, improved performance and easier cleaning in the case of blockage.

Twin impeller design provides the versatility of high flow rates with extra strong pressure.

Thrust balanced impeller design to extend engine life.

Pump casing, diffusers and impellers manufactured from quality corrosion resistant marine grade aluminium for long life.

NEW 3 way discharge port for easy installation with a choice of plumbing sizes. The NEW 3 way discharge is easily adapted to the old 3 way outlets.

Polyester coated pump casing, exterior and interior, for added corrosion resistance.

Patented floating impeller neckrings front and back. The front neckring helps improve pumping efficiency, the back neckring helps extend seal life and dramatically reduce engine wear.

Self priming from up to 6m for more versatile installation options.

Huge 1 1/2" priming port for extra quick filling.

Large drain port with bayonet fit plugs. Plugs have safety retention system.

Low-oil protection on all models - engines won't start or run if oil level is inadequate, thus protecting your engine.

All engines feature cast iron cylinder bore for long life.

Electric starter (battery and leads required) and recoil starter fitted, ensures a choice of starting methods, even if the battery is flat or removed.

Viton seal and oring kit available for herbicide/insecticide spraying.

OPERATING LIMITS

Flows to	680lpm
Maximum total head	120m
Maximum suction Lift	7m
Maximum water temperature	50°C
Minimum water temperature	1°C
Maximum casing pressure	1600kPa
Minimum suction pipe size	2"
Suction pipe strainer	Required
Inlet size	2" BSP(M)*
Outlet sizes	1 x 2" BSP(M)• 2 x 1" BSP(M)•
Priming port	1 x 1 1/2" BSP(M)*

* NPT thread available on request.

- 1x1 1/2" & 2"x1" NPT outlet tee available on request.

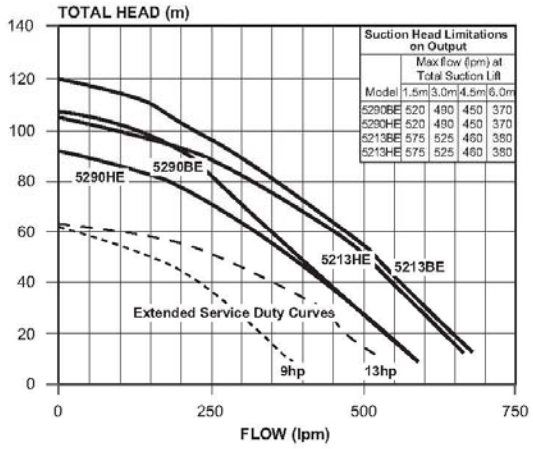
HIO A MFG SCORESBY Quality System Quality Endorsed Company ISO 9001 Lic 10826 Standards Australia

TECHNICAL SPECIFICATIONS

MATERIALS OF CONSTRUCTION

PART	MATERIAL
Suction cover	Marine grade aluminium (AS605)
Diffuser	Marine grade aluminium (AS605)
Impeller	Marine grade aluminium (AS605)
Casing / yoke	Marine grade aluminium (AS605)
Mechanical seal	Carbon / ceramic
3 way discharge	Marine grade aluminium (AS605)
Casing bolts	Zinc plated steel
Yoke bolts	Stainless steel
Flap valve / seal ring	Zinc body, Hytrel seal
Neck ring, priming & drain plug	Glass filled Nylon
Casing, priming & drain plug oring	Nitrile rubber
Discharge gasket	Hytrel
Paint finish	Baked polyester powder coat

HYDRAULIC PERFORMANCE



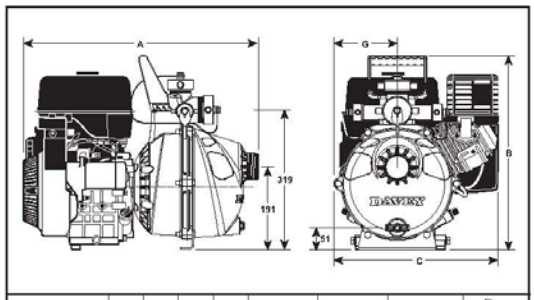
Suction Head Limitations on Output

Model	Max flow (lpm) at Total Suction Lift 1.5m	3.0m	4.5m	6.0m
5290BE	520	490	450	370
5290HE	520	490	450	370
5213BE	575	525	460	380
5213HE	575	525	460	380

ENGINE SPECIFICATIONS

Engine Brand	Briggs & Stratton	Honda	Briggs & Stratton	Honda
Engine Model	Vanguard	GX270E	Vanguard	GX390E
Single Stage Pump Model	5290BE	5290HE	5213BE	5213HE
"Out of box" governed max engine speed @ no load	4200rpm	3800rpm	4200rpm	3800rpm
Max. rated hp @ 3600rpm	9.0	9.0	13.0	13.0
Displacement (cc)	296	270	391	389
Fuel Tank (litres)	6.0	6.0	7.9	6.5
Approx. fuel consumption @ full load @ 3600rpm	3.16	3.05	4.68	3.25
Running time per tank @ full load @ 3600rpm	1.9	1.9	1.7	2.0
Oil Capacity (litres)	1.4	1.1	1.5	1.1
Spark arrestor	Yes	No	Yes	No
dBa @ 3600rpm @ full load	79 @ 4m	79 @ 7m	81.5 @ 4m	78 @ 7m

DIMENSIONS



Model	A	B	C	G	• Inlet BSP	• Outlet BSP	Priming Port BSP	Dry Weight (kg)
5290BE	560	450	427	156	2"	2 x 1" 1 x 2"	1½"	36.8
5290HE	544	450	435	155	2"	2 x 1" 1 x 2"	1½"	28.4
5213BE	584	476	457	171	2"	2 x 1" 1 x 2"	1½"	42.7
5213HE	569	445	455	161	2"	2 x 1" 1 x 2"	1½"	34.7

*NPT thread available on request.
•1x1½" & 2x1" NPT outlet tee available on request.
All dimensions in mm unless otherwise stated.

INSTALLATION & PRIMING

- Fit strainer to bottom of suction pipe; a foot valve is not required
- To prime, fill pump body with water then allow pump to run until drawing water

This literature is not a complete guide to product usage. Further information is available from your Davey dealer, Davey Customer Service Centre and from the relevant product Installation and Operating Instructions. This data sheet must be read in conjunction with the relevant product Installation and Operating Instructions and all applicable statutory requirements. Product specifications may change without notice.
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Visit Davey on-line for further information
www.davey.com.au

DEPEND ON DAVEY
WATER PRODUCTS

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Fax: +61 3 9753 4100
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Fax: 1300 369 119
E-mail: sales@davey.com.au
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Perth - Townsville

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Website: www.daveynz.co.nz
E-mail: sales@daveynz.co.nz

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Davey Pumps Inc.
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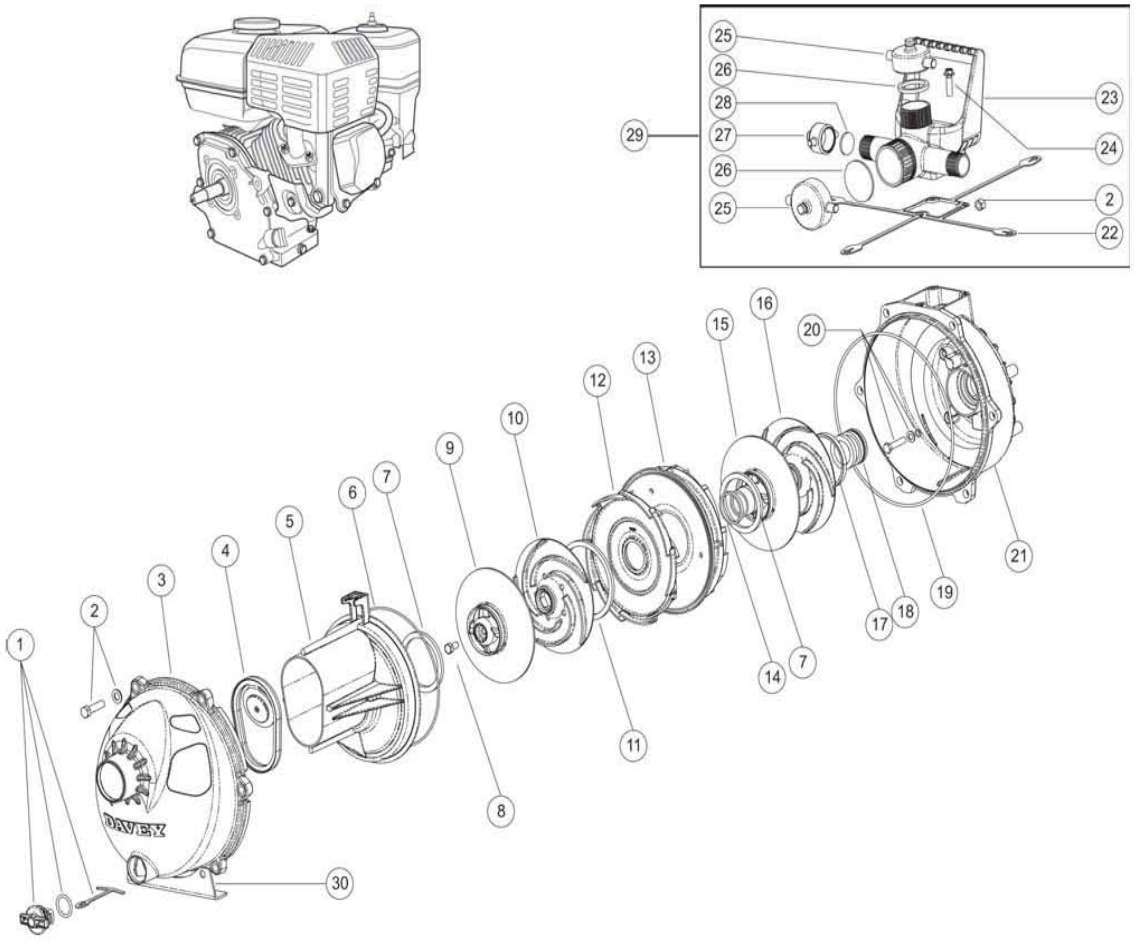
Aurora, Illinois 60504
Ph: +1 630 898 6976
Fax: +1 630 851 7744
Website: www.daveyusa.com
E-mail: sales@daveyusa.com

D990/4K/0605/GPW

ENGINE DRIVEN SELF PRIMING PUMPS

Honda, 5.5hp, Twin Impeller	**5255H/NPT**
Briggs & Stratton, 6hp, Twin Impeller	**5260B/NPT**
Honda, 6.5hp, Twin Impeller	**5265H/NPT**
Briggs & Stratton, 9hp, Twin Impeller, Electric Start	**5290BE/NPT**
Honda, 9hp, Twin Impeller, Electric Start	**5290HE/NPT**
Briggs & Stratton, 13hp, Twin Impeller, Electric Start	**5213BE/NPT**
Honda, 13hp, Twin Impeller, Electric Start	**5213HE/NPT**
CKD Kit, 5/8" Twin Impeller	**5258C/NPT**
CKD Kit, 1" Twin Impeller	**5210C/NPT**

Notes :
A. Neck & balance ring kit includes parts 6,7,11,14,17,19
B. Standard seal kit for 5.5hp, 6hp & 6.5hp model and includes parts 4,6,7,11,14,17,18,19,20
C. Standard seal kit for 9 & 13 hp models and includes parts 4,6,7,11,12
D. Discharge kit include parts 2,14,15,17,18,19,20



ENGINE DRIVEN SELF PRIMING PUMPS

Honda, 5.5hp, Twin Impeller	**5255H/NPT**
Briggs & Stratton, 6hp, Twin Impeller	**5260B/NPT**
Honda, 6.5hp, Twin Impeller	**5265H/NPT**
Briggs & Stratton, 9hp, Twin Impeller, Electric Start	**5290BE/NPT**
Honda, 9hp, Twin Impeller, Electric Start	**5290HE/NPT**
Briggs & Stratton, 13hp, Twin Impeller, Electric Start	**5213BE/NPT**
Honda, 13hp, Twin Impeller, Electric Start	**5213HE/NPT**
CKD Kit, 5/8" Twin Impeller	**5258C/NPT**
CKD Kit, 1" Twin Impeller	**5210C/NPT**

ITEM	NOTES	DESCRIPTION	QTY	PART NO.
1		Priming / drain plug assy	2	32162
2	D	Kit - bolt & nut	1	32163
3		Casing - front 1.5" NPT - 2 stg	1	13525-3PR
4	B, C	Flap valve assy	1	13081-3~
5		Cover plate	1	13386
6	A, B, C	Oring - coverplate	1	400144
7	A, B, C	Neck ring	2	13384
8	B, C	Screw - impeller (pk 4)	1	13367*4
9		Impeller top - 1st stage 9hp model & 5210C/NPT	1	13381-1
9		Impeller top - 1st stage All other models not specified	1	13381
10		Impeller bottom - 1st stage 13hp models only	1	13380
10		Impeller bottom - 1st stage 9hp model & 5210C/NPT	1	13380-1
10		Impeller bottom - 1st stage All other models not specified	1	13533
11	A, B, C	Neck ring balance 1st stage	1	13558
12		Diffuser 1st stage	1	13383
13		Diffuser 2nd stage	1	13382
14	A, B, C	Neck ring - inner stage	1	13476
15		Impeller top - 2nd stage 9hp model & 5210C/NPT	1	13379-1
15		Impeller top -2nd stage All other models not specified	1	13379
16		Impeller bottom - 2nd stage 13hp models only	1	13376
16		Impeller bottom - 2nd stage 9-10hp 9 hp model only	1	13376-1
16		Impeller bottom - 2nd stage All other models not specified	1	13535
17	A, B, C	Neckring balance	1	13366
18	C	Seal mechanical 33mm Type 2100 9/&13hp & 5210C/NPT	1	48779
18	B	Seal - mechanical 5/8" type 6 All other models not specified	1	48801SP~
19	A, B, C	Oring - casing	1	43063
20	B, C	Kit - bolt washer oring (pk4)	1	31327*4~
21		Casing - rear 9 & 13hp models only	1	13039-1SPR~
21		Casing - rear 5/8" All other models not specified	1	13039SPR~
22	D	Gasket - discharge 3 way	1	13539
23	D	Outlet 3 way 1.5" NPT	1	13498SPR
24	D	Screw outlet (pk 3)	1	9615-10*3
25	D	Cap assy blank 1.5" NPT	2	32169
26	D	Gasket 1 1/2" cap	2	13490
27	D	Cap assy blank 1" NPT	2	32170
28	D	Gasket - 1" cap	2	13489
29	D	Discharge kit 2 stage NPT	1	32334
30		Bracket - front case 5 series 9 & 13hp models only	1	13425PR
	A	Neck & balance ring kit	1	32249
	C	Seal kit - 5 series 2 stage 9 & 13hp & 5210C/NPTmodels only	1	32337
	B	Seal kit - 5 series 2 stage All other models not specified	1	32338
		Viton seal kit 33mm - 9 & 13hp & 5210C/NPTmodels only	1	32246
		Viton seal kit 5/8" - All other models not specified	1	32245

SPARK ARRESTOR INSTALLATION INSTRUCTION / 13 HP HONDA

1) remove air filter cover

2) remove air filter

3) remove screws (5) from muffler shield (2 from the top – 2 from the air filter side – 1 from the opposite side)

4) remove muffler shield (upwards)

5) place screen arrestor inside exhaust

6) reinstall muffler shield

7) reinstall air filter and cover

8) install exhaust deflector with (4) self tapping screws supplied

Note: the exhaust deflector can be installed in several positions. That is up to the end user!

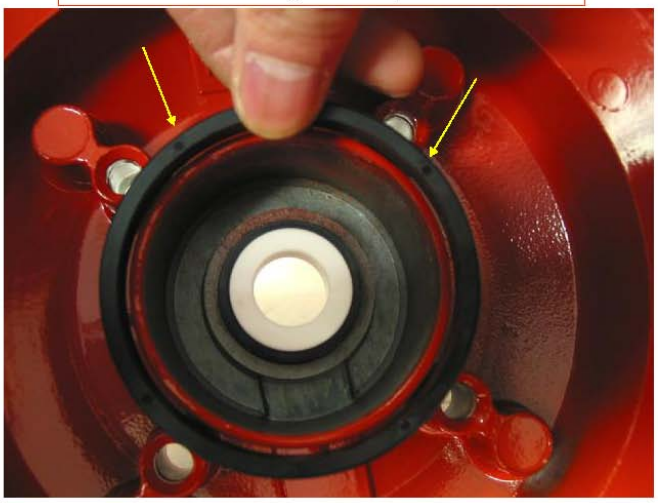
7AK306/5213HE/NPT **2 Stage**
13 HP Honda

Part #	Description/Price	Davey Prod. Code	Notes
3822201	Discharge Gasket/$13.64		
5320902	Valve Flap Assembly/$41.37		
KE00509	Spark Arrestor Kit/$62.24		
2904820	Impeller 1st Stage/$89.81		Sold as set – Top Part #2904801 Davey Part #13381 & Bottom Part #2904821 Davey Part #13380
2904825	Impeller 2nd Stage/$103.63		Sold as set-top part #2904806 Davey part #13379 & Bottom Part #2904826-Davey Part #13376
4415607	CKD Kit 5/8' Twin Impeller/$462.00	5210C	
(IMPELLERS IN 4415607 CKD KIT ARE NOT CORRECT USE 2904820 & 2904825)			
KC02403	Outlet Kit- Twin Impeller/$193.79	32334	
KG01108	Seal Kit/$104.15	32337	
2050303	Pump Casing/$208.34	13525-3PR	
4432500	Assy-Drain Plug/$33.88	32162	
5301003	Diffuser/$61.80	13383	
5301004	Diffuser/$61.80	13382	
5402913	Davey Outlet Kit Screw/$14.07	9615-10*3	Package of 3 Screws
5402914	Davey Twin Impeller Screw/$12.36	13367*4	Package of 4 Screws
3601130	O-Ring - Cover Plate (6)	400144	
3601260	O-Ring – Casing (19)	43063	

OPTIONAL EQUIPMENT

7AK310	Base for Davey Pump	Sold from MP
7AK311	Battery Mounting Kit	Sold from MP

Twin stage self prime



1)Fit stationary seal in firm and even. 2) Fit four stainless screws flat washers and o rings to secure casing to engine. 3) Fit balance ring with **holes in flat facing up**.

4) Fit impeller on to the shaft and tighten down on to mechanical seal. Note hand tight only.

5) Place front part of last stage impeller over spigot

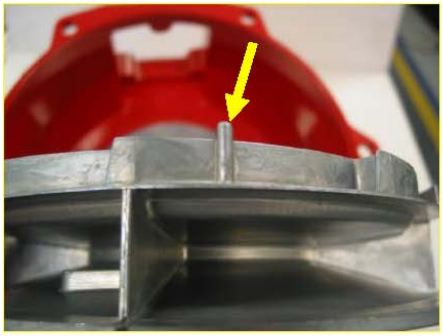
6) Fit intermediate ring over the impeller stem.

7)Fit impeller neck ring and also the intermediate ring. This ring floats on the stem and a recess on the rear of the first stage diffuser. It is to prevent water from taking the path of least resistance.

8)Stretch casing o ring over spigot on rear casing. Do not try to roll it on.

9) Insert o ring into front of last stage diffuser once again do not try to roll it on as it will pop out

10)The diffuser has a spigot on the rear at the top that fits into a hole in the rear casing. Note the three holes in the front of the rear section



16) Fit the neck ring

11) Fit diffuser to assembly and locate pin in the hole in the rear casing

12)Place first stage diffuser over last stage. The three locating pins in the rear of the diffuser fit into holes in last stage.

13)Fit the balance ring on the inside of the rear section of the first stage impeller. Once again it is important that all these rings are fitted.

14) Fit the rear section of the first stage impeller to the assembly

15) Fit impeller top and self tapping screw. The screw is stainless steel with a protective coating applied. We recommend applying Rocol anti-seize to the screw.

17) Fit the check valve to the impeller cover.

18)Tip the cover up and slide the lugs on the top under the casing to fit it on to the assembly correctly.

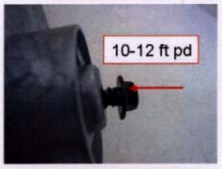
21)Fit the top discharge with gasket. Apply a little Molykoteto the discharge and drain plugs for ease of fitment

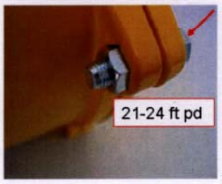
19) Place the cover over the assembly.There is a small slot in the top inside of the cover that sits over a lug on the last stage diffuser. There is no locating fin on the this cover for the slot in the rear casing.

20) Fit the front casing making sure that the o ring is in place and that the locating pins on the inside fit over the check valve gasket.

Torque settings for bolts on Davey Single Stg & Two Stg (Red)

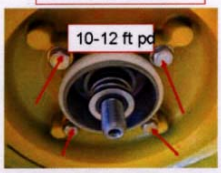
10mm socket





14mm socket

½ inch AF socket



10mm socket

Bolts=8-10 Ft Pounds Torque

20) Fit the front casing making sure that the o ring is in place and that the locating pins on the inside fit over the check valve gasket.

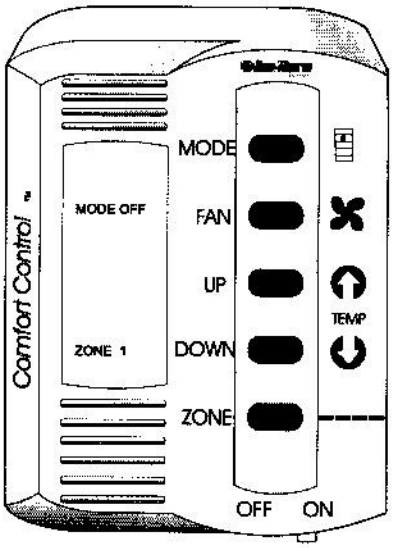
Dometic® Dura-Therm

COMFORT CONTROL CENTER™
Part No. 3109228.001 White
or
3109228.019 Black

USA
SERVICE OFFICE
Dometic Corporation
2320 Industrial Parkway
Elkhart, IN 46516
574-294-2511

CANADA
Dometic Corporation
46 Zatonski, Unit 3
Brantford, ON N3T 5L8
CANADA
519-720-9578

For Service Center Assistance Call:
800-544-4881



This Comfort Control Center will provide your cooling and heating requirements regardless of your vehicle size.

C SA® US

OPERATING INSTRUCTIONS

Comfort Control Center™
3109228.001 White
or
3109228.019 Black

REVISION:
Form No. 3108664.040 5/06
(Replaces 3108664.032)
(French 3109564.032

©2006 Dometic Corporation

LaGrange, IN 46761

LIMITED THREE-YEAR WARRANTY
AIR CONDITIONERS & HEAT PUMPS

THE SELLER NAMED BELOW MAKES THE FOLLOWING WARRANTY WITH RESPECT TO THE DOMETIC PRODUCT:

1. This warranty is made only to the first purchaser (herein after referred to as the "Original Purchaser") who acquires the product for his own use and is installed and operated within the continental United States and Canada.
2. This warranty will be in effect for three years on parts and freight and two years on labor from the date of purchase by the Original Purchaser. It is suggested that the Original Purchaser retain a copy of the dated bill of sale as evidence of the date of purchase.
3. This warranty covers only specified Dometic parts, which shall be free from defects in material and workmanship under normal use. This warranty does not cover conditions unrelated to the material and workmanship of the product. Such unrelated conditions include, but are not limited to: (a) damage not reported within 7 days; (b) faulty installation or installation that does not comply to the RVIA standards and any damage resulting from such; (c) the need for normal maintenance and any damage resulting from the failure to provide such maintenance; (d) failure to follow Sellers instructions for use of this product; (e) any accident to or misuse of any part of this product and any alteration by anyone other than the Seller or its authorized representative; (f) damage or failure caused by installation of accessories or parts not manufactured and marketed by the Seller will void any warranty, implied or written; (g) corrosion, salt water; (h) radio frequency interference (RFI) or electromotive interference (EMI) and (i) installation on semi trucks or off-road vehicles.
4. The specified parts covered by this warranty are as follows: switches, thermostats (excluding infrared remote controls, which are covered for a period of one year, not including batteries), relays, capacitors, motors, electronic module boards, solar panels and the sealed system; compressor, evaporator coil, condenser coil, refrigerant lines, capillary tubes and reversing valve.
5. It is suggested the Original Purchaser provide preventative maintenance on a yearly basis. Suggested preventative maintenance is: (a) check mounting/anchor bolts for proper torque; (b) inspect/clean and comb condenser fins; (c) inspect/clean and comb evaporator fins; (d) inspect/clean evaporator blower wheel and condenser fan blade/blower wheel; (e) clean return air filter. The cost of preventative maintenance is the Original Purchaser's responsibility and should take about one hour.
6. In order to obtain the benefits of this warranty, the Original Purchaser must return the product which is found defective to the Seller named below or to a Dometic Authorized Service Center during the period that this warranty is in effect. The Original Purchaser is responsible for all charges incurred in delivery of the product to the Seller or Dometic Authorized Service Center, and in pick up after the warranty service has been completed. To obtain the location of the nearest Authorized Service Center, please call 1-800-544-4881 or in Canada call 1-519-653-4390.
7. Any item returned in the manner described in paragraph 6 will be examined by the Seller or the Authorized Dometic Service Center. If it is found that the returned item was defective in material and workmanship, the Seller or the Authorized Dometic Service Center will repair the product per the terms outlined in paragraph 4. CONFIRM THE SERVICE AGENCY IS AN AUTHORIZED DOMETIC SERVICE CENTER. DO NOT PAY THE SERVICE AGENCY FOR WARRANTY REPAIRS. SUCH PAYMENTS WILL NOT BE REIMBURSED.
8. The Seller does not authorize any person or company to create any warranty obligations or liability on their behalf. This warranty is not extended by the length of time which you are deprived of the use of the product. Repairs and replacement parts provided under the terms of this warranty shall carry only the non-expired portion of this warranty.
9. In no event shall either Seller be liable for incidental or consequential damages. This includes any damage to another product or products resulting from such a defect. Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitations may not apply.
10. Any implied warranty, including the implied warranty of merchantability and fitness for any purpose, is limited to the duration of this limited warranty. Some states do not allow limitations on how long an implied warranty can last, so the above limitation may not apply.
11. THIS WARRANTY GIVES SPECIFIC LEGAL RIGHTS, YOU MAY ALSO HAVE OTHER RIGHTS WHICH VARY FROM STATE TO STATE. No action to enforce this warranty shall be commenced later than ninety (90) days after the expiration of the warranty period. Claims must be submitted in writing to the Dometic Warranty Department for arbitration.
12. All products (except those specifically built for commercial use) are warranted only when installed on vehicles built to R.V.I.A A119.2 and C.R.V.A, Z-240 Standards.
13. The Seller reserves the right to change the design of any product without notice and with no obligation to make corresponding changes in products previously manufactured.

REVISION:
Form. No. 3307601.025 3/06
(Replaces 3307601.017)
(French 3307602.023)
©2006 Dometic Corporation
LaGrange, IN 46761

DOMETIC CORPORATION
Warranty Department
2320 Industrial Parkway
Elkhart, Indiana 46515
Phone: 574-294-2511
Fax: 574-389-3975

Dometic The Sign of Comfort

Dual Pro Charger®

CHARGING SYSTEMS INTERNATIONAL

INSTALLATION AND OPERATING INSTRUCTIONS FOR THE FOLLOWING CHARGERS:

XL Series | SE SERIES | PRO SERIES

Model Name	Total Output	Amps Per Bank	Battery System
Pro XL	6 amps	6	12V
Dual Pro XL	12 amps	6, 6	12V, 24V
Pro SE	10 amps	10	12V
Dual Pro SE	20 amps	10,10	12V, 24V
Three Bank Pro SE	30 amps	10, 10, 10	12V, 24V, 36V
Four Bank Pro SE	40 amps	10, 10, 10, 10	12V, 24V, 36V, 48V
Pro Charger	15 amps	15	12V
Dual Pro Charger	30 amps	15, 15	12V, 24V
Three Bank Pro Charger	45 amps	15, 15, 15	12V, 24V, 36V

70116

CHARGING SYSTEMS INTERNATIONAL

INSTALLATION AND OPERATING INSTRUCTIONS
FOR THE FOLLOWING BATTERY CHARGING SYSTEMS:

MODELS	MAX AMPS/BANK	NO. OF BANKS	BATTERY SYSTEM
PRO XL	6	1	12
DUAL PRO XL	6	2	12/24
PRO SE	10	1	12
DUAL PRO SE	10	2	12/24
THREE BANK PRO SE	10	3	12/24/36
FOUR BANK PRO SE	10	4	12/24/36/48
PRO CHARGER	15	1	12
DUAL PRO CHARGER	15	2	12/24
THREE BANK PRO CHARGER	15	3	12/24/36

IMPORTANT NOTICE

Please save and read all safety, operating and installation instructions before installing or applying AC power to your Charging Systems International on-board battery charging system. Please contact Charging Systems International with any product, installation, or service questions at 1-800-742-2740.

Introduction

Charging Systems International has been manufacturing waterproof, on-board battery charging systems since 1989. Our charging systems are designed and built tough to withstand intense vibration, extreme temperature variations and submersion without damaging the unit. Our systems use temperature compensation in order to fully charge a battery in hot or cold environments and are controlled by microprocessors in order to assure precise control over each totally independent charging bank. All of our chargers have true reverse polarity protection and shut off completely after each charge cycle.

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Installation Instructions . . . . . Page 5-6
Trouble Shooting . . . . . Page 6-7
Warranty Information . . . . . Page 7

IMPORTANT SAFETY INSTRUCTIONS

SAVE THESE INSTRUCTIONS-This manual contains important safety and operating instructions for battery charger models: Pro XL, Dual Pro XL, Pro SE, Dual Pro SE, Three Bank Pro SE, Four Bank Pro SE, Pro Charger, Dual Pro Charger, Three Bank Pro Charger.

Use of attachments not recommended or sold by Charging Systems International may result in a risk of fire, electrical shock, or injury to persons.

To reduce risk of damage to electric plug and cord, pull by plug rather than cord when disconnecting charger.

When using an extension cord, make sure:

1. That pins on plug of extension cord are the same number, size and shape as those of the charger plug;

2. That extension cord is properly wired and in good electrical condition;

3. That wire size is large enough for ac ampere rating of charger.

Do not operate charger with damaged cord or plug - replace the cord or plug immediately.

Do not operate charger if it has received a sharp blow, been dropped or otherwise damaged in any way; contact Charging Systems International.

Do not disassemble charger; contact the factory when service or repair is required. Incorrect reassembly may result in risk of electrical shock or fire.

To reduce risk of electric shock, unplug charger from outlet before attempting any maintenance or cleaning.

WARNING-RISK OF EXPLOSIVE GASES.

1. WORKING IN THE VICINITY OF A LEAD-ACID BATTERY IS DANGEROUS. Batteries generate explosive gases during normal battery operation. For this reason, it is of utmost importance that each time before using your charger, you read this manual and follow the instructions exactly.

2. To reduce risk of battery explosion, follow these instructions and those published by battery manufacturer and manufacturer of any equipment you intend to use in vicinity of battery. Review cautionary markings on these products and on engine.

PERSONAL PRECAUTIONS

Someone should be within range of your voice or close enough to come to your aid when you work near a lead-acid battery.

Have plenty of fresh water and soap nearby in case battery acid contacts skin, clothing or eyes.

Wear complete eye protection and clothing protection. Avoid touching eyes while working near battery.

If battery acid contacts skin or clothing, wash immediately with soap and water. If acid enters eye, immediately flood eye with running cold water for at least 10 minutes and get medical attention immediately.

NEVER smoke or allow a spark or flame in vicinity of battery or engine.

Be extra cautious to reduce risk of dropping a metal tool onto battery. It might spark or short-circuit battery or other electrical part that may cause explosion.

Remove personal metal items such as rings, bracelets, necklaces, and watches when working with a lead-acid battery. A lead-acid battery can produce a short-circuit current high enough to weld a ring or the like to metal, causing a severe burn.

Use charger for charging a LEAD-ACID (lead acid, sealed lead acid, gel cell and AGM) battery only. It is not intended to supply power to a low voltage electrical system other than in a starter-motor application. Do not use battery charger for charging dry-cell batteries

that are commonly used with home appliances. These batteries may burst and cause injury to persons and damage to property.

NEVER charge a frozen battery.

PREPARING TO CHARGE

If it is necessary to remove the battery to charge, always remove grounded terminal from battery first. Make sure all accessories are off, so as not to cause an arc.

Be sure area around battery is well ventilated while batteries are being charged. Gas fumes can be forcefully blown away by using a piece of cardboard or other nonmetallic material, as a fan.

Clean battery terminals. Be careful to keep corrosion from coming in contact with eyes.

Add distilled water in each cell until battery acid reaches level specified by battery manufacturer. This helps purge excessive gas from cells. Do not overfill. For a battery without cell caps, carefully follow manufacturer's recharging instructions.

Study all battery manufacturers' specific precautions such as removing or not removing cell caps while charging and recommended rates of charge.

Extension cords should be industrial grade/heavy duty U.L. approved and grounded. Check extension cord before use for damage, bent prongs and cuts. Replace if damaged.

Always make your extension cord connection on the charger side first. After connecting the extension cord to the charger then proceed to plug the extension cord to a nearby 120VAC GFCI protected (Ground Fault Circuit Interrupt) outlet.

Always remove the extension cord from the 120VAC outlet first when charging is completed followed by unplugging the charger.

PRODUCT SUMMARY

General Operation:

Use the following guidelines in this manual to install your fully automatic Charging Systems International battery charging system.

Assure that your charger and batteries are properly vented. Connect your extension cord with no AC Power present to the battery charger and proceed to plug your extension cord in at a nearby 120 VAC outlet.

Once you plug in your Charging Systems International battery charging system, your batteries will be simultaneously and independently charged to 100%. Unlike systems that utilize one large charger to attempt to charge multiple batteries, your system utilizes a totally independent battery charger for each battery. Each charging bank will turn itself completely off once the battery is charged and then monitor and maintain the battery indefinitely.

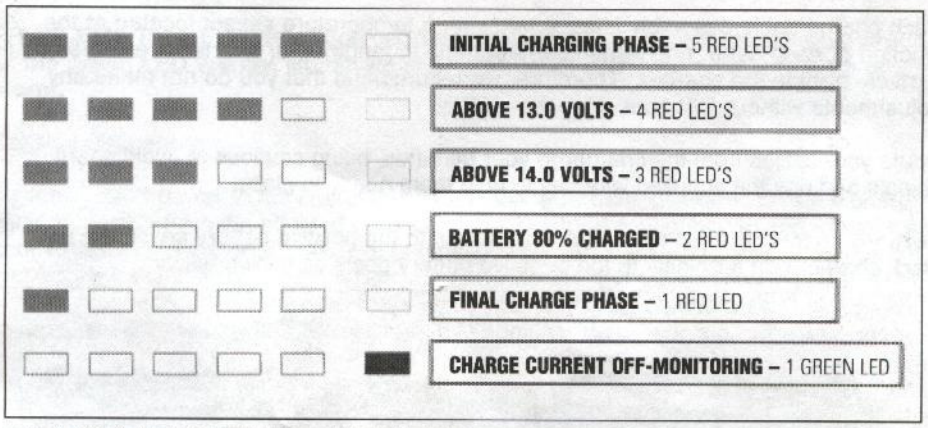
We recommend that you leave your system plugged in to reduce sulfate build-up and to allow your Charging Systems International charging system to keep your batteries fully maintained and ready to perform at their best.

Independent Charging Bank Indications

When your battery charging system is activated, each bank provides charging information utilizing five red LED indicators and one green LED indicator.

The five red LEDs enable you to track the progress of the charge cycle on each battery as the voltage rises.

(see chart on next page)



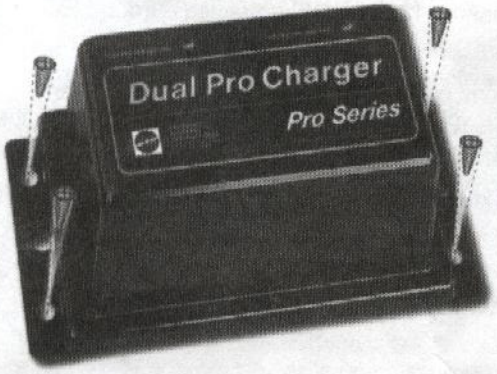
INSTALLATION INSTRUCTIONS

All Charging Systems International battery charging systems are designed to be permanently mounted and have no mounting restrictions.

Do not make any electrical connections to the power supply (AC) or to a battery (DC) until the mounting process has been completed.

Check for fit and appropriate thickness of mounting area. It is recommended that you choose a flat surface. If mounting the charger in a boat please choose a surface as high above the water level as possible. If a compartment wall is chosen, make certain its strength is adequate.

Use the mounting flanges of the charger to mark locations for starter holes. Drill a 1/16" inch hole at each marked location. Then, utilize all stainless steel screws which have been provided and install the charger securely being cautious not to over tighten the screws. Silicon sealer should be used to secure and waterproof the screw holes.



IMPORTANT NOTICE

The mounting bracket of the system contains keyholes that are designed so that some screws can be started before putting the charger into place. The keyhole locations for mounting your charger vary depending on which model you own. On the XL and SE models the mounting flanges run horizontal instead of vertical.

Before making any connections, prepare batteries as follows:

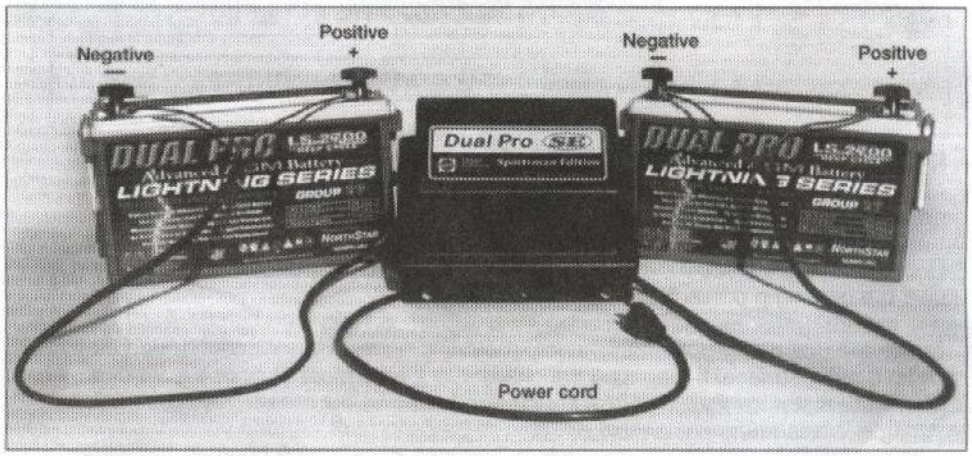
(a) With caps securely in place, thoroughly clean the case and posts with a solution of baking soda and water. Be careful not to allow any soda to get inside the case.

(b) All posts, terminals and connectors should be cleaned to a shiny bright finish, using a wire brush or sand paper. This should be done periodically to assure maximum conductivity.

Each charge cable assembly is equipped with a temperature sensor located at the junction of each set of ring terminals. Attempts to lengthen or shorten the cables could partially disable the charger. Therefore, we recommend that you do not make any adjustments without first consulting the factory.

Route your cables from the charger to your batteries, being cautious to avoid sharp objects and use the supplied wire ties to hold them neatly in place.

Securely connect the red charger ring terminals to the positive battery posts and the black charger ring terminals to the negative battery posts as shown below.



In addition, your charging system is supplied with an AC plug receptacle designed to hold the power cord plug when it is not being used. Locate a convenient site for the receptacle and attach it using the four smaller stainless steel screws.

Connect a heavy duty U.L. approved extension cord to the power cord of your charger and then plug the extension cord in to a nearby 120VAC GFI protected (Ground Fault Circuit Interrupt) outlet.

You should now observe red LED indications on each bank of the charger representing each individual battery being charged. The voltage of each battery will reflect the number of LED indicators illuminated. (See Product Summary)

When charging is complete, remove the extension cord from the 120VAC outlet first and then unplug the charger.

TROUBLE SHOOTING

PROBLEM: No LED indicators illuminate in any of the charger banks.

Solution Sequence:

Check the AC power supply from its source through all connecting points up to the charger by using a meter or test light to confirm that current is being delivered to the charger.

PROBLEM: One red LED flashing.

Solution Sequence:

With the AC power supply cord unplugged, check the ring terminals for correct polarity (Red to positive or +) and (Black to negative or -). Also check for corrosion free secure connections to the batteries. Call the factory for further assistance.

PROBLEM: The LED indications change rapidly back and forth from red to green or the green LED will not illuminate after excessive charging time (16 hours or more).

Solution Sequence:

Disconnect AC power to the charging system. On multi bank chargers, take the charge cable assembly from the affected bank off of the battery it is attached to and attach it to another battery in the boat. Take the original charge cable assembly from this battery and attach it to the battery from which you removed the first cable. Plug the charger in and observe the LED indications. If the rapid LED sequence (red to green repeatedly) occurs on a different bank of the charger, this confirms that there is a battery problem.

On single bank systems, simply try the charger on another battery. If the charger now operates normally (steady red LEDs or changes to green and holds), this signifies that there is a possible problem with the original battery.

If the same bank continues to malfunction, please call the factory.

PROBLEM: A green LED was illuminated before disconnecting the power from the charger, but upon reconnection, red LEDs appear and remain on.

Solution Sequence:

This is normal operating procedure for the system and simply indicates that a re-analysis of the battery status has been initiated and after a series of steps, the green LED will illuminate.

LIMITED WARRANTY

Charging Systems International makes this Limited Warranty only to the original retail purchaser.

Charging Systems International warrants this battery charger for three years from the date of retail purchase against defective materials and/or workmanship. If such should occur, this unit will either be repaired or replaced at the discretion of the manufacturer. It is the responsibility of the original purchaser to return the charger along with proof of purchase, transportation and/or any mailing or handling charges prepaid to the manufacturer or its authorized representative.

This limited warranty is void if the product is misused, improperly maintained, handled carelessly or incorrectly operated. This warranty is also void if the charger is disassembled or repair is attempted by anyone other than an authorized representative.

Charging Systems International makes no other warranty other than this limited warranty and expressly excludes any implied warranty including any warranty for any incidental or consequential damages.

This is the only expressed limited three year warranty authorized by Charging Systems International and does not assume nor authorize anyone to assume or make any other obligation towards the product other than this three year Limited Warranty. Some states do not allow limitation of incidental or consequential damages, so the above limitations may not apply to you.

This warranty gives you specific legal rights and you may also have other rights which vary from state to state.

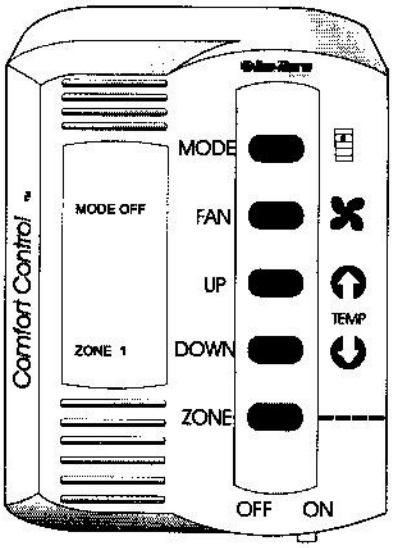
Dometic® Dura-Therm

COMFORT CONTROL CENTER™
Part No. 3109228.001 White
or
3109228.019 Black

USA
SERVICE OFFICE
Dometic Corporation
2320 Industrial Parkway
Elkhart, IN 46516
574-294-2511

CANADA
Dometic Corporation
46 Zatonski, Unit 3
Brantford, ON N3T 5L8
CANADA
519-720-9578

For Service Center Assistance Call:
800-544-4881



This Comfort Control Center will provide your cooling and heating requirements regardless of your vehicle size.

C SA® US

OPERATING INSTRUCTIONS

Comfort Control Center™
3109228.001 White
or
3109228.019 Black

REVISION:
Form No. 3108664.040 5/06
(Replaces 3108664.032)
(French 3109564.032

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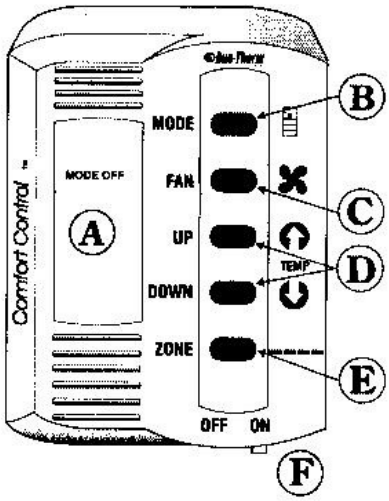
LaGrange, IN 46761

Your recreational vehicle manufacturer has equipped your vehicle with Duo-Therm's Comfort Control Center™. The Comfort Control Center has been designed for you to easily operate all the air conditioning and gas heating appliances found in your vehicle from one location.

In order to familiarize yourself with the operation of the Comfort Control Center, the following diagram along with the accompanying text will explain all the functional characteristics of the system.



A. Liquid Crystal Display
B. Mode Selector Button
C. Fan Speed Selector Button
D. Temperature Selector Buttons
E. Zone and Stage Selector
F. On/Off Switch

A. **LIQUID CRYSTAL DISPLAY** – Your Comfort Control Center is equipped with a liquid crystal display (LCD) that identifies the mode of operation, the temperature set-point, the zone identification and the fan speed. The Comfort Control Center is designed to accept and control many varied air conditioning and gas heating appliances. When you begin to first operate your Comfort Control Center, you will see that the LCD readout will only show the options available based on the appliances installed on your vehicle. An incandescent light will illuminate the LCD area when a selector button is pushed for easy reading at all times.

B. **MODE SELECTOR BUTTON** – Modes of operation available are: **OFF, FAN ONLY, COOL, HEAT PUMP, FURNACE, HEAT STRIP and AUX. HEAT.** Remember, your LCD readout will only show the options available based on the appliances installed on your vehicle. To select the mode of operation, momentarily depress the **MODE** push-button. You will need to continue to depress and release the button until the desired mode is shown in the LCD readout area on the Comfort Control Center.

To determine the Comfort Control Center options available to you, depress and release the **MODE** push-button until it goes through all selections.

C. **FAN SPEEDS** – Possible available fan speeds are: **LOW, MEDIUM, HIGH** and **AUTO**. To select the desired fan speed, momentarily depress the **FAN** push button. You will need to continue to depress and release the **FAN** button until the desired fan speed is shown in the LCD readout area of the Comfort Control Center.

D. **TEMPERATURE SELECTOR BUTTONS** – The temperature Set-point range is from 40° to 99° Fahrenheit or 4° to 37° Celsius. Determination of Fahrenheit or Celsius standard is done at the time of your manufacturer's installation of the Climate Control Center. To set the temperature at your comfort level, simply depress and release the **UP** or **DOWN** push-button until the desired temperature is shown in the LCD readout area of the Comfort Control Center.

E. **ZONE SELECTOR BUTTON** – A **ZONE** is also established at the time of installation of your Comfort Control Center. If you have one air conditioner, you will have one **ZONE**. If your vehicle has more than one cooling system, depending on the manufacturing installation, you may have 2, 3 or 4 **ZONES**. Zones are defined and preset by your manufacturer. A zone is an area of cooling/heating which is controlled independently within that area, and regulated at the Comfort Control Center. A typical example of a two zone application would be a vehicle with two air conditioning systems, one in the front area (living room, kitchen) and one in the back section (bedroom and bath). The front area could be established as **ZONE 1** and the back section **ZONE 2**. You can select the desired temperature and fan speeds for each zone independently, thereby keeping your bedroom cooler than the front portion of the vehicle. To determine the number of established zones in your vehicle, depress the **ZONE** push-button. **ZONE 1** will be the first **ZONE** to appear in the LCD readout. The **ZONE** number selected will begin to flash and will flash for approximately 30 seconds or until another **ZONE** has been selected. Continue to depress and release the **ZONE** button until you see **ZONE 1** reappear.

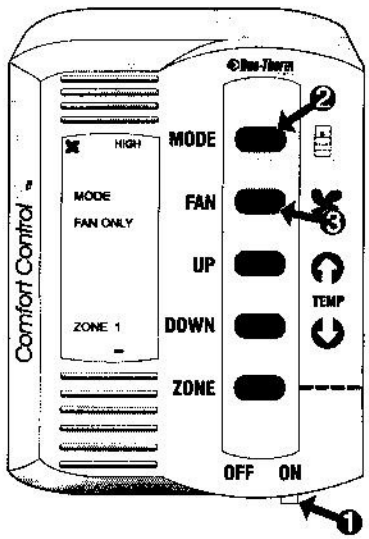
F. **ON/OFF SWITCH** – The ON/OFF switch is located on the lower right hand edge of the Comfort Control Center. Move the lever from side to side to change status.

OPERATING YOUR DUO-THERM COMFORT CONTROL CENTER

The Comfort Control Center allows you the freedom of controlling your vehicle's temperature to provide you with a comfortable environment to enjoy your life-style. With just a few simple steps, you can control which mode of operation you will use, the vehicle temperature and the fan speeds.

A. FAN ONLY MODE OF OPERATION

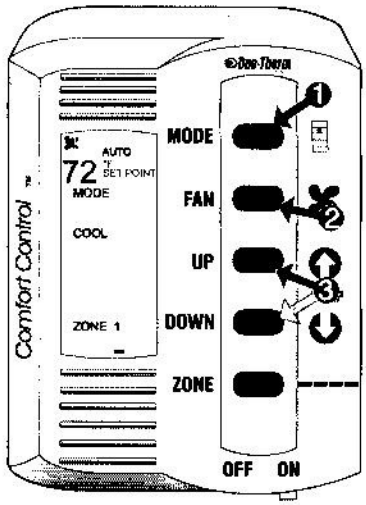
1. Begin by placing the power switch on the lower right hand edge of the Control Center on the **ON** position. To do this, simply move the lever to the right.
2. Momentarily depress and release the **MODE** push-button until the **FAN ONLY** indicator on the Liquid Crystal Display (LCD) is illuminated.
3. Momentarily depress and release the **FAN** push-button until the desired fan speed indicator (**LOW, MED, HIGH, AUTO**) is illuminated. If your vehicle is equipped with a heat pump or a dual basement air conditioning system, your selection choice will be **LOW, HIGH** or **AUTO**.
4. After approximately 5 seconds, the selected fan speed will come on. The **MODE** and **FAN** speed you have selected will remain shown in the LCD area of the Control Center until you change your selection.
5. If your vehicle contains more than one **ZONE**, depress the **ZONE** push-button to select **ZONE 2**, and repeat procedures from step two above. Repeat entire procedure for each additional zone.



B. COOLING MODE OPERATION

(To set cooling temperatures and fan speeds on Duo-Therm Air Conditioners & the cooling mode of Duo-Therm Heat Pumps)

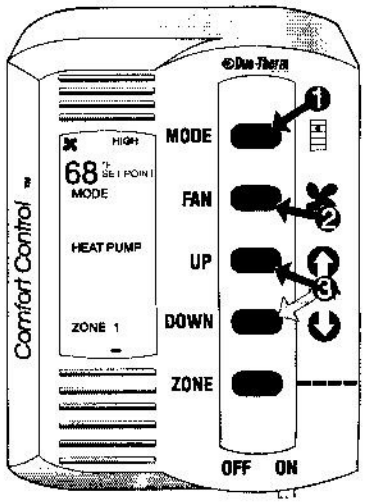
1. Momentarily depress and release the **MODE** push-button until the **COOL** indicator on the LCD is illuminated.
2. Depress and release the **FAN** push-button to select your desired fan speed (**LOW, MEDIUM, HIGH** or **AUTO**). If your vehicle is equipped with a heat pump or a dual basement air conditioner system, your selection choice will be **LOW, HIGH** or **AUTO.**
3. Depress and release the **UP** push-button to increase the temperature or the **DOWN** push-button to decrease the desired temperature. The final selected **SET-POINT** will be displayed in the LCD area of the Comfort Control Center.
4. After a delay of approximately 2 minutes the air conditioner's compressor will come on and the cooling process will begin. Once the room temperature reaches the selected **SET-POINT**, the compressor will cycle off. Once the Comfort Control Center senses the need for cooling, the compressor will restart in approximately two minutes. At this point, the fan will either:
   a.continue to operate in the single selected fan speed or,
   b.cycle **OFF** and **ON** with the compressor if the **AUTO** fan speed has been selected.
5. If your vehicle contains more than one **ZONE**, depress the **ZONE** push-button to select **ZONE 2**, and repeat procedures from Step 1. Repeat entire procedure for each additional zone.



C. HEAT PUMP OPERATION

(To set heating temperatures for vehicles equipped with a Duo-Therm rooftop or basement heat pump. To operate cooling mode with a heat pump, see "B. Cooling Mode Operation", Page 3.)

1. Momentarily depress and release the **MODE** push-button until the **HEAT PUMP** indicator on the LCD is illuminated.
2. If you have not previously set your fan speed, you may do so by depressing and releasing the **FAN** push-button to select the desired fan speed.
3. Depress and release the **UP** push-button to increase the temperature or the **DOWN** push-button to decrease the desired temperature. The final selected **SET-POINT** will be displayed in the LCD area of the Comfort Control Center.
4. After a delay of approximately 2 minutes the heat pump's compressor will come on and the heating process will begin. Once the room temperature reaches the selected **SET-POINT**, the compressor will cycle off. Once the Comfort Control Center senses the need for heating, the compressor will restart in approximately two minutes. At this point, the fan will either:
   a. continue to operate in the single selected fan speed or,
   b. cycle **OFF** and **ON** with the compressor if the **AUTO** fan speed has been selected.
5. If your vehicle contains more than one **ZONE**, depress the **ZONE** push-button to select **ZONE 2**, and repeat procedures from Step 1 above. Repeat entire procedure for each additional zone.

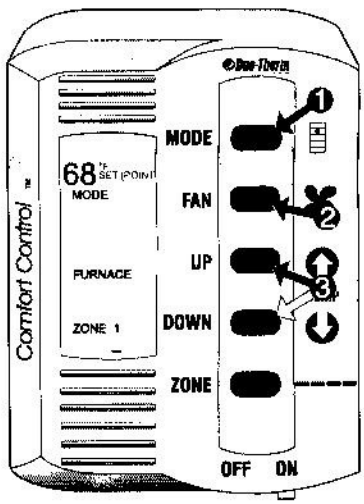


NOTE:
See Page 7, Items F & G for additional Special Heat Pump Features.

D. FURNACE MODE OPERATION

(If your vehicle is equipped with a gas furnace connected to the Comfort Control Center)

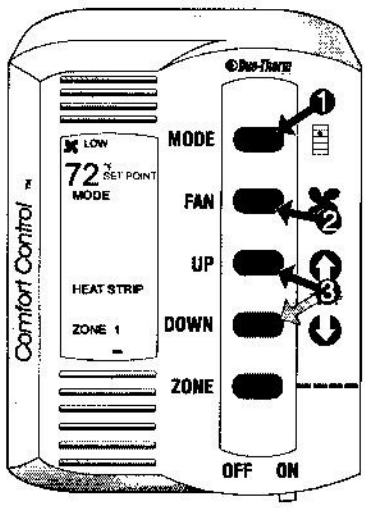
1. Momentarily depress and release the **MODE** push-button until the **FURNACE** indicator on the LCD is illuminated.
2. The A/C fan does not operate in the **FURNACE** mode.
3. Depress and release the **UP** push-button to increase the temperature or the **DOWN** push-button to decrease the desired temperature. The final selected **SET-POINT** will be displayed in the LCD area of the Comfort Control Center.
4. Your Duo-Therm air conditioning system will not operate when the Comfort Control System is in the **FURNACE** mode. For cooling, change the **MODE** to **COOL**.
5. If your vehicle contains more than one **ZONE**, depress the **ZONE** push-button to select **ZONE 2**, and repeat procedures from Step 1 above. Repeat entire procedure for each additional zone.



E. HEAT STRIP MODE OPERATION

(For Duo-Therm air conditioners with an electric heat strip)

1. Momentarily depress and release the MODE push-button until the **HEAT STRIP** indicator on the LCD is illuminated.
2. The fan will operate in **LOW, MED** or **AUTO**. You will not be able to select **HIGH** speed when in the **HEAT STRIP** mode. Depress and release the **FAN** push-button to select desired speed. If your vehicle is equipped with a heat pump or a dual basement air conditioner system, your selection choice will be **LOW** and **AUTO**.
3. Depress and release the **UP** push-button to increase the temperature or the **DOWN** push-button to decrease the temperature. The final selected **SET-POINT** will be displayed in the LCD area of the Comfort Control Center.
4. The electric heat strip will cycle **ON** and **OFF** per the temperature **SET-POINT** displayed. The fan will either:
   a. continue to operate in the selected fan speed or,
   b. cycle **OFF** and **ON** with the heat strip if the **AUTO** fan speed has been selected.
5. If your vehicle contains more than one ZONE, depress the **ZONE** push-button to select **ZONE 2**, and repeat procedures from Step 1 above. Repeat entire procedure for each additional zone.



COMFORT CONTROL CENTER SPECIAL CONTROL FEATURES

A. AUTO FAN

When **AUTO FAN** is selected, the fan speed will be determined by the mode you are in.

1. **COOL MODE** – In the **COOL** mode, which is the air conditioning mode, the fan will automatically select the speed depending upon the difference between the temperature **SET-POINT** and the room temperature. When that difference is:

8° or more	The fan will operate on **HIGH**
4° to 8°	The fan will operate on **MED**
4° or below	The fan will operate on **LOW**

2. **COOL MODE (Heat Pump and Basement units)** – If your vehicle is equipped with a Duo-Therm Heat Pump or Basement unit, the fan will automatically select the fan speed depending upon the difference between the temperature **SET-POINT** and the room temperature.

   When the difference is:

8° or more	– The fan operates on **HIGH**
Less than 8°	– The fan operates on **LOW**

3. **HEAT PUMP MODE** – When **HEAT PUMP** mode is selected, the fan will start running in the **LOW** speed.
4. **HEAT STRIP MODE** – When **HEAT STRIP** mode is selected, the fan will start running in the **LOW** speed.
5. **FAN ONLY MODE** – In the **FAN ONLY** mode, the fan will start running in the **LOW** speed.

B. REFRIGERANT COMPRESSOR TIME DELAY

A time delay of approximately two minutes occurs any time the compressor is required to begin the cooling or heat pump cycle.

C. POWER INTERRUPTION

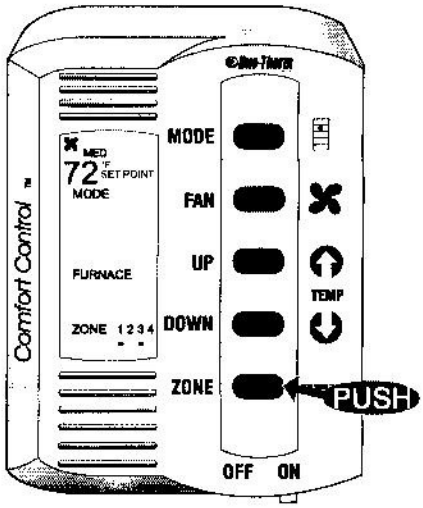
In the event that power to the air conditioner or control is interrupted, the system will restart with the same settings you have previously set.

D. ZONE CONTROL

Your Duo-Therm Control Center will operate cooling and heating appliances which your vehicle manufacturer has designed to heat or cool different areas (**ZONES**) of your RV. The Comfort Control Center will advise you if your vehicle has multiple **ZONES**, by showing **ZONE 1, 2 3** or

(D. Zone Control continued)

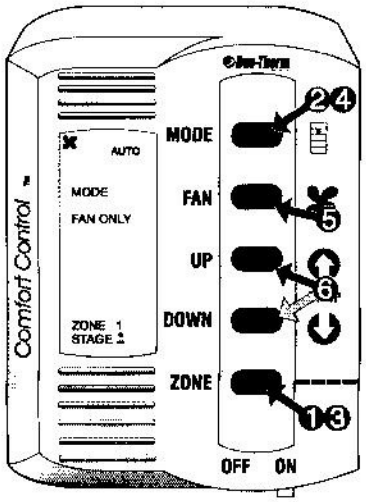
4 illuminated in the LCD readout. In the event your vehicle has multiple zones designed, you have the freedom of selecting the **MODE** of operation for each zone independently. To change from one zone to another, depress the **ZONE** push-button. Each time you depress and release this push-button, the indicator will change the zone data displayed. The zone number flashing indicates zone being programmed. The zone number will flash for approximately 30 seconds unless another zone is selected or programming has been completed. At this time the number will stop flashing and the desplay light will go out. When all zones have been programmed, the zones in operation will be underlined. To program each zone, simply repeat the programming steps shown in the operation section of this manual. Please note: The Comfort Control Center will prevent operating **FURNACE** and **COOL** or **FURNACE** and **HEAT PUMP** at the same time.



E. STAGE CONTROL OPERATION

If your vehicle is equipped with a Duo-Therm Dual Basement Air Conditioner or a Dual Basement Heat Pump, you have an air conditioning system that is designed to optimize comfort and running efficiencies. (Two units within one compartment). This is accomplished as long as the required electrical power is available, by providing an on-demand secondary stage of operation. (NOTE: The primary stage will continue to operate even if there isn't enough electrical power available to run the second stage.) The Comfort Control Center simplifies this operation and allows you to set the primary temperature set-point while the differential temperature set-point which activates the secondary stage is preset. After turning on your Comfort Control Center, perform the following steps to set and activate the stage control operation.

1) Momentarily depress the **ZONE** push-button to select stage in the zone desired
2) Momentarily depress the **MODE** push-button to select "**ON**".
3) Momentarily depress the **ZONE** push-button to select the zone where stage was selected in Step 1.
4) Momentarily depress the **MODE** push-button until the desired mode of operation is selected (**FAN ONLY**, **COOL** or **HEAT PUMP**).
5) Momentarily depress the **FAN** push-button until the desired fan speed is displayed (**LOW**, **HIGH** or **AUTO**).
6) Momentarily depress the **UP** and **DOWN** push-button until the desired room temperature set-point is displayed.

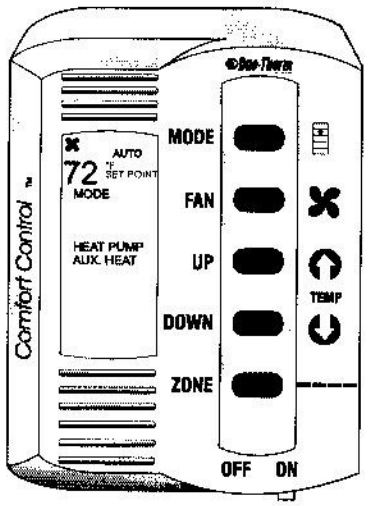


F. AUX. HEAT

When in the **HEAT PUMP** mode, if the outside ambient temperature is measured to be below 30°F and the vehicle is equipped with a furnace connected to the Comfort Control Center, the control will automatically select the **FURNACE** operation and the **HEAT PUMP** will shut down.

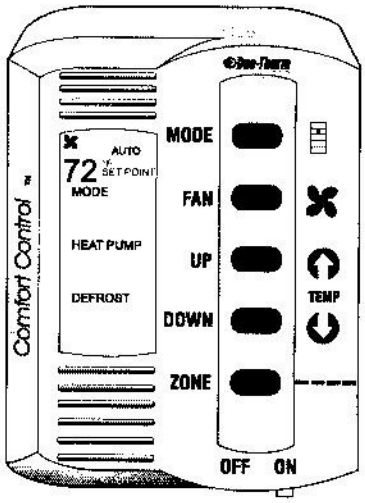
Important: If vehicle is not equipped with a furnace no heat will be available below 30°F. IF vehicle is equipped with a furnace and it is connected to its own thermostat, it must be manually turned ON and OFF for operation.

When this happens, the **AUX. HEAT** and the **HEAT PUMP** indicators on the LCD will illuminate. Once the outside ambient temperature is measured above 38°F, the control will return to the **HEAT PUMP** operation and shut down the furnace if it is connected to the Comfort Control Center. If furnace is not connected to the Comfort Control Center, the furnace thermostat must be manually turned off.



G. DEFROST CYCLE

This cycle is active during **HEAT PUMP** operation and allows the heat pump to operate down to 30°F. When the outside ambient temperature is less than 42°F and greater than 30°F, a defrost timing cycle will begin. The defrost timing cycle will allow operation of the heat pump for 25 minutes. The fan will then be shut off, the refrigerant flow reversed and run for 4-1/2 minutes, this is the **DEFROST** cycle. The refrigerant flow will then be returned to normal and, after a 30 second delay will continue until the temperature is greater than 42°F or until the temperature becomes less than 30°F, at which time the furnace will activate. (See **AUX. HEAT**). During the defrost cycle, the **DEFROST** indicator on the LCD shall be illuminated.

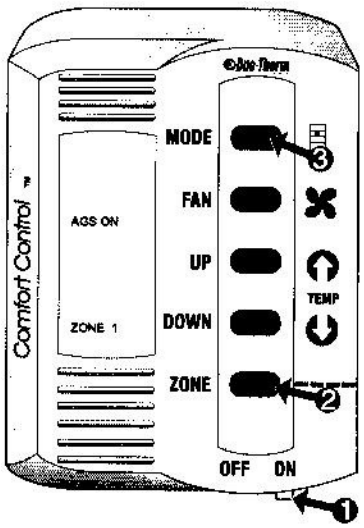


H. OPTIONAL AUTOMATIC GENERATOR START (AGS)

On vehicles equipped with an optional AGS kit the vehicle generator will automatically start when any zone calls for cooling and will shut off when all zones reach set point.

1. Put the power switch in the ON position.
2. Momentarily depress and release the ZONE push-button until AGS indicator appears on the LCD.
3. Momentarily depress and release the MODE push-button to select AGS status.

Important: When shore power is available, AGS must be switched to the off position.



GENERAL INFORMATION

A. The ability of the air conditioner to maintain the desired inside temperature depends on the heat gain of the RV. Some preventative measures taken by the occupants of the RV can reduce the heat gain and improve the performance of the air conditioner. During extremely high outdoor temperatures, the heat gain of the vehicle may be reduced by:

1. Parking the RV in a shaded area.
2. Using window shades (blinds and/or curtains).
3. Keeping windows and doors shut or minimizing usage.
4. Avoiding the use of heat producing appliances.

Starting the air conditioner early in the morning and giving it a "head start" on the expected high outdoor ambient will greatly improve its ability to maintain the desired indoor temperature.

B. The manufacturer of this air conditioner will not be responsible for damage caused by condensed moisture on ceilings or other surfaces. Air contains moisture and this moisture tends to condense on cold surfaces. When air enters the RV, condensed moisture may appear on the ceiling, windows, metal parts, etc. The air conditioner removes this moisture from the air during normal operation. Keeping doors and windows closed when this air conditioner is in operation will minimize condensed moisture on cold surfaces.

C. This equipment must be serviced by qualified personnel and some states require these people to be licensed.

MAINTENANCE

AIR FILTER: Periodically remove the return air filter. Wash the filter with soap and warm water; let dry and then reinstall or replace as required.

Note: Never run the air conditioner without the return air filter in place. This may plug the unit evaporator coil with dirt and may substantially affect the performance of the unit.

Comfort Control Center™: Clean the Comfort Control Center™ with a moist, soft cloth. **DO NOT** use solvents for cleaning.

SERVICE

If your unit fails to operate or operates improperly, check the following before calling your service center.

A. If your RV is connected to a motor generator, check to be sure the motor generator is running and producing power.
B. If the RV is connected to a power supply by a land line, check to be sure the line is sized properly to run air conditioner load and it is plugged into the power supply.
C. Check your 120VAC fuse or circuit breaker to see if it is open.
D. Check your 12VDC fuse or circuit breaker to see if it is open.
E. After the above checks, call your local service center for further help. This unit must be serviced by qualified service personnel only.

When calling for service, always give the following:

A. Air Conditioner Model Number and Serial Number found on Rating Plate located on the Base Pan of the air conditioner.
B. Electronic Control Kit Part Number and Serial Number found on Rating Plate located on the side of the Kit.

RETURN AIR GRILLE MUST BE REMOVED FROM THE RETURN AIR COVER TO VIEW THESE RATING PLATES.

LIMITED THREE-YEAR WARRANTY
AIR CONDITIONERS & HEAT PUMPS

THE SELLER NAMED BELOW MAKES THE FOLLOWING WARRANTY WITH RESPECT TO THE DOMETIC PRODUCT:

1. This warranty is made only to the first purchaser (herein after referred to as the "Original Purchaser") who acquires the product for his own use and is installed and operated within the continental United States and Canada.
2. This warranty will be in effect for three years on parts and freight and two years on labor from the date of purchase by the Original Purchaser. It is suggested that the Original Purchaser retain a copy of the dated bill of sale as evidence of the date of purchase.
3. This warranty covers only specified Dometic parts, which shall be free from defects in material and workmanship under normal use. This warranty does not cover conditions unrelated to the material and workmanship of the product. Such unrelated conditions include, but are not limited to: (a) damage not reported within 7 days; (b) faulty installation or installation that does not comply to the RVIA standards and any damage resulting from such; (c) the need for normal maintenance and any damage resulting from the failure to provide such maintenance; (d) failure to follow Sellers instructions for use of this product; (e) any accident to or misuse of any part of this product and any alteration by anyone other than the Seller or its authorized representative; (f) damage or failure caused by installation of accessories or parts not manufactured and marketed by the Seller will void any warranty, implied or written; (g) corrosion, salt water; (h) radio frequency interference (RFI) or electromotive interference (EMI) and (i) installation on semi trucks or off-road vehicles.
4. The specified parts covered by this warranty are as follows: switches, thermostats (excluding infrared remote controls, which are covered for a period of one year, not including batteries), relays, capacitors, motors, electronic module boards, solar panels and the sealed system; compressor, evaporator coil, condenser coil, refrigerant lines, capillary tubes and reversing valve.
5. It is suggested the Original Purchaser provide preventative maintenance on a yearly basis. Suggested preventative maintenance is: (a) check mounting/anchor bolts for proper torque; (b) inspect/clean and comb condenser fins; (c) inspect/clean and comb evaporator fins; (d) inspect/clean evaporator blower wheel and condenser fan blade/blower wheel; (e) clean return air filter. The cost of preventative maintenance is the Original Purchaser's responsibility and should take about one hour.
6. In order to obtain the benefits of this warranty, the Original Purchaser must return the product which is found defective to the Seller named below or to a Dometic Authorized Service Center during the period that this warranty is in effect. The Original Purchaser is responsible for all charges incurred in delivery of the product to the Seller or Dometic Authorized Service Center, and in pick up after the warranty service has been completed. To obtain the location of the nearest Authorized Service Center, please call 1-800-544-4881 or in Canada call 1-519-653-4390.
7. Any item returned in the manner described in paragraph 6 will be examined by the Seller or the Authorized Dometic Service Center. If it is found that the returned item was defective in material and workmanship, the Seller or the Authorized Dometic Service Center will repair the product per the terms outlined in paragraph 4. CONFIRM THE SERVICE AGENCY IS AN AUTHORIZED DOMETIC SERVICE CENTER. DO NOT PAY THE SERVICE AGENCY FOR WARRANTY REPAIRS. SUCH PAYMENTS WILL NOT BE REIMBURSED.
8. The Seller does not authorize any person or company to create any warranty obligations or liability on their behalf. This warranty is not extended by the length of time which you are deprived of the use of the product. Repairs and replacement parts provided under the terms of this warranty shall carry only the non-expired portion of this warranty.
9. In no event shall either Seller be liable for incidental or consequential damages. This includes any damage to another product or products resulting from such a defect. Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitations may not apply.
10. Any implied warranty, including the implied warranty of merchantability and fitness for any purpose, is limited to the duration of this limited warranty. Some states do not allow limitations on how long an implied warranty can last, so the above limitation may not apply.
11. THIS WARRANTY GIVES SPECIFIC LEGAL RIGHTS, YOU MAY ALSO HAVE OTHER RIGHTS WHICH VARY FROM STATE TO STATE. No action to enforce this warranty shall be commenced later than ninety (90) days after the expiration of the warranty period. Claims must be submitted in writing to the Dometic Warranty Department for arbitration.
12. All products (except those specifically built for commercial use) are warranted only when installed on vehicles built to R.V.I.A A119.2 and C.R.V.A, Z-240 Standards.
13. The Seller reserves the right to change the design of any product without notice and with no obligation to make corresponding changes in products previously manufactured.

REVISION:
Form. No. 3307601.025 3/06
(Replaces 3307601.017)
(French 3307602.023)
©2006 Dometic Corporation
LaGrange, IN 46761

DOMETIC CORPORATION
Warranty Department
2320 Industrial Parkway
Elkhart, Indiana 46515
Phone: 574-294-2511
Fax: 574-389-3975

Dometic The Sign of Comfort

2562433A Rev. A 409

Safety Message to Installers of Siren Speakers

⚠ WARNING

People's lives depend on your proper installation and servicing of Federal Signal products. It is important to read and follow all instructions shipped with this product and the original product. Listed below are some other important safety instructions and precautions you should follow:

Before Installation

Qualifications

- To properly install an electronic siren, you must have a good understanding of automotive electrical procedures and systems, along with proficiency in the installation and service of safety warning equipment. Always refer to the vehicle service manuals when installing equipment on a vehicle.

Sound Hazards

- Your hearing and the hearing of others, in or near your emergency vehicle, could be damaged by loud sounds. This can occur from short exposures to very loud sounds, or from longer exposures to moderately loud sounds. For hearing conservation guidance, refer to federal, state, or local recommendations. OSHA Standard 1910.95 offers guidance on "Permissible Noise Exposure."
- All effective sirens and horns produce loud sounds (120 dB) that may cause permanent hearing loss. Always minimize your exposure to siren sound and wear hearing protection. Do not sound the siren indoors or in enclosed areas where you and others will be exposed to the sound.
- Federal Signal siren amplifiers and speakers are designed to work together as a system. Combining a siren and speaker from different manufacturers may reduce the warning effectiveness of the siren system and may damage the components. You should verify or test your combination to make sure the system works together properly and meets federal, state, and local standards or guidelines.

During Installation

- DO NOT get metal shavings inside the product. Metal shavings can cause the system to fail. If drilling must be done near the unit, place an ESD-approved cover over the unit to prevent metal shavings from entering the unit. Inspect the unit after mounting to be sure there are no shavings present in or near the unit.
- DO NOT connect this system to the vehicle battery until ALL other electrical connections are made, mounting of all components is complete, and you have verified that no shorts exist. If wiring is shorted to vehicle frame, high current conductors can cause hazardous sparks resulting in electrical fires or flying molten metal.

- Be sure the siren amplifier and speaker(s) in your installation have compatible wattage ratings.
- In order for the electronic siren to function properly, the ground connection must be made to the NEGATIVE battery terminal.
- Sound output will be severely reduced if any objects are in front of the speaker. If maximum sound output is required for your application, you should ensure that the front of the speaker is clear of any obstructions.
- Install the speaker(s) as far forward on the vehicle as possible, in a location that provides maximum signaling effectiveness while minimizing the sound reaching the vehicle's occupants. Refer to the National Institute of Justice Guide 500-00 for further information.
- Mounting the speakers behind the grille will reduce the sound output and warning effectiveness of the siren system. Before mounting speakers behind the grille, make sure the vehicle operators are trained and understand that this type of installation is less effective for warning others.
- Sound propagation and warning effectiveness will be severely reduced if the speaker is not facing forward. Carefully follow the installation instructions and always install the speaker with the projector facing forward.
- DO NOT install the speaker(s) or route the speaker wires where they may interfere with the operation of airbag sensors.
- Installation of two speakers requires that you wire the speakers in phase.
- Never attempt to install aftermarket equipment, which connects to the vehicle wiring, without reviewing a vehicle wiring diagram, which is available from the vehicle manufacturer. Insure that your installation will not affect vehicle operation and safety functions or circuits. Always check vehicle for proper operation after installation.
- DO NOT install equipment or route wiring or cord in the deployment path of an airbag.
- Locate the control head so the vehicle, controls, and microphone can be operated safely.
- When drilling into a vehicle structure, be sure that both sides of the surface are clear of anything that could be damaged.

After Installation

- After installation, test the siren system and light system to ensure that it is operating properly.
- Test all vehicle functions, including horn operation, vehicle safety functions and vehicle light systems, to ensure proper operation. Ensure that installation has not affected vehicle operation or changed any vehicle safety function or circuit.
- After testing is complete, provide a copy of these instructions to the instructional staff and all operating personnel.
- File these instructions in a safe place and refer to them when maintaining and/or reinstalling the product.

Failure to follow all safety precautions and instructions may result in property damage, serious injury, or death to you or others.

Unpacking the Kit

After unpacking the kit, inspect it for damage that may have occurred in transit. If it has been damaged, do not install it. File a claim immediately with the carrier, stating the extent of damage. Carefully check all envelopes, shipping labels, and tags before removing or destroying them. Ensure that the parts listed in *Table 1* are included in the package.

Table 1: Kit contents

ES100, ES100-DEU, ES100-UNI (Kit Number 8567207)		
Qty.	**Description**	**Part Number**
2	Side Mounting Bolt, 5/16-18, 5/8" Long	7007010-10

Mounting the Speaker

⚠ WARNING

MOUNTING PRECAUTIONS: ES100 SERIES SPEAKER WIRES
To avoid reducing the sound output and damaging the speaker, ensure that the speaker is mounted with the wires protruding from the bottom of the speaker.

⚠ WARNING

MOUNTING PRECAUTIONS: DIRECTION OF SOUND OPENING
To avoid reduction of sound output, ensure that the speaker is mounted with the sound opening facing directly in the direction intended to warn.

NOTICE

DRILLING PRECAUTIONS
Before drilling holes, check the area into which you plan to drill to ensure you do not damage vehicle components while drilling. All drilled holes should be deburred and all sharp edges should be smoothed. All wires going through drilled holes should be protected by a grommet or convolute/split-loom tubing.

Select an appropriate mounting location that provides both adequate support and sufficient clearance for the speaker assembly. In addition, the mounting location should provide maximum signaling effectiveness while minimizing the sound reaching the vehicle's occupants.

The ES100 Series speakers are compact speakers intended to be mounted with a separately purchased Federal Signal mounting system. If the speakers are installed with another mounting system, the safety and effectiveness of the installation must be carefully evaluated. Refer to the mounting instructions included with the speaker mounting system.

NOTE: Because of the variety of vehicles and possible mounting arrangements, installation details and mounting bracket fabrication must be determined by the installer.

Wiring the Speaker

IMPORTANT: The ES100 series speakers comply with the requirements of SAE J1849 EVS3 and CCR Title 13 Class A when they are used with Federal Signal Corporation electronic sirens.

The ES100 Series speaker includes the three models shown in *Figure 1*.

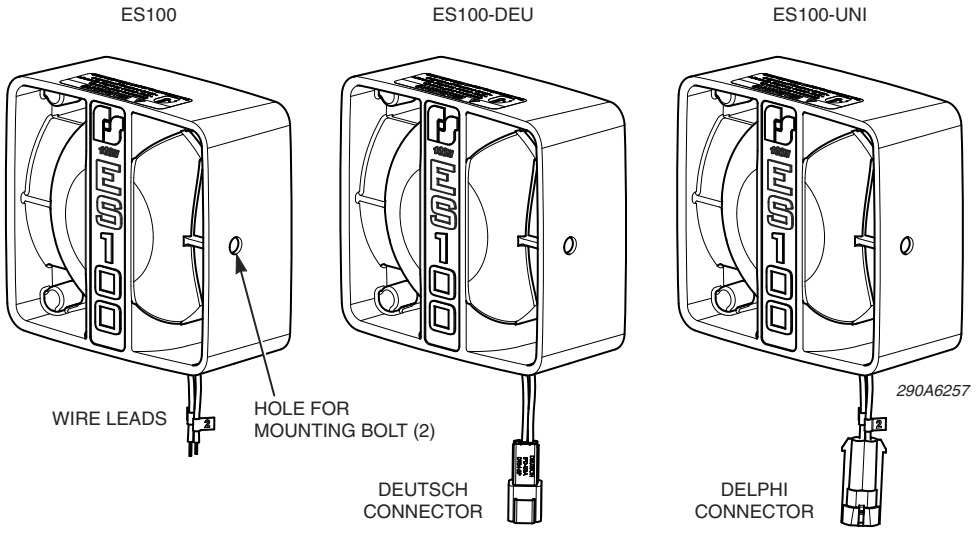


Figure 1: ES100 speaker models

ES100 (18 AWG tinned wire leads)

Connect the black ground lead (#1) and white power lead (#2) from the speaker to the speaker cable from the electronic siren (*Figure 1, ES100*). Refer to the instructions included with the electronic siren for details.

ES100-DEU (Deutsch connector)

Connect the Deutsch connector from the speaker (*Figure 1, ES100-DEU*) to the Deutsch connector from the electronic siren so that pin positions 1 and 2 of the connectors match. The numbers of the pin positions are on the side of the connector housings.

ES100-UNI (Delphi connector)

Connect the Delphi connector from the speaker (*Figure 1, ES100-UNI*) to the electronic siren's speaker's Delphi connector from the electronic siren so that pin positions 1 and 2 of the connectors match. The numbers of the pin positions are on the connector housings.

Testing the Siren System

⚠ WARNING

SOUND HAZARD

All effective sirens and horns produce loud sounds (120 dB) that may cause permanent hearing loss. Always minimize your exposure to siren sound and wear hearing protection. Do not sound the siren indoors or in enclosed areas where you and others will be exposed to the sound.

After the installation, test the siren system to ensure that it is operating properly. Also test all vehicle functions, including horn operation, vehicle safety functions, and vehicle lighting systems to insure proper operation. Ensure that the installation has not affected the vehicle operation or changed any vehicle safety functions or circuits.

Do not test the sound and light system of the vehicle while driving. Operating the vehicle warning systems may pose a hazard to the operator and other drivers if the systems do not function as expected. Test the vehicle only in a controlled environment.

Safety Message To Personnel Operating Federal Signal Siren Speakers

⚠ WARNING

People's lives depend on your safe operation of Federal products. It is important to read and follow all instructions shipped with the products. In addition, listed below are some other important safety instructions and precautions you should follow:

Qualifications

- To properly use an electronic siren and speaker(s), you must have a good understanding of general vehicle operation, a high proficiency in the use of safety warning equipment, and thorough knowledge of state and federal UNIFORM TRAFFIC CODES.

Sound Hazard

- Your hearing and the hearing of others, in or close to your emergency vehicle, could be damaged by loud sounds. This can occur from short exposures to very loud sounds, or from longer exposures to moderately loud sounds. For hearing conservation guidance, refer to federal, state, or local recommendations. OSHA Standard 1910.95 offers guidance on "Permissible Noise Exposure."
- All effective sirens and horns produce loud sounds (120 dB) that may cause permanent hearing loss. Always minimize your exposure to siren sound, roll up your windows and wear hearing protection. Do not sound the siren indoors or in enclosed areas where you and others will be exposed to the sound. Only use the siren for emergency response situations.

Sound Limitations

- Before using the vehicle, check to see if the siren speakers are concealed from view. If the siren speaker is not in clear view on the front of the vehicle, use extra caution when operating the vehicle. A concealed siren speaker installation is less effective at warning others.
- Maximum sound output will be severely reduced if any objects are in front of the speaker. If your installation has obstructions in front of the speaker, drive even more cautiously.
- Frequently inspect the speaker to ensure that it is clear of any obstruction, such as mud or snow, which will reduce maximum sound output.

Signaling Limitations

- Be aware that the use of your visual and audible signaling devices does not give you the right to force your way through traffic. Your emergency lights, siren, and actions are REQUESTING the right-of-way.

- Although your warning system is operating properly, it may not alert everyone. People may not hear, see, or heed your warning signal. You must recognize this fact and continue driving cautiously.
- Situations may occur which obstruct your warning signal when natural or man-made objects are between your vehicle and others. This can also occur when you raise your hood or trunk lid. If these situations occur, be especially careful.

Driving Limitations

- At the start of your shift, you should ensure that the light/sound system is securely attached to the vehicle and operating properly.
- If the unique combination of emergency vehicle equipment installed in your vehicle has resulted in the siren controls being installed in a position that does not allow you to operate them by touch only, OPERATE CONTROLS ONLY WHILE YOUR VEHICLE IS STOPPED.
- If driving conditions require your full attention, you should avoid operating the siren controls while the vehicle is in motion.

Continuing Education

- File these instructions in a safe place and refer to them periodically. Give a copy of these instructions to new recruits and trainees.

Failure to follow these safety precautions may result in property damage, serious injury, or death to you, to passengers, or to others. For operation instructions, refer to the instructions included with the electronic siren.

Ordering Replacement Parts

For replacement parts, see *Table 1* on page 3. To order replacement parts, please contact your local dealer/distributor or:

Mobile Systems Customer Support
Federal Signal Corporation
Phone: 1-800-264-3578

Getting Technical Support and Service

This speaker has no field-serviceable parts. The factory can and will service your speaker. If you are experiencing problems with the speaker, please contact:

Service Department
Federal Signal Corporation
Phone: 1-800-433-9132
Fax: 1-800-343-9706
Email: empserviceinfo@fedsig.com

Returning a Product to Federal Signal

Before returning a product to Federal Signal, call 800-264-3578, 800-433-9132, or 800-824-0254 to obtain a Returned Merchandise Authorization number (RMA number). To expedite the process please be prepared with the following information:

- Your Federal Signal customer or account number.
- The purchase order number under which the items were purchased.
- The shipping method.
- The model or part number of the product being returned.
- The quantity of products being returned.
- Drop ship information as needed.
- Any estimate required.

When you receive your RMA Number:

- Write the RMA number on the outside of the box of returned items.
- Reference the RMA number on your paperwork inside of the box.
- Write the RMA number down so that you can easily check on status of the returned equipment.

Send all material with the issued RMA Number to:

Federal Signal Corporation
2645 Federal Signal Drive
University Park, IL 60466
Attn: Service Department
RMA: #_____

2645 Federal Signal Drive, University Park, IL 60466-3195
Tel.: (800) 264-3578 • Fax: (800) 682-8022
www.fedsig.com

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FEDERAL SIGNAL CORPORATION
Emergency Products

INSTALLATION AND OPERATING INSTRUCTIONS

MS4000/MS4000U Mini-Siren

LIMITED WARRANTY

The Signal Division, Federal Signal Corporation (Federal), warrants each new product to be free from defects in material and workmanship, under normal use and service, for a period of two years on parts replacement and one year on labor from the date of delivery to the first user-purchaser.

During this warranty period, the obligation of Federal is limited to repairing or replacing, as Federal may elect, any part or parts of such product which after examination by Federal discloses to be defective in material and/or workmanship.

Federal will provide warranty for any unit which is delivered, transported prepaid, to the Federal factory or designated authorized warranty service center for examination and such examination reveals a defect in material and/or workmanship.

This warranty does not cover travel expenses, the cost of specialized equipment for gaining access to the product, or labor charges for removal and re-installation of the product. Lamps, flash tubes, or batteries are not covered under warranty.

This warranty does not extend to any unit which has been subjected to abuse, misuse, improper installation or which has been inadequately maintained, nor to units which have problems relating to service or modification at any facility other than the Federal factory or authorized warranty service centers.

THERE ARE NO OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO, ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT SHALL FEDERAL BE LIABLE FOR ANY LOSS OF PROFITS OR ANY INDIRECT OR CONSEQUENTIAL DAMAGES ARISING OUT OF ANY SUCH DEFECT IN MATERIAL OR WORKMANSHIP.

FEDERAL SIGNAL CORPORATION
Emergency Products

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SECTION I
GENERAL DESCRIPTION

MS4000

MS4000U

The Federal Signal MS4000 siren series is an advanced, efficient, and economical Mini-Siren. It offers value packed performance for those who do not require a full-featured siren. It provides WAIL, YELP, PRIORITY, MANUAL siren and AIR HORN functions.

This siren series incorporates the latest solid-state designs for superior reliability and sound quality plus a delayed five-second timer for override tones.

The siren is designed for use in negative grounded vehicles with 12-volt electrical systems. No components protrude from the bottom of the siren to interfere with mounting arrangements.

The MS4000U is an undercover version of the MS4000. A remote switch panel, as pictured above, allows the base unit to be mounted in a hidden location.

Features:

- Economical small and compact - mounts virtually anywhere.
- Easy to operate – new, built-in intersection clearing feature.
- High reliability – advanced circuitry and FET design.
- 100-watt output – meets Class A with just one Federal Signal speaker.
- Output short circuit protected – replaceable fuse protection.
- Tones included – WAIL, YELP, PRIORITY, MANUAL siren (peak and hold) and AIR HORN.
- In states where the PRIORITY tone is not allowed, the JMP1 shunt can be added to eliminate the PRIORITY tone (see PRIORITY SOUND ELIMINATION, section IX, page 12).

Applications:

- Police vehicles
- Fire chief vehicles
- Volunteer vehicles

SECTION II
SPECIFICATIONS

Input voltage	9 Vdc to 15 Vdc
Input current, operating	10 amps max
Polarity	Negative grounded systems only
Standby current	60mA nominal
Operating temperature range	-30°C to +65°C
Frequency ranges	725 to 1575 Hz
Cycle range	WAIL 12 cycles/min YELP 240 cycles/min MANUAL 1425 Hz peak
Output voltage	64V (nominal) peak-to-peak
Output Power	100 watts
Output current	3 amps
Dimensions (HWD)	1.3” (3.4925cm) X 6.3” (15.575cm) X 5.7” (14.478cm)
Shipping Weight	3 lbs. (1.4kg)

SECTION III
SAFETY MESSAGE TO INSTALLERS OF FEDERAL SIGNAL LIGHT AND SOUND SYSTEMS

WARNING

The lives of people depend on your safe installation and servicing of Federal products. It is important to read and follow all instructions shipped with the products. In addition, listed below are some other important safety instructions and precautions you should follow.

Before Installation

Qualifications

- To properly install an electronic siren: you must have a good understanding of automotive electrical procedures and systems along with proficiency in the installation and service of safety warning equipment.

Sound Hazards

- Your hearing and the hearing of others, in or close to your emergency vehicle, could be damaged by loud sounds. This can occur from short exposures to very loud sounds or from longer exposures to moderately loud sounds. For hearing and conservation guidance, refer to federal, state, or local recommendations. OSHA Standard 1910.95 offers guidance on "Permissible Noise Exposure."
- All effective sirens and horns produce loud sounds, which may, in certain situations, cause permanent hearing loss. You should minimize your exposure times and wear suitable hearing protection.

During Installation

- DO NOT connect this system to the vehicle battery until ALL other electrical connections are made, mounting of all components is complete, and you have verified that no shorts exist.
- Be sure the siren amplifier and speaker in your installation have compatible wattage ratings.
- In order for this electronic siren to function properly, the ground connection must be made to the NEGATIVE battery terminal.
- Sound output will be severely reduced if any objects are in front of the speaker. If maximum sound output is required for your application, you should ensure that the front of the speaker is clear of any obstructions.
- Install the speaker in a location which provides maximum signaling effectiveness and minimizes the sound reaching the vehicle's occupants.
- Never attempt to install aftermarket equipment which connects to the vehicle wiring, without reviewing a vehicle wiring diagram – available from the manufacturer. Insure that your installation will not affect vehicle operation or mandated safety functions or circuits.
- DO NOT install equipment, route wiring or cord in the deployment path of an air bag.
- Locate the siren so the vehicle controls can be operated safely.
- When drilling into a vehicle structure, be sure that both sides of the surface are clear of anything that could be damaged.
- If wiring is shorted to vehicle frame, high current conductors can cause hazardous sparks resulting in electrical fires or flying molten metal.

After Installation

- After installation, test the electronic siren and speaker system to ensure that it is operating properly.
- Test all vehicle functions, including horn operation and vehicle light systems, to ensure proper operation. Ensure that installation has not affected vehicle operation or changed any mandated safety function or circuit.
- After testing is complete, provide a copy of these instructions to the instructional staff and all operating personnel.
- File these instructions in a safe place and refer to them when maintaining and/or reinstalling the product.

Failure to follow all safety precautions and instructions may result in property damage, serious injury, or death to you or others.

SECTION IV
INSTALLATION

4-1 INSPECTION OF UNIT

After unpacking the MS4000 series siren, examine it for damage that may have occurred in transit. If the equipment has been damaged, file a claim immediately with the carrier stating the extent of damage. Carefully check all envelopes, shipping labels and tags before removing or destroying them.

4-2 PHYSICAL INSTALLATION

Both electronic sirens come equipped with two mounting brackets, which enables them to be mounted in a variety of positions. Positioning the bracket above the unit allows mounting to the underside of the dash.

The unit should be mounted in a position that is both comfortable and convenient to the operator. Keep visibility and accessibility of controls in mind. To install the unit under the dash, determine the mounting location and proceed as follows. (See figures 4-1 and 4-2).

A. Use one of the mounting brackets as a template and scribe two drill position marks at the selected mounting location under the dash, 7.0” apart. Positioning the bracket below the unit will permit mounting on any horizontal surface.

WARNING

When installing equipment inside air bag equipped vehicles, the installer MUST ensure that the equipment is installed ONLY in areas recommended by the vehicle manufacturer.

Failure to observe this warning will reduce the effectiveness of the air bag, damage the air bag or potentially damage or dislodge the equipment, causing serious injury or death to you or others.

CAUTION

The unit must be installed in an adequately ventilated area. Never install near heater ducts or under vehicle hood.

Before drilling holes in ANY part of a vehicle, be sure that both sides of the mounting surface are clear of parts that could be damaged; such as brake lines, electrical wiring or other vital parts.

B. Drill four mounting holes at the position marks.

Figure 4-1. MS4000 Mounting location

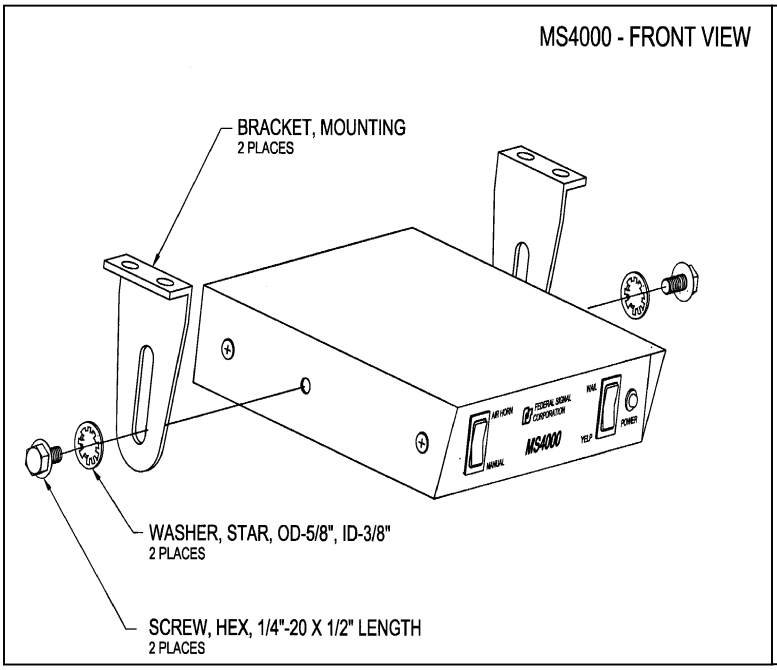
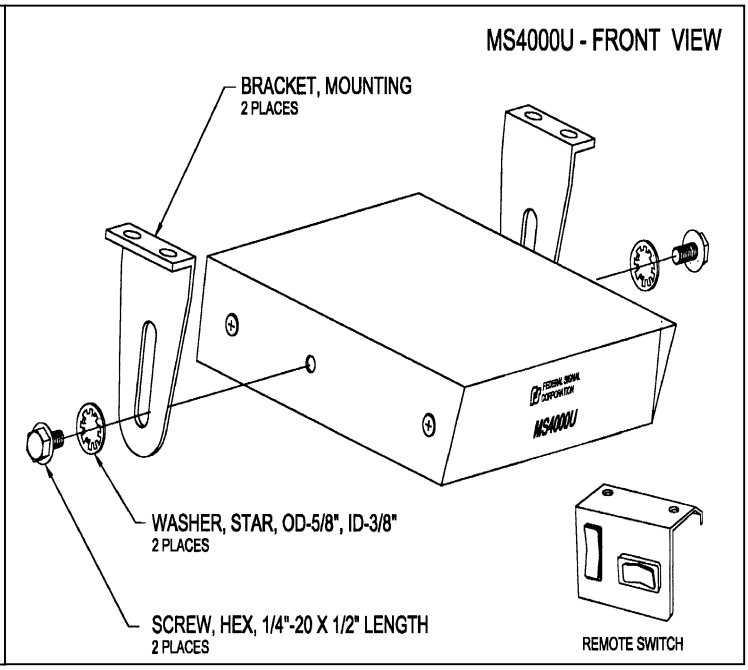


Figure 4-2. MS4000U Mounting location



C. Secure the mounting brackets to the dash with (4 each unsupplied) 10-32 x 3/4 hex head screws, 10-32 split lock washers and 10-32 hex nuts.

D. Secure the electronic siren to the mounting brackets with 1/4" self tapping machine screws and 3/8-ID" internal tooth washers (supplied).

E. Tilt the unit to the desired position. Tighten the 1/4- 20 x 3/8 hex head screws.

4-3 ELECTRICAL CONNECTIONS

WARNING

Failure to observe this WARNING may result in fire, burns or blindness.

If shorted to vehicle frame, high current conductors can cause hazardous sparks resulting in electrical fires or molten metal.

DO NOT connect this system to vehicle battery until ALL other electrical connections are made and mounting of all components is complete.

Verify that no short circuits exist before connecting to the Positive (+) battery terminal.

The power and speaker cables are included on the siren (see figures 4-3 and 4-4). The various wires must be connected as indicated below.

Figure 4-3. MS4000 Wire location

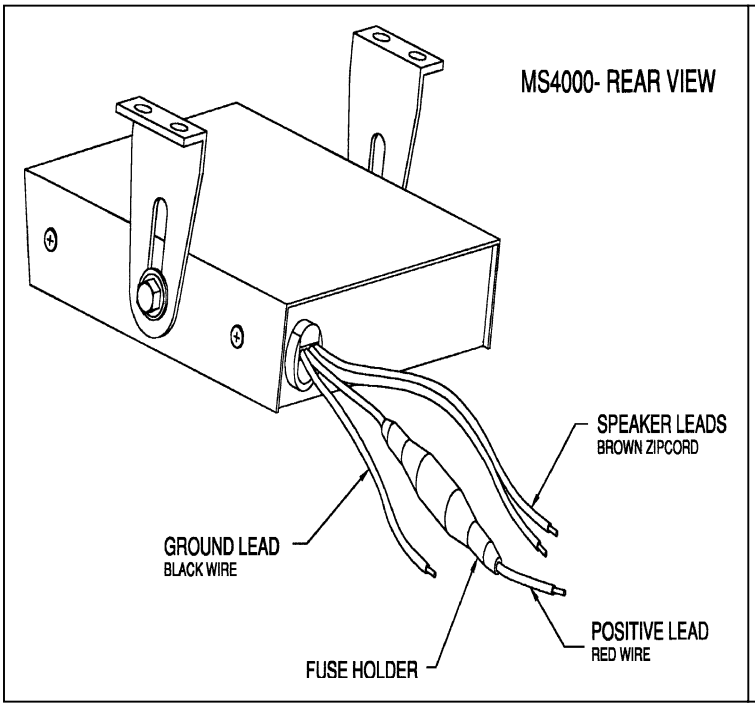
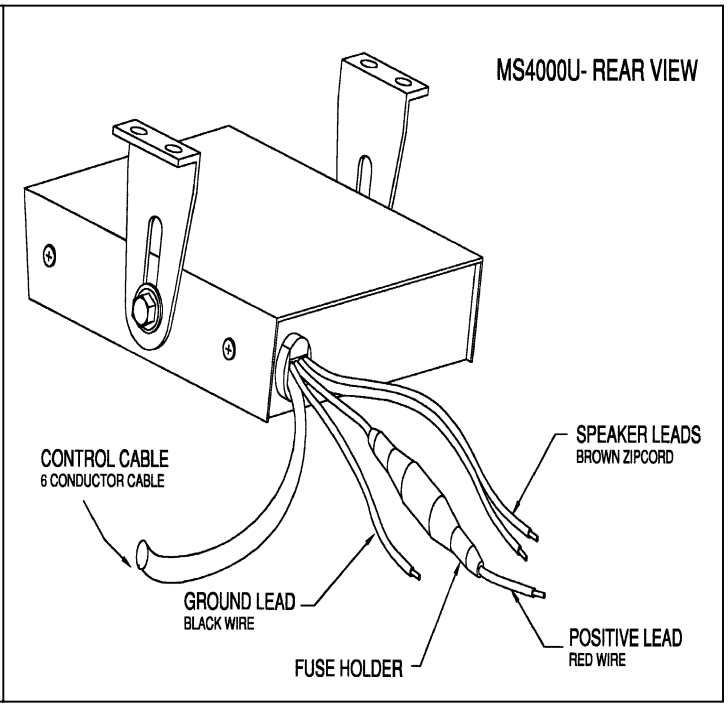


Figure 4-4. MS4000U wire location



A. *Speaker.*

The unit is designed to operate with one 11-ohm impedance speaker.

A speaker is not included as part of the electronic siren. FEDERAL speakers are weatherproof and may be installed in any convenient location; on the fender, behind the grill, etc. Any special mounting instructions applicable to the type of speaker you have selected will be found in the speaker carton.

Using 18-gauge wire, connect the speaker leads (brown zip cord) to the speaker. Ensure that exposed connections are properly insulated (see figures 4-3 and 4-4).

B. *Switch Assembly (MS4000U ONLY).*

Identify the mounting location of the MS4000U switch bracket assembly (see figure 4-5).

1. Route and install the control cable into the vehicle.

2. Trim the cable to fit the desired length. Strip the outer plastic coating of the control cable back approximately 3 inches and strip the individual wires back approximately ¼ inch.

3. Crimp the remaining end of the 5" black wire into the quick-disconnect terminal with the black wire from the control cable. Crimp the quick-disconnect terminals (provided) onto the ends of the remaining wires.

4. Using the tie wrap provided, secure the cable onto the rear of the switch bracket. **Do not cinch down at this time.**

5. Mount the switch bracket into the vehicle, in the desired location.

6. Thread the wires through the switch bracket for the desired switch configuration. Connect the quick disconnect connectors to the rear of the switches in the following manner:

a. BLACK wire to the CENTER pole of the momentary switch.

b. BLUE wire to the AIR HORN pole of the momentary switch.

c. RED wire to the MANUAL pole of the momentary switch.

d. GREEN wire to the CENTER pole of the 3-position switch.

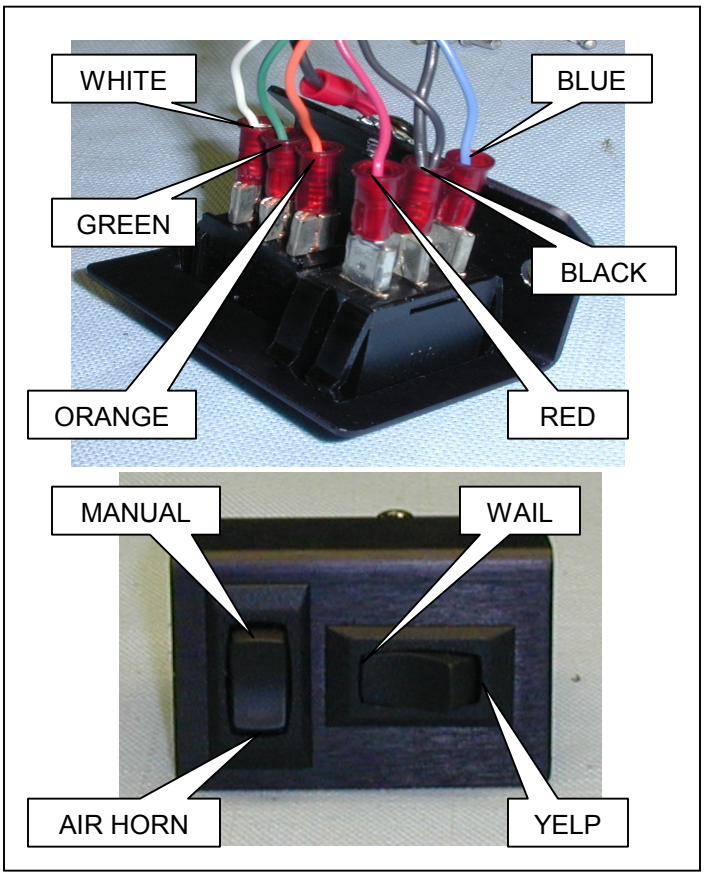
e. WHITE wire to the WAIL pole of the 3-position switch.

f. ORANGE wire to the YELP pole of the 3-position switch.

g. Snap the switches into the bracket.

h. Tighten down the tie wrap holding the control cable.

MS4000U Figure 4-5
Typical wiring and switch configuration



C. *Power Connections.*

The MS4000 Siren Series can operate from any 12-volt NEGATIVE ground vehicle electrical system. Therefore, before making any electrical connections, determine the polarity of the vehicle electrical system ground.

CAUTION

The MS4000 Series Sirens do not have an on-off switch. If power is obtained directly from the vehicle battery, it will continuously draw approximately 0.060A. Since this will eventually discharge the vehicle's battery, it is recommended that the power for the system be obtained from the switched side of the ignition switch circuit.

Before drilling holes in ANY part of the vehicle, ensure that both sides of the surface are clear of parts that could be damaged; such as brake lines, fuel lines, electrical wiring or other vital parts

Drill a hole in the vehicle firewall for the power lead to enter the engine compartment. Place a grommet or similar device in the hole to protect the wire against damage from rough edges.

1. Using 14 gauge wires, route the red and black wires through the existing hole, into the engine compartment. The wires should be routed through existing clamps and holders toward the battery.

2. Connect the black lead to the vehicle battery negative (-) terminal.

3. Connect the red in-line fuse holder lead to the selected 12-volt source.

4-4 TESTING AFTER INSTALLATION

After installation, test the electronic siren to ensure that it is operating properly.

CAUTION

Damage to the unit will occur if not properly fused. Ensure that an in-line fuse (15A) and fuse holder are installed in the red power lead.

The siren is designed to blow the fuse under reverse polarity conditions. If the fuse fails when power is supplied, check and correct the power lead wiring. Install a 15A in-line fuse and reapply power.

After testing is complete, provide a copy of this manual to all operating personnel.

SECTION V
SAFETY MESSAGE TO OPERATORS OF FEDERAL SIGNAL LIGHT/SOUND SYSTEMS

WARNING

The lives of people depend on your safe operation of Federal products. It is important to read and follow all instructions shipped with the products. In addition, listed below are some other important safety instructions and precautions you should follow:

Qualifications

- To properly use an electronic siren and speaker(s): you must have a good understanding of general vehicle operation, a high proficiency in the use of safety warning equipment, and thorough knowledge of state and federal UNIFORM TRAFFIC CODES.

Sound Hazards

- Your hearing and the hearing of others, in or close to your emergency vehicle, could be damaged by loud sounds. This can occur from short exposures to very loud sounds, or from longer exposures to moderately loud sounds. For hearing conservation guidance, refer to federal, state, or local recommendations. OSHA Standard 1910.95 offers guidance on “Permissible Noise Exposure.”

- All effective sirens and horns produce loud sounds which may, in certain situations, cause permanent hearing loss. You should minimize your exposure times and wear suitable hearing protection.

Sound Limitations

- Maximum sound output will be severely reduced if any objects are in front of the speaker. If your installation has obstructions in front of the speaker, drive even more cautiously.

- Frequently inspect the speaker to ensure that it is clear of any obstruction, such as mud or snow, which will reduce maximum sound output.

Signaling Limitations

- Be aware that the use of your visual and audible signaling devices do not give you the right to force your way through traffic. Your emergency lights, siren, and actions are REQUESTING the right-of-way.

- Although your warning system is operating properly, it may not alert everyone. People may not hear, see, or heed your warning signal. You must recognize this fact and continue driving cautiously.

- Situations may occur which obstruct your warning signal when natural or man-made objects are between your vehicle and others, such as when you raise your hood or trunk lid. If these situations occur, be especially careful.

Driving Limitations

- At the start of your shift, you should ensure that the light/sound system is securely attached to the vehicle and operating properly.

- If the unique combination of emergency vehicle equipment installed in your vehicle has resulted in the light/siren controls being installed in a position that does not allow you to operate them by touch only, OPERATE CONTROLS ONLY WHILE YOUR VEHICLE IS STOPPED.

- If driving conditions require your full attention, you should avoid operating the light/siren controls while the vehicle is in motion.

Continuing Education

- File these instructions in a safe place and refer to them periodically. Give a copy of these instructions to new recruits and trainees.

  Failure to follow these safety precautions may result in property damage, serious injury, or death to you, to passengers, or to others.

SECTION VI
OPERATION

6-1 GENERAL

All controls utilized during normal operation of the MS4000 are located on the front panel (see figure 6-1) or on the remote switch panel for the MS4000U.

Two rocker switches operate the siren. The HORN/MANUAL switch provides a momentary action while the WAIL/YELP switch locks into each position. ON/OFF/ON: With the control switches in their center positions, the siren is in standby mode (refer to Figure 6-2).

6-2 WAIL/YELP

Activating the siren switch in either WAIL or YELP will produce the respective siren tones. Return the switch to the center position to turn off the siren tone.

Figure 6-1. MS4000 Switch Function

6-3 AIR HORN/MANUAL

If the WAIL tone is selected and the MANUAL switch is depressed, a 5-second YELP tone is generated. The unit then returns to the WAIL mode (see chart in Figure 6-2).

If the YELP tone is selected and the MANUAL switch is depressed, a 5-second PRIORITY tone is generated. The unit then returns to the YELP mode.

Depressing the AIR HORN switch will interrupt the present operation of the siren with the AIR HORN tone. The AIR HORN tone is removed upon releasing the switch. The unit will return to WAIL or YELP or Standby dependent on the positioning of the WAIL/YELP switch.

With no tone selected, activation of the MANUAL switch will generate a PEAK and HOLD tone.

	WAIL-on	Off	YELP-on
AIR HORN-ON	AIR HORN	AIR HORN	AIR HORN
OFF	WAIL	STANDBY	YELP
MANUAL-ON	5-sec YELP Return to WAIL	PEAK & HOLD	5-sec PRIORITY Return to YELP

Figure 6-2. MS4000/MS4000U Function Chart

SECTION VII
SAFETY MESSAGE TO PERSONNEL SERVICING FEDERAL SIGNAL ELECTRONIC SIRENS

WARNING

The lives of people depend on your safe servicing of products. It is important to read and follow all instructions shipped with the products. In addition, listed below are some other safety instructions and precautions you should follow.

- Read and understand all instructions in this manual before servicing the electronic siren.
- To properly service an electronic siren: you must have a good understanding of automotive electrical procedures and systems, along with proficiency in the installation and service of safety warning equipment.
- Electronic circuit repairs must be performed by a qualified and competent electronic technician.
- Your hearing and the hearing of others, in or close to your emergency vehicle, could be damaged by loud sounds. This can occur from short exposures to very loud sounds or from longer exposures to moderately loud sounds. For hearing conservation guidance, refer to federal, state, or local recommendations. OSHA Standard 1910.95 offers guidance on "Permissible Noise Exposure."
- All effective sirens and horns produce loud sounds, which may cause, in certain situations, permanent hearing loss. You should take appropriate safety precautions such as wearing hearing protection.
- DO NOT connect this system to the positive terminal of the battery until servicing is complete, and you have verified that there are no short circuits to ground.
- In order for the electronic siren to function properly, the ground connection must be made to the NEGATIVE battery terminal.
- After repair, test the electronic siren and speaker system to ensure that it is operating properly.

  Failure to follow all safety precautions and instructions may result in property damage, serious injury, or death to you or others.

SECTION VIII
SERVICE

The factory can and will service your equipment or assist you with technical problems that cannot be handled satisfactorily and promptly locally.

Servicing, other than cosmetic features, should be performed by a qualified Federal Signal service center. If the unit is not working properly, disconnect all electrical connections. Remove the unit from the mounting bracket. Send the unit to the nearest authorized service center or the Federal Signal service department.

Communications and shipments should be addressed to either service location:

Service Department:
FS/Unitrol
1108 Raymond Way
Anaheim, CA 92801

714-871-3336
1-800-854-3375

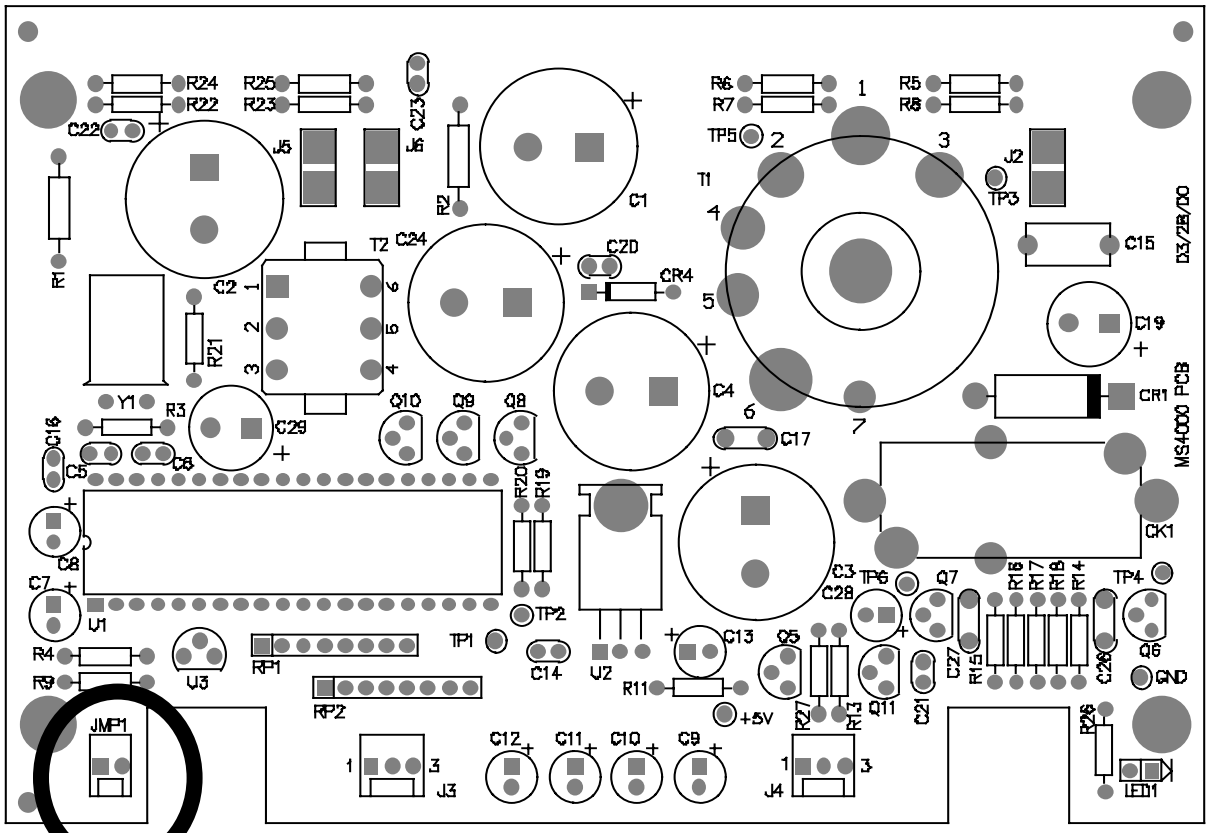
or

Service Department:
Federal Signal
2645 Federal Signal Dr.
University Park, IL 60466

1-800-433-9132

After servicing is complete, perform a test of all functions to ensure the control unit is operating properly.

SECTION IX
Priority Sound Elimination
MS4000/MS4000U



For agencies that operate in areas where the PRIORITY sounds are not authorized we are providing a shunt to be placed on the circuit board at location JMP1. If the end user installs this shunt, the unit will not produce the PRIORITY sounds.

SHUNT TO BE INSTALLED

ELECTRA-STEER™

KIT NUMBER 8051440

Polaris Electric Steering Installation Manual

Thank you for purchasing our ELECTRA-STEER™ 12v electric assist power steering system. Please carefully read this instruction sheet entirely before you begin to install the system.

Remember, before beginning installation, insure that you are in a level well lit, organized, work area. Engage the parking brake, disconnect the battery until power is needed and chock or block the rear wheels to insure the vehicle is stable.

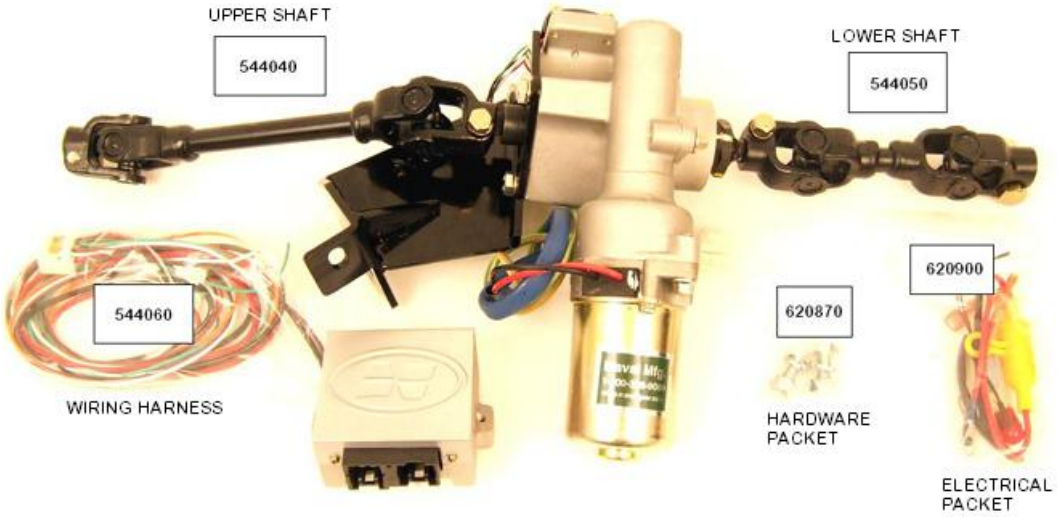
*If you have a 2008 Ranger you will need to remove the parking brake & chock or stabilize the rear wheels.

Full refund will NOT be granted to any kits that are damaged, scratched, or altered in any fashion.

INSTALLATION TIPS:

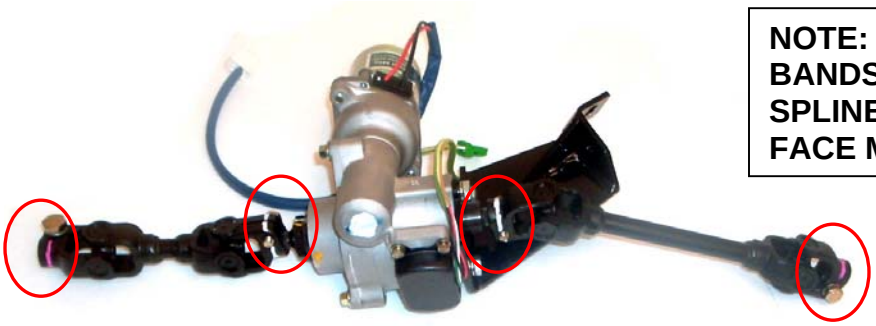
Due to minor variations in vehicle frames, we recommend that you leave all the U-Joint pinch bolts loose until the motor is mounted. Then rock the steering wheel back and forth to allow the U-Joints to align themselves. Complete the installation by tightening these bolts.

KIT CONTENTS:



TOOLS NEEDED TO COMPLETE INSTALLATION:

- 3/8” Electric Drill
- 3/8” Drill Bit
- ½ “ Drill Bit
- Soldering Iron & Solder
- Open End Wrenches: 10mm, 13mm & 17mm
- 3/8” Drive Socket Wrench and 6” extension
- Sockets: 15/16”, 3/8”, 8mm, 10mm, 13mm & 17mm
- Wire Stripper/Cutters
- Hammer
- 50 Ft Lb Adjustable Torque Wrench
- Scribe or Marking Tool
- Heat Gun



NOTE: PINK COLOR BANDS FACE VEHICLE SPLINES AND WHITE FACE MOTOR SPLINES:

REMOVAL OF EXISTING SHAFT ASSEMBLY:

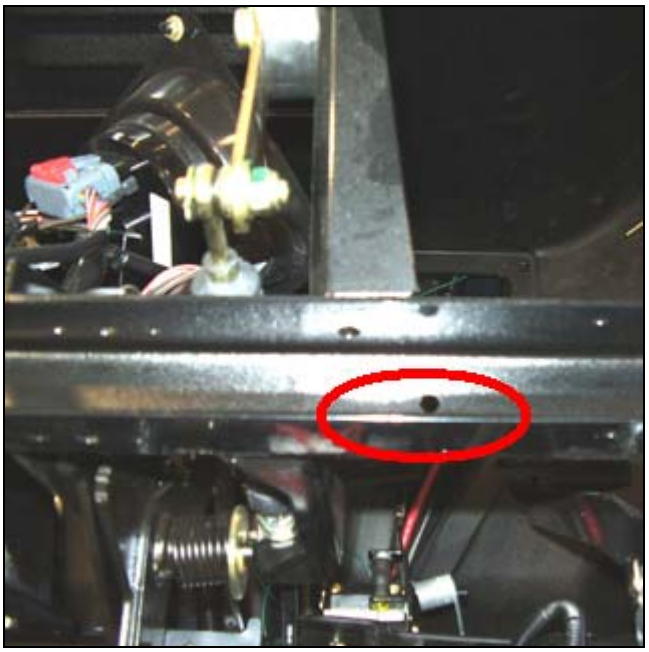
1. Remove center cap from steering wheel & remove the 15/16” nut from steering wheel. Have a second person carefully tap on the upper shaft while you pull up on the wheel to remove it from the taper on the shaft. Be sure not to loose the two wave washers & flat washer from the wheel.

2. Once the steering wheel is removed your next step is to remove the 8mm bolt from the upper shaft to the lower shaft and also remove the 10mm bolt at the rack and pinion that secures the shaft to it.

3. Remove the shaft assembly and store or discard, as it will not be needed again with the Electra-Steer™ unit installed on your vehicle.

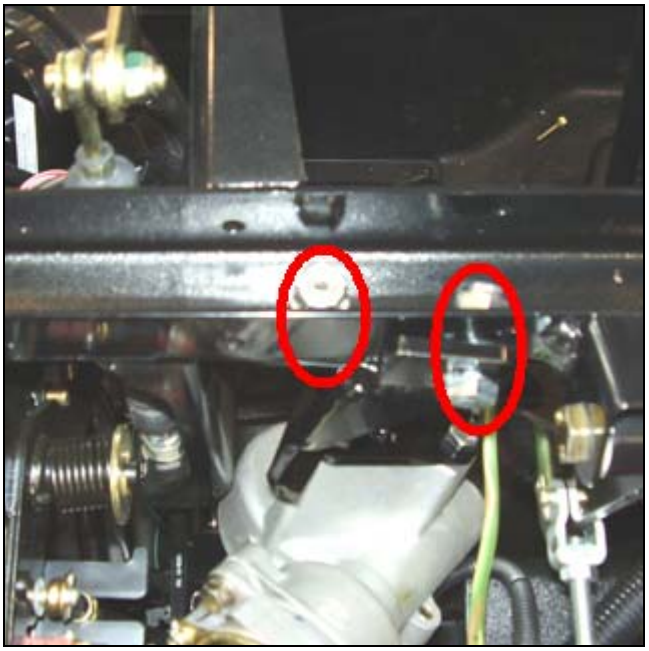
INSTALLATION OF THE ELECTRA-STEER™ KIT:

1. From under hood. Looking down on channel at top of frame you will see a hole approx. ¼ “ you will need to drill this out to 3/8” that is the pilot to start your install bracket.

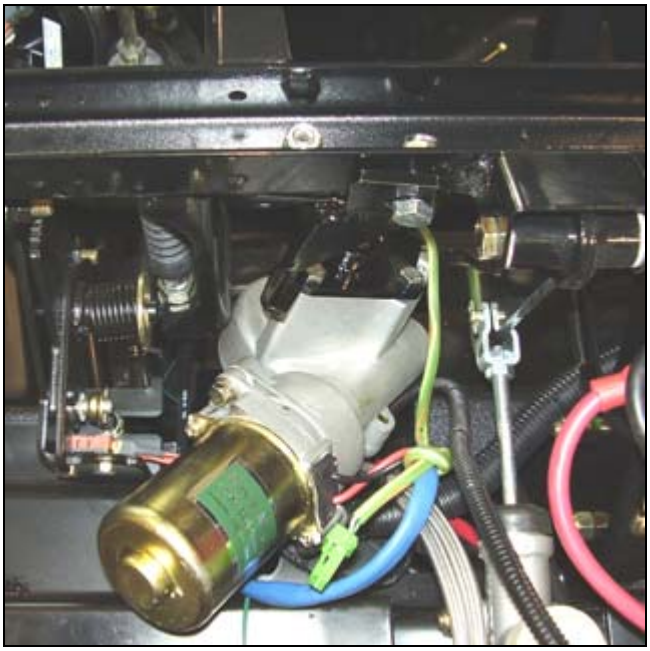


2. Put the bracket on the underside of the frame and install a 3/8 bolt from the bottom side of the bracket and install the lock washer and nut on the topside and snug but leave loose.

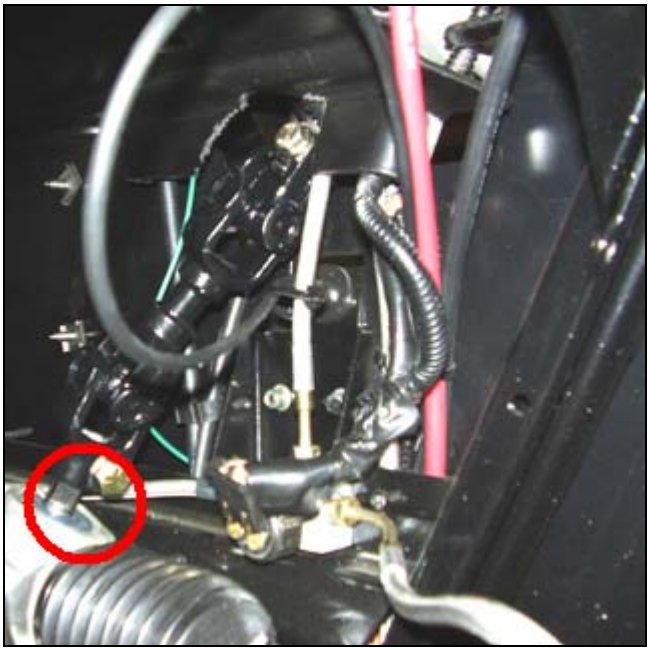
3. The bracket must be flush on the bottom and side. When the bracket is secure on the frame, using the hole in the mounting bracket as a pilot, you may drill the front side hole and install a 3/8” bolt and nut assy. and also leave loose.



4. When you have your motor hanging in place, you can install the lower shaft assy.



5. When installing the lower shaft it is necessary to put the pinion side (rack side) of the shaft on first. Once you have the pinion side on and in place you will have to wiggle the motor & shaft together to allow clearance for the shaft to engage on the motor side. Once you have it installed your next step is install the 10mm lower bolt and nut and install the 8mm bolt and lock washer upper into the holes and torque to 40 ft. lbs.

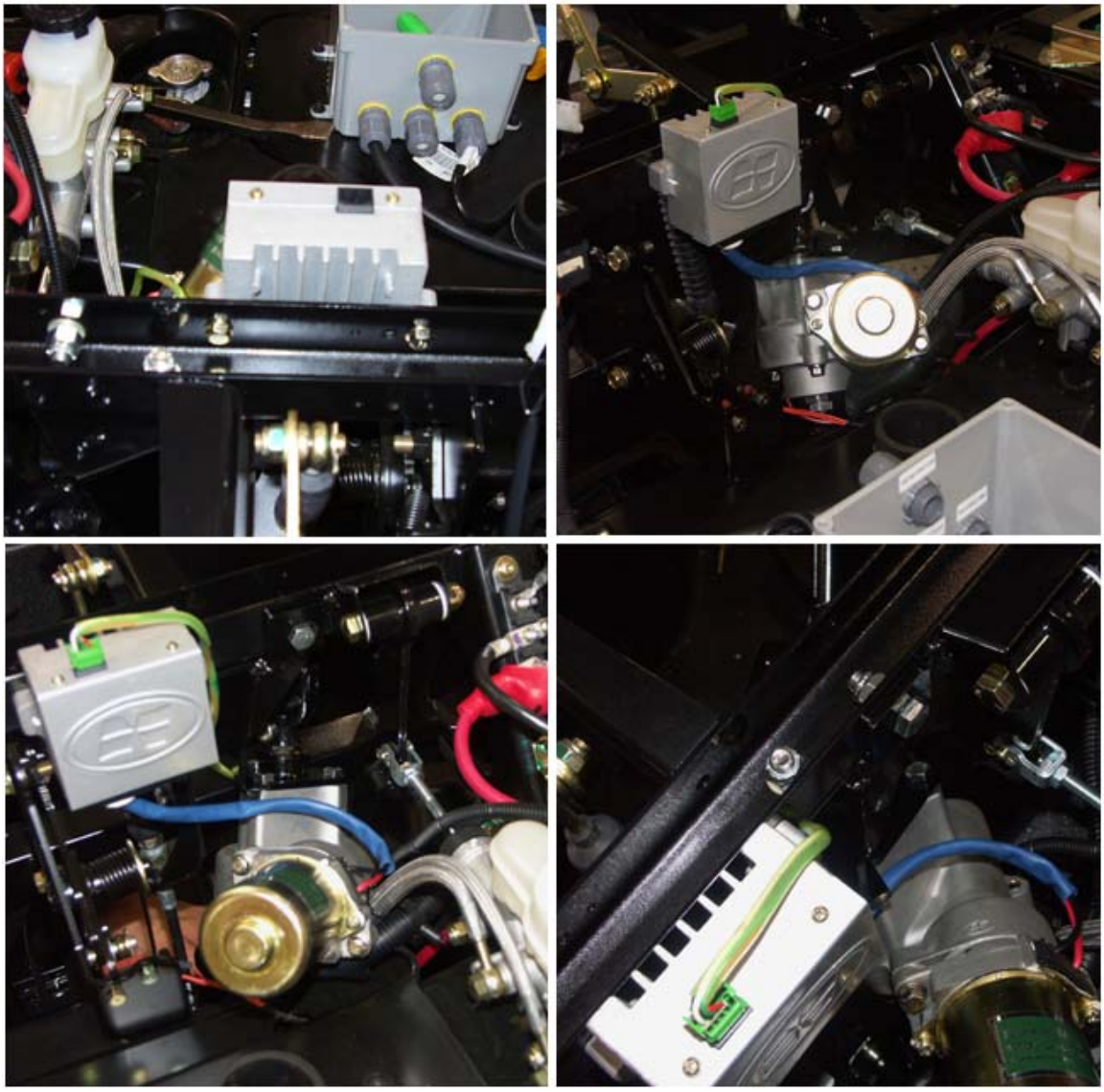


6. You may now torque the bracket bolts to 30 ft lbs.

7. To install the upper shaft, you have to fish the shaft through the column frame and slide the shaft onto the spline of the motor. The steering wheel shaft can then get dropped down through the column and splined onto the u-joint at the top. Install both 8mm bolts and torque to 25 ft lbs.

8. Install the 2 wave washers only and install the steering wheel and nut and torque to 40 ft. lbs.

9. The electric module gets mounted on the same frame as the bracket. There is a hole in the channel that is already there. You can mount 1 side and level the module and mark and drill the second hole and install 8mm bolts supplied with module & tighten snug.



10. The module wiring is described in the schematic supplied. The white wire gets a single spade terminal. The purple or brown wire also gets a spade terminal. **Note:** *these two wires are used for trouble code reading and clearing. They need to be located in an accessible place. They do not get connected to anything.* The orange wire goes to one side of the LED light. The yellow and blue wire is not used and may be trimmed back and taped into the harness. The green wire needs to go to a key on power source usually found on the ignition switch. The other side of the LED needs to be tied into this wire also.

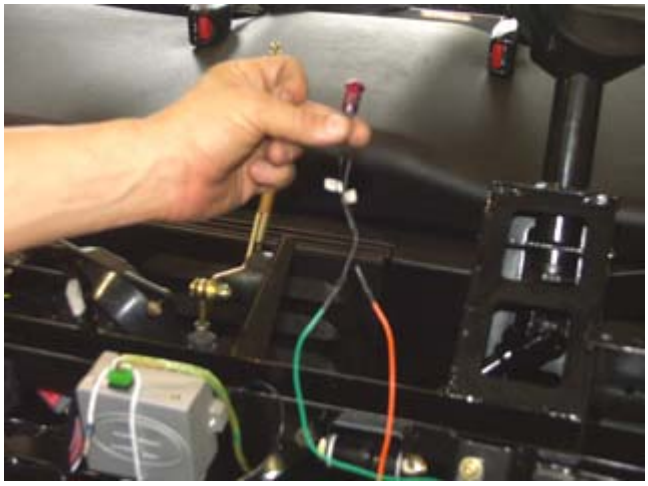
    The heavy red wire and the heavy black wire need to go directly to the battery terminals, or a junction that has constant battery voltage and ground. We have provided a slow blow fuse and it needs to be wired into your power lead. ***Failure to do so may result in a short circuit or malfunction.**

    ****It is strongly suggested that all connections made be soldered & taped to insure integrity. Shrink tube is also supplied to seal your connections.***

11. The LED needs to be mounted in the dash where it is visible. To install the light it's a simple matter of drilling a ½ inch hole and snapping the light into place from the front side.

NOTE: Pay special attention to what is behind your dash before drilling a hole.

12. Once your connections have been made, reconnect your battery, and you may turn the ignition key on. When the key is in the on position, the trouble light will light for approximately 5 seconds and then go out. This is normal operation. The steering should work. The trouble light will only light when there is a problem detected in the system.



13. When you have finished make sure that all your connections are good and your hardware is tight. Make sure your linkage is not binding anywhere and there is ample clearance around any parts or framing.

14. You are now ready to test-drive & enjoy your vehicle. You will immediately notice reduced steering effort!

The ELECTRA-STEER™ unit is designed to "shut down" if it becomes overheated reverting the vehicles manual steering capabilities.

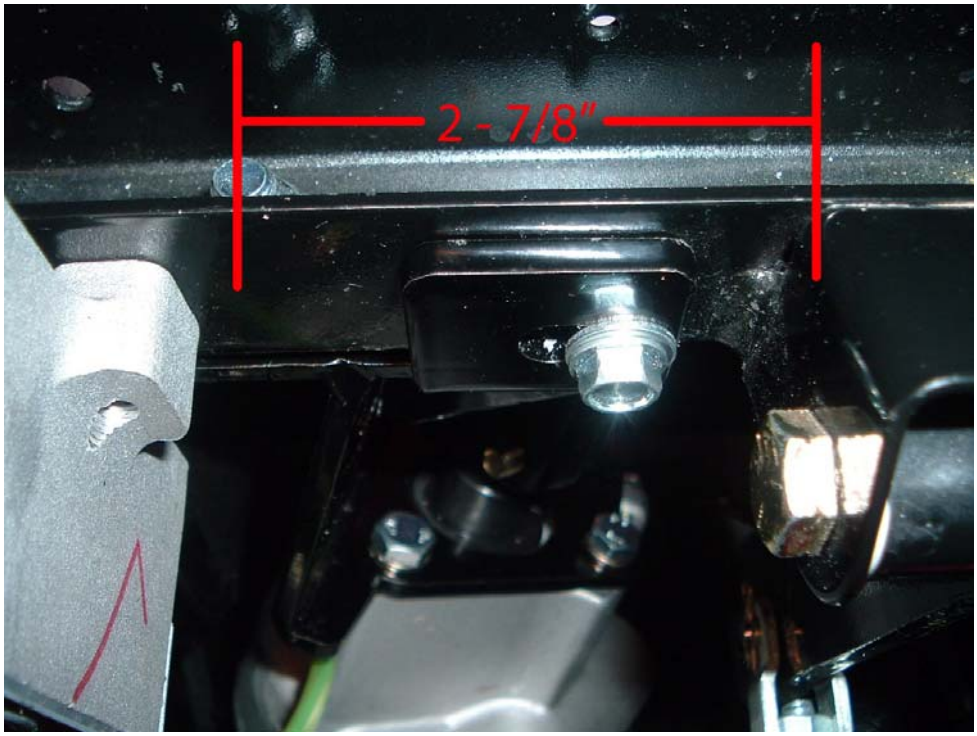
If the unit ceases operation after extensive use or in an extreme environment it will automatically resume it's normal function once it has cooled.

Ranger Supplement for Early 2005 and Previous

1. If you have a 2005 or earlier ranger you most likely do not have the upper pilot hole in the frame.

2. To locate where your pilot hole should be, you need to stand outside the vehicle with the hood open, facing the firewall.

3. With a tape measure, measure from the left side of the brake pedal mounting bracket over 2-7/8” mark the center of the frame channel. This is where you drill a 3/8” hole. After you are done drilling the hole install the mount bracket and drill the front frame hole using the bracket as a template. Drill the hole in the center of the slotted part of the bracket.

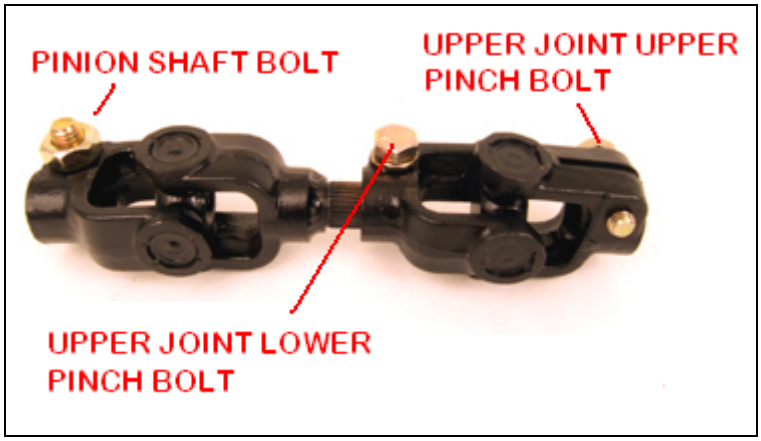


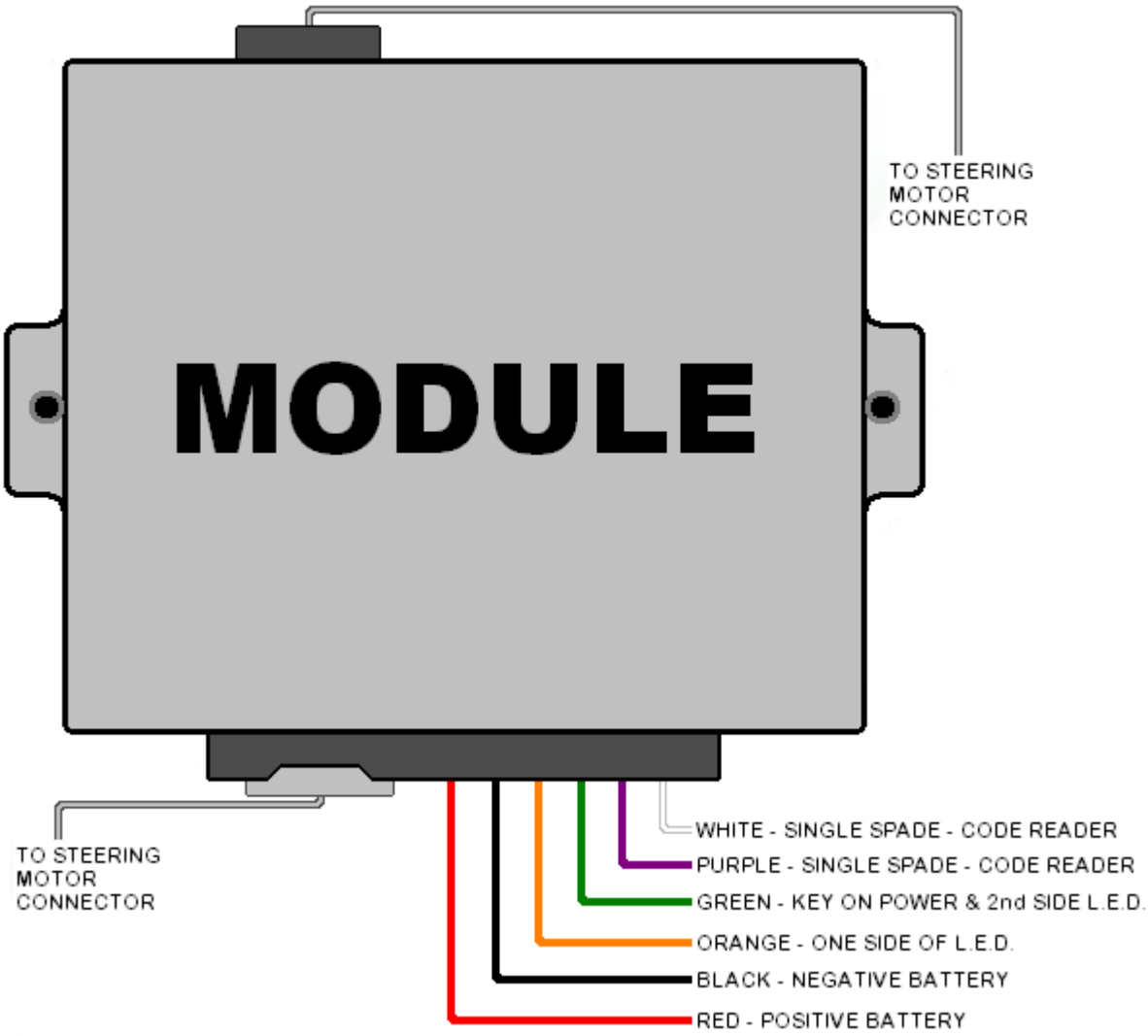
Lower Shaft Install For Polaris Ranger

1. The lower shaft assembly has been made to be an adjustable / slip fit design.

2. Once you have your entire steering motor and brackets mounted and your upper and lower shaft in place, tighten the motor mount bracket to the frame. Tighten your upper shaft pinch bolts. Tighten your lower pinion shaft bolt.

3. For the final step, slide the lower shaft upper u-joint to the motor and install and torque the pinch bolt at the motor. Next tighten the lower pinch bolt on the upper u-joint into position. This sequence of tightening is to ensure proper length and alignment of the lower shaft. Tightening in this sequence automatically sets the correct length of the lower shaft**. Note: The adjustable shaft is provided to cover a model year change in some vehicles. The difference in the vehicles is slight, but does require this adjustable piece.**





In some cases the purple above wire may be substituted for a brown wire!!

The Electra-Steer™Power Steering Assist Unit is intended to be used in accordance with all safety recommendations of the original manufacturer of the vehicle as specified in the Owners Manual. This product is intended for normal operation of the vehicle as specified by the original manufacturer. Maval Manufacturing Inc. and Unisteer Performance Products recommend that this product should not be used in extreme environmental conditions or in competitive activities. Maval Manufacturing Inc. and Unisteer Performance Products do not accept liability for any malfunction, damage, or injury incurred as a result of use of this product in extreme environmental conditions or in competitive activities.
USE DI-ELECTRIC GREASE ON ELECTRICAL CONNECTIONS.

Electra Steer Diagnosis Trouble Code Reading and Code Clearing

1. Verify that your trouble code light is on steady.

2. Peel back a small portion of the orange trouble code light wire to expose the copper portion of it.

3. Next use a jumper wire and go from the purple wire with the single spade connector on it and touch or spike it to the exposed part of the orange wire. You may need to do this a couple of times to get the LED to blink or flicker. Once you see the LED flicker or blink stop spiking the purple to orange and wait for LED to start blinking a code.

4. The light will flash in a sequence like 1 and then 123. This code flash would be interpreted as a code 13. The code will repeat itself 3 times and then go to the next code if there is one in the system. You need to wait until all the codes are read and recorded.

5. Once you know what the codes are you can use this chart to tell where or what the problem may be.

6. Once you have determined what the problem is and make the necessary repairs, you can proceed to clear the codes by running a jumper wire from the white wire with the single spade connector on it to ground.

7. Verify the ignition is off. Place the white wire to ground. Turn key on, wait 5 seconds and the light should go out. When the light goes out turn off ignition and remove jumper wire. Once all repairs are made turn ignition on and see that light proves out normally. This is all there is to it.

Trouble Code	Problem	Diagnosis
41-42-43-44-45-51	Electric motor Malfunction	Change Electric Motor
11-13-14-15	Torque Sensor	Change Sensor
52-54-55	ECU Malfunction	Change Computer
22	No Engine Input	Computer Error
21-23-24	No Speed Signal	Computer Error

We welcome your suggestions & comments to make this or any of our installations better! If you have any questions or problems regarding this product please contact us at:

1555 Enterprise Parkway
Twinsburg OH 44087
800-338-9080

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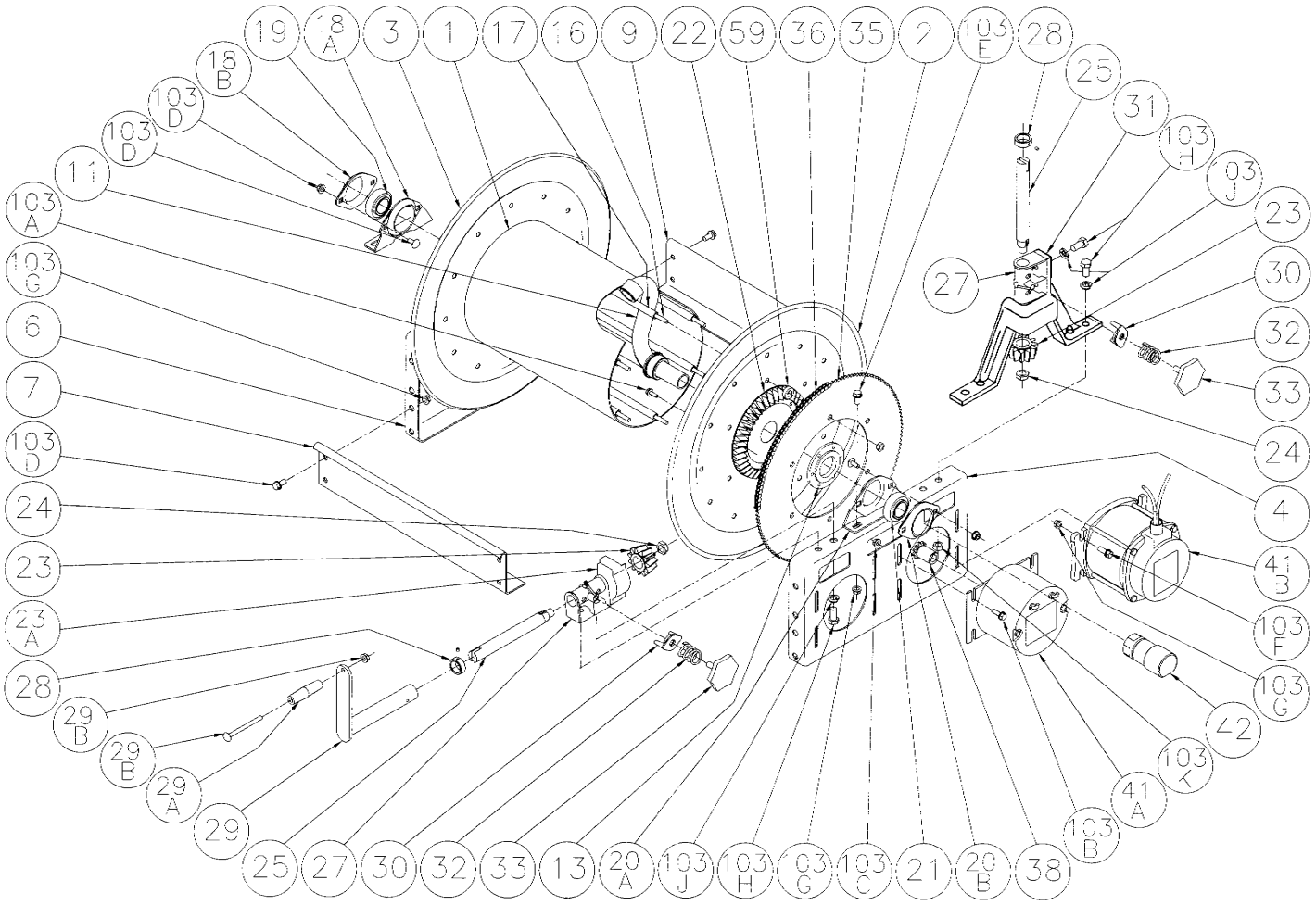
Website: www.hannay.com
E-mail: reels@hannay.com

ISO 84

PARTS LIST

1″ HOSE REEL



PARTS LIST
ISO 84
1″ Hose Reels

When ordering parts

BE SURE TO SPECIFY COMPLETE MODEL NUMBER and SERIAL NUMBER OF REEL.

USE PART NUMBER!

Item No.	Description	PART NUMBER	Quantity
1	Drum, 10-1/2″ Diameter (Specify Model)	9905.3131	1
2	Front Disc, 19-20 Series (Specify Model)	9903.0821	1
2	Front Disc, 21-22 Series (Specify Model)	9903.0921	1
2	Front Disc, 22-23 Series (Specify Model)	9903.1021	1
2	Front Disc, 23-24 Series (Specify Model)	9903.1121	1
2	Front Disc, 25-26 Series (Specify Model)	9903.1321	1
2	Front Disc, 26-27 Series (Specify Model)	9903.1421	1
2	Front Disc, 28-29 Series (Specify Model)	9903.1521	1
2	Front Disc, 30-31 Series (Specify Model)	9903.1621	1
3	Back Disc, 19-20 Series (Specify Model)	9903.0821	1
3	Back Disc, 21-22 Series (Specify Model)	9903.0921	1
3	Back Disc, 22-23 Series (Specify Model)	9903.1021	1
3	Back Disc, 23-24 Series (Specify Model)	9903.1121	1
3	Back Disc, 25-26 Series (Specify Model)	9903.1321	1
3	Back Disc, 26-27 Series (Specify Model)	9903.1421	1
3	Back Disc, 28-29 Series (Specify Model)	9903.1521	1
3	Back Disc, 30-31 Series (Specify Model)	9903.1621	1
4	Front Frame (Up to 23-24)	9906.0003	1
4	Front Frame (Up to 30-31)	9906.5031	1
6	Back Frame (Up to 23-24)	9906.0003	1
6	Back Frame (Up to 30-31)	9906.5031	1
7	Front Foot (Specify Model)	9907.3000	1
9	Back Foot (Specify Model)	9907.3000	1
11	Hub Assembly, w/1″ FNPT Riser (Specify Model)	9901.1600	1
13	EH-936 Washer	9965.0015	2
16	3/8″-16 Carriage Bolt w/Nut	Specify Model	6
17	3/8″ Spacer Pipe (Specify Model)	9904.3200	6
18	Back Bearing Complete	9902.1400	1
18A	Self-Aligning Pillow Block, Back	9902.2900	1
18B	Self-Aligning Bearing Holder, Back	9902.2800	1
19	Back Bearing Insert Only	9902.1500	1
20	Front Bearing Complete	9902.1400	1
20A	Self-Aligning Pillow Block, Front	9902.2900	1
20B	Self-Aligning Bearing Holder, Front	9902.2800	1
21	Front Bearing Insert Only	9902.1500	1
22	Ring Gear, H-26 (Up to 25-26)	9914.0372	1
22	Ring Gear, H-28	9914.0382	1
23	Pinion Gear, H-27 (Up to 25-26)	9914.0393	1
23	Pinion Gear, H-29	9914.0404	1
23A	Gear Guard	9914.0618	1
24	5/8″-18 SAE Hex Nut (ESNA)	9904.5600	1
25	Pinion Shaft (Specify Model)	9914.0250	1
27	Side Pinion Bearing	9914.0243	1
28	Collar & Set Screw	9914.0351	1
29	Crank Handle, H-18 Complete	9914.0011	1
29A	Hand Crank Handle	9914.0506	1
29B	Hand Crank Handle Bolt w/Nut	9914.0511	1
30	Brake Pad, H-3	9914.0433	1
31	Vertical Rewind Bracket	9914.0233	1
32	Brake Spring, H-31	9914.0451	1
33	Brake Wheel	9914.0413	1
35	112T35 Disc Sprocket	9910.1321	1
35	138T35 Disc Sprocket	9910.1423	1
35	180T35 Disc Sprocket	9910.1526	1
36	Chain, #35	Specify Model	1
38	Motor Sprocket, 11T35 x 1-5/16	9910.1118	1
41A	Motor, 12 Volt Nonexplosion-Proof	9915.0042	1
41B	Motor, 12 Volt Explosion-Proof	9915.0003	1
42A	Swivel Joint, Super Swivel, 1″ FxF	9929.8551	1
42B	Swivel Joint, Full Circle, 1” FxF	9929.0501	1
59	Sprocket Spacer	9954.0017	6
103A	5/16″-18 x 1/2″ Spinlock Bolt	9904.2158	5
103B	5/16″-18 x 1″ Spinlock Bolt	9904.2102	4
103C	5/16″-18 Spinlock Nut	9904.6100	4
103D	3/8″-16 x 3/4″ Carriage Bolt w/Nut	9904.0201	4
103E	3/8″-16 x 3/4″ Spinlock Bolt	9904.2201	12
103F	3/8″-16 x 1″ Spinlock Bolt	9904.2202	4
103G	3/8″-16 Spinlock Nut	9904.6200	16
103H	1/2″-13 x 1″ Hex Head Bolt	9904.1402	6
103J	1/2″ Lock Washer	9954.0030	6
103K	1/2″-13 Hex Nut	9904.5400	4

SAFETY GUIDELINES

READ THIS FIRST.

These guidelines provide general safety recommendations for using hose and cable reels. However, the employer should assess and determine if any additional safety measures are required for its particular application and operation, and fully instruct employees on those safety measures.

Additionally, the employer should make a copy of this safety manual available to all employees working with reels. Additional copies of this safety manual may be obtained upon request. No warranty of the correctness or sufficiency of the information in this manual is made by Hannay Reels.

Read all relevant manuals and safety instructions prior to unpackaging reels. If there is ANYTHING you do not understand about the safe installation and use of your Hannay reel, please contact Hannay Reels (Attn: Customer Service). We are always glad to help.

NOTICE

Hannay Reels will not assume any liability for any alterations and/or modifications to Hannay Reels or products supplied by Hannay Reels nor for uses other than for which these products are intended. All warranties expressed or implied will become null and void.

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The reel leader.

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FAX: 1-800-REELING (733-5464)
Int'l. Fax: (518) 797-3259

50M HP 11-04 H-9602-ISG
REV 4

WARNING: PINCH POINT AREAS

USE CAUTION WHEN OPERATING NEAR CHAIN AND SPROCKETS.

Where chain guards are furnished, the reels should not be operated with them removed.

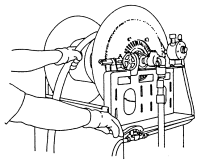
NOTE:

OSHA indicates the appropriate guarding of chains and sprockets is at least partly the responsibility of the final installer of equipment, based on the fact that equipment can be installed in so many different positions and so many different degrees of accessibility to the operator.

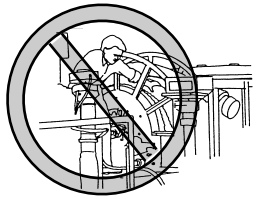
Please make sure that you have thoroughly reviewed this issue when making the installation of the reel.

USE CAUTION WHEN GUIDING HOSE OR CABLE BACK ONTO POWER REELS.

Keep the hand guiding the hose back onto the reel several inches away from the drum so that there is no possibility of trapped or pinched fingers. Use proper personal protection equipment.



KEEP HANDS AWAY FROM SPOKED DISCS WHEN TURNING.

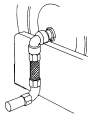


INSTRUCTIONS FOR SAFE FLUID HANDLING

USE A HOSE REEL AND HOSE PROPERLY RATED FOR THE JOB.

Never exceed the pressure rating (psi) specified for a particular reel and hose. Also, make sure that the size and material of both the reel and hose are designed for the intended use.

USE A FLEXIBLE CONNECTOR BETWEEN A SWIVEL JOINT AND INLET PIPING.



CHECK FOR POSSIBLE LEAKS AT FLUID CONNECTIONS PRIOR TO USE.

RELEASE PRESSURE IN HOSE BEFORE REMOVING FITTINGS OR PERFORMING ANY MAINTENANCE.

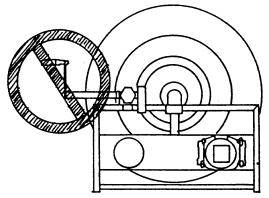
BEFORE WINDING COLLAPSIBLE HOSE ONTO A LIVE REEL, HOSE MUST BE EVACUATED OF ALL FLUID.

POWER REWIND REELS

USE CIRCUIT BREAKERS FOR ELECTRIC REWIND MOTORS.

Make sure that the circuit breaker is properly sized for the motor. Also, check all electrical connections for proper installation prior to use.

REMOVE AUXILIARY CRANK REWIND HANDLE BEFORE USING POWER REWIND.



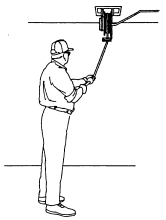
DISCONNECT POWER SOURCE BEFORE PERFORMING MAINTENANCE.

This applies to both electric and air-powered reels. Also, disconnect electrical power before removing junction box covers or collector ring housings.

SPRING REWIND REELS

USE CAUTION WHEN SPRING REEL RATCHET ASSEMBLY LOCK IS DISENGAGED.

When the lock is disengaged, always hold onto the hose or cable and guide it onto the reel as it rewinds.



ON SPRING REELS, NEVER REMOVE THE COVER CONTAINING THE SPRING.

Coiled springs are under tension and removal of cover can result in severe personal injury.

CONSIGNES DE SÉCURITÉ

À LIRE EN PREMIER.

Ces instructions donnent des recommandations générales de sécurité pour l'utilisation d'enrouleurs de câble et de flexible. Mais c'est à l'employeur qu'il revient d'évaluer et de déterminer s'il est nécessaire d'adopter des mesures de sécurité supplémentaires dans le cadre de son application particulière, et d'en informer ses employés.

De plus, l'employeur doit s'assurer que tous les employés travaillant avec l'enrouleurs puissent prendre connaissance de ce manuel de sécurité. Des copies supplémentaires de ce manuel de sécurité peuvent être obtenues sur demande. Aucune garantie n'est faite par Hannay Reels quant à l'exactitude de ce manuel ni à la qualité de son information.

Lire tous les manuels et toutes les consignes de sécurité applicables avant de déballer les enrouleurs. S'il y a QUOI QUE CE SOIT d'incompréhensible au niveau de l'installation et de l'utilisation en toute sécurité des enrouleurs Hannay, veuillez contacter Hannay Reels (à l'attention de Service des clients). Nous serons ravis de vous aider.

REMARQUE

Hannay Reels n'assume aucune responsabilité pour les altérations ou modifications des enrouleurs Hannay ou des produits fournis par Hannay Reels, ni pour les utilisations autres que celles prévues pour ces produits. Toutes les garanties express ou implicites deviennent nulles et non avenues.

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50M HP 11-04 H-9602-ISG REV 4

AVERTISSEMENT : POINTS DE PINCEMENT

ÊTRE TRÈS PRUDENT LORS DU FONCTIONNEMENT PRÈS DE CHAÎNES ET DE PIGNONS.

Si les enrouleurs sont fournies avec des protections de chaîne, il ne faut pas les utiliser avec les protections retirées.

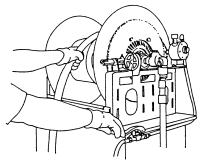
REMARQUE :

OSHA indique qu'une protection appropriée des chaînes et des pignons est au moins partiellement la responsabilité de l'installateur final d'équipement, étant donné que l'équipement peut être installé dans un nombre important de positions différentes et avec un grand nombre de degrés d'accès différents pour l'opérateur.

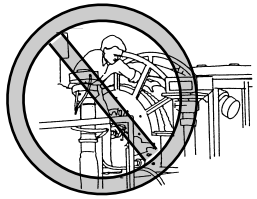
Veuillez vous assurer d'avoir résolu ce problème lors de l'installation de l'enrouleur.

E'TRE PRUDENT LORS DU GUIDAGE DES TUYAUX OU DU CÂBLE POUR LE REMBOBINAGE SUR LES ENROULEURS MOTORISÉES.

Garder la main guidant le flexible sur l'enrouleur à plusieurs centimètres du tambour pour éviter les risques de coincement ou de pincement des doigts. Porter des protections individuelles adequates.



GARDER LES MAINS ÉLOIGNÉES DES DISQUES À RAYONS LORS DE LEUR ROTATION.

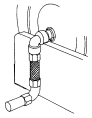


INSTRUCTIONS DE MANIPULATION SANS DANGER DES FLUIDES

UTILISER UN ENROULEUR DE FLEXIBLE ET UN FLEXIBLE D'UNE CAPACITÉ SUFFISANTE POUR LE TRAVAIL ENVISAGÉ.

Ne jamais dépasser la pression nominale spécifiée pour un enrouleur et un tuyau particuliers. De plus, s'assurer que la taille et le matériau de l'enrouleur et du tuyau soient adaptés à l'utilisation envisagée.

UTILISER UN CONNECTEUR FLEXIBLE ENTRE UNE ARTICULATION ET UNE CONDUITE D'ADMISSION.



VÉRIFIER L'ABSENCE DE FUITE AUX RACCORDS DE FLUIDE AVANT L'EMPLOI.

RELÂCHER LA PRESSION DANS LE FLEXIBLE AVANT DE RETIRER LES RACCORDS OU D'EFFECTUER UN ENTRETIEN.

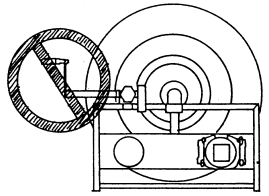
AVANT D'ENROULER UN FLEXIBLE PLAT SUR UN DÉVIDOIR S'ASSURER QUELE FLEXIBLE A ÉTÉ VIDANGÉ DE TOUT LIQUIDE.

ENROULEURS À REMBOBINAGE MOTORISÉ

UTILISER DES DISJONCTEURS POUR LES MOTEURS ÉLECTRIQUES DE REMBOBINAGE.

S'assurer que le disjoncteur soit correctement dimensionné pour le moteur. Vérifier également la bonne installation de toutes les connexions électriques avant l'emploi.

RETIRER LA MANIVELLE AUXILIAIRE DE REMBOBINAGE AVANT DE L'UTILISATION DU REMBOBINAGE MOTORISÉ.



DÉBRANCHER LA SOURCE D'ALIMENTATION AVANT D'EFFECTUER UN ENTRETIEN.

Ceci s'applique à la fois aux enrouleurs électriques et pneumatiques. Débrancher également l'alimentation électrique avant de déposer les couvercles de boîte de jonction et les boîtiers de bague de collecteur.

ENROULEURS À REMBOBINAGE À RESSORT

ÊTRE PRUDENT LORSQUE LE VERROUILLAGE DE CLIQUET DE ENROULEUR À RESSORT EST DÉSENGAGÉ.

Lorsque le verrou est désengagé, toujours tenir le flexible, ou le câble, et le glisser sur l'enrouleur pendant qu'elle se rembobine.

SUR L'ENROULEUR À RESSORT, NE JAMAIS DÉPOSER LE COUVERCLE CONTENANT LE RESSORT.

Les ressorts enrouleurs sont sous tension, et la dépose du couvercle peut entraîner des blessures corporelles graves.

VEILIGHEIDSVOORSCHRIFTEN

LEES DIT EERST.

Deze voorschriften zijn algemene veiligheidsinstructies voor het uitpakken en toepassen van slang- en kabelhaspels. De werkgever dient te beoordelen of extra veiligheidsmaatregelen noodzakelijk zijn voor een specifieke toepassing en dientengevolge de werknemers hierover te instrueren.

Bovendien zou de werkgever een kopie kunnen maken van deze beschikbare handleiding ten behoeve van de veiligheid voor alle werknemers die werken met haspels. Extra kopieën van deze handleiding kunnen verkregen worden op aanvraag. Hannay Reels, Inc., garandeert niet dat de informatie in deze handleiding juist of voldoende is.

Lees alle belangrijke gebruiks- en veiligheidsinstructies voordat u de haspels uitpakt. Bij onduidelijkheden omtrent deze handleiding, neem contact op met Hannay Reels, Inc. Klantenservice. Wij zijn altijd bereid u te helpen.

OPGELET

Hannay Reels aanvaardt geen enkele aansprakelijkheid voor veranderingen en/of wijzigingen aan Hannay haspels en/of produkten geleverd door Hannay. Het voorgaande alsmede ander gebruik dan waarvoor deze produkten bedoeld zijn, heeft tot gevolg dat alle uitdrukkelijke en stilzwijgende garantie ongeldig wordt.

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WAARSCHUWING: KNELPUNTEN

WEES VOORZICHTIG ALS U NABIJ DE KETTING EN TANDWIELEN WERKT.

De haspels niet gebruiken als de kettingbeschermers verwijderd zijn.

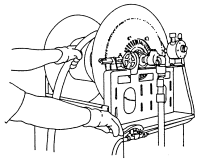
OPMERKING:

In verband met de vele manieren waarop de haspels geïnstalleerd kunnen worden, meent de OSHA dat de installateur mede verantwoordelijk is voor de juiste bescherming van kettingen en kettingwielen.

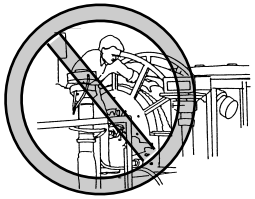
Wilt u ervoor zorgen dat u deze instzucties grondig heeft doorgenomen wanneer u de haspel installeert.

WEES VOORZICHTIG ALS DE SLANG OF KABEL GELEIDT OP EEN MOTORISCH BEDIENDE HASPEL.

Houd uw hand die de slang terugleidt enkele centimeters van de trommel af, zodat er geen mogelijkheid tot beknelde vingers bestaat. Gebruik de gepaste persoonlijke beschermingsmiddelen.



KOM NIET MET UW HANDEN DICHTBIJ DE SPAAKSCHIJVEN WANNEER ZE DRAAIEN.

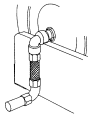


INSTRUCTIES VOOR HET VEILIG OMGAAN MET VLOEISTOF

GEBRUIK EEN SLANGHASPEL EN SLANG DIE GESCHIKT IS VOOR DE TOEPASSING.

Overschrijdt nooit de standaard werkdruk die gespecificeerd is voor de haspel en slang. Verzeker u er ook van dat de maat en het materiaal van de haspel en de slang geschikt zijn voor de toepassing.

GEBRUIK EEN FLEXIBELE VERBINDING TUSSEN EEN DRAAIPUNT EN LEIDINGWERK.



CONTROLEER MOGELIJKE LEKKAGE BIJ FLEXIBELE VERBINDINGEN VOORDAT U DE HASPEL GEBRUIKT.

VERWIJDER DE DRUK IN DE SLANG, VOORDAT U AANSLUITINGEN VERWIJDERT OF ONDERHOUD TOEPAST.

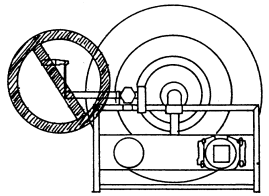
VOORDAT U EEN SLANG ZONDER INLAGEN OM EEN HASPEL WINDT, MOET ALLE VOIESTOF UIT DE SLANG ZIJN.

MOTORISCH BEDIENDE HASPELS

GEBRUIK EEN THERMISCHE BEVEILIGING BIJ TOEPASSING VAN EEN ELEKTRISCHE MOTOR.

Verzeker u ervan dat de thermische beveiliging afgestemd is op de motor. Kijk ook alle elektrische verbindingen nat t.a.v. de installatie voordat u hem gebruikt.

VERWIJDER DE SLINGER, VOORDAT U DE MOTORAANDRIJVING GEBRUIKT.



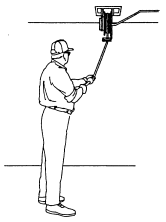
SCHAKEL DE KRACHTBRON UIT VOORDAT U DE HASPEL EEN ONDERHOUDSBEURT GEEFT.

Dit is van toepassing bij de motorisch aangedreven haspel. Schakel de stroom uit voordat u de schakelkast of sleepringen (kabelhaspel) verwijdert.

VEERBEDIENDE HASPELS

WEES VOORZICHTIG WANNEER DE BLOKKERING VAN DE HASPEL WORDT OPGEHEVEN.

Houdt de slang of kabel parallel ten opzichte van de haspel en geleid deze altijd bij oprolling.



VERWIJDER NOOIT DE KAP DIE DE VEER BEDEKT BIJ VEERBEDIENDE HASPELS.

Veren staan onder druk en verwijdering van de kap kan ernstig lichamelijke letstel veroorzaken.

DIRECTRICES DE SEGURIDAD

ROGAMOS LEER PRIMERO.

Estas directrices proporcionan las recomendaciones generales de seguridad para la utilización de los carretes para mangueras y cables. Sin embargo, el empleador debe estudiar y determinar si se requiere alguna medida de seguridad adicional para su aplicación y operación en particular, e instruir a sus empleados sobre esas medidas de seguridad.

Además, el empleador debe poner un ejemplar de este manual de seguridad a disposición de todos los empleados que trabajan con los carretes. Se puede obtener ejemplares adicionales de este manual a solicitud. Hannay Reels no garantiza la exactitud o suficiencia de la información en este manual.

Rogamos leer todos los manuales e instrucciones de seguridad relevantes antes de desembalar los carretes. Si existe CUALQUIER cosa que no se entienda acerca de la instalación segura y uso del carrete Hannay, rogamos contactar a Hannay Reels (Atn: servicio del cliente). Estamos prontos para servir.

AVISO

Hannay Reels no asumirá ninguna obligación por ninguna alteración y/o modificaciones hechas a los carretes de Hannay Reels o productos suministrados por Hannay Reels ni por otros usos que no sean para los cuales están diseñados estos productos. Todas las garantías expresas o implícitas quedarán nulas.

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ADVERTENCIA: PUNTOS DE APRIETE

TENER CUIDADO CUANDO SE TRABAJE CERCA DE LA CADENA Y RUEDAS DENTADAS.

En los casos en que se suministran protectores de cadenas, no se debe usar los carretes si se han sacado los protectores.

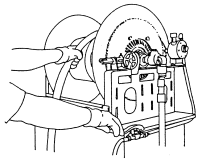
NOTA:

OSHA indica que la protección adecuada de las cadenas y ruedas dentadas es en parte responsabilidad del instalador final del equipo, basado en el hecho que el equipo se puede instalar en tantas posiciones distintas y tantos grados diferentes de accesibilidad para el operador.

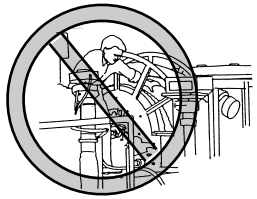
Rogamos asegurarse de examinar detenidamente este asunto cuando se instale el carrete.

TENER CUIDADO CUANDO SE GUIE LA MANGUERA O CABLE DE VUELTA A LOS CARRETES MOTORIZADOS.

Mantener la mano que está guiando la manguera de vuelta al carrete a varios centímetros de distancia del tambor para eliminar toda posibilidad de atraparse o apretarse los dedos. Utilizar el equipo personal apropiado de la Proteccion.



NO ACERCAR LAS MANOS A LAS RUEDAS CON RAYOS CUANDO ESTAN GIRANDO.

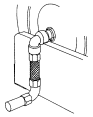


INSTRUCCIONES PARA EL MANEJO SEGURO DE FLUIDOS

USAR UN CARRETE DE MANGUERA Y MANGUERA DE LA CAPACIDAD ADECUADA PARA EL TRABAJO.

Nunca sobrepasar la presión nominal (psi) especificada para un carrete y manguera en particular. Además, asegurarse que el tamaño y el material tanto del carrete como de la manguera están diseñados para el uso al que está destinado.

USAR UN CONECTOR FLEXIBLE ENTRE UNA UNION GIRATORIA Y LA TUBERIA DE ENTRADA



ANTES DE USAR, BUSCAR SI HAY FUGAS EN LAS CONEXIONES DE FLUIDO.

QUITAR TODA LA PRESION DE LA MANGUERA ANTES DE SACAR LOS CONECTORES O HACER REPARACIONES.

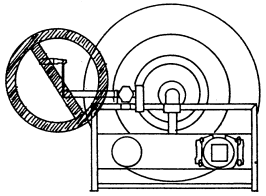
ANTES DE ENROLLAR UNA MANGUERA APLASTABLE EN UN CARRETE CON CORRIENTE, SE DEBE VACIAR TODO EL FLUIDO DE LA MANGUERA.

CARRETES DE ENROLLAMIENTO MOTORIZADO

USAR LOS DISYUNTORES DE CIRCUITO PARA LOS MOTORES ELECTRICOS DE ENROLLAMIENTO.

Asegurarse que el disyuntor de circuito es del tamaño apropiado para el motor. Además, revisar que todas las conexiones eléctricas estén bien instaladas antes de usar el carrete.

ANTES DE UTILIZAR EL ENROLLAMIENTO ELECTRICO, QUITAR LA PALANCA ENROLLADORA AUXILIAR.

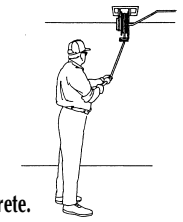


ANTES DE HACER TRABAJOS DE MANTENIMIENTO, DESCONECTAR LA ENERGIA ELECTRICA.

Esto se aplica a los carretes eléctricos y a los neumáticos. También, desconectar la energía eléctrica antes de sacar las tapas de la caja de conexiones o las envueltas del anillo colector..

CARRETES DE ARROLLAMIENTO POR RESORTE

TENER CUIDADO CUANDO EL SEGURO DEL TRINQUETE DEL CARRETE DE RESORTE ESTA DESENGANCHADO.



Cuando el seguro está desenganchado, siempre sujetar la manguera o el cable, y guiarla mientras se enrolla en el carrete.

EN LOS CARRETES DE RESORTE, NUNCA QUITAR LA TAPA QUE CONTIENE EL RESORTE.

Los resortes en espiral están a presión y si se quita la tapa se corre el riesgo de sufrir graves lesiones.

RICHTLINIEN ZUR SICHERHEIT

WICHTIGE INFORMATIONEN, UNBEDINGT LESEN!

Diese Richtlinien geben allgemeine Sicherheitsempfehlungen zum Einsatz von Schlauch- und Kabeltrommeln. Es ist jedoch von Fall zu Fall zu prüfen und festzulegen, ob weitere Sicherheitsmaßnahmen für die jeweilige Anwendung und den Betrieb erforderlich sind, in die das Personal entsprechend einzuweisen ist.

Darüber hinaus ist dem Personal, in deren Aufgabenbereich der Einsatz dieser Trommeln fällt, eine Kopie der Sicherheitsrichtlinien auszuhändigen. Weitere Kopien dieser Richtlinien sind auf Anfrage erhältlich. Für Vollständigkeit und Richtigkeit der Angaben in diesen Richtlinien übernimmt Hannay Reels keine Haftung.

Vor dem Auspacken der Trommeln sind die entsprechenden Bedie nungsanleitungen und Sicherheitsvorschriften zu lesen. Wenn UNKLARHEITEN zur sicheren Montage und zum Einsatz der Trommeln bestehen, nehmen Sie bitte mit Hannay Reels, Abt. Kundenservice oder mit. Ihrer zuständigen Vertretung Kontakt auf.

ANMERKUNG

Hannay Reels übernimmt keine Haftung für Umbauten und/oder Veränderungen an gelieferten Trommeln oder Produkten sowie für deren Einsatz abweichend zur ursprünglichen Bestimmung. Jegliche Haftung, ob direkt oder indirekt ausgesprochen, wird durch solche Maßnahmen null und nichtig.

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ACHTUNG: VERLETZUNGSGEFAHR

VORSICHT BEI ARBEITEN IM BEREICH VON KETTE UND ZAHNRÄDERN.

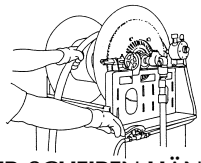
Ist ein Kettenschutz Bestandteil der Lieferung, sind die Trommeln nicht ohne diesen in Betrieb zu nehmen.

ANMERKUNG:
Die Vorschriften der Berufsgenossenschaft besagen, daß ein ausreichender Schutz von Ketten und Zahnrädern zumindest teilweise in der Verantwort-lichkeit des Betreibers liegt, da die Ausrüstung in unterschiedlichsten Lagen und Zugänglichkeiten zum Bedienungspersonal montiert werden kann.

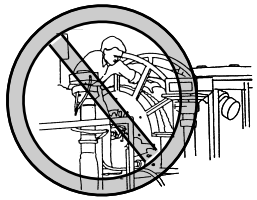
Bitte vergewissern Sie sich, daß der ausreichende Schutz bei der Montage der Trommeln genügend Beachtung findet.

VORSICHT BEI RÜCKFÜHRUNG DES SCHLAUCHS ODER KABELS AUF DIE TROMMEL.

Die Hand zur Rückführung des Schlauchs auf die Trommel nicht zu nah an die Trommel halten, damit die Finger nicht eingeklemmt oder abgeschnürt werden können. Setzen Sie Ausrüstung zum persönlichen Schutz ein.



BEIM DREHEN DER SCHEIBEN HÄNDE AUSSER REICHWEITE DER SPEICHEN HALTEN.

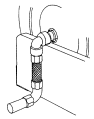


VORSCHRIFTEN ZUM SICHEREN UMGANG MIT FLÜSSIGKEITEN

NUR FÜR DIE ANWENDUNG AUSREICHEND BEMESSENE SCHLAUCHTROMMELN UND SCHLÄUCHE EINSETZEN.

Der für die Trommel oder den Schlauch angegebene Druck darf **in keinem Fall** überschritten werden. Darüber hinaus ist sicherzustellen, daß die Größe und der Werkstoff sowohl von der Trommel als auch vom Schlauch für die jeweilige Anwendung geeignet sind.

ZWISCHEN DREHGELENK UND SCHLAUCHANSCHLUSS IST EIN FLEXIBLES VERBINDUNGSSTÜCK EINZUSETZEN.



VOR EINSATZ SIND DIE PRODUKTANSCHLÜSSE AUF DICHTHEIT ZU PRÜFEN.

VOR DEMONTAGE VON ARMATUREN ODER WARTUNGS-ARBEITEN IST DER AM SCHLAUCH ANLIEGENDEN DRUCK ZU ENTSPANNEN.

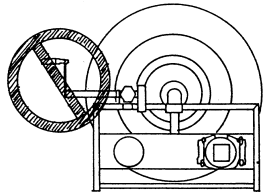
VOR AUFROLLEN EINES FLACHSCHLAUCHS AUF DIE SICH IM EINSATZ BEFINDLICHE TROMMEL, IST DAS GESAMTE MEDIUM ABZULASSEN.

TROMMELN MIT MOTORRÜCKSPULUNG

BEI TROMMELN MIT ELEKTROMOTORISCHER RÜCKSPULUNG SIND SICHERUNGEN EINZUSETZEN.

Es ist sicherzustellen, daß die Sicherung für den Motor ausreichend bemessen ist. Darüber hinaus sind vor dem Einschalten alle elektrischen Verbindungen auf einen ordnungsgemäßen Einbau zu prüfen.

VOR EINSCHALTEN DER MOTORISCHEN RÜCKSPULUNG IST DIE HANDKURBEL ZU ENTFERNEN.



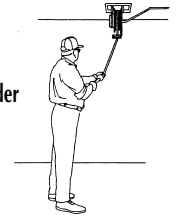
VOR WARTUNGSARBEITEN IST DIE STROMZUFUHR ZU UNTERBRECHEN.

Dies gilt sowohl für Trommeln mit Elektro- als auch mit Druckluftmotor. Die Stromzufuhr ist auch vor Demontage des Deckels der Verteilerdose und des Gehäuses des Kollektorrings zu unterbrechen.

TROMMELN MIT FEDERRÜCKSPULUNG

VORSICHT BEI SPERRKLINKE DES SPERRZAHNRADES AUSSER EINGRIFF.

Wenn die Sperrklinke außer Eingriff ist, muß der Schlauch oder das Kabel beim Rückspulen auf die Trommel gehalten und geführt werden.



BEI TROMMELN MIT FEDERRÜCKSPULUNG DARF DER DECKEL VOM FEDERGEHÄUSE NICHT GEÖFFNET WERDEN.

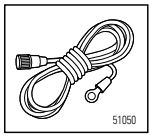
Aufgewickelte Federn stehen unter Spannung und die Entfernung des Deckels kann zu gefährlichen Körperverletzungen führen.

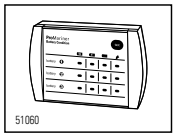
Specifications

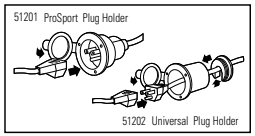
model	part no.	volts	amps	banks	cable size	size H x W x D	weight	AC in
ProTournament 100	51010	12/24	10	2	6'/6'	3"x 11.5" x 6 7/8"	6 lbs	90-270
ProTournament 150	51015	12/24/36	15	3	6'/6'/6'	3"x 13" x 6 7/8"	8 lbs	90-135*
ProTournament 150L	51016	12/24/36	15	3	12'/9'/9'	3"x 13" x 6 7/8"	9 lbs	90-135*
ProTournament 200	51020	12/24	20	2	6'/6'	3"x 13" x 6 7/8"	9 lbs	90-135*
ProTournament 300	51030	12/24/36	30	3	6'/6'/6'	3"x 15.5" x 6 7/8"	10 lbs	90-135*
ProTournament 300L	51031	12/24/36	30	3	12'/9'/9'	3"x 15.5" x 6 7/8"	11 lbs	90-135*
ProTournament 300Quad	51034	12/24/36	30	4	12'/9'/9'/9'	3"x 17" x 6 7/8"	12 lbs	90-135*

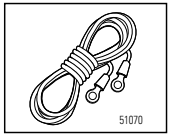
*Internal selection 180 - 270 VAC

Optional Accessories









model	part no.	cable size	volts	banks
ProTournament Remote Temperature Sensor*	51050	10'	n/a	n/a
Remote Battery Bank Status Monitor	51060	10'	12	3
ProTournament AC Plug Holder (white)	51200	n/a	n/a	n/a
ProTournament AC Plug Holder (black)	51201	n/a	n/a	n/a
Universal AC Plug Holder (black)	51202	n/a	n/a	n/a
Universal AC Plug Holder (white)	51203	n/a	n/a	n/a
Battery Bank Cable Extender	51070	9'	n/a	n/a

*not available for ProTournament100 & ProTournament200

To Place an Order Please Contact Your Local Dealer or ProMariner at:
Tel: 603-433-4440 / Fax: 603-433-4442 / www.pmariner.com

Personal Safety Precautions Continued

Never smoke or allow a spark or a flame in the vicinity of a battery or engine.

Be extra cautious to reduce risk of dropping a metal tool onto a battery. It may spark or short-circuit the battery or other electrical parts that may cause explosion.

Remove all personal metal items such as rings, bracelets, necklaces, watches, and jewelry when working near a battery. A battery can produce a short circuit high enough to weld a ring or any metal, causing serious burns.

Use the ProTournament for charging lead acid batteries only. It is not intended to supply low voltage electrical systems other than in a marine application. Do not use the battery charger to charge dry cell batteries that are commonly used with home appliances. These batteries may burst and cause injury to persons and property.

Never charge a frozen battery.

Safety Precautions Prior to Charging Batteries

If necessary to remove a battery from a boat to charge, always remove grounded terminal from battery first. Make sure all accessories in the boat are off, as to not cause an arc.

Be sure the area around the charger and batteries is well ventilated while the batteries are being charged. Gases can be forcefully blown away using a piece of cardboard or other nonmetallic material as a fan.

Clean battery terminals with full eye protection to prevent corrosion from coming in contact with eyes.

Add distilled water in each cell until electrolyte reaches levels specified by the battery manufacturer. This helps purge excessive gases from cells. Do not overfill. For batteries without caps, carefully follow manufacturer's recharging instructions.

Study all manufacturer's specific precautions, such as removing or not removing cell caps while charging, in addition to rates of charge.

Extension cords should be industrial grade / heavy duty U.L. approved and grounded. Check extension cord before use for damage, bent prongs, and cuts. Replace if damaged.

Always make your extension cord connection on the charger side first. After connecting the extension cord to the charger then proceed to plug the extension cord to a nearby 120VAC GFCI protected (Ground Fault Circuit Interrupt) outlet.

Always remove the extension cord from the 120VAC outlet first when charging is completed followed by unplugging the charger.

General Overview

The ProTournament is an Professional Grade 3 Step Marine Battery Charger that is pre-wired for easy installation and is 100% waterproof for all fresh and salt water applications.

The ProTournament's rugged all aluminum case is designed for superior heat dissipation, and corrosion resistance. The ProTournament is not filled with epoxy and is completely serviceable for a lifetime of use. Our advanced electronic technology yields a compact charger that is typically half the height and weight of leading traditional chargers. In addition the ProTournament will charge your batteries to 100% 2 times faster than leading traditional linear chargers without shutting off prematurely.

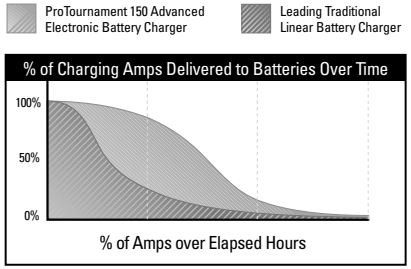
Unlike most traditional linear chargers that under perform when low AC power cord voltage is present as sometimes seen with use of extension cords at docks, lodging sites or at home. The ProTournament series will provide 100% of its charging output even with AC power cord voltage as low as 90VAC.

The ProTournament's "Distributed On-Demand™ 3 Step Charging" technology provides completely isolated charging outputs that will automatically sense and distribute its full rated charging output of 10, 15, or 30 amps (model specific) to any one bank or combination of all banks.

Easy to use at a glance LED indicators will provide you with the charge status of each battery as well as what mode the charger is operating in.

The ProTournament is available in 3 models and can be used in 12, 24, and 36 volt configurations without rewiring or switching. Just attach the output cable terminals as illustrated in the installation section of this manual.

The ProTournament has been designed to give you and your batteries a lifetime of professional performance.



Faster Charging

100% Charge Guaranteed

ProMariner's advanced electronic technology will deliver 2 times the amps to your batteries in the same amount of time when compared to leading traditional linear chargers. That means the ProTournament will charge your batteries twice as fast.

Trouble Shooting Guide

No Red or Green LED Indicator

Check for loss of AC power at the 120VAC Outlet. Confirm GFCI (Ground Fault Circuit Interrupter) has not tripped. Check with a meter or 120VAC test light that AC is present at the end or your extension cord.

Confirm all charger cables are installed with the correct polarity connections at each battery and that all connections are clean and tight.

With the AC power removed and the engine off check the charge level of each battery with on-board "Push-to-Test" feature as described on page 5. If there is no charge level indication for a battery, check each battery with a hydrometer to determine if it has one or more bad cells. (batteries should always be replaced in sets, and always the same type.)

If everything above checks out ok, contact ProMariner for product service.

Battery is Not Charging, Red and Green Indicator is "on"

Confirm all charger cables are installed with the correct polarity connections at each battery, and that all connections are clean and tight. *Reverse polarity connections will blow output fuse, resutling in no output voltage.*

With the charger on, read DC Voltage at each battery. If any of the readings are less than 13.0VDC Proceed with the following:

A. Disconnect AC power at the 120VAC outlet.

B. Remove charger cables from each battery.

C. Reconnect AC power and read DC Voltage across each output cable, if output voltage is approximately 14.5VDC the charger is ok and each battery should be tested with a hydrometer with the charger and engine off to determine if one or more batteries have bad cells. (batteries should always be replaced in sets, and always the same type.)

D. If there is no output when trying to read DC voltage check each output fuse and replace as needed.

If the DC voltage at each charger output there is less than 14.0 volts contact ProMariner for product service.

Owner's Periodic Maintenance Guide

Item:	Battery Connections
Process:	Clean and tighten all battery connections. Follow battery manufacturer's instructions for cleaning a battery. Clean all battery terminals with a wire brush where required and tighten all battery connections.
When:	Monthly

Item:	Battery Electrolyte
Process:	Per battery manufactures instructions monitor and maintain proper levels of distilled water in each battery.
When:	Monthly

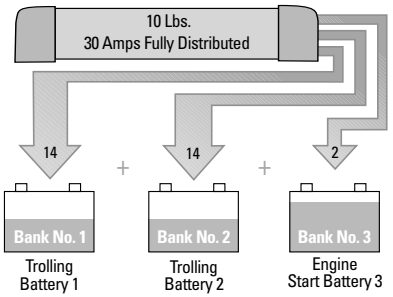
Item:	ProTournament DC Output Wiring
Process:	Visually inspect all wiring for cuts and abrasions. Contact ProMariner if charger needs to be serviced with new wiring.
When:	Monthly

Item:	AC Power Cord and Mounting Hardware Inspection
Process:	Process: Visually inspect the AC power cord. Confirm ground blade is present and all plug blades are in good conditions and not bent out of place. Check all mounting hardware to ensure there is no loose hardware. Tighten were required.
When:	Monthly

ProTournament Charger vs. Leading Traditional Linear Charger

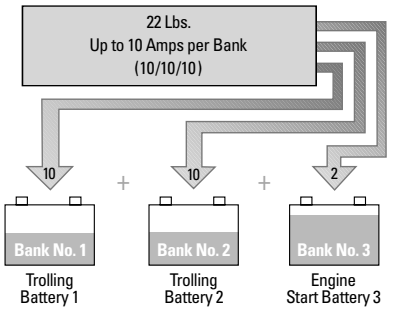
ProTournament's "Distributed On-Demand™ Charging" will automatically distribute its full rated output of 10, 15, 20 or 30 amps (model specific) to any one bank or combination of all battery banks. ProTournament distributes and uses every charging amp with no waste unlike other 2 and 3 bank chargers with an amp limit per bank.

Distributed On-Demand™ 3 Step Charging Output



ProMariner's Distributed On-Demand™ Charging technology ensures 100% of the ProTournament 300's 30 amps is fully utilized. The 8 amps not required by the engine start battery is automatically Distributed On-Demand™ to trolling motor batteries #1 and #2.

Typical Leading Competitive Charging Output



Competitive chargers have an amp limitation per bank as illustrated. The 30 amp (10/10/10) charger only delivers 22 amps. The 8 amps not used by the engine start battery can not be shifted to battery #1 or battery #2.

Note: Above illustration reflects typical battery usage after a day of fishing. Trolling motor batteries are 50% discharged and not usable. Engine start battery is 80% charged from the engine charging system.

General Operation

Install your ProTournament Professional Grade 3 Step Marine Battery Charger to the guidelines in this manual.

Make sure your charger and batteries are properly vented. Connect your extension cord with no AC Power present to the ProTournament and proceed to plug your extension cord in at a nearby 120 VAC GFCI protected (Ground Fault Circuit Interrupt) outlet.

With your ProTournament plugged in properly, it will automatically charges your batteries to 100% while it conditions and extends the life of your batteries. When you're at home always leave your charger plugged in to reduce sulfate build-up allowing your batteries to be maintained at 100% charge for your next fishing trip.

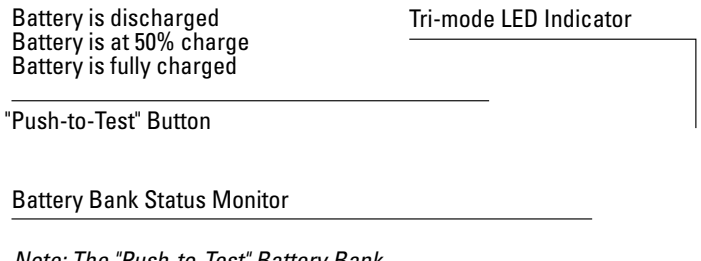
Push-to-Test Battery Bank Status Monitor and Operation

The ProTournament has been designed to provide the information you need when you're on the water, at the dock, lodging site or home. **This feature is only available on ProTournament 150, 300 and 300Quad.**

To use the "Push-to-Test" Battery Bank Status Monitor, AC power must not be present and the engine must be off.

With the AC power removed from the charger and the engine off, simply push the highly visible (yellow) "Push-to-Test" button located on the front of the ProTournament. While holding the "Push-to-Test" button view the relative charge status of each of the batteries connected.

Each battery bank has 3 (green) LED indicators to indicate the following:



Note: The "Push-to-Test" Battery Bank Status Monitor can only be used when AC power is removed and engine is off. ***This feature is only available on ProTournament 150, 300 and 300Quad.***

Note: When only using one battery connect output 1, output 2, and output 3 red wires to the positive side of the battery, and connect the black or yellow ground wires to the negative side of the battery. Not recommended for ProTournament300 or 300Quad

If only two batteries are used connect the unused output cable as instructed above to either one of the two batteries.

Always connect each charger output to a single 12V battery even if the batteries are wired series for 24V or 36V.

Charging Batteries

The ProTournament Series is designed to charge your batteries 2 times faster than leading traditional chargers. "Distributed-On-Demand™ 3 Step Charging" will not only provide you with a significantly faster charging process it will ensure your batteries are charged to 100% while it conditions and extends the life of each battery.

1. Open all battery compartments and ventilate for at least 15 minutes before applying AC power to your charger.

2. Make sure all DC battery connections are tight and clean. Follow battery manufacturer's recommendations for battery cell caps. (loosen caps if applicable)

3. Connect a heavy duty U.L. approved extension cord to the ProTournament charger first. After connecting the extension cord to the charger then proceed to plug the extension cord to a nearby 120VAC GFCI protected (Ground Fault Circuit Interrupt) outlet.

4. Observe the on-board mode LED for a solid red, flashing red indication. This will tell you what mode your charger is in.

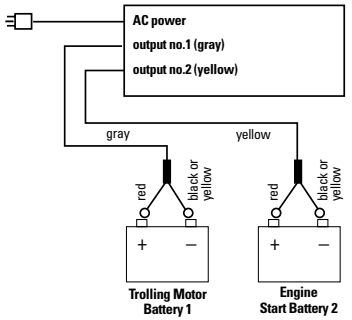
5. Charge your batteries until the tri-mode LED is solid green. This indicates the charging process is completed and your batteries are 100% charged and are being maintained in a gentle float / storage mode. (recommended while your boat is not in use).
The ProTournament can be left on in this mode indefinitely and will never overcharge your batteries. *Refer to the page 5.*

6. When ready to use your boat, unplug the extension cord from the 120VAC outlet first, followed by unplugging the charger.

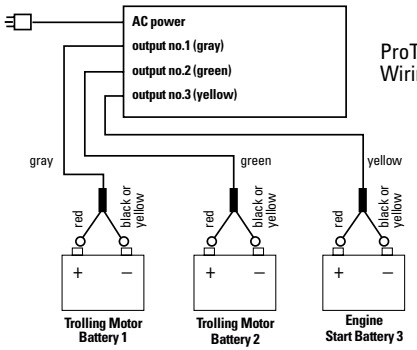
Battery Charge Level Status

With the AC power removed and the engine off, view the front panel of the ProTournament Battery Charger and simply hold down the "Push-to-Test" (yellow) button and observe the charge level indicators for each battery. *Refer to the page 5.*

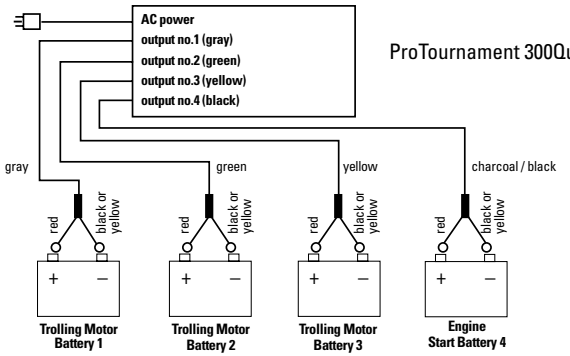
ProTournament Series Wiring Diagrams



ProTournament 100 and 200 Wiring Diagram



ProTournament 150 and 300 Wiring Diagram



ProTournament 300Quad

Charge Mode Indicator and Operation

When the ProTournament Marine Battery Charger is activated the on-board tri-mode LED indicator will illuminate as follows for each step of charging:

Step 1: Fast Charge – Solid Red Indicator

During this mode the on-board tri-mode indicator will be a solid red indicating fast charge.

The charger will deliver its maximum amperage rating to the connected batteries for the fastest charge (current regulation mode) until battery voltage is raised to 14.6 volts (lead acid factory setting). At this time the ProTournament will shift to:

Step 2: Absorption Charge - Flashing Red Indicator or Continued Solid Red for ProTournament100 and 200

During this mode the on-board tri-mode indicator will be flashing red indicating absorption charge.

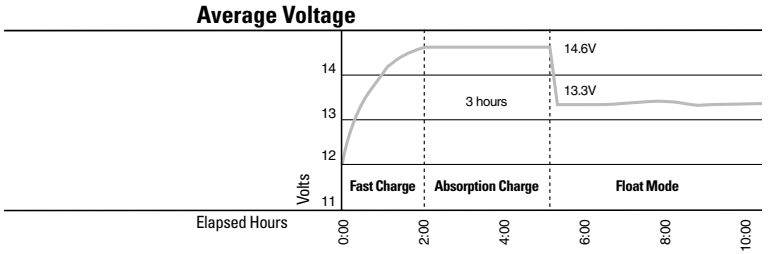
This mode maximizes charge and holds voltage at 14.6 volts (lead acid factory setting) for 3 hours (voltage regulation mode) while letting the batteries determine the amount of amps they can accept. This mode creates activity in the batteries reducing sulfate buildup and conditions batteries for extended life. After approximately 3 hours has elapsed the ProTournament will shift to:

Step 3: Float Mode - Solid Green Indicator

During this mode the on-board tri-mode indicator will be solid green indicating float mode.

A precision 13.3 volts (lead acid factory setting) finishing voltage that maintains each battery (step down voltage regulation mode) which is perfect for short or long storage periods and will never overcharge your batteries.

Note: If the tri-mode LED indicator is not on at all this may be an indication of a short or a faulty battery on one of the banks.



Installation

All ProTournament Battery Chargers are designed to be permanently mounted on-board, and can be mounted at any angle.

Do NOT mix battery types on-board. All batteries should be of the same age and in good operating condition.

Do NOT make any electrical connections to the ProTournament or batteries until the following steps are completed:

11 Easy to follow installation steps:

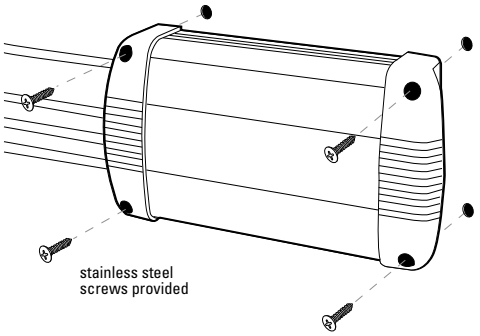
1. Select a mounting location that allows for ventilation any time the charger is used. Open all battery and engine compartments and ventilate for at least 15 minutes before starting the installation of the ProTournament charger.

2. Make sure the selected mounting location allows for a minimum of 6 inches of free space around front and sides of the ProTournament charger. Be sure to place the ProTournament in an accessible area where all indicators are viewable. Confirm all battery cables can reach each of the batteries.

3. Using the ProTournament as a template use a small awl or screwdriver to mark the position of each mounting hole.

4. Using a 1/8" drill bit, drill pilot holes in the (4) marked locations as described in step 3. Apply a silicon sealer in each of the mounting locations to waterproof the screw holes.

5. Position the ProTournament over the mounting holes and using a power screwdriver install the (4) stainless screws provided.



IMPORTANT NOTICE
Confirm the surface you will be mounting the charger to is adequate in strength and thickness to hold the ProTournament in place with stainless steel screws provided.

Installation Continued

6. Prepare each battery in advance by cleaning each terminal post with a wire brush until a shiny surface is obtained.

IMPORTANT NOTICE
As you prepare to attach the positive (red) and negative (yellow or black wires) to the batteries there will be brief low power spark that is generated as you make the connection. This is due to the high frequency capacitors taking a charge. Make sure the (black or yellow) wires are connected as illustrated to the negative side of the battery and the red wires are connected to the positive side or the battery.

7. Run your cables free from sharp objects and hold each of them in place with the cable ties provided. Coil excess cable, do not cut or shorten the length of the cables as there are inline fuses located 4 inches from the end of each red (positive) cable. These fuses are in place to protect wiring in the event of a short.

8. Connect the DC output cables as illustrated on page 9. Make sure the (black or yellow) wires are connected as illustrated to the negative side of the battery and the red wires are connected to the positive side of the battery.

Note: Make sure output no. 1 (gray position) on the charger and output cable is always connected to the most used trolling motor.

9. Make sure all DC connections are tight and correct.

10. Locate the AC power cord in an open-air area of your boat at least 21 inches from the charger, batteries and fuel fill lines.

11. Connect a heavy duty U.L. approved extension cord to the ProTournament charger first. After connecting the extension cord to the charger then proceed to plug the extension cord to a nearby 120VAC GFCI protected (Ground Fault Circuit Interrupt) outlet. Always remove the extension cord from the 120VAC outlet first when charging is completed, followed by unplugging the charger.

You are now connected and charging your batteries. View the indicators on your ProTournament. Assuming your batteries are discharged you should observe a solid red LED indicating the Step 1 Fast Charge Mode.

IMPORTANT NOTICE
For internal selectable modes, REF: Gel Cell, AGM or 180 to 270VAC operation. Please contact ProMariner directly at 1-800-824-0524 for factory assistance.

WARN® ATV WINCH

LIMITED LIFETIME WARRANTY FOR MECHANICAL COMPONENTS
LIMITED ONE (1) YEAR WARRANTY FOR ELECTRICAL COMPONENTS

Warn Industries, Inc. (WARN) warrants to the original purchaser that (a) the mechanical components of the "WARN" ATV Winch will be free of defects in material and workmanship for the lifetime of the winch, and (b) the electrical components will be free of defects in material and workmanship for a period of one (1) year from the original date of purchase. This Warranty applies only to the original purchaser of the winch. To obtain any warranty service, you must provide WARN with proof of purchase and date of purchase acceptable to WARN, such as a copy of your purchase receipt. This warranty does not cover the removal or reinstallation of the winch. WARN will, at its option, repair, replace or refund the purchase price of a defective winch or component, provided you return the defective winch or component during the warranty period, transportation charges prepaid, to Warn Industries' Service Department or a Factory Authorized Service Center. Attach your name, address, telephone number, a description of the problem, and a copy of your receipt and original bill of sale bearing the WARN serial number of the defective winch and date of purchase.

This warranty does not apply (i) to finish and wire rope and synthetic rope, or (ii) if the winch has been damaged by accident, abuse, misuse, collision, overloading, modification, misapplication, improper installation, or improper service. This warranty is void if any WARN serial number has been removed or defaced. Commercial or industrial use or application, or any hoisting application of the winch voids the warranty.

THE WARRANTY SET FORTH ABOVE IS THE ONLY WARRANTY. THERE ARE NO OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

ANY IMPLIED WARRANTY WHICH BY LAW MAY NOT BE EXCLUDED IS LIMITED IN DURATION TO ONE (1) YEAR FROM THE DATE OF ORIGINAL RETAIL PURCHASE OF THE PRODUCT.

No WARN dealer, agent or employee is authorized to make any modification, extension or addition to this warranty.

WARN SHALL NOT BE LIABLE FOR SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, LOST PROFITS, DOWN TIME OR LOSS OF USE) UNDER ANY LEGAL THEORY, EVEN IF WARN WAS ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

Some states do not allow the exclusion of implied warranties or the exclusion or limitation of liability for incidental or consequential damages, or limitations on how long an implied warranty lasts, so the above limitation or exclusion may not apply to you. This warranty gives you specific legal rights. You may also have other rights that vary from state to state.

WARN reserves the right to change Product design without notice. In situations in which WARN has changed a Product design, WARN shall have no obligation to upgrade or otherwise modify previously manufactured Products.

Warranty inquiries within the U.S.A. and Canada should be directed to the address below or visit www.warn.com for a complete list of WARN Authorized Service Centers.

For warranty inquiries outside the U.S.A. and Canada, contact your local dealer/distributor.

For countries not covered by a local dealer/distributor, please contact us at www.warn.com.

WARN INDUSTRIES, INC
Customer Service Department
12900 SE Capps Road
Clackamas, OR 97015
1-800-543-WARN (1-800-543-9276)
www.warn.com

Products Covered By This Warranty
ATV Winch Products

Products Not Covered By This Warranty
Finish and wire rope for ATV Winch Products
Synthetic Rope

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TREUIL POUR ATV WARN®

GARANTIE À VIE LIMITÉE POUR LES COMPOSANTS MÉCANIQUES
GARANTIE LIMITÉE D'UN (1) AN POUR LES COMPOSANTS ÉLECTRIQUES

Warn Industries, Inc. (WARN) garantit à l'acheteur initial les composants mécaniques et électriques des produits WARN spécifiés ci-dessous contre tout défaut de matière première ou vice de fabrication pendant une période d'un an à partir de la date d'achat initiale. Cette garantie ne s'applique qu'a l'acheteur initial des produits. Pour bénéficier du service de garantie, vous devez présenter à WARN une preuve d'achat et une date d'achat acceptables pour Warn, par exemple une copie de la facture d'achat. Cette garantie ne couvre pas le retrait ou la réinstallation du produit. WARN pourra, à son choix, réparer, remplacer ou rembourser le prix d'achat d'un produit ou composant défectueux, à condition que le produit ou composant défectueux soit renvoyé, en port payé, durant la période de garantie, au service entretien et réparations de Warn Industries ou à un centre de service agréé par l'usine. Veuillez joindre vos nom, adresse et numéro de téléphone, une description du problème ainsi qu'une copie du reçu et de la facture d'achat d'origine indiquant le numéro de série WARN du produit défectueux et la date d'achat.

Cette garantie ne s'applique pas pour (i) les pièces ou composants exclus ci-dessous, câble synthétique, ou (ii) au cas où le produit a été endommagé pour cause d'accident, abus, mauvaise utilisation, collision, surcharge, modification, mauvaise application, mauvaise installation ou mauvais entretien. Cette garantie est nulle si l'un des numéros de série de WARN a été supprimé ou oblitéré. Toute utilisation ou application commerciale ou industrielle, ou toute application de levage du produit annulera la garantie.

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Pour toute demande concernant la garantie aux États-Unis ou au Canada, correspondre à l'adresse ci-dessous ou visiter le site www.warn.com pour une liste complète des centres de services agréés WARN.

Pour toute demande concernant la garantie à l'extérieur des États-Unis ou du Canada, contacter le concessionnaire ou distributeur local.

Pour les pays qui ne sont pas couverts par un concessionnaire ou distributeur local, prière de nous contacter à partir du site www.warn.com.

WARN INDUSTRIES, INC
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12900 SE Capps Road
Clackamas, OR 97015
1-800-543-WARN (1-800-543-9276)
1-503-722-3005 International Fax
www.warn.com

Produits couverts par la garantie
Produits pour treuil de quad

Produits non couverts par la garantie
Finition et câble d'acier pour produits pour treuil de quad
Câble synthétique

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CABRESTANTE WARN® PARA VEHÍCULOS TODOTERRENO

GARANTÍA LIMITADA DE POR VIDA PARA LOS COMPONENTES MECÁNICOS

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The Basic Guide to Winching Techniques

Every winching situation has the potential for personal injury. In order to minimize that risk, it is important that you read this Basic Guide carefully, familiarize yourself with the operation of your winch before having to use it, and be constantly safety oriented. In this Guide, we will set forth many of the basic rules of safe winch operation. However, because every winching situation is different, your constant good judgment and consistent focus on safety are of great importance.

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75013 Rev A2

As you read these instructions, you will see WARNINGS, CAUTIONS, NOTICES and NOTES. Each message has a specific purpose. WARNINGS are safety messages that indicate a potentially hazardous situation, which, if not avoided could result in serious injury or death. CAUTIONS are safety messages that indicate a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. A CAUTION may also be used to alert against unsafe practice. CAUTIONS and WARNINGS identify the hazard, indicate how to avoid hazard, and advise of the probable consequence of not avoiding the hazard. NOTICES are messages to avoid property damage. NOTES are additional information to help you complete a procedure. **PLEASE WORK SAFELY!**

WARNING

MOVING PARTS ENTANGLEMENT HAZARD

Failure to observe these instructions could lead to severe injury or death.

To avoid injury to hands or fingers.

- **Always** keep hands clear of rope, hook loop, hook and fairlead opening during installation, operation, and when spooling in or out.
- **Always** use extreme caution when handling hook and rope during spooling operations.
- **Always** use supplied hook strap whenever spooling rope in or out, during installation and during operation.
- **Always** keep vehicle in sight during winching operation.
- **Always** wear heavy leather gloves when handling rope.

WARNING

CHEMICAL AND FIRE HAZARD

Failure to observe these instructions could lead to severe injury or death.

- **Always** remove jewelry and wear eye protection.
- **Never** lean over battery while making connections.
- **Always** verify area is clear of fuel lines, fuel tank, brake lines, electrical wires, etc. when drilling.
- **Never** route electrical cables:
  - Across any sharp edges.
  - Through or near moving parts.
  - Near parts that become hot.
- **Always** insulate and protect all exposed wiring and electrical terminals.
- **Always** install terminal boots as directed in installation instructions.

WARNING

FALLING OR CRUSHING HAZARD

Failure to observe these instructions could lead to severe injury or death.

- **Never** use winch to lift or move persons.
- **Never** use winch as a hoist or to suspend a load.
- **Never** operate winch with less than 5 wraps of rope around the drum. Rope could come loose from the drum, as the rope attachment to the drum is not designed to hold a load.

CAUTION

MOVING PARTS ENTANGLEMENT HAZARD

Failure to observe these instructions could lead to minor or moderate injury.

General Safety:

- **Always** Know Your Winch. Take time to fully read the Installation and Operations Guide, and Basic Guide to Winching Techniques, in order to understand your winch and its operation.
- **Never** operate this winch if you are under 16 years of age.
- **Never** operate this winch when under the influence of drugs, alcohol or medication.
- **Never** exceed winch or rope capacity listed on product data sheet. Double line using a snatch block to reduce winch load.
- **Never** use winch or rope for towing.

Installation Safety:

- **Always** choose a mounting location that is sufficiently strong to withstand the maximum pulling capacity of your winch.
- **Always** use factory approved mounting hardware, components, and accessories.
- **Always** use grade 5 (grade 8.8 metric) or better hardware.
- **Never** weld mounting bolts.
- **Always** use care when using longer bolts than those supplied from factory. Bolts that are too long can damage the base and/or prevent the winch from being mounted securely.
- **Always** mount the winch and attach the hook to the rope's end loop before connecting the electrical wiring.
- **Always** position fairlead with WARNING label on top.
- **Always** spool the rope onto the drum in the direction specified by the winch warning label on the winch and/or documentation. This is required for the automatic brake (if so equiped) to function properly.
- **Always** prestretch rope and respool under load before use. Tightly wound rope reduces chances of "binding", which can damage the rope.

CAUTION

MOVING PARTS ENTANGLEMENT HAZARD

Failure to observe these instructions could lead to minor or moderate injury.

Winching Safety:

- **Always** inspect rope, hook, and slings before operating winch. Frayed, kinked or damaged rope must be replaced immediately. Damaged components must be replaced before operation. Protect parts from damage.
- **Never** leave wired remote control plugged into winch when free spooling, rigging, or when the winch is not being used.
- **Never** hook rope back onto itself. This damages the rope.
- **Always** use a choker chain, choker rope, or tree trunk protector on the anchor.
- **Always** remove any element or obstacle that may interfere with safe operation of the winch.
- **Always** take time to use appropriate rigging techniques for a winch pull.
- **Always** be certain the anchor you select will withstand the load and the strap or chain will not slip.
- **Never** engage or disengage clutch if winch is under load, rope is in tension or drum is moving.
- **Always** select an anchor point as far away as possible. This will provide the winch with its greatest pulling power.
- **Never** touch rope or hook while in tension or under load.
- **Never** touch rope or hook while someone else is at the control switch or during winching operation.
- **Always** stand clear of rope and load and keep others away while winching.
- **Always** be aware of stability of vehicle and load during winching, keep others away. Alert all bystanders of any unstable condition.
- **Never** use a winch to secure a load.

CAUTION

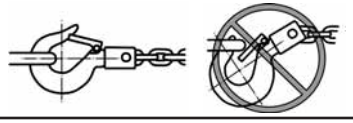
MOVING PARTS ENTANGLEMENT HAZARD

Failure to observe these instructions could lead to minor or moderate injury.

Winching Safety:

- **Always** keep wired remote control lead clear of the drum, rope, and rigging. Inspect for cracks, pinches, frayed wires or loose connections. Replace remote control if damaged.
- **Always** pass wired remote control through a window to avoid pinching lead in door, when using remote inside a vehicle.
- **Never** leave remote control where it can be activated during free spooling, rigging, or when the winch is not being used.
- **Always** require operators and bystanders to be aware of vehicle and or load.

CAUTION



MOVING PARTS ENTANGLEMENT HAZARD

Failure to observe these instructions could lead to minor or moderate injury.

- **Always** use a hook with a latch.
- **Always** ensure hook latch is closed and not supporting load.
- **Never** apply load to hook tip or latch. Apply load only to the center of hook.
- **Never** use a hook whose throat opening has increased, or whose tip is bent or twisted.

CAUTION

CUT AND BURN HAZARD

Failure to observe these instructions could lead to minor or moderate injury.

To avoid injury to hands or fingers:

- **Always** wear heavy leather gloves when handling a rope.
- **Never** let rope slip through your hands.
- **Always** be aware of possible hot surface at winch motor, drum or rope during or after winch use.

NOTICE

AVOID WINCH AND EQUIPMENT DAMAGE

- **Always** avoid side pulls which can pile up rope at one end of the drum. This can damage rope or winch.
- **Always** ensure the clutch is fully engaged or disengaged.
- **Never** use winch to tow other vehicles or objects. Shock loads can momentarily exceed capacity of rope and winch.
- **Always** avoid "powering out" rope for extended distances. This causes excess heat and wear on the winch motor and brake.
- **Always** use care to not damage the vehicle frame when anchoring to a vehicle during a winching operation.
- **Never** "jog" rope under load. Shock loads can momentarily exceed capacity of rope and winch.
- **Never** use winch to secure a load during transport.
- **Never** submerge winch in water.
- **Always** store the remote control in a protected, clean, dry area.
- **Always** double line or pick distant anchor point when rigging. This maximizes pulling power and avoids overloading the winch.

ELECTRIC WINCH BASICS

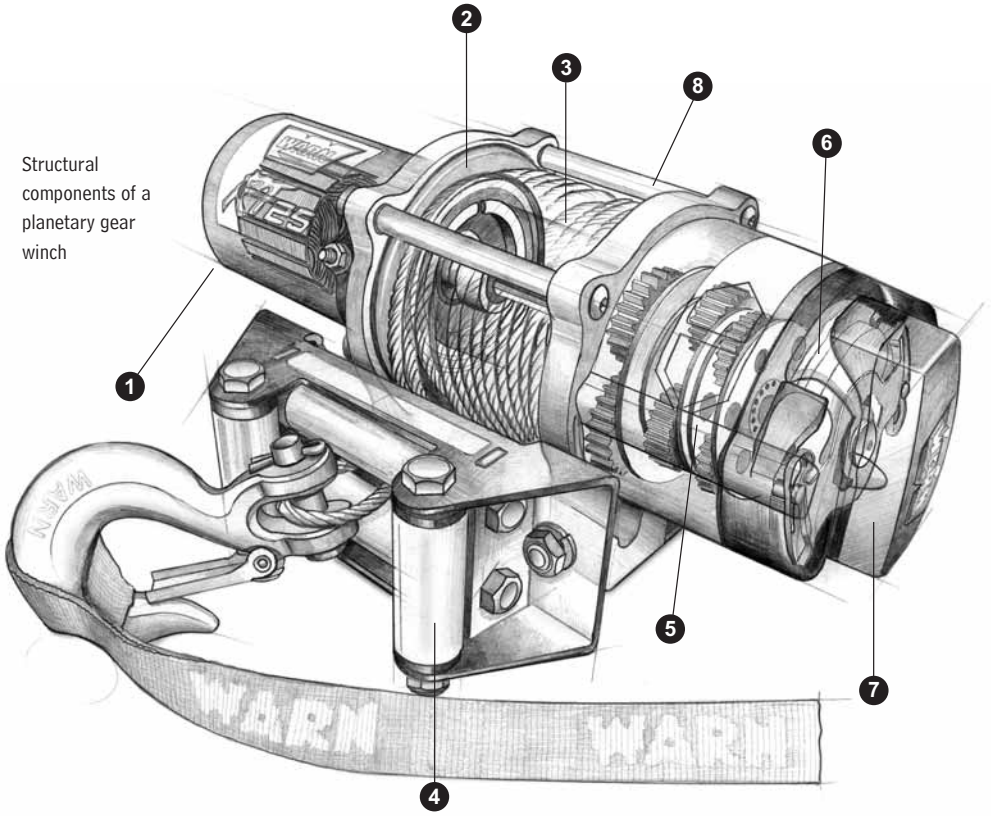
⚠ WARNING
Never operate or install a winch without reading or understanding the operator's manual

So, you have your Warn winch and you're ready to get out on the trails: climb a few boulders, splash a little mud, traverse the occasional stream. Basically, you're ready to explore the backcountry and otherwise have a great time.

Well, if you're smart enough to go prepared with the best, you're probably smart enough to know that to keep having a great time, you need to fully understand your winch and the winching operation.

That's exactly what this guide intends to do: provide you with a basic understanding of your winch and teach you the basics of proper winching techniques. But before we get started, we must emphasize that the information in this guide is general in nature. Because no two situations are alike, it would be nearly impossible to review them all. We can, however, provide you with the general principles and techniques. Then it is up to you to take the time to analyze the situation and apply the proper technique.

Along with a little common sense, the guidelines laid out in this book can help you keep off-roading fun. Just remember to think through each situation before you act and TREAD LIGHTLY!



Structural components of a planetary gear winch

Remote Control Switch

Handheld Wireless Remote Control

Rocker Switch

To start, you should familiarize yourself with your Warn winch and each of its components: Practice using your winch before using it on the trail.

1 Motor Typically the winch motor is powered by the vehicle's battery. The motor provides power to the gear mechanism, which turns the winch drum and winds the rope.

2 Winch Drum The winch drum is the cylinder onto which the rope feeds. The drum is driven by the motor and drive train. Its direction can be changed using the winch switch.

3 Wire / Synthetic Rope The rope's diameter and length are determined by the winch's load capacity and design. Wrapped around the winch drum and fed through the fairlead, the rope is looped at the end to accept the hook's clevis pin.

4 Fairlead When using the winch at an angle, the fairlead (or wire lead) acts to guide the rope onto the spooling drum. It minimizes damage to the rope while it goes through the winch mount or bumper.

5 Gear Train The reduction gear converts the winch motor power into a large pulling force. The gear train design makes it possible for the winch to be lighter and more compact.

6 Braking System Braking action is automatically applied to the winch drum when the winch motor is stopped and there is load on the rope. The braking action is applied by the motor or a separate mechanical brake, depending on the winch construction.

7 Clutch The clutch allows the operator to manually disengage the spooling drum from the gear train, enabling the drum to rotate freely (known as "freespooling"). Engaging the clutch "locks" the winch drum back onto the gear train.

8 Tie Rods Ties the end housings together as a structural unit.

Winch controls come in many forms. All enable the operator to start, stop and change the direction of the winch drum rotation.

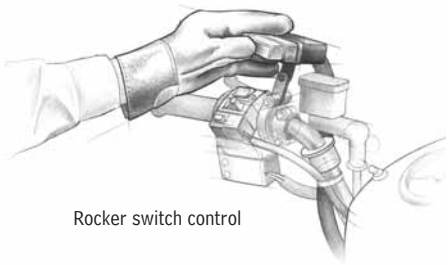
⚠ CAUTION
Never engage or disengage the clutch if winch is under load, rope is in tension, or rope drum is moving.

HOW THE WINCH WORKS

Winch Mechanics

Now that you've familiarized yourself with your Warn winch and its components, we can begin reviewing how it works. The major advantage of an electric-powered winch is that it can provide reliable service for intermittent utility and recreational use even while the vehicle's engine is stalled — assuming, of course, that sufficient battery current is available. Your winch can operate at high current loads, and, for this reason, uses a high current switch system to safely handle the current flow.

It is important to understand that the longer the pull, the more heat that is created, just like a hot plate. Powering out the rope also generates heat and drains the electrical system. Whenever possible, unwind rope by "freespooling." Prolonged winching without cooling the winch motor will damage the motor. Also, even if the engine is idling during winching, the battery may drain faster than it is charging. So pay close attention to make sure you aren't draining your battery too low to start your vehicle.



Rocker switch control

Control Of Your Winch

The winch is controlled by a switch mechanism that provides control of the forward or reverse rotation of the spooling drum.

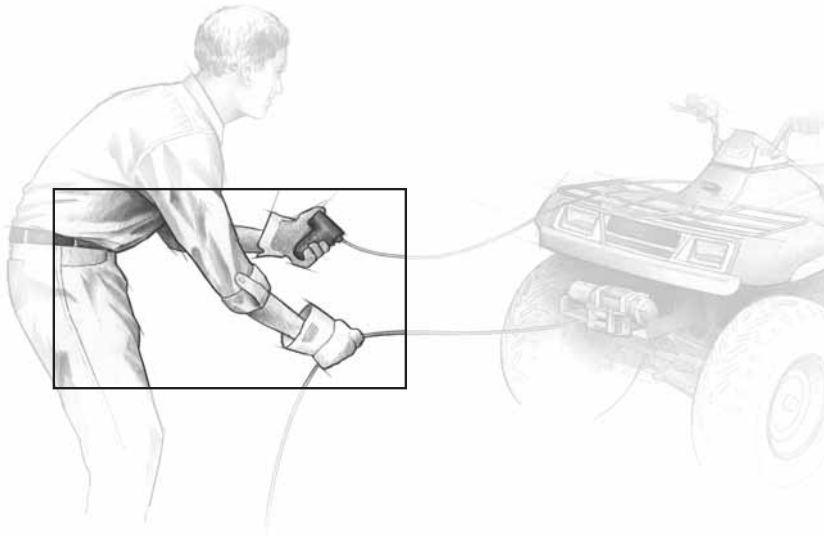
How the Winch Reacts to Load

Warn winches are rated by pulling capacity. The maximum pulling capacity occurs on the first layer of rope on the drum. As the layers increase, the pulling power decreases. It's the mathematics of winching. Exceeding the winch capacity could cause the winch to fail or the rope to break. Thinking through how you intend to use your winch now, could save you a big headache later.

In addition, you'll also want to make sure that your winch's mounting system and your vehicle's frame can accommodate the rated load of your winch.

⚠ WARNING

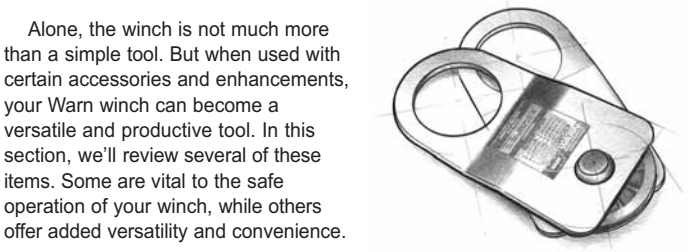
Always keep vehicle in sight during winching operation.



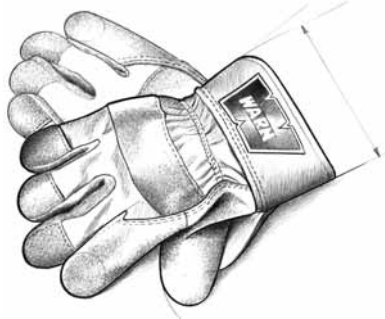
This winch is controlled by the hand held remote control to allow the operator to stand clear during the winching process.

WINCH ACCESSORIES YOU'LL WANT TO HAVE WITH YOU

Alone, the winch is not much more than a simple tool. But when used with certain accessories and enhancements, your Warn winch can become a versatile and productive tool. In this section, we'll review several of these items. Some are vital to the safe operation of your winch, while others offer added versatility and convenience.

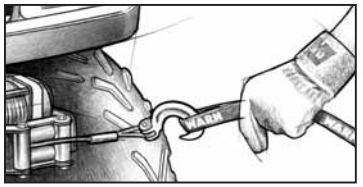


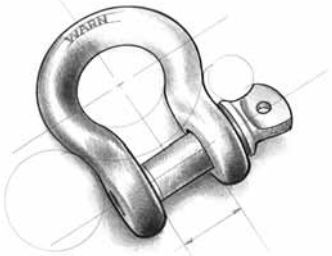
Snatch Block Used properly, the multi-purpose snatch block allows you to: (1) increase your winch's pulling power; and (2) change your pulling direction without damaging the rope. Proper use of the snatch block is covered in "Before You Pull".



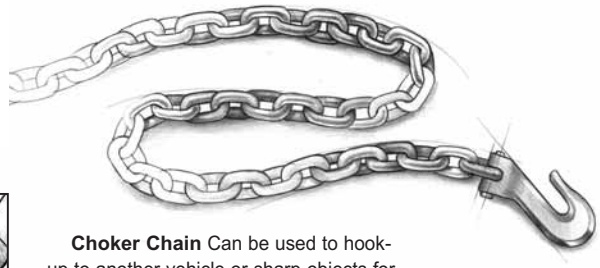
Gloves rope, through use, will develop "barbs" which can slice skin. It is extremely important to wear protective gloves while operating the winch or handling the rope. Avoid loose fitting clothes or anything that could become entangled in the rope and other moving parts.

Hook Strap Use to hold the hook and keep fingers away from the fairlead as the rope is being spooled in. Winches develop tremendous pulling forces and can easily remove fingers and limbs that are placed in pinch points. Put the hook into the loop and hold the strap between the thumb and forefingers.

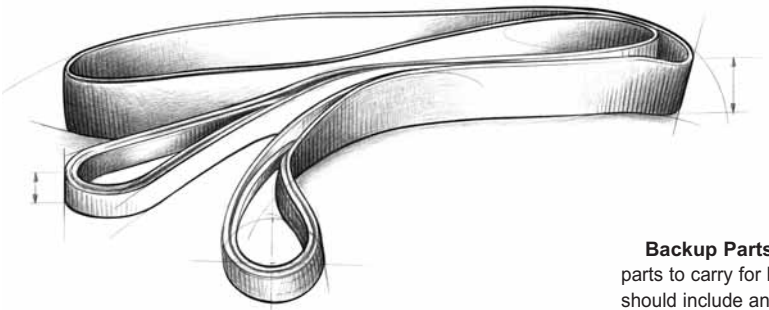




Clevis/D-Shackles The D-Shackle is a safe means for connecting the looped ends of cables, straps and snatch blocks. The shackle's pin is threaded to allow easy removal.



Choker Chain Can be used to hook-up to another vehicle or sharp objects for an anchor point. Chains, however, will damage or kill trees.



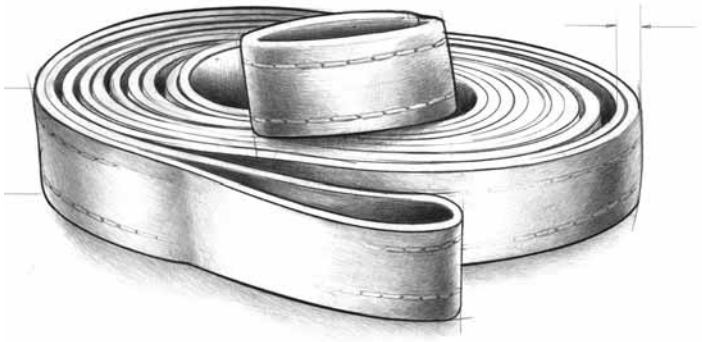
Tree Trunk Protector Typically made of tough, high-quality nylon, it provides the operator an attachment point for the winch rope to a wide variety of anchor points and objects, as well as protect living trees.

Backup Parts Important backup parts to carry for backcountry travel should include an extra screw-pin shackle, snatch block, and remote control unit. For severe and continued winch use, consider including an extra rope and winch hook.

Toolbox Items Items to bring along include hand wrenches, screwdrivers, pliers and tools to change rope.

⚠ CAUTION

Never attach a recovery strap to the winch hook to increase the length of a pull. Never attempt to tow a vehicle or object with the recovery strap attached directly to the winch hook. Never use "bungie" straps that develop tremendous and potentially dangerous amounts of force when stretched.



Recovery Strap Never use a recovery strap in a winching operation. Because it is designed to stretch, it stores energy and could react like a rubber band should your rigging fail. Use the recovery strap to "snatch" out a stuck vehicle.

Shovels & Hand Tools Quite often during winching activities, you'll find yourself in need of some additional help. You may want to carry equipment such as a shovel and an axe.

Battery Recommendations A fully charged conventional ATV battery is recommended to obtain peak performance from your winch. Make sure all electrical connections are clean and tight.

STRETCHING WIRE ROPE

The life of a wire rope is directly related to the use and care it receives. Tensioning the wire rope is critical to ensure a long product life. Tensioning the wire rope will prevent outer layers of wire rope from pinching and deforming the inner layers. During its first use, a new wire rope must be spooled onto its drum under a load of at least **500 lbs**. (227 kgs). Use the following instructions to properly stretch the wire rope onto the winch drum.

1) Choose a **FLAT AND LEVEL** location that is large enough to run out the entire length of wire rope.

2) Turn the clutch lever on the winch to the "Free Spool" position. Grab hook strap and spool out the wire rope to the last 5 wraps on the drum. Once the wire rope is spooled out, turn the clutch lever on the winch to the "Engaged" position.

3) Attach the hook end of the rope to a suitable anchor point and back the vehicle away from the anchor point until there is very little slack in the wire rope. Before getting out of the vehicle, set the parking brake, place the vehicle in gear or park and turn the vehicle off.

4) Power in the winch until all of the wire rope slack is wound onto the winch drum. Wearing gloves, hold tension on the wire rope with one hand; carefully push the wire rope to the side of the drum the wire rope is attached to so there are no gaps between each coil on the drum. Be sure to check that the wire rope is winding off of the bottom of the drum, not the top, or the automatic load holding brake will not function properly. (If the wire rope is winding off the top you have powered the winch "out" instead of "in").

5) The following steps should be done using two people for proper safety. If you attempt to tension your wire rope alone be sure to always engage the parking brake, place the transmission in gear and turn the vehicle off every time you exit the vehicle to inspect the winch wire rope. Never exit the vehicle with a load on the winch wire rope.

6) Use care to evenly wrap each layer to prevent damage to the rope.

7) Instruct your assistant to stand to the side of the vehicle and away from the winch wire rope. Start the vehicle and place the transmission in neutral. Release the parking brake while applying moderate brake pedal pressure. Press power in on the switch. Your assistant should signal you if the wire rope is winding correctly by watching it move across the fairlead as the wire rope is powered in. After winching in for approximately 6 ft, stop winching. Slowly let up off of the brake pedal and then apply the parking brake. This will ensure that there is no load on the winch rope. Then place the transmission in park or gear and turn the vehicle off. Exit the vehicle and inspect the winch to make sure that the wire rope is being evenly wound onto the winch drum and not sinking into the lower layer. If the wire rope is sinking, power the wire rope out and repeat this step from the beginning with more brake pedal pressure.

8) When you are convinced the wire rope is winding onto the winch drum properly, repeat step 6 until the vehicle is within 3 ft of the winch anchor. Once within 3 ft, slowly let up off of the brake pedal and then apply the parking brake. This will ensure that there is no load on the winch wire rope. Then place the transmission in park or in gear and turn the vehicle off. Exit the vehicle. Disconnect the hook from the anchor. While holding onto the supplied hook strap, hold tension on the winch rope and slowly power in the winch by "pulsing" the power in on the remote control until the hook is at the fairlead. **DO NOT POWER THE HOOK INTO THE FAIRLEAD.** This could cause damage to the fairlead.

⚠ WARNING

Never operate winch with less than 5 wraps of rope around the drum. Rope could come loose from the drum, as the rope attachment to the drum is not designed to hold a load.

BEFORE YOU PULL

⚠ WARNING
Never use the winch as a hoist.

⚠ WARNING
Always use supplied hook strap to hold hook when spooling rope in or out.

⚠ CAUTION
Never attempt to disengage the clutch while rope is under tension. Never engage the clutch while the drum is rotating. Always make sure the clutch is fully engaged or disengaged.

⚠ WARNING
Always keep hands and clothing clear of the rope, hook and fairlead opening during operation and when spooling.

Practice using your winch before you get stuck. A real situation is no time to be learning how to use your winch.

Whether you're recovering another vehicle or pulling a stump from the ground, knowing the proper winching techniques can help keep you and others around you safe. And perhaps the most important part of the winching process, regardless of the situation, is what you do before you pull.

In this section, we'll show you the basic fundamentals for effective winching. However, it is up to you to analyze the situation and make the decisions necessary for the proper use of your winch. Apply your knowledge of your winch and the basic fundamentals you've practiced and adjust your techniques to your unique situation. Some keys to remember when using your Warn winch:

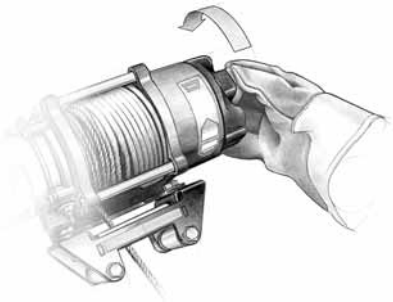
1. **Always take your time to assess your situation and plan your pull carefully.**
2. **Always take your time when using a winch.**
3. **Use the right equipment for your situation.**
4. **Always wear leather gloves and do not allow the rope to slide through your hands.**
5. **You and only you should handle the rope and operate the remote control switch.**
6. **Think safety at all times.**
7. **Practice. Practice and practice the steps.**

Single line pull

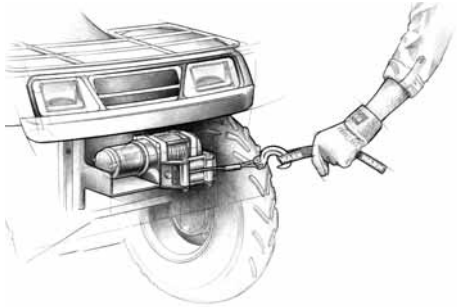
Rigging for the Pull

The following steps describe how to recover your vehicle with rigging a single line pull. Double or multiple line rigging techniques follow the same basic steps, but use a snatch block to assist the process.

Step 1: PUT ON GLOVES.



Step 2: DISENGAGE CLUTCH. To allow free spooling of the winch drum, rotate the clutch lever on the winch to Disengage. Freespooling conserves battery power.



Step 3: FREE THE WINCH HOOK AND ATTACH HOOK STRAP. Free the winch hook from its anchor point. Attach hook strap to the hook (if not attached).

Step 4: PULL ROPE TO ANCHOR POINT. Pull out enough rope to reach your anchor point. Be sure to keep a certain amount of tension in the wire. It can become twisted and overwrap when slackened, leading to rope damage. To prevent loosing the end, hold the winch hook in the hook strap while you work.

Step 5: SECURE TO THE ANCHOR POINT. Once you've established your anchor point, secure the tree trunk protector or choker chain around the object.

How to choose an anchor point:

An anchor point as far away as possible will provide the winch with its greatest pulling power. A secure anchor is critical to winching operations. An anchor must be strong enough to hold while winching. Natural anchors include trees, stumps, and rocks. Hook the cable as low as possible.

If no natural anchors are available, when recovering another vehicle, your vehicle becomes the anchor point. In this case, be sure to put the transmission in neutral, apply the hand brake and block its wheels to prevent your vehicle from moving.

Ideally, you'll want an anchor point that will enable you to pull straight in the direction the vehicle will move. This allows the rope to wind tightly and evenly onto the spooling drum.

Stakes driven in at an angle and tied together.

Buried log with chain secured around the log.

⚠ WARNING
Never operate winch with less than 5 wraps of rope around the drum. Rope could come loose from the drum, as the rope attachment to the drum is not designed to hold a load.

⚠ CAUTION
Never leave remote control plugged into winch while free spooling, rigging or sitting idle.

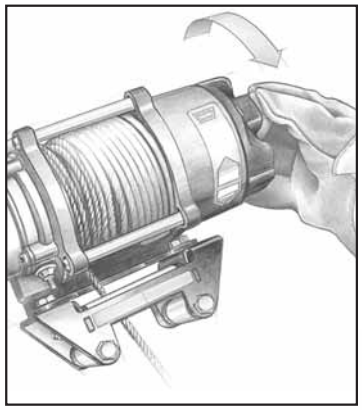
⚠ CAUTION
Never hook rope back onto itself. This damages the rope.

Step 6: ATTACH THE CLEVIS/D-SHACKLE AND HOOK STRAP. Attach the shackle to the two ends of the strap or chain and through the hook loop, being careful not to over tighten (tighten and back-off 1/2 turn).

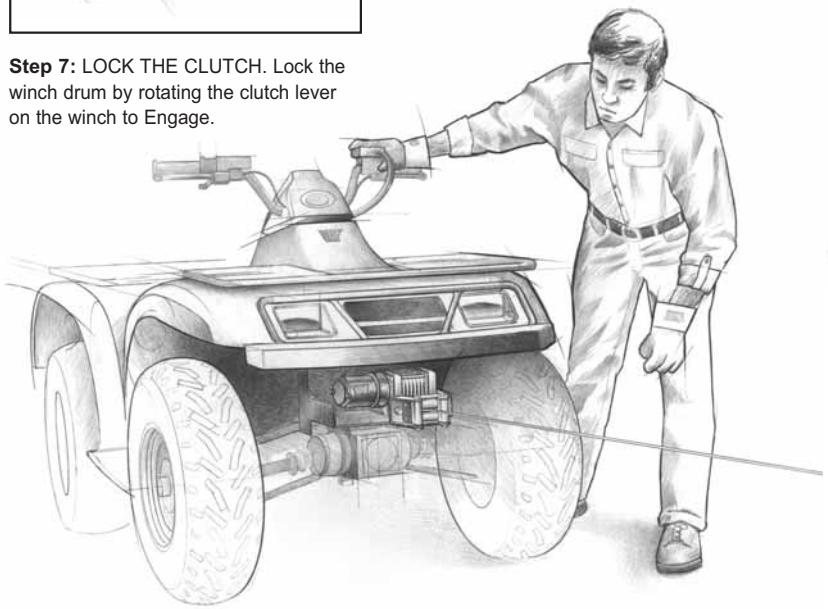
Step 8: CONNECT THE REMOTE CONTROL (if so equipped). Be careful not to let the remote control cord dangle in front of the winch.
Always disconnect the remote control when not in use.

Step 9: PUT ROPE UNDER TENSION. Using the winch switch, slowly wind the rope until no slack remains. Once the rope is under tension, stand well clear, and never step over it.

Step 10: CHECK YOUR ANCHOR. Make sure all connections are secured and free of debris before continuing with the winching procedure.



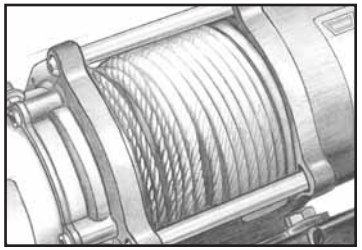
Step 7: LOCK THE CLUTCH. Lock the winch drum by rotating the clutch lever on the winch to Engage.



PULLING

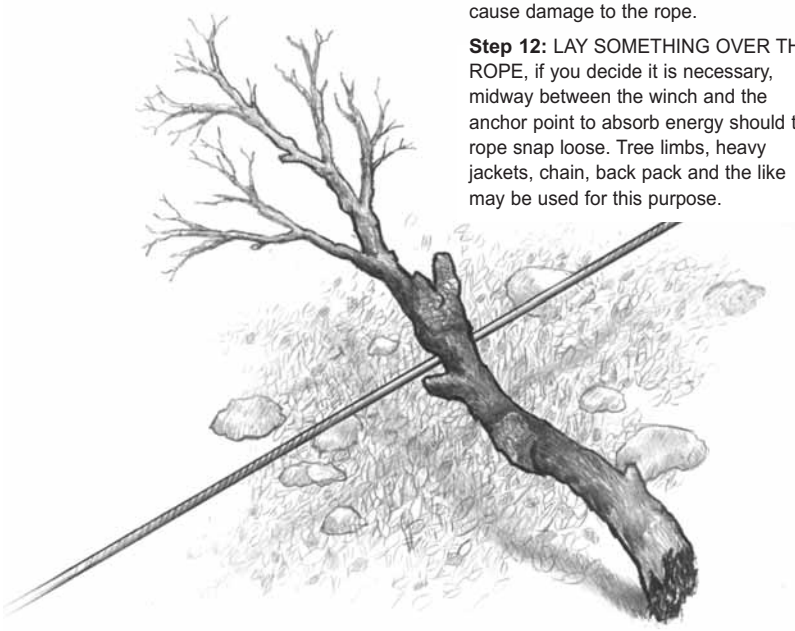
As you probably have already noticed, there are many things to do and consider before you actually begin pulling. Think through what you're doing and you can keep yourself and those around you out of harm's way.

Operating your winch properly is so important, in fact, you should practice these techniques before having to face the distractions and stresses of a real winching situation.



Step 11: CHECK ROPE. The rope should be neatly wound around the spooling drum. Improper winding can cause damage to the rope.

Step 12: LAY SOMETHING OVER THE ROPE, if you decide it is necessary, midway between the winch and the anchor point to absorb energy should the rope snap loose. Tree limbs, heavy jackets, chain, back pack and the like may be used for this purpose.



Run Time Guidelines for WARN ATV/UTV Winches

Load (lbs)	Run Time	Distance (ft)	Cool Time (min)
0	2.5 min	50	12
500	2.0 min	32	10
1000	1.0 min	14	10
1500	25 sec	5	10
2000	15 sec	2	10
2500	10 sec	1	10

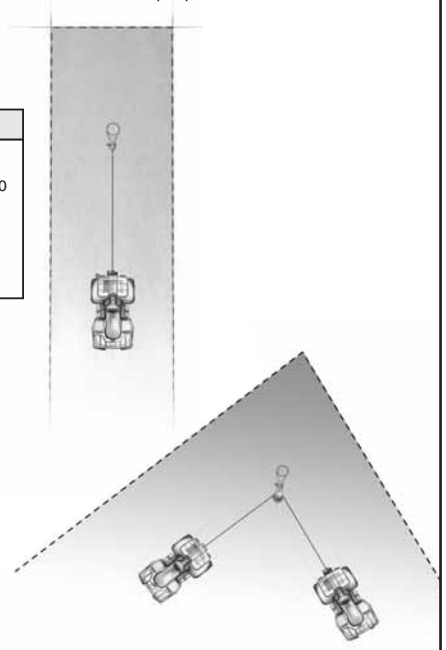
Duty cycles vary for each winch. See specification sheet supplied with your winch.

NOTICE

Avoid over-heating the winch motor. For extended winching, stop at reasonable intervals to allow the winch motor to cool down.

See table for run time guidelines.

Establish "no people" zones:



NOTICE

Never use the winch's rope to tow another vehicle or object.

Step 13: MAKE YOUR INTENTIONS CLEAR. Be sure that everyone in the immediate vicinity surrounding the winching operation is completely aware of your intentions before you pull.

Declare where the spectators should not stand — never behind or in front of the vehicle and never near the rope or snatch block. Your situation may have other "no people" zones.

Step 14: BEGIN WINCHING. With the winching vehicle's engine on and light tension already on the rope, begin winching slowly and steadily. Be sure that the rope is winding evenly and tightly around the spooling drum.

The vehicle may be steered while winching but not driven. Driving vehicle causes rope to become slack and entangled.

NOTICE

Always avoid continuous side pulls which can pile up rope at one end of the drum. This can damage rope or winch.

What to look for under load

The rope must always spool onto the drum on the side nearest the mounting plate as indicated by the warning label on the end of the winch motor.

As you power in, make sure the rope winds evenly and tightly on the drum. This prevents the outer wire wraps from drawing into the inner wraps, binding and damaging the rope.

Perform the pull with the vehicle transmission in neutral and the parking brake off. Be patient and let the winch do all the work. This prevents the vehicle from rolling back and causing a shock load that can damage the winch and rope.

During side pulls the rope tends to stack up at one end of the drum. This stack can become large enough to cause serious damage to the winch. So, line up pulls as straight ahead as possible and stop winching if the rope comes close to the tie rods or mounting plate. To fix an uneven stack, spool out that section of the rope and reposition it to the opposite end of the drum which will free up space for continued winching.

Step 15: FOR VEHICLE RECOVERY, continue pulling until the vehicle is on stable ground. If you are able to drive the vehicle, the winching operation is complete.

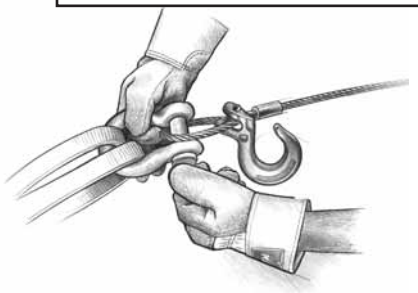
Step 16: SECURE VEHICLE. Once recovery of the vehicle is complete, be sure to secure the vehicle's brakes and put the Transmission in "park". Release tension in the rope.

How to spool under no load

Arrange the rope so it will not kink or tangle when spooled. Be sure any rope already on the spooling drum is wound tightly and evenly layered. Tighten and straighten the layer if necessary. Keep the rope under light tension and spool the rope back onto the winch drum in even layers one layer at a time. At the end of each layer stop spooling and arrange the rope in tight even layers.

Repeat this process until the winch hook is a minimum of 4 ft. (1.2m) from the winch. Pinch the hook between your thumb and forefinger and attach the hook strap. Hold the hook strap between the thumb and forefinger to keep tension on the rope. Walk the rope towards the fairlead, carefully spooling in the remaining rope by pulsing the control switch. Store the hook at the fairlead or tensioned to a suitable location to the side.

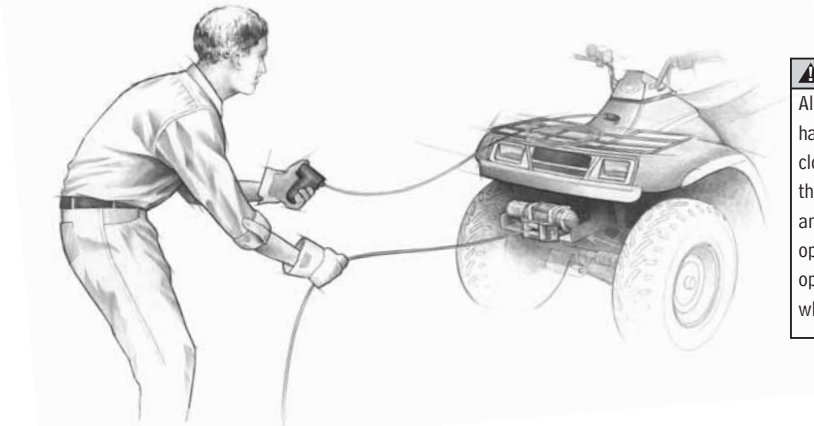
If you do not have the hook strap, use a length of cord or something similar. To prevent serious injury, NEVER put your fingers inside the hook area as you are powering in.



Step 17: DISCONNECT ROPE. Disconnect from the anchor.

Step 18: REWIND ROPE. The person handling the rope should walk the rope in and not let it slide through the hand and control the winch at all times.

Step 19: DISCONNECT REMOTE CONTROL. Disconnect the remote control cord and store in a clean and dry place. Winching operations are now complete. Put the cap on the socket.



⚠ WARNING

Always keep hands and clothing clear of the rope, hook and fairlead opening during operation and when spooling.

RIGGING TECHNIQUES

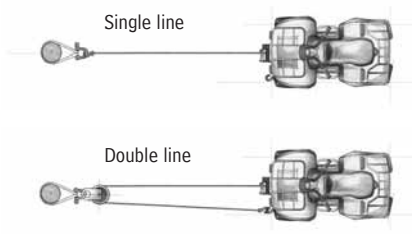
Various winching situations will require application of other winching techniques. These could range from too little distance to achieve maximum pull using straight line rigging, simply increasing pulling power, or maintaining a straight-line pulling situation. You will have to assess what technique is correct for your situation. Think “safety” at all times.

How to change the pulling direction

All winching operations should have a straight line from the winch to the object being pulled. This minimizes the rope collecting on one side of the drum affecting pulling efficiency and damaging rope. A snatch block, secured to a point directly in front of the vehicle, will enable you to change your pulling direction while still allowing the rope to be at 90º to wind properly onto the spooling drum.

Increasing pulling power & duration

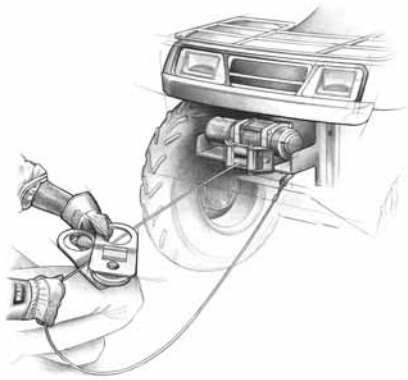
In some cases, you may find yourself needing more pulling power. The use of snatch blocks increases mechanical advantage and that increases your pulling power:



Double line

Because pulling power decreases with the number of layers of rope on the winch drum, you can use a snatch block to double line out more rope. This decreases the number of layers of rope on the drum, and increases pulling power.

Start by feeding out enough rope to free the winch hook. Attach the hook to your vehicle’s frame and run the rope through a snatch block. Do not attach hook to mounting kit.



Disengage the clutch and, using the snatch block, pull out enough wire to reach your anchor point.

Secure to the anchor point with a tree trunk protector or choker chain. Attach the clevis/shackle. Attach the shackle to the two ends of the strap/chain, being careful not to over tighten (tighten and back-off 1/2 turn).

MAINTENANCE

- Inspect the rope before and after each winching operation. If the rope has become kinked or frayed, the rope needs to be replaced immediately. Be sure to also inspect the winch hook and hook pin for signs of wear or damage. Replace if necessary.
- If your winch is equipped with synthetic rope, review and understand the Synthetic Rope Guide. Inspect rope carefully after each use.

  Replace if:
  (1) rope bulk anywhere along the length is reduced by 25% or more by abrasion, (2) two or more adjacent strands are cut, (3) flat areas or lumps are found that are not eliminated by flexing rope, or (4) excessive fused or melted fibers are found. Any such areas will be stiff and the rope will have a glazed appearance.
- Keep winch, rope, and switch control free from contaminants. Use a clean rag or towel to remove any dirt and debris. If necessary, unwind winch completely (leaving a minimum of 5 wraps on spooling drum), wipe clean, and rewind properly before storage. Using a light oil on the wire rope and winch hook can keep rust and corrosion from forming.
- Operating your winch for a long period of time places an extra burden on your vehicle’s battery. Be sure to check and maintain your battery and battery cables according to manufacturer guidelines. Also inspect switch control and all electrical connections to be certain they are clean and tight fitting.
- Inspect the remote control for damage, if so equipped. Be sure to cap the remote socket to prevent dirt and debris from entering the connections. Store remote control in a protected, clean, dry area.
- No lubrication is required for the life of the winch.

SUB-ZERO OPERATION

Freespooling of rope from the winch drum may be more difficult at sub-freezing temperatures. Place clutch in the freespool position and power out the rope for 2-3 m (6-10 ft) to warm the winch.

⚠ CAUTION

Lifting and lowering a snowplow can damage rope. Carefully inspect rope for wear, broken strands and/or kinks. Replace rope if any damage found.

STORAGE

When not being used, the winch should be left with the clutch in the engaged position. This helps the internal parts of the winch withstand the effects of weather and contamination.

THE FINAL ANALYSIS

The basic guide to proper winching techniques cannot cover all the possible situations in which you may need to use a winch. In the final analysis, the decisions you make will determine the final outcome. So think through each situation and each step of use. Always be mindful of your own safety and the safety of others. Pay attention and you’ll have fun.

⚠ WARNING

Never operate winch with less than 5 wraps of rope around the drum. Rope could come loose from the drum, as the rope attachment to the drum is not designed to hold a load.

Le manuel de base des techniques de treuillage

Chaque situation de treuillage peut potentiellement occasionner des blessures. Pour minimiser ce risque, il est important que vous lisiez ce guide de base avec attention, que vous vous familiarisiez avec le maniement du treuil avant de l'utiliser, et que vous vous préoccupiez avant tout de la sécurité. Nous exposons dans ce guide de nombreuses règles de sécurité fondamentales pour le maniement du treuil. Toutefois, comme chaque situation de treuillage est différente, le bon sens et l'attachement constant aux principes de sécurité sont d'une importance primordiale.

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75013 Rev A2

Les directives suivantes comprennent des indications intitulées AVERTISSEMENT, ATTENTION, AVIS et REMARQUE. Chacune a un objectif bien précis : AVERTISSEMENT présente des consignes de sécurité soulignant un danger potentiel qui, s'il n'est pas évité, peut entraîner des blessures graves ou la mort. ATTENTION comprend des consignes de sécurité signalant un danger potentiel qui, s'il n'est pas évité, peut entraîner des blessures légères ou modérées. ATTENTION sert aussi à signaler une utilisation dangereuse. ATTENTION et AVERTISSEMENT identifient un danger, indiquent comment l'éviter et montrent ses conséquences possibles si on l'ignore. AVIS présente des consignes visant à éviter les dommages matériels. REMARQUE donne des renseignements additionnels qui aident à accomplir une procédure. **TRAVAILLEZ PRUDEMMENT !**

AVERTISSEMENT

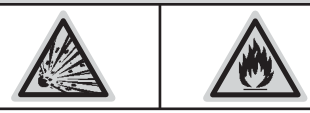
DANGER DE HAPPEMENT PAR DES PIÈCES MOBILES

Le non-respect des consignes peut entraîner des blessures graves ou la mort.

Pour éviter de se blesser les mains et les doigts:

- Toujours garder les mains éloignées du câble, de la boucle du crochet, du crochet et de l'ouverture du guide-câble durant l'installation et l'utilisation du treuil et l'enroulement ou le déroulement du câble.
- Toujours faire très attention en manipulant le crochet et le câble pendant les manœuvres de déroulement.
- Toujours utiliser le cordon du crochet fourni pour enrouler ou dérouler le câble, durant l'installation ou l'utilisation.
- Toujours garder l'œil sur le véhicule durant les opérations de treuillage.
- Toujours porter des gants de cuir épais durant la manipulation du câble.

AVERTISSEMENT



RISQUES ASSOCIÉS AUX PRODUITS CHIMIQUES ET RISQUE D'INCENDIE

Le non-respect des consignes peut entraîner des blessures graves ou la mort.

Toujours retirer les bijoux et porter des lunettes de sécurité.

- Ne jamais se pencher au-dessus de la batterie en procédant aux connexions.
- Avant de percer, toujours s'assurer que la zone ne contient pas de conduites de carburant, de réservoir de carburant, de conduites de frein, de câblage électrique, etc.
- Ne jamais faire passer des câbles électriques :
  -Sur des bords tranchants.
  -Par des pièces mobiles ou à proximité.
  -À proximité de pièces pouvant devenir chaudes.
- Toujours isoler et protéger tous les fils et bornes électriques exposés.
- Toujours installer les capuchons de borne de la manière indiquée dans les instructions d'installation.

AVERTISSEMENT

DANGER DE CHUTE OU D'ÉCRASEMENT

Le non-respect des consignes peut entraîner des blessures graves ou la mort.

- Ne jamais utiliser le treuil pour soulever ou transporter des personnes.
- Ne jamais utiliser le treuil comme palan ou pour suspendre une charge.
- Ne jamais utiliser le treuil avec moins de 5 spires de câble enroulées autour du tambour, car le câble pourrait se dérouler du tambour, étant donné que l'ancrage du câble n'est pas conçu pour retenir une charge.

ATTENTION

DANGER DE HAPPEMENT PAR DES PIÈCES MOBILES

Le non-respect des instructions peut entraîner des blessures mineures ou modérées.

- Toujours se familiariser avec le treuil. Prendre le temps de bien lire le manuel d'installation et le manuel de base des techniques de treuillage afin de comprendre l'appareil et son fonctionnement.
- Les personnes âgées de moins de 16 ans ne doivent jamais faire fonctionner cet appareil.
- Ne jamais faire fonctionner l'appareil sous l'effet de drogues, de l'alcool ou de médicaments.
- Ne jamais excéder la capacité nominale du treuil ou du câble d'acier indiquée sur la fiche technique du produit. Un câblage double avec poulie ouvrante permet de réduire la charge subie par le treuil.
- Ne jamais se servir du treuil ou du câble pour faire du remorquage.
- Toujours choisir une surface de montage suffisamment résistante pour supporter la capacité de traction maximale du treuil.
- Toujours utiliser du matériel de montage, des composants et des accessoires homologués par le fabricant.
- Toujours utiliser un matériel de montage de catégorie 55 (catégorie 8,8 métrique) ou supérieure.
- Ne jamais souder les boulons de montage.
- Toujours faire attention quand on utilise des boulons plus longs que ceux fournis par le fabricant. Des boulons trop longs peuvent endommager la base ou empêcher le treuil d'être monté de manière sûre.
- Toujours monter le treuil et fixer le crochet à la boucle d'extrémité du câble avant de raccorder le câblage électrique.
- Toujours positionner le guide-câble avec l'étiquette d'AVERTISSEMENT sur le dessus.
- Toujours enrouler le câble sur le tambour dans le sens spécifié par l'étiquette d'avertissement apposée sur le treuil ou la documentation du treuil. Cela est nécessaire pour que le frein automatique (le cas échéant) fonctionne correctement.
- Toujours étirer le câble au préalable et l'enrouler sous charge avant de l'utiliser. Un câble enroulé de manière serrée réduit le risque qu'il coince et soit endommagé.

ATTENTION

DANGER DE HAPPEMENT PAR DES PIÈCES MOBILES

Le non-respect des instructions peut entraîner des blessures mineures ou modérées.

- Toujours inspecter le câble, le crochet et les élingues avant de faire fonctionner le treuil. Tout câble effiloché, tordu ou endommagé doit être remplacé immédiatement. Tous les composants endommagés doivent être remplacés avant d'utiliser le produit. Protéger toutes les pièces contre le risque de dommages.
- Ne jamais laisser la télécommande branchée sur le treuil durant la mise en roue libre, le câblage ou quand le treuil n'est pas utilisé.
- Ne jamais accrocher le câble à lui-même. Cela l'endommagerait.
- Toujours utiliser une chaîne ou un câble à nœud coulant, ou une protection de tronc d'arbre sur le point d'ancrage.
- Toujours s'assurer que tous les obstacles potentiels sont écartés.
- Toujours prendre le temps d'utiliser les techniques de câblage appropriées avant de faire fonctionner le treuil.
- Toujours s'assurer que le point d'ancrage choisi peut supporter la charge et que la sangle ou la chaîne ne glisse pas.
- Ne jamais essayer d'embrayer ou de débrayer si le treuil est sous charge, si le câble est en tension ou si le tambour est en train de tourner.
- Toujours choisir un point d'ancrage aussi distant que possible. Cela assure au treuil une puissance de traction maximum.
- Ne jamais toucher le câble ou le crochet lorsque le câble est tendu ou sous charge.
- Ne jamais toucher le câble ou le crochet lorsqu'une autre personne manipule l'interrupteur de commande ou durant le fonctionnement du treuil.
- Toujours se tenir à l'écart du câble et de la charge et ne jamais laisser personne s'approcher durant l'utilisation.
- Toujours être conscient de la stabilité du véhicule et de la charge durant le treuillage. Veiller à ce que personne ne s'approche. Alerter toutes les personnes alentour en cas d'instabilité.
- Ne jamais se servir du treuil pour maintenir une charge.

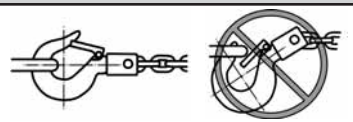
ATTENTION

DANGER DE HAPPEMENT PAR DES PIÈCES MOBILES

Le non-respect des instructions peut entraîner des blessures mineures ou modérées.

- Toujours garder le fil de la télécommande à l'écart du tambour, du câble et du câblage. S'assurer qu'il n'y a pas de fissures, de points de pincement, de fils effilochés ou de connexions desserrées. Remplacer la télécommande en cas de dommages.
- Si l'on manie la télécommande de l'intérieur d'un véhicule, toujours faire passer la télécommande par la fenêtre pour éviter de pincer le fil.
- Ne jamais laisser la télécommande dans un endroit où elle peut être activée durant la mise en roue libre, le câblage ou quand le treuil n'est pas utilisé.
- Toujours exiger de l'opérateur et des personnes présentes d'être conscients du véhicule et de la charge.

ATTENTION



DANGER DE HAPPEMENT PAR DES PIÈCES MOBILES

Le non-respect des instructions peut entraîner des blessures mineures ou modérées.

- Toujours utiliser un crochet avec loquet.
- Toujours s'assurer que le loquet du crochet est fermé et qu'il ne supporte aucune charge.
- Ne jamais appliquer la charge sur l'extrémité ou le loquet du crochet. Appliquer la charge uniquement au centre du crochet.
- Ne jamais utiliser un crochet dont l'ouverture de la gorge a augmenté ou dont l'extrémité est courbée ou tordue.

ATTENTION

RISQUE DE COUPURE ET DE BRÛLURE

Le non-respect des instructions peut entraîner des blessures mineures ou modérées.

Pour éviter de se blesser les mains et les doigts:

- Toujours porter des gants de cuir résistants durant la manipulation du câble.
- Ne jamais laisser le câble glisser dans les mains.
- Toujours penser aux surfaces chaudes au niveau du moteur du treuil, du tambour ou du câble durant ou après l'utilisation du treuil.

AVIS

ÉVITER D'ENDOMMAGER LE TREUIL ET L'ÉQUIPEMENT

- Toujours éviter de tirer sur le côté, ce qui a pour effet d'empiler le câble sur l'une des extrémités du tambour. Cela peut endommager le câble ou le treuil.
- Toujours s'assurer d'avoir complètement embrayé ou complètement débrayé.
- Ne jamais se servir du treuil pour remorquer d'autres véhicules ou objets. Les charges de choc peuvent momentanément dépasser de loin la capacité du câble et du treuil.
- Toujours éviter de dérouler le câble sur de grandes distances. Cela pourrait surchauffer et user le moteur du treuil et le frein.
- Toujours faire attention à ne pas endommager le cadre si l'on décide d'arrimer le véhicule pour pouvoir travailler avec le treuil.
- Ne jamais " secouer " le câble sous charge. Les charges de choc peuvent momentanément dépasser de loin la capacité du câble et du treuil.
- Ne jamais se servir du treuil pour maintenir une charge pendant le transport.
- Ne jamais submerger le treuil dans l'eau.
- Toujours ranger la télécommande dans un endroit sûr, propre et sec.
- Toujours utiliser une ligne double ou choisir un point d'ancrage distant pour le câblage. Cela optimise la puissance de traction et évite de surcharger le treuil.

DONNÉES ESSENTIELLES SUR LE TREUIL ÉLECTRIQUE

⚠ AVERTISSEMENT

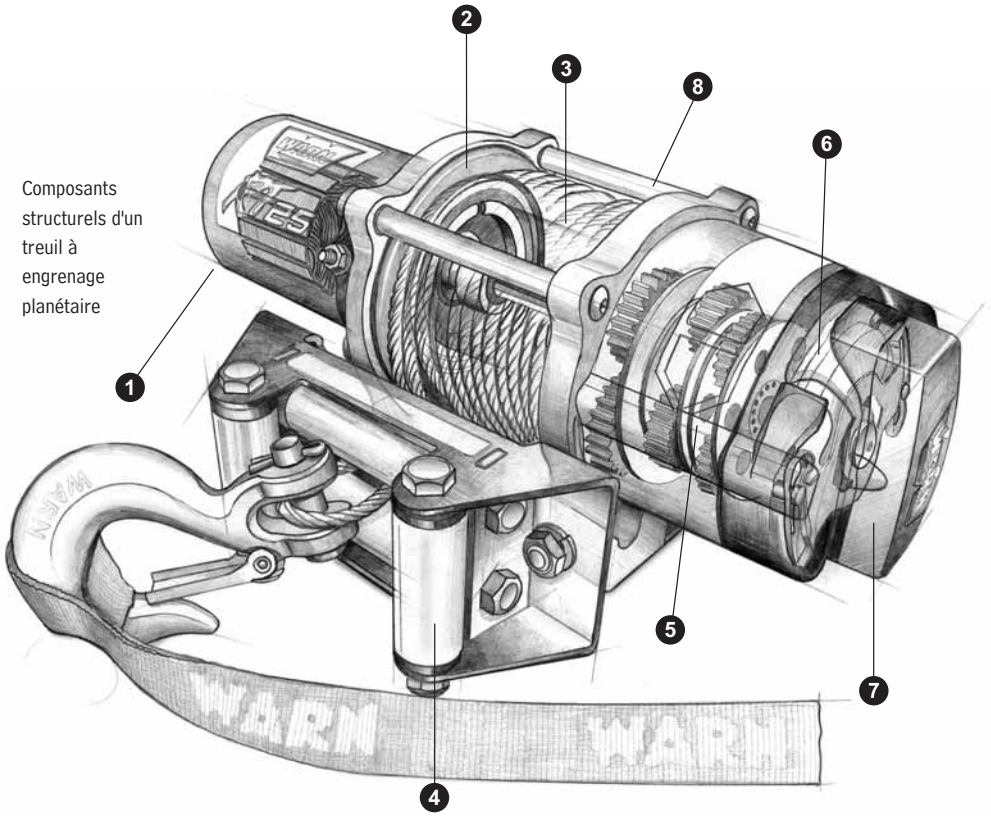
N'installez et ne faites jamais fonctionner un treuil sans avoir lu et compris le manuel de l'utilisateur.

Vous voilà propriétaire d'un treuil Warn et vous êtes prêt à partir sur les pistes : escalader quelques éboulis, faire gicler un peu de boue, traverser un cours d'eau occasionnel. En somme, vous êtes prêt à visiter l'arrière-pays et passer un bon moment.

Si vous avez été suffisamment brillant pour sélectionner le meilleur équipement qui soit, vous êtes sans doute suffisamment brillant pour savoir que pour continuer à passer un bon moment, vous devez pleinement comprendre et maîtriser le treuil et les techniques de treuillage.

C'est exactement l'objectif de ce guide : vous fournir une compréhension globale du treuil et vous enseigner les techniques de treuillage. Mais avant de commencer, nous devons souligner que les informations contenues dans ce guide sont de nature générale. Parce qu'il n'y a pas deux situations identiques, il serait pratiquement impossible de les examiner toutes en détail. Nous pouvons toutefois vous fournir les principes généraux et les techniques. Ce sera ensuite à vous de prendre le temps d'analyser la situation et d'appliquer la technique adéquate.

Avec un peu de bon sens, les règles exposées dans ce livre peuvent vous aider à conserver le plaisir de vos escapades dans la nature. Pensez juste à étudier chaque situation avant d'agir et ALLEZ-Y EN DOUCEUR!



Composants structurels d'un treuil à engrenage planétaire

Télécommande

Télécommande sans fil de poche

Interrupteur à bascule

Pour commencer, vous devez vous familiariser avec le treuil Warn et chacun de ses composants : Entraînez-vous avec le treuil avant de l'utiliser sur la piste.

1 Moteur Le moteur du treuil est typiquement alimenté par la batterie du véhicule. Le moteur fournit la puissance au système d'engrenages qui fait tourner le tambour et enroule le câble.

2 Le tambour du treuil Le tambour du treuil est le cylindre sur lequel le câble s'enroule. Le tambour est entraîné par le moteur et le train d'engrenages. Son sens peut être changé au moyen de la télécommande.

3 Câble d'acier / synthétique Le diamètre du câble et sa longueur sont déterminés par la structure et la puissance de traction du treuil. Enroulé autour du treuil, le câble passe par le guide-câble et se termine par une boucle pour la clavette de la manille.

4 Guide-câble Quand vous utilisez le treuil à un angle, le guide-câble permet de guider le câble sur le tambour. Il minimise les dommages sur le câble lorsqu'il traverse le support du treuil ou le pare-chocs.

5 Train d'engrenages L'engrenage de démultiplicateur convertit la puissance du moteur en une force de traction considérable. La conception du train d'engrenages permet au treuil d'être compact et léger.

6 Système de frein Le frein du tambour est automatiquement actionné lorsque le moteur du treuil est à l'arrêt et qu'il y a une charge sur le câble. L'action de freinage est appliquée par le moteur ou un frein mécanique séparé, selon le type de fabrication du treuil.

7 Embrayage L'embrayage permet à l'opérateur de dissocier manuellement le tambour du train d'engrenages, permettant au tambour de tourner librement (en « roue libre »). Le fait d'embrayer « verrouille » de nouveau le tambour au train d'engrenages.

8 Barres d'accouplement Elles lient ensemble les boîtiers d'extrémité pour constituer une même unité structurelle.

Les commandes de treuil sont très variées. Elles permettent toutes à l'opérateur de démarrer, d'arrêter et de changer le sens de rotation du tambour du treuil.

⚠ ATTENTION

N'essayez jamais d'embrayer ou de débrayer si le treuil est sous charge, si le câble est en tension ou si le tambour est en train de tourner.

COMMENT FONCTIONNE LE TREUIL

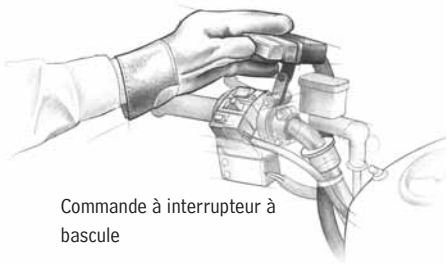
Le treuil d'un point de vue mécanique

Maintenant que vous vous êtes familiarisé avec le treuil Warn et ses composants, vous pouvez commencer à étudier son fonctionnement. L'avantage principal d'un treuil électrique est qu'il peut fournir un service stable pour une utilisation intermittente et récréationnelle, même si le moteur du véhicule est en panne – en supposant bien sûr qu'il y a suffisamment de courant dans la batterie. Le treuil peut opérer avec une intensité de courant importante, et, pour cette raison, le boîtier de contrôle dispose d'un système de contrôle de haute intensité pour gérer le courant en toute sécurité.

Il est important de comprendre que plus le treuillage est long, plus cela crée de la chaleur, exactement comme une plaque chauffante. Le déroulement du câble produit également de la chaleur et draine le système électrique. Dans la mesure du possible, déroulez le câble " en roue libre ". Un treuillage prolongé sans refroidir le moteur du treuil peut endommager celui-ci. De plus, si le moteur du véhicule tourne au ralenti pendant le treuillage, la batterie peut se décharger plus rapidement qu'elle ne se charge. Faîtes donc bien attention pour ne pas vider la batterie au point de ne plus pouvoir redémarrer le véhicule.

⚠ AVERTISSEMENT

Gardez toujours l'œil sur le véhicule durant les opérations de treuillage.



Commande à interrupteur à bascule

Contrôle du treuil

Le treuil est contrôlé par un mécanisme à interrupteur qui permet de contrôler la rotation en avant et en arrière du tambour.

Comment le treuil réagit aux charges

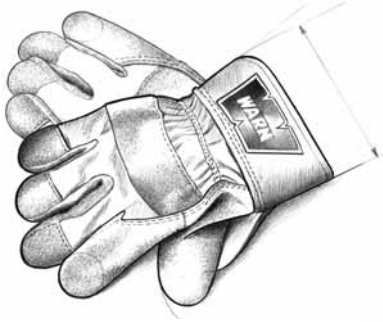
Les performances des treuils Warn sont indiquées selon la capacité de traction. La capacité de traction maximale se produit lorsque la première couche de câble est sur le tambour. Au fur et à mesure que les couches augmentent, la puissance de traction décroît. Cela fait partie des mathématiques du treuillage. Le dépassement de la capacité du treuil peut entraîner un blocage du treuil ou la rupture du câble. Réfléchissez sérieusement aux façons dont vous comptez utiliser le treuil afin d'éviter des tracas plus tard.

De plus, vous devriez également vous assurer que l'ensemble de support du treuil et le cadre du véhicule peuvent supporter la charge nominale du treuil.

Ce treuil est contrôlé par une télécommande portable pour permettre à l'opérateur de se tenir à l'écart pendant le treuillage.

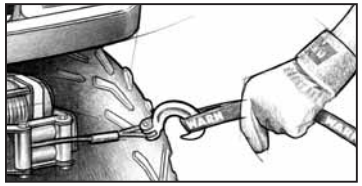
ACCESSOIRES DE TREUILLAGE UTILES

Seul, le treuil n'est guère plus qu'un simple outil. Mais utilisé conjointement avec un certain nombre d'accessoires, votre treuil Warn devient un outil polyvalent extrêmement efficace. Dans cette section, nous allons passer en revue un certain nombre de ces accessoires. Certains d'entre eux sont indispensables pour de bonnes conditions de fonctionnement du treuil, alors que d'autres le rendent plus polyvalent et simple d'utilisation.

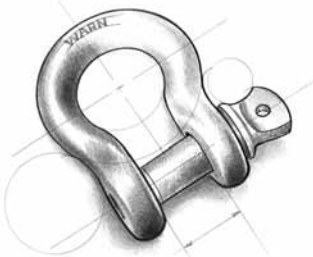


Gants Le câble, par usure, va présenter des « barbillons » qui peuvent déchirer la peau. Il est extrêmement important de porter des gants de protection pendant l'utilisation du treuil ou la manipulation du câble. Évitez de porter des vêtements amples ou quoi que ce soit qui puisse se prendre dans le câble ou dans d'autres parties mobiles du treuil.

Sangle à crochet Utilisez la sangle pour tenir le crochet tout en gardant les doigts éloignés du guide-câble pendant le rembobinage du câble. Les treuils développent une force de traction énorme et peuvent facilement arracher des doigts ou un membre malencontreusement pris dans le câble. Mettez le crochet dans la boucle et tenez la sangle entre le pouce et l'index.

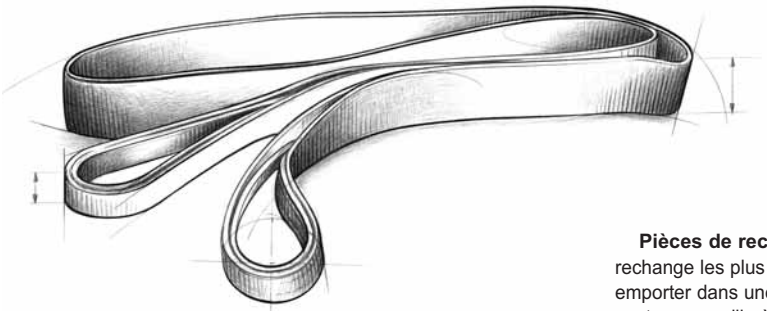


Moufle mobile Utilisée correctement, la moufle mobile multifonctions vous permet :
(1) d'augmenter la puissance de traction du treuil et (2) de changer la direction de treuillage sans endommager le câble. L'utilisation correcte de la poulie est décrite dans la section « Avant de treuiller ».



Manille d'ancrage La manille d'ancrage est un moyen sûr pour attacher ensemble les boucles de câble, les sangles et les poulies ouvrantes. La clavette de la manille est filetée pour faciliter l'extraction.

Élingue L'élingue peut être utilisée pour rattacher le câble à un autre véhicule ou à des objets pour former un point d'ancrage. Une élingue va toutefois endommager ou tuer les arbres.



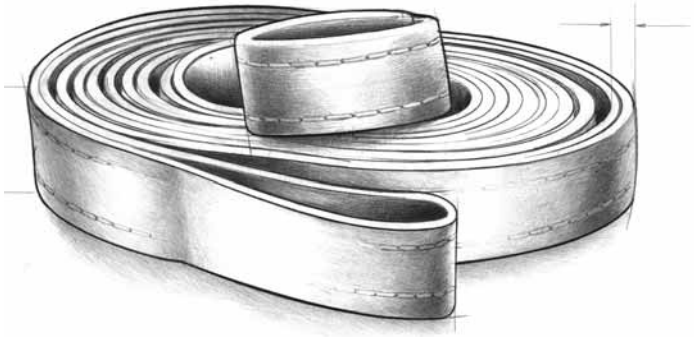
Protection de tronc d'arbre Une sangle de protection de tronc d'arbre est généralement faite en nylon ultra-résistant de haute qualité et offre à l'opérateur une variété de points d'ancrage pour le câble du treuil tout en protégeant le tronc des arbres.

Pièces de rechange Les pièces de rechange les plus importantes à emporter dans une escapade en nature sont une manille à vis de rechange, une moufle mobile et une télécommande. Pour une utilisation intense et continue du treuil, songez également à prendre un câble et un crochet de rechange.

Boîte à outils La boîte à outils doit comprendre des clés, des tournevis, des pinces et des outils pour changer de câble.

⚠ ATTENTION

N'attachez jamais une sangle de dépannage au crochet du treuil pour augmenter la longueur d'un treuillage. N'essayez jamais de remorquer un véhicule ou un objet avec la sangle de dépannage attachée directement au crochet du treuil. N'utilisez jamais des sangles élastiques. Celles-ci développent une force énorme en tension et sont potentiellement dangereuses.



Sangle de dépannage N'utilisez jamais de sangles de dépannage dans une opération de treuillage. Parce qu'elles sont conçues pour s'étirer, elles emmagasinent de l'énergie et peuvent agir comme un élastique si le câblage lâche. Utilisez les sangles de dépannage pour « extraire » un véhicule bloqué.

Pelles et outils manuels Vous aurez souvent besoin d'aide supplémentaire pendant les activités de treuillage. Vous seriez avisé d'emporter différentes pièces d'équipement telles qu'une pelle et une hache.

Recommandation concernant la batterie Il est recommandé d'utiliser une batterie automobile conventionnelle pleinement chargée pour obtenir des performances optimales avec le treuil. Assurez-vous que toutes les connexions électriques sont propres et bien serrées.

ÉTIREMENT INITIAL DU CABLE

La durée de vie du câble est directement liée à son utilisation et à l'entretien qu'il reçoit. Le tensionnement du câble est essentiel si l'on veut assurer une longue durée de vie au produit. Le tensionnement du câble empêchera les couches extérieures du câble de pincer et déformer les couches intérieures. Lors de sa première utilisation, un câble neuf doit être enroulé autour de son tambour sous une charge de **227 kg** ou plus. Suivre les instructions ci-dessous pour étirer correctement le câble sur le tambour du treuil.

1) Choisir un endroit **PLAT** suffisamment grand pour pouvoir dérouler toute la longueur du câble.

2) Mettre le levier d'embrayage du treuil en position de déroulement en roue libre. Saisir le cordon du crochet et dérouler le câble en laissant 5 spires de câble enroulées autour du tambour. Une fois le câble déroulé, mettre le levier d'embrayage du treuil en position d'embrayage.

3) Attacher le crochet du câble à un point d'ancrage adéquat et éloigner le véhicule du point d'ancrage en marche arrière jusqu'à ce que le câble soit presque tendu. Avant de quitter le véhicule, serrer le frein à main, mettre le véhicule en prise ou en stationnement et couper le contact.

4) Enrouler le câble sur le tambour du treuil jusqu'à éliminer complètement le mou du câble. Porter des gants et maintenir la tension sur le câble en tirant d'une main; pousser avec précaution le câble vers le côté du tambour auquel le câble est attaché de sorte qu'il n'y ait pas d'espace entre chaque spire sur le tambour. S'assurer que le câble s'enroule par le bas du tambour et non par le haut, sinon le frein d'arrêt d'automatique de la charge ne fonctionnera pas correctement. (Si le câble s'enroule sur le haut, cela signifie qu'on a actionné le treuil en mode de déroulement et non d'enroulement).

5) Les étapes suivantes doivent être effectuées par deux personnes pour plus de sécurité. Si l'on essaie de tendre le câble tout seul, s'assurer de toujours serrer le frein à main, mettre la transmission en prise et couper le contact chaque fois que l'on quitte le véhicule pour inspecter le câble du treuil. Ne jamais quitter le véhicule lorsque le câble est sous charge.

6) Prendre soin d'enrouler uniformément chaque couche pour éviter d'endommager le câble.

7) Demander à l'assistant de se tenir à côté du véhicule, loin du câble du treuil. Démarrer le véhicule et le mettre au point mort. Relâcher le frein à main tout en appuyant légèrement sur la pédale de frein. Appuyer sur la touche « Power In » de l'interrupteur. L'assistant doit signaler si le câble s'enroule correctement en observant son déplacement sur le guide-câble pendant l'enroulement. Arrêter le treuillage après environ 2 m. Relâcher lentement la pédale de frein puis serrer le frein à main. Ceci permet de s'assurer qu'il n'y a aucune charge sur le câble du treuil. Mettre ensuite la transmission en prise et couper le contact. Quitter le véhicule et inspecter le câble du treuil pour s'assurer qu'il s'enroule uniformément sur le tambour du treuil et qu'il ne s'enfonce pas dans la couche inférieure. Si le câble s'enfonce, dérouler le câble et répéter cette étape à partir du début en mettant plus de pression sur la pédale de frein.

8) Une fois qu'on s'est assuré que le câble s'enroule correctement sur le tambour, répéter l'étape 6 jusqu'à ce que le véhicule soit à moins de 1 m du point d'ancrage du treuil. Une fois à cette distance, relâcher lentement la pédale de frein puis serrer le frein à main. Ceci permet de s'assurer qu'il n'y a aucune charge sur le câble du treuil. Mettre ensuite la transmission en prise et couper le contact. Quitter le véhicule. Décrocher le câble du point d'ancrage. Tout en retenant le cordon du crochet fourni, maintenir la tension sur câble et enrouler lentement le treuil par de petites pressions sur l'interrupteur de commande jusqu'à ce que le crochet atteigne le guide-câble. **NE PAS ENROULER LE CROCHET DANS LE GUIDE-CÂBLE.** Cela pourrait endommager le guide-câble.

⚠ AVERTISSEMENT

Ne jamais utiliser le treuil avec moins de 5 spires de câble enroulées autour du tambour, car le câble pourrait se dérouler du tambour, étant donné que l'ancrage du câble n'est pas conçu pour retenir une charge.

AVANT DE TREUILLER

⚠ AVERTISSEMENT
N'utilisez jamais le treuil comme palan.

⚠ AVERTISSEMENT
Utilisez toujours le cordon du crochet fourni pour enrouler ou dérouler le câble.

⚠ ATTENTION
N'essayez jamais de débrayer pendant que le câble est en tension. N'embrayez jamais pendant que le tambour est en mouvement. Assurez-vous toujours d'avoir complètement embrayé ou complètement débrayé.

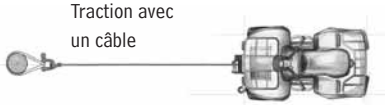
⚠ AVERTISSEMENT
Gardez toujours les mains et les vêtements éloignés du câble, du crochet et de l'ouverture du guide-câble pendant le fonctionnement du treuil et l'enroulement ou le déroulement du câble.

Entraînez-vous à utiliser le treuil avant d'être coincé quelque part. Une situation réelle n'est pas le moment approprié pour apprendre à utiliser le treuil.

Que vous soyez en train de dépanner un autre véhicule ou en train d'arracher une souche du sol, la connaissance des techniques de treuillage vous permettra de maintenir un bon niveau de sécurité pour vous-même et ceux qui vous entourent. Et peut-être que la partie la plus importante de la procédure de treuillage est ce qui est fait avant de treuiller.

Nous allons couvrir dans cette section les fondements d'un treuillage efficace. Toutefois, c'est à vous d'analyser la situation et de prendre les décisions nécessaires pour l'utilisation correcte du treuil. Appliquez ce que vous savez du treuil en théorie et en pratique et adaptez les techniques à la situation dans laquelle vous vous trouvez. Quelques points clé à se rappeler quand vous utilisez le treuil Warn :

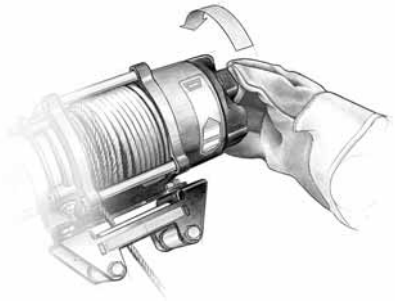
1. **Prenez toujours le temps nécessaire pour évaluer la situation dans laquelle vous vous trouvez et préparez le treuillage avec soin.**
2. **Prenez toujours votre temps quand vous utilisez un treuil.**
3. **Utilisez un équipement adapté à la situation.**
4. **Portez toujours des gants en cuir et ne laissez pas le câble glisser dans les mains.**
5. **Personne d'autre que vous ne doit manier le câble et faire fonctionner la télécommande.**
6. **Pensez toujours en termes de sécurité.**
7. **Entraînez-vous. Faites et refaites les étapes.**


Traction avec un câble

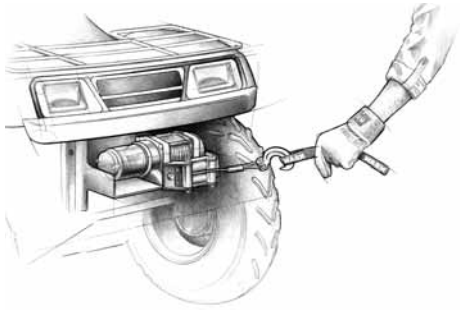
Câbler pour le treuillage

Les étapes suivantes décrivent comment dépanner le véhicule avec un treuillage sur câblage simple. Les techniques de câblage double ou multiple suivent les même étapes de base mais utilisent une moufle mobile pour assister la procédure.

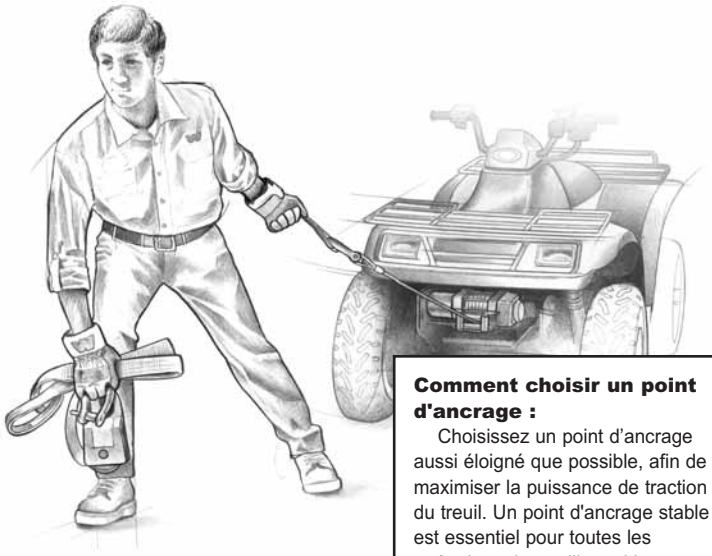
Étape 1 : METTEZ DES GANTS.



Étape 2 : DÉBRAYEZ. Pour permettre au tambour de tourner en roue libre, mettez l'embrayage du treuil en position « Débrayage ». Le déroulement en roue libre économise la batterie.



Étape 3 : LIBÉREZ LE CROCHET DU TREUIL ET ATTACHEZ LE CORDON DU CROCHET. Libérez le crochet du treuil de son point d'ancrage. Attachez le cordon du crochet au crochet (s'il ne l'est pas).



Étape 4 : TIREZ LE CÂBLE JUSQU'AU POINT D'ANCRAGE. Tirez suffisamment de câble pour atteindre le point d'ancrage. Assurez-vous de conserver une certaine tension dans le câble. Il peut se tordre ou se doubler s'il n'est pas tendu, ce qui peut l'endommager. Pour éviter de desserrer l'extrémité, maintenez le crochet dans la sangle à crochet pendant que vous travaillez.

Étape 5 : FIXATION SUR LE POINT D'ANCRAGE. Lorsque vous avez déterminé le point d'ancrage, fixez la sangle de protection de tronc d'arbre ou l'élingue autour de l'objet choisi.

Comment choisir un point d'ancrage :

Choisissez un point d'ancrage aussi éloigné que possible, afin de maximiser la puissance de traction du treuil. Un point d'ancrage stable est essentiel pour toutes les opérations de treuillage. L'ancrage doit être suffisamment solide pour tenir pendant le treuillage. Les points d'ancrages naturels comprennent les arbres, les souches et les rochers. Accrochez le câble aussi bas que possible.

Si aucun point d'ancrage n'est disponible lorsque vous dépannez un autre véhicule, votre véhicule devient le point d'ancrage. Dans ce cas, assurez-vous de mettre la transmission au point mort, mettez le frein à main et calez les roues pour empêcher votre véhicule de bouger.

Idéalement, choisissez un point d'ancrage qui vous permettra de tirer droit dans la direction de déplacement du véhicule. Cela permet au câble de s'enrouler de façon serrée et uniforme sur le tambour du treuil.

Des piquets ou des axes, enfoncés de biais et attachés ensemble.

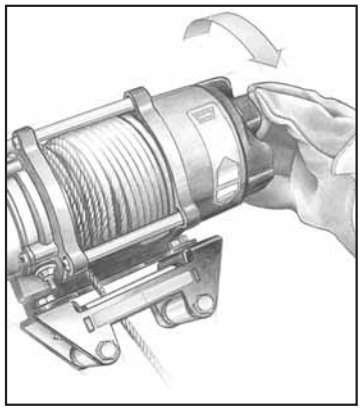
Un tronçon d'arbre enfoncé dans le sol et attaché avec une chaîne.

⚠ AVERTISSEMENT
Ne jamais utiliser le treuil avec moins de 5 spires de câble enroulées autour du tambour, car le câble pourrait se dérouler du tambour, étant donné que l'ancrage du câble n'est pas conçu pour retenir une charge.

⚠ ATTENTION
Ne laissez jamais la télécommande branchée sur le treuil en mode de déroulement en roue libre, de câblage ou de repos.

⚠ ATTENTION
Ne jamais accrocher le câble à lui-même. Cela l'endommagerait.

Étape 6 : ATTACHEZ LA MANILLE D'ANCRAGE ET LE CORDON DU CROCHET. Fixez la manille aux deux bouts du cordon ou de l'élingue et à travers la boucle du crochet, en faisant attention à ne pas trop serrer (serrez puis relâchez d'un demi-tour).

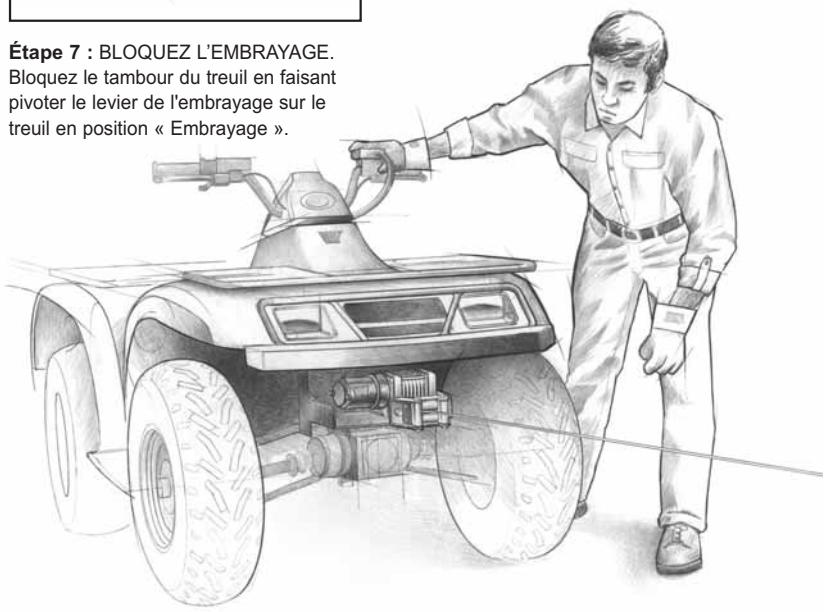


Étape 7 : BLOQUEZ L'EMBRAYAGE. Bloquez le tambour du treuil en faisant pivoter le levier de l'embrayage sur le treuil en position « Embrayage ».

Étape 8 : CONNECTEZ LA TÉLÉCOMMANDE (si vous en avez une). Faites attention à ne pas laisser le cordon de la télécommande pendre devant le treuil. Déconnectez toujours la télécommande quand elle n'est pas utilisée.

Étape 9 : METTEZ LE CÂBLE EN TENSION. En utilisant la télécommande, rembobinez lentement le câble jusqu'à ce qu'il n'y ait plus de mou. Lorsque le câble est en tension, restez bien à l'écart et ne passez jamais par-dessus.

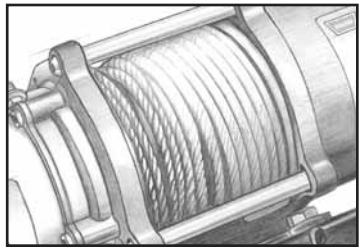
Étape 10 : VÉRIFIEZ LE POINT D'ANCRAGE. Avant de poursuivre la procédure de treuillage, assurez-vous que toutes les connexions sont bien faites et exemptes de débris.



TREUILLAGE

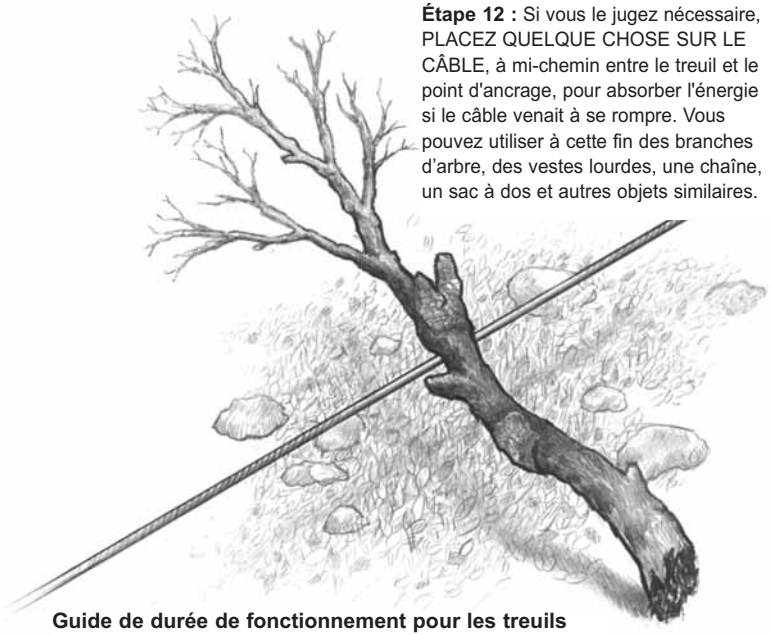
Comme vous l'avez certainement déjà remarqué, il y a de nombreuses choses à faire et à prendre en compte avant de commencer le treuillage. Soyez attentif à ce que vous faites afin d'éviter tout accident.

L'utilisation correcte du treuil est si importante que vous devriez vous entraîner à pratiquer ces techniques avant d'avoir à faire face aux distractions et au stress d'une véritable situation de treuillage.



Étape 11 : VÉRIFIEZ LE CÂBLE. Le câble doit être proprement enroulé autour du tambour. Le câble peut être abîmé s'il n'est pas enroulé correctement.

Étape 12 : Si vous le jugez nécessaire, PLACEZ QUELQUE CHOSE SUR LE CÂBLE, à mi-chemin entre le treuil et le point d'ancrage, pour absorber l'énergie si le câble venait à se rompre. Vous pouvez utiliser à cette fin des branches d'arbre, des vestes lourdes, une chaîne, un sac à dos et autres objets similaires.



AVIS

Évitez de surchauffer le moteur du treuil. Pour un treuillage de longue durée, arrêtez le moteur à intervalles raisonnables pour lui permettre de refroidir.

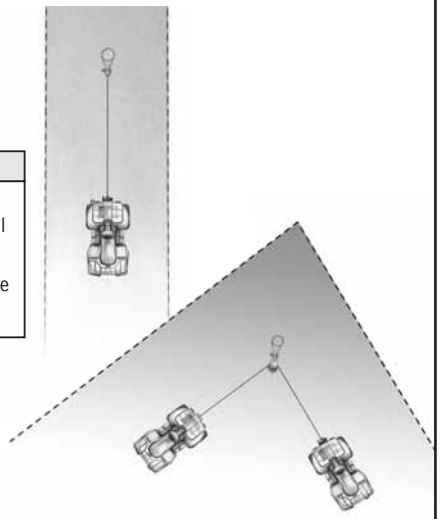
Voir le tableau du guide de durée de fonctionnement.

Guide de durée de fonctionnement pour les treuils WARN de quads/véhicules utilitaires

Charge (lbs)	Durée de fonctionnement	Distance (pi)	Durée de refroidissement (min)
0	2.5 min	50	12
500	2.0 min	32	10
1000	1.0 min	14	10
1500	25 sec	5	10
2000	15 sec	2	10
2500	10 sec	1	10

Le cycle de service varie pour chaque treuil. Voir la fiche technique fournie avec le treuil.

Établissez des « zones interdites » :



AVIS

N'utilisez jamais le câble du treuil pour remorquer un autre véhicule ou objet.

AVIS

Évitez toujours de tirer continuellement sur le côté, ce qui a pour effet d'empiler le câble sur l'une des extrémités du tambour et pourrait endommager le câble ainsi que le treuil.

Étape 13 : FAITES CONNAÎTRE VOS INTENTIONS. Assurez-vous que toutes les personnes présentes à proximité du treuil sont complètement conscientes de vos intentions avant de commencer à treuiller.

Indiquez exactement les emplacements où les spectateurs ne doivent pas se placer—jamais en aval ou en amont du véhicule, ni à proximité du câble ou de la moufle mobile. Votre situation peut présenter d'autres « zones interdites ».

Étape 14 : COMMENCEZ LE TREUILLAGE. Le moteur du véhicule du treuil étant en marche et le câble déjà légèrement tendu, commencez à treuiller lentement et régulièrement. Assurez-vous que le câble s'enroule régulièrement et fermement autour du tambour. Pour faciliter la manœuvre, le véhicule tracté peut être conduit doucement tout en étant tiré par le treuil.

Le véhicule peut être dirigé mais pas conduit durant le treuillage. Le fait de conduire le véhicule contribue à détendre le câble et à l'entremêler.

Ce qu'il faut surveiller sous charge

Le câble doit toujours être enroulé sur le tambour sur le côté le plus proche de la plaque de montage tel qu'indiqué par l'étiquette d'avertissement apposée à l'extrémité du moteur du treuil.

Lorsque vous rembobinez, assurez-vous que le câble d'acier s'enroule sur le tambour de manière uniforme et serrée. Cela empêche les spires extérieures de s'enfoncer dans les spires intérieures, ce qui peut coincer et endommager le câble.

Effectuez la traction en mettant la transmission du véhicule au point mort et en enlevant le frein à main. Soyez patient et laissez le treuil faire tout le travail. Cela empêche le véhicule de reculer et d'exercer un choc sur le câble, ce qui peut endommager le treuil et le câble.

Lorsque vous enroulez le câble en tirant de côté, celui-ci s'empile principalement sur l'une des extrémités du tambour. Un tel empilement peut éventuellement endommager le treuil sérieusement. Pour éviter cela, dirigez le câble le plus droit possible durant la traction et arrêtez le treuil si le câble se rapproche des barres d'accouplement ou de la plaque de montage. Pour corriger un enroulement inégal, déroulez la section de câble en cause et redirigez-la vers l'autre extrémité du tambour, ce qui libérera de la place pour poursuivre le travail avec le treuil.

Étape 15 : POUR LA RÉCUPÉRATION DU VÉHICULE, continuez à tirer jusqu'à ce que le véhicule soit sur un plan stable. Lorsque vous êtes à même de conduire le véhicule, l'opération de treuillage est terminée.

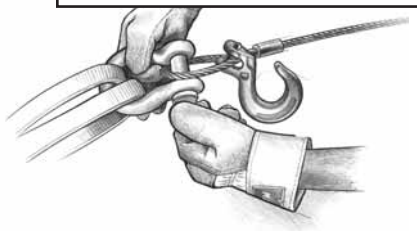
Étape 16 : METTEZ LE VÉHICULE EN SÛRETÉ. Une fois le véhicule récupéré, serrez le frein et mettez le levier de vitesses sur « stationnement ». Relâchez la tension du câble.

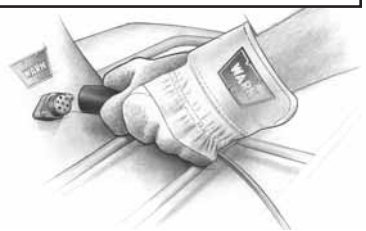
Comment rembobiner à vide

Arrangez le câble à enrouler de manière à ce qu'il ne s'entortille ni ne s'emmêle pendant le rembobinage. Assurez-vous que le câble qui est déjà sur le tambour est enroulé de manière uniforme et serrée. Serrez et arrangez la couche de câble si nécessaire. Gardez une légère tension dans le câble et rembobinez-le sur le tambour du treuil en couches uniformes en procédant couche par couche. À la fin de chaque couche, cessez de rembobiner et assurez-vous que la couche est bien uniforme et serrée.

Refaites la même chose jusqu'à ce que le crochet du treuil soit à au moins 1,2 m (4 pi) du treuil. Prenez le crochet entre le pouce et l'index et attachez le cordon du crochet. Tenez le cordon du crochet entre le pouce et l'index pour maintenir la tension sur le câble. Guidez le câble vers le guide-câble tout en le rembobinant avec précaution avec de petites pressions sur l'interrupteur de commande. Rangez le crochet sur le guide-câble ou tendu sur un endroit approprié sur le côté.

Si vous ne disposez pas de cordon à crochet, utilisez une longueur de corde ou quelque chose de similaire. Pour éviter tout accident grave, éloignez TOUJOURS les doigts de la zone du crochet lorsque vous rembobinez.

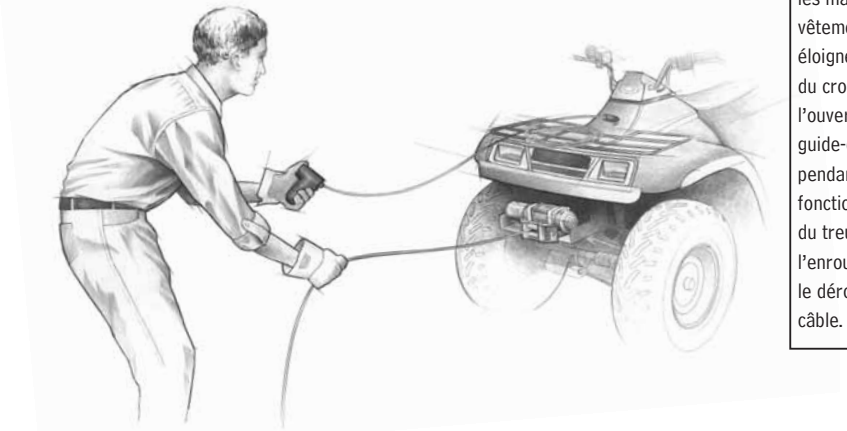




Étape 17 : DÉCONNECTEZ LE CÂBLE. Décrochez le câble du point d'ancrage.

Étape 18 : REMBOBINEZ LE CÂBLE. La personne qui s'occupe du câble doit guider le câble en marchant et non pas en le laissant glisser dans la main, et contrôler le treuil en permanence.

Étape 19 : DÉCONNECTEZ LA TÉLÉCOMMANDE. Déconnectez le cordon de la télécommande et rangez-le dans un lieu propre et sec. Les opérations de treuillage sont à présent terminées. Mettez le capuchon sur la douille.

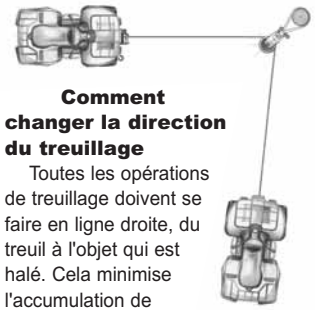


⚠ AVERTISSEMENT

Gardez toujours les mains et les vêtements éloignés du câble, du crochet et de l'ouverture du guide-câble pendant le fonctionnement du treuil et l'enroulement ou le déroulement du câble.

TECHNIQUES DE CÂBLAGE

Différentes situations de treuillage nécessitent d'autres techniques de treuillage. Celles-ci peuvent aller d'un manque de place pour obtenir une traction suffisante en utilisant un câblage direct à la simple augmentation de la puissance de traction ou au maintien d'un treuillage en ligne droite. Vous devrez évaluer la technique la mieux adaptée à la situation. Pensez toujours en termes de « sécurité ».

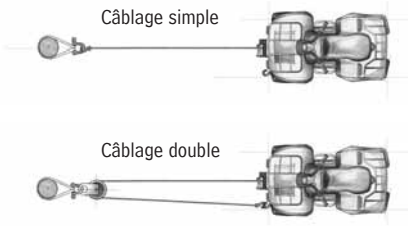


Comment changer la direction du treuillage

Toutes les opérations de treuillage doivent se faire en ligne droite, du treuil à l'objet qui est halé. Cela minimise l'accumulation de câble sur un côté du tambour, ce qui réduit l'efficacité du treuillage tout en endommageant le câble. Une moufle mobile, fixée à un point situé directement en face du véhicule, vous permettra de changer la direction de treuillage tout en conservant un angle de 90° avec le câble, lui permettant ainsi de s'enrouler correctement sur le tambour.

Augmentation de la puissance et de la durée de treuillage

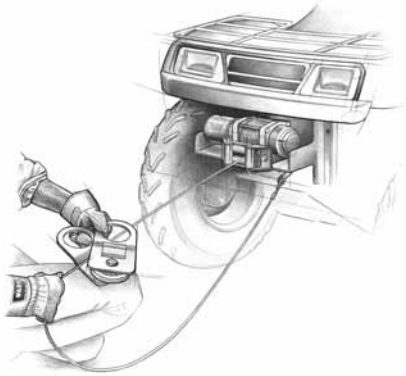
Dans certains cas, vous aurez besoin de plus de puissance de traction. L'utilisation de poulies ouvertes augmente l'avantage mécanique, et, par là même, la puissance de traction :



Câblage double

Comme la puissance de traction décroît en fonction des couches de câble sur le tambour du treuil, vous pouvez utiliser une poulie ouverte pour dédoubler le câblage et réduire la quantité de câble sur le tambour. Ceci réduit le nombre de couches de câble sur le tambour et augmente la puissance de traction.

Commencez par extraire suffisamment de câble pour libérer le crochet du treuil. Attachez le crochet au châssis du véhicule et faites passer le câble par la poulie. Ne fixez pas le crochet au kit de montage.



Débrayez et, tout en utilisant la poulie ouverte, tirez suffisamment de câble pour atteindre le point d'ancrage.

Fixez le câble sur le point d'ancrage avec une sangle de protection ou une élingue. Attachez la manille d'ancrage. Fixez la manille aux deux bouts de la sangle/élingue, en faisant attention à ne pas trop serrer (serrez puis relâchez d'un demi-tour).

MAINTENANCE

- Inspectez le câble avant et après chaque utilisation du treuil. S'il y a un vrillage dans le câble ou que celui-ci est effiloché, il doit être remplacé immédiatement. Examinez également le crochet du treuil et son axe pour détecter tout signe d'usure ou de dommage. Remplacez-le si nécessaire.
- Si votre treuil est équipé d'un câble synthétique, lisez et veillez à bien comprendre le Guide des câbles synthétiques. Inspectez minutieusement le câble après chaque utilisation.

  Remplacez-le si :
  (1) l'épaisseur du câble est réduite sur sa longueur de 25 % ou plus par abrasion, (2) deux torons adjacents ou plus sont coupés, (3) vous trouvez des zones plates ou des bosses et vous ne parvenez pas à les éliminer en faisant fléchir le câble, ou (4) vous trouvez un nombre excessif de fibres fusionnées ou fondues. Dans ce cas, la zone affectée est raide et le câble a un aspect glacé.
- Gardez le treuil, le câble et la télécommande exempts de contaminants. Utilisez un chiffon propre ou une serviette pour enlever les saletés et débris éventuels. Si nécessaire, déroulez complètement le câble (en laissant un minimum de 5 spires sur le tambour), essuyez-le et rembobinez-le correctement avant de le ranger. Appliquez une huile légère sur le câble et le crochet du treuil pour empêcher la rouille et la corrosion.
- Le fonctionnement du treuil pendant une longue période peut mettre la batterie du véhicule à l'épreuve. Assurez-vous de bien vérifier la batterie et ses câbles en suivant les instructions du constructeur. Vérifiez également l'interrupteur de commande et toutes les connexions électriques pour vous assurer qu'ils sont propres et bien serrés.
- Inspectez, le cas échéant, la télécommande au cas où elle serait endommagée. Assurez-vous de bien couvrir la prise de télécommande pour éviter que la poussière et la saleté ne pénètrent dans les connexions. Rangez la télécommande dans un endroit sûr, propre et sec.
- Aucune lubrification n'est nécessaire pendant la durée de service du treuil.

⚠ ATTENTION

Le fait de relever et d'abaisser la lame peut endommager le câble. Contrôlez soigneusement si le câble est usé, s'il est tordu par endroits et s'il comporte des torons brisés. Remplacez le câble s'il est endommagé.

FONCTIONNEMENT PAR MOINS DE ZÉRO

Le déroulement du câble en roue libre à partir du tambour du treuil peut être difficile lorsque les températures sont au-dessous de zéro. Mettez l'embrayage en position de roue libre et déroulez le câble sur 2 à 3 mètres pour réchauffer le treuil.

RANGEMENT

Quand le treuil n'est pas utilisé, laissez l'embrayage du treuil en prise. Ceci aide les pièces internes du treuil à résister à l'effet des intempéries et de la contamination.

⚠ AVERTISSEMENT

Ne jamais utiliser le treuil avec moins de 5 spires de câble enroulées autour du tambour, car le câble pourrait se dérouler du tambour, étant donné que l'ancrage du câble n'est pas conçu pour retenir une charge.

EN DERNIÈRE ANALYSE

Le manuel de base pour les techniques de treuillage ne peut pas couvrir toutes les situations possibles où vous pourriez avoir à utiliser un treuil. En dernière analyse, les décisions que vous prendrez détermineront le résultat final. Assurez-vous donc de bien réfléchir à chaque situation et à chaque étape à effectuer. Gardez toujours à l'esprit votre propre sécurité et celle de ceux qui vous entourent. Faites attention et vous vous amuserez.

Guía básica de técnicas para el uso del cabrestante

En cada situación donde se utiliza un cabrestante existe el potencial de ocasionar daños personales. Para reducir al mínimo este peligro es importante leer esta guía atentamente y familiarizarse con el funcionamiento del cabrestante antes de tener que usarlo; también debe poner atención continuamente en su protección. En esta guía se establecen muchas de las reglas de seguridad para el uso del cabrestante. No obstante, debido a que cada situación en la que se utiliza el cabrestante es diferente, es muy importante su buen juicio y un enfoque constante en la seguridad.

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Al leer estas instrucciones, verá ADVERTENCIAS, PRECAUCIONES, AVISOS y NOTAS. Cada mensaje tiene un propósito específico. Las ADVERTENCIAS son mensajes de seguridad que indican que está ante una situación potencialmente peligrosa que, si no se evita, puede acarrear lesiones graves o la muerte. Las PRECAUCIONES son mensajes de seguridad que indican una situación de posible peligro que, si no se evita, puede resultar en lesiones menores o de poca gravedad. Las PRECAUCIONES pueden también alertar contra prácticas no seguras. Las PRECAUCIONES y ADVERTENCIAS identifican el peligro, indican cómo evitarlo y advierten de las posibles consecuencias si no se evita tal peligro. Los AVISOS son mensajes para evitar daños a la propiedad. Las NOTAS son información adicional que le ayudarán a llevar a cabo un procedimiento. **¡POR FAVOR, TRABAJE SIEMPRE DE FORMA SEGURA!**

ADVERTENCIA

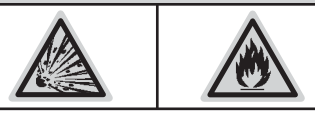
PELIGRO DE ENREDO EN LAS PIEZAS MÓVILES

De no seguirse estas instrucciones podrían producirse lesiones graves o la muerte.

Para evitar daños en las manos.

- Mantenga siempre las manos alejadas del cable, del bucle del gancho, del gancho y de la abertura de la guía durante la instalación, la operación, y en el enrollado y desenrollado.
- Tome siempre medidas extremas de precaución al manejar el gancho y el cable durante las maniobras de enrollado y desenrollado.
- Use siempre la correa suministrada con el gancho cuando vaya a enrollar o desenrollar el cable, durante la instalación y durante la operación.
- Mantenga siempre el vehículo a la vista durante las operaciones del cabrestante.
- Lleve puestos siempre guantes gruesos de cuero para manipular el cable.

ADVERTENCIA



PELIGRO DE INCENDIO Y DE EXPOSICIÓN A PRODUCTOS QUÍMICOS

De no seguirse estas instrucciones podrían producirse lesiones graves o la muerte.

- No lleve nunca puestas joyas o collares, y lleve siempre protección ocular.
- No se apoye nunca en la batería cuando se estén haciendo las conexiones.
- Si se va a perforar, verifique siempre que en el área no haya tuberías o tanques de combustible, tuberías de sistema de frenado, cables eléctricos, etc.
- No pase nunca cables eléctricos:
  - Por bordes que puedan resultar cortantes.
  - A través o en las proximidades de piezas móviles.
  - Cerca de piezas que puedan ponerse calientes.
- Proteja y aísle siempre todo cableado y terminal eléctrico que esté expuesto.
- Instale siempre cubiertas para los terminales tal y como se indica en las instrucciones de instalación.

ADVERTENCIA

PELIGRO DE CAÍDAS O APLASTAMIENTOS

De no seguirse estas instrucciones podrían producirse lesiones graves o la muerte.

- No utilice nunca el cabrestante para levantar o desplazar personas.
- No use nunca el cabrestante como grúa o para suspender una carga.
- No accione nunca el cabrestante si no hay al menos 5 vueltas de cable alrededor del tambor. El cable podría soltarse del tambor ya que el dispositivo de sujeción del cable al tambor no es apto para soportar una carga.

⚠ PRECAUCIÓN

PELIGRO DE ENREDARSE EN LAS PIEZAS MÓVILES

De no seguirse estas instrucciones, podrían producirse lesiones menores o de moderada gravedad.

- Tenga siempre presente cómo funciona el cabrestante. Tómese su tiempo para leer toda la guía de instalación y la guía básica de técnicas de uso del cabrestante para poder comprender el funcionamiento y la operación del mismo.
- El cabrestante no deberá ponerse en manos de personas menores de 16 años de edad.
- No ponga nunca en funcionamiento este cabrestante si se encuentra bajo los efectos de drogas, alcohol o medicamentos.
- No exceda nunca la capacidad del cabrestante o del cable que se indica en la hoja técnica del producto. Emplee un cable doble utilizando una polea pasteca para reducir la carga del cabrestante.
- No use nunca el cabrestante o el cable para remolcar.
- Elija siempre una ubicación de montaje que sea lo suficientemente sólida para soportar la capacidad de carga máxima del cabrestante.
- Use siempre piezas de montaje, componentes y accesorios aprobados por el fabricante.
- Utilice siempre piezas de montaje de grado 5 o superior.
- No suelde nunca los pernos de montaje.
- Tenga precaución siempre cuando use pernos más largos que los suministrados por el fabricante. Unos pernos de longitud excesiva pueden dañar la base o hacer que el montaje del cabrestante no resulte seguro.
- Monte el cabrestante y acople el gancho al bucle final del cable siempre antes de conectar el cableado eléctrico.
- Ponga siempre la guía del cable con la etiqueta de ADVERTENCIA en su parte superior.
- Enrolle y desenrolle el cable al tambor siempre en la dirección especificada en la etiqueta de advertencia del cabrestante o en la documentación. Esto es necesario para el funcionamiento correcto del freno automático (si viene equipado).
- Realice siempre un estiramiento previo del cable y vuelva a enrollarlo con carga antes de usarlo. Un cable bien enrollado reduce las posibilidades de tener "dobleces", que pueden dañar el cable.

⚠ PRECAUCIÓN

PELIGRO DE ENREDARSE EN LAS PIEZAS MÓVILES

De no seguirse estas instrucciones, podrían producirse lesiones menores o de moderada gravedad.

- Inspeccione siempre el cable, el gancho y las eslingas antes de poner el cabrestante en funcionamiento. Si el cable está deshilachado, retorcido o dañado, deberá reemplazarse de inmediato. Los componentes dañados deberán reemplazarse antes de la operación. Evite que las piezas resulten dañadas.
- No deje nunca el control remoto con cable conectado al cabrestante cuando se esté haciendo enrollado libre, maniobras o cuando no se esté usando el cabrestante.
- No enganche nunca el cable sobre sí mismo. Esto lo deterioraría.
- Utilice siempre una cadena o un cable de estrangulación, o un protector de tronco en el anclaje.
- Retire siempre cualquier elemento u obstáculo que pueda provocar inseguridad en la operación del cabrestante.
- Tómese siempre su tiempo para asegurar la carga con técnicas apropiadas antes de arrastrarla con el cabrestante.
- Verifique siempre que el anclaje seleccionado soportará la carga y que la correa o la cadena no se deslizará.
- Nunca embrague ni desembrague si el cabrestante está soportando una carga, si el cable está en tensión o si el tambor está en movimiento.
- Seleccione siempre un punto de anclaje lo más lejano posible. De esta forma se proporciona al cabrestante su máxima capacidad de tracción.
- No toque nunca el cable ni el gancho mientras éstos se encuentren en tensión o con carga.
- No toque nunca el cable ni el gancho si hay alguien cerca del interruptor de control, o si el cabrestante está en funcionamiento.
- Manténgase siempre alejado del cable y de la carga, y no deje que otros se acerquen cuando el cabrestante esté en funcionamiento.
- Tenga siempre presente la estabilidad del vehículo y de la carga durante el uso del cabrestante; haga que las personas presentes se mantengan alejadas. Alerte a todas las personas presentes de cualquier posible inestabilidad.
- Nunca utilice el cabrestante para amarrar una carga.

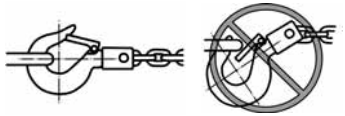
⚠ PRECAUCIÓN

PELIGRO DE ENREDARSE EN LAS PIEZAS MÓVILES

De no seguirse estas instrucciones, podrían producirse lesiones menores o de moderada gravedad.

- Mantenga siempre el cable del control remoto alejado del tambor, el cable y el cordaje. Inspeccione la posible existencia de grietas, pellizcos, cables deshilachados o conexiones sueltas. Reemplace el control remoto si se encuentra defectuoso.
- Cuando use el control remoto dentro de un vehículo pase siempre el control remoto a través de una ventana para evitar que se pellizque su cable con la puerta.
- No deje nunca el control remoto donde pueda activarse durante el enrollado libre, maniobrado, o cuando el cabrestante no esté en uso.
- Requiera siempre al operador y personas presentes que vigilen el vehículo y la carga.

⚠ PRECAUCIÓN

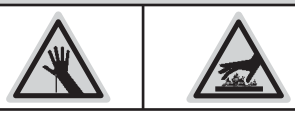


PELIGRO DE ENREDARSE EN LAS PIEZAS MÓVILES

De no seguirse estas instrucciones, podrían producirse lesiones menores o de moderada gravedad.

- Utilice siempre un gancho con seguro.
- Verifique siempre que el seguro del gancho esté cerrado y que no soporte la carga.
- No aplique nunca una carga a la punta del gancho o al seguro. Aplique la carga únicamente al centro del gancho.
- No use nunca un gancho cuya abertura haya aumentado o cuya punta esté doblada o retorcida.

⚠ PRECAUCIÓN



PELIGRO DE CORTES Y QUEMADURAS

De no seguirse estas instrucciones, podrían producirse lesiones menores o de moderada gravedad.

Para evitar daños en las manos:

- Lleve puestos siempre guantes gruesos de cuero para manipular el cable.
- Nunca deje que el cable se deslice por sus manos.
- Tenga siempre en cuenta que las superficies del motor, del tambor o del cable del cabrestante pueden estar calientes durante o después del uso del mismo.

AVISO

EVITE DAÑOS AL EQUIPO Y AL CABRESTANTE

- Evite siempre los arrastres laterales, ya que pueden apilar el cable en un extremo del tambor. Esto puede dañar el cable o el cabrestante.
- Compruebe siempre que se ha embragado o desembragado completamente.
- No utilice nunca el cabrestante para remolcar otros vehículos u objetos. Las cargas repentinas pueden exceder momentáneamente la capacidad del cable y del cabrestante.
- Evite siempre desenrollar el cable a distancias muy largas. Esto originará un exceso de calor y desgaste en el motor y el freno del cabrestante.
- Sea precavido siempre para no dañar la estructura cuando vaya a anclar su vehículo en una operación con el cabrestante.
- No desplace nunca el cable en pequeñas sacudidas cuando esté con carga. Las cargas repentinas pueden exceder momentáneamente la capacidad del cable y del cabrestante.
- Nunca utilice el cabrestante para amarrar una carga durante su transporte.
- No sumerja nunca el cabrestante en agua.
- Guarde siempre el control remoto en un área protegida, limpia y seca.
- Emplee siempre un cable doble o elija un punto de anclaje distante cuando vaya a utilizar un cordaje. Esto maximiza la potencia de tiro y evita la sobrecarga del cabrestante.

LO FUNDAMENTAL DEL CABRESTANTE ELÉCTRICO

⚠ ADVERTENCIA

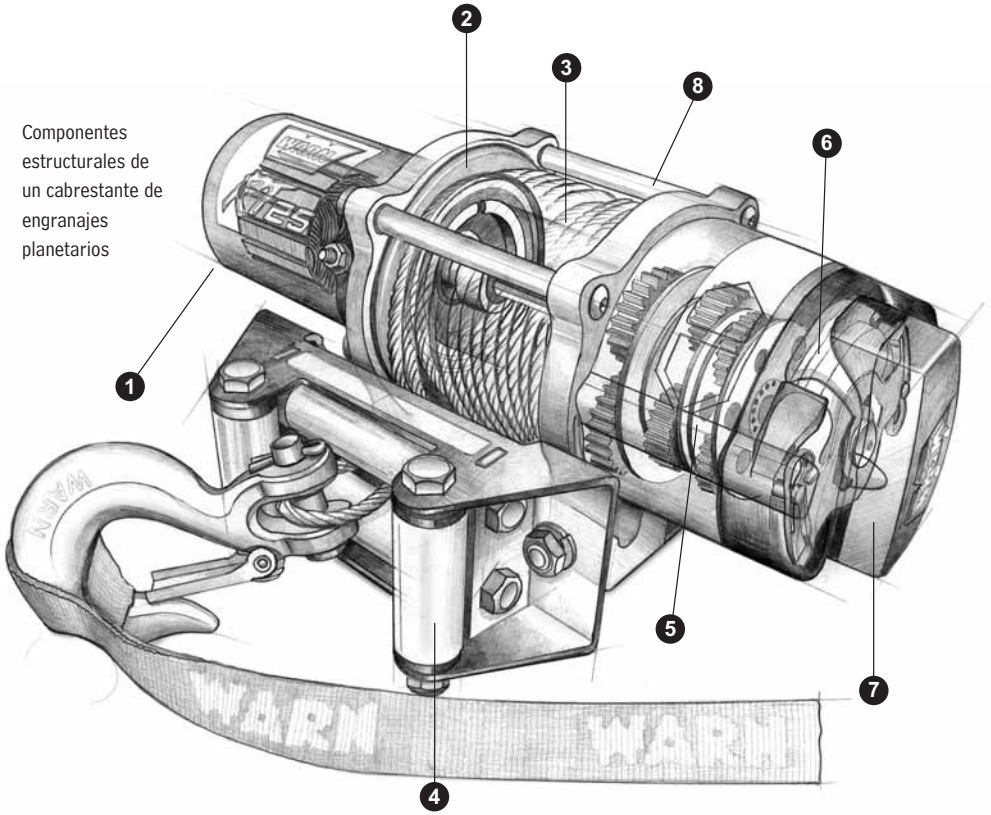
No accione ni instale nunca el cabrestante sin antes leer y comprender completamente el manual del usuario.

De modo que ya tiene el cabrestante Warn y está preparado para probarlo: subir a unas cuantas rocas, salpicar un poco de barro y atravesar algún que otro arroyo. En resumen, ya está usted preparado para explorar el campo y para disfrutar.

Muy bien, si es lo suficientemente inteligente como para ir preparado con lo mejor, probablemente también lo sea para saber que, si quiere disfrutar, tiene que entender perfectamente cómo funciona el cabrestante.

Esto es precisamente lo que intenta hacer esta guía: proporcionarle un conocimiento básico del cabrestante y enseñarle lo fundamental de las técnicas apropiadas de uso. Pero antes de comenzar debemos poner énfasis en que la información en esta guía es solamente de carácter general. Debido a que no hay dos situaciones iguales, sería casi imposible ilustrar todas ellas. Podemos, no obstante, proporcionarle los principios y las técnicas generales. Después es responsabilidad suya tomarse el tiempo necesario para analizar la situación y aplicar la técnica apropiada.

Junto con un poco de sentido común, las instrucciones que se incluyen en este libro le pueden ayudar a disfrutar de la máquina. No olvide que debe analizar cada situación antes de proceder y ACTUAR CAUTELOSAMENTE.



Componentes estructurales de un cabrestante de engranajes planetarios

Interruptor del control remoto

Control remoto inalámbrico de mano

Conmutador Rocker

Para comenzar, debe familiarizarse con el cabrestante Warn y con cada uno de sus componentes: Practique el uso del cabrestante antes de utilizarlo.

1 Motor Por lo general, el motor del cabrestante funciona con la batería de su vehículo. El motor proporciona energía al mecanismo de engranajes, el cual gira el tambor del cabrestante y enrolla el cable.

2 Tambor del cabrestante El tambor del cabrestante es el cilindro en el cual se enrolla el cable. El tambor funciona por medio del motor y el tren accionador. Su sentido de giro se puede cambiar utilizando el conmutador del cabrestante.

3 Cable / Cable sintético El diámetro del cable y su longitud se determinan de acuerdo a la capacidad de carga del cabrestante y al diseño del mismo. Enrollado alrededor del tambor del cabrestante a través de la guía, el cable se enlaza al final para aceptar el perno del enganche.

4 Guía Cuando se usa el cabrestante en ángulo, la guía del cable actúa para dirigir el cable hacia el tambor de enrollado. Esto reduce al mínimo daños al cable cuando pasa por la montura o el paragolpes del cabrestante.

5 Tren de engranajes El engranaje de reducción convierte la energía del motor del cabrestante en una fuerza de gran tracción. El diseño del tren de engranajes hace posible que el cabrestante sea más ligero y compacto.

6 Sistema de freno El freno se acciona automáticamente en el tambor del cabrestante cuando se para el motor de éste y hay carga en el cable. El freno se acciona por medio del motor o por un freno mecánico separado, según la construcción del cabrestante.

7 Embrague El embrague permite al usuario desactivar el tambor de enrollado desde el sistema de engranajes, permitiendo al tambor girar libremente (llamado “enrollado manual”). Al embragar se “bloquea” el tambor del cabrestante de nuevo en el tren de engranaje.

8 Varillas de conexión Unen las cubiertas extremas para formar una unidad estructural.

Los controles del cabrestante vienen en muchas formas. Todas ellas permiten al usuario iniciar, parar y cambiar la dirección de la rotación del tambor del cabrestante.

⚠ PRECAUCIÓN

Nunca embrague ni desembrague si el cabrestante está soportando una carga, si el cable está en tensión o si el tambor del cable está en movimiento.

CÓMO FUNCIONA EL CABRESTANTE

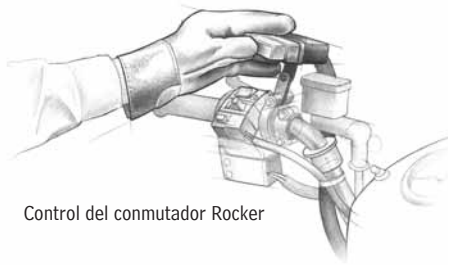
Mecánica del cabrestante

Ahora que ya se ha familiarizado con el cabrestante Warn y sus componentes, podemos empezar a ver cómo funciona. La mayor ventaja de un cabrestante eléctrico es que puede proporcionar un servicio fiable, bien sea para usarse en el trabajo o en situaciones recreativas, incluso cuando el motor del vehículo se cala, por supuesto, suponiendo que hay la suficiente corriente disponible en la batería. El cabrestante puede funcionar a altas cargas de corriente y, por esta razón, utiliza un sistema de conmutación de alta corriente para aceptar sin peligro el flujo de corriente.

Es importante comprender que cuanto más prolongando sea el tiro, más calor se creará, igual que una plancha caliente. El desenrollar el cable también genera calor y drena el sistema eléctrico. Siempre que sea posible, desenrolle el cable "libremente". Asimismo, incluso si el motor está en marcha en vacío durante el funcionamiento, la batería puede desgastarse más rápidamente que cargarse. Por lo tanto, preste atención para asegurarse de que la batería no se está desgastando demasiado y que luego no pueda poner en marcha su vehículo.

⚠ ADVERTENCIA

Mantenga siempre el vehículo a la vista durante las operaciones del cabrestante.



Control del conmutador Rocker

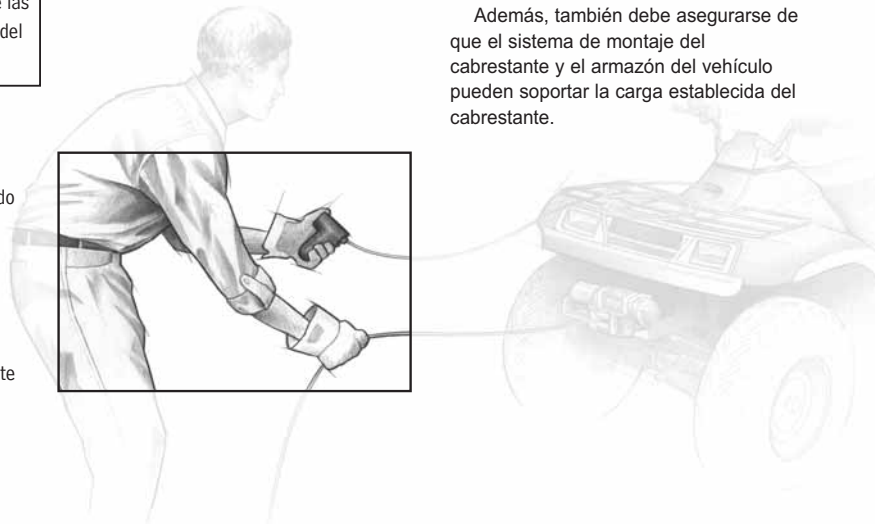
Control del cabrestante

El cabrestante está controlado por un mecanismo de conmutación que proporciona control de rotación hacia adelante y hacia atrás en el tambor de enrollado.

Cómo reacciona el cabrestante a la carga

Los cabrestantes Warn se clasifican por su capacidad de tracción. La capacidad de tracción máxima ocurre en la primera capa de cable en el tambor. A medida que aumentan las capas, disminuye la potencia de tiro. Esta es la realidad matemática del uso de cabrestantes. El exceder la capacidad del cabrestante puede producir que éste falle o que el cable se rompa. El analizar ahora cómo quiere usar el cabrestante le puede evitar graves problemas más tarde.

Además, también debe asegurarse de que el sistema de montaje del cabrestante y el armazón del vehículo pueden soportar la carga establecida del cabrestante.

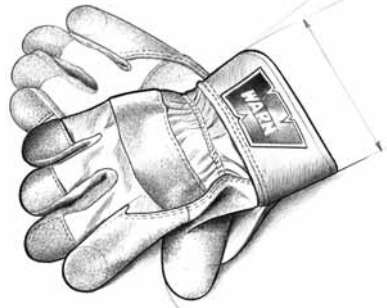


Este cabrestante está controlado por el control remoto de mano para permitir al usuario estar alejado durante el proceso de tracción.

LOS ACCESORIOS DEL CABRESTANTE QUE NECESITARÁ

El cabrestante no es mucho más que una simple herramienta. Pero cuando se utiliza con ciertos accesorios y mejoras, el cabrestante Warn puede convertirse en una herramienta de múltiples usos y muy productiva. En esta sección veremos varios de estos aspectos. Algunos de ellos son vitales para utilizar el cabrestante sin correr peligro, pero otros ofrecen versatilidad adicional y comodidad.

Polea. Si se usa la polea correctamente, ésta le permite: (1) aumentar la potencia de tiro del cabrestante y (2) cambiar la dirección de tiro sin dañar el cable. El uso apropiado de la polea se cubre en la sección “Antes de usar el cabrestante”.

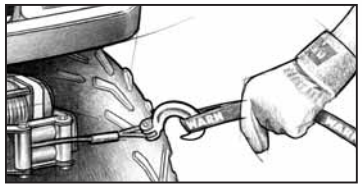


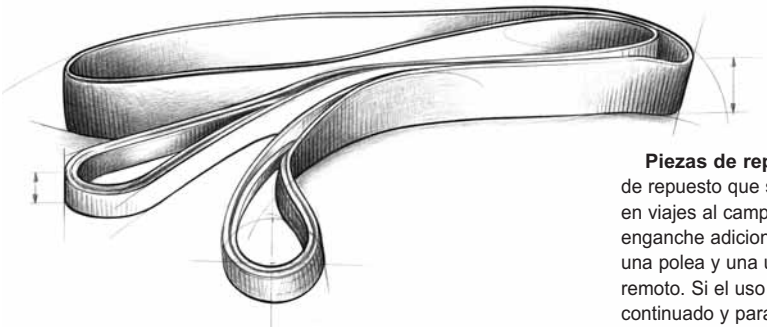
Guantes. Con el uso, el cable llegará a tener “púas” que pueden cortar la piel. Es extremadamente importante llevar guantes protectores mientras el cabrestante está en funcionamiento o se está tocando el cable. Evite usar ropa suelta o cualquier cosa que se pueda enredar en el cable o en otras partes móviles.

Correa del gancho. Se utiliza para sujetar el gancho y proteger los dedos de la guía a medida que se está enrollando el cable. Los cabrestantes adquieren una gran fuerza de tiro y pueden fácilmente cortar dedos y miembros del cuerpo que se encuentren en puntos determinados. Ponga el gancho dentro del enlace y sujete la correa entre el pulgar y el dedo índice.

Enganches en forma de D. El enganche en forma de D es un medio seguro de conectar los extremos enlazados de cables, correas y poleas. El perno del enganche es roscado para poderlo quitar fácilmente.

Cadena de estrangulación. Se puede utilizar para enganchar a otro vehículo o a objetos cortantes como punto de anclaje. No obstante, las cadenas dañarán o matarán los árboles utilizados.

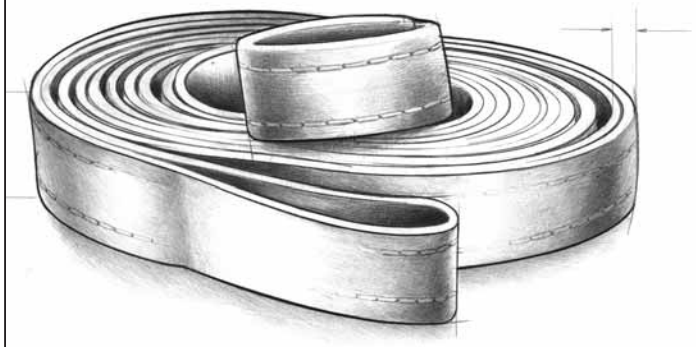




Protector de tronco de árbol. Por lo general fabricado de nilón de gran calidad, proporciona al usuario un punto de unión para el cable del cabrestante a una gran variedad de puntos de anclaje y objetos, al mismo tiempo que protege los árboles vivos.

⚠ PRECAUCIÓN

Nunca sujete la correa de recuperación al gancho del cabrestante para incrementar la longitud de tiro. Nunca intente remolcar un vehículo u objeto con la correa de recuperación sujeta directamente al gancho del cabrestante. Nunca utilice correas de goma que producen una gran fuerza al estirarse, lo cual supone un posible peligro.



Correa de recuperación. Nunca utilice una correa de recuperación durante el funcionamiento del cabrestante. Como está diseñada para estirarse, ésta acumula energía y puede reaccionar como una goma elástica si falla el maniobrado. Utilice la correa de recuperación para “extraer” un vehículo estancado.

Palas y herramientas de mano. Con mucha frecuencia, durante las actividades de tracción, se dará cuenta de que necesita más ayuda. Quizás quiera llevar herramientas como una pala o un hacha.

Piezas de repuesto. Algunas piezas de repuesto que son importantes llevar en viajes al campo son, por ejemplo, un enganche adicional de perno roscado, una polea y una unidad de control remoto. Si el uso del cabrestante es continuado y para trabajos de consideración, sería recomendable incluir un cable y un gancho adicionales.

Algunos artículos que se recomienda. llevar en la caja de herramientas son llaves de tuercas manuales, destornilladores, alicates y herramientas para cambiar el cable.

Recomendaciones para la batería. Se recomienda una batería convencional ATV totalmente cargada para obtener los mejores resultados del cabrestante. Compruebe que las conexiones eléctricas estén limpias y apretadas.

TENSIÓN DEL CABLE

La vida útil del cable está directamente relacionada con la forma en que se utiliza y se cuida el mismo. Tensar el cable es fundamental para garantizar una larga vida útil del mismo. Al tensarse el cable se evitará que las capas exteriores del mismo pellizquen o deformen las capas interiores. Durante su primer uso, un cable nuevo debe enrollarse en el tambor bajo una carga de por lo menos 227 kg (500 lbs.). Siga las instrucciones siguientes para tensar el cable correctamente en el tambor del cabrestante.

1) Escoja una superficie **PLANA** que sea lo suficientemente amplia como para poder extender todo el cable.

2) Gire la palanca del embrague del cabrestante hacia la posición “Free Spool” (enrollado libre). Agarre la correa del gancho y desenrolle el cable hasta las últimas 5 vueltas de éste en el tambor. Una vez desenrollado el cable, ponga la palanca del embrague del cabrestante en la posición “Engaged” (embragado).

3) Acople el extremo del cable con gancho a un punto de anclaje apropiado y aleje el vehículo de tal punto hasta que quede muy poco cable suelto. Antes de salir del vehículo, ponga el freno de mano, deje una velocidad puesta o en aparcado (vehículos automáticos) y apague el vehículo.

4) Enrolle el cable hasta que todo se haya enrollado en el tambor del cabrestante. Utilizando guantes, mantenga la tensión en el cable con una mano; empuje cuidadosamente el cable hacia el lado del tambor al que esté enganchado el cable, de forma que no haya espacios libres entre cada vuelta en el tambor. Verifique que el cable esté enrollándose en la parte inferior del tambor y no en la superior, ya que, en caso contrario, el freno de carga automático no funcionará correctamente. (Si el cable se desenrolla en la parte superior, habrá puesto el cabrestante en posición de desenrollar en lugar de enrollar).

5) Para una mayor seguridad, los pasos siguientes deberán realizarlos dos personas. Si trata de tensar el cable usted solo, verifique siempre que el freno de mano esté puesto, deje una marcha puesta y apague el vehículo cada vez que salga del mismo para inspeccionar el cable. No salga nunca del vehículo con una carga aplicada al cable.

6) Procure enrollar cada vuelta parejamente para evitar daños al cable.

7) Pida a su ayudante que se ponga en la parte lateral del vehiculo, alejado del cable del cabrestante. Arranque el vehículo y ponga la transmisión en punto muerto. Suelte el freno de mano mientras que presiona moderadamente el pedal del freno. Pulse en enrollar en el control. Su ayudante deberá indicarle si el cable se está enrollando correctamente a medida que observa cómo se desplaza por la guía de cable mientras se enrolla. Después de enrollar aproximadamente 2 metros (6 pies) de cable, pare el enrollado. Lentamente deje de presionar el pedal del freno para aplicar el freno de mano. Esto asegurará que no haya carga en el cable del cabrestante. A continuación, ponga la transmisión en aparcado (vehículos automáticos) o ponga una velocidad con la palanca de cambios y apague el vehículo. Salga del vehículo y asegúrese de que el cable del cabrestante esté enrollándose parejamente en el tambor y no hundiéndose en la capa inferior. Si el cable se está hundiendo, desenróllelo y repita este paso desde el principio con más presión en el pedal del freno.

8) Cuando esté convencido de que el cable está enrollándose correctamente en el tambor, repita el paso 6 hasta que el vehículo se encuentre a 1 metro (3 pies) del anclaje del cabrestante. Una vez esté a 1 metro (3 pies), lentamente deje de presionar el pedal del freno para aplicar el freno de mano. Esto asegurará que no hay carga en el cable del cabrestante. A continuación, ponga la transmisión en aparcado (vehículos automáticos) o ponga una velocidad con la palanca de cambios y apague el vehículo. Salga del vehículo. Desenganche el gancho del punto de anclaje. Mientras que agarra la correa del gancho (incluida con el producto), mantenga la tensión en el cable del cabrestante y enróllelo lentamente pulsando el botón de enrollado en el control remoto hasta que el gancho llegue a la guía. **NO PERMITA QUE EL GANCHO TOQUE LA GUIA.** Esto podría causar daños a la guía.

⚠ ADVERTENCIA

No accione nunca el cabrestante si no hay al menos 5 vueltas de cable alrededor del tambor. El cable podría soltarse del tambor ya que el dispositivo de sujeción del cable al tambor no es apto para soportar una carga.

ANTES DE USAR EL CABRESTANTE

⚠ ADVERTENCIA
Nunca utilice el cabrestante como si fuese una grúa.

⚠ ADVERTENCIA
Utilice siempre la correa suministrada para sostener el gancho cuando vaya a enrollar o desenrollar el cable.

⚠ PRECAUCIÓN
Nunca intente desembragar cuando el cable esté en tensión. No embrague nunca cuando el tambor esté girando. Compruebe siempre que se ha embragado o desembragado completamente.

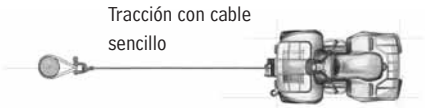
⚠ ADVERTENCIA
Mantenga siempre las manos y la ropa alejadas del cable, del gancho y de la abertura de la guía durante el accionamiento y el enrollado.

Practique el uso del cabrestante antes de quedarse estancado. Una situación real no es el momento para aprender a utilizarlo.

El conocer las técnicas apropiadas en el uso del cabrestante, ya sea para recuperar otro vehículo o para sacar un tocón de árbol de la tierra, puede servir para protegerse a sí mismo y a las personas que le rodean. Quizás la parte más importante en el uso del cabrestante sea, en cualquier situación, lo que usted hace antes de la tracción.

En esta sección le mostramos lo fundamental para usar su cabrestante eficazmente. No obstante, usted es el responsable de analizar la situación y tomar las decisiones necesarias para usar correctamente el cabrestante. Aplique sus conocimientos sobre el cabrestante y los principios básicos que haya practicado y adapte sus técnicas a la situación en particular. Cuando vaya a utilizar el cabrestante Warn recuerde lo siguiente:

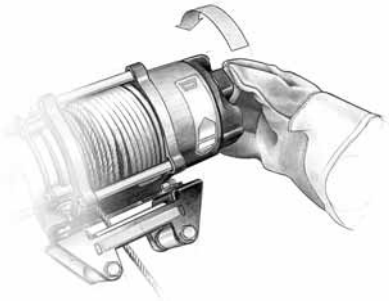
1. **Tómese su tiempo siempre para evaluar la situación y planifique la operación de tracción cuidadosamente.**
2. **Tómese su tiempo siempre cuando utilice un cabrestante.**
3. **Utilice el equipo apropiado para su situación en particular.**
4. **Utilice siempre guantes de cuero y no permita que el cable se deslice entre sus manos.**
5. **Únicamente usted deberá manejar el cable y operar el conmutador del control remoto.**
6. **Piense en su seguridad en todo momento.**
7. **Práctica Practique lo más posible cada fase.**



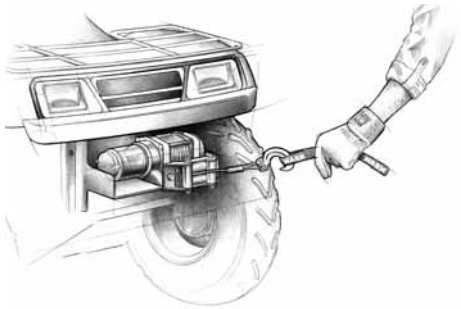
Maniobrado para la tracción

Las siguientes fases describen cómo recuperar su vehículo utilizando tracción con cable sencillo. Las técnicas de maniobrado de cable doble o múltiple siguen el mismo proceso pero utilizan una polea para realizar la tracción.

Fase 1: PÓNGASE LOS GUANTES.



Fase 2: DESEMBRAGUE. Para permitir un enrollado libre del tambor del cabrestante, gire la palanca del embrague para desembragar. El enrollado libre conserva la energía en la batería.



Fase 3: LIBERE EL GANCHO DEL CABRESTANTE Y ACOPLE LA CORREA DEL MISMO. Libere el gancho del cabrestante de su punto de anclaje. Acople la correa del gancho al mismo (si no estuviera acoplada).

Fase 4: TIRE DEL CABLE HACIA EL PUNTO DE ANCLAJE. Desenrolle suficiente cable para alcanzar el punto de anclaje. Debe haber cierta tensión en el cable. El cable se puede dañar si se enreda o se enrolla más de lo debido al aflojarlo. Para evitar perder el final, ponga el gancho del cabrestante en la correa del gancho mientras usted trabaja.

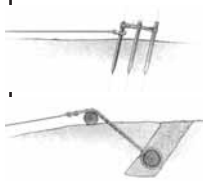
Fase 5: ASEGURAR AL PUNTO DE ANCLAJE. Una vez que haya elegido un punto de anclaje, asegure el protector del tronco del árbol o la cadena de estrangulamiento alrededor del objeto.

CÓMO ELEGIR UN PUNTO DE ANCLAJE:

Un punto de anclaje lo más alejado posible proporcionará al cabrestante la mayor capacidad de tracción posible. Un anclaje seguro es vital en el uso del cabrestante. El punto de anclaje debe ser lo suficientemente fuerte como para sujetar el cabrestante mientras se esté usando. Los puntos naturales de anclaje pueden ser árboles, tocones o rocas. Enganche el cable en la parte más baja posible.

Si no se encuentran puntos naturales de anclaje cuando se está tratando de recuperar otro vehículo, su vehículo será dicho punto. En esta situación, la transmisión se deberá poner en neutro, también habrá que accionar el freno de mano y bloquear las ruedas para evitar que su vehículo se mueva.

Lo ideal es tener un punto de anclaje que le permita tirar en línea recta en dirección hacia donde el vehículo se vaya a mover. Esto permitirá que el cable se enrolle bien y de forma igualada en el tambor de enrollado.

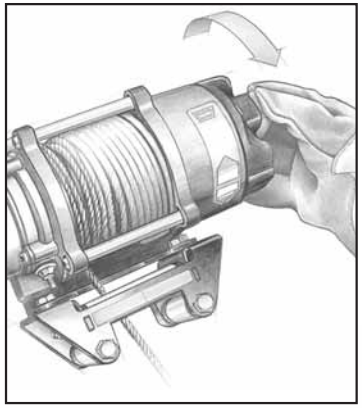


⚠ ADVERTENCIA
No accione nunca el cabrestante si no hay al menos 5 vueltas de cable alrededor del tambor. El cable podría soltarse del tambor ya que el dispositivo de sujeción del cable al tambor no es apto para soportar una carga.

⚠ PRECAUCIÓN
No deje nunca el control remoto enchufado al cabrestante cuando efectúe un enrollado manual, cuando maniobre o con el cabrestante activo pero parado.

⚠ PRECAUCIÓN
No enganche nunca el cable sobre sí mismo. Esto deterioraría el cable.

Fase 6: ACOPLE EL ENGANCHE EN FORMA DE D Y LA CORREA DEL GANCHO. Acople el enganche a los dos extremos de la correa o la cadena y a través del bucle del gancho, teniendo cuidado de no sobretensarla (tense y retroceda media vuelta).



Fase 7: BLOQUEO DEL EMBRAGUE. Bloquee el tambor del cabrestante girando la palanca del embrague para embragar.

Fase 8: CONECTE EL CONTROL REMOTO (si viene incluido). Tenga cuidado de que el cable del control remoto no se enrede enfrente del cabrestante. Desconecte siempre el control remoto cuando no lo esté usando.

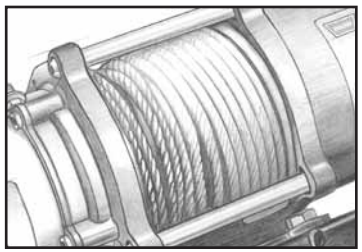
Fase 9: PONGA EL CABLE EN TENSIÓN. Utilizando el conmutador del cabrestante, enrolle lentamente el cable hasta que esté completamente tenso. Una vez que el cable esté tenso, aléjese lo más posible y no lo pise nunca.

Fase 10: COMPRUEBE EL ESTADO DEL PUNTO DE ANCLAJE. Asegúrese de que todas las conexiones estén aseguradas y despeje el área de cualquier objeto antes de continuar con el proceso de tracción.

TRACCIÓN

Como ya habrá notado, hay mucho que hacer y que tener en cuenta antes de empezar la tracción. Piense en lo que está haciendo para poder protegerse así mismo y a los demás.

Es muy importante accionar correctamente el cabrestante; de hecho, debería practicar estas técnicas antes de enfrentarse a las distracciones y el estrés que conlleva una situación real donde hay que utilizarlo.



Fase 11: COMPRUEBE EL CABLE. El cable deberá estar enrollado de forma adecuada en el tambor. El cable se puede dañar si el enrollado no se hace correctamente.

Fase 12: PONGA ALGO SOBRE EL CABLE, si cree que es necesario, a la mitad entre el cabrestante y el punto de anclaje para absorber fuerza en caso que el cable se suelte. Ramas de árboles, chaquetas pesadas, cadenas, mochilas y objetos parecidos se pueden utilizar con este propósito.

AVISO

Evite sobrecalentar el motor del cabrestante. Si el uso del cabrestante se va a realizar durante un periodo de tiempo largo, pare el motor del mismo en intervalos razonables para permitir que se enfríe.

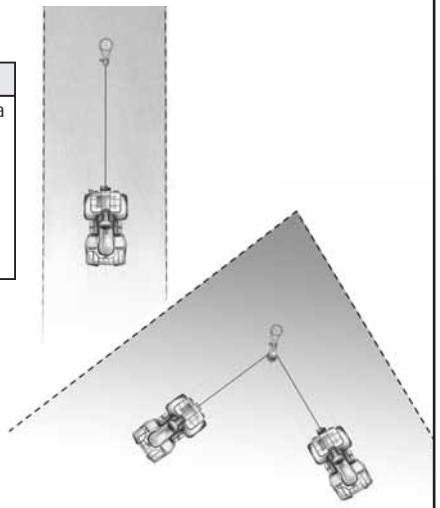
Consulte la tabla para ver las pautas de tiempo de funcionamiento.

Pautas de tiempo de funcionamiento para cabrestantes WARN para vehículos ATV/UTV

Carga (lbs)	Tiempo de funcionamiento	Distancia (pies)	Tiempo de enfriamiento (min)
0	2.5 min	50	12
500	2.0 min	32	10
1000	1.0 min	14	10
1500	25 sec	5	10
2000	15 sec	2	10
2500	10 sec	1	10

Los ciclos de trabajo varían dependiendo del modelo de cabrestante. Consulte la hoja de especificaciones que viene con el cabrestante.

Establezca las zonas "prohibidas para las personas":



AVISO

No utilice nunca el cable del cabrestante para remolcar otro vehículo o un objeto.

Fase 13: AVISE DE SUS INTENCIONES. Asegúrese de que todas las personas que estén en las inmediaciones del cabrestante que se vaya a poner en uso sepan bien las intenciones que usted tiene antes de comenzar la tracción.

Ponga límites en cuanto al lugar donde los espectadores deben estar—nunca detrás o enfrente del vehículo y nunca cerca del cable. Su situación puede exigir tener otras zonas donde la gente no puede estar.

AVISO

Evite siempre los tirones laterales continuos ya que pueden apilar el cable en un extremo del tambor. Esto puede dañar el cable o el cabrestante.

Fase 14: PONGA EN FUNCIONAMIENTO EL CABRESTANTE. Con el motor en funcionamiento del vehículo que se va a usar para ayudar al cabrestante y con el cable ya ligeramente tensado, comience la tracción lentamente y a un ritmo constante. El cable se tendrá que enrollar correctamente alrededor del tambor. Para obtener mejor tracción, el vehículo del que se está tirando podrá conducirse lentamente mientras se usa el cabrestante.

El vehículo puede moverse con el volante cuando se esté usando el cabrestante, pero no debe conducirse. El desplazamiento del vehículo ocasionará que el cable no se enrolle bien y se enrede.

Qué hay que considerar cuando haya carga

El cable debe enrollarse siempre en el tambor empezando por el lado más próximo a la placa de montaje, según se indica en la etiqueta de advertencia situada en el extremo del motor del cabrestante.

Al enrollar el cable éste debe quedar tenso y bien distribuido en el tambor. Esto evita que las vueltas más externas del cable se traben con las vueltas internas, lo cual puede ocasionar atascamientos y daños al cable.

Realice el arrastre con la transmisión del vehículo en punto muerto y con el freno de mano desactivado. Tenga paciencia y deje que el cabrestante haga el trabajo. Esto evitará que el vehículo retroceda provocando tirones que pueden dañar el cabrestante o el cable.

Durante operaciones de tiro lateral, el cable tiende a acumularse en un extremo del tambor. Esta acumulación de cable puede hacerse excesiva, lo que puede causar daños serios al cabrestante. Por consiguiente, haga las operaciones de tiro en línea recta si es posible y pare el cabrestante si el cable se acerca a las varillas de conexión o a la placa de montaje. Para solucionar la acumulación desigual de cable, desenrolle esa sección del mismo y colóquelo en el extremo opuesto del tambor, lo que dejará espacio para continuar con el enrollado.

Fase 15: PARA RECUPERAR UN VEHÍCULO, continúe tirando hasta que éste se encuentre en terreno firme. Si puede conducir el vehículo, el uso del cabrestante habrá finalizado.

Fase 16: ASEGURE EL VEHÍCULO. Una vez que se haya recuperado el vehículo, accione los frenos del mismo y ponga la transmisión en "aparcar" (si es automática). Afloje la tensión del cable.

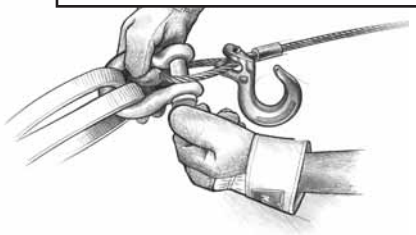
Cómo enrollar el cable cuando no hay carga.

Disponga el cable de forma que no se doble ni se trabe al enrollarlo. Asegúrese de que el cable ya enrollado en el tambor esté bien tenso y dispuesto en capas uniformes. Tense y enderece la capa si es necesario. Mantenga el cable bajo tensión ligera y enrolle el mismo de nuevo en el tambor del cabrestante en capas uniformes, una después de la otra. Al final de cada capa deje de enrollar y coloque el cable en capas iguales bien apretadas.

Repita este proceso hasta que el gancho del cabrestante quede a una distancia mínima de 4 pies (1,2 m) del cabrestante. Coja el gancho entre el pulgar y el dedo índice y acople la correa del mismo. Coja la correa entre el pulgar y el índice para mantener la tensión del cable. Ayude al cable hacia la guía, enrollando cuidadosamente el resto del cable mientras pulsa el interruptor del control.

Ponga el gancho en la guía o tense hasta un lugar adecuado a un lado.

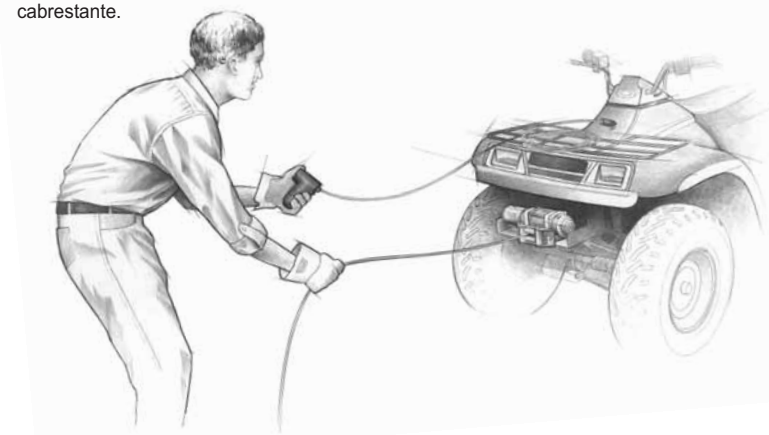
Si no tiene la correa del gancho, utilice la longitud de un cordón o algo parecido. Para prevenir lesiones graves, NUNCA ponga los dedos dentro del área del gancho al enrollar.



Fase 17: DESCONECTE EL CABLE. Desconecte el cable del punto de anclaje.

Fase 18: ENROLLE EL CABLE. La persona encargada del cable deberá ayudar con el enrollado del mismo y no dejarlo resbalar por la mano; ésta deberá también controlar en todo momento el cabrestante.

Fase 19: DESCONECTE EL CONTROL REMOTO. Desconecte el cordón del control remoto y guárdelo en un lugar limpio y seco. Las operaciones del cabrestante ya se han finalizado. Ponga la tapa en la toma.

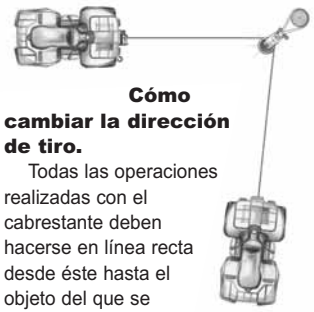


⚠ ADVERTENCIA

Mantenga siempre las manos y la ropa alejadas del cable, del gancho y de la abertura de la guía durante el accionamiento y el enrollado.

TÉCNICAS DE MANIOBRADO

En varias situaciones donde se utiliza el cabrestante se requieren aplicaciones de otras técnicas de tracción. Éstas pueden ser tales como poner una distancia corta para obtener una tracción máxima utilizando el maniobrado de línea recta o simplemente aumentar la potencia de tiro, o mantener una situación de tiro en línea recta. Usted tendrá que decidir qué técnica es la más adecuada para la situación en que se encuentra. Tenga en mente la "seguridad" en todo momento.

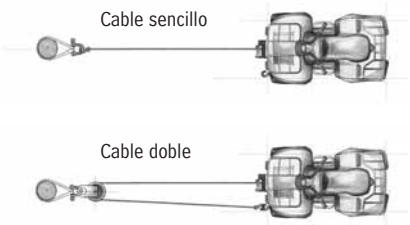


Cómo cambiar la dirección de tiro.

Todas las operaciones realizadas con el cabrestante deben hacerse en línea recta desde éste hasta el objeto del que se quiera tirar. Esto reduce al mínimo la acumulación del cable a un lado sólo del tambor, lo cual afecta el tiro eficaz y daña el cable. Una polea, fijada en un punto directamente enfrente del vehículo, le permitirá cambiar la dirección del tiro mientras continúa permitiendo al cable estar a un ángulo de 90º para enrollarse correctamente en el tambor.

Aumento de la potencia de arrastre y duración

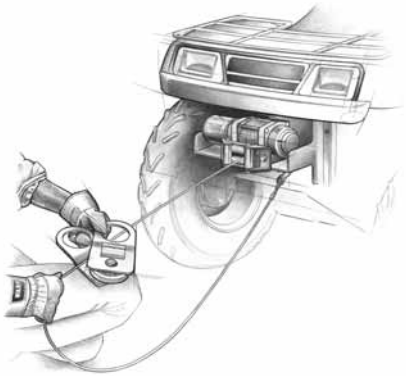
En algunos casos notará que se necesita más potencia de tiro. El uso de poleas aumentan la ventaja mecánica y esto incrementa la potencia de tiro:



Cable doble

Debido a que la potencia de tiro disminuye con el número de capas del cable en el tambor del cabrestante, se puede utilizar una polea para utilizar el cable doble. Esto disminuye el número de capas del cable en el tambor y aumenta la potencia de tiro.

Comience soltando suficiente cable como para sacar el gancho del cabrestante. Enganche el gancho al armazón del vehículo y pase el cable a través de la polea. No enganche el gancho al conjunto de montaje.



Desembrague y utilice la polea, suelte el suficiente cable como para alcanzar el punto de anclaje.

Asegure el punto de anclaje con el protector del tronco del árbol o la cadena de estrangulación. Acoplamiento del enganche. Acople el enganche a los dos extremos de la correa o cadena, teniendo cuidado de no sobretensarla (tense y retroceda media vuelta).

MANTENIMIENTO

- Inspeccione el cable de tiro antes y después de cada operación efectuada con el cabrestante. Si el cable se ha retorcido o deshilachado, necesitará reemplazarse de inmediato. Inspeccione también el gancho del cabrestante y el pasador del mismo por si estuvieran desgastados o dañados. Reemplácelos si es necesario.
- Si el cabrestante está equipado con cable sintético, lea el contenido de la Guía del cable sintético. Inspeccione el cable meticulosamente después de cada uso.

  Reemplácelo si:
  (1) el volumen del cable se ha reducido en cualquier parte de él en un 25% o más debido a la abrasión, (2) dos o más hilos adyacentes están cortados, (3) se encuentran partes planas o protuberancias que no desaparecen al doblar el cable, o (4) se encuentran excesivas fibras fusionadas o fundidas. Cualquier área de este tipo estará rígida y el cable tendrá una apariencia glaseada.
- Mantenga limpios de contaminantes el cabrestante, el cable y el control de conmutación. Utilice un paño limpio o una toalla para quitar la suciedad. Si es necesario, desenrolle el cabrestante completamente (dejando un mínimo de 5 vueltas en el tambor de enrollado), límpielo bien y vuelva a enrollar correctamente antes de almacenar. Si se aplica un aceite ligero al cable y al gancho del cabrestante se evitará la formación de óxido y corrosión.
- El usar el cabrestante durante un largo periodo de tiempo gasta demasiada batería en el vehículo. Revise y mantenga en buen estado la batería y los cables de la misma de acuerdo a las instrucciones del fabricante. Inspeccione también el control de conmutación y todas las conexiones eléctricas para cerciorarse que están limpias y en buenas condiciones.
- Inspeccione el control remoto, si lo tuviera, para cerciorarse de que no esté dañado. Asegúrese de cubrir el control remoto para evitar que entre suciedad en las conexiones. Almacene el control remoto en un área protegida, limpia y seca.
- No se requiere lubricación durante la vida de uso del cabrestante.

OPERACIÓN A TEMPERATURAS BAJO CERO

El enrollado libre del cable desde el tambor del cabrestante puede resultar más difícil a temperaturas bajo cero. Ponga el embrague en la posición de enrollado libre y desenrolle el cable 2 o 3 m para calentar el cabrestante.

ALMACENAMIENTO

Cuando no se esté usando, el cabrestante deberá dejarse con el embrague puesto. Esto ayudará a las piezas internas del cabrestante a soportar los efectos de las inclemencias del tiempo y la contaminación.

EL ANÁLISIS FINAL

La guía básica de técnicas apropiadas de tracción no puede cubrir todas las posibles situaciones en que se tenga que utilizar un cabrestante. En el análisis final, las decisiones que usted tome determinarán el resultado final. Por lo tanto, analice bien cada situación y cada fase de uso. Piense siempre en su propia protección y la de los demás. Ponga atención y lo podrá disfrutar.

⚠ PRECAUCIÓN

Alzar y descender una máquina quitanieves puede dañar el cable. Inspeccione el cable cuidadosamente para detectar posibles desgastes, hilos rotos o retorcimientos en el cable. Reemplace el cable si encuentra algún daño.

⚠ ADVERTENCIA

No accione nunca el cabrestante si no hay al menos 5 vueltas de cable alrededor del tambor. El cable podría soltarse del tambor ya que el dispositivo de sujeción del cable al tambor no es apto para soportar una carga.

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Installation Guide:
Dominator™ Lightbar
(with End Flashers)
Model(s): D2, D4****, D6******, D8*******

Automotive: Lightbars

Safety First

This document provides all the necessary information to allow your Whelen product to be properly and safely installed. Before beginning the installation and/or operation of your new product, the installation technician and operator must read this manual completely. Important information is contained herein that could prevent serious injury or damage.

- **Proper installation of this product requires the installer to have a good understanding of automotive electronics, systems and procedures.**
- **If mounting this product requires drilling holes, the installer MUST be sure that no vehicle components or other vital parts could be damaged by the drilling process. Check both sides of the mounting surface before drilling begins. Also de-burr any holes and remove any metal shards or remnants. Install grommets into all wire passage holes.**
- **If this manual states that this product may be mounted with suction cups, magnets, tape or Velcro®, clean the mounting surface with a 50/50 mix of isopropyl alcohol and water and dry thoroughly.**
- **Do not install this product or route any wires in the deployment area of your air bag. Equipment mounted or located in the air bag deployment area will damage or reduce the effectiveness of the air bag, or become a projectile that could cause serious personal injury or death. Refer to your vehicle owner's manual for the air bag deployment area. The User/Installer assumes full responsibility to determine proper mounting location, based on providing ultimate safety to all passengers inside the vehicle.**
- **For this product to operate at optimum efficiency, a good electrical connection to chassis ground must be made. The recommended procedure requires the product ground wire to be connected directly to the NEGATIVE (-) battery post.**
- **If this product uses a remote device to activate or control this product, make sure that this control is located in an area that allows both the vehicle and the control to be operated safely in any driving condition.**
- **Do not attempt to activate or control this device in a hazardous driving situation.**
- **This product contains either strobe light(s), halogen light(s), high-intensity LEDs or a combination of these lights. Do not stare directly into these lights. Momentary blindness and/or eye damage could result.**
- **Use only soap and water to clean the outer lens. Use of other chemicals could result in premature lens cracking (crazing) and discoloration. Lenses in this condition have significantly reduced effectiveness and should be replaced immediately. Inspect and operate this product regularly to confirm its proper operation and mounting condition. Do not use a pressure washer to clean this product.**
- **It is recommended that these instructions be stored in a safe place and referred to when performing maintenance and/or reinstallation of this product.**
- **FAILURE TO FOLLOW THESE SAFETY PRECAUTIONS AND INSTRUCTIONS COULD RESULT IN DAMAGE TO THE PRODUCT OR VEHICLE AND/OR SERIOUS INJURY TO YOU AND YOUR PASSENGERS!**

For warranty information regarding this product, visit **www.whelen.com/warranty**

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Form No.13897E (052009)

Specifications:

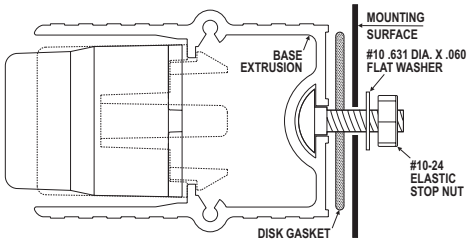
Input Voltage:	12.8 VDC +/- 20%
Input Current - Sim:	Peak - 3.2 Amps (Avg.: 1.28 Amps)
Input Current - Alt:	Peak - 1.6 Amps (Avg.: 0.64 Amps)
Input Sync:	Active Low
Sync Phase:	Phase I & II @ 400ms
Input Scan-Lock™:	+12 VDC @ 20 ma

Installation:

IMPORTANT! The lightbar should be located a minimum of 16" from any radio antennas!

Note: When routing the wires, it is very important that you choose a path that will keep the wires away from excessive heat or any vehicle equipment that could compromise the integrity of the wires (ex. trunk lids, door jams, etc.).

End view of extrusion with endcap removed.



1. Position the unit in its proposed mounting location. Draw a pencil line onto the mounting surface along the top and bottom of the extrusion and a “centerline” centered between the two.
2. Two 1/4” holes are required to mount this unit. These holes may be located anywhere along the horizontal centerline that you drew in step one. It’s best to locate the holes as far apart as possible. Mark the hole location onto the mounting surface.
3. Using a 1/4” drill bit, drill a hole in each of the areas scribed in the previous step.
4. Slide the 2 carriage bolts (installed in the rear of the bar) over to the 2 mounting holes, install the rubber gaskets onto the bolts then insert them into the mounting holes.
5. Secure the unit by threading the flat washer and elastic stop nut onto each bolt and tightening them firmly.

Wiring: **Refer to the wiring diagram on the next page.**

WARNING: All customer supplied wires that connect to the positive terminal of the battery must be sized to supply at least 125% of the maximum operating current and FUSED at the battery to carry that load. DO NOT USE CIRCUIT BREAKERS WITH THIS PRODUCT!

Operation: White/Violet / Scan-Lock™

Scan-Lock allows you to choose from several flash patterns. To change a flash pattern, turn on the desired lighthead:

CYCLE THROUGH ALL PATTERNS: To cycle forward, apply +12 volts to the WHITE/VIOLET wire for less than 1 second and release. **To cycle backward,** apply +12 volts to the WHITE/VIOLET wire for more than 1 second and release.

SET A PATTERN AS DEFAULT: When the desired pattern is displayed, allow it to run for more than 5 seconds. The lighthead will now display this pattern when active.

RESET TO THE FACTORY DEFAULT PATTERN: Turn off power and apply +12 volts to the WHITE/VIOLET wire while turning power back on.

Note: If you wish to connect the pattern selection wire (WHITE/ VIOLET) to a switch, an SPST momentary switch is recommended.

Available Scan-Lock™ Flash Patterns:

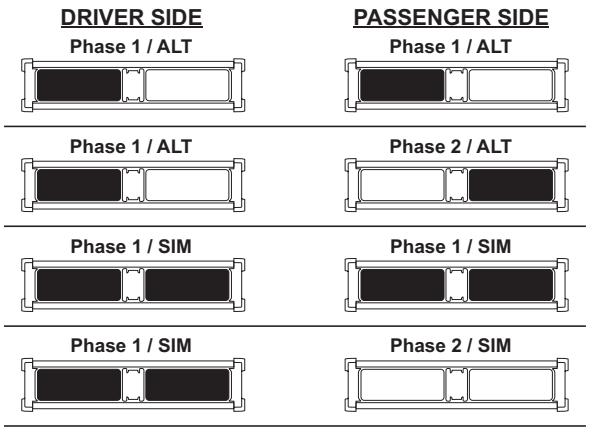
4, 6 & 8 Lamp Arrays: SignalAlert™ 75 > CometFlash® 75 > SingleFlash 375 > SingleFlash 75 > ActionFlash™ > ModuFlash™ > ZigZag 60 > ZigZag 90 ZigZag 120 > ActionScan™
2 Lamp Array: Signal Alert™ 75 > CometFlash® 75 > SingleFlash 375 SingleFlash 75 > ActionFlash™ > ModuFlash™ > ActionScan™

Grey / SYNC:

As an example, we will synchronize two 2 lighthead Dominators™. The 2-lighthead Dominator™ has 4 unique modes for each of the 4 flash patterns that can be synchronized; Alternating Phase 1, Alternating Phase 2, Simultaneous Phase 1 and Simultaneous Phase 2.

In Alternating Mode: The left lightbar alternates with the right lightbar.
In Simultaneous Mode: The left and right lightbars flash simultaneously.

EXAMPLE:
Two, 2-light Dominators™ mounted on the rear deck.



Synchronized lightbars, must be set to the same pattern. Not all patterns can be synchronized. Below are patterns available for SYNC.

Available Sync Patterns — **Pattern Sequence**

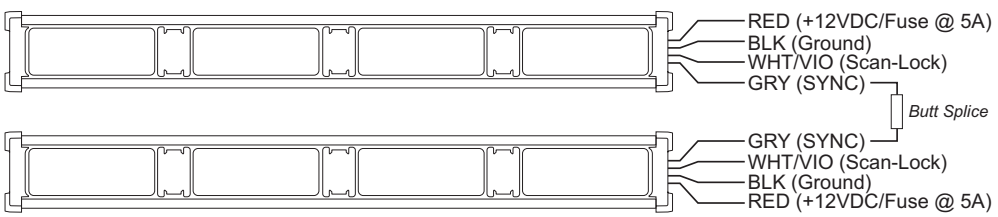
4, 6 & 8 Lamp Arrays

SignalAlert™ 75 ..... Alt. - In-Out - Checker Board - Sim. Phase I - Sim. Phase II
CometFlash® 75 ..... Alt. - In-Out - Checker Board - Sim. - Phase I - Sim. Phase II
SingleFlash 375 ..... Alt. - In-Out - Checker Board - Sim. - Phase I - Sim. Phase II
SingleFlash 75 ..... Alt. - In-Out - Checker Board - Sim. - Phase I - Sim. Phase II

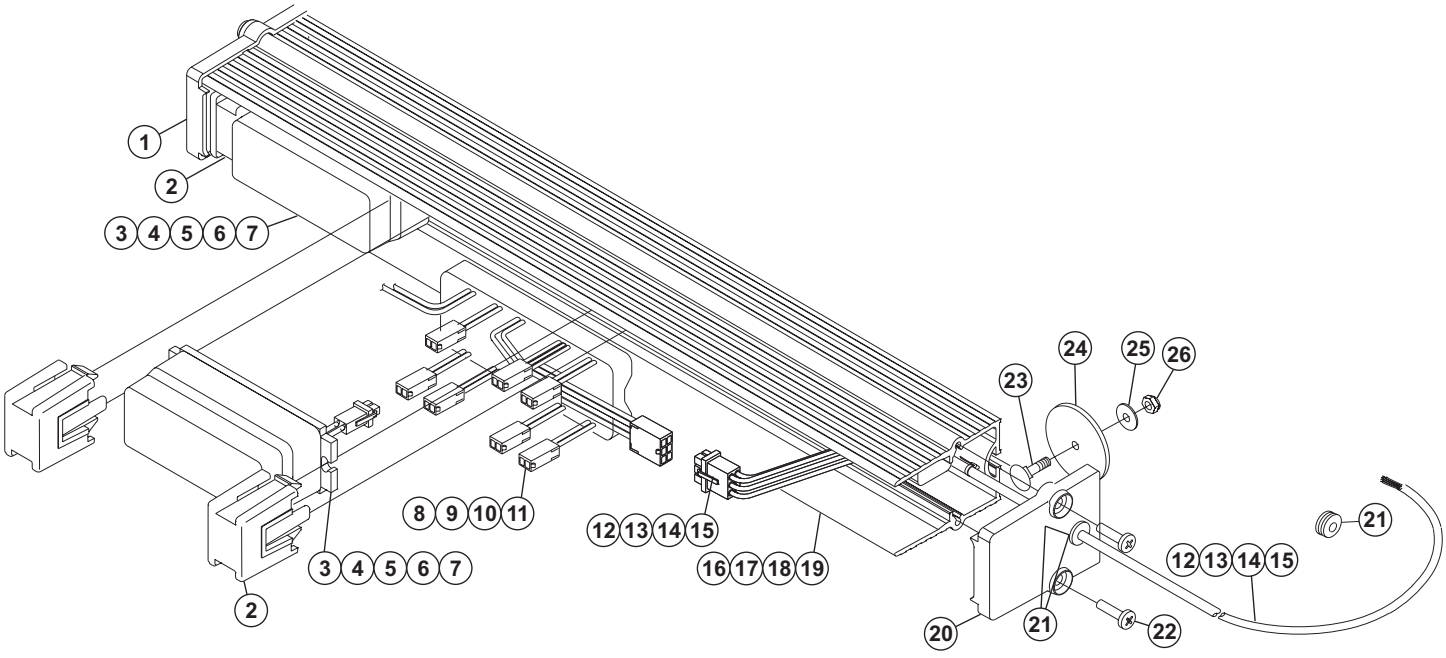
2 Lamp Array:

SignalAlert™ 75 ..... Alternating - Simultaneous - Phase I - Simultaneous Phase II
CometFlash® 75 ..... Alternating - Simultaneous - Phase I - Simultaneous Phase II
SingleFlash 375 ..... Alternating - Simultaneous - Phase I - Simultaneous Phase II
SingleFlash 75 ..... Alternating - Simultaneous - Phase I - Simultaneous Phase II

Wiring



QTY	QTY	QTY	QTY	ITEM	PART NUMBER	DESCRIPTION	"A"
			*		01-0684607-( )	DOMINATOR™ / FLASHER - 2 LT	7.11
		*			01-0684607-( )	DOMINATOR™ / FLASHER - 4 LT	14.21
	*				01-0684607-( )	DOMINATOR™ / FLASHER - 6 LT	23.26
*					01-0684607-( )	DOMINATOR™ / FLASHER - 8 LT	30.36
1	1	1	1	**1**	11-263726-000	ENDCAP / 3 TIR EXTR. MT. without HOLE	
9	7	3	1	**2**	38-0463725-00	DIVIDER / EXTRUSION MOUNT	
A/R	A/R	A/R	A/R	**3**	02-036B494612	LIGHTHEAD, TIR3™ LED (AMBER)	
A/R	A/R	A/R	A/R	**4**	02-036B494622	LIGHTHEAD, TIR3™ LED (BLUE)	
A/R	A/R	A/R	A/R	**5**	02-036B494632	LIGHTHEAD, TIR3™ LED (WHITE)	
A/R	A/R	A/R	A/R	**6**	02-036B494642	LIGHTHEAD, TIR3™ LED (GREEN)	
A/R	A/R	A/R	A/R	**7**	02-036B494652	LIGHTHEAD, TIR3™ LED (RED)	
-	-	-	1	**8**	01-0264929-01	ELECT. ASSY / 2 LIGHTHEAD FLASHER	
-	-	1	-	**9**	01-0269777-A4	ELECT. ASSY / 4 LIGHTHEAD FLASHER	
-	1	-	-	**10**	01-0269777-A6	ELECT. ASSY / 6 LIGHTHEAD FLASHER	
1	-	-	-	**11**	01-0269777-A8	ELECT. ASSY / 8 LIGHTHEAD FLASHER	
-	-	-	1	**12**	46-0743087-A2	CABLE ASSY with MINI UMNL CONN. 13"	
-	-	1	-	**13**	46-0743087-A4	CABLE ASSY with MINI UMNL CONN. 17"	
-	1	-	-	**14**	46-0743087-A6	CABLE ASSY with MINI UMNL CONN. 20"	
1	-	-	-	**15**	46-0743087-A8	CABLE ASSY with MINI UMNL CONN. 24"	
-	-	-	1	**16**	11-443031-006	EXTRUSION / MACH'D - 6.75 3TIR TA	
-	-	1	-	**17**	11-443031-013	EXTRUSION / MACH'D - 13.85 3TIR TA	
-	1	-	-	**18**	11-443031-022	EXTRUSION / MACH'D - 22.90 3TIR TA	
1	-	-	-	**19**	11-443031-030	EXTRUSION / MACH'D - 30.00 3TIR TA	
1	1	1	1	**20**	11-263726-001	ENDCAP / 3 / TIR™ EXTR. MT. w/.50 HOLE	
2	2	2	2	**21**	21-11091202-0	GROMMET	
4	4	4	4	**22**	14-062219-06D	SCREW / #6-32 X 3/8 PPHMS ROLOK ZN	
2	2	2	2	**23**	14-104066-100	CARRIAGE BOLT / #10-24 X 5/8 LG SS	
2	2	2	2	**24**	38-0223063-00	GASKET / DISK	
2	2	2	2	**25**	16-1002220-50	WASHER, #10 FLAT .631 DIA. X .060	
2	2	2	2	**26**	13-104120-062	NUT / #10-24 ELASTIC STOP	



Pantone 4625C

POLARIS®

The Way Out.

2010

RANGER 4X4 700 EFI
RANGER 6X6 700 EFI

Owner's Manual

for Maintenance and Safety

⚠WARNING

Improper vehicle use can result in SEVERE INJURY or DEATH.

NEVER:

- **Operate on public roads. A collision can occur with another vehicle.**
- **Carry more than two passengers, or passengers under age five.**
- **Use ALCOHOL or DRUGS before or while operating this vehicle.**
- **Operate at speeds too fast for your skills or the conditions.**
- **Operate this vehicle on HILLS steeper than 15 degrees ∠ 15°. To prevent flipover in hilly terrain, use throttle and brakes gradually.**

ALWAYS:

- **Avoid paved surfaces, which may adversely affect handling and control.**
- **Use proper RIDING TECHNIQUES to avoid vehicle overturns on hills and rough terrain, and in turns.**
- **Wear eye protection.**

REVERSE operation can be dangerous, even at low speeds. Steering becomes difficult. To prevent flipover, avoid sharp turns.

The park brake will supply increased braking, but should be used as a parking brake only.

READ OWNER'S MANUAL.
FOLLOW ALL INSTRUCTIONS AND WARNINGS.

POLARIS®
The Way Out.

For your nearest Polaris dealer,
call 1-800-POLARIS
or visit www.polarisindustries.com
Polaris Sales Inc.,
2100 Hwy. 55, Medina, MN 55340
Phone 1-888-704-5290
Part No. 9921268 Rev 02
Printed in USA

⚠ WARNING

Read, understand, and follow all of the instructions and safety precautions in this manual and on all product labels.

Failure to follow the safety precautions could result in serious injury or death.

⚠ WARNING

The engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects or other reproductive harm.

WELCOME

Thank you for purchasing a Polaris vehicle, and welcome to our worldwide family of Polaris owners. We proudly produce an exciting line of utility and recreational products.

- Snowmobiles
- All-terrain vehicles (ATVs)
- *RANGER* utility vehicles
- Victory motorcycles

We believe Polaris sets a standard of excellence for all utility and recreational vehicles manufactured in the world today. Many years of experience have gone into the engineering, design, and development of your Polaris vehicle, making it the finest machine we've ever produced.

For safe and enjoyable operation of your vehicle, be sure to follow the instructions and recommendations in this owner's manual. Your manual contains instructions for minor maintenance, but information about major repairs is outlined in the Polaris Service Manual and should be performed only by a Factory Certified Master Service Dealer (MSD) Technician.

Your Polaris dealer knows your vehicle best and is interested in your total satisfaction. Be sure to return to your dealership for all of your service needs during, and after, the warranty period.

We also take great pride in our complete line of apparel, parts and accessories, available through our online store at www.purepolaris.com. Have your accessories and clothing delivered right to your door!

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The Way Out.

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Printed in U.S.A.

2008 *RANGER* 4X4 700 EFI/*RANGER* 6X6 700 EFI Owner's Manual

P/N 9921268

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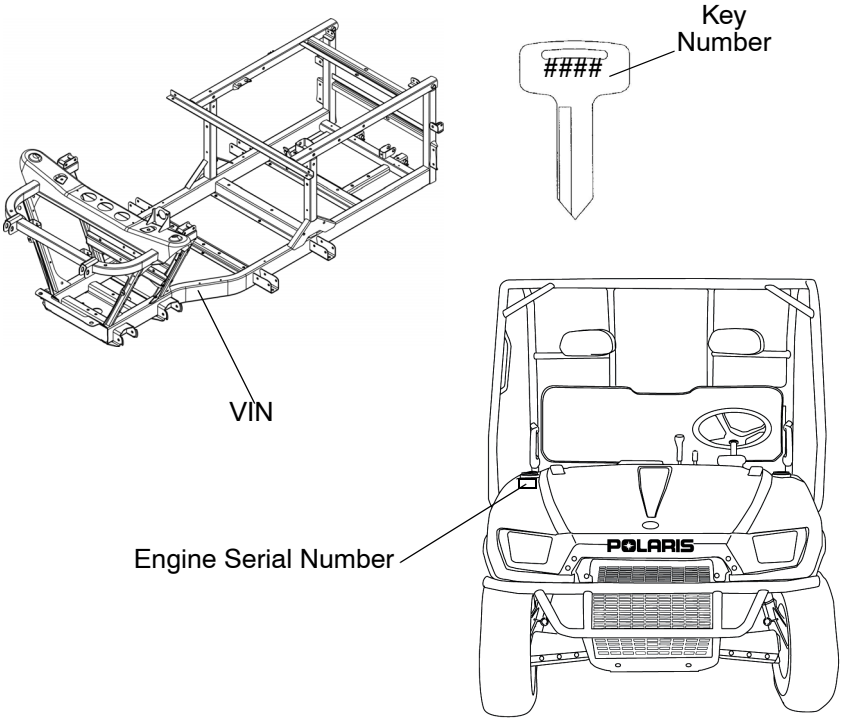
VEHICLE IDENTIFICATION NUMBERS

Record your vehicle's identification numbers and key number in the spaces provided. Remove the spare key and store it in a safe place. An ignition key can be duplicated only by ordering a Polaris key blank (using your key number) and mating it with one of your existing keys. The ignition switch must be replaced if all keys are lost.



Vehicle Model Number: _____

Frame VIN: _____

Engine Serial Number: _____

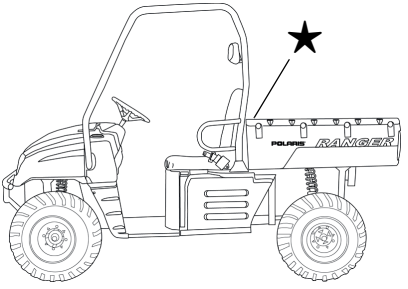
Key Number _____

Safety Decals and Locations

Warning decals have been placed on the vehicle for your protection. Read and follow the instructions of the decals on the vehicle carefully. If any of the decals depicted in this manual differ from the decals on your vehicle, always read and follow the instructions of the decals *on the vehicle*.

If any decal becomes illegible or comes off, contact your Polaris dealer to purchase a replacement. Replacement *safety* decals are provided by Polaris at no charge. The part number is printed on the decal.

Container/Passenger/Tire Pressure Warning



WARNING

Remove flammable material containers from box before filling.

- Passengers can be thrown off. This can cause serious injury or death.
- Never carry passengers in cargo box.

Maximum 2X4 Box Load 850 lbs. (386 kg)

Maximum 4X4 Box Load 1000 lbs. (455 kg)

Maximum 6X6 Box Load 1200 lbs. (545 kg)

IMPROPER TIRE PRESSURE OR OVERLOADING can cause loss of control resulting in SEVERE INJURY OR DEATH.

TIRE PRESSURE IN PSI (KPa):

RANGER - 2X4 and 4X4 FRONT 10 (69) REAR 10 (69)

RANGER - 6X6 FRONT 10 (69) CENTER 10 (69) REAR 10 (69)

MAXIMUM WEIGHT CAPACITY INCLUDES WEIGHT OF OPERATOR, PASSENGER, CARGO, AND ACCESSORIES.

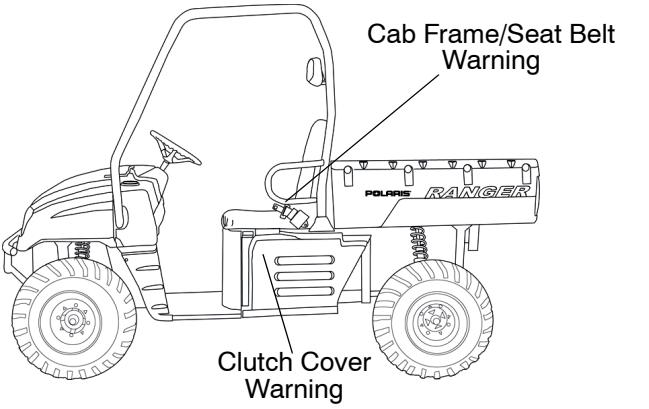
RANGER 2X4 and 4X4 is 1500 LBS. (682 KG)

RANGER 6X6 is 1750 LBS. (795 KG)

Reduce speed and allow greater distance for braking when carrying cargo. Overloading or carrying tall, off-center, or unsecured loads will increase your risk of losing control. Loads should be centered and carried as low as possible in box. For stability on rough or hilly terrain, reduce speed and cargo. Be careful if load extends over the side of the box.

Read Owner's Manual for more detailed loading information.

SAFETY
Safety Decals and Locations



Clutch Cover Warning

WARNING

NO STEP

- Moving parts hazard under belt-clutch guard. To prevent serious injury, do not operate vehicle with guard removed.
- Do not modify engine or clutch. Doing so can cause part failure, possible imbalance, and excessive engine RPM which can result in serious injury or death.

Cab Frame/Seat Belt Warning

WARNING

- VEHICLE ROLLOVER could cause severe injury or death. This cab frame is not designed or intended to provide rollover protection.
- ALWAYS WEAR YOUR SEAT BELT for maximum protection.

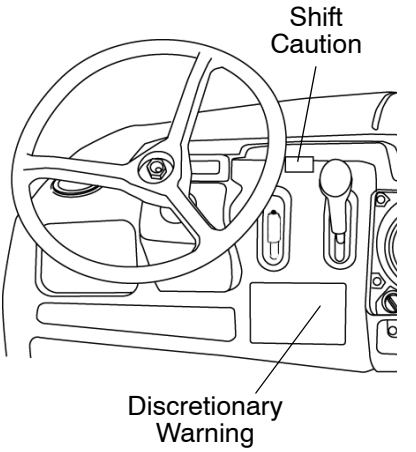
Safety Decals and Locations

Shift Caution

CAUTION

To avoid transmission damage, shift only when vehicle is stationary and at idle.

Discretionary Warning



WARNING

Improper vehicle use can result in SEVERE INJURY or DEATH.

NEVER:

- Operate on public roads. A collision can occur with a another vehicle.
- Carry more than two passengers, or passengers under age five.
- Use ALCOHOL or DRUGS before or while operating this vehicle.
- Operate at speeds too fast for your skills or the conditions.
- Operate this vehicle on HILLS steeper than 15 degrees ⟋ 15°. To prevent flipover on hilly terrain, use throttle and brakes gradually.

ALWAYS:

- Avoid paved surfaces which may adversely affect handling and control.
- Use proper RIDING TECHNIQUES to avoid vehicle overturns on hills and rough terrain and in turns.
- Wear eye protection.

REVERSE operation can be dangerous even at low speeds. Steering becomes difficult. To prevent flipover, avoid sharp turns.

The park/emergency brake lever will supply increased braking, but should be used as an emergency or parking brake only.

READ OWNER'S MANUAL. FOLLOW ALL INSTRUCTIONS AND WARNINGS.

IF OWNER'S MANUAL IS MISSING, CONTACT A POLARIS DEALER FOR A REPLACEMENT.

THIS GENERAL PURPOSE OFF-ROAD UTILITY VEHICLE DOES NOT MEET FEDERAL MOTOR VEHICLE SAFETY STANDARDS FOR ON-ROAD VEHICLES.

SAFETY
Operator Safety

⚠ WARNING

Failure to follow the warnings contained in this manual can result in severe injury or death.

A Polaris *RANGER* is not a toy and can be hazardous to operate. This vehicle handles differently than other vehicles, such as motorcycles and cars. A collision or rollover can occur quickly, even during routine maneuvers like turning, or driving on hills or over obstacles, if you fail to take proper precautions.

Read and understand your owner's manual and all warnings before operating the vehicle.

Age Restrictions

This vehicle is an ADULT VEHICLE ONLY. Operation is prohibited for anyone under 16 years of age. No person under the age of 5 may ride as a passenger in this vehicle.

Know Your Vehicle

As the operator of the vehicle, you are responsible for your personal safety, the safety of others, and the protection of our environment. Read and understand your owner's manual, which includes valuable information about all aspects of your vehicle, including safe operating procedures.

The *RANGER* is an off-road vehicle. Familiarize yourself with all laws and regulations concerning the operation of this vehicle in your area.

We strongly advise you to strictly follow the recommended maintenance program outlined in your owner's manual. This preventive maintenance program is designed to ensure that all critical components on your vehicle are thoroughly inspected at specific intervals.

Operator Safety

The following signal words and symbols appear throughout this manual and on your vehicle. Your safety is involved when these words and symbols are used. Become familiar with their meanings before reading the manual.

⚠

The *safety alert symbol*, on your vehicle or in this manual, alerts you to the potential for injury.

⚠ WARNING

The *safety alert warning* indicates a potential hazard that may result in serious injury or death.

⚠ CAUTION

The *safety alert caution* indicates a potential hazard that may result in minor injury or damage to the vehicle.

CAUTION

A *caution* indicates a situation that may result in damage to the vehicle.

NOTE

A *note* will alert you to important information or instructions.

SAFETY
Operator Safety

⚠ WARNING
Serious injury or death can result if you do not follow these instructions and procedures, which are outlined in further detail within your owner's manual.

- Read this manual and all labels carefully. Follow the operating procedures described.
- Never allow anyone without a valid driver's license to operate this vehicle.
- Minimum age recommendation for passengers is five years old. Passengers under five years of age require special restraints which are not available with this vehicle. Driver and passenger should wear their seat belts at all times.
- Never permit a guest to operate this vehicle unless the guest has read this manual and all product labels.
- To reduce tipover risk, be especially careful when encountering obstacles and slopes and when braking on hills or during turns.
- This vehicle is for off road use only. Never operate on public roads. Always avoid paved surfaces.
- Helmets are recommended whenever driving this vehicle in an aggressive manner. Eye protection is recommended at all times.
- Never consume alcohol or drugs before or while operating this vehicle.
- Never operate at excessive speeds. Always travel at a speed proper for the terrain, visibility and operating conditions, and your experience.
- Never attempt jumps or other stunts.
- Always inspect your vehicle each time you use it to make sure it's in safe operating condition. Always follow the inspection and maintenance procedures and schedules described in this manual.
- Always keep both hands on the steering wheel and both feet on the floorboards of the vehicle during operation.
- Always travel slowly and use extra caution when operating on unfamiliar terrain. Be alert to changing terrain.
- Never operate on excessively rough, slippery or loose terrain.

Operator Safety

- Always follow proper procedures for turning as described in this manual. Practice turning at slow speeds before attempting to turn at faster speeds. Never turn at excessive speeds.
- Always have this vehicle checked by an authorized Polaris dealer if it has been involved in an accident.
- Never operate this vehicle on hills too steep for the vehicle or for your abilities. Practice on smaller hills before attempting larger hills.
- Always follow proper procedures for climbing hills as described in this manual. Check the terrain carefully before attempting to climb a hill. Never climb hills with excessively slippery or loose surfaces. Never open the throttle suddenly or make sudden gear changes. Never go over the top of a hill at high speed.
- Always follow the proper procedures outlined in this manual for traveling downhill and for braking on hills. Check the terrain carefully before descending a hill. Never travel downhill at high speed. Avoid going downhill at an angle, which would cause the vehicle to lean sharply to one side. Travel straight down the hill where possible.
- Always check for obstacles before operating in a new area. Never attempt to operate over large obstacles such as rocks or fallen trees. Always follow the proper procedures outlined in this manual when operating over obstacles.
- Always be careful of skidding or sliding. On slippery surfaces such as ice, travel slowly and exercise caution to reduce the chance of skidding or sliding out of control.
- Never operate your vehicle in fast-flowing water or in water deeper than that specified in this manual. Wet brakes may have reduced stopping ability. Test your brakes after leaving water. If necessary, apply them lightly several times to let friction dry out the pads.
- Always be sure there are no obstacles or people behind your vehicle when operating in reverse. When it's safe to proceed in reverse, move slowly. Avoid turning at sharp angles in reverse.
- Always use the proper size and type of tires specified in this manual. Always maintain proper tire pressure as specified on page 5.

SAFETY
Operator Safety

- Never modify this vehicle through improper installation or use of accessories.
- Never exceed the stated load capacity for this vehicle. Cargo should be properly distributed and securely attached. Reduce speed and follow the instructions in this manual for hauling cargo or pulling a trailer. Allow a greater distance for braking.
- Always wear the seat belts when operating this vehicle. Seat belts reduce the severity of injury in case of a sudden stop or collision.
- Always keep arms and legs inside the cab frame while the vehicle is in motion.
- Always engage the park brake before getting out of the vehicle. See page 37.
- Always apply the service brakes before releasing the park brake.
- Always turn off the engine before refueling. Make sure the refueling area is well ventilated and free of any source of flame or sparks. Gasoline is extremely flammable. See page 21 for fuel safety warnings.
- Always remove the ignition key when the vehicle is not in use to prevent unauthorized use or accidental starting.

FOR MORE INFORMATION ABOUT SAFETY, call Polaris at 1-800-342-3764.

Operator Safety

⚠ WARNING

Make sure your *RANGER* is in excellent operating condition at all times. We strongly recommend that the operator check all safety components before each ride.

Polaris *RANGER*s are designed to provide safe operation when used as directed. Failure of critical machine components may result from operation with any modifications, especially those that increase speed or power. The *RANGER* may become aerodynamically unstable at speeds higher than those for which it is designed. Loss of control may occur at higher speeds. Modifications may also create a safety hazard and lead to bodily injury.

Do not make any modifications to your *RANGER*.

Equipment Modifications

We are concerned for the safety of our customers and for the general public. Therefore, we strongly recommend that consumers do not install on a Polaris *RANGER* any equipment that may increase the speed or power of the vehicle, or make any other modifications to the vehicle for these purposes. Any modifications to the original equipment of the vehicle create a substantial safety hazard and increase the risk of bodily injury.

The warranty on your Polaris *RANGER* is terminated if any equipment has been added to the vehicle, or if any modifications have been made to the vehicle, that increase its speed or power.

NOTE: The addition of certain accessories, including (but not limited to) mowers, blades, tires, sprayers, or large racks, may change the handling characteristics of the vehicle. Use only Polaris-approved accessories, and familiarize yourself with their function and effect on the vehicle.

SAFETY
Operator Safety

⚠ WARNING

POTENTIAL HAZARD

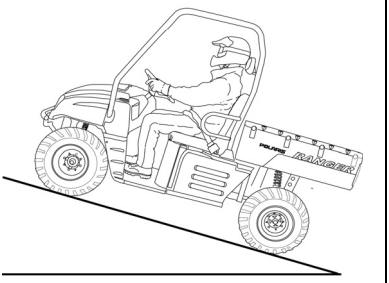
Stalling, rolling backwards while climbing a hill

WHAT CAN HAPPEN

Vehicle overturn

HOW TO AVOID THE HAZARD

Maintain a steady speed when climbing a hill.



If you lose all forward speed:

Apply the brakes.

Engage the park brake after fully stopped.

If you begin rolling backwards:

Never apply engine power.

Apply the brakes gradually.

When fully stopped, engage the park brake.

In the event of an accident, have a qualified service dealer check the complete vehicle for possible damage, including (but not limited to) brakes, throttle and steering.

⚠ WARNING

POTENTIAL HAZARD

Operating this vehicle on paved surfaces

WHAT CAN HAPPEN

Loss of control

HOW TO AVOID THE HAZARD

This vehicle's tires are designed for off-road use only, not for use on pavement. Paved surfaces may seriously affect handling and control of the vehicle, and may cause the vehicle to go out of control.

Avoid operating the vehicle on pavement. If you must operate on a paved surface, travel slowly and do not make sudden turns or stops.

Operator Safety

⚠ WARNING

POTENTIAL HAZARD

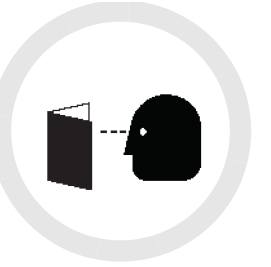
Operating this vehicle without proper instruction

WHAT CAN HAPPEN

Loss of control, accident

HOW TO AVOID THE HAZARD

The risk of an accident is greatly increased if the operator does not know how to operate the vehicle properly in different situations and on different types of terrain.



All operators must read and understand the Owner's Manual and all warning and instruction labels before operating the vehicle.

⚠ WARNING

POTENTIAL HAZARD

Operating this vehicle on public streets, roads or highways

WHAT CAN HAPPEN

Collision with another vehicle

HOW TO AVOID THE HAZARD

Never operate this vehicle on any public street, road or highway, including dirt or gravel.

In many states it's illegal to operate vehicles of this type on public streets, roads and highways.

SAFETY
Operator Safety

⚠ WARNING

POTENTIAL HAZARD

Operating this vehicle after consuming alcohol or drugs

WHAT CAN HAPPEN

Could seriously affect your judgment.

Could cause you to react more slowly.

Could affect your balance and perception.

Could result in an accident.

HOW TO AVOID THE HAZARD

Driving a *RANGER* requires your full attention. DO NOT drink alcohol or use drugs or medications before or while driving. They will reduce your alertness and slow your reaction time. In most states and provinces, it's prohibited by law to drive while intoxicated or under the influence of drugs.

⚠ WARNING

POTENTIAL HAZARD

Operating this vehicle at excessive speeds

WHAT CAN HAPPEN

Loss of control, accident

HOW TO AVOID THE HAZARD

Always travel at a speed proper for the terrain, visibility and operating conditions, and your experience.

Operator Safety

⚠ WARNING
POTENTIAL HAZARD Attempting jumps and other stunts WHAT CAN HAPPEN Loss of control, accident and/or vehicle overturn HOW TO AVOID THE HAZARD Never attempt jumps and other stunts. Avoid exhibition driving.

⚠ WARNING
POTENTIAL HAZARD Operating on frozen bodies of water. WHAT CAN HAPPEN Severe injury or death can result if the vehicle and/or the operator fall through the ice. HOW TO AVOID THE HAZARD Never operate the *RANGER* on a frozen body of water.

SAFETY
Operator Safety

⚠ WARNING

POTENTIAL HAZARD

Failure to inspect the vehicle before operating

Failure to properly maintain the vehicle

WHAT CAN HAPPEN

Accident, equipment damage

HOW TO AVOID THE HAZARD

Always inspect your *RANGER* before each use to make sure it's in safe operating condition.

Always follow the inspection and maintenance procedures and schedules described in the Owner's Manual.

⚠ WARNING

POTENTIAL HAZARD

Failure to use extra caution when operating this vehicle on unfamiliar terrain

WHAT CAN HAPPEN

Loss of control, vehicle overturn

HOW TO AVOID THE HAZARD

Travel slowly and use extra caution when operating on unfamiliar terrain.

Always be alert to changing terrain conditions when operating the vehicle. You may come upon hidden rocks, bumps, or holes suddenly, without enough time to react.

Operator Safety

⚠ WARNING

POTENTIAL HAZARD

Failure to follow the minimum age recommendations for this vehicle

WHAT CAN HAPPEN

Serious injury or death (the child or others)

HOW TO AVOID THE HAZARD

Only persons with a valid driver's license should operate a Polaris *RANGER*.

Even though a child may be within the age group for which some vehicles are recommended, he or she may not have the skills, abilities, or judgment needed to operate the vehicle safely and may be involved in a serious accident.

⚠ WARNING

POTENTIAL HAZARD

Operating this vehicle with improper tires or with improper or uneven tire pressure

WHAT CAN HAPPEN

Loss of control, accident and/or overturn

HOW TO AVOID THE HAZARD

Always use the size and type of tires specified in the Owner's Manual for this vehicle. See page 5.

Always maintain proper tire pressure as described on the decal and in the Owner's Manual. See page 5.

SAFETY
Operator Safety

⚠ WARNING

Leaving the keys in the ignition can lead to unauthorized use of the vehicle resulting in serious injury or death. Always remove the ignition key when the vehicle is not in use.

⚠ WARNING

After any overturn or accident, have a qualified service dealer inspect the entire vehicle for possible damage, including (but not limited to) brakes, throttle and steering systems.

⚠ WARNING

Exhaust system components are very hot during and after use of the vehicle. Hot components can cause serious burns and fire. Do not touch hot exhaust system components. Always keep combustible materials away from the exhaust system. Use caution when traveling through tall grass, especially dry grass.

Fuel Safety

⚠ WARNING

Gasoline is highly flammable and is explosive under certain conditions. Always exercise extreme caution whenever handling gasoline.

Always stop the engine when refueling.

Always refuel outdoors or in a well ventilated area.

Do not smoke or allow open flames or sparks in or near the refueling area or where gasoline is stored.

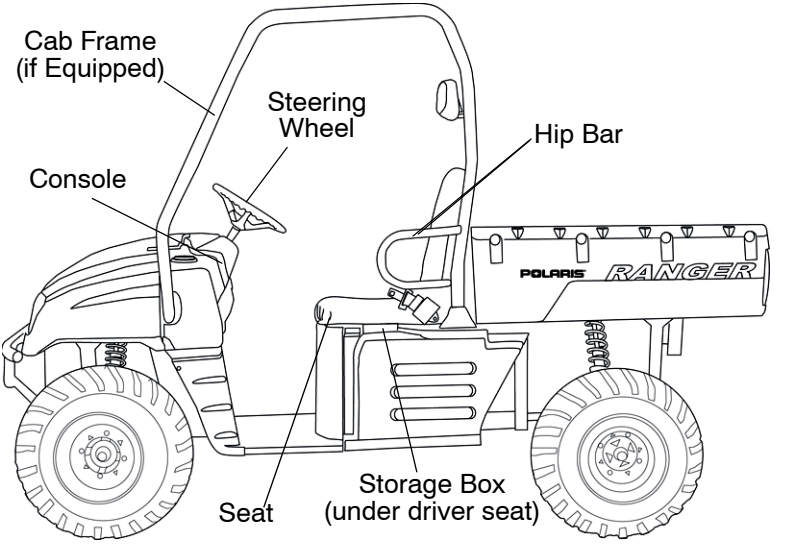
Do not over fill the tank. Do not fill the tank neck.

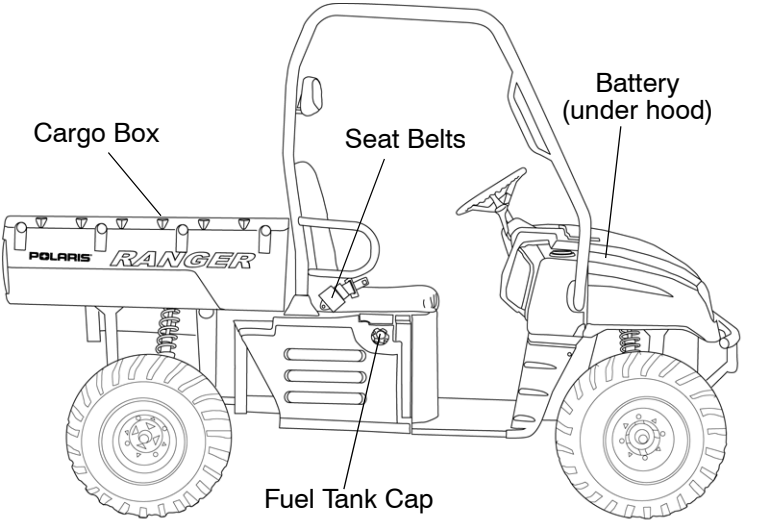
If gasoline spills on your skin or clothing, immediately wash it off with soap and water and change clothing.

Never start the engine or let it run in an enclosed area. Gasoline powered engine exhaust fumes are poisonous and can cause loss of consciousness and death in a short time.

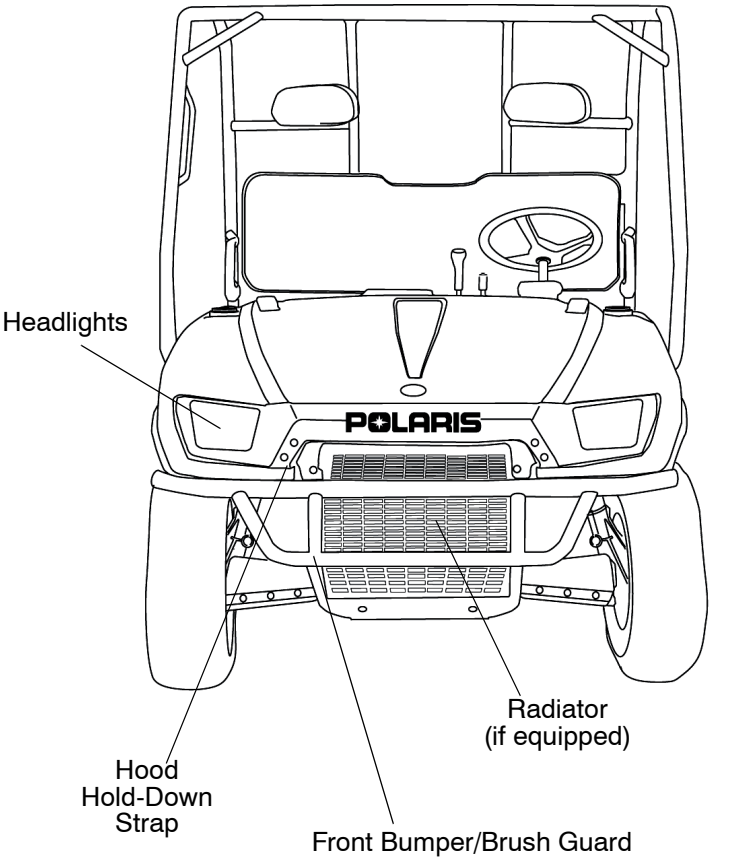
FEATURES AND CONTROLS
Component Locations

Some Polaris vehicles are equipped with special features such as the cab frame. Not all models come with all features. Refer to the specifications section beginning on page 110.

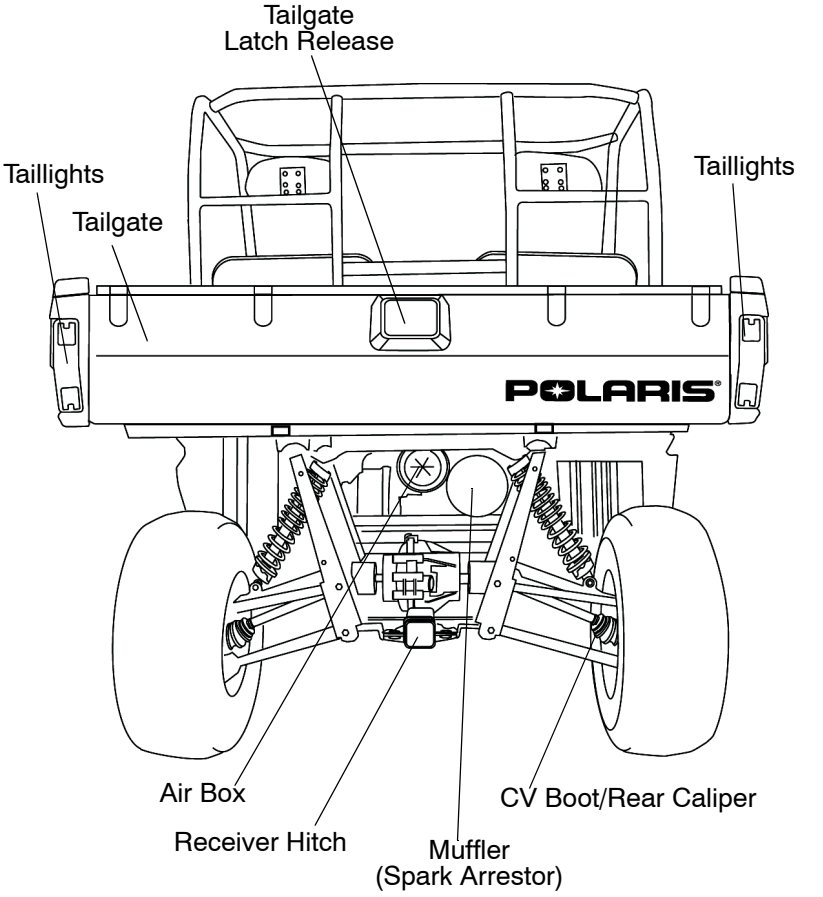




Component Locations



FEATURES AND CONTROLS
Component Locations



Trailer Hitch Bracket

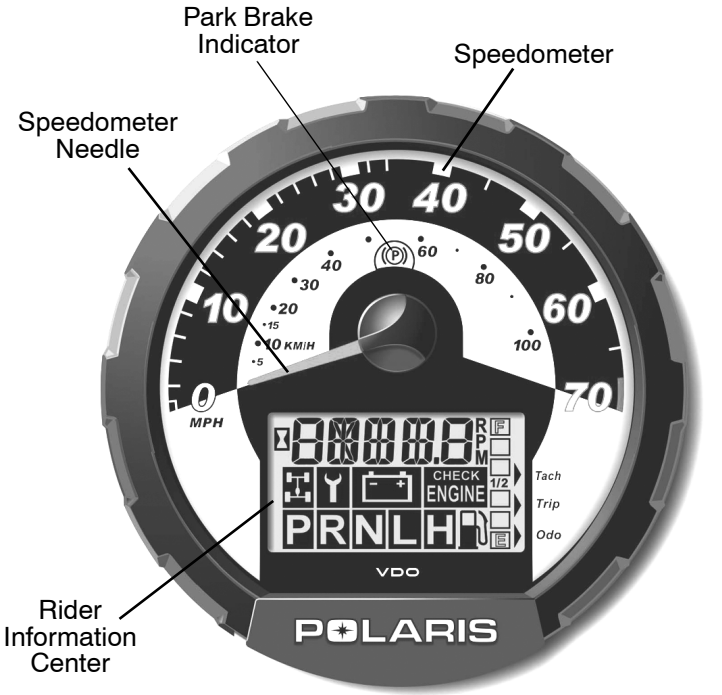
This vehicle is equipped with a receiver hitch bracket for a trailer hitch. Trailer towing equipment is not supplied with this vehicle.

To avoid injury and property damage, always heed the warnings and towing capacities outlined on pages 52-55.

Component Locations

Instrument Cluster

Your *RANGER* is equipped with an instrument cluster that senses vehicle speed from the right front wheel. The instrument cluster measures distance in miles as well as time, hours of operation and engine RPM. Refer to page 34 for the location of the instrument cluster.

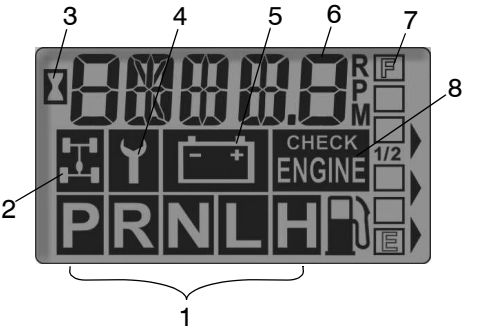


NOTE: In addition to showing vehicle speed, the speedometer needle flashes when a low fuel condition exists.

FEATURES AND CONTROLS
Instrument Cluster
Rider Information Center

The rider information center is located in the instrument cluster. All segments will light up for 2.5 seconds at start-up.

NOTE: If the instrument cluster fails to illuminate, a battery over-voltage may have occurred and the instrument cluster may have shut off to protect the electronic speedometer. If this occurs, take the vehicle to your Polaris dealer for proper diagnosis.



1. **Gear Indicator** - This indicator displays gear shifter position.
   H = High Gear
   L = Low Gear
   N = Neutral
   R = Reverse Gear
2. **AWD Indicator** - This indicator illuminates when the AWD switch is in the AWD position.
3. **Engine Hour Display Indicator**
4. **Service Interval/Diagnostic Mode Indicator**
5. **Low Battery and Over Voltage** - This warning usually indicates that the vehicle is operating at an RPM too low to keep the battery charged. It may also occur when the engine is at idle and high electrical load (lights, cooling fan, accessories) is applied. Drive at a higher RPM or recharge the battery to clear the warning.
6. **Odometer/Tachometer/Tripmeter/ Hour Meter/Clock**
7. **Fuel Gauge** - The segments of the fuel gauge show the level of fuel in the fuel tank. When the last segment clears, a low fuel warning is activated. All segments will flash, FUEL will display in the LCD, and the speedometer needle will blink. Refuel immediately.
8. **Check Engine Warning Indicator** - This indicator serves two purposes. The word HOT displays if the engine overheats. It also appears if an EFI-related fault occurs. Do not operate the vehicle if this warning appears. Serious engine damage could result.

Instrument Cluster

Rider Information Center

Standard Modes

Use the yellow mode button located under the speedometer to toggle through the mode options. See page 34.

Odometer Mode

The odometer records the miles traveled by the vehicle.

Trip Meter Mode

The trip meter records the miles traveled by the vehicle on each trip if it's reset before each trip. To reset the trip meter, select the trip meter mode. Press and hold the mode button (override button) until the total changes to 0.

NOTE: In the Rider Information Center, the trip meter display contains a decimal point, but the odometer displays without a decimal point.

Hour Meter Mode

This mode logs the total hours the engine has been in operation.

Tachometer Mode

The engine RPM is displayed digitally.

NOTE: Small fluctuations in the RPM from day to day may be normal because of changes in humidity, temperature and elevation.

Clock Mode

The clock displays time in a 12-hour format. To reset the clock, see page 28.

FEATURES AND CONTROLS

Instrument Cluster

Rider Information Center

Diagnostic Mode

The wrench icon will display when the gauge is in the diagnostic mode. To exit the diagnostic mode, turn the key switch off and on. Any movement of the tires will also cause the gauge to exit the diagnostic mode.

To enter the diagnostics mode:

1. Turn the key switch off and wait 10 seconds.
2. Lock the parking brake.
3. Place the transmission in neutral.
4. Hold the mode/reverse override button and turn the key switch on. Release the switch as soon as the display is activated.
5. Use the mode button to toggle through the diagnostic screens.

Clock Screen

To reset the clock:

1. Enter the diagnostic mode.
2. Toggle to the clock screen.
3. Press and hold the mode button until the hour display flashes. Release the button.
4. Press and release the mode button once to advance the setting by one hour. Press and *hold* the mode button to advance the hours quickly.
5. When the desired hour is displayed, wait approximately four seconds, until the minute display flashes.
6. Use the same procedure to reset the minutes.
7. When the display stops flashing, the mode has been set.

NOTE: Do not turn the key switch off until the display stops flashing or the new setting will not be locked into the memory.

Instrument Cluster

Rider Information Center

Diagnostic Mode

Battery Voltage Screen

View this screen to check battery voltage level.

Tachometer Screen

View the tachometer to check engine speed.

AWD Diagnostic Screen

The gauge indicates whether or not current is flowing through the AWD coil (only on models with switchable AWD). This screen is for informational purposes only. Please see your dealer for all major repairs.

Gear Circuit Diagnostic Screen

This screen displays the resistance value (in ohms) being read at the gear switch input of the gauge. This screen is for informational purposes only. Please see your dealer for all major repairs.

Programmable service interval

When the hours of engine operation equal the programmed service interval setting, the wrench icon will flash for 5 seconds each time the engine is started. When this feature is enabled, it provides a convenient reminder to perform routine maintenance. See page 30.

NOTE: The service interval is programmed at 50 hours at the factory.

FEATURES AND CONTROLS
Instrument Cluster
Rider Information Center
Diagnostic Mode
Programmable service interval

To enable or disable the service interval:

1. Enter the diagnostic mode.
2. Toggle to the service interval screen.
3. Press and hold the mode button for about seven (7) seconds, until either ON or OFF appears in the Rider Information Center, depending on your preference.

To reset the service interval:

1. Enter the diagnostic mode.
2. Toggle to the service interval screen.
3. Press and hold the mode button for 2-3 seconds, until the wrench icon flashes. Release the button.
4. Press and release the mode button once to advance the setting by one hour. Press and *hold* the mode button to advance the hours quickly.

NOTE: If you scroll past the intended number, press and hold the button until the hours cycle back to zero.

5. When the desired setting is displayed, wait until the wrench icon stops flashing. The new service interval is now programmed.

Miles/Kilometers toggle

The display in the tripmeter and odometer can be changed to display either standard or metric units of measurement.

1. Enter the diagnostic mode.
2. Toggle to the screen that displays either kilometers (KM) or miles (MP).
3. Press and hold the mode button until the letters flash, then press and release the button once. When the display stops flashing, the mode has been set

Instrument Cluster

Rider Information Center

Downloading Codes

The EFI diagnostic mode is for informational purposes only. Please see your Polaris dealer for all major repairs.

See page 32 for Blink Codes and Failure Descriptions. Use the following procedure to download blink codes (failure codes) from the EFI module.

1. Engage the parking brake.
2. Stop the engine.
3. Turn the key switch to the ON position.
4. Turn the key switch off and on three times in less than five seconds, then leave the switch on. Any blink code numbers stored in the EFI module will display, one at a time, on the screen. The number “61” and the word “END” displays after all codes have been transmitted.

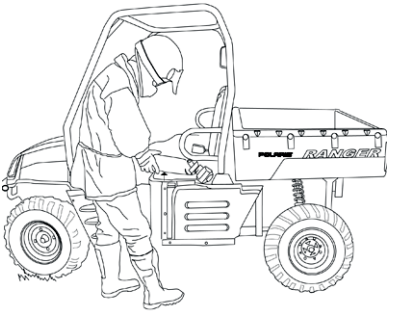
Downloading Codes

Blink Code	Failure Description
--	No RPM Signal
21	Loss of Synchronization
45	Barometric Pressure Sensor: Circuit Low Input
46	Barometric Pressure Sensor: Circuit High Input
22	TPS: Open or Short Circuit to Ground
22	TPS: Short Circuit to Battery
23	RAM Error: Defective ECU
42	Engine Temp Sensor Circuit: Short to Ground
42	Engine Temp Sensor Circuit: Open or Short to Battery
51	Injector 1: Open Load
51	Injector 1: Short Circuit to Ground
51	Injector 1: Short Circuit to Battery
52	Injector 2: Open Load
52	Injector 2: Short Circuit to Ground
52	Injector 2: Short Circuit to Battery
53	Rear Differential: Open Load (*RANGER* 4X4 only)
53	Rear Differential: Short Circuit to Ground (*RANGER* 4X4 only)
53	Rear Differential: Short Circuit to Battery (*RANGER* 4X4 only)
54	Engine Temp Lamp: Open Load
54	Engine Temp Lamp: Short Circuit to Ground
54	Engine Temp Lamp: Short Circuit to Battery
55	Diag Lamp: Open Load
55	Diag Lamp: Short Circuit to Ground
55	Diag Lamp: Short Circuit to Battery
56	Pump Relay: Open Load
56	Pump Relay: Short Circuit to Ground
56	Pump Relay: Short Circuit to Battery
57	Reverse Beeper: Open Load
57	Reverse Beeper: Short Circuit to Ground
57	Reverse Beeper: Short Circuit to Battery
58	Cooling Fan: Open Load
58	Cooling Fan: Short Circuit to Ground
58	Cooling Fan: Short Circuit to Battery
41	Intake Air Temp Sensor: Open or Short Circuit to +Sensor Voltage
41	Intake Air Temp Sensor: Short Circuit to Ground
61	END

Seat Removal

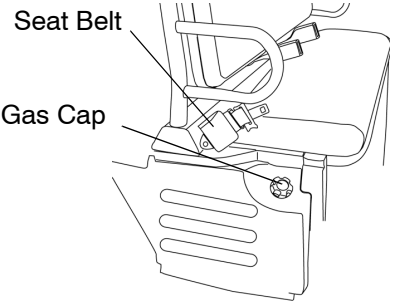
Pull up on the front of the seat and slide it toward the front of the vehicle.

Install the seat by sliding the tabs into the rear of the seat base. Push down firmly on the front of the seat until the pins are fully seated into the grommets.



Fuel Cap

The fuel tank filler cap is located on the right-hand side of the vehicle near the passenger seat. When refueling, always use either leaded or unleaded gasoline with a minimum pump octane number of 87 R+M/2 octane. *Do not use E-85 fuel.*



Seat Belts

The *RANGER* is equipped with lap-style seat belts for the operator and passenger.

⚠ WARNING

Falling from a moving vehicle could result in serious injury or death. Always fasten your seat belt securely before operating or riding in the *RANGER*.

Passengers under five years of age require special restraints, which are not available with this vehicle. No person under the age of five may ride in the *RANGER*.

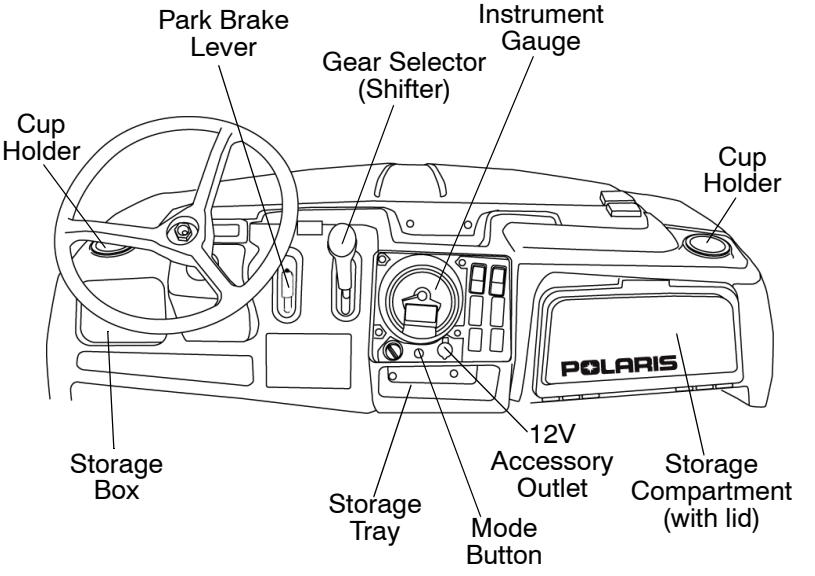
To wear the seat belt properly, follow this procedure:

1. Place the belt across your lap as low on your hips as possible. Make sure that the belt is not twisted.
2. Push the latch plate into the buckle until it clicks.
3. Release the strap, it will self-tighten.

NOTE: The center belt must be tightened manually by pulling on the strap.

4. To release the seat belt, press the square red button in the buckle's center.

FEATURES AND CONTROLS
Console



Auxiliary Outlet

The 12-volt accessory plug receptacle has spade connections on the back that may be used to power an auxiliary light or other optional accessories or lights. The connections are behind the console, under the hood.

Mode Button

The yellow button located directly under the speedometer is used to toggle through mode options available such as odometer, trip meter, hour meter, tachometer and clock. See page 27 for operation of the modes.

Gear Selector

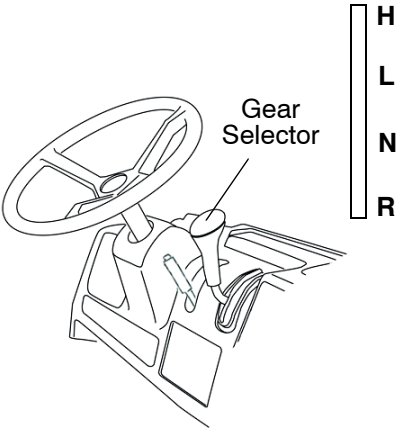
H: High Gear

L: Low Gear

N: Neutral

R: Reverse

NOTE: Low gear is the primary driving range for the *RANGER*. High gear is intended for use on hard-packed surfaces with light loads.



To change gears, stop the vehicle, and with the engine idling, move the lever to the desired gear. Do not attempt to shift gears with engine speed above idle or while the vehicle is moving.

NOTE: Maintaining shift linkage adjustment is important to assure proper transmission function. See your dealer if you experience any shifting problems.

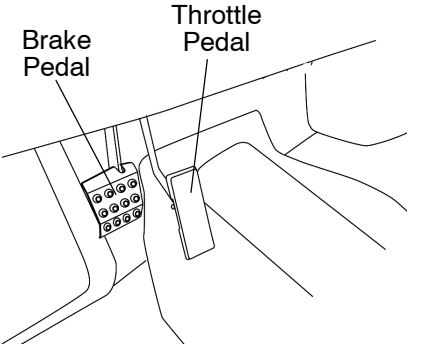
CAUTION
Do not attempt to shift the transmission while the vehicle is moving or damage to the transmission could result. Always shift when the vehicle is stationary and the engine is at idle.

Brake Pedal

Depress the brake pedal to slow or stop the vehicle. Apply the brakes while starting the engine.

Throttle Pedal

Push the pedal down to increase engine speed. Spring pressure returns the pedal to the rest position when released. Always check that the throttle pedal returns normally before starting the engine. Make sure there's adequate throttle pedal freeplay. See page 88 for throttle pedal adjustment procedures.



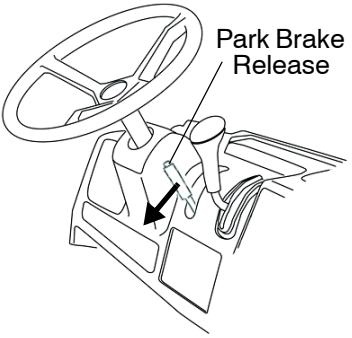
Park Brake Lever

To help prevent the vehicle from rolling, engage the park brake when parking the vehicle. When the park brake is fully engaged and the park brake indicator is illuminated, engine speed is limited to 1300 RPM in all gears, including neutral. If throttle is applied, this limiting feature prevents operation, which protects the park brake pads from excessive wear.

NOTE: This feature will not operate properly if the park brake connector or switch (under the hood) malfunctions or becomes disconnected, or if the switch has moved. Check for disconnection, then see your dealer promptly if this feature fails to operate properly.

Always apply the service brakes before engaging or releasing the park brake.

1. Apply the brakes.
2. Pull the park brake lever downward as far as possible.
3. To release the park brake, apply the brakes. Press the park brake release inward and move the lever upward as far as possible.



⚠ WARNING

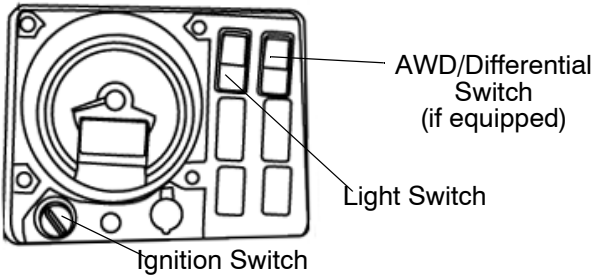
Operating the vehicle while the park brake is engaged could cause loss of control and result in serious injury or death. Always disengage the park brake before operating the vehicle.

When the park brake is fully engaged and the park brake indicator is illuminated, engine speed is limited to 1300 RPM in all gears, including neutral. If throttle is applied, this limiting feature prevents operation, which protects the park brake pads from excessive wear.

Inspect and adjust park brake cable tension after the first 25 hours of operation and every 100 hours thereafter to ensure proper cable tension. See page 90.

NOTE: This feature will not operate properly if the park brake connector or switch (under the dash) malfunctions or becomes disconnected, or if the switch has moved. Check for disconnection, then see your Polaris service technician promptly if this feature fails to operate properly.

Switches



Ignition Switch

The ignition switch is a three-position, key-operated switch. The key can be removed from the switch when it is in the OFF position.

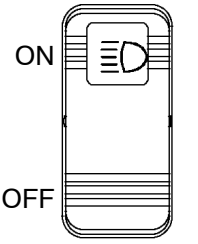
OFF	The engine is off. Electrical circuits are off, except Acc, 12V.
ON	Electrical circuits are on. Electrical equipment can be used.
START	Turn the key to the START position to engage the electric starter. The key returns to the ON position when released.

⚠ WARNING

Leaving the keys in the ignition can lead to unauthorized use of the vehicle resulting in serious injury or death. Always remove the ignition key when the vehicle is not in use.

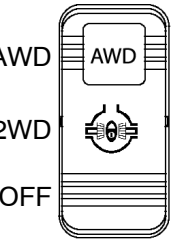
Switches

Light Switch



The ignition switch key must be in the ON/RUN position to operate the headlights. Use the light switch to turn the headlights on or off.

AWD/Differential Lock Switch



The AWD/Differential Switch has three positions: All Wheel Drive (AWD), Differential Lock/Two Wheel Drive (2WD) and Off (1WD/turf mode).

Press the top of the rocker switch to engage All Wheel Drive (AWD). See page 58 for AWD operating instructions.

Move the rocker switch to the center position (4X4 models) to lock the differential and operate in two wheel drive (2WD). See page 57 for Differential Lock operating instructions.

Press the bottom of the switch to unlock the differential and allow the rear drive wheels to operate independently (1WD). This mode of operation is well suited to turf driving or when active traction is not needed.

OPERATION
Break-In Period

The break-in period for your new Polaris *RANGER* is the first twenty hours of operation, or the time it takes to use the first two tanks full of gasoline. No single action on your part is as important as a proper break-in period. Careful treatment of a new engine will result in more efficient performance and longer life for the engine. Perform the following procedures carefully.

CAUTION
Excessive heat build-up during the first three hours of operation will damage close-fitted engine parts. Do not operate at full throttle or high speeds for extended periods during the first three hours of use.

Engine and Drivetrain Break-in

1. Fill the fuel tank with gasoline. Heed the gasoline warnings on page 21.
2. Check the oil level. See page 68. Add the recommended oil as needed to maintain the oil level in the normal (safe) operating range.
3. Drive slowly at first. Select an open area that allows room to familiarize yourself with vehicle operation and handling.
4. Vary throttle positions. Do not operate at sustained idle.
5. Perform regular checks on fluid levels, controls and areas outlined on the daily pre-ride inspection checklist. See page 41.
6. Pull only light loads.
7. During the break-in period, change both the oil and the filter at 25 hours.
8. Inspect and adjust park brake cable tension after the first 25 hours of operation and every 100 hours thereafter to ensure proper cable tension. See page 90.

PVT Break-in (Clutches/Belt)

A proper break-in of the clutches and drive belt will ensure a longer life and better performance. Break in the clutches and belt by operating at slower speeds during the break-in period as recommended. Pull only light loads. Avoid aggressive acceleration and high speed operation during the break-in period.

Pre-Ride Inspection

⚠ WARNING

If a proper inspection is not done before each use, severe injury or death could result. Always inspect the vehicle before each use to ensure it's in proper operating condition.

Item	Remarks	Page
Brake system/pedal travel	Ensure proper operation	36 89
Brake fluid	Ensure proper level	89
Front suspension	Inspect, lubricate if necessary	65
Rear suspension	Inspect, lubricate if necessary	65
Steering	Ensure free operation	91
Tires	Inspect condition and pressure	5 93
Wheels/fasteners	Inspect, ensure fastener tightness	93
Frame nuts, bolts, fasteners	Inspect, ensure tightness	-
Fuel and oil	Ensure proper levels	26 68
Coolant level	Ensure proper level	80 81
Coolant hoses	Inspect for leaks	-
Throttle	Ensure proper operation	87
Indicator lights/switches	Ensure operation	38
Air filter, pre-filter	Inspect, clean	85
Air box sediment tube	Drain deposits whenever visible	85
Headlamp	Check operation, apply Polaris dielectric grease when lamp is replaced	95
Brake light/tail lamp	Check operation, apply Polaris dielectric grease when lamp is replaced	96

OPERATION
Starting the Engine

⚠ WARNING
Engine exhaust contains poisonous carbon monoxide and can cause loss of consciousness resulting in severe injury or death. Never run an engine in an enclosed area.

1. Sit in the driver's seat and fasten the seat belt.
2. Engage the park brake.
3. Shift the transmission to neutral.
4. Apply the brakes.

NOTE: Do not press the throttle pedal while starting the engine.

5. Turn the ignition key past the ON/RUN position to START. Engage the starter for a maximum of five seconds. Release the key when the engine starts.
6. If the engine does not start within five seconds, release the ignition switch and wait five seconds. Repeat steps 5 and 6 until the engine starts.
7. Vary the engine RPM slightly with the throttle to aid in warm up until the engine idles smoothly.

CAUTION
Operating the vehicle immediately after starting could cause engine damage. Allow the engine to warm up for several minutes before operating the vehicle.

Stopping the Engine

1. Release the throttle pedal completely and brake to a complete stop.
2. Turn the engine off.
3. Engage the park brake.

⚠ WARNING
A rolling vehicle can cause property damage and serious injury. Always engage the park brake after stopping the engine.

Braking

1. Release the throttle pedal completely.
2. Press on the brake pedal evenly and firmly.

NOTE: Practice starting and stopping (using the brakes) until you're familiar with the controls.

NOTE: When the throttle pedal is released completely and the engine speed drops near an idle, the vehicle has no engine braking.

⚠ WARNING
Failure to allow for increased braking distance when hauling cargo or towing a trailer may result in accident and injury. Always slow down and allow additional braking distance when towing or hauling cargo.

OPERATION
Driving Safely
Driving Procedure

1. Sit in the driver's seat and fasten the seat belt.
2. After starting the engine and allowing it to warm up, apply the service brakes, and shift the transmission into gear.
3. Check your surroundings and determine your path of travel.
4. Release the park brake.
5. Keeping both hands on the steering wheel, slowly release the brakes and depress the throttle with your right foot to begin driving.
6. Drive slowly. Practice maneuvering and using the throttle and brakes on level surfaces.

NOTE: Low gear is the primary range for operating the *RANGER*. High gear is intended for use on hard-packed surfaces with light loads.

Driving Safely

Driving on Slippery Surfaces

When driving on slippery surfaces such as wet trails, loose gravel, or ice, be alert for the possibility of skidding and sliding. Under these conditions, follow these precautions:

1. Slow down when entering slippery areas.
2. Maintain a high level of alertness, reading the trail and avoiding quick, sharp turns, which can cause skids.
3. Correct a skid by turning the steering wheel in the direction of the skid.
4. Drive with AWD engaged (if equipped) to assist in controlling the vehicle.

CAUTION

Severe damage to the drive train may occur if the AWD is engaged while the wheels are spinning. Always allow the wheels to stop spinning before engaging AWD.

⚠ WARNING

Failure to exercise care when operating on slippery surfaces can result in loss of tire traction and cause loss of control, accident, and serious injury or death.

Never apply the brakes during a skid.

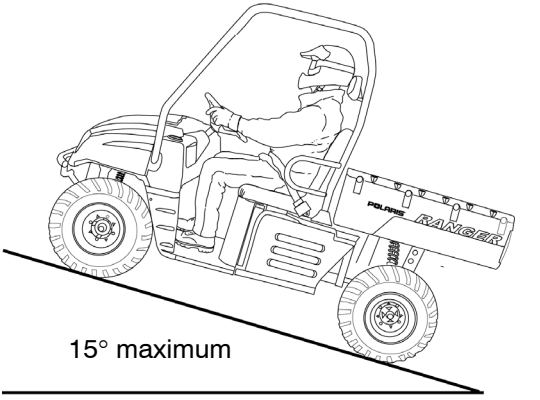
Do not operate on excessively slippery surfaces.

Always reduce speed and use additional caution when operating on slippery surfaces

OPERATION
Driving Safely
Driving Uphill

Whenever traveling uphill, follow these precautions:

1. Always travel straight uphill.
2. Avoid steep hills (15° maximum).
3. Keep both feet on the floor.
4. Proceed at a steady rate of speed and throttle opening.



⚠ WARNING

Climbing hills improperly can cause loss of control or vehicle overturn. Always check the terrain carefully before climbing a hill.

Braking and handling are greatly affected when operating in hilly terrain. Improper procedure could cause loss of control or overturn and result in serious injury or death.

Avoid climbing steep hills (15° maximum).

Use extreme caution when operating on hills, and follow proper operating procedures outlined in the owner's manual.

Never climb hills with excessively slippery or loose surfaces.

Never open the throttle suddenly.

Never go over the crest of a hill at high speed. An obstacle, a sharp drop, or another vehicle or person could be on the other side of the hill.

Driving Safely

Driving on a Sidehill (Sidehilling)

⚠ WARNING

Crossing hillsides or turning on hills can result in loss of control or vehicle overturn, resulting in severe injury or death. Avoid crossing the side of a hill when possible. When unavoidable, exercise extreme caution. Avoid operating on steep hills (15° maximum).

Driving Downhill

Whenever descending a hill, follow these precautions:

1. Proceed directly downhill.
2. Slow down.
3. Apply the brakes *slightly* to aid in slowing.

⚠ WARNING

Traveling downhill improperly could cause loss of control or vehicle overturn. Always check the terrain carefully before descending a hill.

Never descend a hill at high speed. Excessive speed may result in loss of vehicle control and lead to serious injury or death. Always operate slowly when traveling downhill.

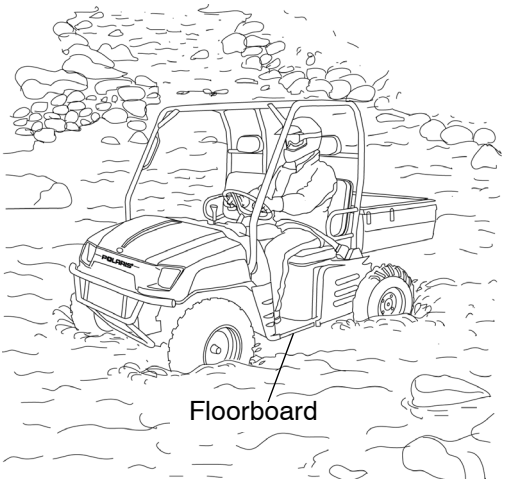
Avoid descending a hill at an angle, which would cause the vehicle to lean sharply to one side. Travel straight downhill when possible.

OPERATION
Driving Safely
Driving Through Water

⚠ WARNING

The large tires on your *RANGER* may cause the vehicle to float in deep or fast-flowing water, which could result in loss of control and lead to serious injury or death. Never cross deep or fast-flowing water with your *RANGER*.

Your Polaris *RANGER* can operate through water up to a maximum recommended depth equal to the floorboards. Follow these procedures when operating through water:



1. Always determine water depths and current before entering.
2. Choose a crossing where both banks have gradual inclines.
3. Proceed slowly, avoiding rocks and obstacles.
4. After leaving water, always dry the brakes by applying light pressure to the pedal repeatedly until braking action is normal.

NOTE: After running your vehicle in water, it's *critical* that you perform the services outlined in the Periodic Maintenance Chart beginning on page 60. Give special attention to engine oil, transmission oil, front and rear gearcases, and all grease fittings.

CAUTION

Immersion can result in major damage if the vehicle isn't serviced correctly and promptly. After immersion, always take the vehicle to your dealer service. *Do not start the engine!*

If it's impossible to bring the vehicle to your dealer before starting the engine, perform the service outlined on page 97, and take the vehicle to your dealer at the first opportunity.

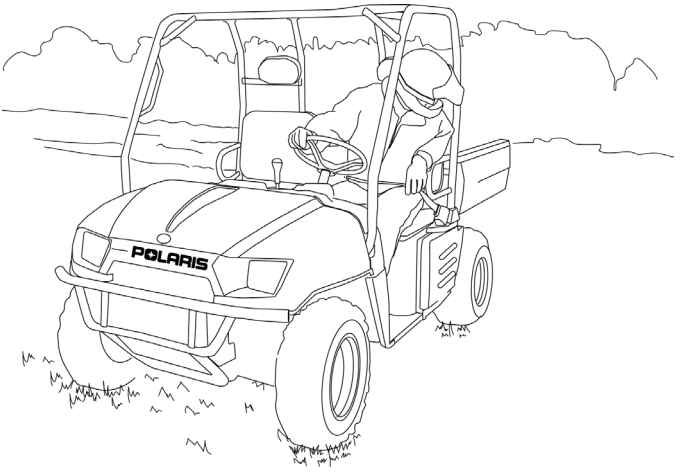
Driving Safely

Driving Over Obstacles

Be alert! Look ahead and learn to read the terrain you're traveling on. Watch for hazards such as logs, rocks and low hanging branches.

⚠ WARNING
Severe injury or death can result if your vehicle suddenly comes in contact with a hidden obstacle. Not all obstacles are immediately visible. Reduce speed and travel with caution in unfamiliar terrain.

OPERATION
Driving Safely
Driving in Reverse



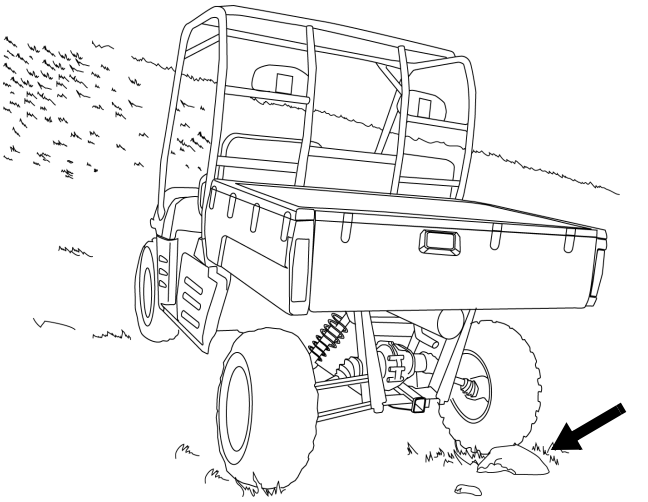
Follow these guidelines when operating in reverse:

1. Back slowly.
2. Apply the brakes lightly for stopping.
3. Avoid turning at sharp angles.
4. Always avoid backing downhill.
5. Never open the throttle suddenly while backing.
6. Always inspect left and right fields of vision before backing.

⚠ WARNING
Failure to use caution when operating in reverse can result in serious injury or death. Before shifting into reverse, always check for obstacles or people behind the vehicle and follow the reverse operation procedures outlined in this manual. Always back slowly.

Driving Safely

Parking on an Incline



Avoid parking on an incline if possible. If it's unavoidable, follow these precautions:

1. Place the transmission in gear.
2. Engage the park brake.
3. Turn the engine off.
4. Block the rear wheels on the downhill side.

⚠ WARNING

A rolling vehicle can cause property damage and serious injury. Always engage the park brake after stopping the engine. Always block the downhill side of the wheels if leaving the vehicle on a hill, or park the vehicle in a sidehill position instead.

Operating the vehicle while the park brake is engaged could cause loss of control and result in serious injury or death. Always disengage the park brake before operating the vehicle.

OPERATION
Driving Safely
Hauling Cargo

⚠ WARNING

Hauling cargo improperly can alter vehicle handling and may cause loss of control or brake instability, which can result in serious injury or death. Always follow these precautions when hauling cargo:

REDUCE SPEED AND ALLOW GREATER DISTANCES FOR BRAKING WHEN HAULING CARGO.

Always load the cargo box with the load as far forward and as low as possible.

When operating over rough or hilly terrain, reduce speed and cargo to maintain stable driving conditions.

Always operate the vehicle with extreme care when hauling or towing loads.

Slow down and drive in the lowest gear available.

SECURE ALL LOADS BEFORE OPERATING. Unsecured loads can create unstable operating conditions, which could result in loss of control of the vehicle.

OPERATE ONLY WITH STABLE AND SAFELY ARRANGED LOADS. When handling off-centered loads that cannot be centered, securely fasten the load and operate with extra caution. Always attach the tow load to the hitch point designated for your vehicle.

HEAVY LOADS CAN CAUSE BRAKING AND CONTROL PROBLEMS. Use extreme caution when applying brakes with a loaded vehicle. Avoid terrain or situations that may require backing downhill.

USE EXTREME CAUTION when operating with loads that extend over the rack sides. Stability and maneuverability may be adversely affected, causing the vehicle to overturn.

DO NOT TRAVEL FASTER THAN THE RECOMMENDED SPEEDS. Vehicle should never exceed 10 mph (16 kph) while towing a load on a level grass surface. Vehicle speed should never exceed 5 mph (8 kph) when towing loads in rough terrain, while cornering, or while ascending or descending a hill.

Driving Safely

Hauling Cargo

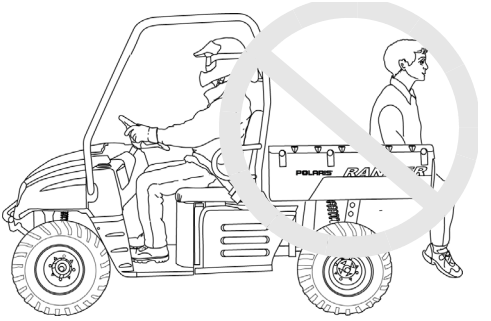
The *RANGER* has been designed to carry or tow specific capacities. Always read and understand the load distribution warnings listed on the warning labels. Never exceed the following capacities.

Model	Maximum Capacities (Level Ground)	Cargo Box
RANGER 4X4 EFI	1500 lbs. (681 kg)	1000 lbs. (454 kg)
RANGER 6X6 EFI	1750 lbs. (794 kg)	1250 lbs (567 kg)

⚠ WARNING

Driving with passengers in the cargo box can result in severe injury or death.

Never allow passengers to ride in the cargo box. Passengers must always ride in the cab with seat belts fastened securely.



OPERATION
Driving Safely
Dumping the Cargo Box

⚠ WARNING

Operating the vehicle while the cargo box is raised could result in severe injury. The box could close unexpectedly and cause injury to the driver or passenger. The rear tires will also catch the rear of a raised box, damaging the vehicle and creating hazardous driving conditions. Never operate this vehicle with the cargo box in the raised position.

1. Select a level site to dump the cargo box. Do not attempt to dump or unload the vehicle while parked on an incline.
2. Engage the park brake.
3. Dismount the vehicle.
4. Ensure that the cargo is positioned evenly or toward the front of the cargo box.

5. Release the tailgate by pulling up on the tailgate latch.
6. Stand clear and pull up on the cargo box release lever.
7. Lift the front of the cargo box to dump the cargo.
8. Lower the cargo box and push down securely to latch.

⚠ WARNING

If the weight distribution on the box is located toward the rear of the box when the release lever is pulled forward, the box may dump unexpectedly and cause serious injury to the operator or bystanders.

Never operate the dump lever without ensuring that the load is positioned evenly or at the front of the box.

Driving Safely

Towing Loads

⚠ WARNING

Towing improperly can alter vehicle handling and may cause loss of control or brake instability, which can result in serious injury or death. Always follow these precautions when towing:

Never load more than 150 lbs. (68.1 kg) tongue weight on the towing bracket.

Do not operate the vehicle faster than 10 mph (16 km/h) when towing. See page 52. Towing a trailer increases braking distance.

Do not tow more than the recommended weight for the vehicle. See the towing capacity chart below and the specifications charts beginning on page 110.

Attach a trailer to the trailer hitch bracket only. Do not attach a trailer to any other location or you may lose control of the vehicle.

Never tow a trailer on a grade steeper than 15°.

Model	Total Towed Load Weight (Level Ground)	Total Towed Load Weight (15° grade)	Total Hitch Vertical Weight	Maximum Towing Speed
RANGER 4x4 700 EFI	2000 lbs. (907 kg)	850 lbs. (386 kg)	150 lbs. (68.1 kg)	10 mph (16 kph)
RANGER 6X6 700 EFI	2000 lbs. (907 kg)	1000 lbs. (454 kg)	150 lbs. (68.1 kg)	10 mph (16 kph)

Belt Life

To extend belt life, use the lowest gear possible when hauling or towing heavy cargo.

OPERATION
Driving Safely
Parking the Vehicle

⚠ WARNING

A rolling vehicle can cause property damage and serious injury. Always engage the park brake after stopping the engine.

1. Stop the vehicle on a level surface.
2. Turn the engine off.
3. Engage the park brake.
4. Remove the ignition switch key to prevent unauthorized use.

⚠ WARNING

Gasoline is extremely flammable and can be explosive under certain conditions. When parking inside a garage or other structure, be sure that the structure is well ventilated and that the vehicle is not close to any source of flame or sparks, including any appliance with pilot lights.

Differential Lock (4X4 Models)

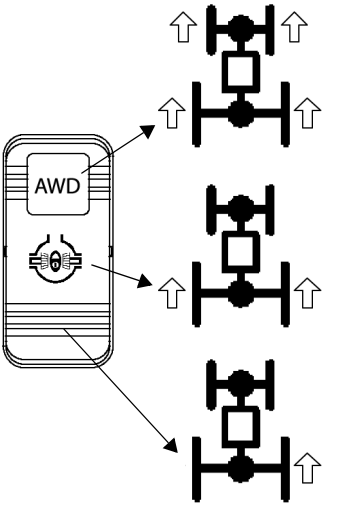
Locking the Differential

The 4X4 rear axle is equipped with a lockable differential that allows the operator to choose between an open differential or a closed differential. Locking the differential in slippery or low traction conditions helps improve traction.

Press the top of the rocker switch to engage All Wheel Drive (AWD).

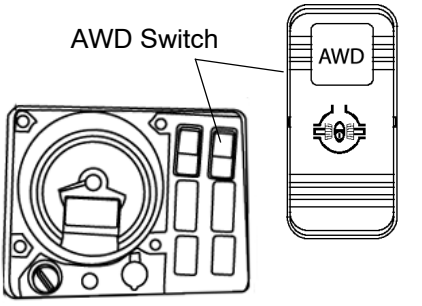
Move the rocker switch to the center position to lock the differential and operate in two wheel drive (2WD).

Press the bottom of the switch to unlock the differential and allow the rear drive wheels to operate independently (1WD). This mode of operation is well suited to turf driving or whenever aggressive traction is not required.



CAUTION
Damage to the differential can occur if it is engaged while the vehicle is traveling at high speeds or while the rear wheels are spinning. Slow the vehicle to nearly stopped before engaging the differential.

OPERATION
All Wheel Drive (AWD)



The illuminated amber AWD switch indicates that the vehicle is in AWD.

When the AWD switch is on, the front wheels will automatically engage any time the rear wheels lose traction. When the rear wheels regain traction, the front wheels will automatically disengage. There is no limit to the length of time the vehicle may remain in AWD.

When the *RANGER* 6X6 AWD switch is in the off position, the vehicle is in two-wheel drive at all times.

When the *RANGER* 4X4 AWD switch is in the off position, the differential is open and the vehicle is in one-wheel drive for operation on turf or when active traction is not needed. When the AWD switch is in the center position the differential is locked and the vehicle is in two-wheel drive. See page 57.

The AWD switch may be turned on or off while the vehicle is moving. If the switch is turned off while the front hubs are driving, they will not release until the rear wheels regain traction.

CAUTION
Switching to AWD while the rear wheels are spinning may cause severe drive shaft and clutch damage. Always switch to AWD while the rear wheels have traction or are at rest.

Disengaging AWD

Under certain conditions, it may be possible for the front gearcase to remain locked unnecessarily. This condition causes increased steering effort and some vehicle speed restriction. If the front gearcase remains locked after following these instructions, return the vehicle to your dealer for service.

1. Stop the vehicle.
2. Operate in reverse for at least 10 feet.
3. Stop completely.
4. Shift into low gear and drive forward.

EMISSION CONTROL SYSTEMS

Noise Emission Control System

Do not modify the engine, intake or exhaust components, as doing so may affect compliance with U.S.A. EPA noise control requirements (40 CFR 205) and local noise level requirements.

Operation on Public Lands in the U.S.A.

Your Polaris vehicle has a spark arrestor that was tested and qualified to be in accordance with the USDA Forest Service Standard 5100-1C. Federal law requires that this spark arrestor be installed and functional when the vehicle is operated on public lands.

Operation of off-road vehicles on public lands in the U.S.A. is regulated by 43 CFR 8343.1(c). Violations are subject to monetary penalties. Federal regulations can be viewed online at www.gpoaccess.gov/ecfr/.

Crankcase Emission Control System

This engine is equipped with a closed crankcase system. Blow-by gases are forced back to the combustion chamber by the intake system. All exhaust gases exit through the exhaust system.

Exhaust Emission Control System

Exhaust emissions are controlled by engine design. An electronic fuel injection (EFI) system controls fuel delivery. The engine and EFI components are set at the factory for optimal performance and are not adjustable.

The emissions label is located on the frame under the seat.

Electromagnetic Interference

This spark ignition system complies with Canadian ICES-002.

This vehicle complies with the EMC requirements European directives 97/24/EC and 89/336/EEC

MAINTENANCE
Periodic Maintenance Chart

Careful periodic maintenance will help keep your vehicle in the safest, most reliable condition. Inspection, adjustment and lubrication of important components are explained in the periodic maintenance chart.

Inspect, clean, lubricate, adjust and replace parts as necessary. When inspection reveals the need for replacement parts, use genuine Polaris parts available from your Polaris dealer.

Record maintenance and service in the Maintenance Log beginning on page 128.

NOTE: Service and adjustments are important for proper vehicle operation. If you're not familiar with safe service and adjustment procedures, have a qualified dealer perform these operations.

Maintenance intervals in the following chart are based upon average riding conditions and an average vehicle speed of approximately ten (10) miles per hour. Vehicles subjected to severe use must be inspected and serviced more frequently.

Severe Use Definition

- Frequent immersion in mud, water or sand
- Racing or race-style high RPM use
- Prolonged low speed, heavy load operation
- Extended idle
- Short trip cold weather operation

Pay special attention to the oil level. A rise in oil level during cold weather can indicate contaminants collecting in the oil sump or crankcase. Change oil immediately if the oil level begins to rise. Monitor the oil level, and if it continues to rise, discontinue use and determine the cause or see your dealer.

Periodic Maintenance Chart

Maintenance Chart Key

▶ Perform these operations more often for vehicles subjected to severe use.

E Emission Control System Service - 4 Cycle (California)

■ Have an authorized Polaris dealer perform these services.

⚠ WARNING

Improperly performing the procedures marked with a ■ could result in component failure and lead to serious injury or death. Have an authorized Polaris dealer perform these services.

MAINTENANCE
Periodic Maintenance Chart

Perform all services at whichever maintenance interval is reached first.

Item		Maintenance Interval (whichever comes first)			Remarks
		Hours	Calendar	Miles (Km)	
■	Steering	-	Pre-Ride	-	Make adjustments as needed. See Pre-Ride Checklist on page 41.
▶	Front suspension	-	Pre-Ride	-	
▶	Rear suspension	-	Pre-Ride	-	
	Tires	-	Pre-Ride	-	
▶	Brake fluid level	-	Pre-Ride	-	
▶	Brake pedal travel				
	Brake system	-	Pre-Ride	-	
	Wheels/fasteners	-	Pre-Ride	-	
	Frame fasteners	-	Pre-Ride	-	
▶	Engine oil level	-	Pre-Ride	-	
▶ E	Air filter, pre-filter	-	Daily	-	Inspect; clean often; replace as needed
▶ E	Air box sediment tube	-	Daily	-	Drain deposits when visible
	Coolant (if applicable)	-	Daily	-	Check level daily, change coolant every 2 years
	Headlamp/tail lamp	-	Daily	-	Check operation; apply dielectric grease if replacing
▶ E	Air filter, main element	-	Weekly	-	Inspect; replace as needed
▶ ■	Brake pad wear	10 H	Monthly	-	Inspect periodically
	Battery	20 H	Monthly	-	Check terminals; clean; test
▶	Front Gearcase Oil (if equipped)	25 H	Monthly	-	Inspect level; change yearly
▶	Middle Gearcase Oil (if equipped)	25 H	Monthly	-	Inspect level; change yearly
▶	Rear gearcase oil (if equipped)	25 H	Monthly	-	Inspect level; change yearly
▶	Transmission oil	25 H	Monthly	-	Inspect level; change yearly

▶ Perform these procedures more often for vehicles subjected to severe use.
E Emission Control System Service - 4 Cycle (California)
■ Have an authorized Polaris dealer perform these services.

Periodic Maintenance Chart

	Item	Maintenance Interval (whichever comes first)			Remarks
		Hours	Calendar	Miles (Km)	
▶ E	Engine breather filter (if equipped)	25 H	Monthly	-	Inspect; replace if necessary
▶	Engine oil change (break-in)	25 H	1 M	-	Perform a break-in oil change at one month
	Park brake cable tension	25 H	1 M	-	Check tension, adjust
▶	General lubrication	50 H	3 M	-	Lubricate all fittings, pivots, cables, etc.
	Shift Linkage	50 H	6 M	-	Inspect, lubricate, adjust
■	Steering	50H	6 M	-	Lubricate
▶	Front Suspension	50 H	6 M	-	Lubricate
▶	Rear Suspension	50 H	6 M	-	Lubricate
■ E	Throttle cable/ ETC switch	50 H	6 M	-	Inspect; adjust; lubricate; replace if necessary
E	Throttle body air intake ducts/flange	50 H	6 M	-	Inspect duct for proper sealing/air leaks
	Drive belt	50 H	6 M	-	Inspect; adjust; replace as needed
	Cooling system (if applicable)	50 H	6 M	-	Inspect coolant strength seasonally; pressure test system yearly
	Park brake cable tension	100 H	6 M	-	Check tension, adjust
▶	Engine oil change	100 H	6 M	-	Perform a break-in oil change at one month
▶	Oil filter change	100 H	6 M	-	Replace with oil change

▶ Perform these procedures more often for vehicles subjected to severe use.
E Emission Control System Service - 4 Cycle (California)
■ Have an authorized Polaris dealer perform these services.

MAINTENANCE
Periodic Maintenance Chart

	Item	Maintenance Interval (whichever comes first)			Remarks
		Hours	Calendar	Miles (Km)	
■ E	Fuel system	100 H	12 M	-	Check for leaks at tank cap, lines, fuel valve, filter, pump, throttle body; replace lines every two years
■	Fuel filter	100 H	12 M	-	Replace yearly
▶	Radiator (in applicable)	100 H	12 M	-	Inspect; clean external surfaces
▶	Cooling Hoses	100 H	12 M	-	Inspect for leaks
▶	Engine mounts	100 H	12 M	-	Inspect
	Exhaust muffler/ pipe	100 H	12 M	-	Inspect
▶ E	Spark plug	100 H	12M	-	Inspect; replace as needed
■	Ignition timing	100 H	12 M	-	Inspect
▶	Wiring	100 H	12 M	-	Inspect for wear, routing, security; apply dielectric grease to connectors subjected to water, mud, etc.
■	Clutches (drive and driven)	100 H	12 M	-	Inspect; clean; replace worn parts
■	Front wheel bearings	100 H	12 M	-	Inspect; replace as needed
■	Brake fluid	200 H	24 M	-	Change every two years
	Spark arrestor	300 H	36 M	-	Clean out
	Idle speed	-			Adjust as needed
■	Toe adjustment	-			Inspect periodically; adjust when parts are replaced
■ ▶	Auxiliary brake (if equipped)	-			Inspect daily; adjust as needed
	Headlight aim	-			Adjust as needed

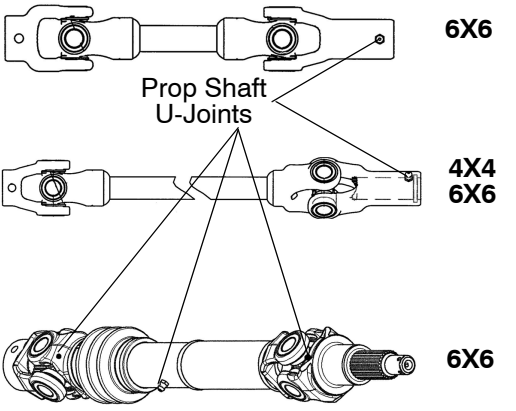
▶ Perform these procedures more often for vehicles subjected to severe use.
E Emission Control System Service - 4 Cycle (California).
■ Have an authorized Polaris dealer perform these services

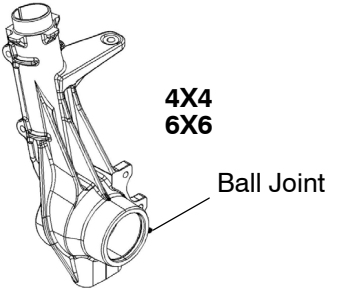
Lubrication Recommendations

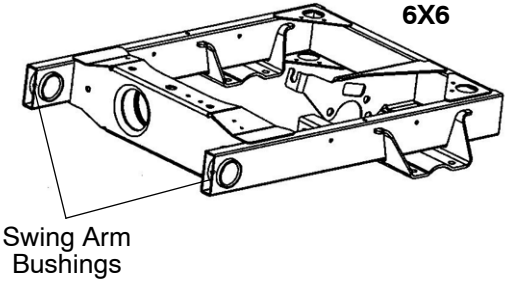
Check and lubricate all components at the intervals outlined in the Periodic Maintenance Chart beginning on page 60, or more often under severe use, such as wet or dusty conditions. Items not listed in the chart should be lubricated at the general lubrication interval.

Item	Lube	Method
Engine Oil	PS-4 PLUS 2W-50	Add to proper level on dipstick. See page 68.
Brake Fluid	DOT 4	Maintain level between fill lines. See page 89.
Main Gearcase Oil (Transmission)	Premium AGL Synthetic Gearcase Lube	See page 71.
Front Gearcase Oil	Premium Demand Drive Hub Fluid	See page 73.
Middle Gearcase Oil (6X6 only)	Premium ATV Angle Drive Fluid	See page 74.
Rear Gearcase Oil	Premium ATV Angle Drive Fluid	See page 75.
Prop Shaft U-joints	Polaris Premium U-Joint Lube	Locate fittings and grease. See page 66.
Front Prop Shaft Yoke	Polaris Premium U-Joint Lube	Locate fittings and grease (3 pumps maximum). See page 66.
Ball Joint	Polaris Premium all Season Grease or grease conforming to NLGI No. 2	Locate fitting (back side of struts), grease with grease gun. See page 66.
Swing Arm Bushings	Polaris Premium all Season Grease or grease conforming to NLGI No. 2	Locate fittings on swing arm and grease with grease gun. See page 66.

MAINTENANCE
Lubrication Recommendations







Engine Oil

Always check and change the engine oil at the intervals outlined in the Periodic Maintenance Chart beginning on page 60. Always change the oil filter whenever changing oil.

Polaris recommends the use of Polaris PS-4 *PLUS Performance* Synthetic 2W-50 4-cycle oil or a similar oil. See page 114 for the part numbers of Polaris products.

CAUTION

Mixing brands or using a non-recommended oil may cause serious engine damage. Always use the recommended oil. Never mix oil brands.

⚠ WARNING

Vehicle operation with insufficient, deteriorated, or contaminated engine oil will cause accelerated wear and may result in engine seizure, accident, and injury. Always perform the maintenance procedures as outlined in the Periodic Maintenance Chart.

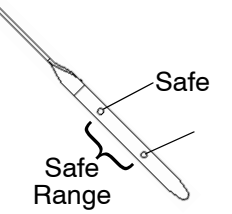
MAINTENANCE
Engine Oil

Always check and change the oil at the intervals outlined in the Periodic Maintenance Chart beginning on page 60. Always use the recommended engine oil.

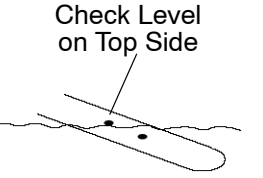
Oil Check

The oil dipstick and fill tube is located on the engine.

1. Position the vehicle on a level surface.
2. Apply the brakes. Start the engine and allow it to idle for 20-30 seconds. Stop the engine.
3. Lift the lever lock to remove the dipstick. Wipe it dry with a clean cloth.
4. Reinstall the dipstick completely, but do not lock it. The dipstick must be screwed completely in to keep the angle and depth of the stick consistent.
5. Remove the dipstick and check the oil level. Maintain the oil level in the safe range. Do not overfill.



NOTE: Due to the dipstick entry angle into the crankcase, the oil level will read higher on the bottom side of the dipstick. Always read the level on the upper surface of the dipstick.



6. After reinstalling the dipstick, be sure to seat the lever lock.

Engine Oil

Oil and Filter Change

CAUTION
Hot oil can cause serious burns to skin. Do not allow hot oil to come into contact with skin.

Always change the oil and filter at the intervals outlined in the Periodic Maintenance Chart beginning on page 60. Always change the oil filter whenever changing oil.

1. Position the vehicle on a level surface.
2. Run the engine for two to three minutes until warm. Stop the engine.
3. Clean the area around the drain plug.
4. Place a drain pan beneath engine crankcase and remove the drain plug.
5. Allow the oil to drain completely.
6. Reinstall the sealing washer on the drain plug.

NOTE: The sealing surfaces on drain plug and crankcase should be clean and free of burrs, nicks or scratches.

7. Reinstall the drain plug. Torque to 20 ft. lbs. (27 Nm).
8. Place shop towels beneath the oil filter. Using an oil filter wrench, turn the filter counter-clockwise to remove it.
9. Using a clean dry cloth, clean the filter sealing surface on the crankcase.
10. Lubricate the o-ring on the new filter with a film of fresh engine oil. Check to make sure the o-ring is in good condition.
11. Install the new filter and turn by hand until the filter gasket contacts the sealing surface, then turn and additional 1/2 turn.

MAINTENANCE
Engine Oil
Oil and Filter Change

12. Remove the dipstick and fill the sump with two quarts (1.9 l) of recommended oil.
13. Shift the transmission to neutral.
14. Engage the park brake.
15. Apply the brakes. Start the engine. Allow it to idle for one to two minutes.
16. Stop the engine. Inspect for leaks.
17. Re-check the oil level on the dipstick and add oil as necessary to bring the level to the upper mark on the dipstick.
18. Dispose of used filter and oil properly.

Gearcases
Gearcase Specification Chart

Gearcase	Lubricant	Capacity	Fill Plug Torque	Drain Plug Torque
Main Gearcase (Transmission)	Premium AGL Synthetic Gearcase Lube	15.2 oz. (450 ml)	14 ft. lbs. (19.4 Nm)	14 ft. lbs. (19.4 Nm)
Front Gearcase	Premium Demand Drive Hub Fluid	5 oz. (150 ml)	8-10 ft. lbs. (11-13.6 Nm	11 ft. lbs. (15 Nm)
Middle Gearcase (6X6)	Premium ATV Angle Drive Fluid	6.75 oz. (200 ml)	14 ft. lbs. (19.4 Nm)	14 ft. lbs. (19.4 Nm)
Rear Gearcase (4X4)	Premium ATV Angle Drive Fluid	18 oz. (532 ml)	40-50 ft. lbs. (54-68 Nm	30-45 in. lbs. (3-5 Nm)
Rear Gearcase (6X6)	Premium ATV Angle Drive Fluid	10 oz. (300 ml)	14 ft. lbs. (19.4 Nm)	14 ft. lbs. (19.4 Nm)

Gearcases

Transmission (Main Gearcase)

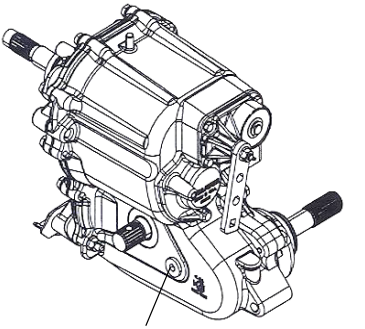
Always check and change the transmission oil at the intervals outlined in the Periodic Maintenance Chart beginning on page 60. Maintain the oil level even with the bottom of the fill plug hole.

Refer to the Gearcase Specifications Chart on page 70 for recommended lubricants, capacities and torque specifications. See page 114 for the part numbers of Polaris products.

The fill plug is located at the rear of the vehicle.

Oil Check

1. Position the vehicle on a level surface.
2. Remove the fill plug.
3. Check the oil level.
4. Add the recommended oil as needed.
5. Reinstall the fill plug. Torque to specification.



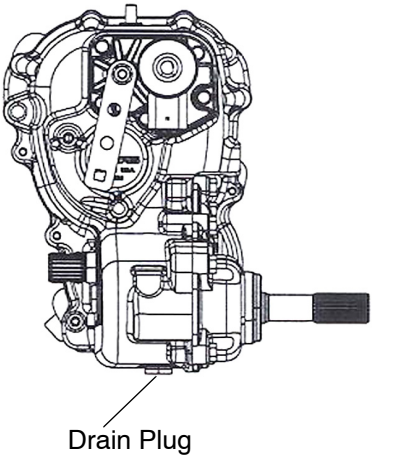
MAINTENANCE

Gearcases

Transmission (Main Gearcase)

Oil Change

The drain plug is located on the bottom of the transmission. Access the drain plug through the drain hole in the skid plate.



1. Remove the fill plug.
2. Place a drain pan under the drain plug. Remove the drain plug. Drain the oil. Dispose of used oil properly.
3. Wipe the magnetic end of the drain plug clean to remove accumulated metallic filings.
4. After the oil has drained completely, install a new sealing washer.
5. Reinstall the drain plug. Torque to specification.
6. Add the recommended oil as needed. Do not overfill.
7. Reinstall the fill plug. Torque to specification.
8. Check for leaks.

Gearcases

Front Gearcases

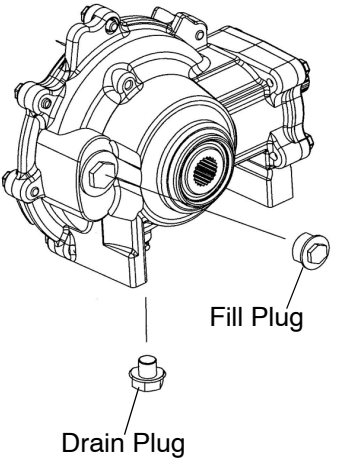
Always check and change the front gearcase oil at the intervals outlined in the Periodic Maintenance Chart beginning on page 60. Maintain the oil level even with the bottom thread of the fill plug hole.

Refer to the Gearcase Specifications Chart on page 70 for recommended lubricants, capacities and torque specifications. See page 114 for the part numbers of Polaris products.

The front gearcase fill plug is located on the right side of the front gearcase.

Oil Check

1. Position the vehicle on a level surface.
2. Remove the fill plug. Check the oil level.
3. Add the recommended oil as needed.
4. Reinstall the fill plug. Torque to specification.



Oil Change

1. Support the vehicle securely with a jackstand.
2. Remove the front tire on the driver's side.
3. Remove the fill plug.
4. Place a drain pan under the drain plug on the bottom right-hand side.
5. Remove the drain plug. Drain the oil. Discard used oil properly.
6. Clean the drain plug. Reinstall the drain plug. Torque to specification.
7. Add the recommended oil.
8. Reinstall the fill plug. Torque to specification.
9. Check for leaks.

MAINTENANCE

Gearcases

Middle Gearcase (6X6)

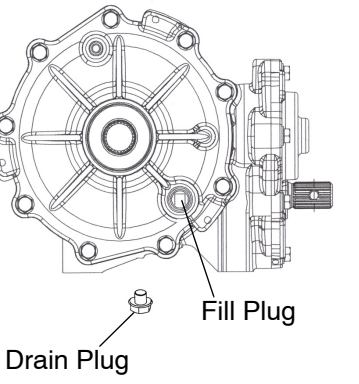
Always check and change the middle gearcase oil at the intervals outlined in the Periodic Maintenance Chart beginning on page 60. Maintain the oil level even with the bottom thread of the fill plug hole.

Refer to the Gearcase Specifications Chart on page 70 for recommended lubricants, capacities and torque specifications. See page 114 for the part numbers of Polaris products.

The middle gearcase fill plug is located on the side of the gearcase.

Oil Check

1. Position the vehicle on a level surface.
2. Remove the fill plug. Check the oil level.
3. Add the recommended oil as needed.
4. Reinstall the fill plug. Torque to specification.



Oil Change

1. Remove the fill plug.
2. Remove the drain plug from the bottom of the gearcase. Drain the oil into a drain pan. Discard used oil properly.
3. Clean and reinstall the drain plug. Torque to specification.
4. Add the recommended fluid.
5. Reinstall the fill plug. Torque to specification.
6. Check for leaks

Gearcases

Rear Gearcase

Always check and change the rear gearcase oil at the intervals outlined in the Periodic Maintenance Chart beginning on page 60.

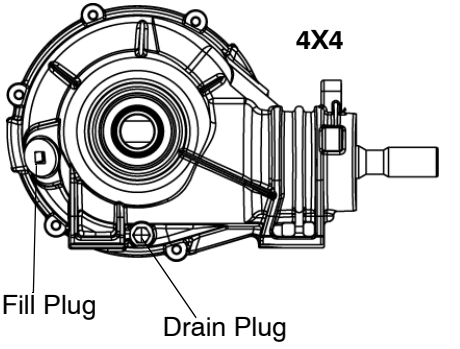
Refer to the Gearcase Specifications Chart on page 70 for recommended lubricants, capacities and torque specifications. See page 114 for the part numbers of Polaris products.

The rear gearcase fill plug is on the driver's side of the rear gearcase.

Oil Check (4X4)

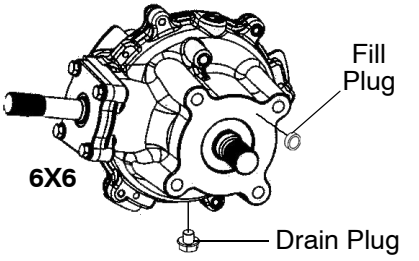
Maintain the oil level even with the bottom thread of the fill plug hole.

1. Position the vehicle on a level surface.
2. Remove the fill plug. Check the oil level.
3. Add the recommended oil as needed.
4. Reinstall the fill plug. Torque to specification.



Oil Check (6X6)

The easiest way to check for adequate oil in the 6X6 is to drain and refill the gearcase to capacity (see page 70). Perform the oil change as outlined on page 76.



MAINTENANCE

Gearcases

Rear Gearcase

Oil Change

1. Remove the fill plug.
2. Place a drain pan under the drain plug. Remove the drain plug.
3. Drain the oil. Dispose of used oil properly.
4. Clean the drain plug. Reinstall the drain plug. Torque to specification.
5. Add the recommended oil.
6. Reinstall the fill plug. Torque to specification.
7. Check for leaks.

Spark Plugs

CAUTION

Using non-recommended spark plugs can result in serious engine damage. Always use Polaris-recommended spark plugs. Refer to the specifications section beginning on page 110.

Spark Plug Gap/Torque

Model	Electrode Gap	New Plug Torque	Used Plug Torque
RANGER 4X4 EFI	.035" (.9 mm)	18 ft. lbs. (24 Nm)	18 ft. lbs. (24 Nm)
RANGER 6X6 EFI	.035" (.9 mm)	18 ft. lbs. (24 Nm)	18 ft. lbs. (24 Nm)

Spark plug condition is indicative of engine operation. The spark plug firing end condition should be read after the engine is warmed up and the vehicle is driven at higher speeds. Immediately check the spark plug for correct color. See page 78.

⚠ WARNING

A hot exhaust system and engine can cause serious burns. Wear protective gloves when removing a spark plug for inspection.

MAINTENANCE

Spark Plugs

Spark Plug Condition

Normal Plug

The normal insulator tip is gray, tan or light brown. There will be few combustion deposits. The electrodes are not burned or eroded. This indicates the proper type and heat range for the engine and the service.

NOTE: The tip should not be white. A white insulator tip indicates overheating, caused by use of an improper spark plug or incorrect throttle body adjustments.

Wet Fouled Plug

The wet fouled insulator tip is black. A damp oil film covers the firing end. There may be a carbon layer over the entire nose. Generally, the electrodes are not worn. General causes of fouling are excessive oil, use of non-recommended injection oil or incorrect throttle body adjustments.

Spark Plug Removal and Replacement

1. Remove the seat to access the engine compartment.
2. Remove the spark plug cap. Using the spark plug wrench provided in the tool kit, remove the plug by rotating it counterclockwise.
3. Reverse the procedure for spark plug installation. Torque to specification. See page 77.

Cooling System

Operation

The engine coolant level is controlled or maintained by the recovery system. The recovery system components are the overflow bottle, radiator filler neck, radiator pressure cap and connecting hose.

As coolant operating temperature increases, the expanding (heated) excess coolant is forced out of the radiator, past the pressure cap, and into the overflow bottle. As engine coolant temperature decreases, the contracting (cooled) coolant is drawn back up from the tank, past the pressure cap, and into the radiator.

NOTE: Some coolant level drop on new vehicles is normal as the system is purging itself of trapped air. Observe coolant levels and maintain as recommended by adding coolant to the overflow bottle.

Adding or Changing Coolant

To ensure that the coolant maintains its ability to protect the engine, we recommend that the system be completely drained every two years and a fresh mixture of antifreeze and water added. Polaris recommends the use of Polaris Premium 60/40 anti-freeze/coolant or a 50/50 mixture of high quality aluminum compatible anti-freeze/coolant and distilled water. Polaris Premium 60/40 is already premixed and ready to use. Do not dilute with water. See page 114 for the part numbers of Polaris products.

NOTE: Always follow the manufacturer's mixing recommendations for the freeze protection required in your area.

Any time the cooling system has been drained for maintenance or repair, replace the coolant. If the recovery bottle has run dry, the level in the radiator should be inspected. Add coolant as needed.

MAINTENANCE
Cooling System
Radiator and Cooling Fan

Always check and clean the screen and radiator fins at the intervals outlined in the Periodic Maintenance Chart beginning on page 60. Do not obstruct or deflect air flow through the radiator by installing unauthorized accessories in front of the radiator or behind the cooling fan. Interference with the radiator air flow can lead to overheating and consequent engine damage.

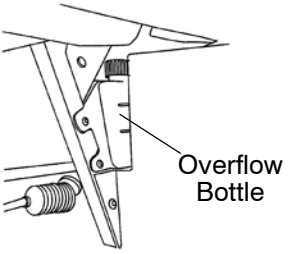
CAUTION
Washing the vehicle with a high-pressure hose could damage the radiator fins and impair the radiator's effectiveness. Using a high-pressure system is not recommended.

Coolant Level

Always check and change the coolant at the intervals outlined in the Periodic Maintenance Chart beginning on page 60. Maintain the coolant level between the minimum and maximum marks on the bottle (when the fluid is cool).

The overflow bottle is located in front of the right front wheel.

1. Position the vehicle on a level surface.
2. View the coolant level in the overflow bottle.
3. If the coolant level is below the safe operating range, lift the hood and locate the overflow bottle lid. Remove the lid and use a funnel to add coolant through the filler opening. Reinstall the cap.



NOTE: If coolant must be added often, or if the overflow bottle runs completely dry, there may be a leak in the system. Have the cooling system inspected by your Polaris dealer.

Cooling System

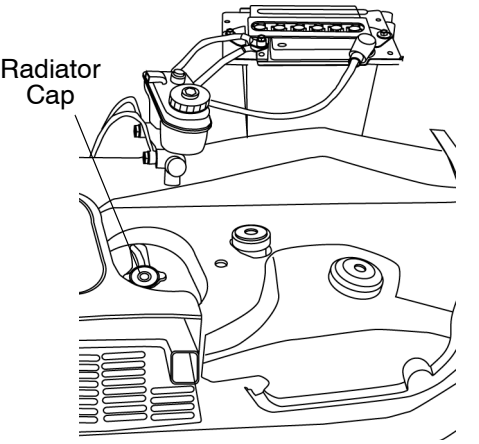
Radiator Coolant Level

Always check and clean the screen and radiator fins at the intervals outlined in the Periodic Maintenance Chart beginning on page 60. Do not obstruct or deflect air flow through the radiator by installing unauthorized accessories in front of the radiator or behind the cooling fan. Interference with the radiator air flow can lead to overheating and consequentially, engine damage.

⚠ WARNING

Escaping steam can cause severe burns. Never remove the pressure cap while the engine is warm or hot. Always allow the engine to cool before removing the pressure cap.

1. Lift the hood.
2. Slowly remove the radiator cap.
3. View the coolant level through the opening.
4. Use a funnel and slowly add coolant as needed.



NOTE: This procedure is required only if the cooling system has been drained for maintenance and/or repair. But if the overflow bottle has run dry, the level in the radiator should also be inspected.

NOTE: Use of a non-standard pressure cap will not allow the recovery system to function properly. See your dealer for the correct replacement part.

MAINTENANCE
Polaris Variable Transmission (PVT) System

Belt slip is responsible for creating excessive heat that destroys belts, wears clutch components and causes outer clutch covers to fail. Switch to low range while operating at slower speeds to extend the life of the PVT components (belt, cover, etc.).

When To Use Low Range and High Range

Condition	Range to Use
Operating at speeds less than 7 MPH (11 km/h)	Low
Towing heavy loads	Low
Operating in rough terrain (swamps, mountains, etc.)	Low
Operating at speeds greater than 7 MPH (11 km/h)	High

PVT System

⚠ WARNING

Failure to comply with the instructions in this warning can result in severe injury or death.

Do not modify any component of the PVT system. Doing so may reduce its strength so that a failure may occur at a high speed. The PVT system has been precision balanced. Any modification will cause the system to be out of balance, creating vibration and additional loads on components.

The PVT system rotates at high speeds, creating large amounts of force on clutch components. Extensive engineering and testing has been conducted to ensure the safety of this product. However, as the owner, you have the following responsibilities to make sure this system remains safe:

- Always follow all recommended maintenance procedures. See your dealer as outlined in the owner's manual.
- This PVT system is intended for use on Polaris products only. Do not install it in any other product.
- Always make sure the PVT housing is securely in place during operation.

MAINTENANCE
PVT System
PVT Drying

There may be some instances when water is accidently ingested into the PVT system. Use the following instructions to dry it out before operating.

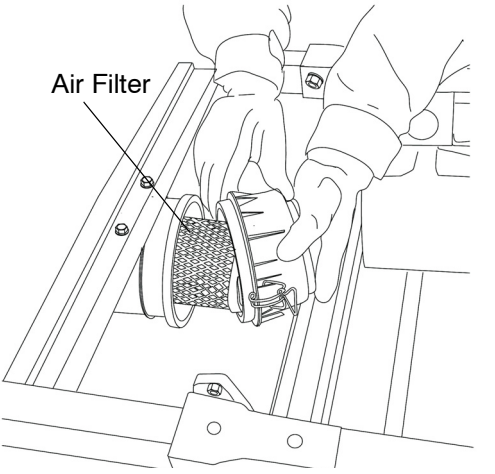
1. Loosen the bottom screws that secure the clutch cover.
2. Allow the water to drain.
3. Tighten the screws.
4. Apply the brakes. Start the engine.
5. Engage the park brake.
6. Shift the transmission to neutral.
7. Apply varying throttle for 10-15 seconds to expel the moisture and air-dry the belt and clutches. Do not hold the throttle wide open for more than 10 seconds.
8. Allow the engine RPM to settle to idle speed. Apply the service brakes. Release the park brake and shift the transmission to the lowest available range.
9. Test for belt slippage. If the belt slips, repeat the process.
10. Take the vehicle to your dealer for service as soon as possible.

Filter Systems

Air Filter

Always change the air filter at the intervals outlined in the Periodic Maintenance Chart beginning on page 60.

1. Lift the cargo box to access the air box.
2. Remove the air box cover and inspect the gasket. It should adhere tightly to the cover and seal all the way around.
3. Remove the air filter.
4. Do not attempt to clean the main element. Install a new air filter.



NOTE: Apply a small amount of general purpose grease to the sealing edges of the filter before installing.

5. Inspect the air box for oil or water deposits. If present, drain them into a suitable container.

NOTE: Service the air filter more frequently if the vehicle is operated in wet conditions or at high throttle openings for extended periods.

Fuel Filter

Your Polaris vehicle is equipped with an in-line fuel filter. Have your dealer replace it after every 100 hours of operation. Do not attempt to clean the fuel filter.

MAINTENANCE
Spark Arrestor

⚠ WARNING

Failure to heed the following warnings while servicing the spark arrestor could result in serious injury or death.

Do not perform service on the spark arrestor while the system is hot. Exhaust system temperatures can reach 1000° F. Allow components to cool sufficiently before proceeding.

Remove any combustible materials from the area.

Wear eye protection and gloves.

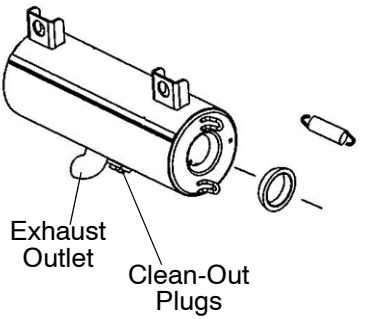
Do not stand behind or in front of the vehicle while purging.

Never run the engine in an enclosed area. Exhaust contains poisonous carbon monoxide gas that can cause loss of consciousness or death in a very short time.

Never go under the vehicle while it's inclined.

Use the following procedure to periodically purge accumulated carbon from the exhaust pipe.

1. Remove the arrestor clean-out plugs located on the bottom of the muffler.
2. Shift the transmission to neutral. Apply the brakes. Start the engine.
3. Purge accumulated carbon from the system by momentarily revving the engine several times.
4. If carbon is expelled, cover or plug the exhaust outlet and rap on the pipe around the clean-out plugs while revving the engine several more times.



5. If particles are still suspected to be in the muffler, elevate the rear of the vehicle one foot higher than the front. Engage the park brake. Block the wheels. Make sure the transmission is in neutral and repeat steps 3 and 4 until no more particles are expelled when the engine is revved.
6. Stop the engine. Allow the arrestor to cool.
7. Reinstall the arrestor plugs and remove the outlet cover or plug.

Throttle System

⚠ WARNING

Failure to check or maintain proper operation of the throttle system can result in an accident and lead to serious injury or death if the throttle pedal sticks during operation.

Never start or operate this vehicle if it has a sticking or improperly operating throttle pedal.

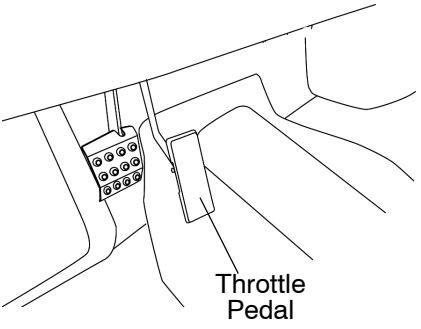
Immediately contact your dealer for service if throttle problems arise.

Always check the pedal for free movement and return before starting the engine and occasionally during operation.

Throttle Freeplay

If the throttle pedal has excessive play due to cable stretch or mis-adjustment, it will cause a delay in throttle response, especially at low engine speed. The throttle may also not open fully. If the throttle pedal has no freeplay, the throttle may be hard to control, and the idle speed may be erratic.

Check the throttle pedal freeplay at the intervals outlined in the Periodic Maintenance Chart beginning on page 60. Adjust the freeplay if necessary.



Throttle Freeplay Inspection

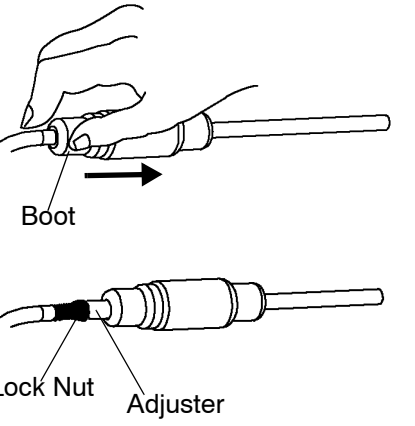
1. Engage the park brake. Shift the transmission to neutral.
2. Apply the brakes. Start the engine. Allow it to warm up thoroughly.
3. Measure the distance the throttle pedal moves before the engine begins to pick up speed. Freeplay should be 1/16 to 1/8 inches (1.6-3.2 mm).

MAINTENANCE
Throttle System
Throttle Body/Idle RPM

Idle RPM is preset by the manufacturer. If the engine idle speed is not satisfactory, please see your Polaris dealer for adjustment.

Throttle Freeplay Adjustment

1. Remove the seat.
2. Locate the throttle cable adjuster.
3. Squeeze the end of the rubber boot and slide it far enough to expose the end of the inline cable adjuster.
4. Loosen the adjuster lock nut.
5. Rotate the boot to turn the adjuster until 1/16" to 1/8" (1.5-3 mm) of freeplay is achieved at the throttle pedal. See page 87.



NOTE: While adjusting, lightly flip the throttle pedal up and down.

6. Tighten the lock nut.
7. Squeeze the end of the rubber boot and slide it over the cable adjuster to its original position.

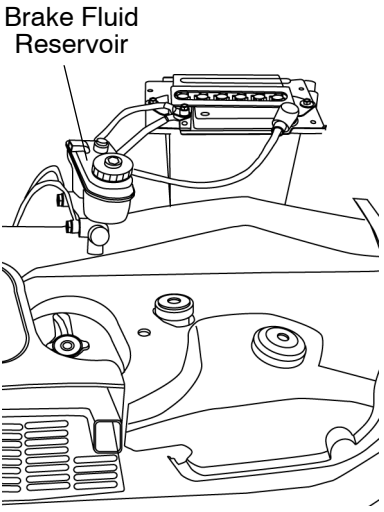
Brakes

The front and rear brakes are hydraulic disc type brakes activated by the brake pedal. See page 36.

Brake Fluid

Inspect the brake system routinely. Inspect the level of the brake fluid before each operation.

Change the brake fluid every two years and any time the fluid becomes contaminated, the fluid level is below the minimum, or if the type and brand of the fluid in the reservoir are unknown.



1. Position the vehicle on a level surface.
2. View the brake fluid level at the reservoir under the hood. The level should be between the upper (MAX) and lower (MIN) level lines.
3. If the fluid level is lower than the upper level line, add brake fluid to the upper (MAX) line.
4. Apply the brake forcefully for a few seconds and check for fluid leakage around the fittings.

⚠ WARNING

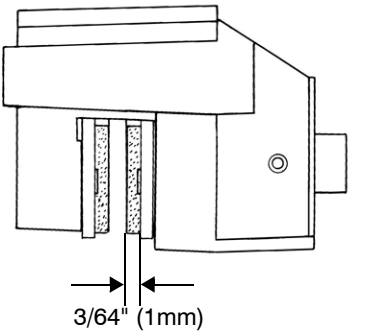
After opening a bottle of brake fluid, always discard any unused portion. Never store or use a partial bottle. Brake fluid is hygroscopic, meaning it rapidly absorbs moisture from the air. The moisture causes the boiling temperature of the brake fluid to drop, which can lead to early brake fade and the possibility of accident or severe injury.

MAINTENANCE

Brakes

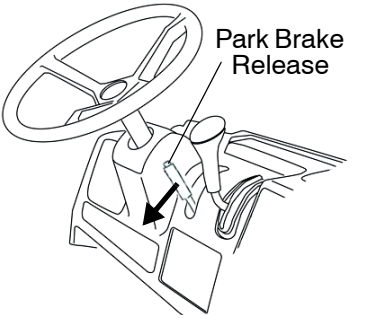
Brake Inspection

1. Check the brake system for fluid leaks.
2. Check the brake pedal for excessive travel or a spongy feel.
3. Check the friction pads for wear, damage and looseness.
4. Inspect the brake disc spline and pad wear surface for excessive wear.
5. Change pads when worn to 3/64" (1 mm).



Park Brake Inspection

1. Apply the brakes.
2. Pull the park brake lever downward as far as possible.
3. Check the vehicle for movement. The vehicle should not roll while parked. If the vehicle moves, adjust the park brake.



Park Brake Adjustment

Inspect and adjust park brake cable tension after the first 25 hours of operation and every 100 hours thereafter to ensure proper cable tension. Loss of tension in the park brake cable may cause illumination of the park brake light and activation of the limiting feature. If this occurs, move the park brake lever to the forward-most position, then inspect and adjust park brake cable tension.

NOTE: If performing this service is difficult due to conditions or location, open the hood and temporarily disconnect the park brake connector. This will inactivate the limiting function. Reconnect the connector as soon as possible, and adjust the park brake cable to proper tension.

1. Position the vehicle on a level surface.
2. Shift the transmission to neutral.
3. Loosen or tighten the nuts on the lever end of the park brake cable as needed.

Steering Wheel Inspection

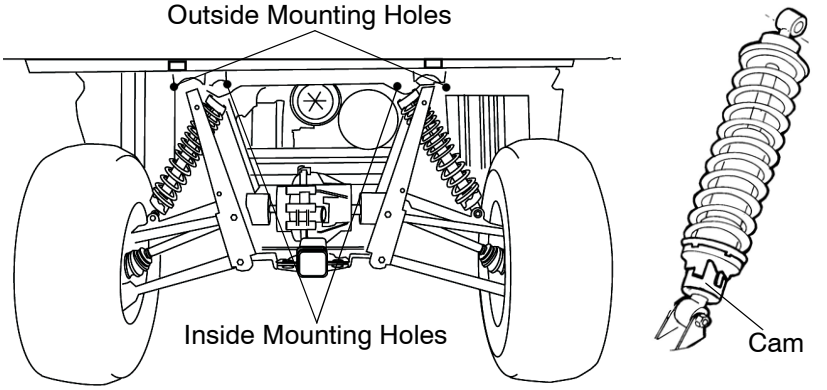
Check the steering wheel for specified freeplay and smooth operation at the intervals outlined in the Periodic Maintenance Chart beginning on page 60.

1. Position the vehicle on level ground.
2. Lightly turn the steering wheel left and right.
3. There should be 0.8"-1.0" (20-25 mm) of freeplay.
4. If there is excessive freeplay or strange noises, or the steering feels rough or "catchy," have the steering system inspected by an authorized Polaris dealer.

Suspension Adjustment (4X4)

The 4X4 rear suspension may be adjusted to provide a stiffer suspension if necessary.

1. Remove the top shock mounting bolts from the inside mounting holes.
2. Reposition the shocks to the outside mounting holes.
3. Reinstall the shock mounting bolts. Torque to 30 ft. lbs. (40 Nm).



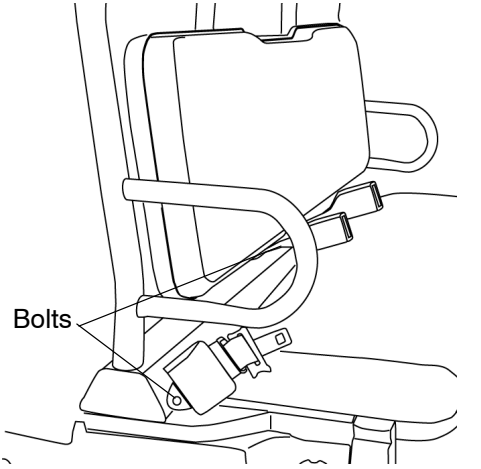
Rear Spring Adjustment

The rear shock absorber springs are adjusted by rotating the adjustment cam either clockwise or counterclockwise to increase or decrease spring tension.

MAINTENANCE
Seat Belts

Inspect all three seat belts for proper operation before each use of the vehicle.

1. Push the latch plate into the buckle until it clicks. The latch plate must slide smoothly into the buckle. A click indicates that it's securely latched.
2. Push the red button in the middle of the buckle to make sure it releases freely.
3. Check the belt webbing for wear, cuts or damage. If any irregularities are found, have the seat belt system checked and/or replaced by an authorized Polaris dealer.



The *RANGER* seat belt is adjustable and should be adjusted for both the operator and passengers before driving. Although having the belt at 30° is typical for many people, it will not accommodate all body sizes and shapes. Make sure the seat belt is adjusted to the lowest possible lap position before riding.

1. To adjust, loosen the bolts.
2. Reposition both the buckle and retractor. Tighten the bolts.

NOTE: The center belt does not self adjust. Before riding, pull on the strap to secure the belt on the lap of the center passenger.

⚠ WARNING
Failure to follow the age recommendations for this vehicle could result in serious injury or death. No one under the age of 16 may operate this vehicle. No one under the age of 5 may ride as a passenger in this vehicle.

Tires

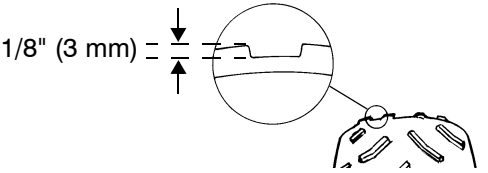
⚠ WARNING

Operating your vehicle with worn tires will increase the possibility of skidding, loss of control and an accident, which could result in serious injury or death. Always replace tires when the tread depth measures 1/8" (3 mm) or less.

Improper tire inflation or the use of non-standard size or type of tires may adversely affect vehicle handling, which could result in vehicle damage or personal injury. Always maintain proper tire pressure. When replacing tires, always use original equipment size and type.

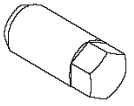
Tire Tread Depth

Always replace tires when tread depth is worn to 1/8" (3 mm) or less.



Axle and Wheel Nut Torque Specifications

Inspect the following items occasionally for tightness, and if they've been loosened for maintenance service.

Nut Type	Location	Nut Torque
Lug Nut 	Front and Rear	90 ft. lbs. (122 Nm)
2-Piece Flange Nut	Front and Rear	35 ft. lbs. (47 Nm)
Spindle Nut	Front	70 ft. lbs. (95 Nm)
Hub Retaining Nuts	Center and Rear	110 ft. lbs. (150 Nm)

NOTE: Do not lubricate the stud or the lug nut.

MAINTENANCE
Tires

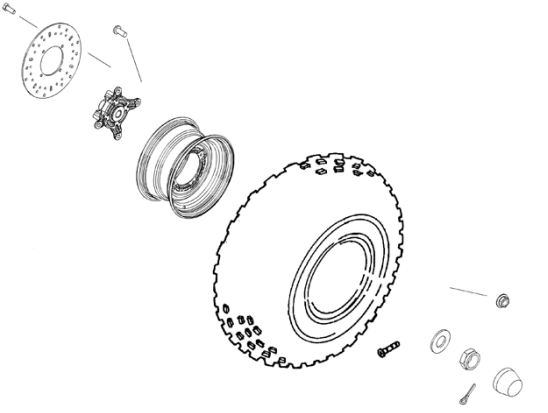
⚠ WARNING
Improperly installed wheels can adversely affect tire wear and vehicle handling, which can result in serious injury or death. Always ensure that all nuts are torqued to specification. Do not service axle nuts that have a cotter pin installed. See your Polaris dealer.

Wheel Removal

1. Stop the engine. Place the transmission in gear. Engage the park brake.
2. Loosen the wheel nuts slightly.
3. Elevate the side of the vehicle by placing a suitable stand under the frame.
4. Remove the wheel nuts and washers. Remove the wheel.

Wheel Installation

1. Place the transmission in gear.
2. Engage the park brake.
3. Place the wheel in the correct position on the wheel hub. Be sure the valve stem is toward the outside and rotation arrows on the tire point toward forward rotation.



4. Attach the wheel nuts and washers and finger tighten.
5. Carefully lower the vehicle to the ground.
6. Torque the wheel nuts to specification. See page 93.

Lights

When servicing a halogen lamp, don't touch the lamp with bare fingers. Oil from your skin leaves a residue, causing a hot spot that will shorten the life of the lamp.

⚠ WARNING

Poor lighting while driving can result in severe injury or death. Headlight and taillight lenses become dirty during normal operation. Wash the headlights frequently to maintain lighting quality.

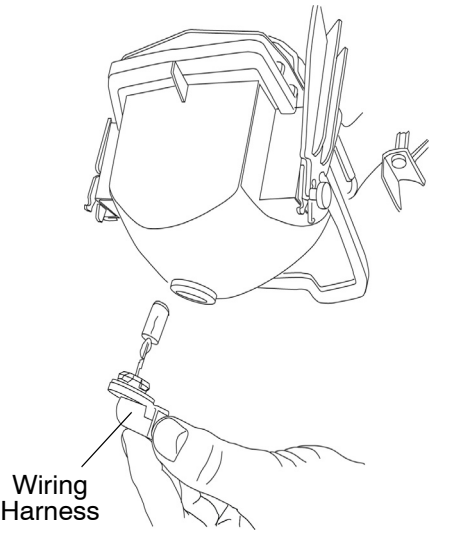
Hot components can cause serious burns to skin. Do not service the headlamps until they've cooled sufficiently.

Headlight Lamp Replacement

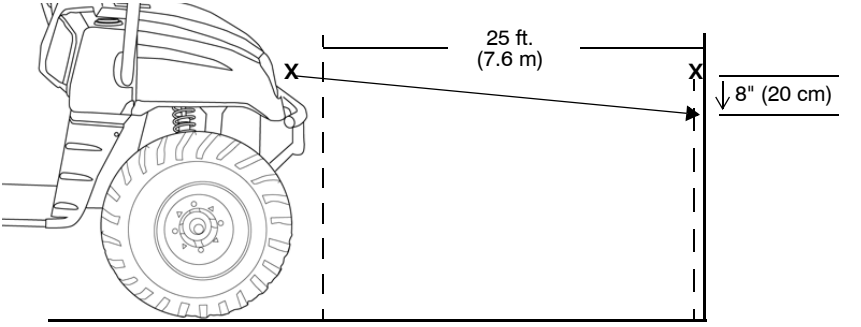
1. Open the hood.
2. Unplug the headlamp from the wiring harness. Be sure to pull on the connector, not on the wiring.
3. Turn the lamp counter-clockwise to remove it.
4. Install the new lamp.

NOTE: Make sure the tab on the lamp locates properly in the housing.

5. Reinstall the harness assembly into the headlight assembly.



MAINTENANCE
Lights
Headlight Beam Adjustment



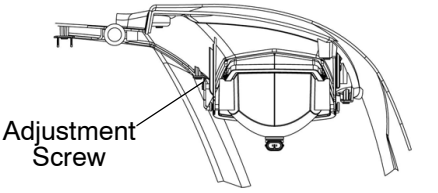
1. Place the vehicle on a level surface with the headlight approximately 25 ft. (7.6 m) from a wall.
2. Measure the distance from the floor to the center of the headlight and make a mark on the wall at the same height.
3. Apply the brakes. Start the engine. Turn on the headlights.
4. Observe the headlight aim. The most intense part of the headlight beam should be aimed 8" (20 cm) below the mark placed on the wall in step 2.

NOTE: Include the weight of a rider on the seat while performing this step.

5. If the headlight needs adjustment, open the hood.

NOTE: The lights are part of the hood assembly.

6. Turn the adjustment screw to adjust the beam.
7. Close the hood. Repeat steps 4-6 until the beam is properly adjusted.



View of driver's headlight with hood lifted.

Brake Lights

When the brake pedal is depressed, the console brake light comes on. Check the brake light before each ride.

1. Turn the ignition switch to the ON position.
2. Depress the brake pedal. The brake light should come on after about 10 mm (0.4 in.) of pedal travel. If the light doesn't come on, check the bulb.

Vehicle Immersion

CAUTION
If your vehicle becomes immersed, major engine damage can result if the machine is not thoroughly inspected. Take the vehicle to your dealer before starting the engine.

If it's impossible to take your *RANGER* to a dealer before starting it, follow the steps outlined below.

1. Move the vehicle to dry land or at the very least, to water below the footrests.
2. Dry any water present in the air box.
3. Filter replacement is required if water is present.
4. Thoroughly dry the air pre-cleaner located under the hood.
5. Remove the spark plugs.
6. Turn the engine over several times using the electric start.
7. Dry the spark plugs and reinstall, or replace with new plugs.

NOTE: Attempt to start the engine. If necessary, repeat the drying procedure.

8. Take the vehicle to your dealer for service as soon as possible, whether you succeed in starting it or not.

NOTE: If water has been ingested into the PVT follow the procedure on page 84 for drying.

MAINTENANCE
Battery

Your vehicle may have either a sealed battery, which requires little maintenance, or a conventional battery. A sealed battery can be identified by its flat covers on the top of the battery. A conventional battery has six filler caps on the top of the battery.

Conventional Battery

Always keep battery terminals and connections free of corrosion. If cleaning is necessary, remove the corrosion with a stiff wire brush. Wash with a solution of one tablespoon baking soda and one cup water. Rinse well with tap water and dry off with clean shop towels. Coat the terminals with dielectric grease or petroleum jelly. Be careful not to allow cleaning solution or tap water into the battery.

⚠ WARNING

Battery electrolyte is poisonous. It contains sulfuric acid. Serious burns can result from contact with skin, eyes or clothing.

Antidote:

External: Flush with water.

Internal: Drink large quantities of water or milk. Follow with milk of magnesia, beaten egg, or vegetable oil. Call physician immediately.

Eyes: Flush with water for 15 minutes and get prompt medical attention.

Batteries produce explosive gases. Keep sparks, flame, cigarettes, etc. away. Ventilate when charging or using in an enclosed space. Always shield eyes when working near batteries. KEEP OUT OF REACH OF CHILDREN.

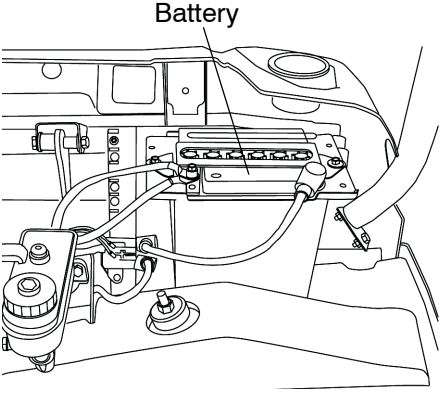
Battery

⚠ WARNING

Improperly connecting or disconnecting battery cables can result in an explosion and cause serious injury or death. When removing the battery, always disconnect the negative (black) cable first. When reinstalling the battery, always connect the negative (black) cable last.

Battery Removal

1. Open the hood.
2. On conventional batteries, remove the battery vent tube.
3. Disconnect the black (negative) battery cable first.
4. Disconnect the red (positive) battery cable last.
5. Lift the battery out of the vehicle. Be careful not to tip a conventional battery sideways, which could spill electrolyte.



CAUTION

If electrolyte spills, immediately wash it off with a solution of one tablespoon baking soda and one cup water to prevent damage to the vehicle.

MAINTENANCE
Battery
Battery Installation

Using a new battery that has not been fully charged can damage the battery and result in a shorter life. It can also hinder vehicle performance. Follow the battery charging instructions on page 102 before installing the battery.

1. Ensure that the battery is fully charged.
2. Place the battery in the battery holder.
3. With conventional batteries, install the battery vent tube (sealed batteries do not have a vent tube).

NOTE: The vent tube must be free of obstructions and securely installed. Route the tube away from the frame and vehicle body to prevent contact with electrolyte.

⚠ WARNING

Battery gases could accumulate in an improperly installed vent tube and cause an explosion, resulting in serious injury or death. Always ensure that the vent tube is free of obstructions and is securely installed as recommended.

4. On conventional batteries, coat the terminals with dielectric grease or petroleum jelly.
5. Connect and tighten the red (positive) cable first.
6. Connect and tighten the black (negative) cable last.
7. Verify that cables are properly routed.

Battery

Battery Storage

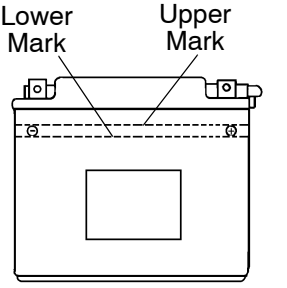
Whenever the vehicle is not used for a period of three months or more, remove the battery from the vehicle, ensure that it's fully charged, and store it out of the sun in a cool, dry place. Check battery voltage each month during storage and recharge as needed to maintain a full charge. See page 102.

NOTE: Battery charge can be maintained by using a Polaris Battery Tender charger or by charging about once a month to make up for normal self-discharge. Battery Tender can be left connected during the storage period, and will automatically charge the battery if the voltage drops below a pre-determined point. See page 114 for the part numbers of Polaris products.

Battery Fluid (Conventional Battery)

A poorly maintained battery will deteriorate rapidly. Check the battery fluid level often. Maintain the fluid level between the upper and lower level marks.

Add only distilled water. Tap water contains minerals that are harmful to a battery.



MAINTENANCE
Battery
Battery Charging (Conventional Battery)

1. Remove the battery from the vehicle to prevent damage from leaking or spilled electrolyte during charging. See page 99.
2. Charge the battery with a charging output no larger than 1/10 of the battery's amp/hr rating. Charge as needed to raise the specific gravity to 1.270 or greater.
3. Reinstall the battery. See page 100. Make sure the positive terminal is toward the front of the vehicle.

Battery Charging (Sealed Battery)

The following battery charging instructions apply only to the installation of a sealed battery. Read all instructions before proceeding with the installation of this battery.

The sealed battery is already filled with electrolyte and has been sealed and *fully charged* at the factory. *Never* pry the sealing strip off or add any other fluid to this battery.

The single most important thing about maintaining a sealed battery is to keep it fully charged. Since the battery is sealed and the sealing strip cannot be removed, you must use a voltmeter or multimeter to measure DC voltage.

⚠ WARNING

An overheated battery may explode, causing severe injury or death. Always watch charging times carefully. Stop charging if the battery becomes very warm to the touch. Allow it to cool before resuming charging.

For a refresh charge, follow all instructions carefully.

1. Check the battery voltage with a voltmeter or multimeter. A fully charged battery will register 12.8 V or higher.
2. If the voltage is less than 12.8 volts, recharge the battery at 1.2 amps or less until battery voltage is 12.8 or greater.

NOTE: When using an automatic charger, refer to the charger manufacturer's instructions for recharging. When using a constant current charger, use the guidelines on the next page for recharging.

Battery

Battery Charging (Sealed Battery)

NOTE: Always verify battery condition before and 1-2 hours after the end of charging.

State of Charge	Voltage	Action	Charge Time (Using constant current charger @ standard amps specified on top of battery)
100%	12.8-13.0 volts	None, check at 3 mos. from date of manufacture	None required
75%-100%	12.5-12.8 volts	May need slight charge, if no charge given, check in 3 months	3-6 hours
50%-75%	12.0-12.5 volts	Needs charge	5-11 hours
25%-50%	11.5-12.0 volts	Needs charge	At least 13 hours, verify state of charge
0%-25%	11.5 volts or less	Needs charge with desulfating charger	At least 20 hours

MAINTENANCE
Cleaning and Storage
Washing the Vehicle

Keeping your Polaris vehicle clean will not only improve its appearance but it can also extend the life of various components.

CAUTION
High water pressure may damage components. Polaris recommends washing the vehicle by hand or with a garden hose, using mild soap. Certain products, including insect repellents and chemicals, will damage plastic surfaces. Do not allow these types of products to contact the vehicle.

The best and safest way to clean your Polaris vehicle is with a garden hose and a pail of mild soap and water.

1. Use a professional-type washing cloth, cleaning the upper body first and the lower parts last.
2. Rinse with clean water frequently.
3. Dry surfaces with a chamois to prevent water spots.

Washing Tips

- Avoid the use of harsh cleaners, which can scratch the finish.
- Do not use a power washer to clean the vehicle.
- Do not use medium to heavy duty compounds on the finish.
- Always use clean cloths and pads for cleaning and polishing. Old or reused cloths and pads may contain dirt particles that will scratch the finish.

Cleaning and Storage

Washing the Vehicle

If a high pressure water system is used for cleaning (not recommended), exercise extreme caution. The water may damage components and could remove paint and decals. Avoid directing the water stream at the following items:

- Wheel bearings
- Radiator
- Transmission seals
- Brakes
- Cab and body panels
- Labels and decals
- Electrical components and wiring

NOTE: If warning and safety labels are damaged, contact your Polaris dealer for free replacement.

Grease all zerk fittings immediately after washing. Allow the engine to run for a while to evaporate any water that may have entered the engine or exhaust system.

Polishing the Vehicle

Polaris recommends the use of common household aerosol furniture polish for polishing the finish on your Polaris vehicle. Follow the instructions on the container.

Polishing Tips

- Avoid the use of automotive products, some of which can scratch the finish of your vehicle.
- Always use clean cloths and pads for cleaning and polishing. Old or reused cloths and pads may contain dirt particles that will scratch the finish.

MAINTENANCE
Cleaning and Storage
Chrome Wheel Care (if equipped)

Proper maintenance will protect chrome wheels from corrosion, preserve wheel life and ensure a “like new” appearance for many years.

NOTE: Chrome wheels exposed to road salt (or salt in the air in coastal areas) are more susceptible to corrosion if not properly cleaned. Clean chrome wheels more often if they're exposed to salt or other corrosive elements.

1. Wash chrome wheels frequently. Use a mild detergent. Never use abrasive cleaners on plated or painted surfaces.
2. Rinse well with clear water. Soap, detergents, salt, dirt, mud and other elements can cause corrosion.
3. Polish the clean chrome wheels periodically. Use an automotive grade chrome polish.
4. Routinely and liberally apply a weather resistant wax to each polished chrome wheel. Choose a product suitable for chrome finishes. Read and follow the product labels and instructions.

Removing Corrosion

If light rust is found on the chrome finish, use steel wool (#0000-OTT grade) to remove it. Gently rub the affected areas with the steel wool until the corrosion has been removed. Clean and polish the wheel as outlined above.

Cleaning and Storage

Storage Tips

CAUTION

Starting the engine during the storage period will disturb the protective film created by fogging and damage could occur. Never start the engine during the storage period.

Clean the Exterior

Make any necessary repairs and clean the vehicle as recommended. See page 104.

Stabilize the Fuel

1. Fill the fuel tank.
2. Add Polaris Carbon Clean Fuel Treatment or Polaris Fuel Stabilizer. Follow the instructions on the container for the recommended amount.

NOTE: Carbon Clean removes water from fuel systems, stabilizes fuel and removes carbon deposits from pistons, rings, valves and exhaust systems.

3. Allow the engine to run for 15-20 minutes to allow the stabilizer to disperse through the entire fuel delivery system.

Oil and Filter

Change the oil and filter. See page 69.

Air Filter / Air Box

Inspect and clean or replace the pre-cleaner and air filter. See page 85. Clean the air box. Drain the sediment tube.

Fluid Levels

Inspect the fluid levels. Add or change fluids as recommended in the Periodic Maintenance Chart beginning on page 60.

- Front and rear gearcase fluid
- Transmission fluid
- Brake fluid (change every two years and any time the fluid looks dark or contaminated)
- Coolant (test strength/fill)

Inspect and Lubricate

Inspect all cables and lubricate all areas of the vehicle as recommended in the Periodic Maintenance Chart beginning on page 60.

MAINTENANCE
Cleaning and Storage
Storage Tips
Fog the Engine

1. Treat the fuel system with Polaris Carbon Clean. Follow the instructions on the container. Start the engine. Allow it to idle for several minutes so the Carbon Clean reaches the injectors. Stop the engine.
2. Remove the spark plugs and add 2-3 tablespoons of engine oil. To access the plug holes, use a section of clear 1/4" hose and a small plastic squeeze bottle filled with the pre-measured amount of oil.

NOTE: Do this carefully! If you miss the plug holes, oil will drain from the spark plug cavities into the hole at the front of the cylinder head, and appear to be an oil leak.

3. Reinstall the spark plugs. Torque to specification. See page 78.
4. Apply dielectric grease to the inside of each spark plug cap and reinstall the caps onto the plugs.
5. Turn the engine over several times. Oil will be forced in and around the piston rings and ring lands, coating the cylinder with a protective film of fresh oil.
6. If Polaris fuel system additive is not used, fuel tank, fuel lines, and injectors should be completely drained of gasoline.

Battery Maintenance

See pages 101-103 for storage and charging procedures.

Storage Area/Covers

Be sure the storage area is well ventilated. Cover the vehicle with a genuine Polaris cover.

NOTE: Do not use plastic or coated materials. They do not allow enough ventilation to prevent condensation, and may promote corrosion and oxidation.

Removal from Storage

1. Check the battery electrolyte level and charge the battery if necessary. Install it in the vehicle. Make sure the battery vent hose is routed properly and that it's not pinched or restricted in any way.
2. Make sure the spark plug is tight.
3. Fill the fuel tank with fuel.
4. Check all the points listed in the Daily Pre-Ride Inspection section on page 41.

NOTE: Tightness of the bolts, nuts and other fasteners should be checked by an authorized Polaris dealer.

5. Lubricate at the intervals outlined in the Periodic Maintenance Chart beginning on page 60.

⚠ WARNING

Engine exhaust contains poisonous carbon monoxide and can cause loss of consciousness or death. Never run an engine in an enclosed area.

Transporting the *RANGER*

Follow these procedures when transporting the vehicle.

1. Stop the engine.
2. Remove the key to prevent loss during transporting.
3. Place the transmission in gear.
4. Engage the park brake.
5. Secure the fuel cap, oil cap and seat.
6. Always tie the frame of the *RANGER* to the transporting unit securely with suitable straps or rope. Do not attach tie straps to the front A-arm bolt pockets.

SPECIFICATIONS

RANGER 4X4 700 EFI	
Maximum Weight Capacity	1500 lbs. (682 kg) (includes weight of operator, passenger, cargo, accessories)
Fuel Capacity	8.8 gal. (33.3 l)
Engine Oil Capacity	2 qts. (2.1 l)
Coolant Capacity	3.25 qts. (3 l)
Towing Capacity	2000 lbs. (907 kg)
Hitch Tongue Capacity	150 lbs. (68 kg)
Max. Cargo Box Load	1000 lbs. (454 kg)
Overall Length	113 in. (282 cm)
Overall Width (box)	60 in. (152.4 cm)
Overall Width (tires)	58 in. (147.3 cm)
Overall Height	75 in. (190.5 cm)
Wheelbase	76 in. (193 cm)
Cargo Box (L x W x H)	58 x 42 x 10 in. (147 x 106.7 x 25.4 cm)
Ground Clearance	11.5 in. (29 cm)
Min. Turning Radius	132 in. (335.3 cm)
Engine	4 valve 4 stroke twin cylinder with counter balance
Displacement	683 cc
Bore x Stroke	80 x 68
Alternator Output	500 W @ 3000 RPM
Compression Ratio	9.40:1
Starting System	Electric
Fuel System	Electronic Fuel Injection
Ignition System	ECU
Spark Plug / Gap	RC7YC /.035 in. (0.9 mm)
Front Suspension	MacPherson strut w/8 in. (20.3 cm) of travel
Rear Suspension	Independent w/9.0 in. (22.9 cm) of travel

RANGER 4X4 700 EFI	
Lubrication System	Pressurized Wet Sump
Engine Oil	2W-50
Driving System Type	PVT, 4-wheel independent shaft, lockable differential
Shift Type	Single Lever (H/L/N/R)
Gear Reduction - Low	8.71:1
Gear Reduction - Reverse	5.94:1
Gear Reduction - High	3.14:1
Drive Ratio - Front:	3.83:1
Drive Ratio - Final	3.70:1
Tire Size - Front	26 x 8 - 12
Tire Size - Rear	26 x 11 - 12
Tire Pressure - Front	8-12 psi
Tire Pressure - Rear	8-12 psi
Brakes, Front/Rear	Foot Activated, 4 wheel hydraulic disc
Brake, Park	Hand activated, mechanical
Hood Headlight	2 single beam, 50W, quartz/halogen
Taillights	2 single beam, 5W
Brake Light	2 single beam, 5W
Indicator Light	1.0 W

NOTE: See your Polaris dealer for clutching specifications.

SPECIFICATIONS

RANGER 6X6 700 EFI	
Maximum Weight Capacity	1750 lbs. (795 kg) (includes weight of operator, passenger, cargo, accessories)
Fuel Capacity	8.8 gal. (33.3 l)
Engine Oil Capacity	2 qts. (2.1 l)
Coolant Capacity	3.25 qts. (3 l)
Towing Capacity	2000 lbs. (907 kg)
Max. Cargo Box Load	1250 lbs. (567 kg)
Overall Length	120 in. (304.8 cm)
Overall Width (box)	60 in. (152.4 cm)
Overall Width (tires)	58 in. (147.3 cm)
Overall Height	75 in. (190.5 cm)
Wheelbase	90 in. (228.6 cm)
Cargo Box (L x W x H)	58 x 48 x 10 in. (147 x 122 x 25.4 cm)
Ground Clearance	7.2 in. (18 cm)
Min. Turning Radius	180 in. (457.2 cm)
Engine	4 valve 4 stroke twin cylinder with counter balance
Displacement	683 cc
Bore x Stroke	80 x 68
Alternator Output	500 W @ 3000 RPM
Compression Ratio	9.40:1
Starting System	Electric
Fuel System	Electronic Fuel Injection
Ignition System	ECU
Spark Plug / Gap	RC7YC /.035 in. (0.9 mm)
Front Suspension	MacPherson strut w/6.25 in. (15.9 cm) of travel
Center Suspension	Independent w/ 5.25 in. (13.3 cm) of travel
Rear Suspension	Swing arm w/dual shocks w/6.25 in. (15.9 cm) of travel

RANGER 6X6 700 EFI	
Lubrication System	Pressurized Wet Sump
Engine Oil	2W-50
Driving System Type	PVT
Shift Type	Single Lever, Console (H/L/N/R)
Gear Reduction - Low	8.71:1
Gear Reduction - Reverse	5.9:1
Gear Reduction - High	3.14:1
Drive Ratio - Front:	3.83:1
Drive Ratio - Final	3.70:1
Tire Size - Front	25 x 10 - 12
Tire Size - Center/Rear	25 x 11 - 12
Tire Pressure - Front	8-12 psi
Tire Pressure - Rear	8-12 psi
Brakes, Front/Rear	Foot Activated, 4 wheel hydraulic disc
Brake, Park	Hand activated, mechanical
Hood Headlight	2 single beam, 50W, quartz/halogen
Taillights	2 single beam, 5W
Brake Light	2 single beam, 5W
Indicator Light	1.0 W

NOTE: See your Polaris dealer for clutching specifications.

POLARIS PRODUCTS

Part Number	Description
Engine Lubricant	
2870791	Fogging Oil (12 oz. Aerosol)
2876244	PS-4 PLUS Performance Synthetic 2W-50 4-Cycle Oil (qt./.95 l)
2876245	PS-4 PLUS Performance Synthetic 2W-50 4-Cycle Oil (gal./3.8 l)
Gearcase / Transmission Lubricants	
2873602	Premium AGL Synthetic Gearcase Lubricant (qt.)
2873603	Premium AGL Synthetic Gearcase Lube (gal.)
2871653	Premium ATV Angle Drive Fluid (8 oz.)
2872276	Premium ATV Angle Drive Fluid (2.5 gal.)
2870465	Pump for Gallon Jug
2871654	Premium Demand Drive Hub Fluid (8 oz.)
2872277	Premium Demand Drive Hub Fluid (2.5 gal.)
Coolant	
2871323	60/40 Coolant (gal.)
2871534	60/40 Coolant (qt.)
Grease / Specialized Lubricants	
2871312	Grease Gun Kit, Premium All Season (3 oz.)
2871322	Premium All Season Grease (3 oz. cartridge)
2871423	Premium All Season Grease (14 oz. cartridge)
2871460	Starter Drive Grease (2 oz.)
2871515	Premium U-Joint Lube (3 oz.)
2871551	Premium U-Joint Lube (14 oz.)
2871329	Dielectric Grease (Nyogel™)
2872073	Chain Lube, Aerosol (6.25 oz.)
2872348	Chain Lube, Aerosol (16 oz.)
Additives / Miscellaneous	
2871326	Carbon Clean Plus (12 oz.)
2872189	DOT 4 Brake Fluid
2871956	Loctite™ 565 Thread Sealant
2871076	Polaris Battery Tender™ Charger

Drive Belt Wear/Burn

Possible Cause	Solution
Driving onto a pickup or tall trailer in high range	Use low range during loading.
Starting out going up a steep incline	Use low range. See warnings on page 46.
Driving at low RPM or ground speed (3-7 MPH)	Drive at a higher speed or use low range more frequently. See page 82.
Insufficient warm-up at low ambient temperatures	Warm the engine at least 5 minutes. With the transmission in neutral, advance the throttle to about 1/8 throttle in short bursts, 5 to 7 times. The belt will become more flexible and prevent belt burning.
Slow/easy clutch engagement	Use the throttle quickly and effectively.
Towing/pushing at low RPM/low ground speed	Use low range only.
Utility use/plowing	Use low range only.
Stuck in mud or snow	Shift the transmission to low range and carefully use fast, aggressive throttle application to engage clutch. **WARNING**: Excessive throttle may cause loss of control and vehicle overturn.
Climbing over large objects from a stopped position	Shift the transmission to low range and carefully use fast, brief, aggressive throttle application to engage clutch. **WARNING**: Excessive throttle may cause loss of control and vehicle overturn.
Belt slippage from water or snow ingestion into the PVT system	Dry out the PVT. See page 84. Inspect clutch seals for damage if repeated leaking occurs.
Clutch malfunction	See your Polaris dealer.
Poor engine performance	Check for fouled plugs or foreign material in gas tank or fuel lines. See your dealer.
Slippage from failure to warm up belt	Always warm up the belt by operating below 30 mph for one mile (5 miles or more when temperature is below freezing).
Wrong or missing belt	Install the recommended belt.
Improper break-in	Always break in a new belt and/or clutch. See pages 40 and 82.

TROUBLESHOOTING

Park Brake Engine Limiting Feature Fails to Disengage

Possible Cause	Solution
Park brake is not completely disengaged	Ensure lever is in forward-most position
Park brake connector malfunction or switch movement or failure	Disconnect the connector if temporary continued operation is necessary, see your dealer promptly for service

Engine Doesn't Turn Over

Possible Cause	Solution
Low battery voltage	Recharge the battery to 12.8 VDC
Loose battery connections	Check all connections and tighten
Loose solenoid connections	Check all connections and tighten
Loose electronic control box connections	Inspect, clean, reinstall connectors

Engine Turns Over, Fails to Start

Possible Cause	Solution
Out of fuel	Refuel
Clogged fuel filter	Inspect and clean or replace
Water is present in fuel	Drain the fuel system and refuel
Old or non-recommended fuel	Replace with fresh recommended fuel
Fouled or defective spark plugs	Inspect plugs and replace if necessary
No spark to spark plug	Inspect plugs and replace if necessary
Water or fuel in crankcase	Immediately see your Polaris dealer
Low battery voltage	Recharge the battery to 12.8 VDC
Mechanical failure	See your dealer

Engine Backfires

Possible Cause	Solution
Weak spark from spark plug	Inspect, clean and/or replace spark plugs
Incorrect spark plug gap or heat range	Set gap to specs or replace plugs
Old or non-recommended fuel	Replace with fresh recommended fuel
Incorrectly installed spark plug wires	See your dealer
Incorrect ignition timing	See your dealer
Mechanical failure	See your dealer
Loose ignition connections	Check all connections and tighten
Water present in fuel	Replace with fresh recommended fuel

Engine Pings or Knocks

Possible Cause	Solution
Poor quality or low octane fuel	Replace with recommended fuel
Incorrect ignition timing	See your dealer
Incorrect spark plug gap or heat range	Set gap to specs or replace plugs

Engine Runs Irregularly, Stalls or Misfires

Possible Cause	Solution
Fouled or defective spark plugs	Inspect, clean and/or replace spark plugs
Worn or defective spark plug wires	See your dealer
Incorrect spark plug gap or heat range	Set gap to specs or replace plugs
Loose ignition connections	Check all connections and tighten
Water present in fuel	Replace with new fuel
Low battery voltage	Recharge battery to 12.8 VDC
Kinked or plugged fuel tank vent line	Inspect and replace
Incorrect fuel	Replace with recommended fuel
Clogged air filter	Inspect and clean or replace
Other mechanical failure	See your dealer
Possible Lean Fuel Cause	**Solution**
Low or contaminated fuel	Add or change fuel, clean the fuel system
Low octane fuel	Replace with recommended fuel
Clogged fuel filter	Replace filter
Possible Rich Fuel Cause	**Solution**
Fuel is very high octane	Replace with lower octane fuel

TROUBLESHOOTING

Engine Stops or Loses Power

Possible Cause	Solution
Out of fuel	Refuel
Kinked or plugged fuel vent line	Inspect and replace
Water is present in fuel	Replace with new fuel
Fouled or defective spark plugs	Inspect, clean and/or replace spark plug
Worn or defective spark plug wires	See your dealer
Incorrect spark plug gap or heat range	Set gap to specs or replace plug
Loose ignition connections	Check all connections and tighten
Low battery voltage	Recharge the battery to 12.8 VDC
Incorrect fuel	Replace with fresh recommended fuel
Clogged air filter	Inspect and clean or replace
Other mechanical failure	See your dealer
Overheated engine	Clean radiator screen and core, clean engine exterior, see your dealer

LIMITED WARRANTY

Polaris Sales Inc., 2100 Highway 55, Medina, MN 55340, gives a SIX MONTH LIMITED WARRANTY on all components of the Polaris *RANGER* against defects in material or workmanship. Polaris also gives a one year limited warranty on the final drive chain for failure due to defects. This warranty covers the parts and labor charges for repair or replacement of defective parts which are covered by this warranty. This warranty begins on the date of purchase. This warranty is transferable to another consumer during the warranty period through a Polaris dealer.

REGISTRATION

At the time of sale, the Warranty Registration Form must be completed by your dealer and submitted to Polaris within ten days. Upon receipt of this registration, Polaris will record the registration for warranty. No verification of registration will be sent to the purchaser as the copy of the Warranty Registration Form will be the warranty entitlement. If you have not signed the original registration and received the customer copy, please contact your dealer immediately. NO WARRANTY COVERAGE WILL BE ALLOWED UNLESS YOUR VEHICLE IS REGISTERED WITH POLARIS.

Initial dealer preparation and set-up of your vehicle is very important in ensuring trouble-free operation. Purchasing a machine in the crate or without proper dealer set-up will void your warranty coverage.

WARRANTY COVERAGE AND EXCLUSIONS: LIMITATIONS OF WARRANTIES AND REMEDIES

The Polaris limited warranty excludes any failures that are not caused by a defect in material or workmanship. This warranty does not cover accidental damage, normal wear and tear, abuse or improper handling. This warranty also does not cover any vehicle that has been altered structurally, modified, neglected, improperly maintained, used for racing, or used for purposes other than for which it was manufactured, or for any damages which occur during trailer transit or as a result of unauthorized service or the use of unauthorized parts. In addition, this warranty does not cover physical damage to paint or finish, stress cracks, tearing or puncturing of upholstery material, corrosion, or defects in parts, components or the vehicle due to fire, explosions or any other cause beyond Polaris' control.

This warranty does not cover the use of unauthorized lubricants, chemicals, or fuels that are not compatible with the vehicle. The exclusive remedy for breach of this warranty shall be, at Polaris' exclusive option, repair or replacement of any defective materials, or components or products. THE REMEDIES SET FORTH IN THIS WARRANTY ARE THE ONLY REMEDIES AVAILABLE TO ANY PERSON FOR BREACH OF THIS WARRANTY. POLARIS SHALL HAVE NO LIABILITY TO ANY PERSON FOR INCIDENTAL, CONSEQUENTIAL OR SPECIAL DAMAGES OF ANY DESCRIPTION, WHETHER ARISING OUT OF EXPRESS OR IMPLIED WARRANTY OR ANY OTHER CONTRACT, NEGLIGENCE, OR OTHER TORT OR OTHERWISE. Some states do not permit the exclusion or limitation of incidental or consequential damages or implied warranties, so the above limitations or exclusions may not apply to you if inconsistent with controlling state law.

WARRANTY

LIMITATIONS OF WARRANTIES AND REMEDIES

ALL IMPLIED WARRANTIES (INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE) ARE LIMITED IN DURATION TO THE ABOVE SIX MONTH WARRANTY PERIOD. POLARIS FURTHER DISCLAIMS ALL EXPRESS WARRANTIES NOT STATED IN THIS WARRANTY. Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you if inconsistent with controlling state law.

HOW TO OBTAIN WARRANTY SERVICE

If your vehicle requires warranty service, you must take it to a Polaris Servicing Dealer. When requesting warranty service you must present your copy of the Warranty Registration form to the dealer. (THE COST OF TRANSPORTATION TO AND FROM THE DEALER IS YOUR RESPONSIBILITY). Polaris suggests that you use your original selling dealer; however, you may use any Polaris Servicing Dealer to perform warranty service.

Please work with your dealer to resolve any warranty issues. Should your dealer require any additional assistance they will contact the appropriate person at Polaris.

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

If any of the above terms are void because of state or federal law, all other warranty terms will remain in effect.

Lubricants

1. Mixing oil brands or using non-recommended oil may cause engine damage. We recommend the use of Polaris engine oil.

2. Damage resulting from the use of non-recommended lubricants may not be covered by warranty.

SPARK ARRESTOR

Polaris warrants that the spark arrestor in this vehicle will meet the efficiency requirements of 43 CFR 8343.1(c) for at least 1000 hours when subjected to normal use and when maintenance and installation are in accordance with Polaris recommendations.

Exported Vehicles

EXCEPT WHERE SPECIFICALLY REQUIRED BY LAW, THERE IS NO WARRANTY OR SERVICE BULLETIN COVERAGE ON THIS VEHICLE IF IT IS SOLD OUTSIDE THE COUNTRY OF THE SELLING DEALER'S AUTHORIZED LOCATION.

This policy does not apply to vehicles that have received authorization for export from Polaris Industries. Dealers may not give authorization for export. You should consult an authorized dealer to determine this vehicle's warranty or service bulletin coverage if you have any questions.

This policy does not apply to vehicles registered to government officials or military personnel on assignment outside the country of the selling dealer's authorized location.

This policy does not apply to Safety Recalls.

How to Get Service

In the Country where your vehicle was purchased:

Warranty or Service Bulletin repairs must be done by an authorized Polaris dealer. If you move or are traveling within the country where your vehicle was purchased, Warranty or Service Bulletin repairs may be requested from any authorized Polaris dealer who sells the same line as your vehicle.

Outside the Country where your vehicle was purchased:

If you are traveling temporarily outside the country where your vehicle was purchased, you should take your vehicle to an authorized Polaris dealer. You must show the dealer photo identification from the country of the selling dealer's authorized location as proof of residence. Upon residence verification, the servicing dealer will be authorized to perform the warranty repair.

If You Move:

If you move to another country, be sure to contact Polaris Customer Assistance and the customs department of the destination country before you move. Vehicles importation rules vary considerably from country to country. You may be required to present documentation of your move to Polaris Industries in order to continue your warranty coverage. You may also be required to obtain documentation from Polaris Industries in order to register your vehicle in your new country.

If Purchased From A Private Party:

If you purchase a Polaris product from a private citizen outside of the country in which the vehicle was originally purchased, all warranty coverage will be denied.

Notice

If your vehicle is registered outside of the country where it was purchased, and you have not followed the procedure set out above, your vehicle will no longer be eligible for warranty or service bulletin coverage of any kind. (Vehicles registered to Government officials or military personnel on assignment outside of the country where the vehicle was purchased will continue to be covered by the basic warranty.)

For questions call Polaris Customer Assistance:

United States: 1-888-704-5290

Canada: 1-204-925-7100

WARRANTY

U.S.A. EPA Emissions Limited Warranty

This All Terrain Vehicle (ATV) or Off Road Utility Vehicle (ORUV) emissions limited warranty is in addition to the Polaris standard limited warranty for this vehicle.

Polaris warrants that this vehicle is; (1) designed, built, and equipped to conform at the time of initial sale with the requirements of 40 CFR 1051 and, (2) free from defects in materials and workmanship that may keep it from meeting these requirements.

The emissions warranty period for this vehicle begins on the date the vehicle is delivered to the original retail purchaser and ends 30 months (2.5 years) after that date, or after 5000 km (3100 miles), whichever comes first.

This emission-related warranty covers components whose failure would increase an engine's emissions, including electronic controls, fuel injection, exhaust-gas recirculation, aftertreatment, or any other system utilized in this vehicle to control emissions. Replacing or repairing other components not covered by this emissions warranty or the standard warranty is the responsibility of the owner; including the parts, labor and other costs associated with recommended maintenance.

The exclusive remedy for breach of this limited warranty shall be, at the exclusive option of Polaris, repair or replacement of any defective materials, components or products. THE REMEDIES SET FORTH IN THIS LIMITED WARRANTY ARE THE ONLY REMEDIES AVAILABLE TO ANY PERSON FOR BREACH OF THIS WARRANTY. POLARIS SHALL HAVE NO LIABILITY TO ANY PERSON FOR INCIDENTAL, CONSEQUENTIAL OR SPECIAL DAMAGES OF ANY DESCRIPTION,WHETHER ARISING OUT OF EXPRESS OR IMPLIED WARRANTY OR ANY OTHER CONTRACT, NEGLIGENCE OR OTHER TORT OR OTHERWISE.

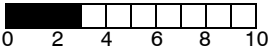
ALL IMPLIED WARRANTIES (INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE) ARE LIMITED IN DURATION TO THE WARRANTY PERIOD DESCRIBED HEREIN. POLARIS DISCLAIMS ALL EXPRESS WARRANTIES NOT STATED IN THIS WARRANTY. Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply if it is inconsistent with the controlling state law.

This limited warranty excludes failures not caused by a defect in material or workmanship. This limited warranty does not cover damage due to accidents, abuse or improper handling, maintenance or use. This limited warranty also does not cover any engine that has been structurally altered, or any engine that has been used in racing competition. This limited warranty also does not cover physical damage, corrosion or defects caused by fire, explosions or other similar causes beyond the control of Polaris.

If you have any questions regarding your warranty rights and responsibilities, you should contact the Polaris Warranty Department at 1-888-704-5290.

California Emission Control Warranty Statement

The Air Index of this Engine is 3



Most Clean Least Clean

Note: The lower the Air Index, the less pollution.

This engine is certified to be emission compliant for 1000 hours of use.

Your Warranty Rights and Obligations

The California Air Resources Board and Polaris Industries Inc., 2100 Highway 55, Medina, Minnesota 55340 (herein "POLARIS") are pleased to explain the emission control system warranty on your 2005 and later Large Spark Ignition Engine (herein "LSI engine"). "The California Air Resources Board has designated this engine for this vehicle as an LSI engine which produces 25 and greater horsepower and the vehicle has a six (6) or four (4)-wheel drive and/or a round steering wheel." In California, this LSI engine must be designed, built and equipped to meet the state's stringent anti-smog standards. Polaris must warrant the emission control system on your LSI engine for the period of time described below, provided there has been no abuse, neglect or improper maintenance of your LSI engine.

Your emission control system includes parts such as the carburetor and the ignition system. Also included may be hoses, connectors and other emission-related assemblies.

Where a warrantable condition exists, POLARIS will repair your LSI engine at no cost to you, including diagnosis, parts and labor.

Manufacturer's Warranty Coverage:

The 2005 and later LSI engines are warranted for two (2) years. If any emission related part on your LSI engine is defective, the part will be repaired or replaced by POLARIS.

WARRANTY

California Emission Control Warranty Statement

Owner's Warranty Responsibilities:

- As the LSI engine owner, you are responsible for the performance of the required maintenance listed in your Owner's Safety and Maintenance Manual (herein "Owner's Manual"). POLARIS recommends that you retain all receipts covering maintenance on your LSI engine, but POLARIS cannot deny warranty solely for the lack of receipts or for your failure to ensure the performance of all scheduled maintenance.
- As the LSI engine owner, you should, however, be aware that POLARIS may deny you warranty coverage if your LSI engine or a part has failed due to abuse, neglect, improper maintenance or unapproved modifications.
- You are responsible for presenting your LSI engine to a dealer authorized by POLARIS as soon as a problem exists. The warranty repairs should be completed in a reasonable amount of time, not to exceed 30 days.

If you have any questions regarding your warranty rights and responsibilities, you should contact the Polaris Warranty Department at 1-888-704-5290.

Limited Warranty California Only

POLARIS warrants to the owner of 2005 and later LSI engines that the LSI engine (1) has been designed, built, and equipped at the time of manufacture so as to conform with the applicable regulations of the California Air Resources Board and, (2) is free from defects in materials and workmanship which may cause it to fail to conform with those regulations as applicable according to the terms and conditions stated below.

Warranty Period

This warranty period begins on the date, which the LSI engine is delivered, to the original retail purchaser and ends two years after that date. During this two year period POLARIS warrants to the original retail purchaser and each subsequent purchaser that the LSI engine is free from defect in material and workmanship that can cause the failure of a warranted emission-related part.

What is Covered Under This Warranty

Repair and/or replacement of any warranted emission-related part will be performed at no charge provided the work is performed at an authorized dealer. There will also be no charge for any diagnostic labor performed at an authorized dealer, which leads to the determination that a warranted emission-related part is defective.

Any warranted part which is not scheduled for replacement as required maintenance, or which is scheduled only for regular inspection to the effect of "repair or replace as necessary" shall be warranted for the warranty period. Any warranted part which is scheduled for replacement as required maintenance shall be warranted for the period of time up to the first scheduled replacement of that part. This warranty shall apply only towards the repair, replacement, and/or adjustment of the component parts listed below.

California Emission Control Warranty Statement

Emission-Related Parts Covered Under This Warranty

(1) Fuel Metering System
  (i) Carburetor and internal parts (and/or pressure regulator or fuel injection system)
  (ii) Air/fuel ratio feedback and control system, if applicable
  (iii) Cold start enrichment system, if applicable
  (iv) Regulator assy (gaseous fuel, if applicable)
(2) Air Induction System
  (i) Intake manifold, if applicable
  (ii) Air filter
(3) Ignition System
  (i) Spark plugs
  (ii) Magneto or electronic ignition system
  (iii) Spark advance/retard system, if applicable
(4) Exhaust manifold, if applicable
(5) Miscellaneous Items Used in Above Systems
  (i) Electronic controls, if applicable
  (ii) Hoses, belts, connectors, and assemblies
  (iii) Filter lock assy (gaseous fuel, if applicable)

If an authorized dealer determines that other LSI engine components have been damaged due to the failure of a warranted emission-related part during the warranty period, POLARIS will repair and/or replace the necessary components.

WARRANTY

California Emission Control Warranty Statement

What is Not Covered Under This Warranty

This warranty does not cover any emission-related part which malfunctions, fails or is damaged due to alterations and/or modifications such as changing, adding or removing parts.

When the LSI engine is being serviced under warranty, POLARIS and any of its authorized dealers shall not be liable for any loss of use of the LSI engine, for any damage to goods, or loss of time or inconvenience. This limited warranty also does not apply to any emission-related part which malfunctions, fails, or is damaged due to failure to follow the maintenance and operating instructions specified in the 2005 and later Owner's Manual including:

(a) Improper or inadequate maintenance of any warranted emission-related part

(b) Improper installation, adjustment, or repair of the LSI engine or any warranted emission-related part unless performed by an authorized dealer

(c) Failure to use recommended fuel as specified in the 2005 and later Owner's Manual

(d) Repairs and diagnosis performed outside of an authorized dealer

(e) Use of parts which are not authorized by POLARIS

Maintenance Schedule

The LSI engine owner is responsible for having all scheduled inspection and maintenance services performed at the intervals specified in the 2005 and later Owner's Manual and to retain records of these services as having been performed. These records should be transferred to each subsequent owner of the LSI engine. POLARIS cannot deny a claim solely because there are no records of scheduled maintenance, however, a warranty claim may be denied if the failure to perform the scheduled maintenance and inspection resulted in the failure of a warranted emission-related part. As a minimum, the LSI engine owner is responsible for the scheduled inspection and maintenance described below which are based on the procedures described in the Owner's Manual.

▶ Perform these procedures more often for vehicles subjected to severe use.
E Emission-Related Service.
■ Have an authorized Polaris dealer perform these services

Item		Maintenance Interval (whichever comes first)			Remarks
		Hours	Calendar	Miles (Km)	
▶ E	Air filter, pre-filter	-	Daily	-	Inspect; clean often
▶ E	Air box sediment tube	-	Daily	-	Drain deposits when visible
▶ E	Air filter, main element	-	Weekly	-	Inspect; replace as needed
▶ E	Engine breather filter (if equipped)	25 H	Monthly	-	Inspect; replace if necessary
■ E	Throttle Cable/ ETC Switch	50 H	6 M	-	Inspect; adjust; lubricate; replace if necessary
E	Throttle body air intake ducts/flange	50 H	6 M	-	Inspect ducts for proper sealing/air leaks
■ E	Valve clearance	100 H	12M	-	Inspect; adjust
■ E	Fuel system	100 H	12 M	-	Check for leaks at tank cap, lines, fuel valve, filter, pump, throttle body; replace lines every two years
■ E	Spark plug	100 H	12 M	-	Inspect; replace as needed

Repair and Replacement of Emission-Related Parts

It is recommended that only LSI engine replacement parts, which have been authorized and approved by POLARIS, should be used in the performance of any warranty maintenance or repairs of emission-related parts. These replacement parts will be provided at no charge if the part is still under warranty.

How to File a Warranty Claim/Where to Get Warranty Service

All repairs qualifying under this Limited Warranty must be performed by a dealer who sold you the LSI engine or a dealer authorized by POLARIS. In the event that any emission-related part is found to be defective during the warranty period, you must notify the Polaris Warranty Department at 1-888-704-5290 and you will be advised of the appropriate dealer where the warranty repair is to be performed.

MAINTENANCE LOG

Use the following chart to record periodic maintenance.

DATE	MILES (KM) OR HOURS	TECHNICIAN	SERVICE PERFORMED / COMMENTS

MAINTENANCE LOG

DATE	MILES (KM) OR HOURS	TECHNICIAN	SERVICE PERFORMED / COMMENTS

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Owner's Manual Supplement
2008 *RANGER*
P/N 9921696

Please keep this supplement with your owner's manual at all times.

Park Brake Cable Tension

When the park brake is fully engaged and the park brake indicator is illuminated, engine speed is limited to 1300 RPM in all gears, including neutral. If throttle is applied, this limiting feature prevents operation, which protects the park brake pads and drive belt from excessive wear.

NOTE: Inspect and adjust park brake cable tension after the first 25 hours of operation and every 100 hours thereafter to ensure proper cable tension.

Loss of tension in the park brake cable may cause illumination of the park brake light and activation of the limiting feature. If this occurs, move the park brake lever to the forward-most position, then inspect and adjust park brake cable tension.

NOTE: If performing this service is difficult due to conditions or location, open the hood and temporarily disconnect the park brake connector. This will inactivate the limiting function. Reconnect the connector as soon as possible, and adjust the park brake cable to proper tension.

See your dealer for service if this feature fails to operate properly.

P/N 9921696 Rev 02 9/17/07
Printed in USA

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2008 *RANGER*
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See your dealer for service if this feature fails to operate properly.

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Printed in USA

POLARIS®
The Way Out.

2009 *RANGER* 700
4X4 CREW / 6X6

SERVICE MANUAL

PN 9921885

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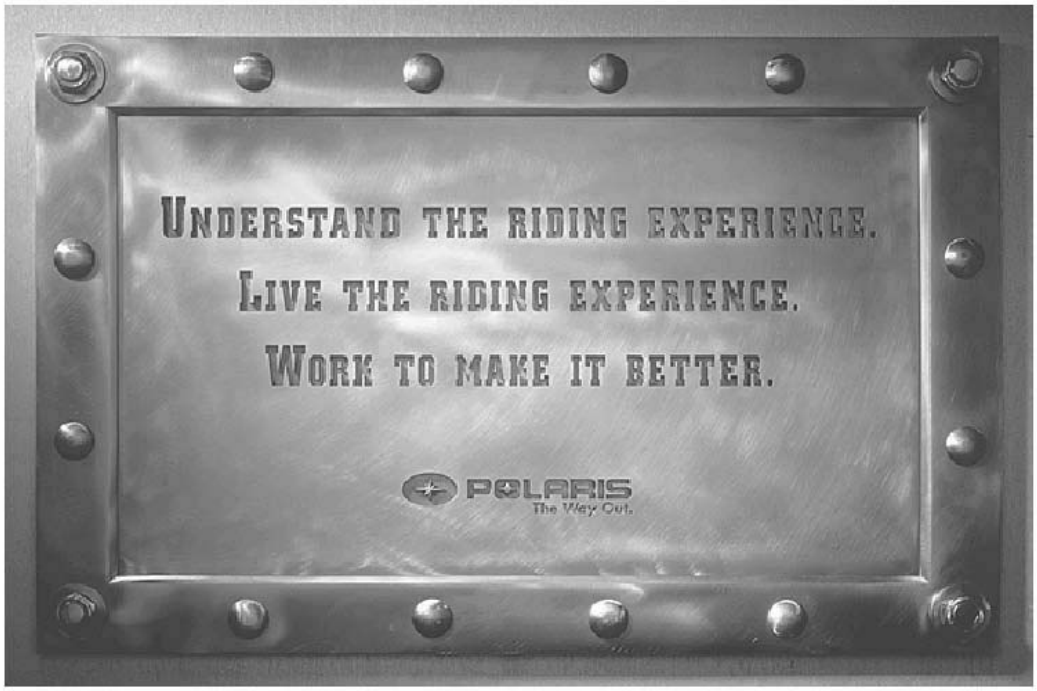
The Way Out.



2009 *RANGER* 700 4X4 CREW / 6X6 SERVICE MANUAL

FOREWORD

The information printed within this publication includes the latest product information at time of print. The most recent version of this Service Manual is available in electronic format at www.polarisdealers.com.

This Service Manual is designed primarily for use by certified Polaris Master Service Dealer technicians in a properly equipped shop and should be kept available for reference. All references to left and right side of the vehicle are from the operator's perspective when seated in a normal riding position.

Some procedures outlined in this manual require a sound knowledge of mechanical theory, tool use, and shop procedures in order to perform the work safely and correctly. Technicians should read the text and be familiar with service procedures before starting the work. Certain procedures require the use of special tools. Use only the proper tools as specified.

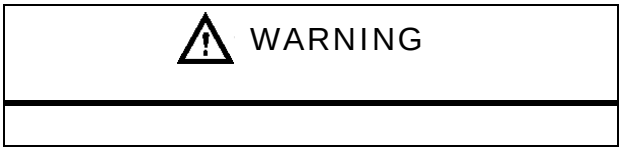
Comments or suggestions about this manual may be directed to: Service Publications Dept. @ Polaris Sales Inc. 2100 Hwy 55 Medina Minnesota 55340.

Publication Printed August 2008 (PN 9921885)

© Copyright 2008 Polaris Sales Inc. All information contained within this publication is based on the latest product information at the time of publication. Due to constant improvements in the design and quality of production components, some minor discrepancies may result between the actual vehicle and the information presented in this publication. Depictions and/or procedures in this publication are intended for reference use only. No liability can be accepted for omissions or inaccuracies. Any reprinting or reuse of the depictions and/or procedures contained within, whether whole or in part, is expressly prohibited. Printed in U.S.A.

UNDERSTANDING MANUAL SAFETY LABELS AND DIRECTIONS

Throughout this manual, important information is brought to your attention by the following symbols:



SAFETY ALERT WARNING indicates a potential hazard that may result in severe injury or death to the operator, bystander or person(s) inspecting or servicing the vehicle.

SAFETY ALERT CAUTION indicates a potential hazard that may result in minor personal injury or damage to the vehicle.

CAUTION indicates special precautions that must be taken to avoid vehicle damage or property damage.

NOTE:

NOTE provides key information by clarifying instructions.

IMPORTANT:

IMPORTANT provides key reminders during disassembly, assembly and inspection of components.

TRADEMARKS

POLARIS ACKNOWLEDGES THE FOLLOWING PRODUCTS MENTIONED IN THIS MANUAL:

Loctite, Registered Trademark of the Loctite Corporation

Nyogel, Trademark of Wm. F. Nye Co.

Fluke, Registered Trademark of John Fluke Mfg. Co.

Mity-Vac, Registered Trademark of Neward Enterprises, Inc.

Torx, Registered Trademark of Textron

Hilliard, Trademark of the Hilliard Corporation

Warn, Trademark of Warn Industries

FOX, Registered Trademark of FOX RACING SHOX

RydeFX, Registered Trademark of ArvinMeritor

Some Polaris factory publications can be downloaded from www.polarisindustires.com, purchased from www.purepolaris.com or by contacting the nearest Polaris dealer.

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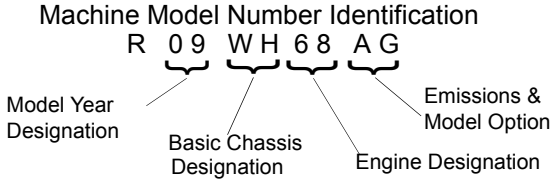
MODEL INFORMATION

Model Identification

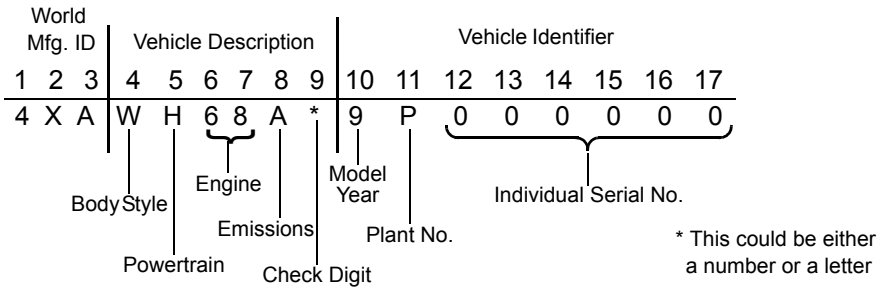
The machine model number must be used with any correspondence regarding warranty or service.



Engine Designation Number

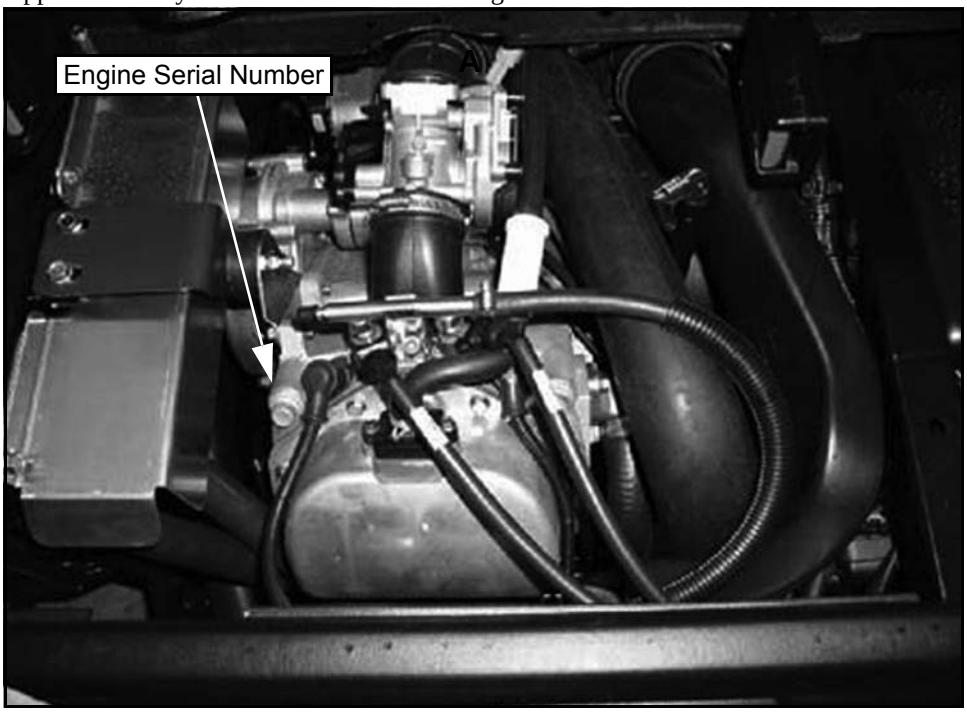
EH068OLE046PLE .....Twin, Liquid Cooled, OHV 4 Stroke, Electric Start

VIN Identification



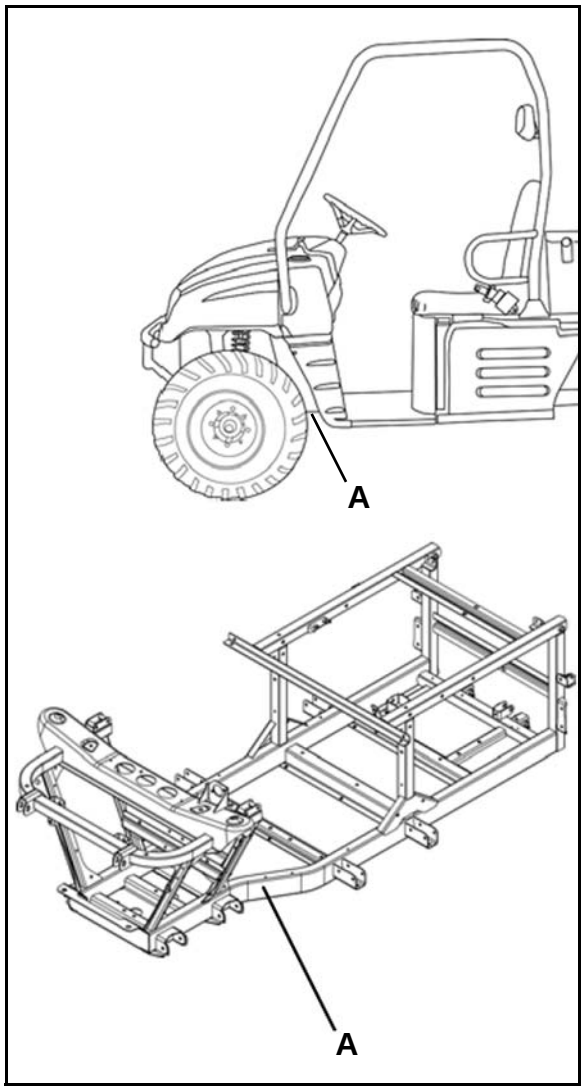
Engine Serial Number Location

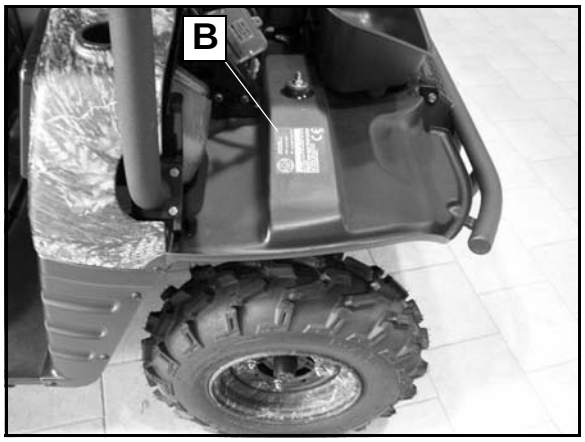
Whenever corresponding about an engine, be sure to refer to the engine model number and serial number. This information can be found on the sticker applied to the cylinder head on the side of engine.



Vehicle Identification Number (VIN) Location

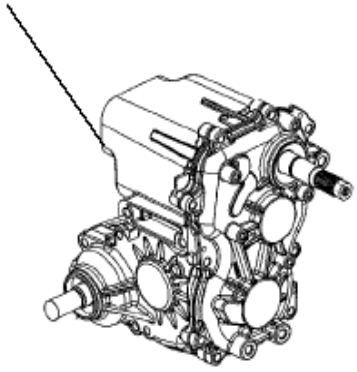
The machine model number and serial number are important for vehicle identification. The vehicle identification number (A) is stamped on the lower LH frame rail close to the front drive wheel. The model and serial numbers are also located on a sticker under the hood (B).





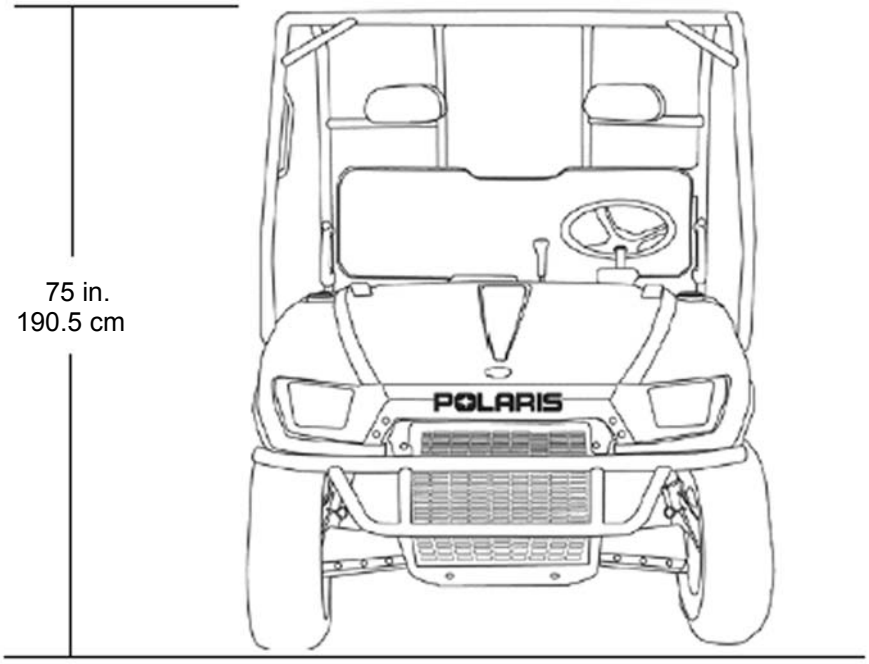
Transmission I.D. Number Location

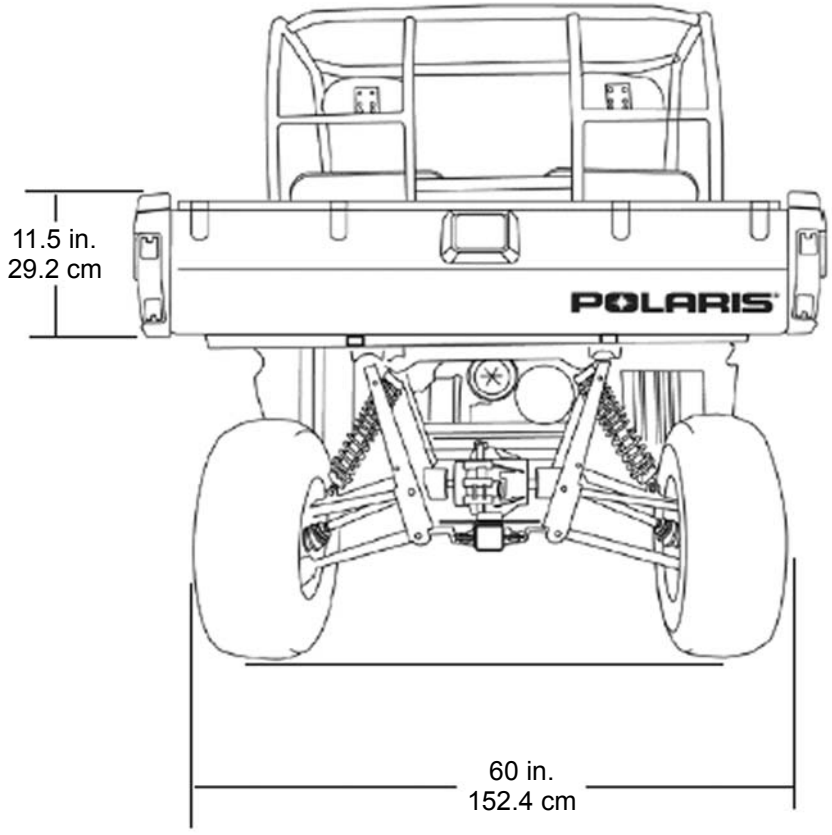
The transmission I.D. number is located on the right side when installed in the vehicle.



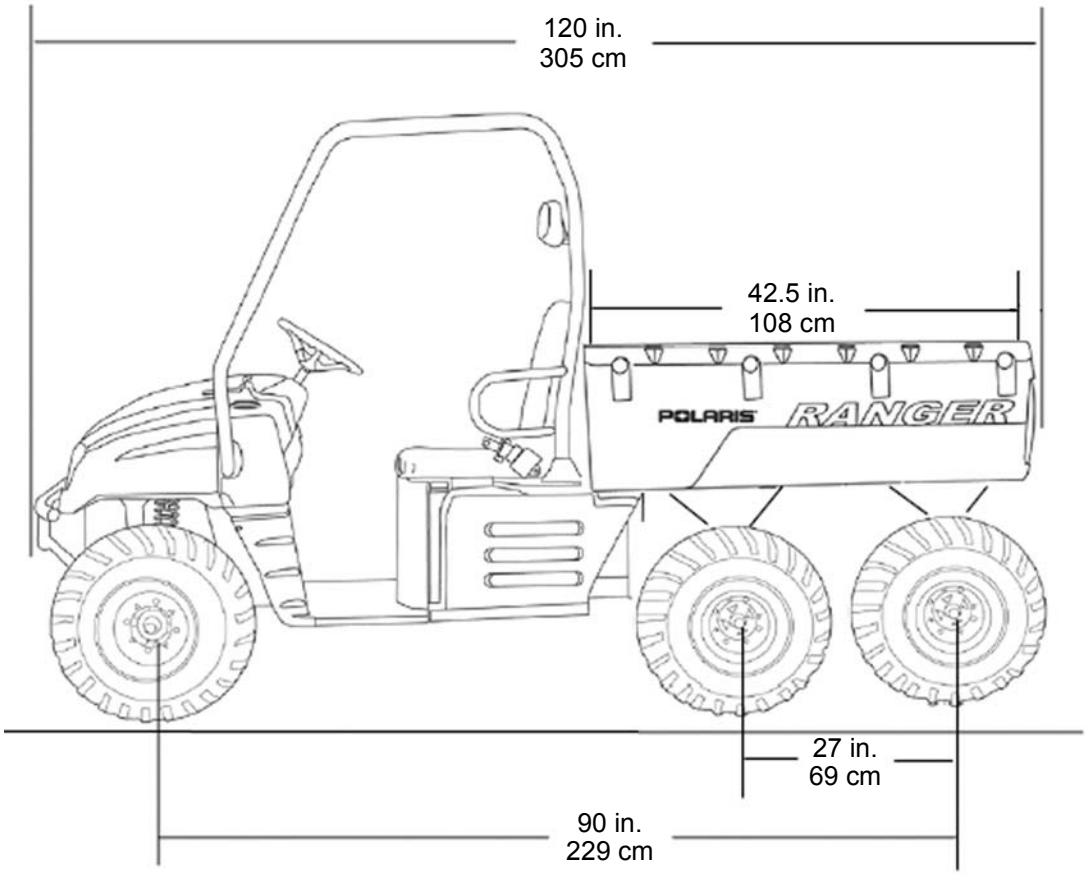
VEHICLE DIMENSIONS

RANGER 4x4 CREW / 6X6 (Height and Width)

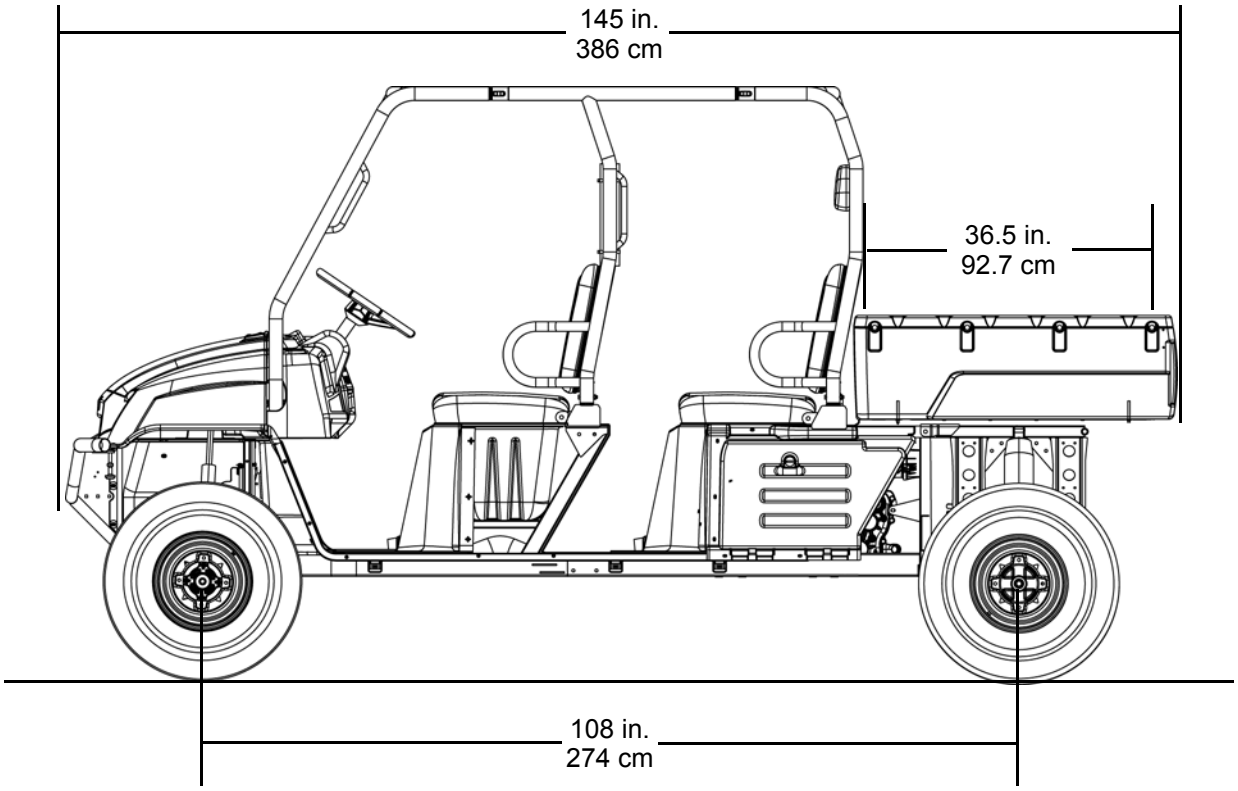




RANGER 6X6 (Length and Wheel Base)



RANGER 4x4 CREW (Length and Wheel Base)



GENERAL SPECIFICATIONS

MODEL: 2009 *RANGER* 4X4 CREW

MODEL NUMBER: R09WH68AC, AG, AH, AR
ENGINE MODEL: EH68OLE

Category	Dimension / Capacity
Length	145 in. / 386 cm
Width	60 in. / 152.4 cm
Height	75 in. / 190.5 cm
Wheel Base	108 in. / 274 cm
Ground Clearance	11 in. / 27.9 cm
Turning Radius	224 in. / 569 cm
Dry Weight	1460 lbs. / 664 kg
Gross Vehicle Weight	3360 lbs. / 1524 kg
Cargo Box Capacity	1000 lbs. / 454 kg
Cargo Box Dimensions	54 x 36.5 x 11.5 in. (137 x 92.7 x 29.2 cm)
Vehicle Payload	1750 lbs. / 794 kg (Includes driver and five passengers)
Hitch Towing Capacity	2000 lbs. / 907 kg
Hitch Tongue Capacity	150 lbs. / 68 kg

MODEL: 2009 *RANGER* 4X4 CREW

MODEL NUMBER: R09WH68AC, AG, AH, AR

ENGINE MODEL: EH68OLE

Engine	
Platform	Polaris Domestic Twin Cylinder, Liquid Cooled, 4-Stroke
Engine Model Number	EH068OLE049
Engine Displacement	683cc
Number of Cylinders	2
Bore & Stroke (mm)	80 x 68 mm
Compression Ratio	9.40:1
Compression Pressure	150-170 psi
Engine Idle Speed	1150 ± 100 RPM
Lubrication	Pressurized Wet Sump
Oil Requirements	PS-4 PLUS 2W-50 Synthetic
Oil Capacity	2 qts. / 1.9 L
Coolant Capacity	n/a
Overheat Warning	Instrument Cluster Indicator
Exhaust System	2 to 1 Canister Style
Fuel System	
Fuel System Type	Bosch Electronic Fuel Injection
Fuel Delivery	Electronic Fuel Pump (in tank)
Fuel Pressure	39 psi
Fuel Filters	See Chapter 4
Fuel Capacity / Requirement	9 gal. (34 L) 87 Octane (minimum)
Electrical	
Alternator Max Output	500 Watts @ 3000 RPM
Lights: Main Headlights	2 - Single Beam 50W / Halogen
Tail	5 Watts x 2
Brake	5 Watts x 2
Indicator Panel Lights	1 Watt (ea.)
Starting System	Electric Start
Ignition System	Bosch EFI (ECU Controlled)
Ignition Timing	7° BTDC @ 1200 RPM
Spark plug / Gap	Champion RC7YC3 / .035 in. (0.9 mm)
Battery / Model / Amp Hr	Yuasa YB30L-B / 30 Amp Hr. / 12 Volt
Instrument Panel Type	Multifunction Speedometer
DC Outlet	Standard
Relays	Fan / Power / Rear Diff Solenoid
Circuit Breakers	Fan Motor: 15 Amp
Fuses	Main Chassis: 20 Amp Accessory: 20 Amp Power Relay: 15 Amp ECU: 6 Amp

Drivetrain	
Transmission Type	Polaris Automatic PVT
Transmission Gear Ratio: Front / Rear High Low Reverse	 4.43:1 / 3.83:1 10.08:1 / 8.71:1 6.87:1 / 5.94:1
Shift Type	In Line Shift - H / L / N / R
Front Gearcase Oil Requirements	Polaris Demand Drive Fluid 5 oz. (150 ml)
Transmission Oil Requirements	Polaris Full Synthetic AGL 43.6 oz. (1290 ml)
Rear Gearcase Oil Requirements	Polaris ATV Angle Drive Fluid 18 oz. (532 ml)
Belt	3211118
Clutch Center Distance	10.05” (255 mm)
Steering / Suspension	
Front Suspension	MacPherson Strut
Front Travel	8 in. (20.3 cm)
Rear Suspension	Independent Rear Suspension
Rear Travel	9 in. (22.9 cm)
Rear Shock Preload Adjustment	Cam Adjustment
Toe Out	1/8 - 1/4 in. (3.2 - 6.35 mm)
Wheels / Brakes	
Front Wheel Size	12 x 6
Rear Wheel Size	12 x 8
Front Tire Make / Model / Size	Carlisle / PXT / 26 x 9 R12
Rear Tire Make / Model / Size	Carlisle / PXT / 26 x 11 R12
Tire Air Pressure - Front / Rear	12 psi / 16 psi
Brakes / Brake Fluid	4 Wheel Hydraulic Disc / DOT 4
Parking Brake	Hand Actuated (in dash)

CLUTCH CHART

Altitude		Shift Weight	Drive Spring	Driven Spring
Meters (Feet)	**0-1500 (0-5000)**	21-74 (5632117)	Red/Blue (7043372)	Blk/Almd (7043167)
	1500-3700 (5000 - 12000)	21-70 (5632127)	Red/Blue (7043372)	Blk/Almd (7043167)

MODEL: 2009 *RANGER* 6X6

MODEL NUMBER: R09RF68AF, AR
ENGINE MODEL: EH068OLE

Category	Dimension / Capacity
Length	120 in. / 305 cm
Width	60 in. / 152.4 cm
Height	75 in. / 190.5 cm
Wheel Base	90 in. / 229 cm
Ground Clearance	7.2 in. / 18.3 cm
Turning Radius	186 in. / 472 cm
Dry Weight	1410 lbs. / 640 kg
Gross Vehicle Weight	3310 lbs. / 1501 kg
Cargo Box Capacity	1250 lbs. / 567 kg
Cargo Box Dimensions	54 x 42.5 x 11.5 in. (137 x 108 x 29.2 cm)
Vehicle Payload	1750 lbs. / 794 kg (Includes driver and two passengers)
Hitch Towing Capacity	2000 lbs. / 907 kg
Hitch Tongue Capacity	150 lbs. / 68 kg

MODEL: 2009 *RANGER* 6X6

MODEL NUMBER: R09RF68AF, AR

ENGINE MODEL: EH68OLE

Engine	
Platform	Polaris Domestic Twin Cylinder, Liquid Cooled, 4-Stroke
Engine Model Number	EH068OLE048
Engine Displacement	683cc
Number of Cylinders	2
Bore & Stroke (mm)	80 x 68 mm
Compression Ratio	9.40:1
Compression Pressure	150-170 psi
Engine Idle Speed	1150 ± 100 RPM
Lubrication	Pressurized Wet Sump
Oil Requirements	PS-4 PLUS 2W-50 Synthetic
Oil Capacity	2 qts. / 1.9 L
Coolant Capacity	3.25 qts. (3.08 L)
Overheat Warning	Instrument Cluster Indicator
Exhaust System	2 to 1 Canister Style
Fuel System	
Fuel System Type	Bosch Electronic Fuel Injection
Fuel Delivery	Electronic Fuel Pump (in tank)
Fuel Pressure	39 psi
Fuel Filters	See Chapter 4
Fuel Capacity / Requirement	9 gal. (34 L) 87 Octane (minimum)
Electrical	
Alternator Max Output	500 Watts @ 3000 RPM
Lights: Main Headlights	2 - Single Beam 50W / Halogen
Tail	5 Watts x 2
Brake	5 Watts x 2
Indicator Panel Lights	1 Watt (ea.)
Starting System	Electric Start
Ignition System	Bosch EFI (ECU Controlled)
Ignition Timing	7° BTDC @ 1200 RPM
Spark plug / Gap	Champion RC7YC3 / .035 in. (0.9 mm)
Battery / Model / Amp Hr	Yuasa YB30L-B / 30 Amp Hr. / 12 Volt
Instrument Panel Type	Multifunction Speedometer
DC Outlet	Standard
Relays	Fan / Power
Circuit Breakers	Fan Motor: 15 Amp
Fuses	Main Chassis: 20 Amp Accessory: 20 Amp Power Relay: 15 Amp ECU: 6 Amp

Drivetrain	
Transmission Type	Polaris Automatic PVT
Transmission Gear Ratio: Front / Rear High Low Reverse	 4.43:1 / 3.83:1 10.08:1 / 8.71:1 6.87:1 / 5.94:1
Shift Type	In Line Shift - H / L / N / R
Front Gearcase Oil Requirements	Polaris Demand Drive Fluid 5 oz. (150 ml)
Transmission Oil Requirements	Polaris Full Synthetic AGL 43.6 oz. (1290 ml)
Mid Gearcase Oil Requirements	Polaris ATV Angle Drive Fluid 6.75 oz. (200 ml)
Rear Gearcase Oil Requirements	Polaris ATV Angle Drive Fluid 10 oz. (300 ml)
Belt	3211118
Clutch Center Distance	10.05” (255 mm)
Steering / Suspension	
Front Suspension	MacPherson Strut
Front Travel	8 in. (20.3 cm)
Center Suspension	Progressive Rate / Independent
Center Travel	5.25 in. (13.3 cm)
Rear Suspension	Swing Arm w/Dual Shocks
Rear Travel	6.25 in. (16 cm)
Rear Shock Preload Adjustment	Cam Adjustment
Toe Out	1/8 - 1/4 in. (3.2 - 6.35 mm)
Wheels / Brakes	
Front Wheel Size	12 x 6 / 10 gauge
Middle / Rear Wheel Size	12 x 8 / 10 gauge
Front Tire Make / Model / Size	Titan / AT489 / 25 x 10 R12
Middle / Rear Tire Make / Model / Size	Titan / AT489 / 25 x 11 R12
Tire Air Pressure Front / Middle / Rear	8 - 12 psi
Brakes / Brake Fluid	4 Wheel Hydraulic Disc / DOT 4
Parking Brake	Hand Actuated (in dash)

CLUTCH CHART

Altitude		Shift Weight	Drive Spring	Driven Spring
Meters (Feet)	**0-1500 (0-5000)**	21-74 (5632117)	Red/Blue (7043372)	Blk/Almd (7043167)
	1500-3700 (5000 - 12000)	21-70 (5632127)	Red/Blue (7043372)	Blk/Almd (7043167)

VEHICLE INFORMATION

Publication Numbers

Model	Model No.	Owner's Manual PN	Parts Manual PN
2009 *RANGER* 4x4 CREW	R09WH68AC, AG, AH, AR	9921882	9921884
2009 *RANGER* 6x6	R09RF68AF, AR	9921871	9921874

NOTE: When ordering service parts be sure to use the correct parts manual.

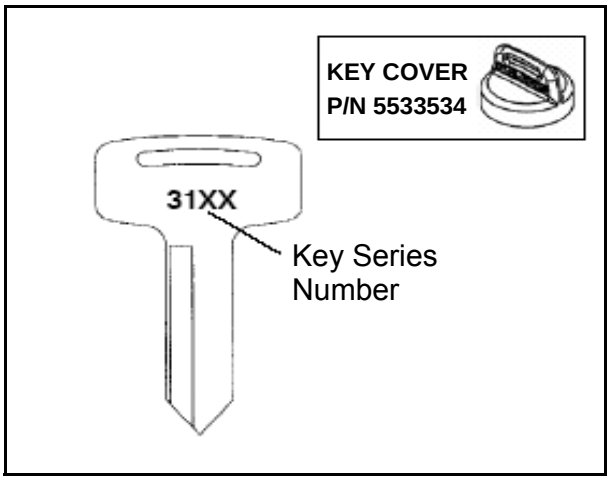
NOTE: Polaris factory publications can be found at www.polarisindustries.com or purchased from www.purepolaris.com.

Paint Codes

Painted Part	Color Description	Polaris Number
Main Frame / Cab Frame / Bumpers	Medium Gloss Black	P-067
Main Frame / Cab Frame / Plastic	Gloss Black	P-070
Plastic - Hood / Dash	Dark Green	P-195
Plastic - Hood / Dash	Solar Red	P-342
Cab Frame / Bumpers	Flat Black Wrinkle	P-418
Plastic - Hood / Dash	Mossy Oak™	P-455
Plastic - Hood / Dash	Delta Green	P-492
Plastic - Hood / Dash	Cherry Metallic	P-554

Replacement Keys

Replacement keys can be made from the original key. To identify which series the key is, take the first two digits on the original key and refer to the chart to the right for the proper part number.



Series#	Part Number
20	4010278
21	4010278
22	4010321
23	4010321
27	4010321
28	4010321
31	4110141
32	4110148
67	4010278
68	4010278

SPECIAL TOOLS

Special tools may be required while servicing this vehicle. Some of the tools listed or depicted are mandatory, while other tools maybe substituted with a similar tool, if available. Polaris recommends the use of Polaris Special Tools when servicing any Polaris product. Dealers may order special tools through Polaris' official tool supplier, SPX Corporation, by phone at 1-800-328-6657 or on-line at http://polaris.spx.com/.

MISC. SPECIFICATIONS AND CHARTS

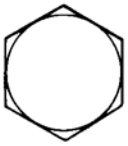
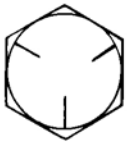
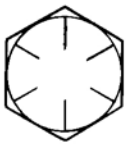
Conversion Table

Unit of Measure	Multiplied by	Converts to
ft. lbs.	x 12	= in. lbs.
in. lbs.	x .0833	= ft. lbs.
ft. lbs.	x 1.356	= Nm
in. lbs.	x .0115	= kg-m
Nm	x .7376	= ft.lbs.
kg-m	x 7.233	= ft. lbs.
kg-m	x 86.796	= in. lbs.
kg-m	x 10	= Nm
in.	x 25.4	=mm
mm	x .03937	= in.
in.	x 2.54	= cm
mile (mi.)	x 1.6	= km
km	x .6214	= mile (mi.)
Ounces (oz)	x 28.35	= Grams (g)
Fluid Ounces (fl. oz.)	x 29.57	= Cubic Centimeters (cc)
Cubic Centimeters (cc)	x .03381	= Fluid Ounces (fl. oz.)
Grams (g)	x 0.035	= Ounces (oz)
lb.	x .454	= kg
kg	x 2.2046	= lb.
Cubic inches (cu in)	x 16.387	= Cubic centimeters (cc)
Cubic centimeters (cc)	x 0.061	= Cubic inches (cu in)
Imperial pints (Imp pt)	x 0.568	= Liters (l)
Liters (l)	x 1.76	= Imperial pints (Imp pt)
Imperial quarts (Imp qt)	x 1.137	= Liters (l)
Liters (l)	x 0.88	= Imperial quarts (Imp qt)
Imperial quarts (Imp qt)	x 1.201	= US quarts (US qt)
US quarts (US qt)	x 0.833	= Imperial quarts (Imp qt)
US quarts (US qt)	x 0.946	= Liters (l)
Liters (l)	x 1.057	= US quarts (US qt)
US gallons (US gal)	x 3.785	=Liters (l)
Liters (l)	x 0.264	= US gallons (US gal)
Pounds - force per square inch (psi)	x 6.895	= Kilopascals (kPa)
Kilopascals (kPa)	x 0.145	= Pounds - force per square inch (psi)
Kilopascals (kPa)	x 0.01	= Kilograms - force per square cm
Kilograms - force per square cm	x 98.1	= Kilopascals (kPa)
π (3.14) x R^2 x H (height)		= Cylinder Volume

°C to °F: $^{9/5}$**(°C + 32) = °F** **°F to °C:** $^{5/9}$**(°F - 32) = °C**

Standard Torque Specifications

The following torque specifications are to be used only as a general guideline. There are exceptions in the steering, suspension, and engine areas. Always consult the exploded views or each manual section for torque values of fasteners before using standard torque.

Bolt Size	Threads/In	Grade 2	Grade 5	Grade 8
		Torque in. lbs. (Nm)		
#10 -	24	27 (3.1)	43 (5.0)	60 (6.9)
#10 -	32	31 (3.6)	49 (5.6)	68 (7.8)
		Torque ft. lbs. (Nm)*		
1/4 -	20	5 (7)	8 (11)	12 (16)
1/4 -	28	6 (8)	10 (14)	14 (19)
5/16 -	18	11 (15)	17 (23)	25 (35)
5/16 -	24	12 (16)	19 (26)	29 (40)
3/8 -	16	20 (27)	30 (40)	45 (62)
3/8 -	24	23 (32)	35 (48)	50 (69)
7/16 -	14	30 (40)	50 (69)	70 (97)
7/16 -	20	35 (48)	55 (76)	80 (110)
1/2 -	13	50 (69)	75 (104)	110 (152)
1/2 -	20	55 (76)	90 (124)	120 (166)

Metric

6 x 1.0	72-78 In. lbs.
8 x 1.25	14-18 ft. lbs.
10 x 1.25	26-30 ft. lbs.

*To convert ft. lbs. to Nm multiply foot pounds by 1.382
*To convert Nm to ft. lbs. multiply Nm by .7376.

SPECIFIC TORQUE VALUES OF FASTENERS
Refer to exploded views in the appropriate section.

SAE Tap / Drill Sizes

Thread Size	Drill Size	Thread Size	Drill Size
#0-80	3/64	1/2-13	27/64
#1-64	53	1/2-20	29/64
#1-72	53	9/16-12	31/64
#2-56	51	9/16-18	33/64
#2-64	50	5/8-11	17/32
#3-48	5/64	5/8-18	37/64
#3-56	45	3/4-10	21/32
#4-40	43	3/4-16	11/16
#4-48	42	7/8-9	49/64
#5-40	38	7/8-14	13/16
#5-44	37	1-8	7/8
#6-32	36	1-12	59/64
#6-40	33	1 1/8-7	63/64
#8-32	29	1 1/8-12	1 3/64
#8-36	29	1 1/4-7	1 7/64
#10-24	24	1 1/4-12	1 11/64
#10-32	21	1 1/2-6	1 11/32
#12-24	17	1 1/2-12	1 27/64
#12-28	4.6mm	1 3/4-5	1 9/16
1/4-20	7	1 3/4-12	1 43/64
1/4-28	3	2-4 1/2	1 25/32
5/16-18	F	2-12	1 59/64
5/16-24	I	2 1/4-4 1/2	2 1/32
3/8-16	O	2 1/2-4	2 1/4
3/8-24	Q	2 3/4-4	2 1/2
7/16-14	U	3-4	2 3/4
7/16-20	25/64		

Metric Tap / Drill Sizes

Tap Size	Drill Size	Decimal Equivalent	Nearest Fraction
3 x .50	#39	0.0995	3/32
3 x .60	3/32	0.0937	3/32
4 x .70	#30	0.1285	1/8
4 x .75	1/8	0.125	1/8
5 x .80	#19	0.166	11/64
5 x .90	#20	0.161	5/32
6 x 1.00	#9	0.196	13/64
7 x 1.00	16/64	0.234	15/64
8 x 1.00	J	0.277	9/32
8 x 1.25	17/64	0.265	17/64
9 x 1.00	5/16	0.3125	5/16
9 x 1.25	5/16	0.3125	5/16
10 x 1.25	11/32	0.3437	11/32
10 x 1.50	R	0.339	11/32
11 x 1.50	3/8	0.375	3/8
12 x 1.50	13/32	0.406	13/32
12 x 1.75	13/32	0.406	13/32

Decimal Equivalents

1/64 ..... .0156
1/32 ..... .0312 ... 1 mm = .0394″
3/64 ..... .0469
1/16 ..... .0625
5/64 ..... .0781 ... 2 mm = .0787″
3/32 ..... .0938
7/64 ..... .1094 ... 3 mm = .1181″
1/8. ... .1250
9/64 ..... .1406
5/32 ..... .1563 ... 4 mm = .1575″
11/64 ..... .1719
3/16 ..... .1875 ... 5 mm = .1969″
13/64 ..... .2031
7/32 ..... .2188
15/64 ..... .2344 ... 6 mm = .2362″
1/4 .... .25
17/64 ..... .2656 ... 7 mm = .2756″
9/32 ..... .2813
19/64 ..... .2969
5/16 ..... .3125 ... 8 mm = .3150″
21/64 ..... .3281
11/32 ..... .3438 ... 9 mm = .3543″
23/64 ..... .3594
3/8 .... .375
25/64 ..... .3906 ... 10 mm = .3937″
13/32 ..... .4063
27/64 ..... .4219 ... 11 mm = .4331″
7/16 ..... .4375
29/64 ..... .4531
15/32 ..... .4688 ... 12 mm = .4724″
31/64 ..... .4844
1/2 .... .5 ..... 13 mm = .5118
33/64 ..... .5156
17/32 ..... .5313
35/64 ..... .5469 ... 14 mm = .5512″
9/16 ..... .5625
37/64 ..... .5781 ... 15 mm = .5906″
19/32 ..... .5938
39/64 ..... .6094
5/8 .... .625 ..... 16 mm = .6299″
41/64 ..... .6406
21/32 ..... .6563 ... 17 mm = .6693″
43/64 ..... .6719
11/16 ..... .6875
45/64 ..... .7031 ... 18 mm = .7087″
23/32 ..... .7188
47/64 ..... .7344 ... 19 mm = .7480″
3/4 .... .75
49/64 ..... .7656
25/32 ..... .7813 ... 20 mm = .7874″
51/64 ..... .7969
13/16 ..... .8125 ... 21 mm = .8268″
53/64 ..... .8281
27/32 ..... .8438
55/64 ..... .8594 ... 22 mm = .8661″
7/8 .... .875
57/64 ..... .8906 ... 23 mm = .9055″
29/32 ..... .9063
59/64 ..... .9219
15/16 ..... .9375 ... 24 mm = .9449″
61/64 ..... .9531
31/32 ..... .9688 ... 25 mm = .9843
63/64 ..... .9844
1 ..... 1.0

Glossary of Terms

ABDC: After bottom dead center.
ACV: Alternating current voltage.
Alternator: Electrical generator producing voltage alternating current.
ATDC: After top dead center.
BBDC: Before bottom dead center.
BDC: Bottom dead center.
BTDC: Before top dead center.
CC: Cubic centimeters.
Center Distance: Distance between center of crankshaft and center of driven clutch shaft.
Chain Pitch: Distance between chain link pins (No. 35 = 3/8" or 1 cm). Polaris measures chain length in number of pitches.
CI: Cubic inches.
Clutch Buttons: Plastic bushings which aid rotation of the movable sheave in the drive and driven clutch.
Clutch Offset: Drive and driven clutches are offset so that drive belt will stay nearly straight as it moves along the clutch face.
Clutch Weights: Three levers in the drive clutch which relative to their weight, profile and engine RPM cause the drive clutch to close and grip the drive belt.
Crankshaft Run-Out: Run-out or "bend" of crankshaft measured with a dial indicator while crankshaft is supported between centers on V blocks or resting in crankcase. Measure at various points especially at PTO.
DCV: Direct current voltage
CVT: Centrifugal Variable Transmission (Drive Clutch System)
DCV: Direct current voltage.
Dial Bore Gauge: A cylinder measuring instrument which uses a dial indicator. Good for showing taper and out-of-round in the cylinder bore.
Electrical Open: Open circuit. An electrical circuit which isn't complete.
Electrical Short: Short circuit. An electrical circuit which is completed before the current reaches the intended load. (i.e. a bare wire touching the chassis).
End Seals: Rubber seals at each end of the crankshaft.
Engagement RPM: Engine RPM at which the drive clutch engages to make contact with the drive belt.
ft.: Foot/feet.
Foot Pound: Ft. lb. A force of one pound at the end of a lever one foot in length, applied in a rotational direction.
g: Gram. Unit of weight in the metric system.
gal.: Gallon.
ID: Inside diameter.
in.: Inch/inches.
Inch Pound: In. lb. 12 in. lbs. = 1 ft. lb.
kg/cm²: Kilograms per square centimeter.
kg-m: Kilogram meters.
Kilogram/meter: A force of one kilogram at the end of a lever one meter in length, applied in a rotational direction.
l or ltr: Liter.
lbs/in²: Pounds per square inch.
Left or Right Side: Always referred to based on normal operating position of the driver.
m: Meter/meters.
Mag: Magneto.
Magnetic Induction: As a conductor (coil) is moved through a magnetic field, a voltage will be generated in the windings. Mechanical energy is converted to electrical energy in the stator.
mi.: Mile/miles.
mm: Millimeter. Unit of length in the metric system. 1 mm = approximately .040".
Nm: Newton meters.
OD: Outside diameter.
Ohm: The unit of electrical resistance opposing current flow.
oz.: Ounce/ounces.
Piston Clearance: Total distance between piston and cylinder wall.
psi.: Pounds per square inch.
PTO: Power take off.
PVT: Polaris Variable Transmission (Drive Clutch system)
qt.: Quart/quarts.
Regulator: Voltage regulator. Regulates battery charging system output at approx. 14.5 DCV as engine RPM increases.
Reservoir Tank: The fill tank in the liquid cooling system.
Resistance: In the mechanical sense, friction or load. In the electrical sense, ohms, resulting in energy conversion to heat.
RPM: Revolutions per minute.
Seized Piston: Galling of the sides of a piston. Usually there is a transfer of aluminum from the piston onto the cylinder wall.
Possible causes: 1) improper lubrication; 2) excessive temperatures; 3) insufficient piston clearance; 4) stuck piston rings.
Stator Plate: The plate mounted under the flywheel supporting the battery charging coils.
TDC: Top dead center. Piston's most outward travel from crankshaft.
Volt: The unit of measure for electrical pressure of electromotive force. Measured by a voltmeter in parallel with the circuit.
Watt: Unit of electrical power. Watts = amperes x volts.
WOT: Wide open throttle.

CHAPTER 2
MAINTENANCE

2

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PERIODIC MAINTENANCE CHART

Periodic Maintenance Overview

Inspection, adjustment and lubrication of important components are explained in the periodic maintenance chart.

Inspect, clean, lubricate, adjust and replace parts as necessary. When inspection reveals the need for replacement parts, use genuine Pure Polaris parts available from your Polaris dealer.

NOTE: Service and adjustments are critical. If you're not familiar with safe service and adjustment procedures, have a qualified dealer perform these operations.

Maintenance intervals in the following chart are based upon average riding conditions and an average vehicle speed of approximately 10 miles per hour. Vehicles subjected to severe use must be inspected and serviced more frequently.

Severe Use Definition

- Frequent immersion in mud, water or sand
- Racing or race-style high RPM use
- Prolonged low speed, heavy load operation
- Extended idle
- Short trip cold weather operation

Pay special attention to the oil level. A rise in oil level during cold weather can indicate contaminants collecting in the oil sump or crankcase. Change oil immediately if the oil level begins to rise. Monitor the oil level, and if it continues to rise, discontinue use and determine the cause or see your dealer.

Break-In Period

The break-in period consists of the first 25 hours of operation, or the time it takes to use 14 gallons (53 liters) of fuel. Careful treatment of a new engine and drive components will result in more efficient performance and longer life for these components.

- Drive vehicle slowly at first while varying the throttle position. Do not operate at sustained idle.
- Pull only light loads.
- Perform regular checks on fluid levels and other areas outlined on the daily pre-ride inspection checklist.
- Change both the engine oil and filter after 25 hours or one month.
- See "Owner's Manual" for additional break-in information.

Maintenance Chart Key

The following symbols denote potential items to be aware of during maintenance:

■ = CAUTION: Due to the nature of these adjustments, it is recommended this service be performed by an authorized Polaris dealer.

▸ = SEVERE USE ITEM: See information provided above.

E = Emission Control System Service (California).

NOTE: Inspection may reveal the need for replacement parts. Always use genuine Polaris parts.

⚠ WARNING

Improperly performing the procedures marked ■ could result in component failure and lead to serious injury or death. Have an authorized Polaris dealer perform these services.

Pre-Ride - 25 Hour Maintenance Interval

Item		Maintenance Interval (whichever comes first)			Remarks
		Hours	Calendar	Miles (KM)	
■	Steering	-	Pre-Ride	-	Make adjustments as needed. See Pre-Ride Checklist on Page 2.13.
▸	Front Suspension	-	Pre-Ride	-	
▸	Rear Suspension	-	Pre-Ride	-	
	Tires	-	Pre-Ride	-	
▸	Brake Fluid Level	-	Pre-Ride	-	
▸	Brake Pedal Travel	-	Pre-Ride	-	
	Brake Systems	-	Pre-Ride	-	
	Wheels / Fasteners	-	Pre-Ride	-	
	Frame Fasteners	-	Pre-Ride	-	
▸ E	Engine Oil Level	-	Pre-Ride	-	
▸ E	Air Filter / Pre-Filter	-	Daily	-	Inspect;clean often
▸ E	Air Box Sediment Tube	-	Daily	-	Drain deposits when visible
	Coolant Level	-	Daily	-	Check level daily, change coolant every 2 years
	Head Lamp / Tail Lamp	-	Daily	-	Check operation; apply dielectric grease if replacing
▸ E	Air Filter, Main Element	-	Weekly	-	Inspect; replace as needed
▸ ■	Brake Pad Wear / Inspect Parking Brake Pads	10 H	Monthly	-	Inspect periodically
	Battery	20 H	Monthly	-	Check terminals; clean; test
▸ ■	Parking Brake Cable Adjustment	25 H	-	-	Inspect; adjust tension after first 25 hours
▸	Front Gearcase Oil (if equipped)	25 H	Monthly	-	Inspect level; change yearly
▸	Middle Gearcase Oil (if equipped)	25 H	Monthly	-	Inspect level; change yearly
▸	Rear Gearcase Oil (if equipped)	25 H	Monthly	-	Inspect level; change yearly
▸	Transmission Oil	25 H	Monthly	-	Inspect level; change yearly
▸ E	Engine Breather Filter (if equipped)	25 H	Monthly	-	Inspect; replace if necessary
▸ E	Engine Oil Change (Break-In Period)	25 H	1 M	-	Perform a break-in oil change at one month

▸ Perform these procedures more often for vehicles subjected to severe use.
E Emission Control System Service (California)
■ Have an authorized Polaris dealer perform these services.

50 - 100 Hour Maintenance Interval

	Item	Maintenance Interval (whichever comes first)			Remarks
		Hours	Calendar	Miles (KM)	
▸	General Lubrication	50 H	3 M	-	Lubricate all grease fittings, pivots, cables, etc.
	Shift Linkage	50 H	6 M	-	Inspect, lubricate, adjust
■	Steering	50 H	6 M	-	Lubricate
▸	Front Suspension	50 H	6 M	-	Lubricate
▸	Rear Suspension	50 H	6 M	-	Lubricate
■ E	Throttle Cable / Throttle Pedal	50 H	6 M	-	Inspect; adjust; lubricate; replace if necessary
E	Throttle Body Air Intake Ducts / Flange	50 H	6 M	-	Inspect ducts for proper sealing/air leaks
	Drive Belt	50 H	6 M	-	Inspect; adjust; replace as needed
	Cooling System	50 H	6 M	-	Inspect coolant strength seasonally; pressure test system yearly
▸ ■	Parking Brake Cable Adjustment	100 H	-	-	Inspect; adjust tension as needed
▸ E	Engine Oil Change	100 H	6 M	-	Perform a break-in oil change at 25 hours/ one month
▸ E	Oil Filter Change	100 H	6 M	-	Replace with oil change

▸ Perform these procedures more often for vehicles subjected to severe use.
E Emission Control System Service (California)
■ Have an authorized Polaris dealer perform these services.

100 - 300 Hour Maintenance Interval

	Item	Maintenance Interval (whichever comes first)			Remarks
		Hours	Calendar	Miles (Km)	
■ E	Fuel System	100 H	12M	-	Check for leaks at tank cap, fuel lines, fuel pump, and fuel rail. Replace lines every two years.
▸	Radiator	100 H	12M	-	Inspect; clean external surfaces
▸	Cooling Hoses	100 H	12M	-	Inspect for leaks
▸	Engine Mounts	100 H	12M	-	Inspect
	Exhaust Muffler / Pipe	100 H	12M	-	Inspect
■ E	Spark Plug	100 H	12M	-	Inspect; replace as needed
▸	Wiring	100 H	12M	-	Inspect for wear, routing, security; apply dielectric grease to connectors subjected to water, mud, etc.
■	Clutches (Drive and Driven)	100 H	12M	-	Inspect; clean; replace worn parts
■	Front Wheel Bearings	100 H	12M	-	Inspect; replace as needed
■	Toe Adjustment	100 H			Inspect periodically; adjust when parts are replaced
■	Brake Fluid	200 H	24M	-	Change every two years (DOT 4)
	Spark Arrestor	300 H	36M	-	Clean out
▸ ■	Auxiliary Brake	-			Inspect daily; adjust as needed
	Headlight Aim	-			Adjust as needed

▸ Perform these procedures more often for vehicles subjected to severe use.
E Emission Control System Service (California)
■ Have an authorized Polaris dealer perform these services.

SERVICE PRODUCTS AND LUBES

Polaris Lubricants, Maintenance and Service Products

Part No.	Description
Engine Lubricant	
2870791	Fogging Oil (12 oz. Aerosol)
2876244	PS-4 PLUS Performance Synthetic 2W-50 4-Cycle Engine Oil (Quart)
2876245	PS-4 PLUS Performance Synthetic 2W-50 4-Cycle Engine Oil (Gallon)
Gearcase / Transmission Lubricants	
2873602	Premium Synthetic AGL Gearcase Lube (12 oz. bottle) (12 Count)
2873603	Premium Synthetic AGL Gearcase Lube (1 Gal.) (4 Count)
2871653	Premium ATV Angle Drive Fluid (8 oz.) (12 Count)
2872276	Premium ATV Angle Drive Fluid (2.5 Gal) (2 Count)
2870465	Oil Pump for 1 Gallon Jug
2871654	Premium Demand Drive Fluid (8 oz.) (12 Count)
2872277	Premium Demand Drive Fluid (2.5 gal.) (2 Count)
Grease / Specialized Lubricants	
2871322	Premium All Season Grease (3 oz. cartridge) (24 Count)
2871423	Premium All Season Grease (14 oz. cartridge) (10 Count)
2871460	Starter Drive Grease (12 Count)
2871515	Premium U-Joint Lube (3 oz.) (24 Count)
2871551	Premium U-Joint Lube (14 oz.) (10 Count)
2871312	Grease Gun Kit
2871329	Dielectric Grease (Nyogel™)
Coolant	
2871323	60/40 Coolant (Gallon) (6 Count)
2871534	60/40 Coolant (Quart) (12 Count)

NOTE: Each item can be purchased separately at your local Polaris dealer.

Part No.	Description
Additives / Sealants / Thread Locking Agents / Misc.	
2870585	Loctite™ Primer N, Aerosol, 25 g
2871956	Loctite™ Thread Sealant 565 (50 ml.) (6 Count)
2871949	Loctite™ Threadlock 242 (50 ml.) (10 Count)
2871950	Loctite™ Threadlock 242 (6 ml.) (12 Count)
2871951	Loctite™ Threadlock 262 (50 ml.) (10 Count)
2871952	Loctite™ Threadlock 262 (6 ml.) (12 Count)
2871953	Loctite™ Threadlock 271 (6 ml.) (12 Count)
2871954	Loctite™ Threadlock 271 (36 ml.) (6 Count)
2870584	Loctite™ 680-Retaining Compound (10 ml.)
2870587	Loctite™ 518 Gasket Eliminator / Flange Sealant (50 ml.) (10 Count)
2871326	Premium Carbon Clean (12 oz.) (12 Count)
2870652	Fuel Stabilizer (16 oz.) (12 Count)
2871957	Black RTV Silicone Sealer (3 oz. tube) (12 Count)
2871958	Black RTV Silicone Sealer (11 oz. cartridge) (12 Count)
2872189	DOT 4 Brake Fluid (12 Count)
2871557	Crankcase Sealant, 3-Bond 1215 (5oz.)
2872893	Engine Degreaser (12oz.) (12 Count)

NOTE: The number count indicated by each part number in the table above indicates the number of units that are shipped with each order.

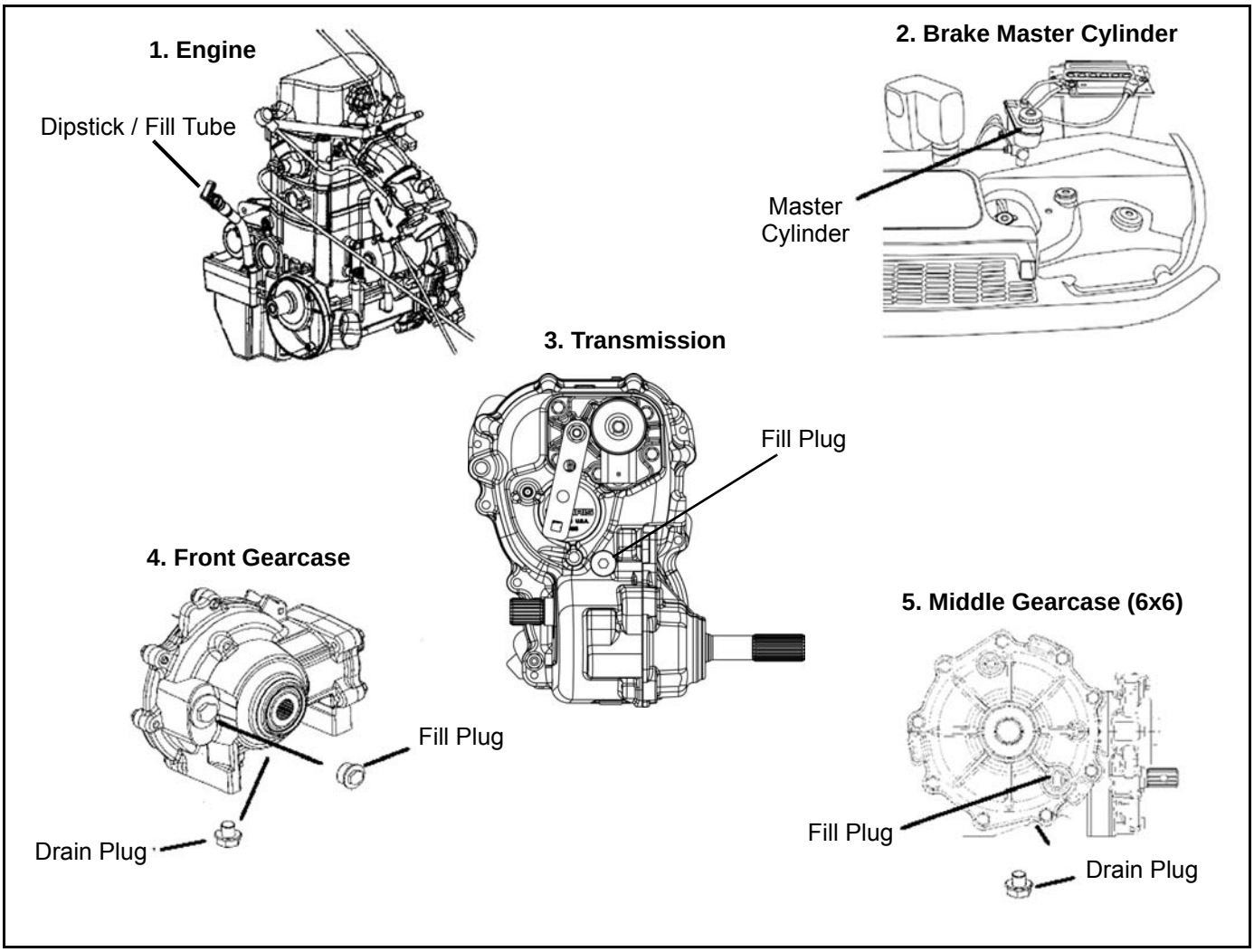
MAINTENANCE REFERENCES

Item	Lube Rec.	Method	Frequency*
1. Engine Oil	Polaris PS-4 PLUS Performance Synthetic 2W-50 4-Cycle Engine Oil (2876244)	Add oil to proper level indicated on dipstick.	Change after 1st month (25 hrs), 6 months or 100 hours thereafter; Change more often in extremely dirty conditions, or short trip cold weather operation.
2. Brake Fluid	DOT 4 (PN 2872189)	Fill reservoir between MAX and Min lines.	As required. Change fluid every 2 years.
3. Transmission	Polaris AGL Gearcase Lubricant (PN 2873602)	Add lube to bottom of fill plug threads.	Change annually. Change more often if used in severe conditions.
4. Front Gearcase	Premium Demand Drive Fluid (PN 2871654)	Drain completely. Add lube to specified quantity.	Change annually***
5. Middle Gearcase	Polaris ATV Angle Drive Fluid (PN 2871653)	Drain completely. Add lube to specified quantity.	Semi-annually**

* More often under severe use, such as operated in water or under severe loads.

**Semi-annually or 50 hours of operation (refer to Maintenance Schedule for additional information)

***Annually or 100 hours of operation (refer to Maintenance Schedule for additional information)



Maintenance References, Continued.....

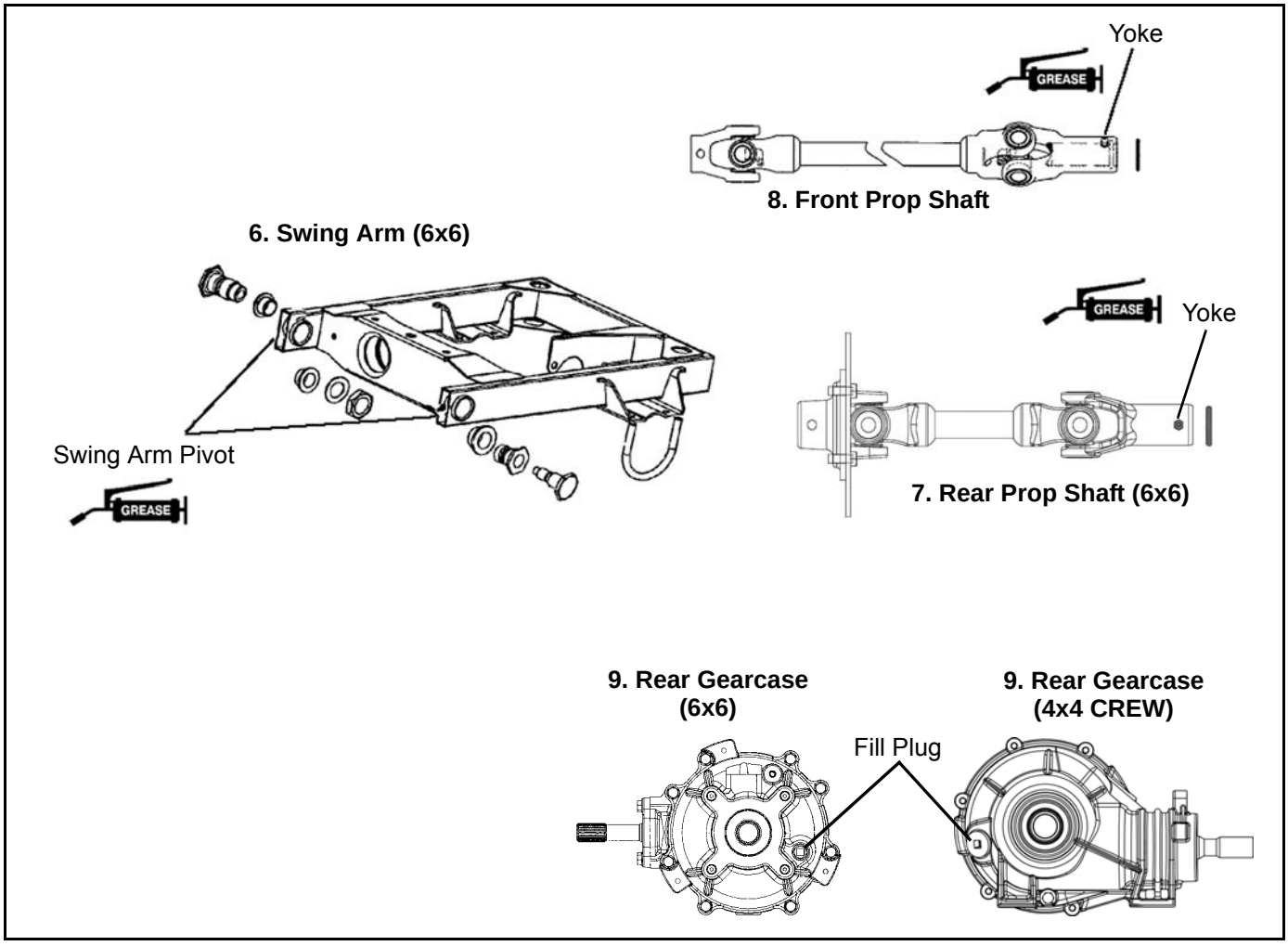
Item	Lube Rec.	Method	Frequency*
6. Swing Arm Pivot	Polaris All Season Grease (PN 2871423)	Locate grease fitting on inside of the swing arm pivot.	Semi-annually**
7. Rear Prop Shaft Yoke	Polaris Premium U-Joint Lube (PN 2871551)	Locate fittings and grease with grease gun.	Semi-annually**
8. Front Prop Shaft Yoke	Polaris Premium U-Joint Lube (PN 2871551)	Locate fittings and grease with grease gun.	Semi-annually**
9. Rear Gearcase	Polaris ATV Angle Drive Fluid (PN 2871653)	Drain completely. Add lube to specified quantity.	Change annually***

* More often under severe use, such as operated in water or under severe loads.

**Semi-annually or 50 hours of operation (refer to Maintenance Schedule for additional information)

***Annually or 100 hours of operation (refer to Maintenance Schedule for additional information)

Grease conforming to NLGI No. 2, such as Polaris Premium All Season Grease, Conoco Superlube M or Mobilegrease Special



GENERAL VEHICLE INSPECTION AND MAINTENANCE

Pre-Ride / Daily Inspection

Perform the following pre-ride inspection daily, and when servicing the vehicle at each scheduled maintenance.

- Tires - check condition and pressures
- Fuel and oil tanks - fill both tanks to their proper level; Do not overfill oil tank
- All brakes - check operation and adjustment (includes auxiliary brake)
- Throttle - check for free operation and closing
- Headlight/Taillight/Brakelight - check operation of all indicator lights and switches
- Engine stop switch - check for proper function
- Wheels - check for tightness of wheel nuts and axle nuts; check to be sure axle nuts are secured by cotter pins
- Air cleaner element - check for dirt; clean or replace
- Steering - check for free operation noting any unusual looseness in any area
- Loose parts - visually inspect vehicle for any damaged or loose nuts, bolts or fasteners
- Engine coolant - check for proper level at the recovery bottle
- Check all rear suspension components for wear or damage.

Frame, Nuts, Bolts, and Fasteners

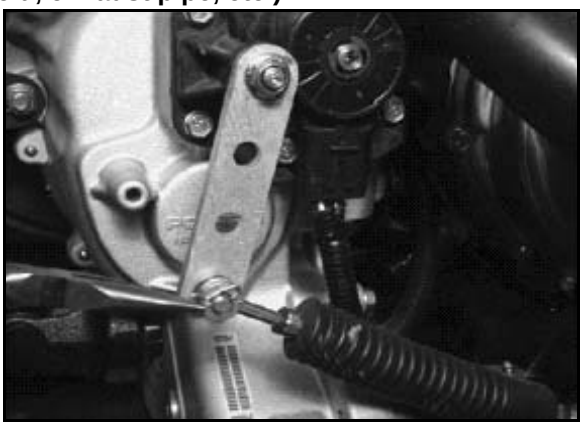
Periodically inspect the torque of all fasteners in accordance with the maintenance schedule. Check that all cotter pins are in place. Refer to specific fastener torques listed in each chapter.

Shift Linkage Inspection / Adjustment

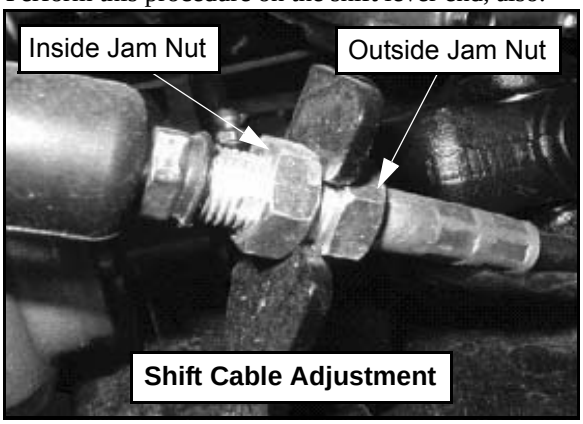
Linkage rod adjustment is necessary when symptoms include:

- No All Wheel Drive light
- Noise on deceleration
- Inability to engage a gear
- Excessive gear clash (noise)
- Shift selectors moving out of desired range

NOTE: Remove necessary components to gain access to shift linkage cable ends (i.e. exhaust heat shield, exhaust pipe, etc.)

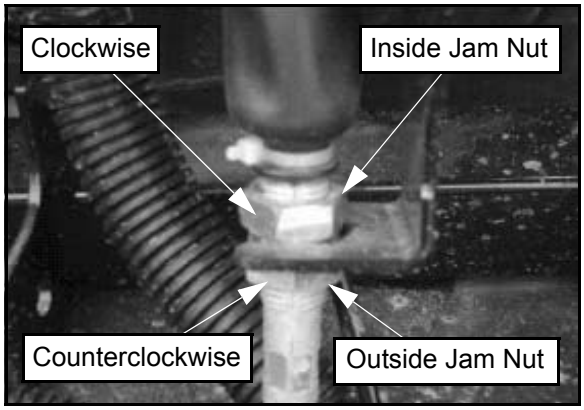


1. Inspect shift linkage cable, clevis pins, and pivot bushings and replace if worn or damaged.
2. Be sure idle speed is adjusted properly.
3. Place gear selector in neutral. Make sure the transmission bell crank is engaged in the neutral position detents.
4. With two wrenches loosen the outside jam nut counterclockwise. Turn the outside jam nut 1 1/2 turns. Perform this procedure on the shift lever end, also.



5. After turning the outside jam nut 1 1/2 turns. Hold the outside jam nut with a wrench and tighten the inside jam nut clockwise, until it is tight against the bracket.
6. Repeat Step 4 and Step 5 until the proper adjustment is made for the transmission cable.

7. Use this procedure to loosen or tighten the shift linkage cable as needed.



FUEL SYSTEM AND AIR INTAKE

Fuel System

⚠ WARNING

Gasoline is extremely flammable and explosive under certain conditions.
Always stop the engine and refuel outdoors or in a well ventilated area.
Do not smoke or allow open flames or sparks in or near the area where refueling is performed or where gasoline is stored.
Do not overfill the tank. Do not fill the tank neck.
If you get gasoline in your eyes or if you swallow gasoline, seek medical attention immediately.
If you spill gasoline on your skin or clothing, immediately wash it off with soap and water and change clothing.
Never start the engine or let it run in an enclosed area. Engine exhaust fumes are poisonous and can result loss of consciousness or death in a short time.
Never drain the fuel when the engine is hot. Severe burns may result.

Fuel Lines

1. Check fuel lines for signs of wear, deterioration, damage or leakage. Replace if necessary.

2. Be sure fuel lines are routed properly and secured with cable ties. **CAUTION:** Make sure lines are not kinked or pinched.

3. Replace all fuel lines every two years.

Fuel Filter

The fuel pump on the *RANGER* 700 EFI is non-serviceable. If the internal fuel pump filters require service, the fuel tank and fuel pump must be replaced as an assembly.

NOTE: See the "Electronic Parts Catalog" for more information.

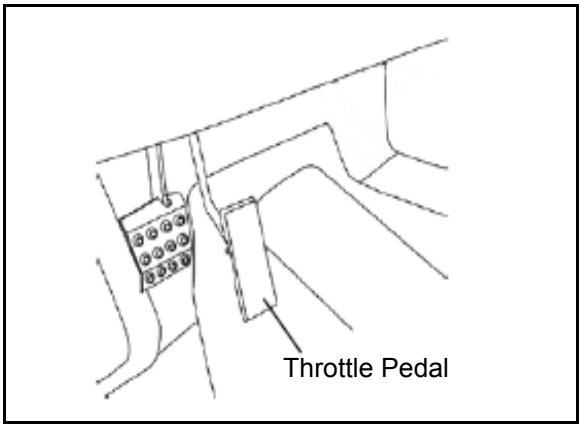
NOTE: For all other information related to the EFI System refer to Chapter 4.

Vent Lines

1. Check fuel tank and transmission vent lines for signs of wear, deterioration, damage or leakage. Replace every two years.

2. Be sure vent lines are routed properly and secured with cable ties. **CAUTION:** Make sure lines are not kinked or pinched

Throttle Pedal Inspection



If the throttle pedal has excessive play due to cable stretch or cable misadjustment, it will cause a delay in throttle speed. Also, the throttle may not open fully. If the throttle pedal has no play, the throttle may be hard to control, and the idle speed may be erratic.

Check the throttle pedal play periodically in accordance with the Periodic Maintenance Chart and adjust the play if necessary.

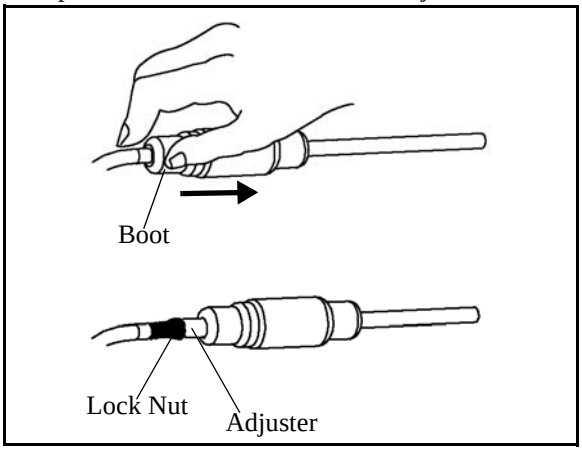
Throttle Freeplay Adjustment

Inspection

1. Apply the parking brake.
2. Put the gear shift lever in the N (Neutral) position.
3. Start the engine, and warm it up thoroughly.
4. Measure the distance the throttle pedal moves before the engine begins to pick up speed. Free play should be 1/16" - 1/8" (1.5 - 3 mm).

Adjustment

1. Remove the seat.
2. Locate the throttle cable adjuster.
3. Squeeze the end of the rubber boot and slide it far enough to expose the end of the inline cable adjuster.



4. Loosen the adjuster lock nut.
5. Rotate the boot to turn the adjuster until 1/16" to 1/8" (1.5 - 3 mm) of freeplay is achieved at the throttle pedal.

NOTE: While adjusting, lightly flip the throttle pedal up and down.

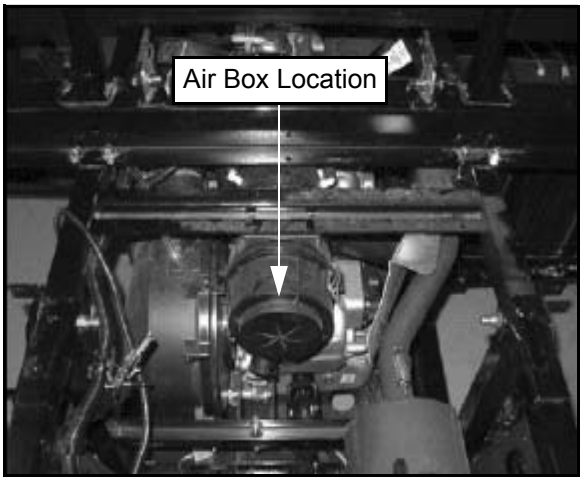
6. Tighten the lock nut.
7. Squeeze the end of the rubber boot and slide it over the cable adjuster to its original position.

Air Filter Service

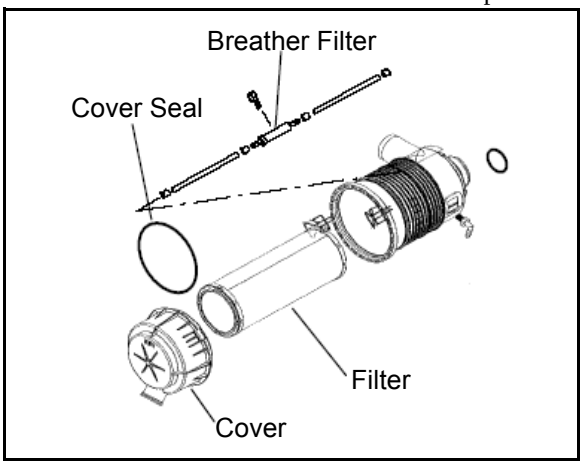
It is recommended that the air filter be replaced annually. When riding in extremely dusty conditions replacement will be required more often.

The filter should be inspected periodically before each ride, using the following procedure.

1. Lift the box to access the filter box cover.



2. Remove clips (2) from air box cover and remove cover. Inspect the gasket. It should adhere tightly to the cover and seal all the way around.
3. Remove air filter assembly. Do not clean the main filter, the filter should be replaced.
4. Inspect main element and replace if necessary. If the filter has been soaked with fuel or oil it must be replaced.



Installation

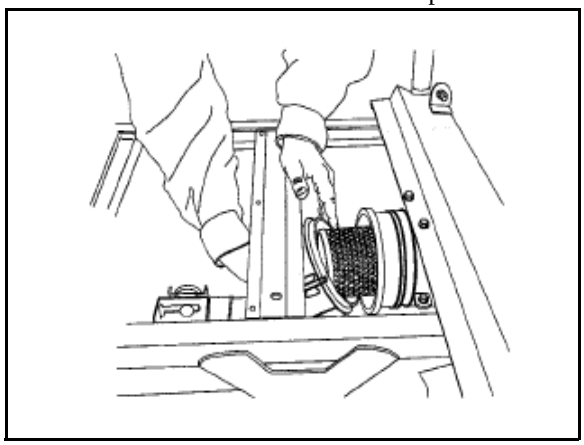
1. Reinstall the filter into the air box container. Be sure the filter fits tightly in the air box.

NOTE: Apply a small amount of general purpose grease to the sealing edges of the filter before installing.

2. Check air box. If oil or water deposits are found, drain them into a suitable container.

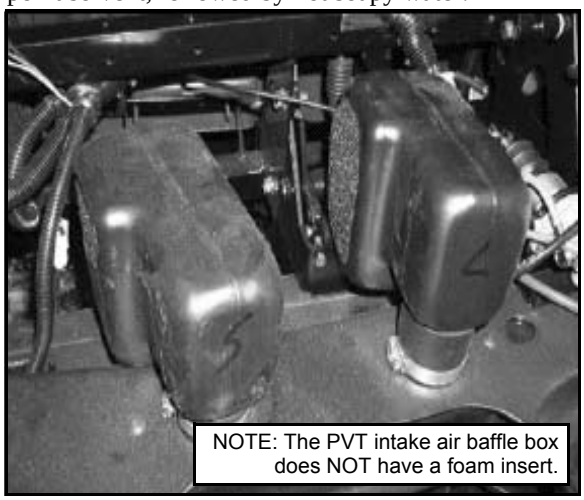
NOTE: Service more frequently if vehicle is operated in wet conditions or at high throttle openings for extended periods.

3. Install air box cover and secure with clips.

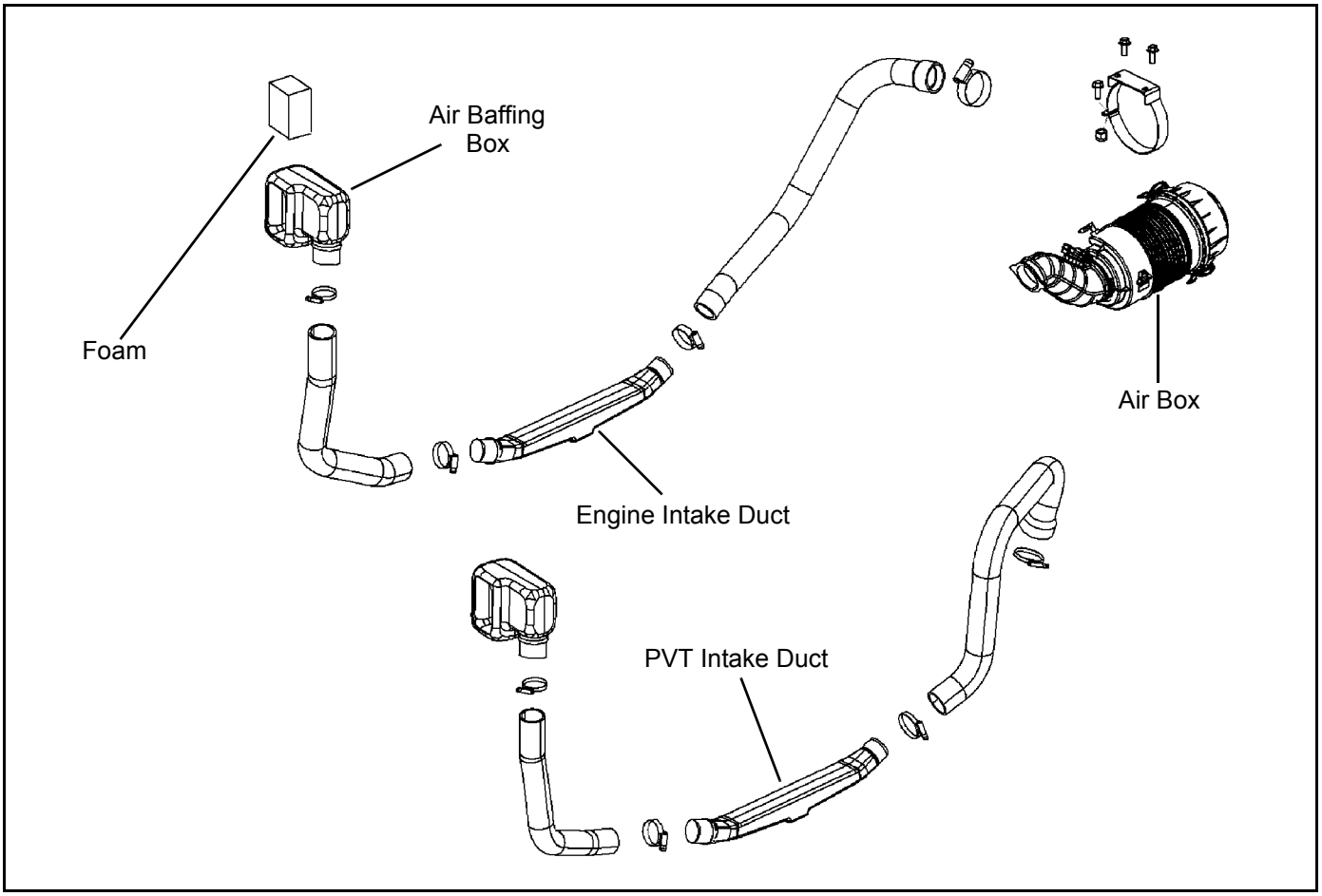


Air Intake Inspection

1. Lift the hood.
2. Inspect the foam insert in the engine intake air baffle box. If the foam insert is dirty, clean the foam with a high flash point solvent, followed by hot soapy water.



3. Rinse and dry the foam thoroughly.
4. Inspect the foam for tears or damage. Replace if necessary.
5. Reinstall the foam insert into the air baffle box.



ENGINE

Compression and Leakdown Test

NOTE: This engine does NOT have decompression components. Compression readings will vary in proportion to cranking speed during the test. Average compression (measured) is about 150-200 psi during a compression test.

A smooth idle generally indicates good compression. Low engine compression is rarely a factor in running condition problems above idle speed. Abnormally high compression can be caused by carbon deposits in the combustion chamber or worn, damaged exhaust cam lobes. Inspect camshaft and combustion chamber if compression is abnormally high.

A cylinder leakdown test is the best indication of engine condition. Follow manufacturer's instructions to perform a cylinder leakage test (never use high pressure leakage testers, as crankshaft seals may dislodge and leak).

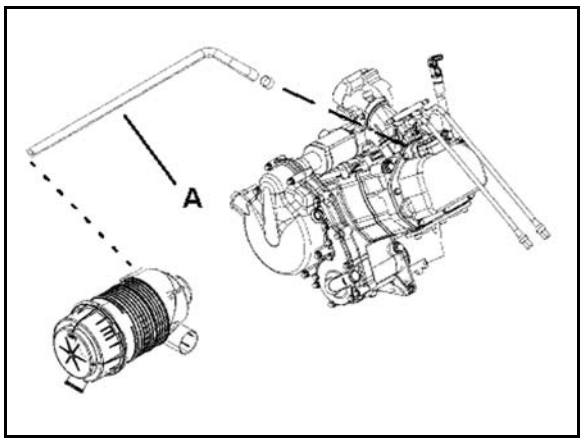
Cylinder Compression
Standard: 150-200 PSI

Cylinder Leakdown
Service Limit 15%

(Inspect for cause if test exceeds 15%)

Breather Hose Inspection

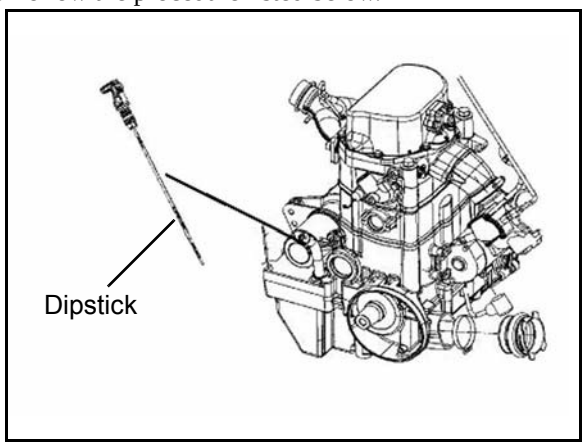
The engine is equipped with a breather hose (A). Inspect the breather hose for possible kinks or wear. The hose is form fitted for a proper fit. Follow the breather hose from the side of the airbox to the engine valve cover.



NOTE: Make sure lines are not kinked or pinched.

Engine Oil Level

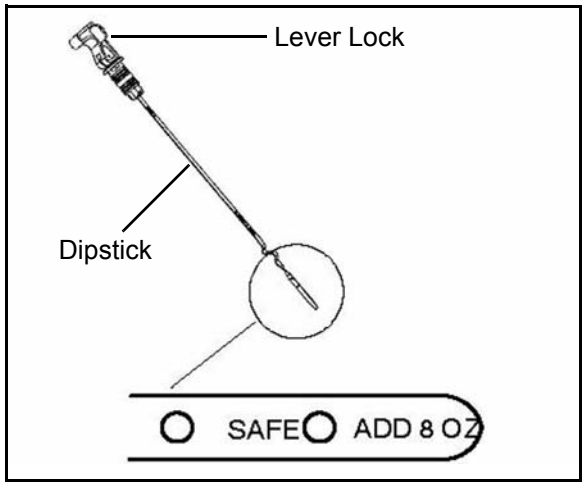
The twin cylinder engine is a wet-sump engine, meaning the oil is contained in the bottom of the crankcase. To check the oil level follow the procedure listed below.



1. Set machine on a level surface and set the parking brake.
2. Be sure the machine has sat for awhile before removing the dipstick.

IMPORTANT: Do not run the machine and then check the dipstick.

3. Stop engine and unlock the lever lock. Remove dipstick and wipe dry with a clean cloth.

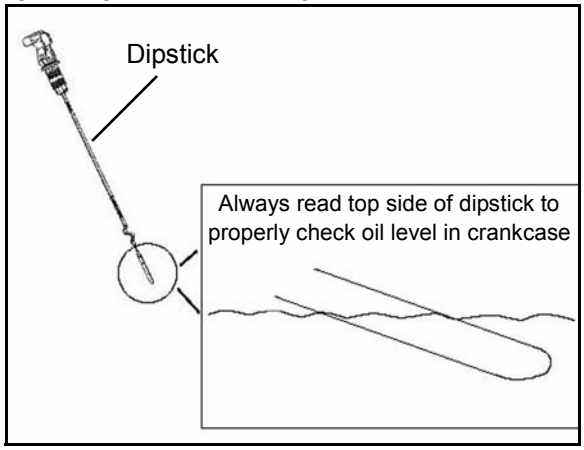


4. Reinstall dipstick and push it into place. Do not lock the dipstick.

NOTE: Make certain the dipstick is inserted all the way into the filler tube to keep the angle and depth of dipstick consistent. When reinstalling the dipstick, make certain to seat the lever lock.

5. Remove dipstick and check to see that the oil level is in the normal range. Add oil as indicated by the level on the dipstick. Do not overfill (see NOTE below!).

NOTE: Due to the dipstick entry angle into the crankcase, the oil level will read higher on the bottom side of the dipstick. Proper level indication is determined on the upper surface of the dipstick as it is being removed, regardless of the level marks being on top or on bottom (see the next illustration).



NOTE: A rising oil level between checks in cool weather driving can indicate contaminants such as gas or moisture collecting in the crankcase. If the oil level is over the full mark, change the oil immediately.

Engine Oil and Filter Change

⚠ WARNING

Personal injury can occur when handling used oil. Hot oil can cause burns or skin damage.

Recommended Engine Oil:

Polaris PS-4 PLUS Synthetic 2W-50
(PN 2876244) (Quart)

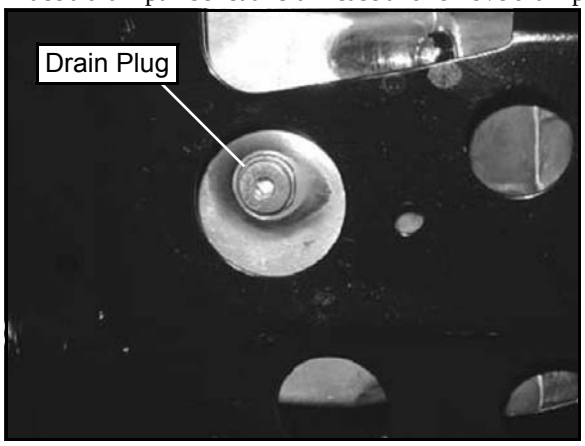
Ambient Temperature Range
-40° F to 120° F

1. Place vehicle on a level surface.
2. To ease access to the oil filter, try to access the oil filter from the front engine cover or remove the storage container located under the driver side seat (refer to Chapter 5 for front engine cover and storage removal).
3. Run engine two to three minutes until warm. Stop engine.
4. Clean area around drain plug at bottom of engine. Drain plug is accessible through the skid plate.

⚠ CAUTION

Oil may be hot. Do not allow hot oil to come into contact with skin, as serious burns may result.

5. Place a drain pan beneath crankcase and remove drain plug.

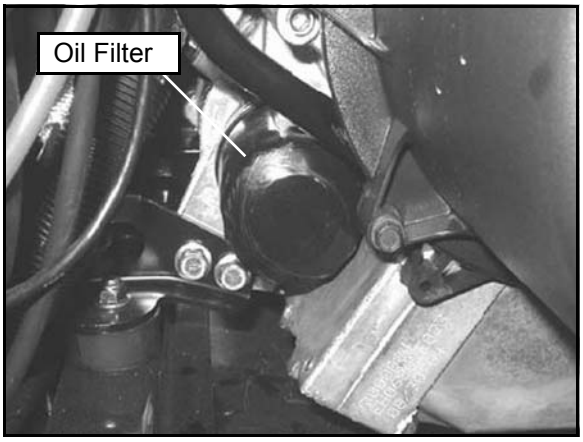


6. Allow oil to drain completely.
7. Replace the sealing washer on drain plug.

NOTE: The sealing surface on the drain plug should be clean and free of burrs, nicks or scratches.

8. Reinstall drain plug and torque to **16 ± 2 ft. lbs. (21.7 ± 2.7 Nm)**.

9. Place shop towels beneath oil filter. Using Oil Filter Wrench (PV-43527), turn filter counterclockwise to remove.



10. Using a clean dry cloth, clean filter sealing surface on crankcase.

11. Lubricate O-ring on new filter with a film of fresh engine oil. Check to make sure the O-ring is in good condition.

12. Install new filter and turn by hand until filter gasket contacts the sealing surface, then turn an additional 1/2 turn.

13. Remove dipstick and fill sump with 2 quarts (1.9 l) of Polaris PS-4 PLUS 2W-50 Synthetic engine oil (PN 2876244).

= T
Crankcase Drain Plug Torque: 16 ± 2 ft. lbs. (21.7 ± 2.7 Nm) **Oil Filter Torque:** Turn by hand until filter gasket contacts sealing surface, then turn an additional 1/2 turn **Oil Filter Wrench:** (PV-43527)

14. Place gear selector in neutral and set parking brake.

15. Start the engine and let it idle for one to two minutes. Stop the engine and inspect for leaks.

16. Re-check the oil level on the dipstick and add oil as necessary to bring the level to the upper mark on the dipstick.

17. Dispose of used oil and oil filter properly.

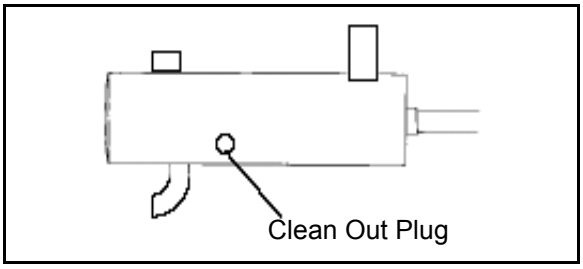
Exhaust Pipe

⚠ WARNING

Do not perform clean out immediately after the engine has been run, as the exhaust system becomes very hot. Serious burns could result from contact with exhaust components.
To reduce fire hazard, make sure that there are no combustible materials in the area when purging the spark arrestor.
Wear eye protection.
Do not stand behind or in front of the vehicle while purging the carbon from the spark arrestor.
Never run the engine in an enclosed area. Exhaust contains poisonous carbon monoxide gas.
Do not go under the machine while it is inclined. Set the hand brake and block the wheels to prevent roll back.
Failure to heed these warnings could result in serious personal injury or death.

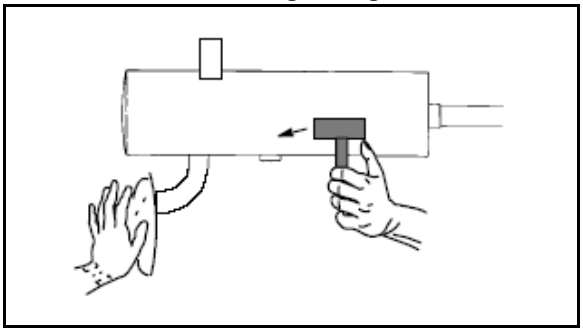
The exhaust pipe must be periodically purged of accumulated carbon as follows:

1. Remove the clean out plugs located on the bottom of the muffler as shown below.

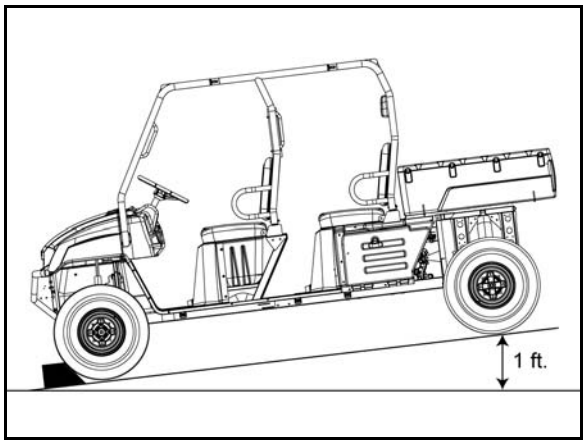


2. Place the transmission in Park and start the engine. Purge accumulated carbon from the system by momentarily revving the engine several times.

3. If some carbon is expelled, cover the exhaust outlet and lightly tap on the pipe around the clean out plugs with a rubber mallet while revving the engine several more times.



4. If particles are still suspected to be in the muffler, back the machine onto an incline so the **rear** of the machine is one foot higher than the front. Set the hand brake and block the wheels. Make sure the machine is in Park and repeat Steps 2 and 3. SEE WARNING



5. If particles are still suspected to be in the muffler, drive the machine onto the incline so the **front** of the machine is one foot higher than the rear. Set the hand brake and block the wheels. Make sure the machine is in Park and repeat Steps 2 and 3. SEE WARNING
6. Repeat steps 2 through 5 until no more particles are expelled when the engine is revved.
7. Stop the engine and allow the arrestor to cool.
8. Reinstall the clean out plugs.

TRANSMISSION AND GEARCASES

Transmission Lubrication

NOTE: It is important to follow the transmission maintenance intervals described in the Periodic Maintenance Chart. Regular fluid level inspections should be performed as well.

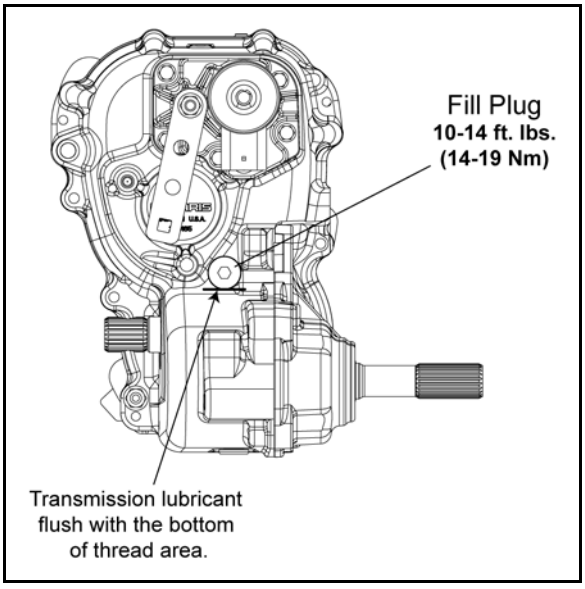
The transmission lubricant level should be checked and changed in accordance with the maintenance schedule.

- Be sure vehicle is positioned on a level surface when checking or changing the lubricant.
- Check vent hose to be sure it is routed properly and unobstructed.

Transmission Lubricant Level Check

The fill plug is located on the right side of the transmission. Access the fill plug from the rear right-hand side of the vehicle. Maintain the fluid level even with the bottom threads of the fill plug hole.

1. Position vehicle on a level surface.
2. Remove the fill plug and check the lubricant level.



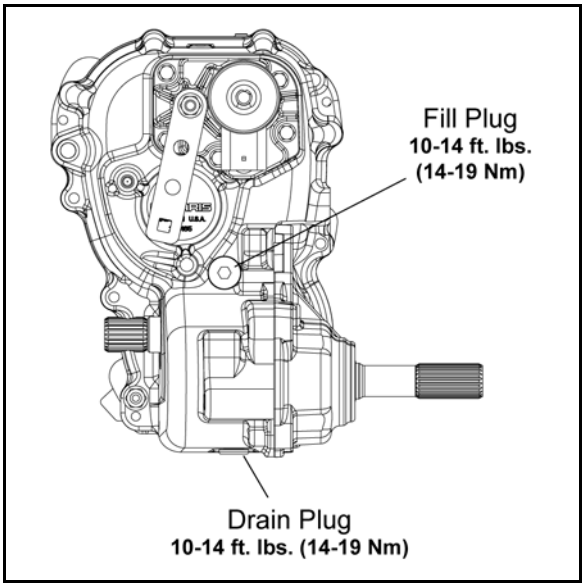
3. If lubricant level is not even with the bottom threads, add the recommended lubricant as needed. Do not overfill.
4. Reinstall the fill plug and torque to specification.

= T
Drain / Fill Plug Torque: **14 ft. lbs. (19 Nm)**

Transmission Lubricant Change

Access the drain plug on the right-hand side of the vehicle through the skid plate.

1. Remove the fill plug (refer to "Transmission Lubricant Level Check").
2. Place a drain pan under the transmission drain plug.
3. Remove the drain plug and allow lubricant to drain completely.



4. Clean the drain plug magnetic surface.
5. Reinstall drain plug with a new O-ring and torque to specification.
6. Add the recommended amount of lubricant through the fill plug hole. Maintain the lubricant level at the bottom of the fill plug hole when filling the transmission. Do not overfill.

=
Recommended Transmission Lubricant: Full Synthetic AGL (PN 2873602) (Quart) **Capacity:** 43.6 oz. (1290 ml)

7. Reinstall fill plug with a new O-ring and torque to specification.

= T
Drain / Fill Plug Torque: **14 ft. lbs. (19 Nm)**

8. Check for leaks. Dispose of used lubricant properly.

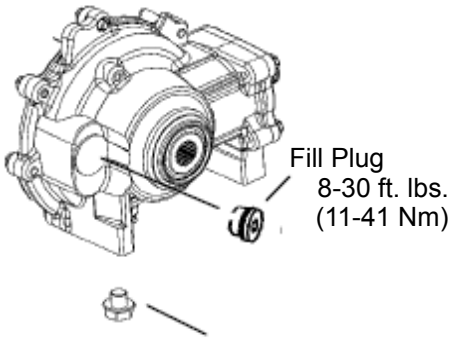
Front Gearcase Lubrication

The gearcase lubricant level should be checked and changed in accordance with the maintenance schedule.

- Be sure vehicle is level with parking brake on before proceeding.
- Check vent hose to be sure it is routed properly and unobstructed.
- The correct front gearcase lubricant to use is Polaris Premium Demand Fluid.

FRONT GEARCASE

Make sure vent is unobstructed



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Front Gearcase Specifications **Specified Lubricant:** Premium Demand Drive Fluid (PN 2871654) **Capacity:** 5.0 oz. (150 ml.)

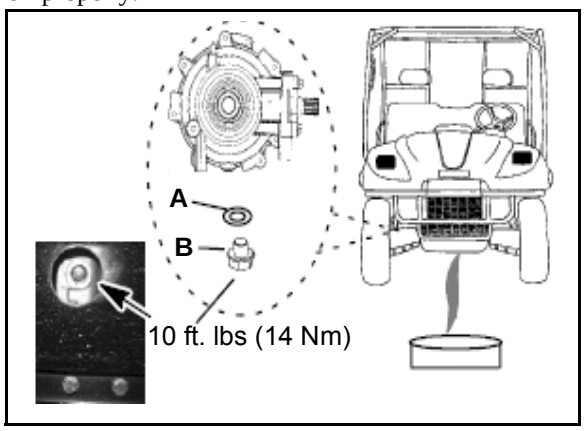
= T
Fill Plug Torque: 8-30 ft. lbs. (11-41 Nm) **Drain Plug Torque:** 10 ft. lbs. (14 Nm)

To check the lubricant level:

The front gearcase lubricant level cannot be checked with a dipstick. The gearcase must be drained and re-filled with the proper amount of lubricant or be filled to the bottom of the fill plug hole threads. Refer to procedures.

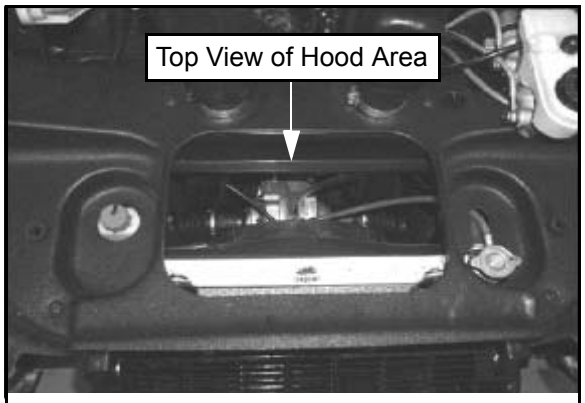
To change gearcase lubricant:

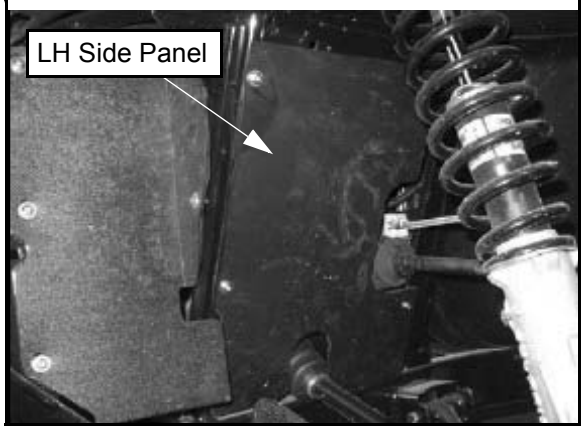
1. Remove gearcase drain plug (B) (11 mm) located on the bottom of the gearcase and drain oil. (The drain plug is accessible through the skid plate.) Catch and discard used oil properly.



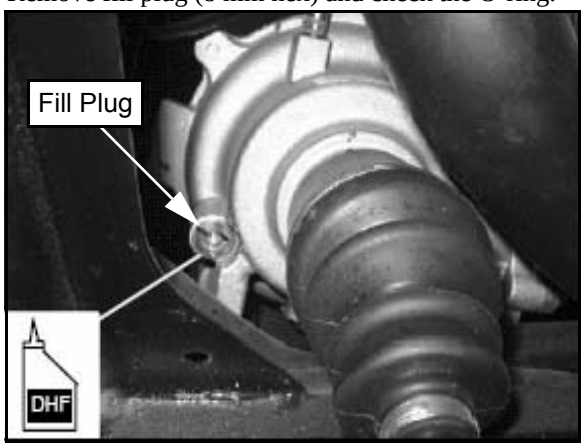
2. Clean and reinstall drain plug (B) using a new sealing washer (A). Torque to **10 ft. lbs. (14 Nm)**.

3. The fill plug can be accessed through the top hood area by removing the storage box or by removing the left side panel in the left wheel well.

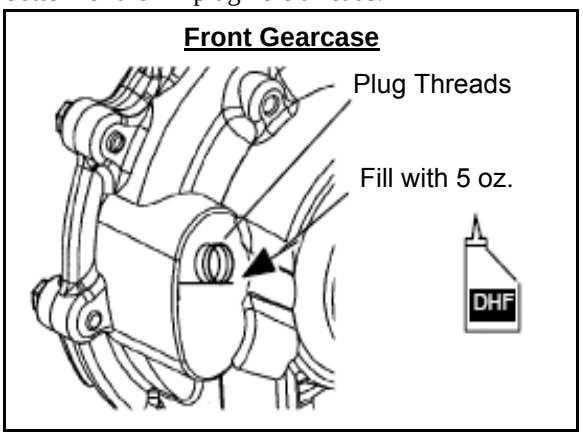




4. Remove fill plug (8 mm hex) and check the O-ring.



5. Fill with the recommended fluid amount (5 oz.) or to the bottom of the fill plug hole threads.



6. Install fill plug and check for leaks.

Middle Gearcase Lubrication (6x6)

Middle Gearcase Specifications (6x6)

Specified Lubricant:
ATV Angle Drive Fluid (PN 2871653)
Capacity: 6.75 oz. (200 ml.)

Drain Plug / Fill Plug Torque:
14 ft. lbs. (19.4 Nm)

The gearcase lubricant level should be checked and changed in accordance with the maintenance schedule.

- Be sure vehicle is level with parking brake on before proceeding.
- Check vent hose to be sure it is routed properly and unobstructed.

- The correct middle gearcase lubricant to use is ATV Angle Drive Fluid

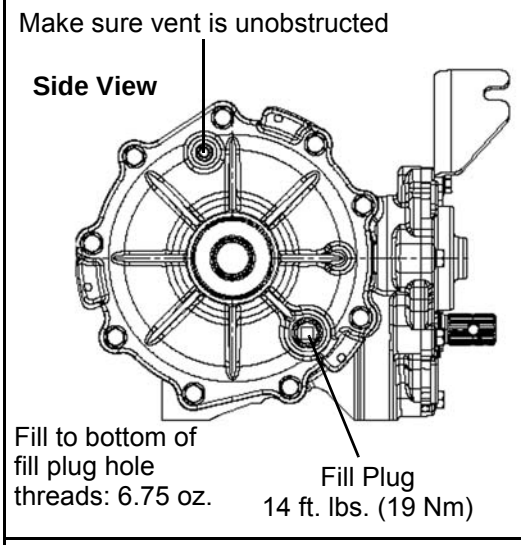
To check the lubricant level:

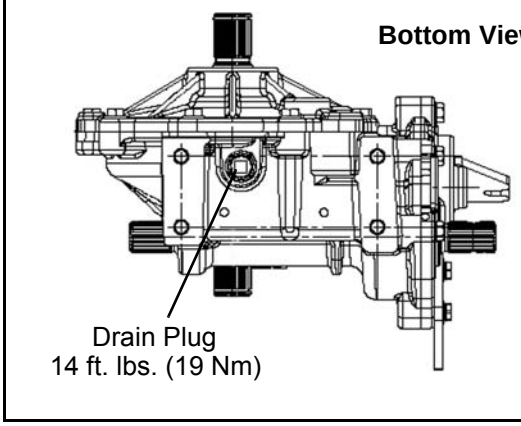
The gearcase must be drained and re-filled with the proper amount of lubricant. Refer to the procedure below.

To change middle gearcase lubricant:

1. With the *RANGER* on a level surface, remove the fill plug and check the lubricant level. Lubricant should be kept at the specified level, according to the proper gearcase specifications listed.
2. Support the vehicle securely with a jack stand and remove the front tire on the driver's side.
3. Remove gearcase drain plug located on the bottom of the gearcase and drain oil. (The drain plug is accessible through the skid plate.) Catch and discard used oil properly.
4. Clean and reinstall drain plug using a new sealing washer.
5. Remove the fill plug and add the recommended amount of lubricant.
6. Install fill plug. Check for leaks.

MIDDLE GEARCASE (6X6)





Rear Gearcase Lubrication (4x4 CREW)

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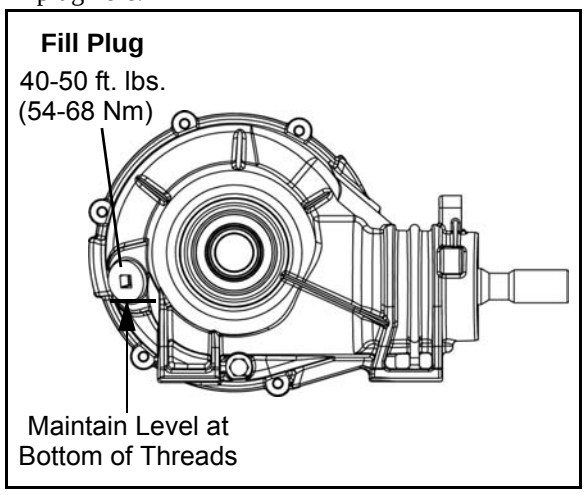
Rear Gearcase Specifications (4x4 CREW)

Specified Lubricant:
ATV Angle Drive Fluid (PN 2871653)

Capacity: 18 oz. (532 ml)

Lubricant Level Check:

The fill plug is located on the right side of the rear gearcase. Maintain the fluid level even with the bottom of the threads of the fill plug hole.



1. Position the vehicle on a level surface.
2. Remove the fill plug and check the fluid level. The lubricant level should be even with the bottom of the threads of the fill plug hole.
3. Add the recommended lubricant as needed.
4. Reinstall the fill plug and torque to **40-50 ft. lbs. (54-68 Nm)**

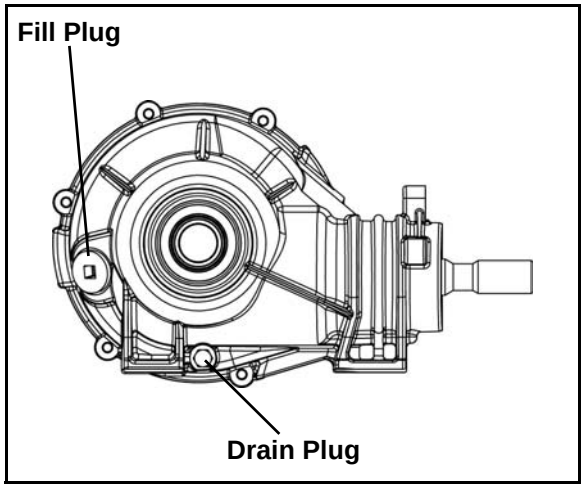
= T

Fill Plug Torque: 40-50 ft. lbs. (54-68 Nm)

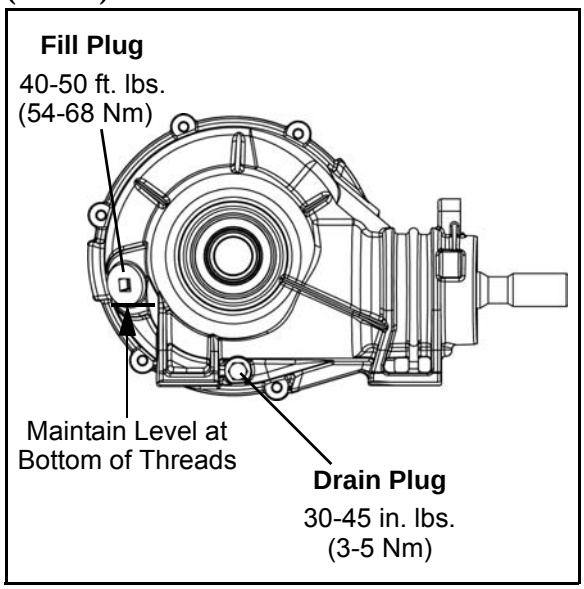
Drain Plug Torque: 30-45 in. lbs. (3-5 Nm)

Lubricant Change:

The drain plug is located on the bottom right side of the rear gearcase.



1. Remove the fill plug.
2. Place a drain pan under the drain plug.
3. Remove the drain plug and allow the lubricant to drain completely.
4. Clean the drain plug.
5. Reinstall the drain plug and torque to **30-45 in. lbs. (3-5 Nm)**.



6. Add the recommended lubricant. Maintain the fluid level even with the bottom threads of the fill plug hole.
7. Reinstall the fill plug and torque to **40-50 ft. lbs. (54-68 Nm)**.
8. Check for leaks. Discard used lubricant properly.

Rear Gearcase Lubrication (6x6)

Rear Gearcase Specifications (6x6)

Specified Lubricant:
ATV Angle Drive Fluid (PN 2871653)

Capacity: 10 oz. (300 ml)

The gearcase lubricant level should be checked and changed in accordance with the maintenance schedule.

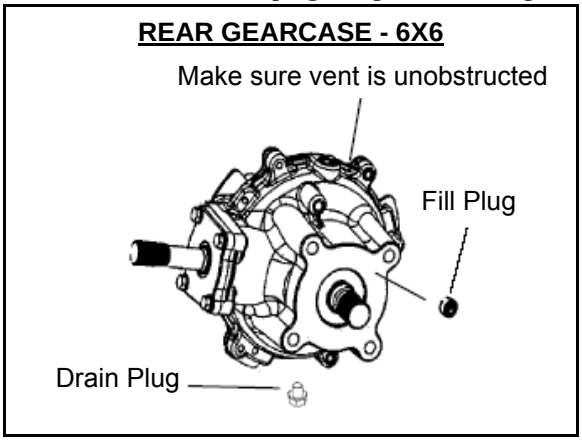
- Be sure vehicle is level before proceeding with parking brake on.
- Check vent hose to be sure it is routed properly and unobstructed.
- The correct rear gearcase lubricant to use is Polaris ATV Angle Drive Fluid

To check the lubricant level:

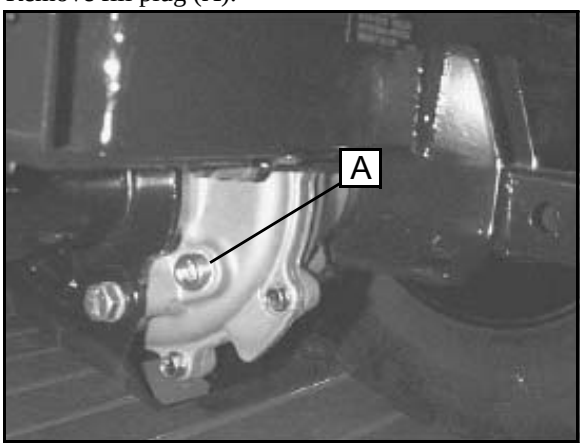
The gearcase must be drained and re-filled with the proper amount of lubricant. Refer to the procedure below.

To change rear gearcase lubricant:

1. With the vehicle on a level surface, remove the fill plug and check the lubricant level. Lubricant should be kept at the specified level, according to the proper gearcase specifications listed.
2. Support the vehicle securely with a jack stand and remove the front tire on the driver's side.
3. Remove gearcase drain plug located on the bottom of the gearcase and drain oil. (The drain plug is accessible through the skid plate.) Catch and discard used oil properly.
4. Clean and reinstall drain plug using a new sealing washer.



5. Remove fill plug (A).



6. Fill with 10 oz. (300 ml.) or fill to the bottom of the threads of the fill plug hole.

7. Install fill plug and torque to **14 ft. lbs (19 Nm)**. Check for leaks.

= T
Drain Plug / Fill Plug Torque: 14 ft. lbs. (19.4 Nm)

COOLING SYSTEM

Liquid Cooling System Overview

The engine coolant level is controlled or maintained by the recovery system. The recovery system components are the recovery bottle, radiator filler neck, radiator pressure cap and connecting hose.

As coolant operating temperature increases, the expanding (heated) excess coolant is forced out of the radiator past the pressure cap and into the recovery bottle. As engine coolant temperature decreases the contracting (cooled) coolant is drawn back up from the tank past the pressure cap and into the radiator.

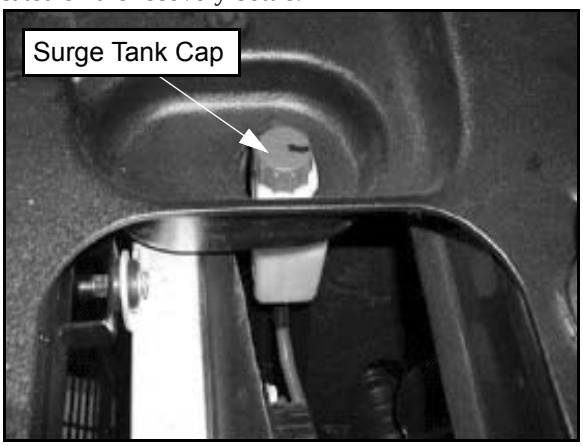
NOTE: Some coolant level drop on new machines is normal as the system is purging itself of trapped air. Observe coolant levels often during the break-in period.

Overheating of engine could occur if air is not fully purged from system.

Polaris Premium 60/40 is already premixed and ready to use. Do not dilute with water.

Coolant Level Inspection

The recovery bottle, located on the left side of the machine, must be maintained between the minimum and maximum levels indicated on the recovery bottle.

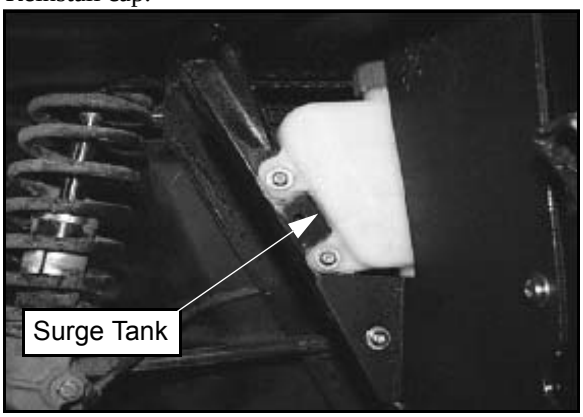


With the engine at operating temperature, the coolant level should be between the upper and lower marks on the coolant reservoir. If not:

1. Remove reservoir cap. Inner splash cap vent hole must be clear and open.

2. Fill reservoir to upper mark with Polaris Premium 60/40 Anti Freeze / Coolant or 50/50 or 60/40 mixture of antifreeze and distilled water as required for freeze protection in your area.

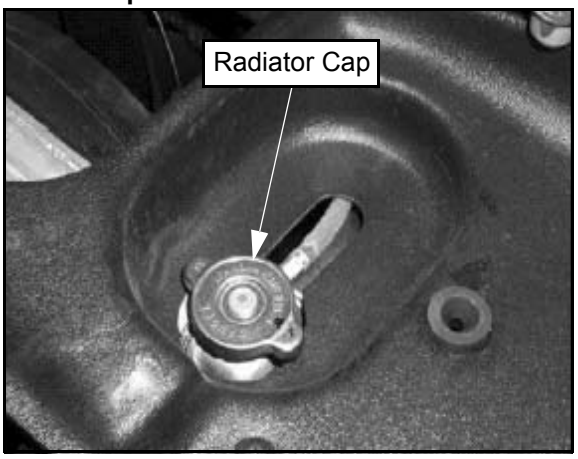
3. Reinstall cap.



NOTE: If overheating is evident, allow system to cool completely and check coolant level in the radiator and inspect for signs of trapped air in system.

Radiator Coolant Level Inspection

NOTE: This procedure is only required if the cooling system has been drained for maintenance and/or repair. However, if the recovery bottle has run dry, or if overheating is evident, the level in the radiator should be inspected and coolant added if necessary.



⚠ WARNING

Never remove the pressure cap when the engine is warm or hot. Escaping steam can cause severe burns. The engine must be cool before removing the pressure cap.

NOTE: Use of a non-standard pressure cap will not allow the recovery system to function properly.

To access the radiator pressure cap raise the front hood. The radiator cap is located on the drivers side.

Coolant Strength / Type

Test the strength of the coolant using an antifreeze hydrometer.

Antifreeze Hydrometer

- A 50/50 or 60/40 mixture of antifreeze and distilled water will provide the optimum cooling, corrosion protection, and antifreeze protection.
- Do not use tap water, straight antifreeze, or straight water in the system. Tap water contains minerals and impurities which build up in the system.
- Straight water or antifreeze may cause the system to freeze, corrode, or overheat.

Polaris 60/40 Anti-Freeze / Coolant

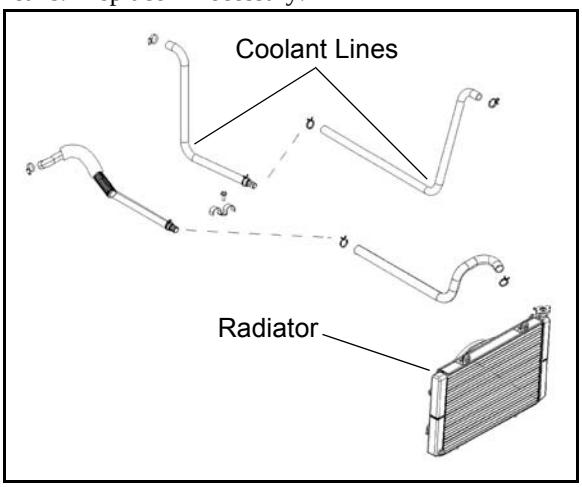
(PN 2871323)

Cooling System Pressure Test

Refer to Chapter 3 for cooling system pressure test procedure.

Cooling System Hoses

1. Inspect all hoses for cracks, deterioration, abrasion or leaks. Replace if necessary.



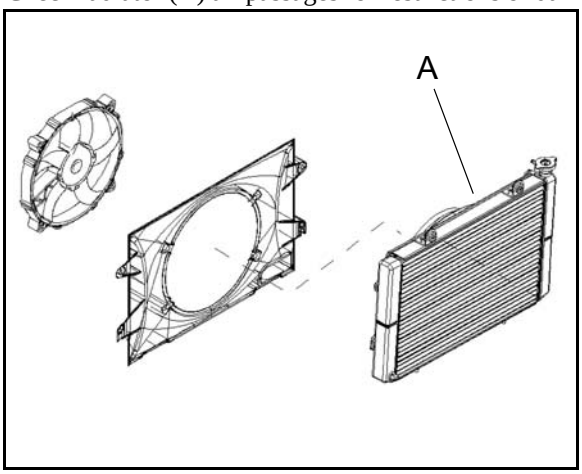
2. Check tightness of all hose clamps.

⚠ CAUTION

Do not over-tighten hose clamps at radiator, or radiator fitting may distort, causing a restriction to coolant flow. Radiator hose clamp torque is 36 in. lbs. (4 Nm).

Radiator

1. Check radiator (A) air passages for restrictions or damage.

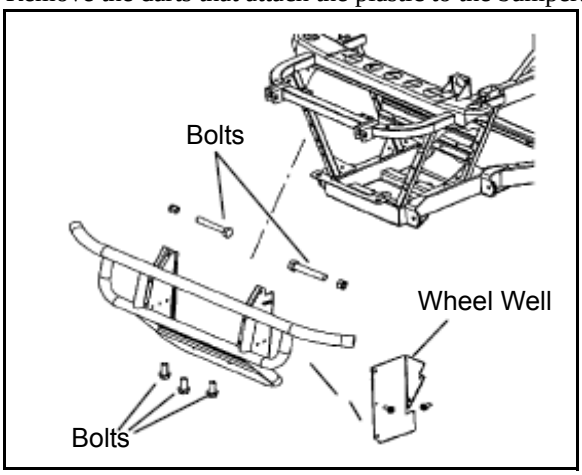


2. Carefully straighten any bent radiator fins.

3. Remove any obstructions with compressed air or low pressure water.

Coolant Drain / Radiator Removal

1. Remove the front bumper. Remove three bolts that secure the bumper to the bottom of the frame. Remove six screws (both sides) that secure the wheel well panel to the frame. Remove two bolts that secure the top bumper to the frame. Remove the darts that attach the plastic to the bumper.



2. Remove two mounting screws that secure the top of the radiator to the frame. Remove the radiator cap. Pull the radiator out of the frame at an angle.

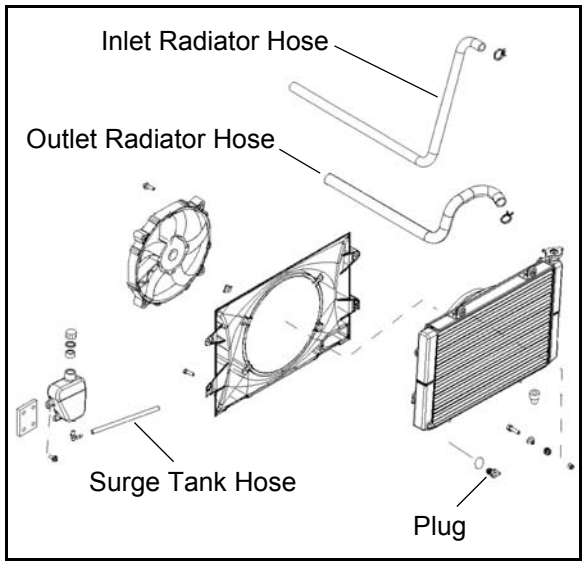
NOTE: If you have trouble reaching the top radiator bolts, remove four screws from the top front of the hood liner. Prop the front of the hood up 1.5 inches (38.10 mm) to help remove the top bolts that secure the radiator to the frame.

3. Remove the drain plug and drain the coolant from the radiator. Drain the coolant into a suitable container and properly dispose of the coolant.

4. Remove the outlet radiator hose, inlet radiator hose, surge tank hose, and overflow hose from the radiator.

5. Disconnect the fan motor harness and remove the radiator from the vehicle. Take care not to damage the cooling fins.

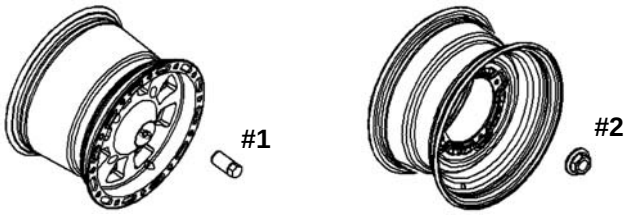
6. Remove the radiator.



FINAL DRIVE / WHEEL AND TIRE

Wheel and Hub Torque Table

Item	Nut Type	Specification
Aluminum Wheels (Cast)	Lug Nut (1)	90 ft. lbs. (122 Nm)
Steel Wheels (Black / Camo)	Flange Nut (2)	35 ft. lbs. (47 Nm)
Front Hub Nut	-	60 ft. lbs. (81 Nm)
Rear & Center Hub Retaining Nut	-	110 ft. lbs. (150 Nm)

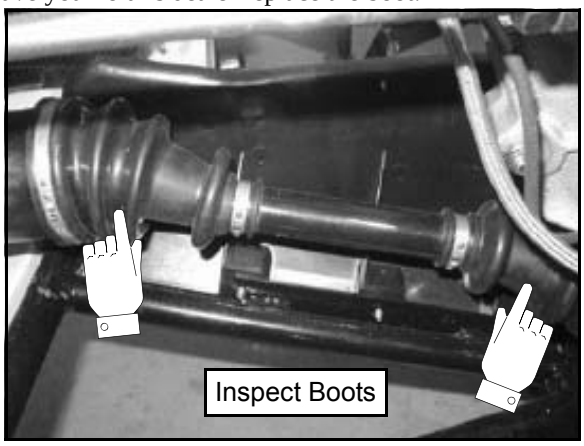


Aluminum Wheel
(LE Models)
90 ft. lbs. (122 Nm)

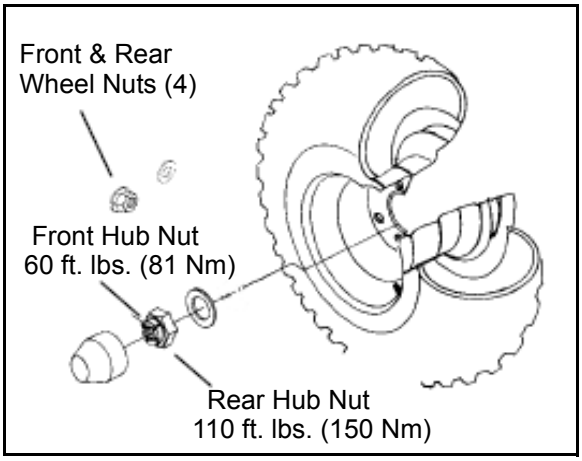
Steel Wheel
(Standard Models)
35 ft. lbs. (47 Nm)

CV Shaft Boot Inspection

Inspect the CV shaft boots for damage, tears, wear, or leaking grease. If the rubber boot exhibits any of these symptoms, replace the boot. Refer to Chapter 7 for CV boot replacement, or have you Polaris dealer replace the boot.



Wheel Removal



1. Stop the engine, place the transmission in gear and lock the parking brake.
2. Loosen the wheel nuts slightly.
3. Elevate the side of the vehicle by placing a suitable stand under the footrest frame.
4. Remove the wheel nuts and washers and remove the wheel.

Wheel Installation

1. With the transmission in gear and the parking brake locked, place the wheel in the correct position on the wheel hub. Be sure the valve stem is toward the outside and rotation arrows on the tire point toward forward rotation.
2. Attach the washers (if applicable) and wheel nuts and finger tighten them.
3. Lower the vehicle to the ground.
4. Securely tighten the wheel nuts to the proper torque listed in the torque table at the beginning of this section.

⚠ CAUTION

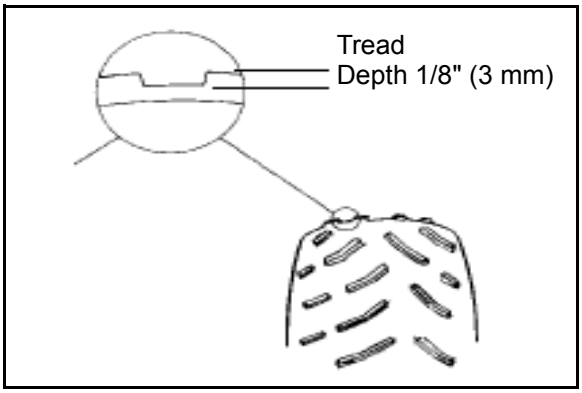
If wheels are improperly installed it could affect vehicle handling and tire wear. On vehicles with tapered rear wheel nuts, make sure tapered end of nut goes into taper on wheel.

Tire Inspection

- Improper tire inflation may affect vehicle maneuverability.
- When replacing a tire always use original equipment size and type.
- The use of non-standard size or type tires may affect vehicle handling.

Tire Tread Depth

Always replace tires when tread depth is worn to 1/8" (3 mm) or less.



⚠ WARNING

Operating a *RANGER* with worn tires will increase the possibility of the vehicle skidding easily with possible loss of control.

Worn tires can cause an accident.

Always replace tires when the tread depth measures 1/8", (.3 cm) or less.

Tire Pressure

⚠ CAUTION

Maintain proper tire pressure.
Refer to the warning tire pressure decal applied to the vehicle.

Tire Pressure Inspection (PSI - Cold)	
Model	**Front / Rear**
6x6	8-12 psi / 8-12 psi
4x4 CREW	12 psi / 16 psi

ELECTRICAL AND IGNITION SYSTEM

Battery Maintenance

Keep battery terminals and connections free of corrosion. If cleaning is necessary, remove the corrosion with a stiff wire brush. Wash with a solution of one tablespoon baking soda and one cup water. Rinse well with tap water and dry off with clean shop towels. Coat the terminals with dielectric grease or petroleum jelly.

Be careful not to allow cleaning solution or tap water into the battery

⚠ WARNING

Battery electrolyte is poisonous. It contains sulfuric acid. Serious burns can result from contact with skin, eyes or clothing. Antidote:

External: Flush with water.

Internal: Drink large quantities of water or milk. Follow with milk of magnesia, beaten egg, or vegetable oil. Call physician immediately.

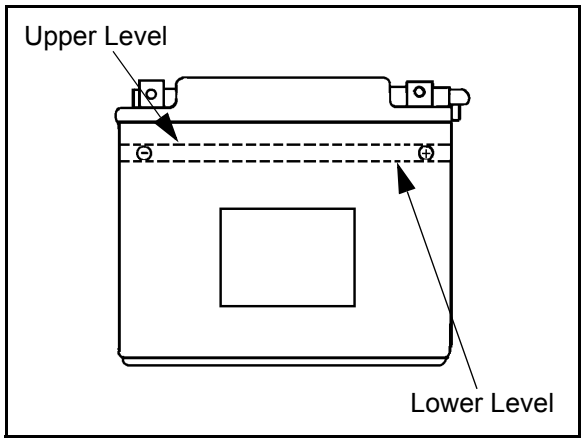
Eyes: Flush with water for 15 minutes and get prompt medical attention.

Batteries produce explosive gases.
Keep sparks, flame, cigarettes, etc. away.
Ventilate when charging or using in an enclosed space. Always shield eyes when working near batteries.
KEEP OUT OF REACH OF CHILDREN.

NOTE: Batteries must be fully charged before use or battery life will be reduced by 10-30% of full potential. Charge battery for 3-5 hours at a current equivalent of 1/10 of the battery's rated amp/hour capacity. Do not use the alternator to charge a new battery.

Battery Fluid Level (Conventional Battery)

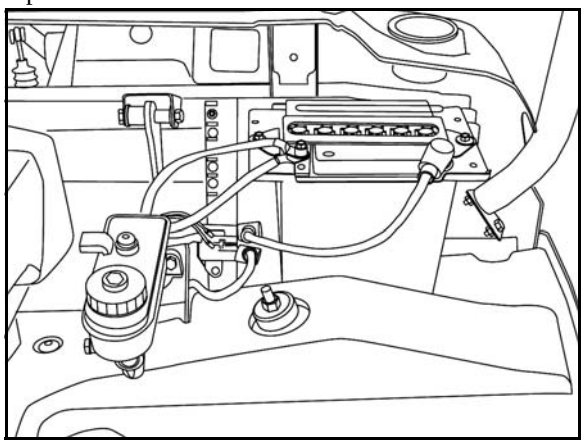
A poorly maintained battery will deteriorate rapidly. Check the battery fluid level often. Maintain the fluid level between the upper and lower level marks.



Add only distilled water. Tap water contains minerals that are harmful to a battery.

Battery Removal

1. Open the Hood.



2. Remove the battery vent tube from the battery.
3. Disconnect the black (negative) battery cable.
4. Disconnect the red (positive) battery cable.
5. Lift the battery out of the vehicle, being careful not to tip it sideways and spill any electrolyte.

> **⚠ CAUTION**
>
> To reduce the chance of sparks: Whenever removing the battery, disconnect the negative (black) cable first. When reinstalling the battery, install the negative cable last.

Battery Installation

Using a new battery that has not been fully charged can damage the battery and result in a shorter life. It can also hinder vehicle performance. Follow the battery charging procedure before installing the battery.

1. Ensure that the battery is fully charged.
2. Place the battery in the battery holder.
3. Install the battery vent tube.

NOTE: The vent tube must be free of obstructions and securely installed. Route the tube away from the frame and vehicle body to prevent contact with electrolyte.

4. Coat the terminals with dielectric grease or petroleum jelly.
5. Connect and tighten the red (positive) cable first.
6. Connect and tighten the black (negative) cable last.
7. Verify that cables are properly routed.

Battery Storage

Whenever the vehicle is not used for a period of three months or more, remove the battery from the vehicle, ensure that it's fully charged, and store it out of the sun in a cool, dry place. Check battery voltage each month during storage and recharge as needed to maintain a full charge.

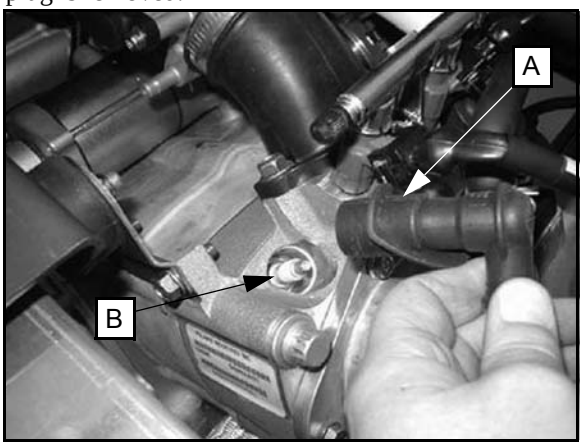
NOTE: Battery charge can be maintained by using a Polaris battery tender charger or by charging about once a month to make up for normal self-discharge. Battery tenders can be left connected during the storage period, and will automatically charge the battery if the voltage drops below a pre-determined point.

Battery Charging

1. Remove the battery from the vehicle to prevent damage from leaking or spilled electrolyte during charging.
2. Charge the battery with a charging output no larger than 1/10 of the battery's amp/hr rating. Charge as needed to raise the specific gravity to 1.270 or greater.
3. Reinstall the battery.

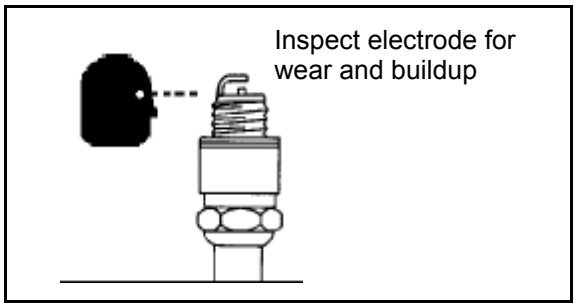
Spark Plug Service

1. Remove both spark plug high tension leads (A). Clean plug area so no dirt and debris can fall into engine when plug is removed.



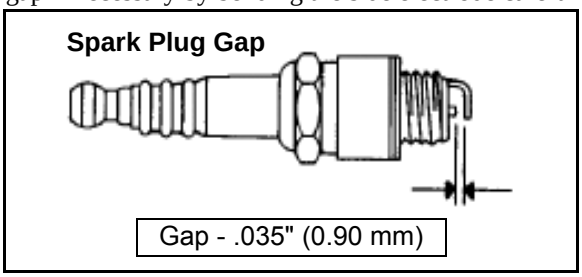
2. Remove spark plugs (B).

3. Inspect electrodes for wear and carbon buildup. Look for a sharp outer edge with no rounding or erosion of the electrodes.



4. Clean with electrical contact cleaner or a glass bead spark plug cleaner only. **CAUTION:** A wire brush or coated abrasive should not be used.

5. Measure gap with a wire gauge. Refer to specifications in picture below for proper spark plug type and gap. Adjust gap if necessary by bending the side electrode carefully.



6. If necessary, replace spark plug with proper type. **CAUTION:** Severe engine damage may occur if the incorrect spark plug is used.

7. Apply a small amount of anti-seize compound to the spark plug threads.

8. Install spark plug and torque to specification.

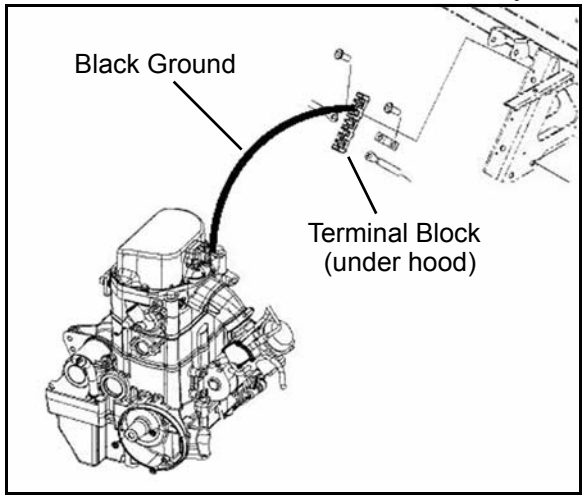
Recommended Spark Plug:
Champion RC7YC3

= T

Spark Plug Torque:
18 ft. lbs. (24 Nm)

Engine To Frame Ground

Inspect engine ground cable connection. Be sure it is clean and tight. The ground cable runs from the engine to the terminal block located under the front hood next to the battery.



STEERING AND SUSPENSION

Steering

The steering components should be checked periodically for loose fasteners, worn tie rod ends, and damage. Also check to make sure all cotter pins are in place. If cotter pins are removed, they must not be re-used. Always use new cotter pins.

Replace any worn or damaged steering components. Steering should move freely through entire range of travel without binding. Check routing of all cables, hoses, and wiring to be sure the steering mechanism is not restricted or limited.

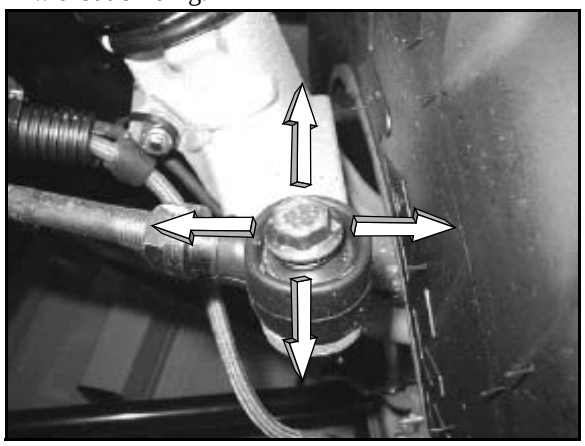
NOTE: Whenever steering components are replaced, check front end alignment.

⚠ WARNING

Due to the critical nature of the procedures outlined in this chapter, Polaris recommends steering component repair and adjustment be performed by an authorized Polaris MSD-certified technician when replacing worn or damaged steering parts.
Use only genuine Polaris replacement parts.

Tie Rod End / Steering Inspection

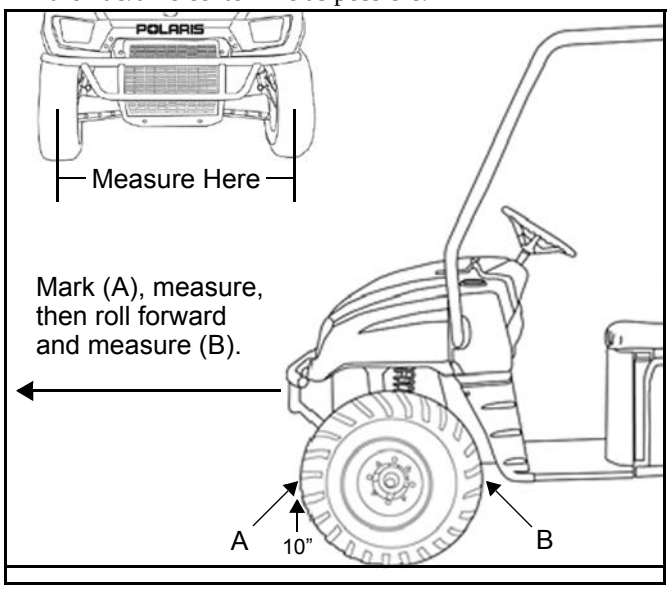
- To check for play in the tie rod end, grasp the steering tie rod, pull in all directions feeling for movement.
- Replace any worn steering components. Steering should move freely through entire range of travel without binding.



- Elevate front end of machine so front wheels are off the ground. Check for any looseness in front hub / wheel assembly by grasping the tire firmly at top and bottom first, and then at front and rear. Try to move the wheel and hub by pushing inward and pulling outward.
- If abnormal movement is detected, inspect the hub and wheel assembly to determine the cause (loose wheel nuts or loose front hub nut).
- Refer to the Final Drive chapter for more information.

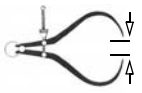
Wheel Toe Alignment Inspection

1. Place machine on a smooth level surface and set steering wheel in a straight ahead position. Secure the steering wheel in this position.
2. Place a chalk mark on the center line of the front tires approximately 10” (25.4 cm) from the floor or as close to the hub/axle center line as possible.



NOTE: It is important the height of both marks be equally positioned to get an accurate measurement.

3. Measure the distance between the marks and record the measurement. Call this measurement “A”.
4. Rotate the tires 180° by moving the vehicle forward. Position chalk marks facing rearward, even with the hub/axle center line.
5. Again measure the distance between the marks and record. Call this measurement “B”. Subtract measurement “B” from measurement “A”. The difference between measurements “A” and “B” is the vehicle toe alignment. The recommended vehicle toe tolerance is 1/8”, to 1/4”, (.3 to .6 cm) toe out. This means the measurement at the front of the tire (A) is 1/8”, to 1/4”, (.3 to .6 cm) wider than the measurement at the rear (B).

 **= In. / mm.**

Wheel Toe-Out: **(A) - (B) = 1/8 - 1/4" (.3 to .6 cm)**

Toe Adjustment

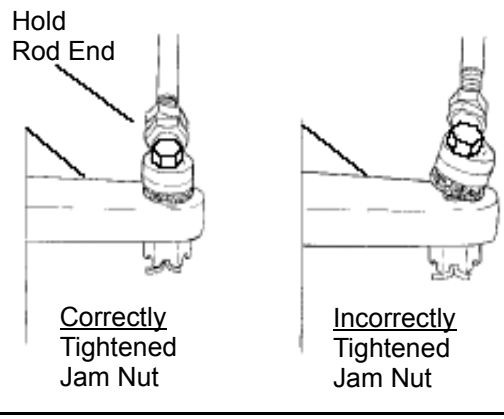
If toe alignment is incorrect, measure the distance between vehicle center and each wheel. This will tell you which tie rod needs adjusting.

NOTE: Be sure steering wheel is straight ahead before determining which tie rod(s) need adjustment.

> **⚠ CAUTION**
>
> During tie rod adjustment, it is very important that the following precautions be taken when tightening tie rod end jam nuts.
> If the rod end is positioned incorrectly it will not pivot, and may break.

To adjust toe alignment:

- Hold tie rod end to keep it from rotating.
- Loosen jam nuts at both end of the tie rod.
- Shorten or lengthen the tie rod until alignment is as required to achieve the proper toe setting as specified in "Wheel Toe Alignment".
- **IMPORTANT:** When tightening the tie rod end jam nuts, the rod ends must be held parallel to prevent rod end damage and premature wear. Damage may not be immediately apparent if done incorrectly.

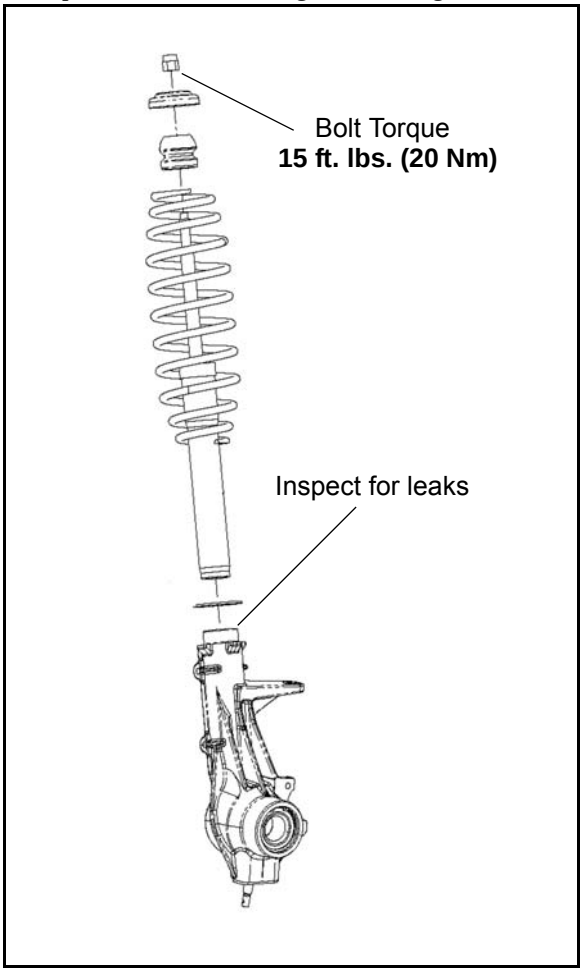


- After alignment is complete, torque jam nuts to **12-14 ft. lbs. (16-19 Nm)**.

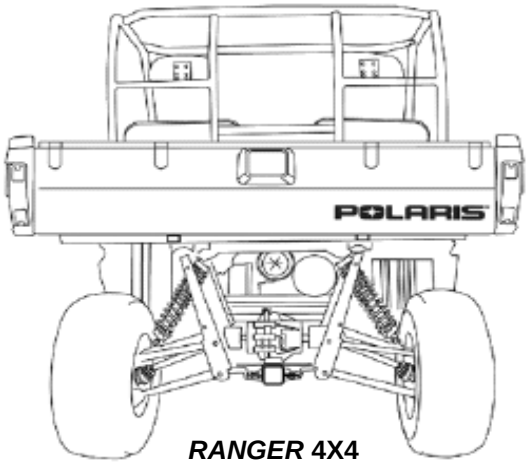
> **= T**
>
> **Tie Rod Jam Nut Torque:**
> 12-14 ft. lbs. (16-19 Nm)

Front Suspension

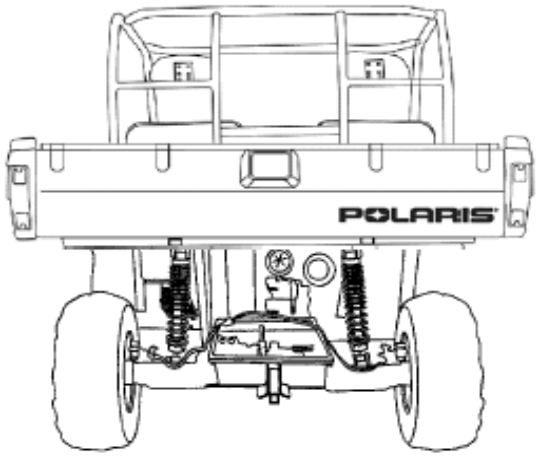
- Compress and release front suspension. Damping should be smooth throughout the range of travel.
- Check all front suspension components and fasteners for wear or damage.
- Inspect front strut cartridges for leakage.



Rear Suspension



***RANGER* 4X4**
Independent Rear Suspension



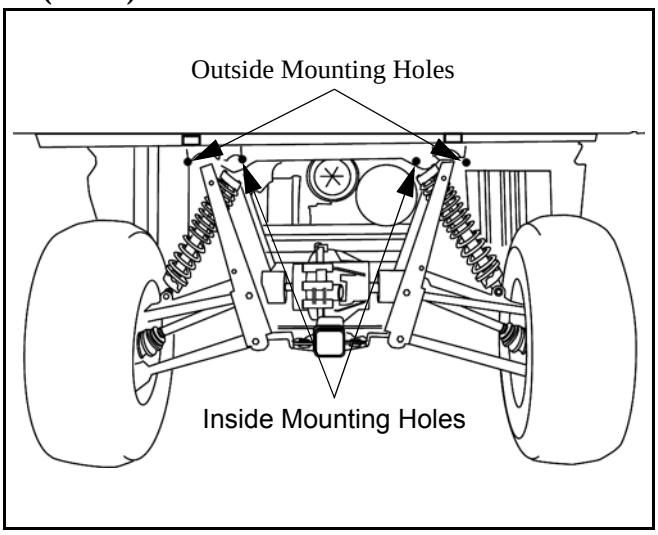
***RANGER* 6X6**
Rear Swingarm Suspension

- Compress and release rear suspension. Damping should be smooth throughout the range of travel.
- Check all rear suspension components for wear or damage.
- Inspect shock for leakage.

Rear Suspension Adjustment (4x4 CREW)

The rear suspension may be adjusted to provide a stiffer suspension if necessary.

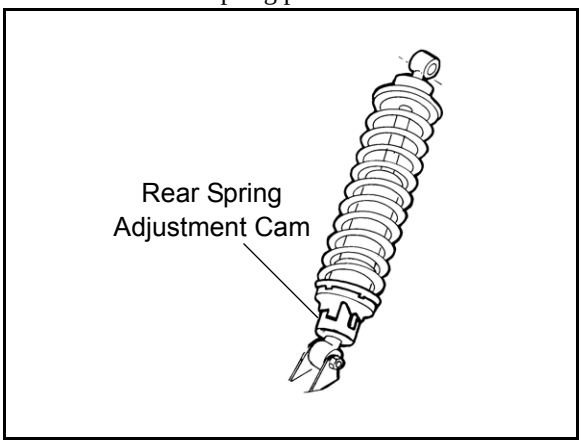
1. Remove the top shock mounting bolts from the inside mounting holes.
2. Reposition the shocks to the outside mounting holes.
3. Reinstall the shock mounting bolts. Torque to **30 ft. lbs. (40 Nm).**



Rear Spring Adjustment

The rear shock absorber springs are adjusted by rotating the adjustment cam either clockwise or counterclockwise to increase or decrease spring tension.

To adjust the suspension, use the adjustment cam located near the bottom of the rear shock. This will allow you to increase or decrease the amount of spring preload.



Shock Spanner Wrench

(PN 2870872)

BRAKE SYSTEM

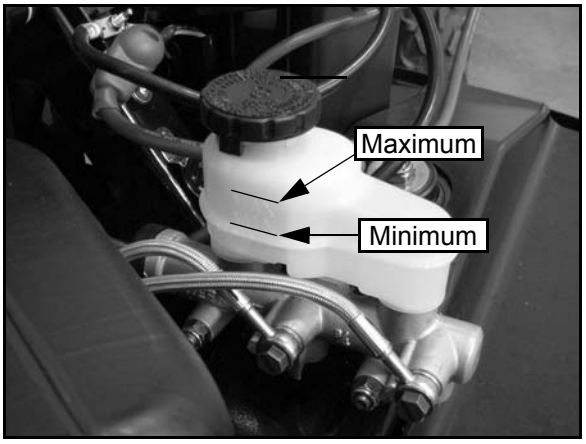
Brake Fluid Inspection

Always check the brake pedal travel and inspect the brake fluid reservoir level before each operation. If the fluid level is low, add DOT 4 brake fluid only.

Brake fluid should be changed every two years. The fluid should also be changed anytime the fluid becomes contaminated, the fluid level is below the minimum level, or if the type and brand of the fluid in the reservoir is unknown.

The brake fluid master cylinder reservoir can be accessed by lifting up the front hood.

1. Position the vehicle on a level surface.
2. Place the transmission in Neutral (N) and set the parking brake.
3. View the brake fluid level in the reservoir. The level should be between the MAX and MIN level lines.
4. If the fluid level is lower than the MIN level line, add brake fluid until it reaches the MAX level line.
5. Install the reservoir cap and apply the brake pedal forcefully for a few seconds and check for fluid leakage around the master cylinder fittings and the brake caliper fittings.

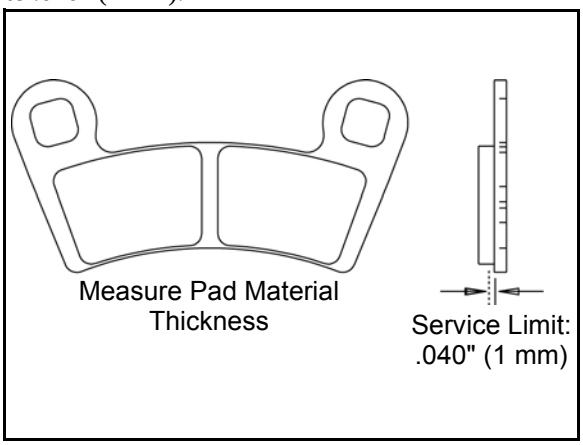


Brake Hose and Fitting Inspection

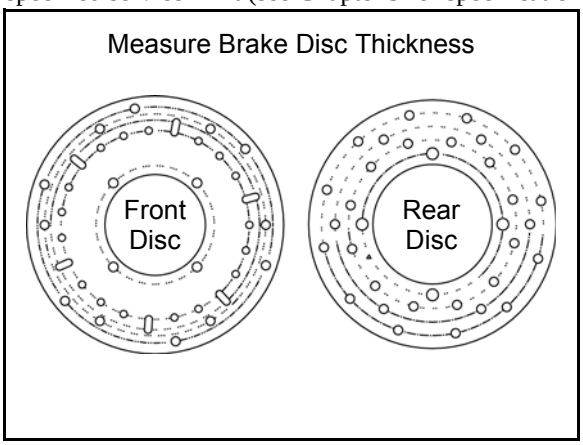
Check brake system hoses and fittings for cracks, deterioration, abrasion, and leaks. Tighten any loose fittings and replace any worn or damaged parts.

Brake Pad / Disc Inspection

1. Check the brake pads for wear, damage, or looseness.
2. Inspect the brake pad wear surface for excessive wear.
3. Pads should be changed when the friction material is worn to .040” (1 mm).



4. Check surface condition of the brake discs.
5. Measure the thickness of the front and rear brake discs.
6. The disc(s) should be replaced if thickness is less than the specified service limit (see Chapter 9 for specifications).



Parking Brake Cable Adjustment

When the parking brake is fully engaged and the parking brake indicator is illuminated, engine speed is limited to 1300 RPM in all gears, including neutral. If throttle is applied, this limiting feature prevents operation, which protects the parking brake pads from excessive wear.

NOTE: Inspect the parking brake cable tension after the first 25 hours of operation and every 100 hours of operation afterwards to ensure proper cable tension.

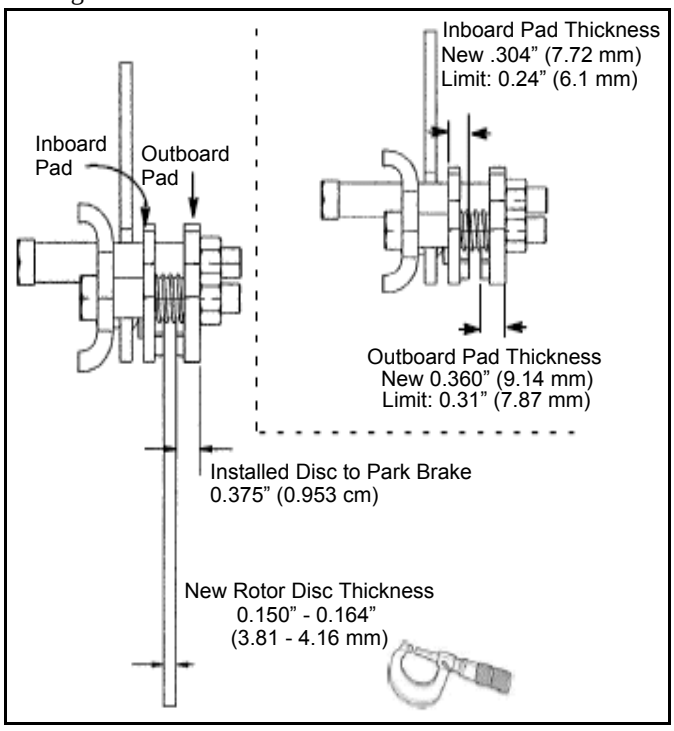
Loss of tension in the parking brake cable will cause illumination of the parking brake light and activation of the limiting feature. If this occurs, inspect and adjust parking brake cable tension. If performing this service is difficult due to conditions or location, open the hood and temporarily disconnect the parking brake connector. Reconnect the connector as soon as practicable and adjust the parking brake cable to proper tension.

1. Pull back on the parking brake lever (located in the dash).
2. After 2 to 3 clicks the "(P)" brake light should illuminate on the instrument cluster and the wheels of the vehicle should not rotate when turning by hand. After 8 full clicks of lever travel, the vehicle should not roll while parked.
3. If the vehicle moves, adjustment is necessary.
4. Adjust the parking brake cable where the cable attaches to the caliper mount bracket located on the rear gearcase.

Adjustment Procedure: Refer to "Chapter 9 - Brakes" for complete adjustment procedure.

Parking Brake Pad Inspection

Measure the thickness of the rear caliper parking brake pads. Replace assembly as needed. See illustration below for proper readings.



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ENGINE

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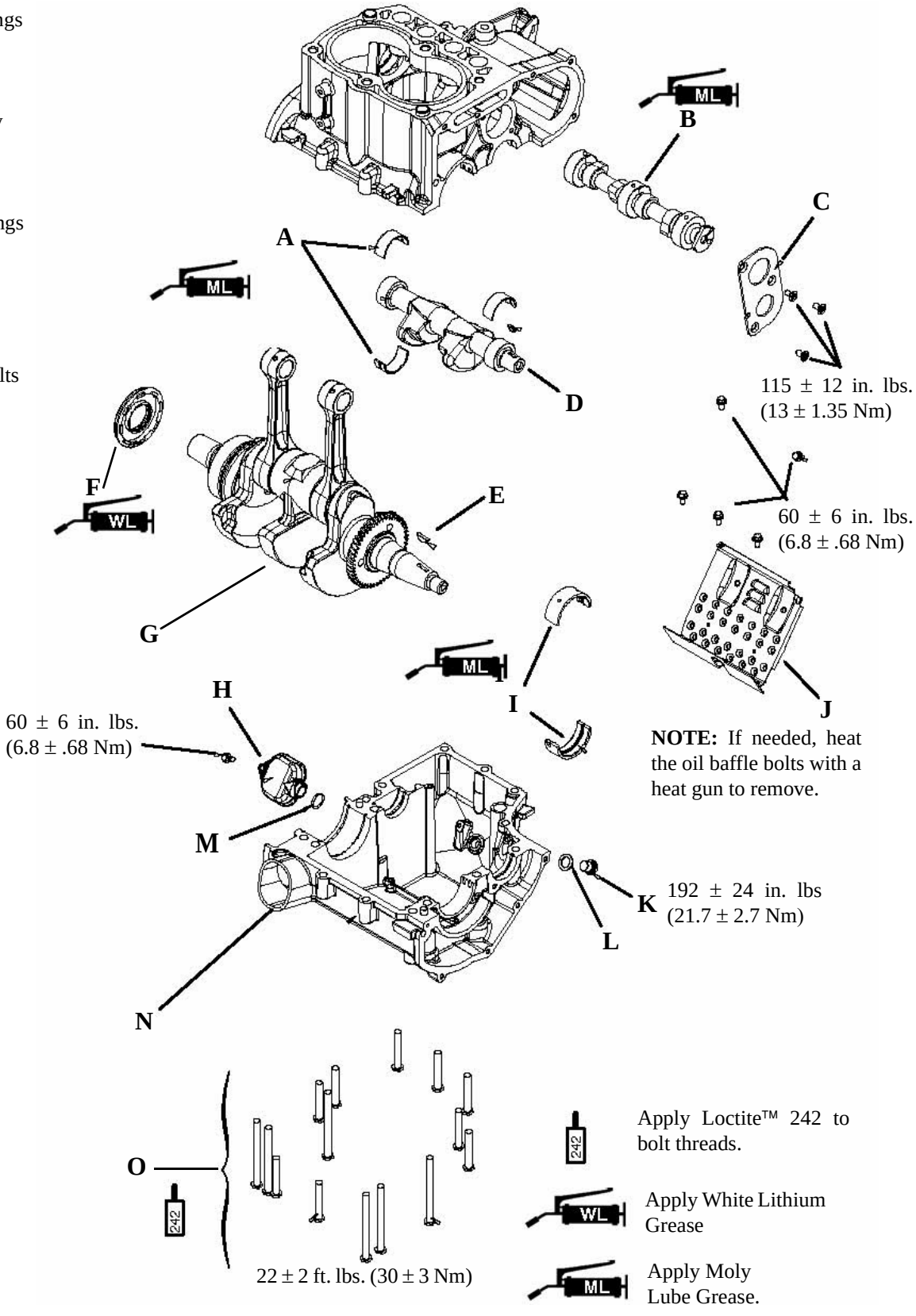
ENGINE SPECIFICATIONS

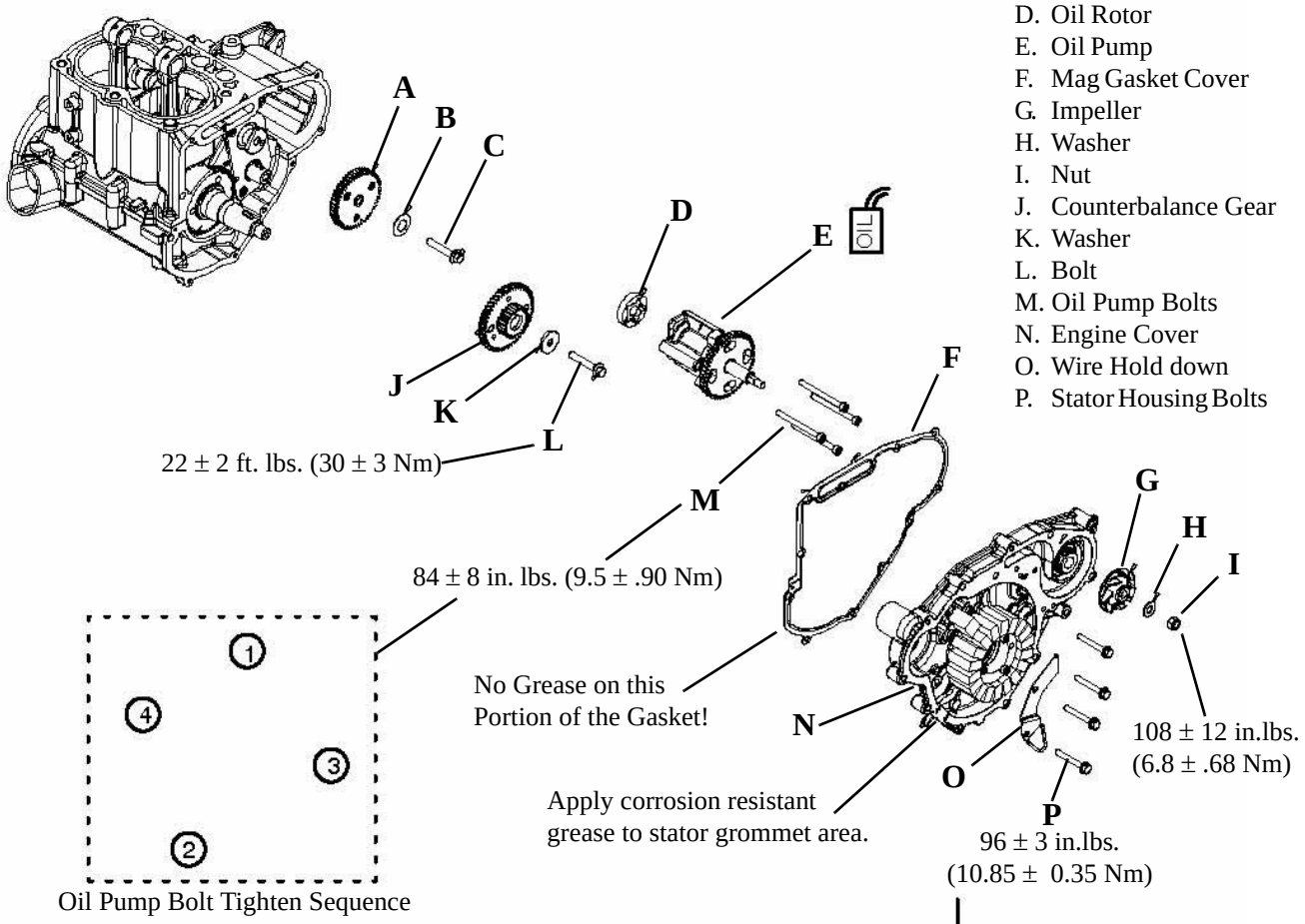
Crankcase Exploded Views

A. Journal Bearings
B. Camshaft
C. Thrust Plate
D. Balance Shaft
E. Woodruff Key
F. Flange Seal
G. Crankshaft
H. Oil Pickup
I. Journal Bearings
J. Baffle
K. Oil Plug
L. Washer
M. O-ring
N. Crankcase
O. Crankcase Bolts

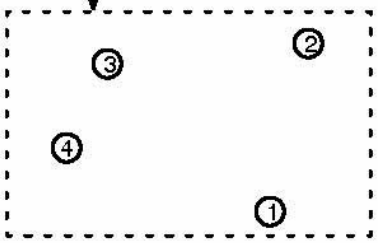


Oil Pump / Water Pump / Engine Cover Exploded View

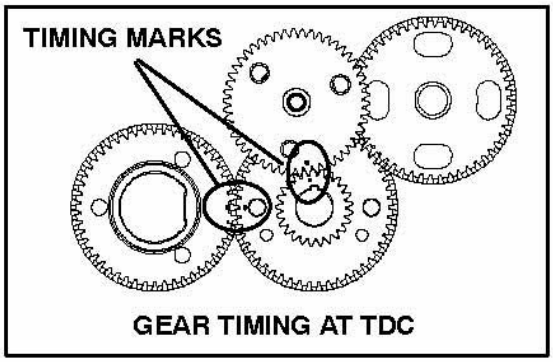
A. Split Gear
B. Washer
C. Bolt
D. Oil Rotor
E. Oil Pump
F. Mag Gasket Cover
G. Impeller
H. Washer
I. Nut
J. Counterbalance Gear
K. Washer
L. Bolt
M. Oil Pump Bolts
N. Engine Cover
O. Wire Hold down
P. Stator Housing Bolts



Oil Pump Bolt Tighten Sequence



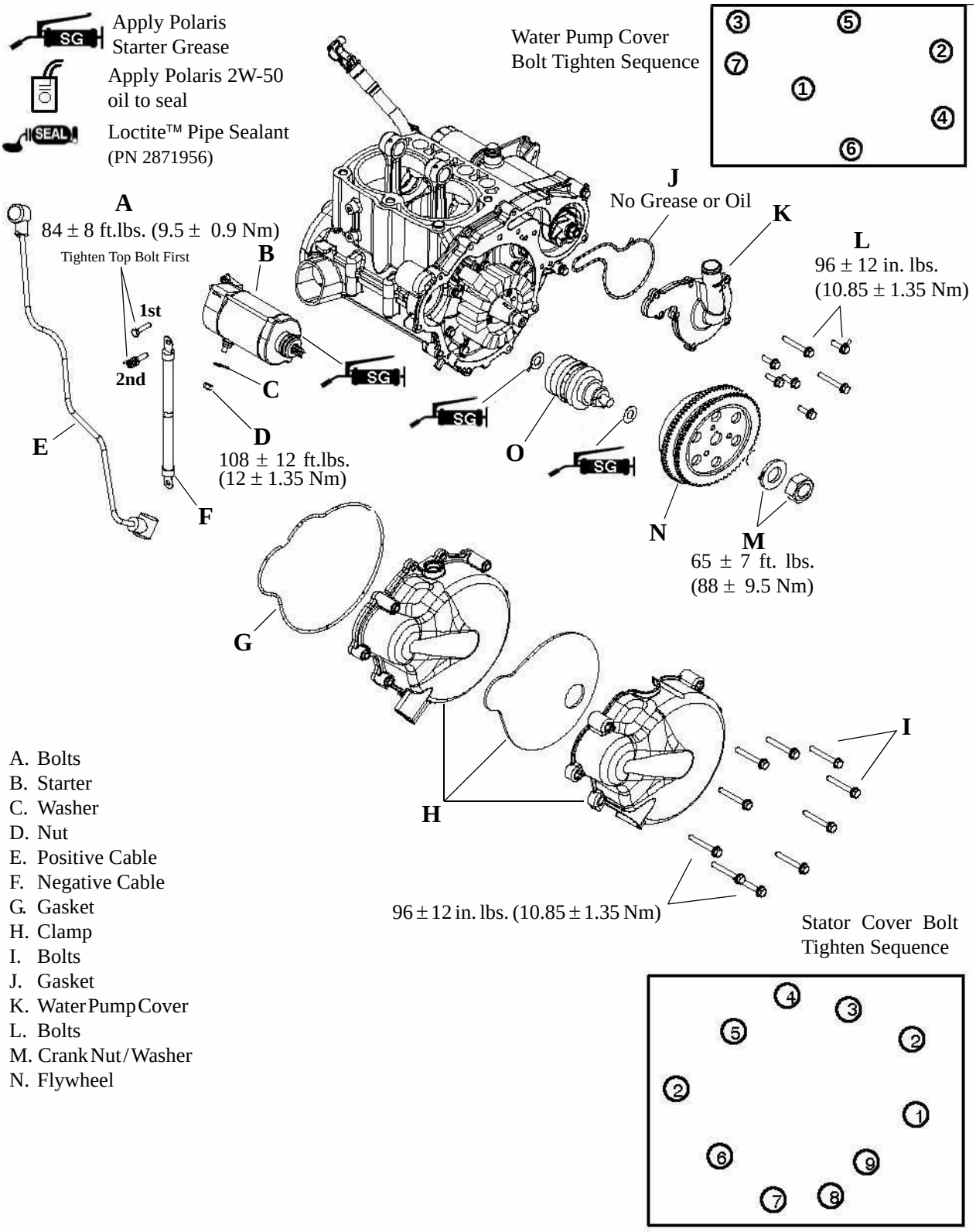
Mag Cover Bolt Tighten Sequence



OIL Apply Polaris 2W-50 oil to component

WL Apply White Lithium Grease

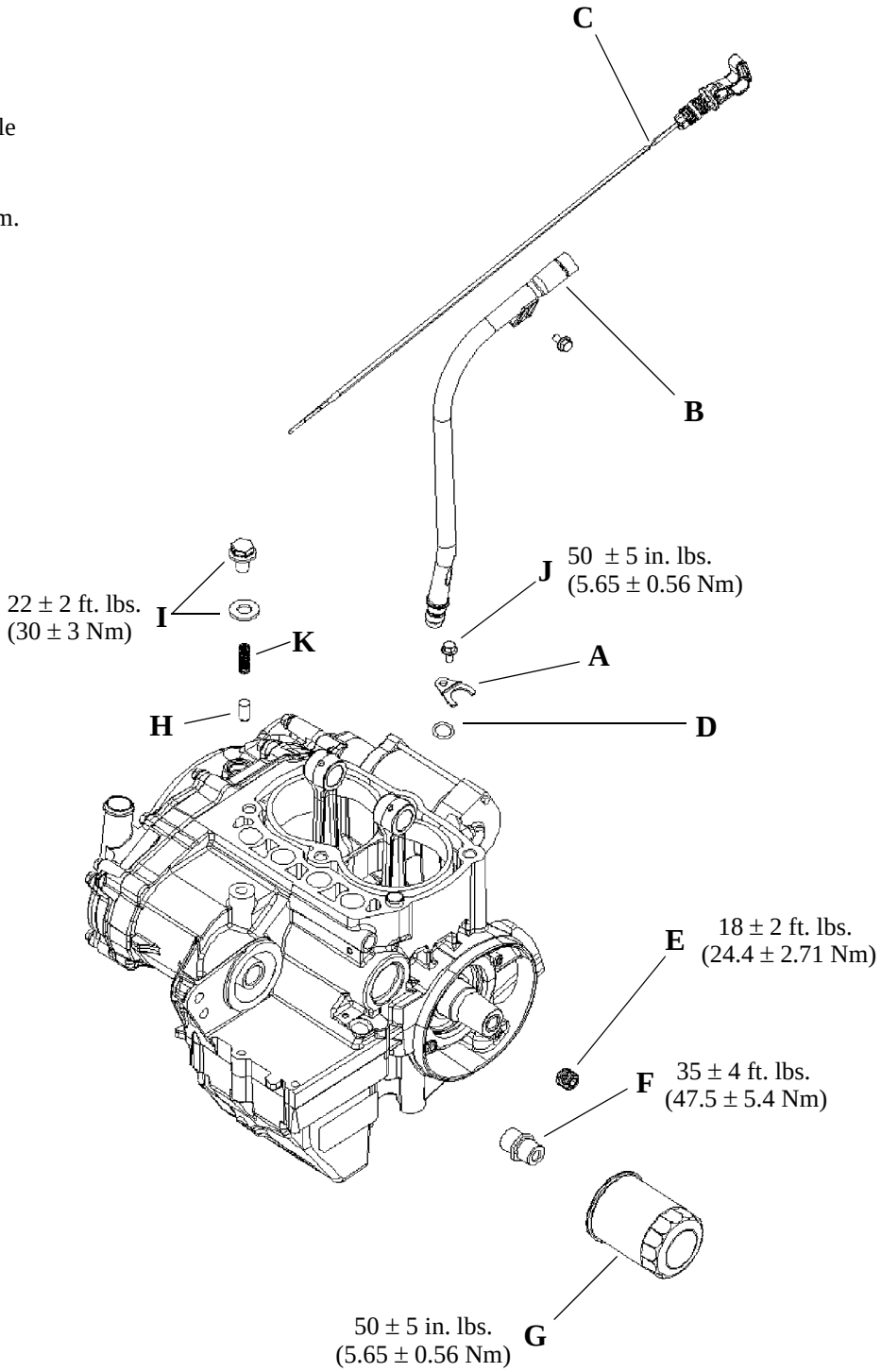
Stator Cover / Starter / Water Pump Exploded View



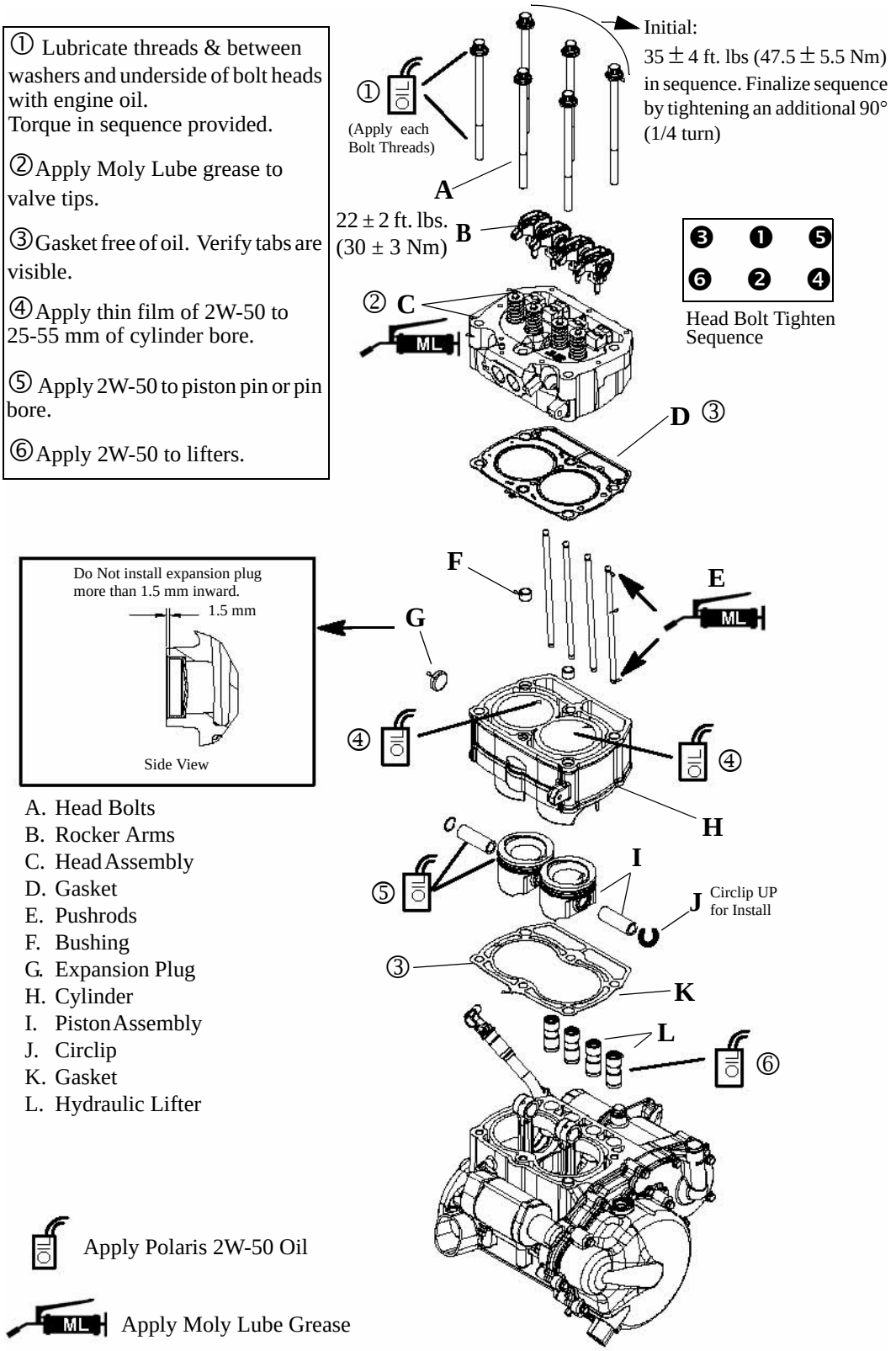
A. Bolts
B. Starter
C. Washer
D. Nut
E. Positive Cable
F. Negative Cable
G. Gasket
H. Clamp
I. Bolts
J. Gasket
K. Water Pump Cover
L. Bolts
M. Crank Nut / Washer
N. Flywheel

Oil Filter / Pressure Relief / Dipstick Assembly Exploded View

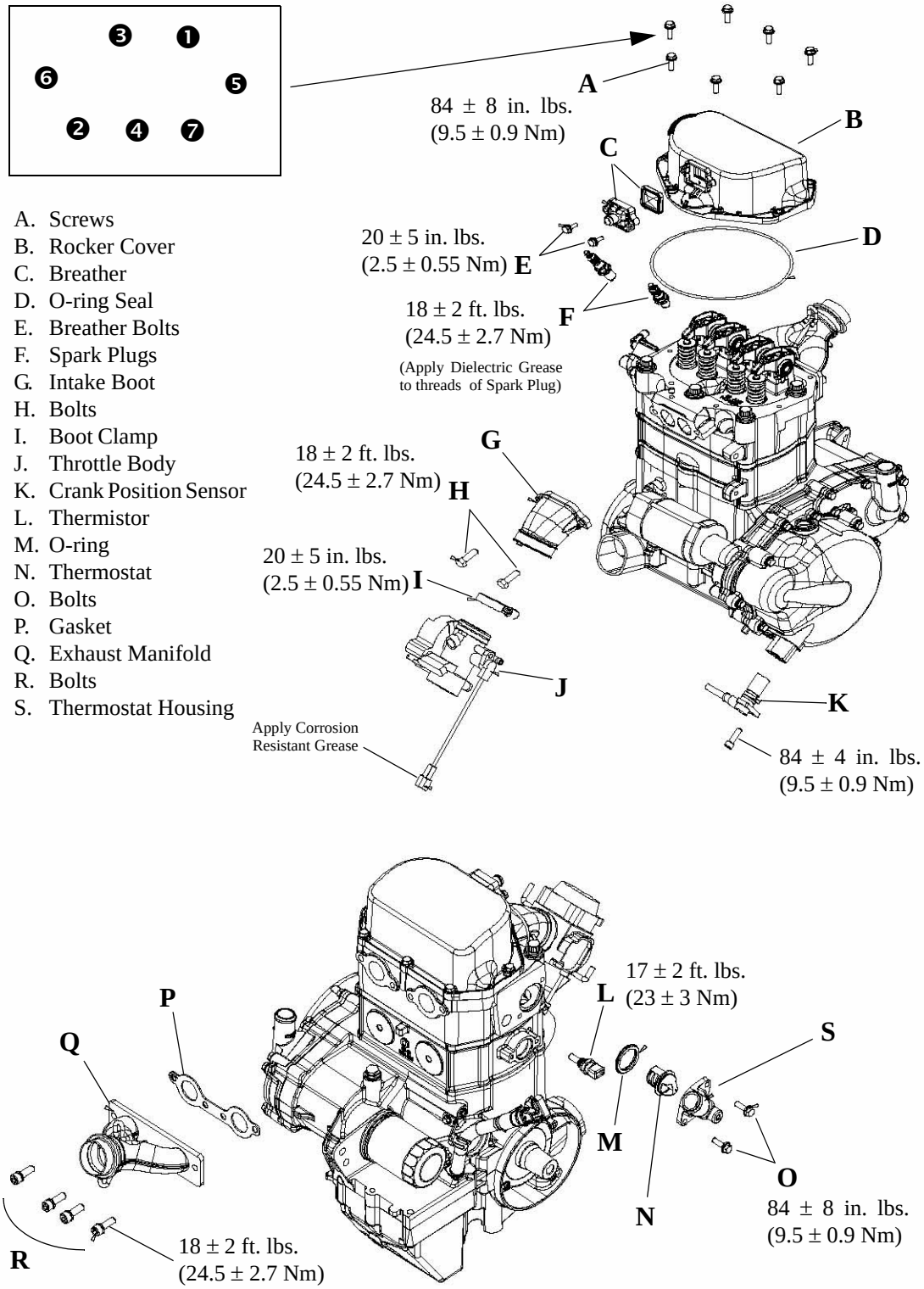
A. Clamp
B. Oil Fill Tube
C. Dipstick
D. O-ring
E. Hex Plug
F. Oil Filter Nipple
G. Oil Filter
H. Dowel
I. Galley Plug Asm.
J. Screw
K. Relief Spring



Cylinder / Cylinder Head / Piston Exploded View



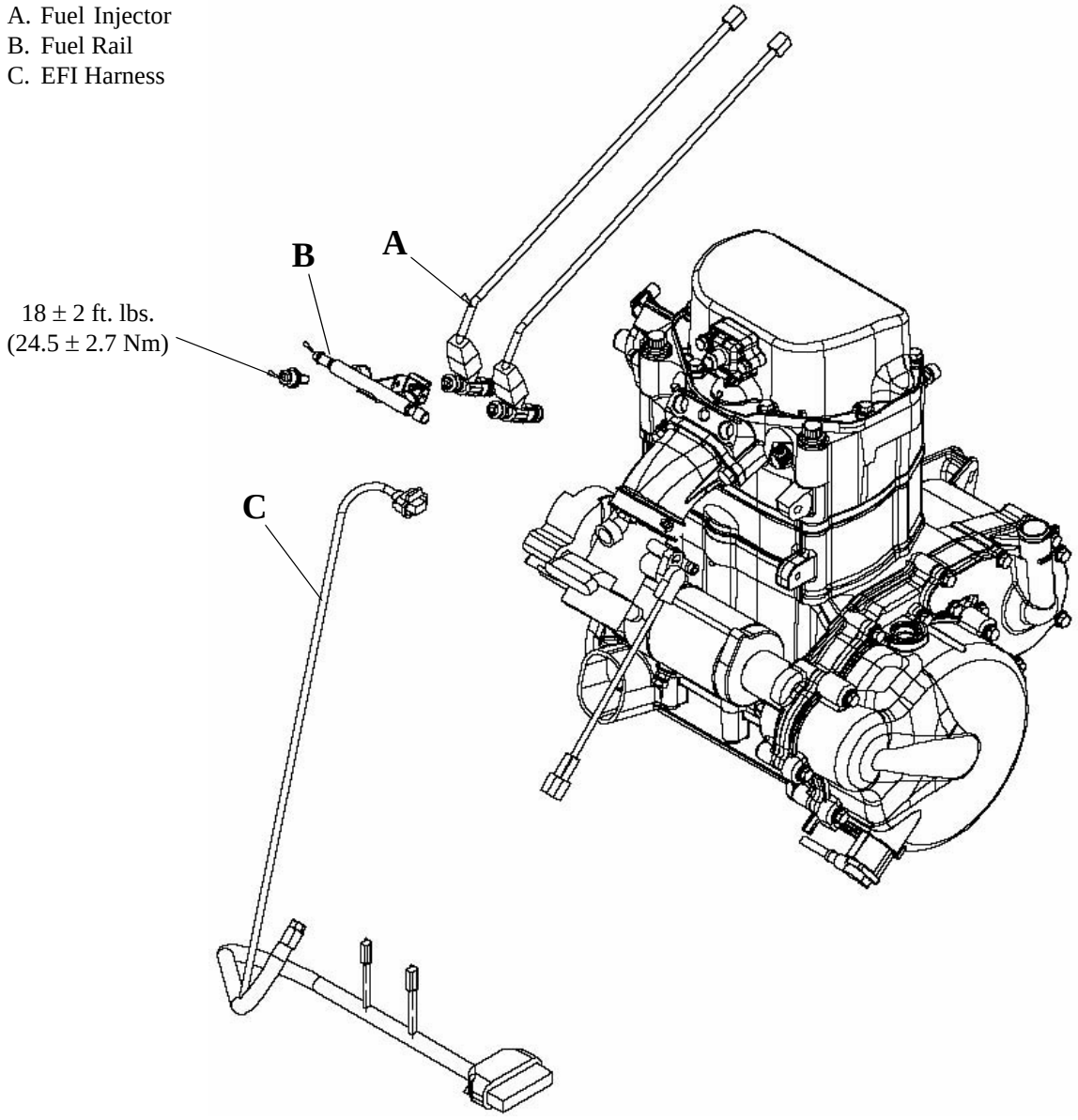
Engine Sensors / Valve Cover / General Component Exploded View



A. Screws
B. Rocker Cover
C. Breather
D. O-ring Seal
E. Breather Bolts
F. Spark Plugs
G. Intake Boot
H. Bolts
I. Boot Clamp
J. Throttle Body
K. Crank Position Sensor
L. Thermistor
M. O-ring
N. Thermostat
O. Bolts
P. Gasket
Q. Exhaust Manifold
R. Bolts
S. Thermostat Housing

EFI Harness / Fuel Injection Exploded View

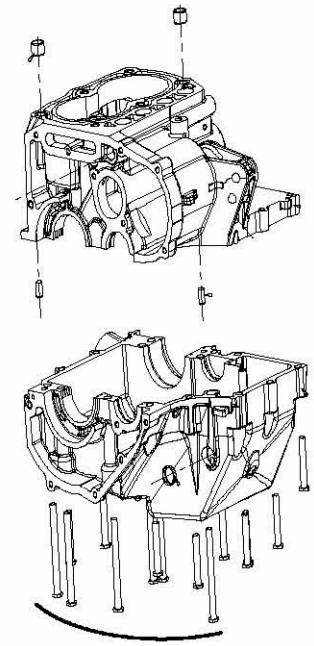
A. Fuel Injector
B. Fuel Rail
C. EFI Harness



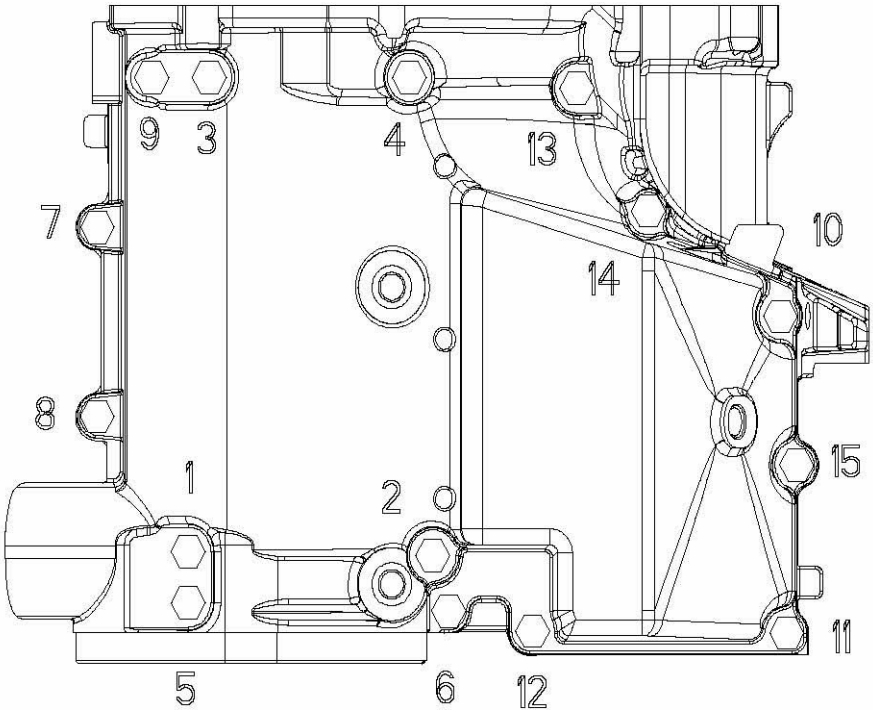
NOTE: See Chapter 4 for more information on the EFI system.

Engine Fastener Torque Patterns

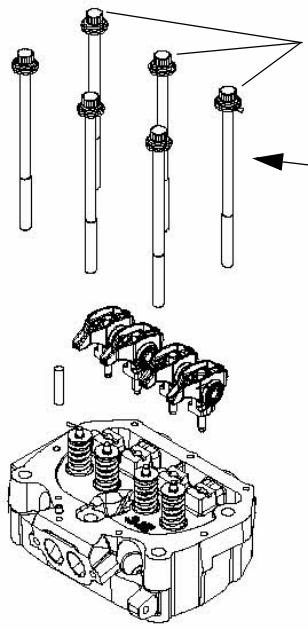
Crankcase Bolt Tighten Sequence



22 ± 2 ft. lbs. (30 ± 3 Nm)

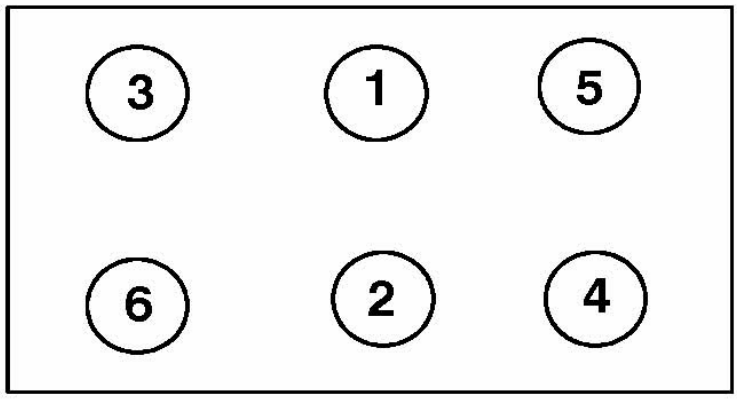


Cylinder Head Bolt Tighten Sequence



Lubricate threads and between washer and underside of bolt with engine oil. Torque in sequence to spec provided, allow the gasket to set for 1 minute, then tighten in sequence 90° (1/4 turn).

35 ± 4 ft. lbs.
(47.5 ± 5.5 Nm) + 90° (1/4 turn)



Torque Specifications

Engine Torque Specifications

Fastener	Size	in. lbs. (Nm)	ft. lbs. (Nm)
Camshaft Gear	8 mm		22 ± 2 (30 ± 3)
Camshaft Thrust Plate	6 mm	115 ± 12 (13 ± 1.35)	9.5 ± 1 (13 ± 1.35)
Throttle Body Adaptor Bolts	8 mm	216 ± 24 (24.5-± 2.7)	18 ± 2 (24.5 ± 2.7)
Counterbalance Gear	8 mm		22 ± 2 (30 ± 3)
Crankcase Bolts	8 mm		* 22 ± 2 (30 ± 3)
Crankcase Breather	5 mm	20 ± 5 (2.5 ± 0.55)	-
Cylinder Head Bolts	11 mm		* 35 ± 4 (47.5 ± 5.5)
Exhaust Manifold	8 mm	216 ± 24 (24.5 ± 2.70)	18 ± 2 (24.5 ± 2.7)
Flywheel	14 mm		65 ± 7 (88 ± 9.50)
Injector Rail	8 mm	216 ± 24 (24.5 ± 2.70)	18 ± 2 (24.5 ± 2.7)
Magneto Cover	6 mm	* 96 ± 3 (10.85 ± 0.35)	-
Oil Baffle Weldment	5 mm	60 ± 6 (6.8 ± 0.68)	-
Oil Drain Bolt (Crankcase)	12 mm	192 ± 24 (21.7 ± 2.7)	16 ± (21.7)
Oil Fill Tube Bolt	5 mm	50 ± 5 (5.64 ± 0.56)	-
Oil Filter Pipe Fitting	20 mm		35 ± 4 (47.5 ± 5.4)
Oil Pick Up	5 mm	60 ± 6 (6.8 ± 0.68)	-
Oil Pressure Relief Plug	10 mm	22 ± 2 (30 ± 3)	-
Oil Pump Housing Screw	6 mm	* 84 ± 8 (9.50 ± 0.90)	-
Rocker Arm	8 mm		* 22 ± 2 (30 ± 3)
Rocker Cover	6 mm	* 84 ± 8 (9.5 ± 0.9)	-
Spark Plug	14 mm	216 ± 24 (24.5 ± 2.7)	18 ± 2 (24.5 ± 2.7)
Starter Motor	6 mm	* 84 ± 8 (9.5 ± 0.9)	-
Stator Assembly	6 mm	96 ± 3 (10.85 ± 0.35)	-
Stator Housing	6 mm	* 96 ± 3 (10.85 ± 0.35)	-
Temperature Switch	3/8 NPT		17 ± 2 (23 ± 3)
Thermostat Housing	6 mm	84 ± 8 (9.5 ± 0.9)	-
Timing Plug	3/4-16		7 - 9 (10 - 12)
Trigger Coil/Stator Wire Holddown	5 mm	* 96 ± 3 (10.85 ± 0.35)	-
Water Pump Housing Cover	6 mm	* 96 ± 3 (10.85 ± 0.35)	-
Water Pump Impeller Nut	8 mm	108 ± 3 (12 ± 0.35)	-

NOTE: * See exploded views for notes or torque sequences.

700 EFI Engine Service Specifications

Cylinder Head - Engine Specifications

Main Component: Cylinder Head		EH068OLE
Camshaft	Cam Lobe Height - Intake / Exhaust	1.3334" (33.8674 mm)
	Camshaft Journal Outer Diameter - Mag	1.654" ± 0.00039" (42 ± 0.010 mm)
	Camshaft Journal Outer Diameter - Center	1.634"± 0.00039" (41.50 ± 0.010 mm)
	Camshaft Journal Outer Diameter - PTO	1.614" ± 0.00039" (41 ± 0.010 mm)
	Camshaft Journal Bore Inner Diameter - Mag	1.656" ± 0.00039" (42.07 ± 0.010 mm)
	Camshaft Journal Bore Inner Diameter - Center	1.637" ± 0.00039" (41.58 ± 0.010 mm)
	Camshaft Journal Bore Inner Diameter - PTO	1.617" ± 0.00039" (41.07 ± 0.010 mm)
	Camshaft Oil Clearance	0.00276" ± 0.00079" (0.07 ± 0.02 mm)
	Camshaft End Play	0.0167" ± 0.0098" (0.425 ± 0.25 mm)
Counter Balance	Counter Balance End Play	0.005" (0.127 mm)
Cylinder Head	Cylinder Head - Surface warp limit	0.00394" (0.1 mm)
	Cylinder Head - Standard height	3.478" (88.35 mm)
Valve Seat	Valve Seat - Contacting Width - Intake	0.0472" ± 0.00787" - 0.0039" (1.20 ± 0.20 - 0.10mm)
	Valve Seat - Contacting Width - Exhaust	0.0591" ± 0.00787" - 0.0039" (1.50 ± 0.20 - 0.10 mm)
	Valve Seat Angle	45.5° ± 0.255°
Valve Guide	Valve Guide Inner diameter	0.2367" ± 0.00029" (6.012 ± 0.007 mm)
	Valve Guide Protrusion Above Head	0.807" ± 0.0039" (20.50 ± 0.01 mm)
Valve	Valve Margin Thickness - Intake	Standard: 0.79" (20.06 mm) Max- 0.98" (24.89 mm) Min.- 0.59" (14.98 mm)
	Valve Margin Thickness - Exhaust	Standard: 0.80" (20.32 mm) Max- 1.0" (25.4 mm) Min.- 0.60" (15.24 mm)
	Valve Stem Diameter - Intake	0.2356" ± 0.00039" (5.985 ± 0.01 mm)
	Valve Stem Diameter - Exhaust	0.2351" ± 0.00039" (5.972 ± 0.01 mm)
	Valve Stem Oil Clearance - Intake	0.00228" ± 0.00098" (0.058 ± 0.025 mm)
	Valve Stem Oil Clearance - Exhaust	0.00275" ± 0.00098" (0.0870 ± 0.025mm)
	Valve Stem Overall Length - Intake	4.51" ± 0.01476" (114.5550 ± 0.375 mm)
	Valve Stem Overall Length - Exhaust	4.5453" ± .01496" (115.45 ± 0.38 mm)
Valve Spring	Valve Spring Overall Length - Free Length	1.735" (46.069 mm)
	Valve Spring Overall Length - Installed Height	Intake - 1.4638" (37.18 mm) Exhaust - 1.4736" (37.43 mm)

Cylinder / Piston - Engine Specifications

Main Components: Cylinder / Piston / Connecting Rod		EH068OLE
Cylinder	Cylinder - Surface warp limit (mating with cylinder head)	0.004" (0.10 mm)
	Cylinder Bore - Standard	3.1495" (80 mm)
	Cylinder Taper Limit	0.00031" (0.008 mm)
	Cylinder Out of Round Limit	0.00030" (0.0075 mm)
	Cylinder to Piston Clearance	.0015" ± .00059" (.040 ± .015mm)
Lifter	Lifter Outer Diameter Standard	0.84245" ± 0.00025" (21.39 8 ± 0.00635 mm)
	Lifter Block Bore	0.8438" ± 0.00062" (21.4322 ± 0.0157 mm)
Piston	Piston - Standard	3.1477" ± .000121" (79.954 ± .003mm)
	Piston Standard Inner Diameter of Piston Pin Bore	0.78789" ± .00009" (20.0125 ± 0.003 mm)
Piston Pin	Piston Pin Outer Diameter	0.7874" - 0.7872" (20 - 19.995 mm)
	Piston Pin - Standard Clearance - Piston Pin to Pin Bore	0.00059" ± 0.0002" (0.015 ± 0.005 mm)
	Piston Pin - Degree of Fit	Piston pin must be a push fit (by hand) at 68° F (20° C)

Piston / Connecting Rod / Crankshaft - Engine Specifications

Main Components: Piston / Connecting Rod			EH068OLE
Piston Ring	Installed Gap	Top Ring - Standard	0.0059± 0.138" (0.15 ± 0.35mm)
		Top Ring - Limit	> 15% Leakdown
		Second Ring - Standard	0.0098 ± 0.197" (0.25 ± 0.50mm)
		Second Ring - Limit	> 15% Leakdown
		Oil Ring - Standard	0.0196± 0.00984" (0.50 ± 0.25mm)
		Oil Ring - Limit	> 15% Leakdown
	Ring to Groove Clearance	Top Ring - Standard	0.0024" ± 0.0008" (0.060 ± 0.020 mm)
		Top Ring - Limit	> 15% Leakdown
		Second Ring - Standard	0.0028" ± 0.0008" (0.070 ± 0.020 mm)
		Second Ring - Limit	> 15% Leakdown
Connecting Rod	Connecting Rod Small End I.D.		0.789"– 0.78841" (20.030 – 20.015 mm)
	Connecting Rod Small End Radial Clearance		0.0098"± 0.00039" (0.025 ± 0.010mm)
	Connecting Rod Big End Side Clearance		0.01181"± 0.00591" (0.030 ± 0.015mm)
	Connecting Rod Big End Radial Clearance		0.0015"± 0.00006" (0.0038 ± 0.0015mm)
Crankshaft	Crankshaft Runout Limit		0.00236" (0.060mm)

Special Tools

Part Number	Tool Description
PV-43527	OIL FILTER WRENCH
2200634	VALVE SEAT RECONDITIONING KIT
PU-45257	VALVE SPRING COMPRESSOR
PU-45652	VALVE PRESSURE HOSE
2871043	FLYWHEEL PULLER
2870390	PISTON SUPPORT BLOCK
PU-45497-1	CAM GEAR SPRING INSTALLATION KIT
PU-45497-2	CAM GEAR TOOTH ALIGNMENT TOOL
PU-45498	CAM SPANNER WRENCH
PU-45838	GEAR HOLDER
PA-44995	WATER PUMP MECHANICAL SEAL INSTALLER
PU-45543	UNIVERSAL DRIVER HANDLE
PA-45483	MAIN SEAL INSTALLER
PU-45658	CRANKSHAFT MAIN SEAL SAVER
PA-45401	WATER PUMP SEAL SAVER
2870975	MITY VAC™ PRESSURE TEST TOOL
PU-45778	OIL SYSTEM PRIMING TOOL

GENERAL ENGINE SERVICE

Accessible Components

Following Components can be serviced or removed with the engine installed: **(See Page 3.17 for 6x6 Valve Cover R & R)**

- Flywheel
- Alternator (Stator)
- Starter Motor/Drive
- Cylinder Head **(6x6: See Page 3.17)**
- Cylinder **(6x6: See Page 3.17)**
- Piston / Rings **(6x6: See Page 3.17)**
- Camshaft **(6x6: See Page 3.17)**
- Rocker Arms **(6x6: See Page 3.17)**
- Oil pump / Water Pump / Oil Pump Drive Gear
- Gear Train Components

Following Components Require Engine Removal for service:

- Counterbalance Shaft or Bearings
- Connecting Rod
- Crankshaft
- Crankshaft Main Bearings
- Crankcase

Piston Identification

Four stroke engine rings have a rectangular profile. See "PISTON RING INSTALLED GAP" for ring installation. Use the information below to identify pistons and rings.

Engine Model	Piston Diameter
EH068OLE	80 mm

Cooling System Specifications

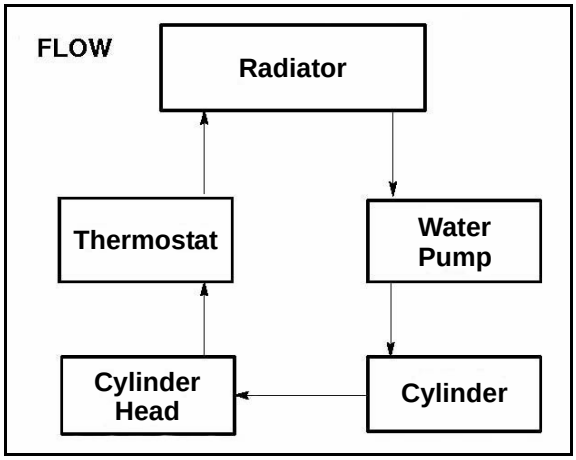
Condition	Specification
Thermostat Open	180° F (82° C)
Thermostat Full Open Lift	6 mm at 203° F (95° C)
Thermostat Closed	171° F (77° C)
System Capacity	3.25 Quarts (2.13L)
Radiator Cap Pressure Relief	13 PSI

Polaris Premium Antifreeze
2871534 - Quart
2871323 - Gallon

Recommended Coolant

Use only high quality antifreeze/coolant mixed with distilled water in a 50/50 or 60/40 ratio, depending on freeze protection required in your area.

CAUTION: Using tap water in the cooling system will lead to a buildup of deposits which may restrict coolant flow and reduce heat dissipation, resulting in possible engine damage. Polaris Premium 60/40 Antifreeze/Coolant is recommended for use in all cooling systems and comes pre-mixed, ready to use.



Cooling System Pressure Test

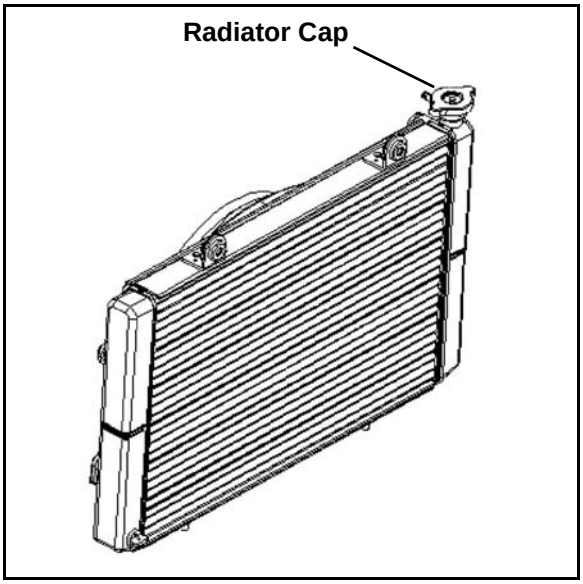
1. Lift up the front hood.
2. Remove the pressure cap from the radiator and pressure test the cooling system using a commercially available tester.
3. The system must retain 10 psi for five minutes or longer. If pressure loss is evident within five minutes, check radiator, all cooling system hoses and clamps and water pump seal for leakage.

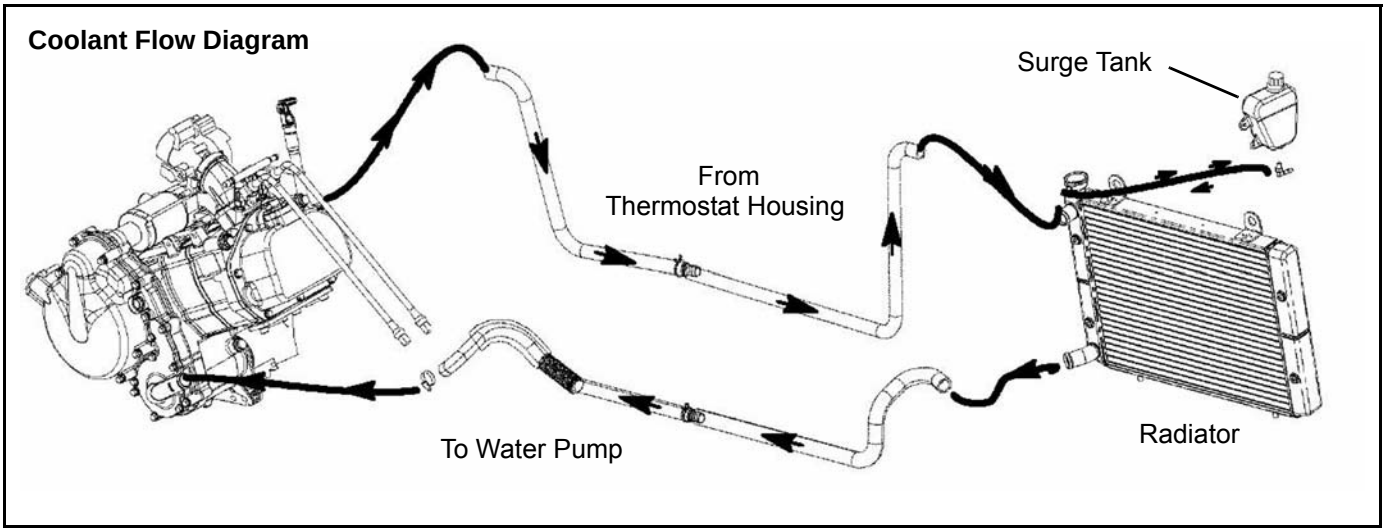
Radiator Cap Pressure Test

⚠ WARNING

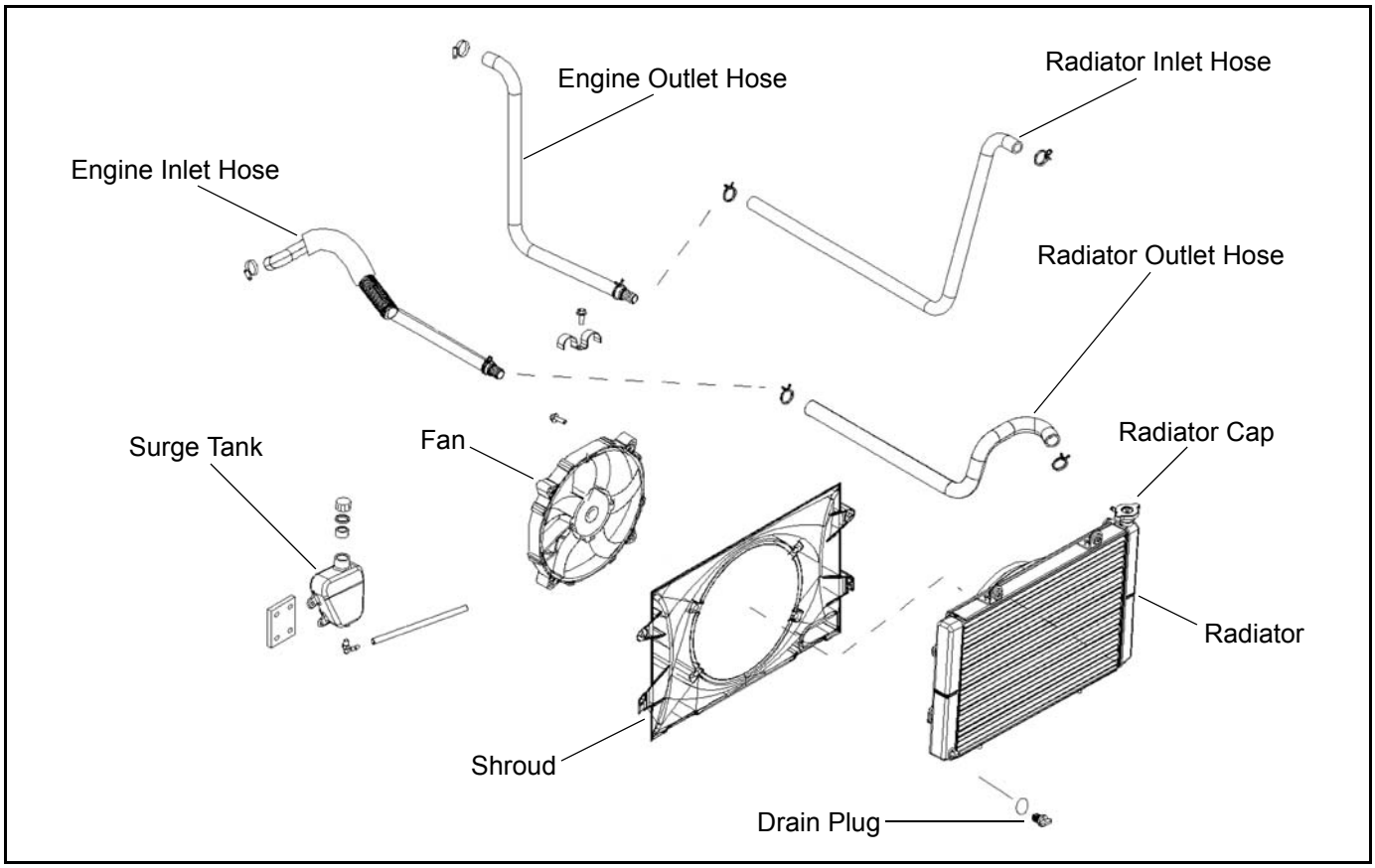
Never remove radiator cap when engine is warm or hot. The cooling system is under pressure and serious burns may result. Allow the engine and cooling system to cool before servicing.

1. Remove radiator pressure cap and test using a cap tester (commercially available).
2. The radiator cap relief pressure is 13 lbs. Replace cap if it does not meet this specification.





Cooling System Exploded View



Cooling System Bleeding Procedure

> **⚠ WARNING**
>
> Always wear safety glasses and proper shop clothing when performing the procedures in this manual. Failing to do so may lead to possible injury or death.

> **⚠ CAUTION**
>
> Use caution when performing these procedures. Coolant may be hot and may cause severe injury or burns.

NOTE: If the coolant level is LOW in the radiator, or if there are leaks in the system, the coolant system will not draw coolant from the reservoir tank.

NOTE: Use this procedure when a unit overheats and no apparent leaks in the cooling system are found.

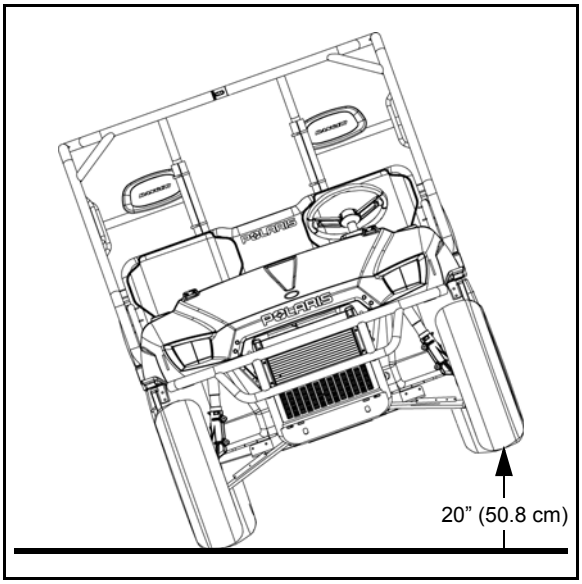
1. Place the vehicle in Neutral and set the parking brake.

> **⚠ CAUTION**
>
> Be sure the engine has cooled and there is no pressure built up in the cooling system before removing the radiator cap. The coolant may be hot and could cause severe injury or burns.

2. Remove radiator cap (A) and top off coolant.
3. Remove surge tank fill cap (B) and fill the surge tank to the full line.

4. Elevate the driver's side of the vehicle 20" (50.8 cm) off the ground so the thermostat housing is at the highest point on the cylinder head. This will allow any trapped air to accumulate near the thermostat housing bleed screw.

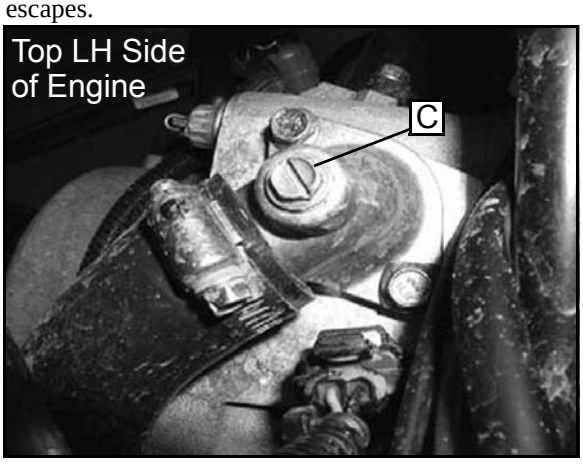
> **⚠ CAUTION**
>
> Serious injury may result if machine tips or falls. Be sure machine is secure before beginning this service procedure.



5. Start the engine and let it idle for 5-10 minutes or until the thermostat opens and allows coolant to flow through the system.

6. Squeeze the coolant lines by hand to help purge the system of air.

7. Slightly loosen the bleed screw (C) on the thermostat housing to allow the trapped air to escape. If no air is present, a steady stream of coolant will stream out. If air is present, the screw will bubble and sputter as the air escapes.



8. Add Polaris Premium Antifreeze to the radiator if the level goes down.

9. Tighten the bleed screw to 70 ± 10 in.lbs. (8 ± 1.13 Nm) on the thermostat housing and properly install the radiator cap.

> **⚠ WARNING**
>
> Be sure to install the radiator cap before shutting off the engine.
> Coolant may spit out of the radiator.

10. Stop the engine and let cool, top off the radiator filler neck with coolant. If you hear or see a "glug" at the filler neck or there is a dropping of the coolant level, indicating that coolant has been pulled into the system. Fill the surge tank only after you have completely filled the cooling system at the radiator filler neck.

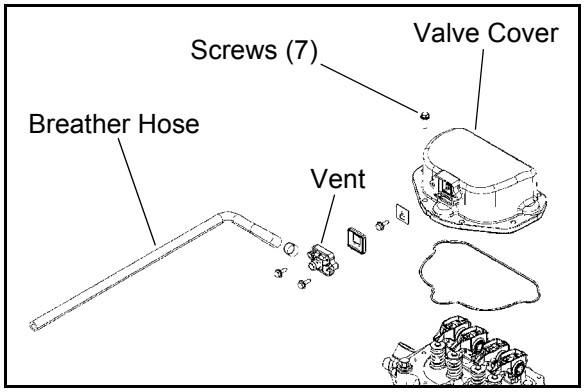
11. Repeat this procedure, if overheating still occurs.

Valve Cover Removal - 6x6 Models (Engine Installed)

The *RANGER* 6x6 models have a different engine mounting system that makes it more difficult to access and remove the engine valve cover. Use the procedure provided in this section of the chapter to remove the valve cover and allow for engine top-end component service.

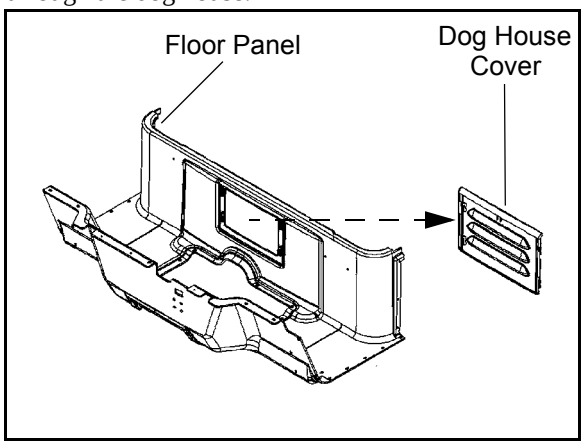
1. Remove the seat base.

2. Remove the clamp from the valve cover breather hose and remove the hose and valve cover vent.

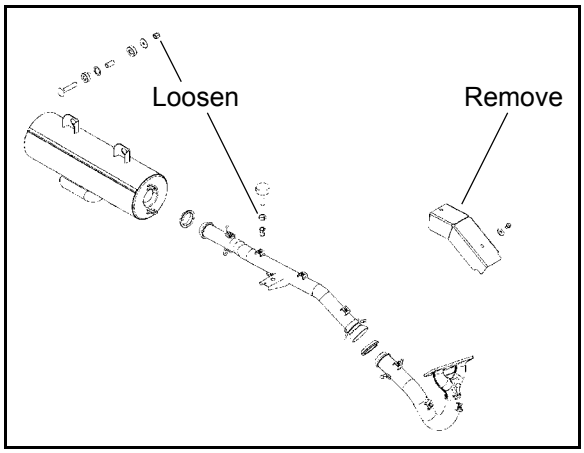


3. Remove the 7 screws that retain the valve cover.

4. Remove the front dog house cover located in the floor panel of the *RANGER*. The valve cover will have to be removed through the dog house.



5. Remove the heat shield shown below and loosen the exhaust mounts.

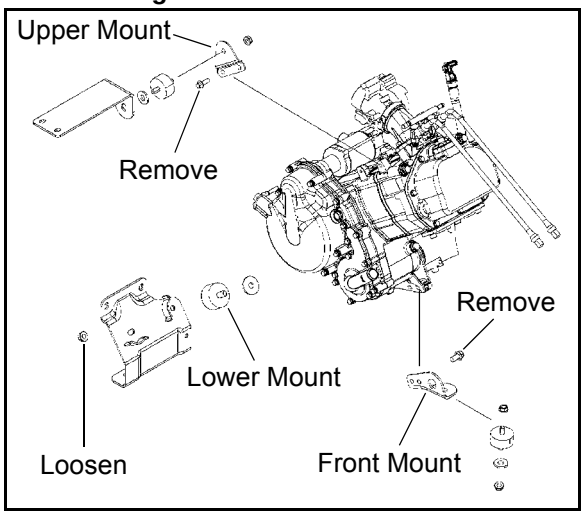


6. Remove the upper engine mount.

7. Loosen the lower engine mount bolts, but DO NOT completely remove them.

8. Remove the front engine mount bolts from the engine case.

NOTE: You may need to support the engine during this step by using a jack or by using wooden blocks between the engine and frame.



9. Move the engine to allow the valve cover to be removed through the dog house cover hole.

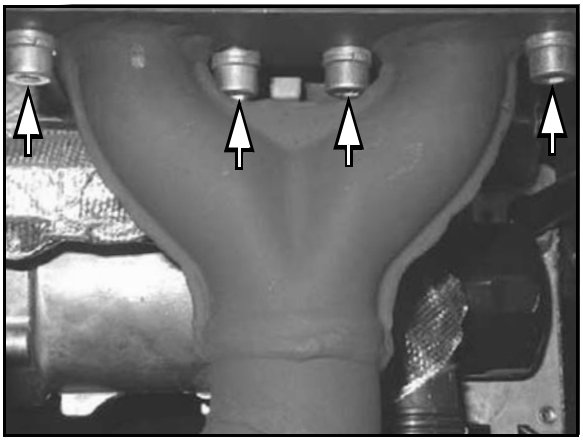
10. To reinstall, reverse steps 1-9. Torque all bolts to specification as listed earlier in this chapter.

NOTE: It may be necessary to use a pry bar to get the bolts back in during reassembly.

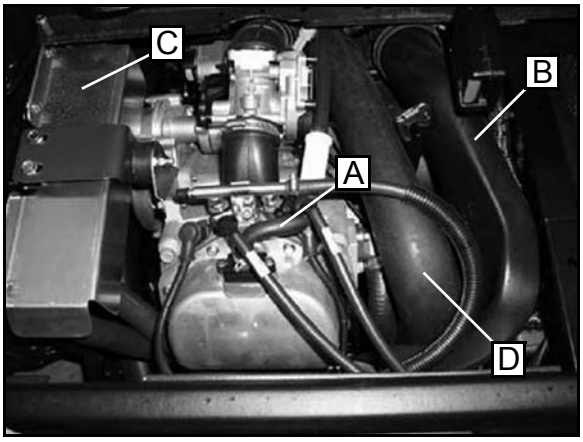
Engine Removal

> **WARNING**
>
> Always wear safety glasses and proper shop clothing when performing the procedures in this manual. Failing to do so may lead to possible injury or death.

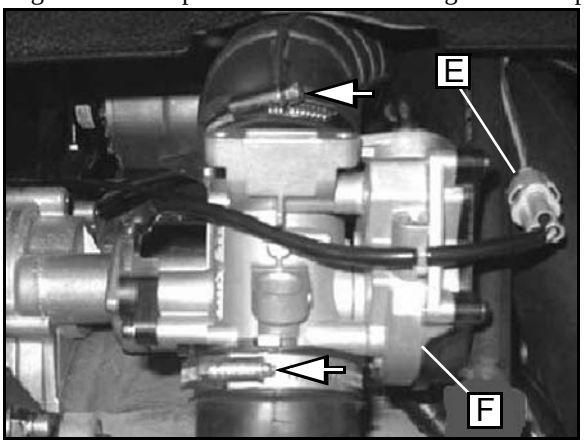
1. Clean work area.
2. Thoroughly clean the engine and chassis.
3. Disconnect battery (-) negative cable.
4. Remove the following parts as required:
   - Seat
   - Storage unit under driver seat (Refer to chapter 5)
5. Remove middle dog house cover and remove exhaust pipe bolts.



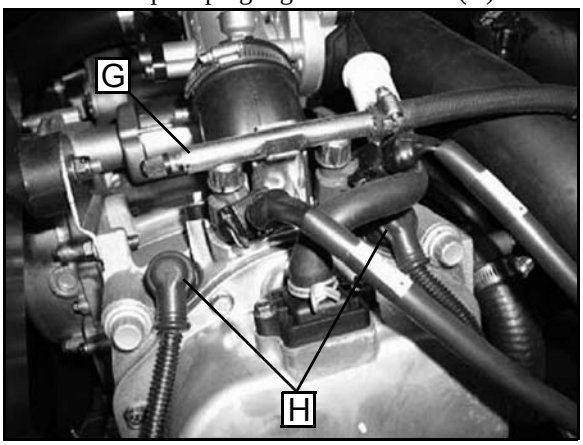
6. Remove springs from exhaust pipe and remove pipe.
7. Refer to PVT System in Chapter 6 to remove outer clutch cover, drive belt, drive clutch, driven clutch, and inner cover.
8. Drain coolant and engine oil.
9. Remove the air breather line (A).
10. Remove PVT exhaust duct (B).
11. Remove the exhaust shield (C).
12. Disconnect the air intake hose (D) from the air box and remove the air intake hose.



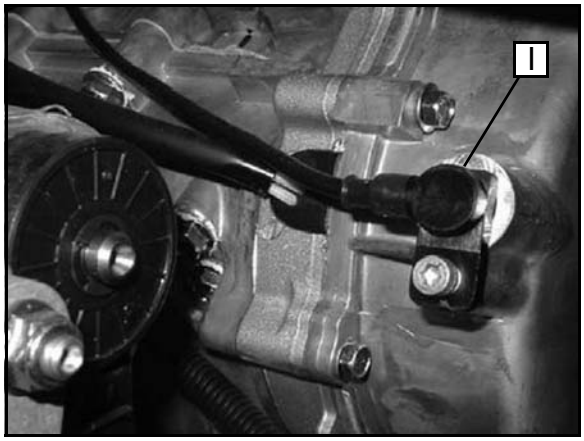
13. Disconnect the Throttle Position Sensor at the electrical connector (E). Remove the clamps that secure the throttle body (F) to the air intake boot and engine intake boot. Remove the throttle body (F). Insert a shop towel into the engine intake to prevent dirt from entering the intake port.



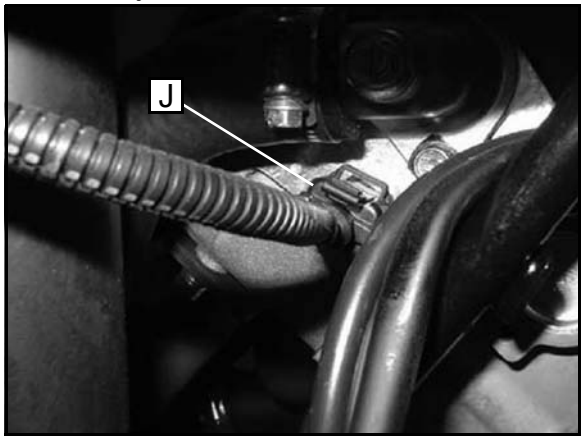
14. Relieve the fuel pressure in the fuel rail (refer to Chapter 4, “FUEL INJECTION”) for proper procedure. Carefully remove the fuel rail (G) and injectors.
15. Remove the spark plug high tension leads (H).



16. Remove the crank position sensor (I) located on the mag cover.



17. Disconnect the coolant temperature sensor (J) from the left side of the cylinder.



18. Disconnect the coolant hoses. Properly dispose of any antifreeze from the engine or hoses.

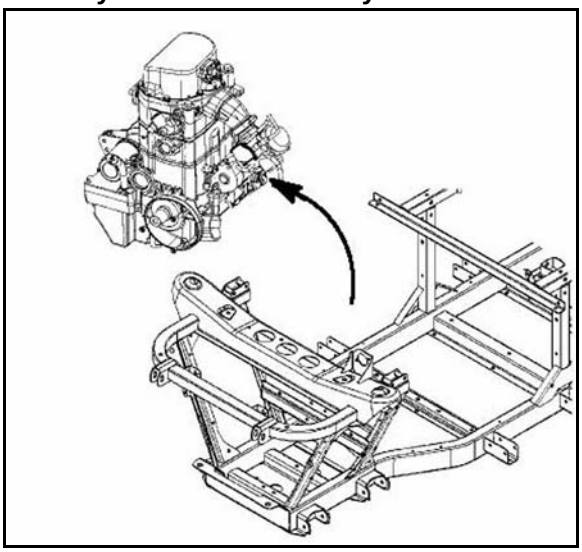
19. When removing starter cables, note and mark ground cable and positive (+) cable mounting angle and locations. Remove the cables.

20. Remove all engine mount nuts and / or engine mount plates.

21. With all hoses and wires disconnected, the engine can be pulled straight out of the chassis.

NOTE: Rotating the engine to the left 90 degrees (valve cover facing left), may ease engine removal.

NOTE: Use caution when lifting the engine out of frame. Use an engine lift or other means if the engine is too heavy to be lifted manually.



22. For engine installation, reverse procedures.

Engine Installation Notes

After the engine is installed in the frame, review this checklist and perform all steps that apply:

General Items

1. Install previously removed components using new gaskets, seals, and fasteners where applicable.

NOTE: Properly route all electrical harnesses and re-attach any fasteners or protective tubing. Check for any possible rubbing points of electrical wires.

2. Perform regular checks on fluid levels, controls, and all important areas on the vehicle as outlined in the daily pre-ride inspection checklist (refer to Chapter 2 or the Owner's Manual).

PVT System

1. Adjust center distance of drive and driven clutch. (Chapter 6)

2. Adjust clutch offset, alignment, and belt deflection. (Chapter 6)

3. Clean clutch sheaves thoroughly and inspect inlet and outlet ducts for proper routing and sealing. (Chapter 6)

Transmission

1. Inspect transmission operation and adjust linkage if necessary. Refer to Chapter 2 and Chapter 8.

Exhaust

1. Replace exhaust gaskets. Seal connections with high temp silicone sealant.

2. Check to be sure all springs are in good condition.

Bleed Cooling System

NOTE: Follow coolant bleeding procedure outlined earlier in this chapter

Engine Break-In Period

The break-in period for a Polaris *RANGER* engine is defined as the first 25 hours of operation, or the time it takes to use 2 full tanks of gasoline. No single action on your part is as important as a proper break-in period. Careful treatment of a new engine will result in more efficient performance and longer life for the engine. Perform the following procedures carefully:

CAUTION
Use only Polaris PS-4 PLUS 2W-50 Synthetic engine oil or an equivalent. Never substitute or mix oil brands. Serious engine damage and voiding of warranty can result. Do not operate at full throttle or high speeds for extended periods during the first three hours of use. Excessive heat can build up and cause damage to close fitted engine parts.

1. Fill fuel tank with unleaded or leaded fuel which has a minimum pump octane number of 87= (R+ M)/2.

2. Check oil level indicated on dipstick. Add oil if necessary (Refer to Chapter 2, “Engine Oil Level”).

3. Drive slowly at first to gradually bring engine up to operating temperature.

4. Vary throttle positions. Do not operate at sustained idle or sustained high speed.

5. Perform regular checks on fluid levels, controls and all important bolt torques.

6. Pull only light loads during initial break-in.

7. Change oil and oil filter after break-in period at 25 hours.

Engine Lubrication Specifications

Capacity - Approximately 2 U.S. Quarts (1.9 l)

Oil Type - Polaris PS-4 PLUS 2W-50 Synthetic

Filter Wrench - PV-43527 or equivalent

- Oil Pressure Specification -
35-39 PSI @ 5500 RPM, Polaris 2W-50 Synthetic, Engine at operating temperature.

Oil Pressure Test

1. Remove blind plug/sender from left side of crankcase.

2. Insert a 1/8 NPT oil pressure gauge adaptor into the crankcase and attach the gauge.

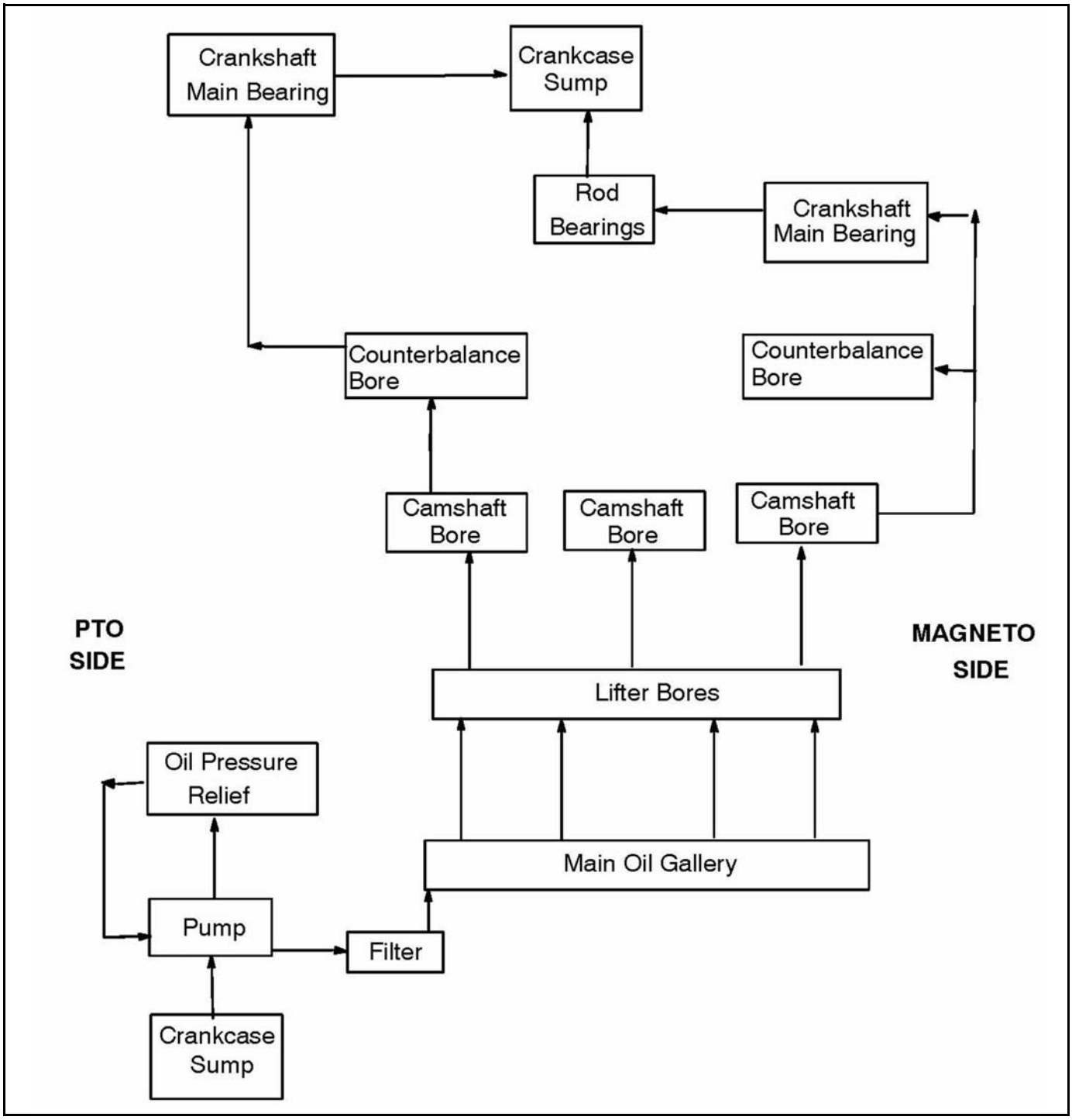
3. Start engine and allow it to reach operating temperature, monitoring gauge indicator.

NOTE: Use only Polaris PS-4 PLUS 2W-50 Synthetic Engine Oil.

Oil Pressure at 5500 RPM (Engine Hot):
Standard: 39 PSI
Minimum: 35 PSI

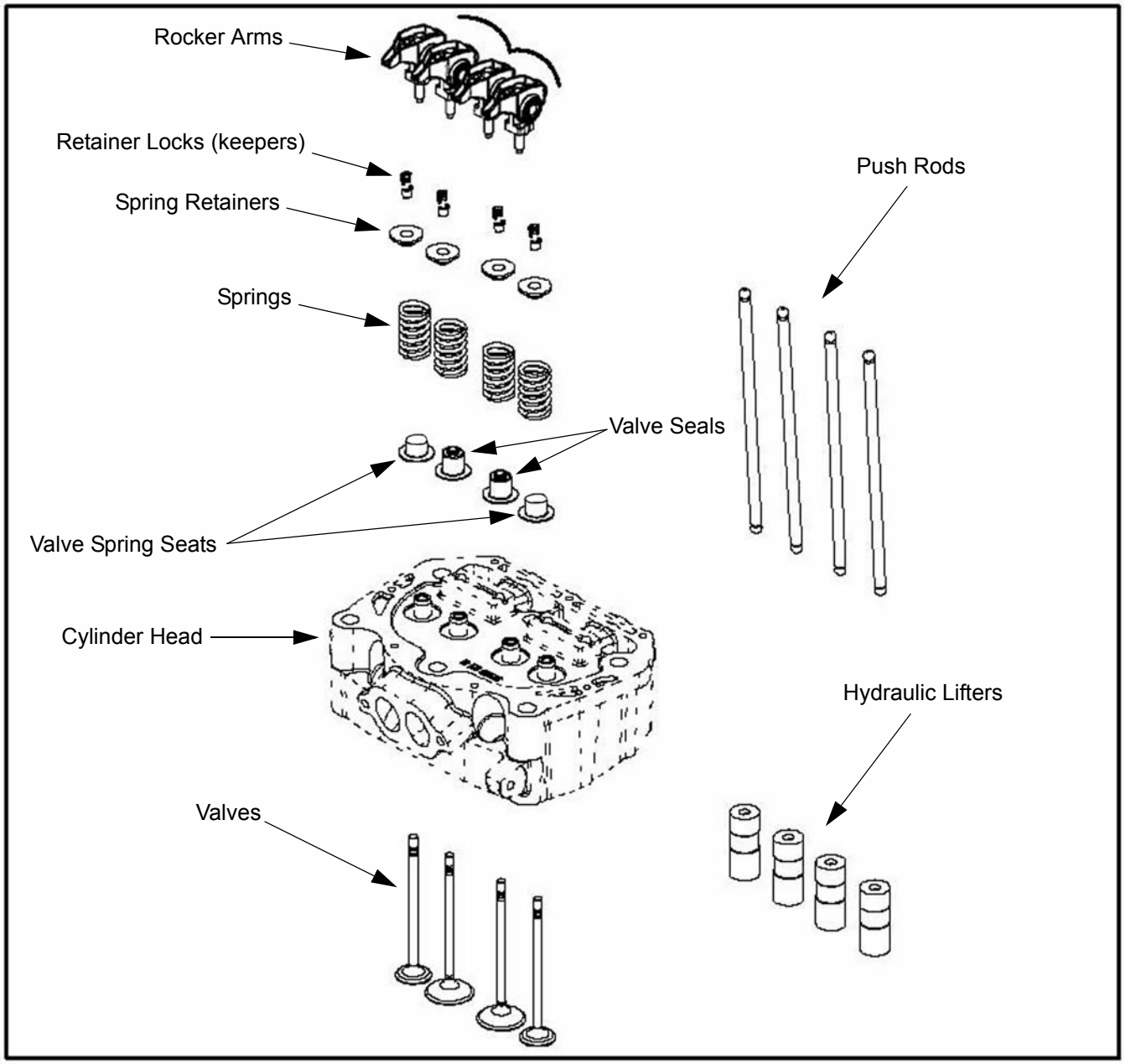
Oil Flow Chart

This chart describes the flow of oil through the 700 engine. Beginning in the crankcase sump, the oil is drawn through an oil galley to the feed side of the oil pump. The oil is then pumped through the oil filter. If the oil filter is obstructed, a bypass valve contained in the filter allows oil to bypass the filter element. At this point, the oil is supplied to the main oil galley through a crankcase passage. Oil is then diverted three ways from the main oil galley, with the first path entering the camshaft bores, onto the rear balance shaft journal and then draining back into the crankcase sump. The second oil path from the main oil galley feeds the lifter bores and then drains back to the crankcase sump. The third oil path flows through a crankcase galley to the MAG side crankshaft journal and also to the front balance shaft journal and onto the crankcase sump. The oil pressure switch is fed off the main oil galley.



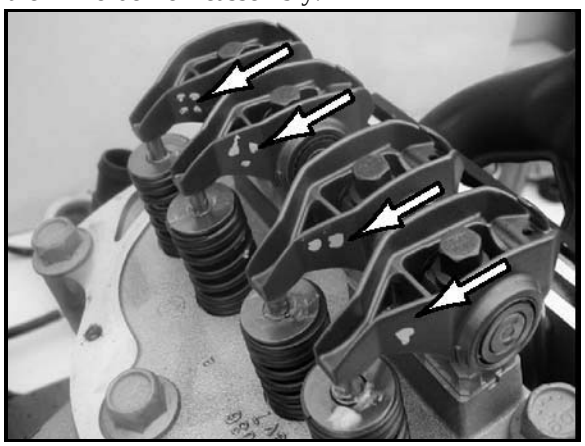
ENGINE DISASSEMBLY AND INSPECTION

Cylinder Head Assembly Exploded View



Rocker Arms

1. Mark or tag rocker arms in order of disassembly to keep them in order for reassembly.



2. Inspect the wear pad at the valve end of the rocker arm for indications of scuffing or abnormal wear. If the pad is grooved, replace the rocker arm.

NOTE: Do not attempt to true this surface by grinding.

3. Check the rocker arm pad and fulcrum seat for excessive wear, cracks, nicks or burrs.

Push Rods

1. Clean push rods (A) in a suitable solvent. Blow dry push rods with compressed air.

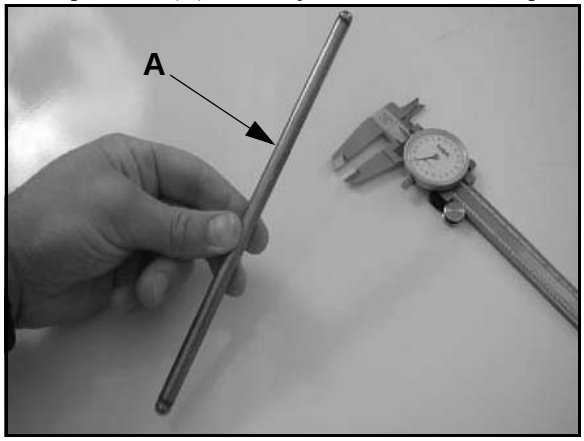
2. Use compressed air to confirm the oil passage is clear in the center of the push rod.

> **⚠ WARNING**
>
> Always wear safety glasses when working with compressed air to prevent personal injury.

3. Check the ends of the push rods (A) for nicks, grooves, roughness or excessive wear.

4. The push rods (A) can be visually checked for straightness while they are installed in the engine by rotating them with the valve closed. Push rods can also be checked with a dial indicator or rolled across a flat surface to check for straightness.

5. If the push rod (A) is visibly bent, it should be replaced.

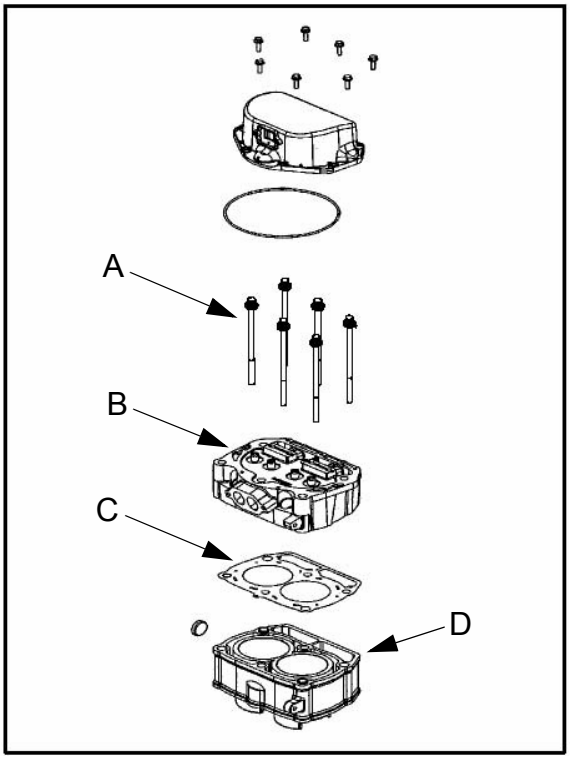


Cylinder Head Removal

1. Loosen the six cylinder head bolts evenly 1/8 turn each in a criss-cross pattern until loose.

2. Remove bolts (A) and tap cylinder head (B) lightly with a soft face hammer until loose. **CAUTION:** Tap only in reinforced areas or on thick parts of cylinder head casting to avoid damaging the head or cylinder.

3. Remove cylinder head (B) and head gasket (C) from the cylinder (D).



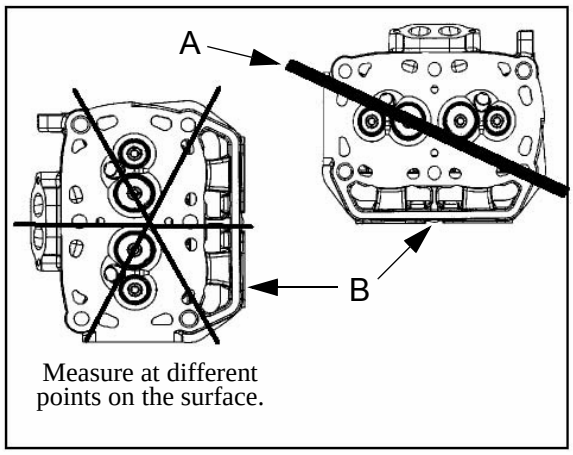
Cylinder Head Inspection

Thoroughly clean cylinder head surface to remove all traces of gasket material and carbon.

CAUTION
Use care not to damage sealing surface.

Cylinder Head Warp

1. Lay a straight edge (A) across the surface of the cylinder head (B) at several different points and measure warp by inserting a feeler gauge between the straight edge and the cylinder head surface. If warp exceeds the service limit, replace the cylinder head.



Measure at different points on the surface.

= In. / mm.
Cylinder Head Warp Limit: .004" (.1016 mm) max

Valve Seal / Spring Service (On Engine)

NOTE: The following procedure is only for servicing the top end of the valve train when replacing valve springs or replacing valve seals.

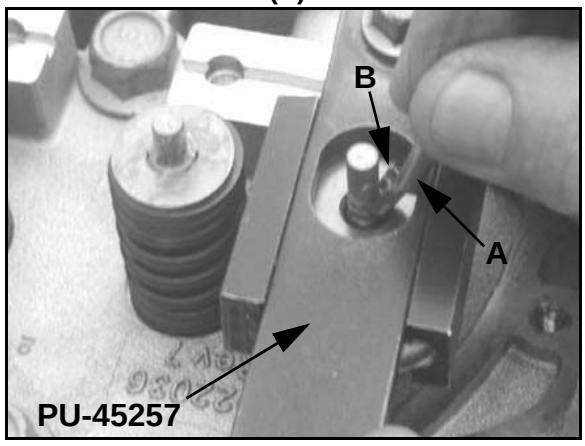
In some cases the valve train can be serviced while the cylinder head is still on the engine. Keep all parts in order with respect to their location in the cylinder head.

⚠ WARNING
Wear eye protection or a face shield during cylinder head disassembly and reassembly.

1. Having already removed the valve cover, rocker arms and pushrods, align the cylinder to be worked on at top dead center (TDC). Install the Valve Pressure Hose **(PU-45652)** into the spark plug hole. Hook the hose to an air compressor and supply 50 to 100 psi to the hose. This will seat the valves during valve spring removal. Do not remove air from the hose at anytime until reassembly is completed.

2. Using the Valve Spring Compressor **(PU-45257)**, compress the valve spring and remove the valve keepers.

NOTE: A small parts magnet (A) can aid in the removal of the retainers (B).



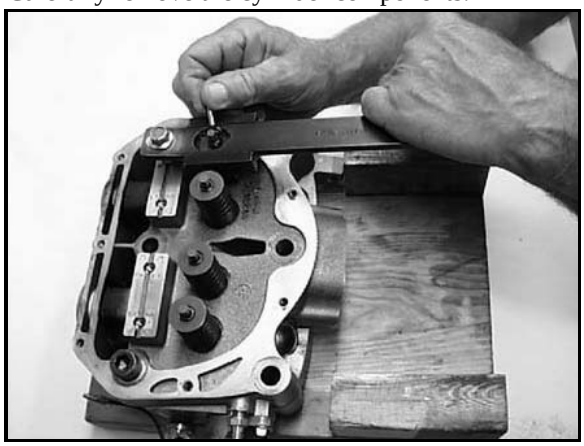
NOTE: To prevent damage to the valve seals, do not compress the valve spring more than is needed to remove the valve keepers.

3. Remove spring retainer and spring.

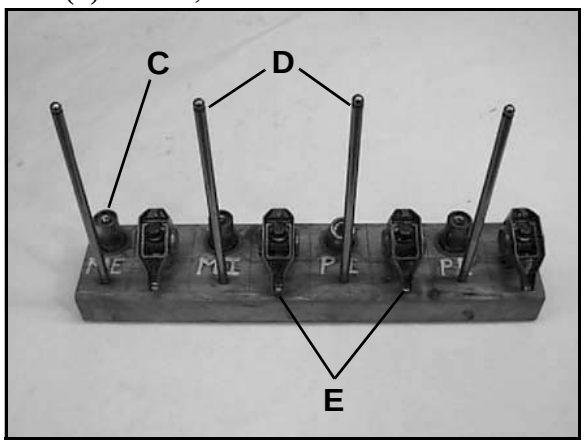
4. The valve seals are now serviceable.

Cylinder Head Disassembly

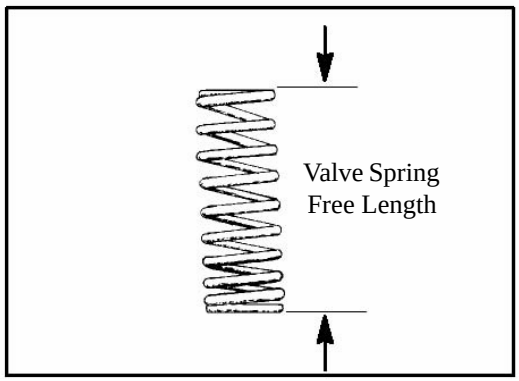
1. Carefully remove the cylinder components.



2. Place the hydraulic lifters (C), pushrods (D), and rocker arms (E) in a safe, clean area.



3. Measure free length of spring with a Vernier caliper. Compare to specifications. Replace spring if measurement is out of specification.



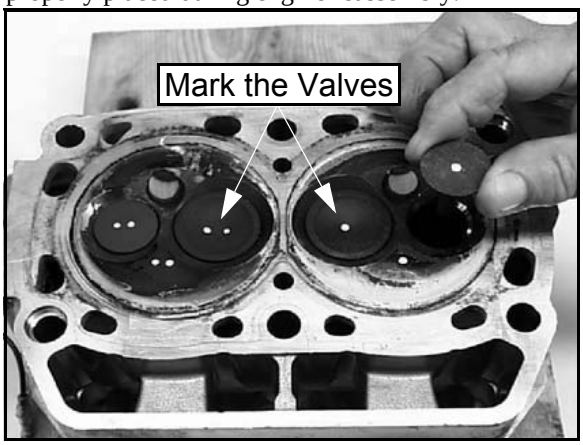
= In. / mm.

Valve Spring Free Length:
Std: 1.735" (44.069 mm)

4. Remove valve guide seals.

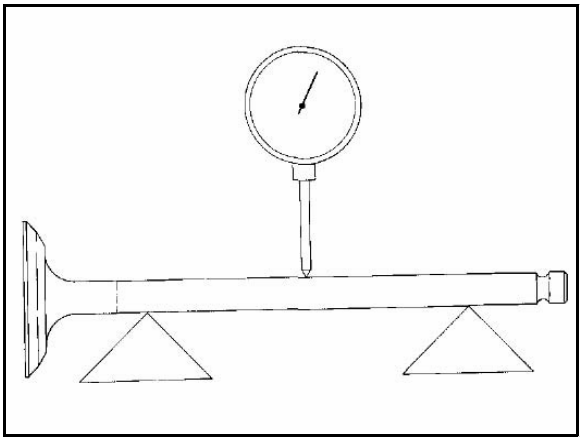
IMPORTANT: It is recommended to replace seals whenever the cylinder head is disassembled. Hardened, cracked or worn valve seals will cause excessive oil consumption and carbon buildup.

5. Mark the valves with a white pen. Remove the valves from the cylinder head. This will ensure that the valves are properly placed during engine reassembly.

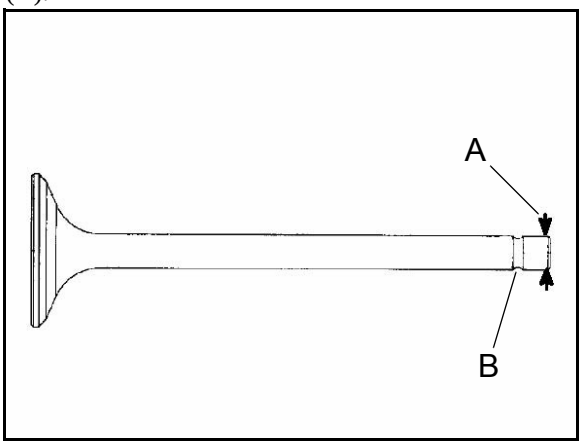


Valve Inspection

1. Remove all carbon from valves with a soft wire wheel or brush.
2. Check valve face for runout, pitting, and burnt spots. To check for bent valve stems, mount valve in a drill or use "V" blocks and a dial indicator.



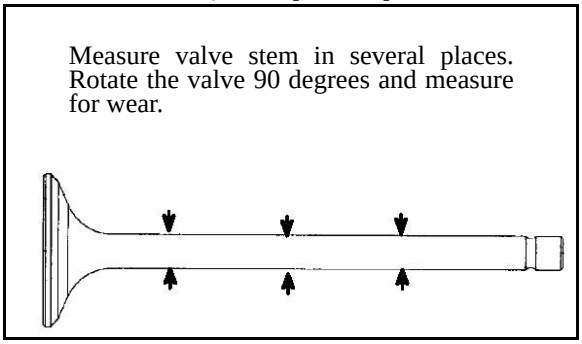
3. Check end of valve stem for flaring, pitting, wear or damage (A).



4. Inspect split keeper groove for wear or flaring of the keeper seat area (B).

NOTE: The valves can be re-faced or end ground, if necessary. They must be replaced if extensively worn, burnt, bent, or damaged.

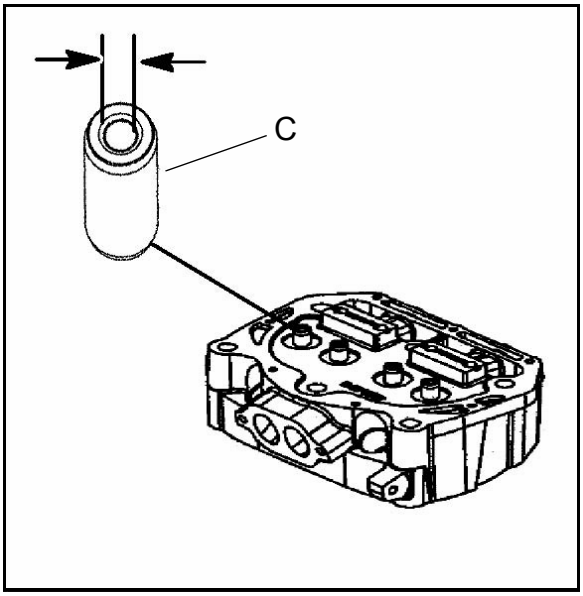
5. Measure diameter of valve stem with a micrometer in three places, then rotate 90 degrees and measure again (six measurements total). Compare to specifications.

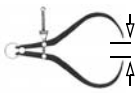


= In. / mm.

Valve Stem Diameter:
Intake: 0.2356" + 0.00039"
(5.985 + 0.01 mm)
Exhaust: 0.2351" + 0.00039"
(5.972 + 0.01 mm)

6. Measure valve guide (C) inside diameter at the top middle and end of the guide using a small hole gauge and a micrometer. Measure in two directions.



 **= In. / mm.**

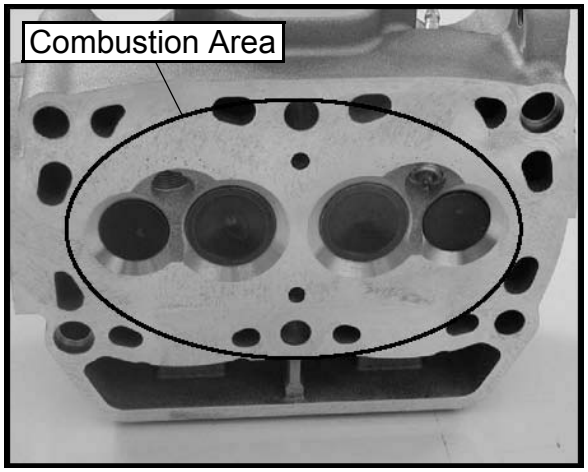
Valve Guide I.D.:
0.23672" + 0.000295"
(6.0617 + 0.0075 mm)

7. Subtract valve stem measurement from the valve guide measurement to obtain stem to guide clearance. NOTE: The valve guides cannot be replaced. Be sure to measure each guide and valve combination individually.

Combustion Chamber

1. Clean all accumulated carbon deposits from combustion chamber and valve seat area with carbon cleaner and a soft plastic scraper.

IMPORTANT: Do not use a wire brush, metal scraper, or abrasive cleaners to clean the bottom of the cylinder head. Extensive damage to the cylinder head may result. Wear safety glasses during cleaning.



Valve Seat Reconditioning

NOTE: Polaris recommends that the work be done by a local machine shop that specializes in this area.

NOTE: The cylinder head valve guides cannot be replaced.

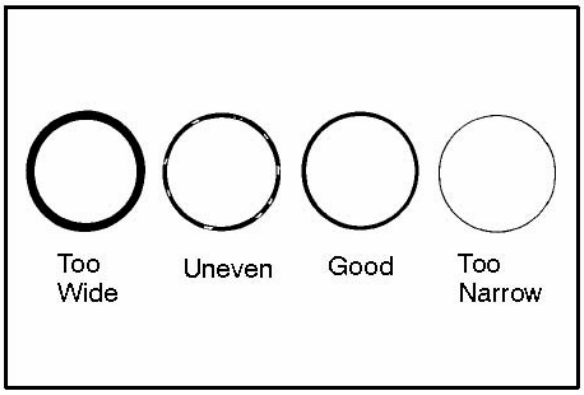
> **⚠ WARNING**
>
> Wear eye protection or a face shield during cylinder head disassembly and reassembly.

Valve Seat Inspection

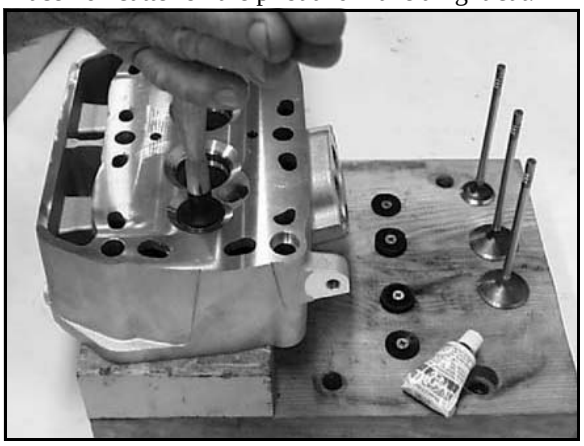
Inspect valve seat in cylinder head for pitting, burnt spots, roughness, and uneven surface. If any of the above conditions exist, the valve seat must be reconditioned. *If the valve seat is cracked the cylinder head must be replaced.*

Follow the manufacturers instructions provided with the valve seat cutters in the Cylinder Head Reconditioning Kit **(PN 2200634)**. Abrasive stone seat reconditioning equipment can also be used. Keep all valves in order with their respective seat.

NOTE: Valve seat width and point of contact on the valve face is very important for proper sealing. The valve must contact the valve seat over the entire circumference of the seat, and the seat must be the proper width all the way around. If the seat is uneven, compression leakage will result. If the seat is too wide, seat pressure is reduced, causing carbon accumulation and possible compression loss. If the seat is too narrow, heat transfer from valve to seat is reduced. The valve may overheat and warp, resulting in burnt valves.



1. Install pilot into valve guide.
2. Apply cutting oil to valve seat and cutter.
3. Place 46° cutter on the pilot and make a light cut.



4. Inspect the cut area of the seat:

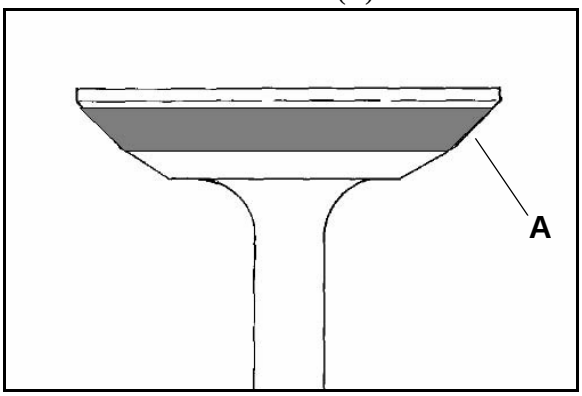
* If the contact area is less than 75% of the circumference of the seat, rotate the pilot 180° and make another light cut.

* If the cutter now contacts the uncut portion of the seat, check the pilot. Look for burrs, nicks, or runout. If the pilot is bent it must be replaced.

* If the contact area of the cutter is in the same place, the valve guide is distorted from improper installation

* If the contact area of the initial cut is greater than 75%, continue to cut the seat until all pits are removed and a new seat surface is evident. **NOTE:** Remove only the amount of material necessary to repair the seat surface.

5. To check the contact area of the seat on the valve face, apply a thin coating of Prussian Blue™ paste to the valve seat. If using an interference angle (46°) apply black permanent marker to the entire valve face (A).



6. Insert valve into guide and tap valve lightly into place a few times.

7. Remove valve and check where the Prussian Blue™ indicates seat contact on the valve face. The valve seat should contact the middle of the valve face or slightly above, and must be the proper width.

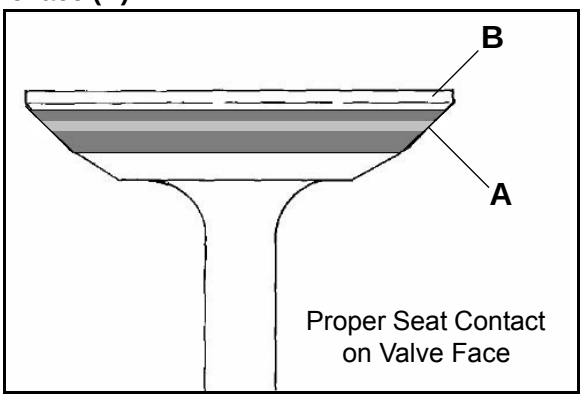
* If the indicated seat contact is at the top edge of the valve face and contacts the margin area (B) it is too high on the valve face. Use the 30° cutter to lower the valve seat.

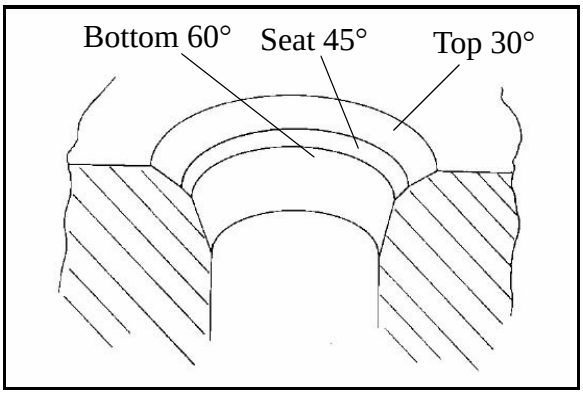
* If too low, use the 60° cutter to raise the seat. When contact area is centered on the valve face, measure seat width.

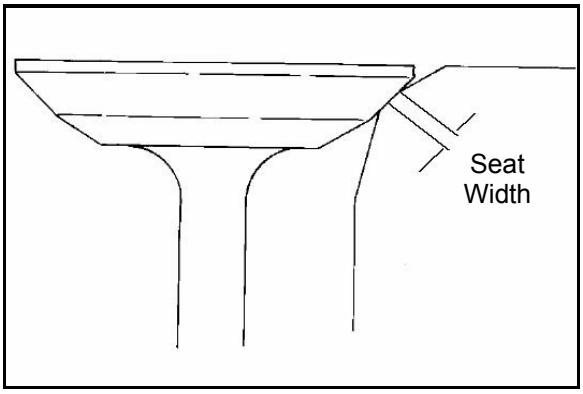
* If the seat is too wide or uneven, use both top and bottom cutters to narrow the seat.

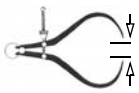
* If the seat is too narrow, widen using the 45° cutter and re-check contact point on the valve face and seat width after each cut.

NOTE: When using an interference angle, the seat contact point on the valve will be very narrow, and is a normal condition. Look for an even and continuous contact point all the way around the valve face (A).









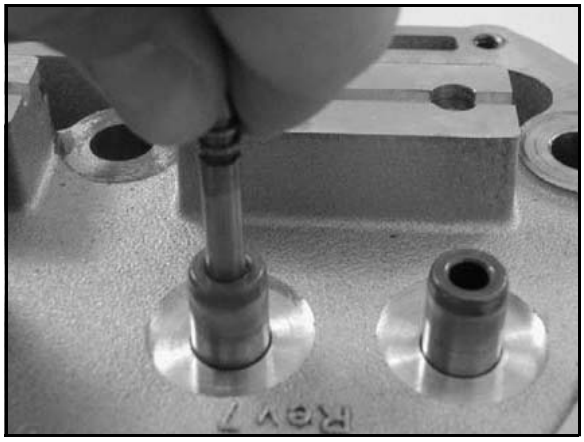
Valve Seat Width:
Intake Std: .028" (.7 mm)
Limit: .055" (1.4 mm)
Exhaust Std: .039l (1.0 mm)
Limit: .071" (1.8 mm)

8. Clean all filings from the area with hot soapy water. Rinse and dry with compressed air.

9. Lubricate the valve guides with clean engine oil, and apply oil or water based lapping compound to the face of the valve.

NOTE: Lapping is not required with an interference angle valve job.

10. Insert the valve into its respective guide and lap using a lapping tool or a section of fuel line connected to the valve stem.



11. Rotate the valve rapidly back and forth until the cut sounds smooth. Lift the valve slightly off of the seat, rotate 1/4 turn, and repeat the lapping process. Do this four to five times until the valve is fully seated, and repeat process for the other valve(s).

12. Thoroughly clean cylinder head and valves.

Cylinder Head Reassembly

NOTE: Assemble the valves one at a time to maintain proper order.

1. Apply engine oil to valve guides and seats.

2. Coat valve stem with molybdenum disulfide grease or 2W-50 Synthetic engine oil.

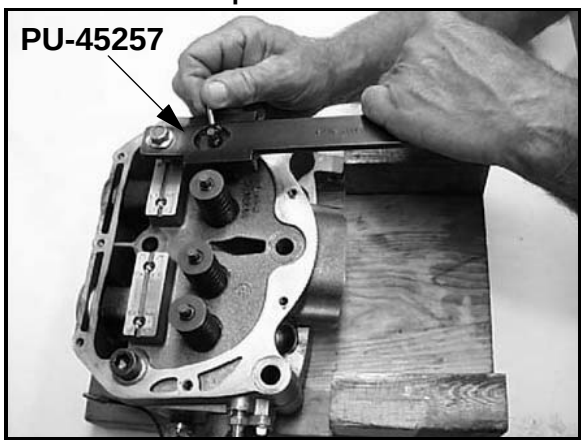
3. Install valve carefully with a rotating motion to avoid damaging valve seal.

4. Valve seals should be installed after the valves are in the head to avoid valve seal damage. Install new valve seals on valve guides.

5. Dip valve spring and retainer in clean engine oil and install.

6. Place retainer on spring and install Valve Spring Compressor **(PU-45257)**. Install split keepers with the gap even on both sides.

NOTE: A small magnet can be used to aid in the installation of the keepers.

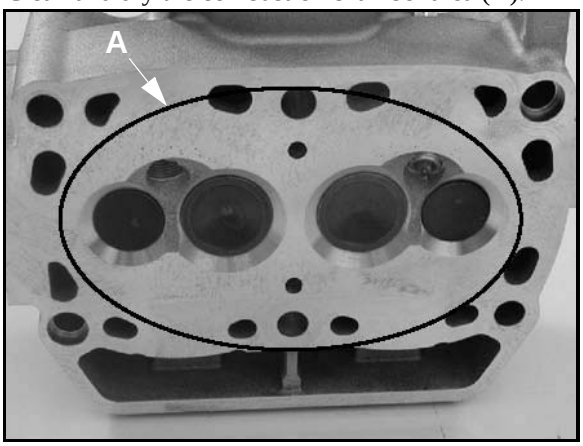


7. Repeat procedure for remaining valves. When all valves are installed, tap lightly with soft faced hammer on the end of the valves to seat the split keepers.

NOTE: To prevent damage to the valve seals, do not compress the valve spring more than necessary to install the keepers.

Valve Sealing Test

1. Clean and dry the combustion chamber area (A).



2. Pour a small amount of clean solvent onto the intake port and check for leakage around each intake valve. The valve seats should hold fluid with no seepage.

3. Repeat for exhaust valves by pouring fluid into exhaust port.

Cylinder Removal

1. Follow engine disassembly procedures to remove rocker cover and cylinder head.

2. Tap cylinder (A) lightly with a rubber mallet in the reinforced areas only until loose.

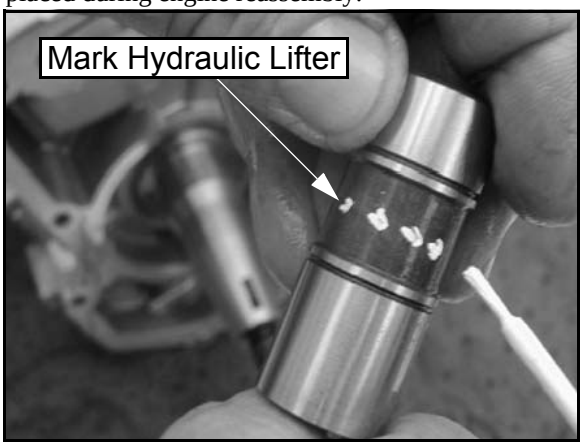
3. Rock cylinder forward and backward while lifting it from the crankcase, supporting pistons and connecting rods. Support pistons with Piston Support Block (PN 2870390).

Valve Lifter Removal / Inspection

1. Remove the valve lifters by reaching into the crankcase and pushing the lifter up through the lifter bore by hand.

2. Thoroughly clean the lifters in cleaning solvent and wipe them with a clean, lint-free cloth.

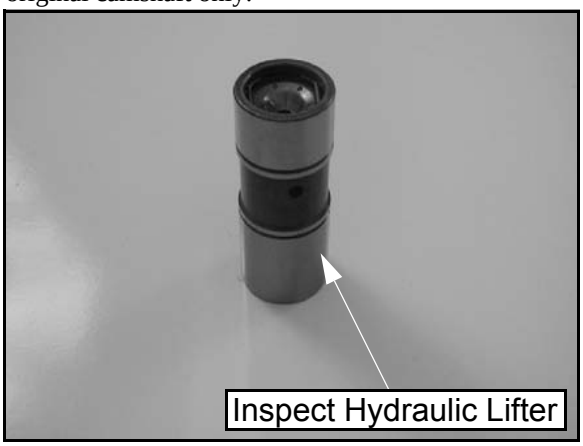
3. Mark the lifters with a white pen if using the lifters for reassembly. This will ensure that the lifters are properly placed during engine reassembly.



4. Check the lifters for wear or scores.

5. Check the bottom end of lifter to make sure that it has a slight convex.

6. If the bottom surface has worn flat, it may be used with the original camshaft only.



NOTE: Lifters that are scored, worn, or if the bottom is not smooth should be replaced with new lifters and cam as an assembly. If replacing the lifters, the camshaft should also be replaced.

Piston Removal

1. Remove circlip (A). Mark the piston with a white pen to ensure proper orientation (if reused) during assembly.

NOTE: If the pistons are to be reused, reassemble the pistons in the same cylinder and direction from which they were removed.

NOTE: New pistons are non-directional and can be placed in either cylinder.

2. Remove piston circlip and push piston pin out of piston. If necessary, heat the crown of the piston slightly with a propane torch. **CAUTION:** Do not apply heat to the piston rings. The ring may lose radial tension.

3. Remove top compression ring:

***Using a piston ring pliers:** Carefully expand ring and lift it off the piston. **CAUTION:** Do not expand the ring more than the amount necessary to remove it from the piston, or the ring may break.

***By hand:** Placing both thumbs as shown, spread the ring open and push up on the opposite side. Do not scratch the ring lands.

4. Repeat procedure for second ring.

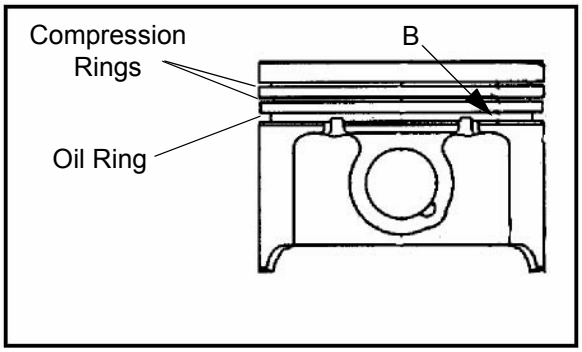
5. Remove the oil control ring.

The oil control ring is a three piece design consisting of a top and bottom steel rail and a center expander section. The top rail has a locating tab on the end which fits into a notch (B) in the upper oil ring land of the piston.

To Remove:

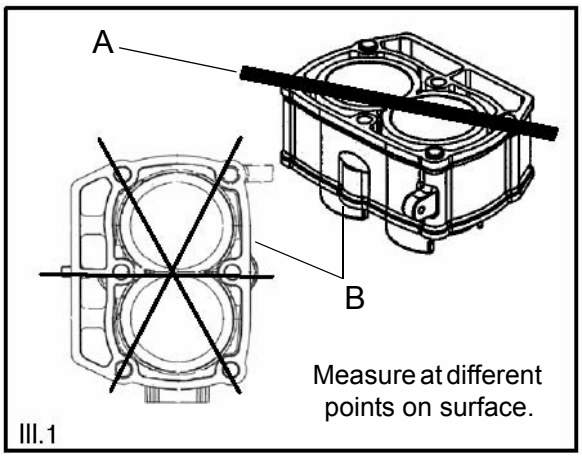
A) Remove the top rail first followed by the bottom rail.

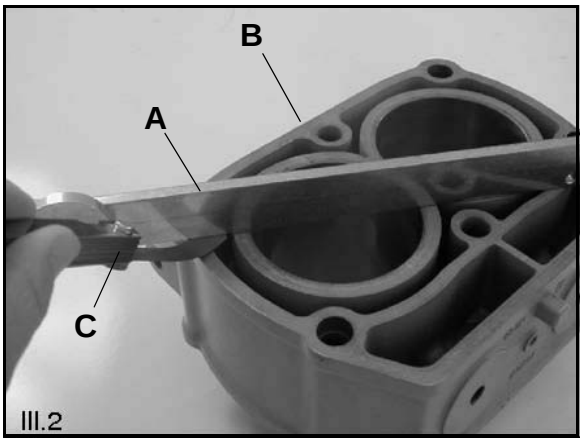
B) Remove the expander.



Cylinder Inspection

1. Remove all gasket material from the cylinder sealing surfaces.
2. Inspect the top of the cylinder (B) for warp using a straight edge (A) and feeler gauge (C). Refer to Ill. 1 and Ill. 2.

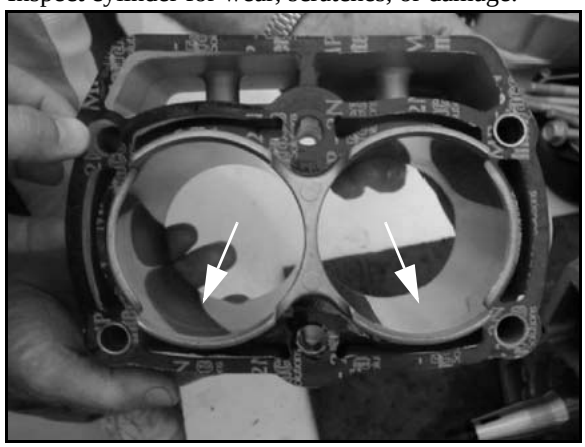




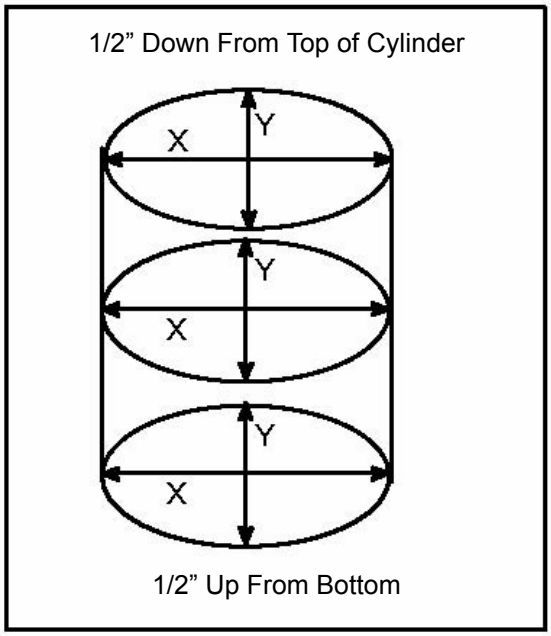
= In. / mm.

Cylinder Warp: .004" (0.1 mm) Max.

3. Inspect cylinder for wear, scratches, or damage.



4. Inspect cylinder for taper and out of round with a telescoping gauge or a dial bore gauge. Measure in two different directions, front to back and side to side, on three different levels (1/2, down from top, in the middle, and 1/2, up from bottom). Record measurements. If cylinder is tapered or out of round beyond .002", the cylinder must be replaced.



= In. / mm.

Cylinder Taper Limit:
.002" (9.05mm) Max.

Cylinder Out of Round:
Limit: .002" (.0 mm) Max.

700 Standard Bore Size
(Both Cylinders): 3.1496" (80 mm)

Cylinder Hone Selection And Honing Procedure

Cylinders may be wet or dry honed depending upon the hone manufacturer's recommendations. Wet honing removes more material faster and leaves a more distinct pattern in the bore.

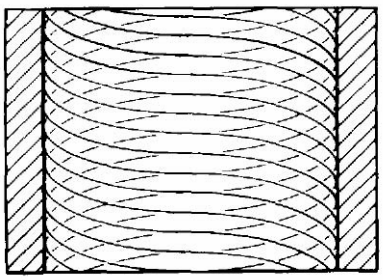
CAUTION
A hone which will straighten as well as remove material from the cylinder is very important. Using a common spring loaded glaze breaker for honing is not advised for nicasil cylinders. Polaris recommends using a rigid hone or arbor honing machine. Cylinders may be wet or dry honed depending upon the hone manufacturer's recommendations. Wet honing removes more material faster and leaves a more distinct pattern in the bore.

Honing To Deglaze

A finished cylinder should have a cross-hatch pattern to ensure piston ring seating and to aid in the retention of the fuel/oil mixture during initial break in. Hone cylinder according to hone manufacturer's instructions, or these guidelines:

- Honing should be done with a diamond hone. Cylinder could be damaged if the hone is not hard enough to scratch the nicasil lining.
- Use a motor speed of approximately 300-500 RPM, run the hone in and out of the cylinder rapidly until cutting tension decreases. Remember to keep the hone drive shaft centered (or cylinder centered on arbor) and to bring the stones approximately 1/2, (1.3 cm) above and below the bore at the end of each stroke.
- Release the hone at regular intervals and inspect the bore to determine if it has been sufficiently de-glazed, and to check for correct cross-hatch.
  NOTE: Do not allow cylinder to heat up during honing.
- After honing has been completed, inspect cylinder for thinning or peeling.

If cylinder wear or damage is excessive, it will be necessary to replace the cylinder. The cylinders are lined with a nicasil coating and are not repairable. Hone only enough to de-glaze the outer layer of the cylinder bore.



Example of Cross Hatch Pattern

IMPORTANT: Clean the cylinder after honing

If cylinder wear or damage is excessive, it will be necessary to replace the cylinder. The cylinders are lined with a nicasil coating and are not repairable. Hone only enough to de-glaze the outer layer of the cylinder bore.

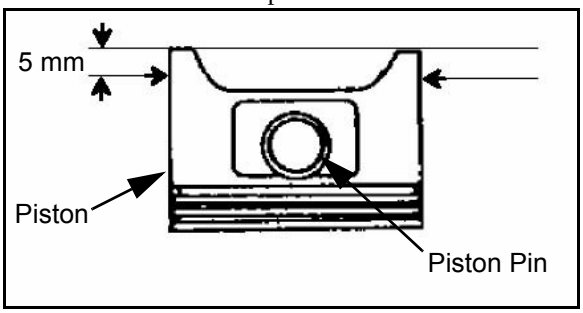
Cleaning the Cylinder After Honing

It is very important that the cylinder be thoroughly cleaned after honing to remove all grit material. Wash the cylinder in a solvent, then in hot, soapy water. Pay close attention to areas where the cylinder sleeve meets the aluminum casting (transfer port area). Use electrical contact cleaner if necessary to clean these areas. Rinse thoroughly, dry with compressed air, and oil the bore immediately with Polaris Lubricant.

Piston-to-Cylinder Clearance

Measure piston outside diameter at a point 5 mm up from the bottom of the piston at a right angle to the direction of the piston pin.

Subtract this measurement from the maximum cylinder measurement obtained in Step 5.

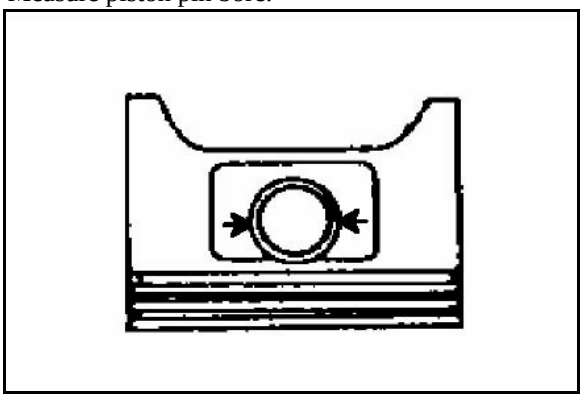


Piston to Cylinder Clearance:
See "700 EFI Engine Service Specifications" on page 3.11

Piston O.D.:
See "700 EFI Engine Service Specifications" on page 3.11

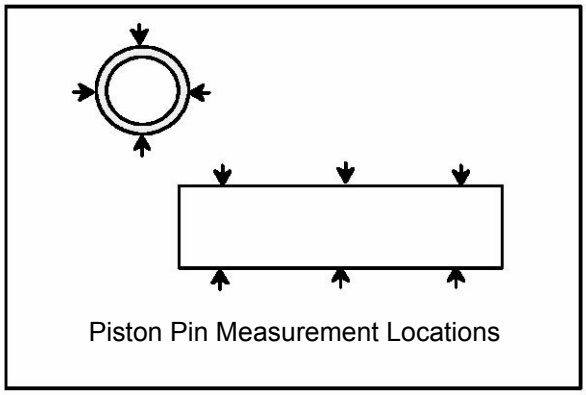
Piston / Rod Inspection

1. Measure piston pin bore.



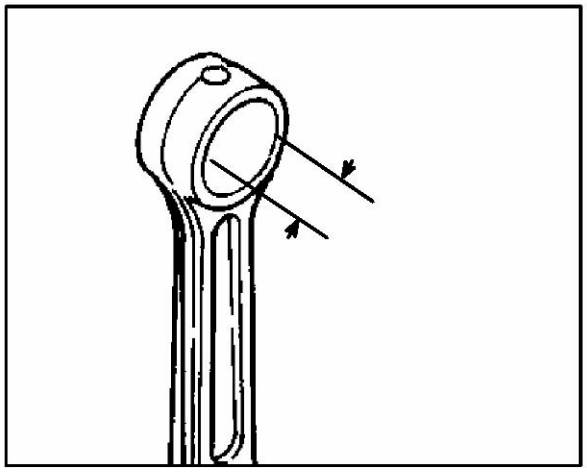
Piston Pin Bore:
See "700 EFI Engine Service Specifications" on page 3.11

2. Measure piston pin O.D. Replace piston and/or piston pin if out of tolerance.



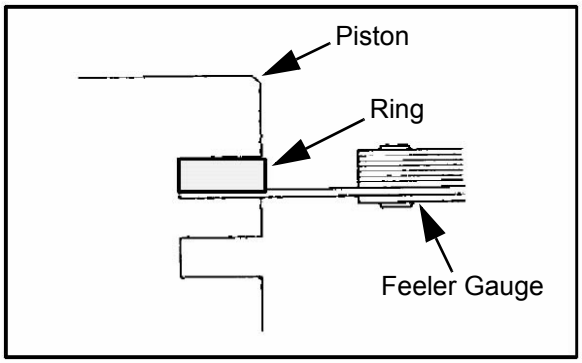
Piston Pin O.D.:
See "700 EFI Engine Service Specifications" on page 3.11

3. Measure connecting rod small end ID.



Connecting Rod Small End I.D.:
See "700 EFI Engine Service Specifications" on page 3.11

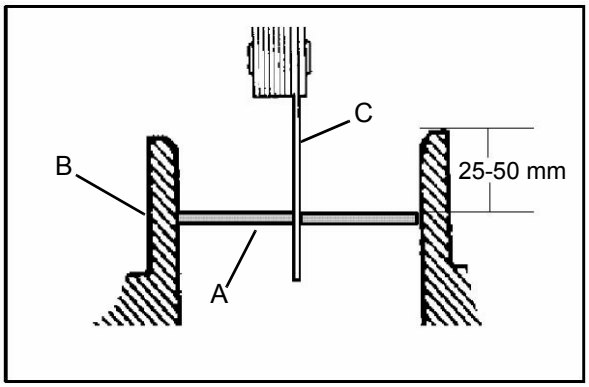
4. Measure piston ring to groove clearance by placing the ring in the ring land and measuring with a thickness gauge. Replace piston and rings if ring-to-groove clearance exceeds service limits.



See "700 EFI Engine Service Specifications" on page 3.11

Piston Ring Installed Gap

1. Place each piston ring (A) inside cylinder (B) using piston to push ring squarely into place as shown.



Piston Ring Installed Gap
See "700 EFI Engine Service Specifications" on page 3.11

NOTE: Ring should be installed with the mark facing upward.

2. Measure installed gap with a feeler gauge (C) at both the top and bottom of the cylinder.

IMPORTANT: A difference in end gap indicates cylinder taper. The cylinder should be measured for excessive taper and out of round.

3. If the bottom installed gap measurement exceeds the service limit, replace the rings. If ring gap is smaller than the specified limit, file ring ends until gap is within specified range.

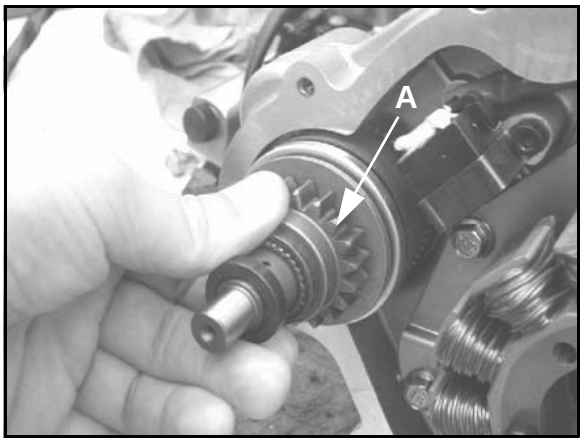
NOTE: Always check piston ring installed gap after re-boring a cylinder or when installing new rings. A re-bored cylinder should always be scrubbed thoroughly with hot soapy water, rinsed, and dried completely. Wipe cylinder bore with oil immediately to remove residue and prevent rust.

Starter Drive Bendix Removal / Inspection

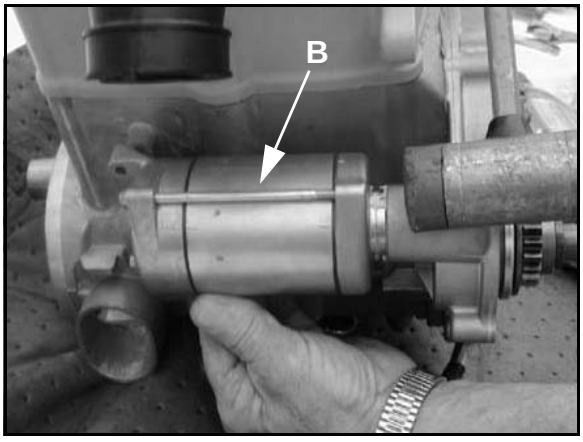
1. Remove stator housing bolts and remove housing.
2. Remove the flywheel nut and washer. Install Flywheel Puller (PN 2871043) and remove flywheel.

NOTE: Do not thread the puller bolts into the flywheel more than 1/4, or stator coils may be damaged.

3. Remove starter bendix assembly (A). Note the thrust washers located on both sides of the bendix.

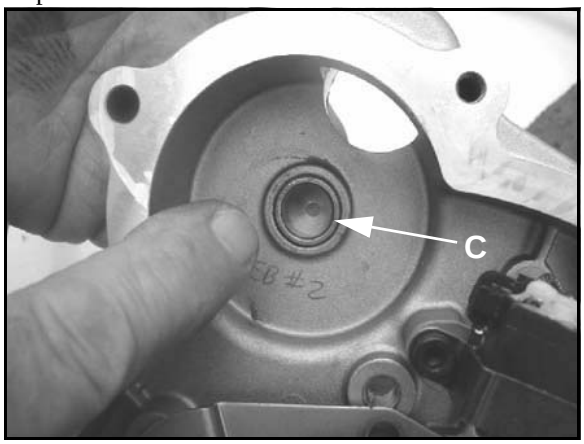


4. Inspect the thrust washer for wear or damage and replace if necessary.
5. After the bendix is removed, remove the two bolts retaining the starter. Tap on the starter assembly (B) with a soft faced mallet to loosen the starter from the crankcase.



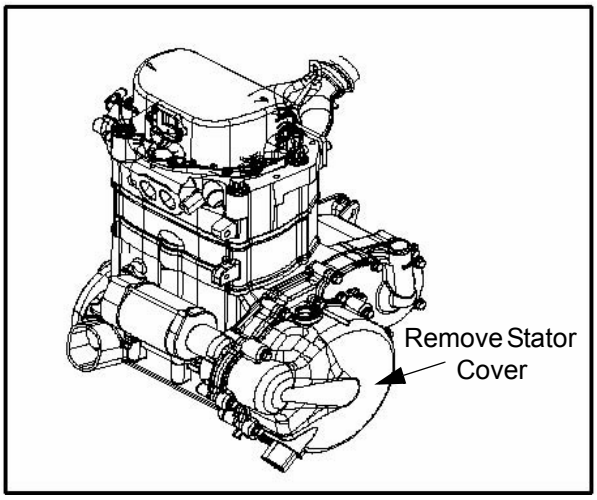
6. Inspect gear teeth on starter drive (A). Replace starter drive if gear teeth are cracked, worn, or broken.

7. Inspect the bendix bushing (C) in the mag cover for wear. Replace as needed.



Flywheel / Stator Removal / Inspection

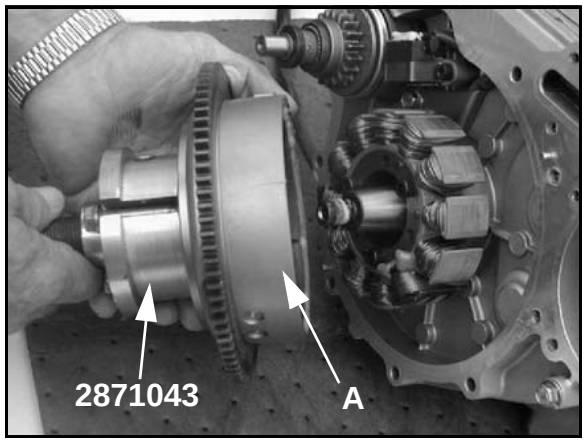
1. Remove stator housing bolts and remove housing.



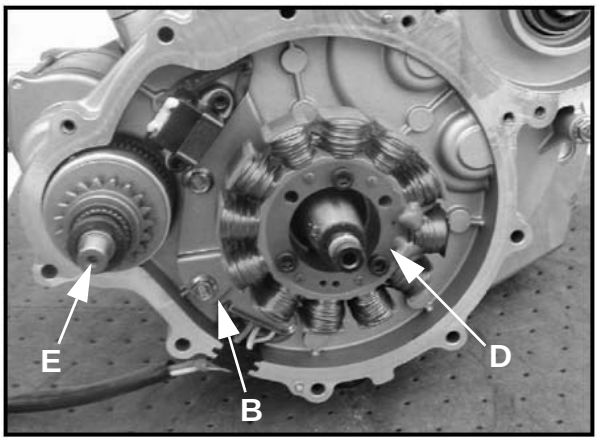
2. Remove flywheel nut and washer.

3. Install Flywheel Puller **(PN 2871043)** and remove flywheel (A).

> **CAUTION**
>
> Do not thread the puller bolts into the flywheel more than 1/4, or stator coils may be damaged.



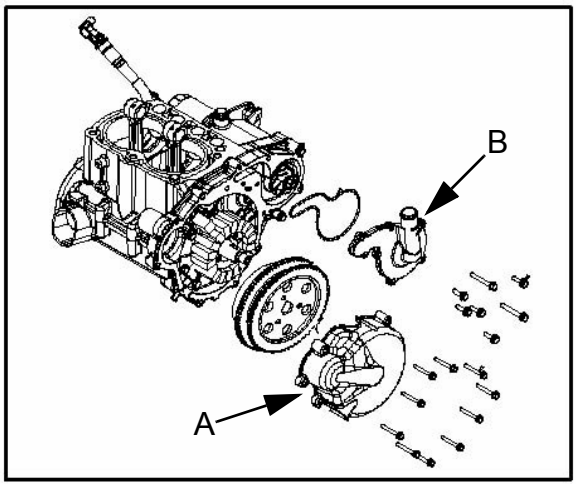
4. Use caution when removing the wire holddown (B) and the stator assembly (D). **Do not tap or bump the gear /stator housing cover or the stator.** This could cause the seal around the gear/stator housing cover and the crankcase to break, causing a leak.



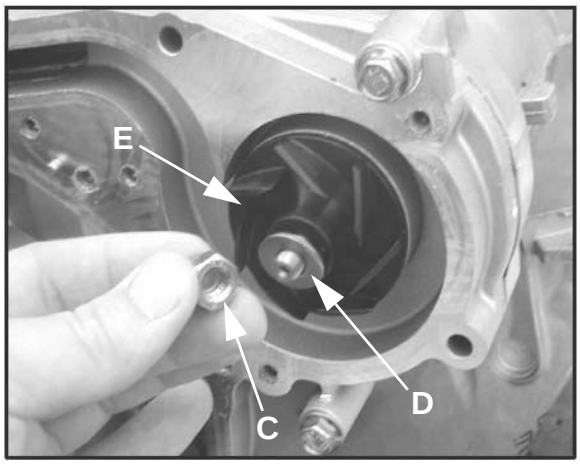
5. Remove the bendix (E) if necessary.

Engine Crankcase Disassembly / Inspection

1. Remove the stator cover (A) and water pump cover (B).



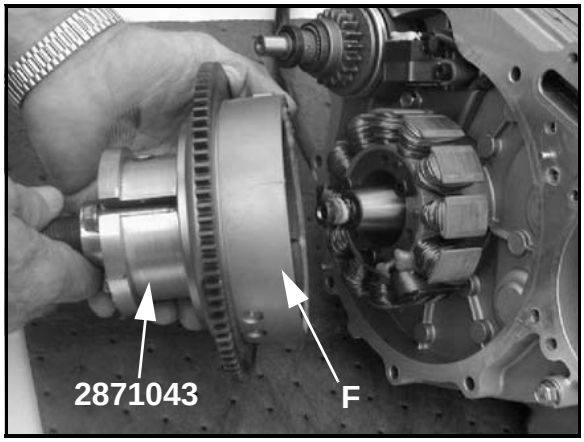
2. Remove the nylok nut (C), washer (D), and water pump impeller (E). Remove part of the water pump seal behind the impeller.



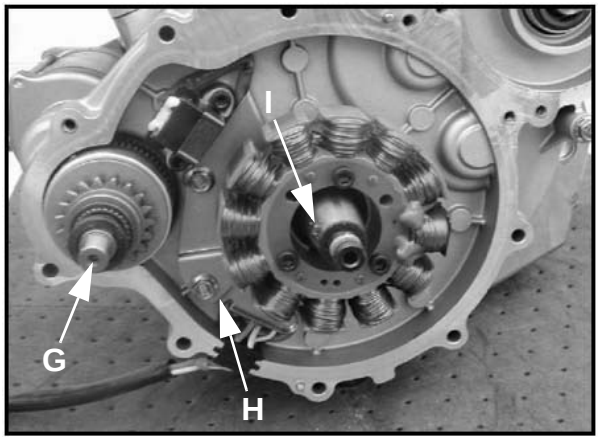
3. Remove flywheel nut and washer.

4. Install Flywheel Puller **(PN 2871043)** and remove flywheel (F).

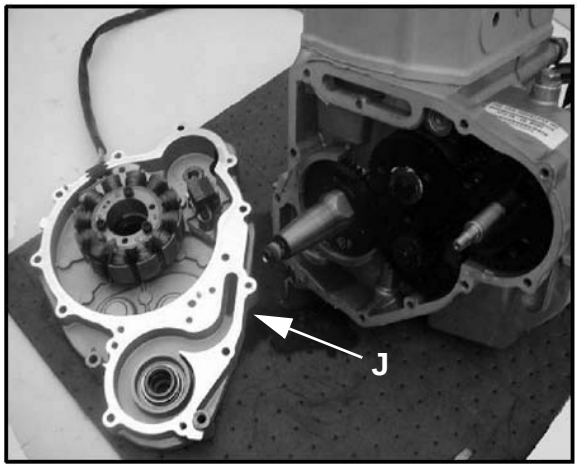
> **⚠ CAUTION**
>
> Do not thread the puller bolts into the flywheel more than 1/4, or stator coils may be damaged.



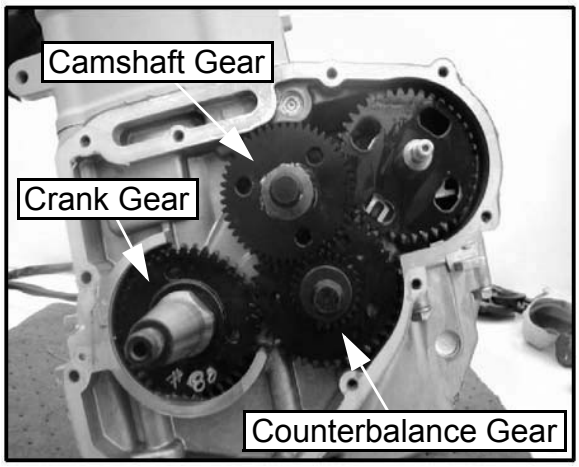
5. Remove the starter bendix (G), wire holddown plate (H), and the woodruff key (I) from the crankshaft. The stator does not have to be removed at this point.



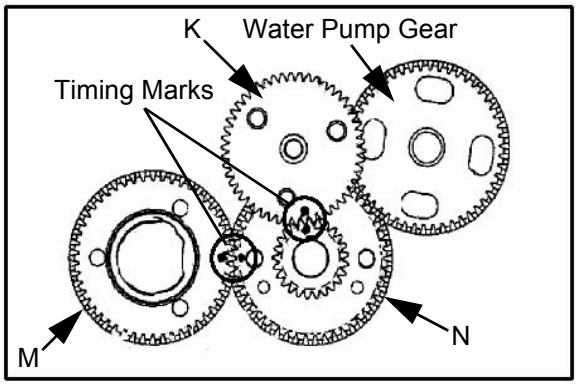
6. Remove the gear/stator housing bolts and remove the gear/stator housing cover (J) and gasket from the crankcase. Be sure to catch the excess oil from the crankcase.



7. Note the positions of the gears in the photo.



8. Use a white pen to accent the timing marks on the following gears: camshaft gear (K), crankshaft gear (M), or counterbalance gear (N) This will ensure proper gear alignment and timing during reassembly of the gears.

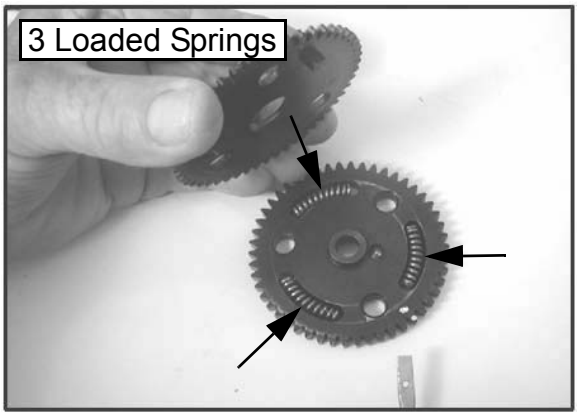


NOTE: If replacing one of the gears, it is recommended that all of the gears be replaced. A gear kit is available.

9. Use the Cam Gear Tooth Alignment Tool (PU-45497-2) (O) to align the cam split gear assembly. With the split gear aligned, remove the bolt and cam gear assembly.

NOTE: Install the Cam Gear Tooth Alignment Tool (PU-45497-2) into the assembly hole counter clockwise from the timing mark as shown.

10. Inspect the cam gear teeth and check to make sure there is spring tension offsetting the teeth between the two gears. If there is no tension, check the springs inside of the cam gear assembly.



11. The cam gear assembly contains three loaded springs. To open the cam gear assembly:

* Place the cam gear on a flat surface with the timing mark side facing up.

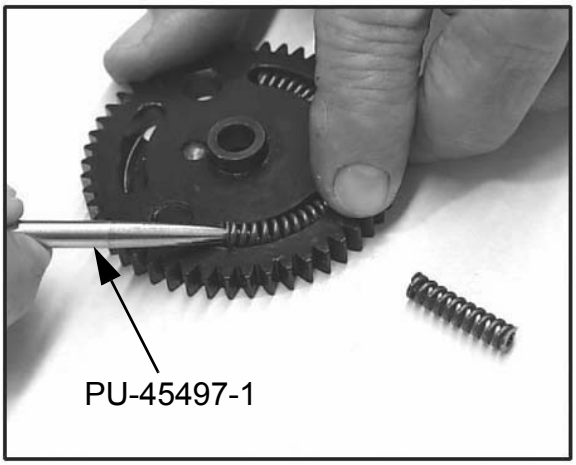
* While holding both gears together, lightly work a small flathead screwdriver between the two gears.

* Remove the top gear. The springs should stay in place.

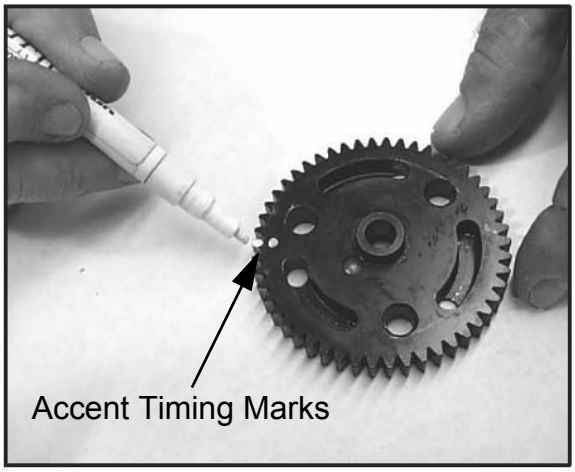
⚠ CAUTION

Wear safety glasses at all times. Use caution when working with the top gear.
The springs could cause injury or become lost should they pop out.

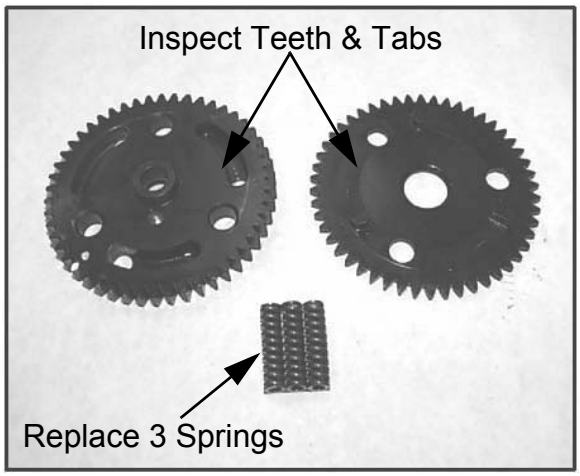
12. Remove all three springs using one of the tapered pins from the Tapered Pins **(PU-45497-1)**.



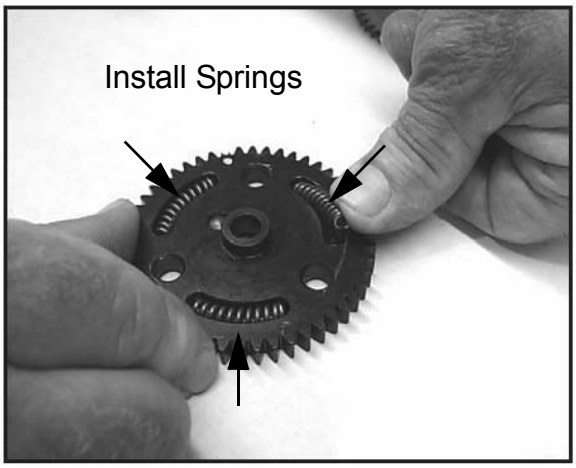
13. With a white marking pen, accent the timing mark on the gear that contains the springs.



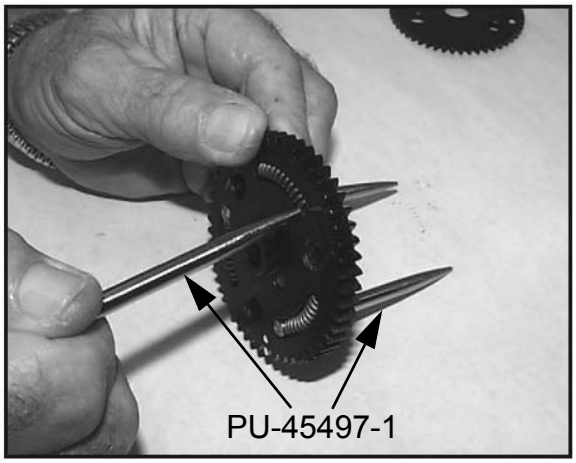
14. Inspect the gear teeth and the three tabs on the gears for wear.



15. Install the new springs into the grooves of the cam gear.



16. Insert the pointed dowels from the Tapered Pins **(PU-45497-1)** into the cam gear.



To Assemble:

* Hold the spring with one finger.

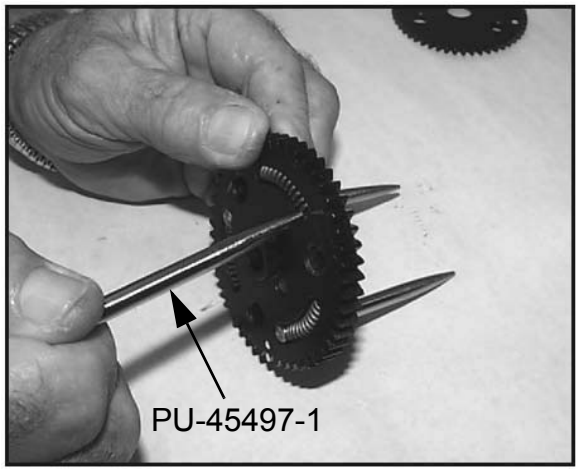
* Start the pointed end of the tapered pin into the cam gear hole and slowly push the dowel through the hole until the end of the dowel is almost flush with the spring.

* Perform this procedure with all three tapered pins.

* Do not push the pins too far through or the springs will pop out.

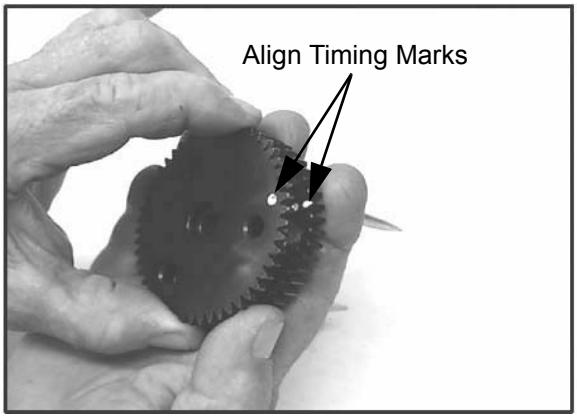
NOTE: Do not remove the tapered pins at this time.

17. Note in the photograph that the Tapered Pins **(PU-45497-1)** are below flush with end of the springs. This helps to align the three gear tabs during the next step.



Cam Gear Spring Installation Tool Kit:
(PU-45497)
Tapered Pins:
(PU-45497-1)
Cam Gear Tooth Align Tool:
(PU-45497-2)

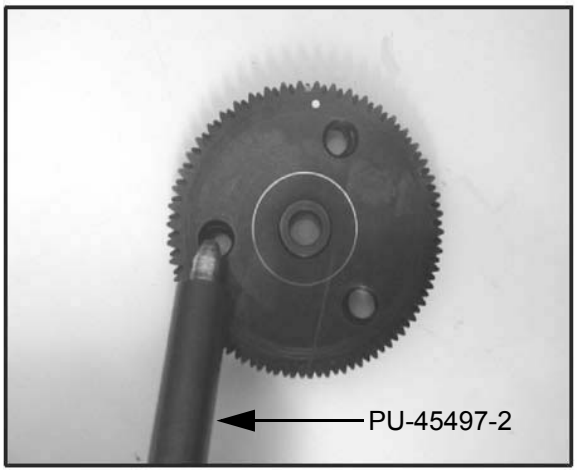
18. Line up the two gears using the timing marks and the three gear tabs that were referenced earlier. Push the gears back together, using both hands and hold securely.



19. Once the gears are pressed together, firmly hold the gears together with one hand. Carefully remove the Tapered Pins **(PU-45497-1)** by pulling them out one at a time with the other hand.

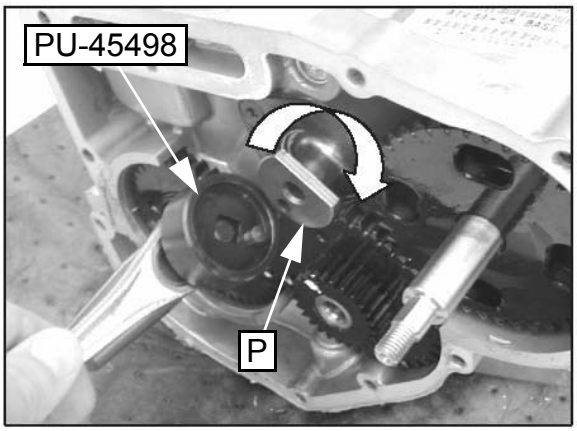
20. After the tapered pins are removed, be sure the cam gear assembly is held together tightly. Place the cam gear assembly on a flat surface. Use the Cam Gear Tooth Alignment Tool **(PU-45497-2)** to align the teeth of the cam gears, as shown in the picture.

NOTE: Install the Cam Gear Alignment Tool (PU-45497-2) into one assembly hole counter clockwise from the timing mark.



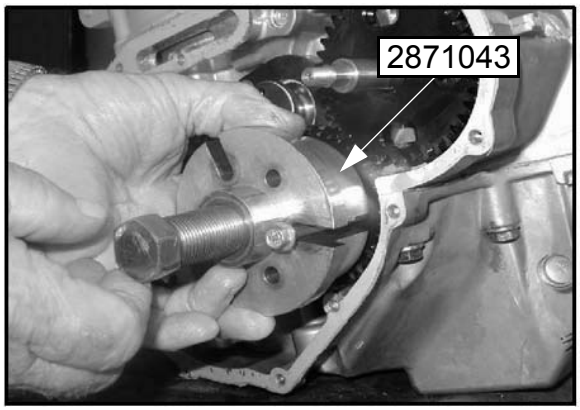
NOTE: For ease of installing the Cam Gear Alignment Tool (PU-45497-2), use a twisting motion when pushing down on the tool.

21. To remove the balance shaft gear, the flat side of the camshaft (P) must face the balance shaft gear. To rotate the camshaft, use the Cam Spanner Wrench (PU-45498) to rotate the camshaft so the flat side of the camshaft faces the balance shaft gear.

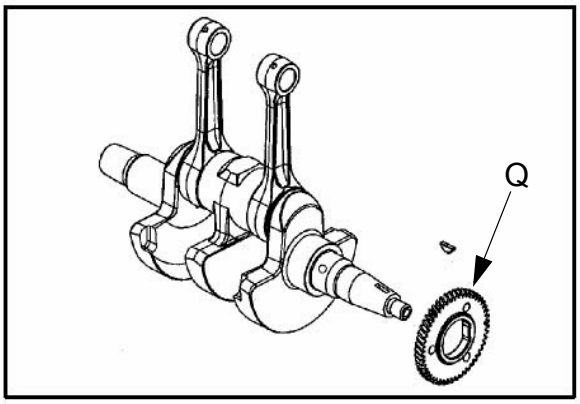


NOTE: This Cam Spanner Wrench (PU-45498) is only needed to rotate the camshaft when the entire valve train is assembled. If the rocker arms are removed, the cam-shaft can be turned by hand.

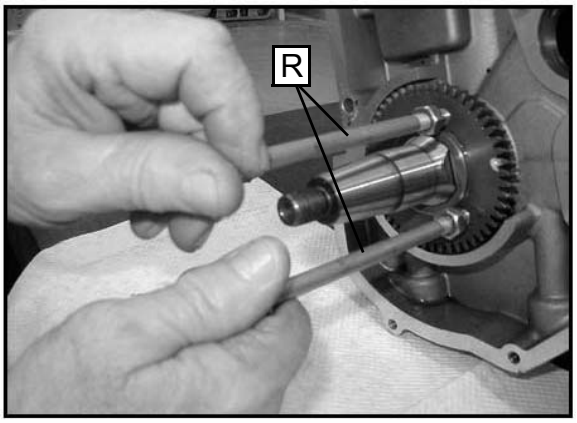
22. Remove the bolt and nut from the balance shaft gear. Try to remove the balance shaft gear. If the gear does not come off manually, use the Flywheel Puller (PN 2871043) to remove the balance shaft gear.



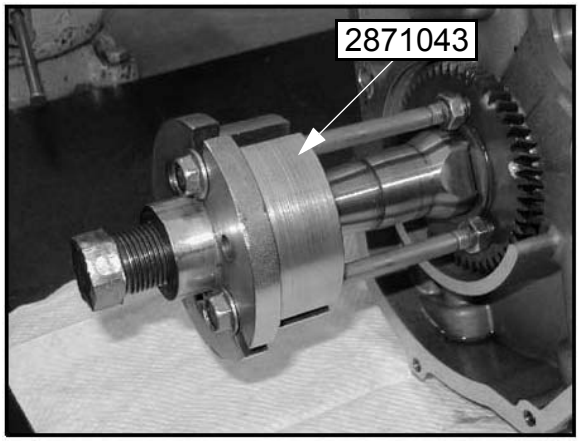
23. Inspect the crankshaft gear (Q) for broken or worn teeth. If the crankshaft gear does not need to be replaced, it does not need to be removed. If the crankshaft gear is damaged, remove the crankshaft gear with the Flywheel Puller **(PN 2871043).**



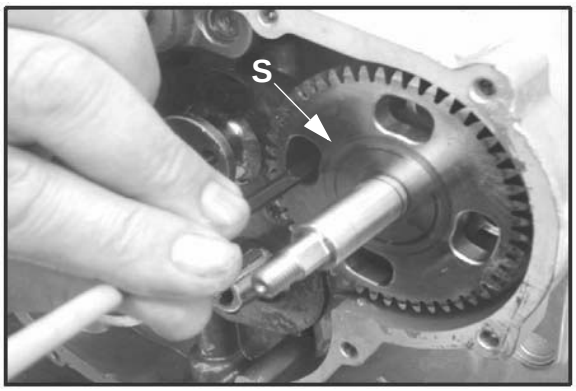
24. Install the two puller bolts (R). Tighten the puller bolts up so that the bolts are at equal length.



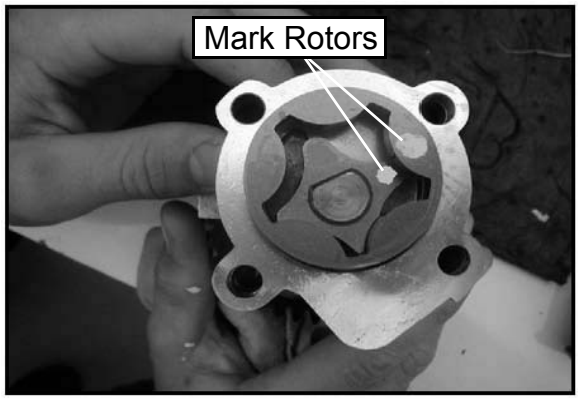
25. Install the Flywheel Puller (**PN 2871043**) and remove the crankshaft gear, if needed.



26. Rotate the water/oil pump gear (S), so that all four bolts are visible though the gear. Remove the four bolts with a hex wrench. Pull out the pump.

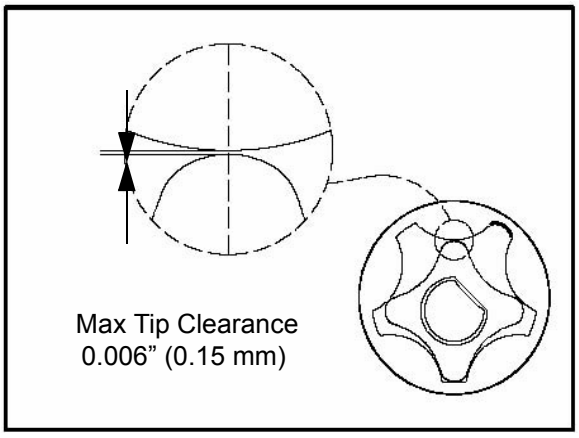


27. Inspect the oil pump rotors for wear. Mark the rotors with a white pen to ensure, upon reassembly, that the correct sides of the rotors are installed and mesh with the same edges as previously installed.

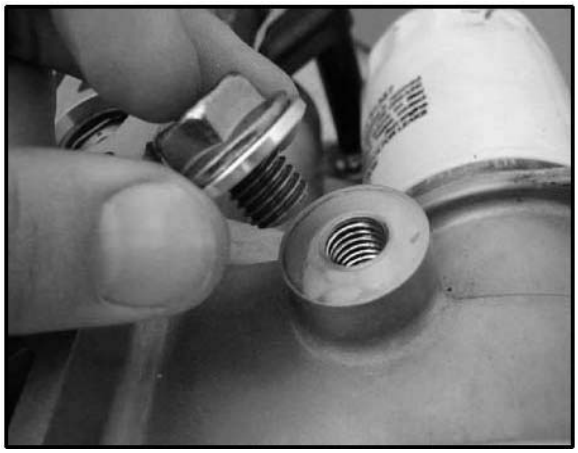


NOTE: If replacing the old rotors, new replacement rotors will fit into the original oil/water pump housing.

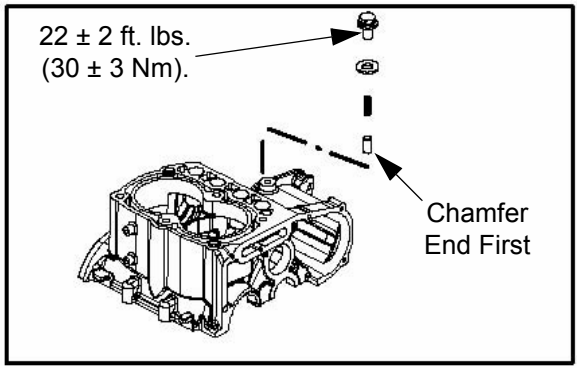
28. Use a feeler gauge to measure the clearance between the two rotors. Measure the gap between the two rotor tips as shown below. **The clearance should not exceed 0.006" (0.15 mm)**.



29. Remove the oil pressure relief. The oil pressure relief consists of a bolt, washer, spring, and valve (dowel). Inspect the valve (dowel) for signs of possible obstructions. Use compressed air to blow out any debris.



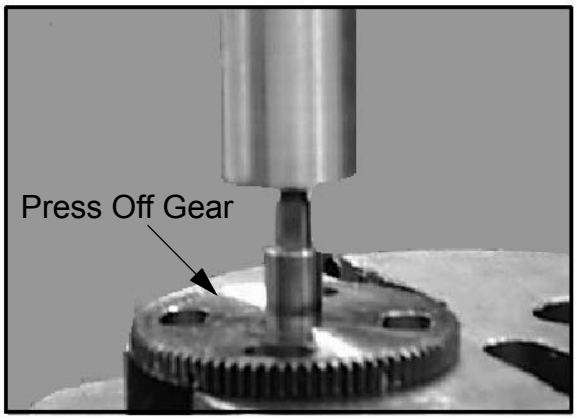
30. Reinstall the valve (dowel chamfered end first). Install the spring, washer, and bolt. Torque to specification .



= T
22 ± 2 ft. lbs. (30 ± 3 Nm)

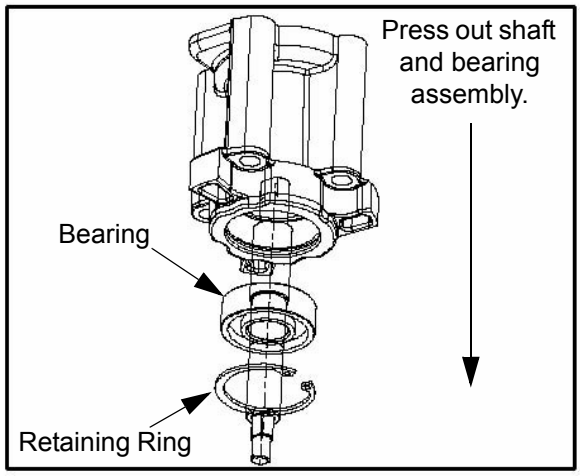
NOTE: Be sure to place the tapered end of the valve (dowel) in first. If the valve is installed incorrectly, oil pressure and oil priming problems will occur.

31. Carefully press the gear off the assembly while supporting the housing assembly.

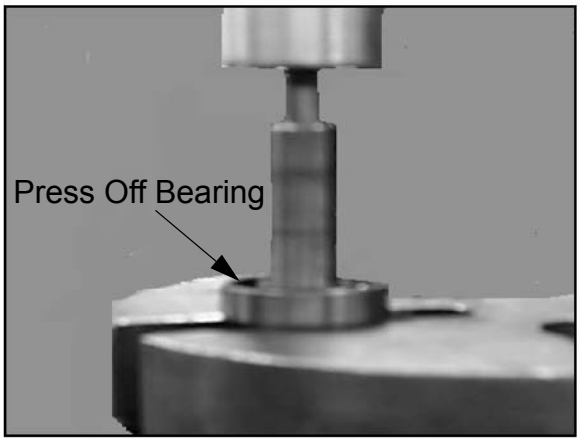


⚠ CAUTION
Wear appropriate safety gear during this procedure. Protective gloves, clothing and eye wear are required.

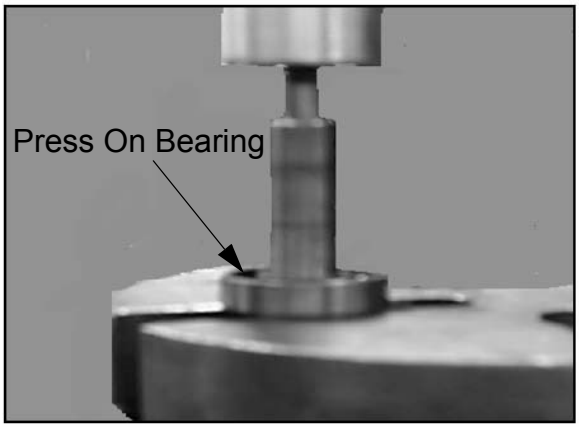
32. Remove the snap ring from the assembly. Place the housing in a support and press out the bearing/shaft assembly.



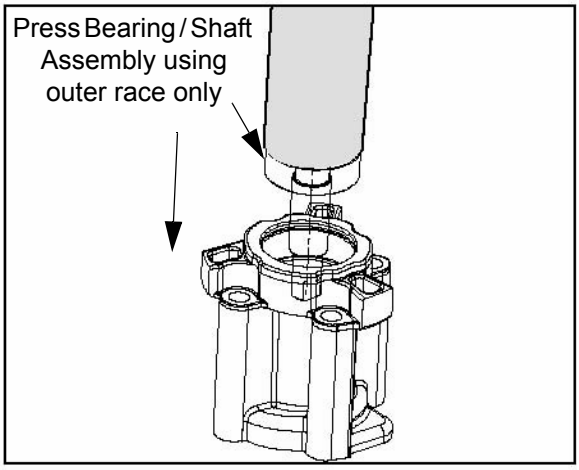
33. Place the shaft in a press to remove the bearing.



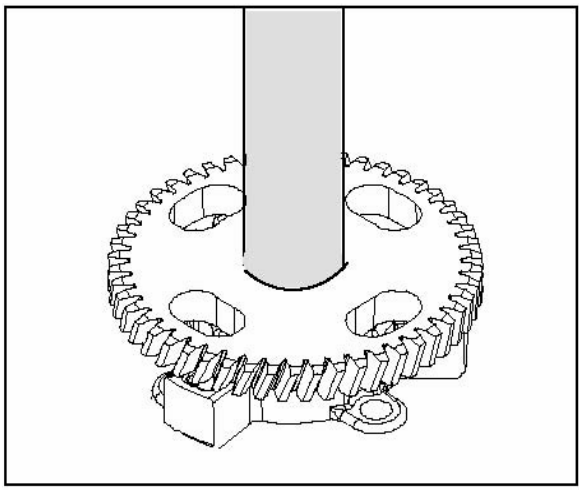
34. Press shaft into the new bearing..



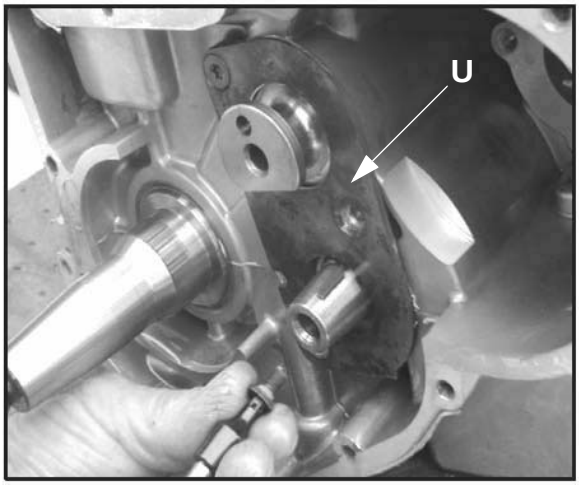
35. Press the bearing/shaft assembly using the bearing's outer race. Do not use the shaft to press the assembly into the housing, as bearing damage may result. Install retaining ring.



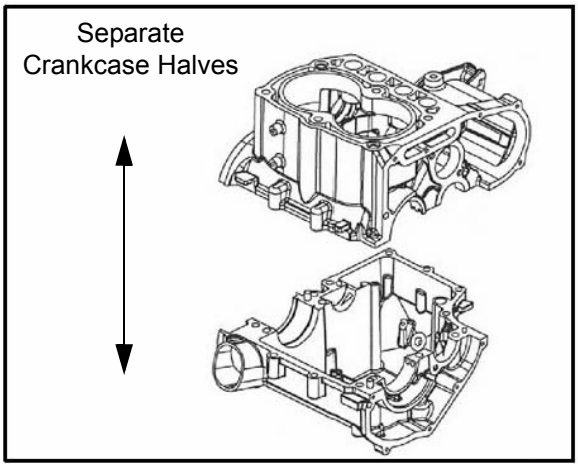
36. Press gear onto shaft while supporting the housing.



37. Remove thrust plate (U).

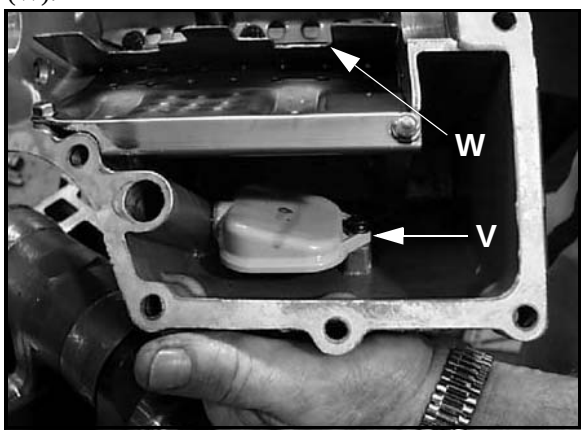


38. Remove PTO end engine mount. Remove crankcase bolts. Tap on the reinforced areas on the cases using soft hammer. Carefully separate the two crankcase halves.

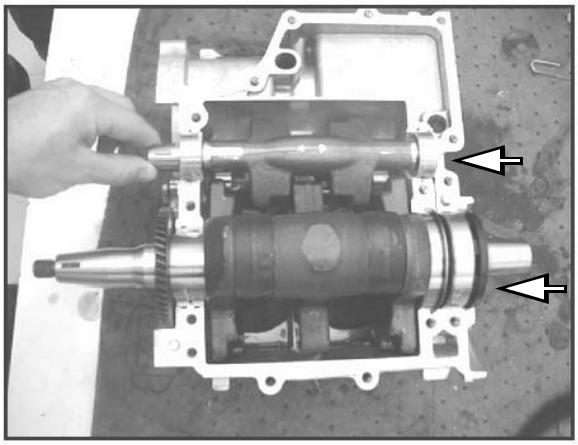


NOTE: Only remove the oil baffle if the baffle is damaged. When removing the oil baffle bolts, use a heat gun to heat the bolts and loosen the Loctite™. This will prevent any possible damage to the bolts or to the crankcase casting.

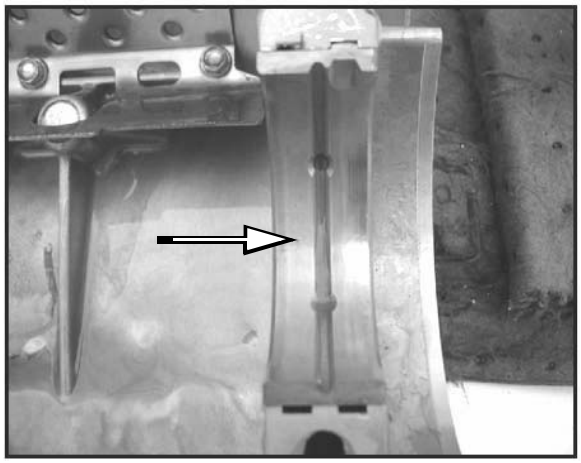
39. Remove and clean oil pick up (V) and oil baffle weldment (W).



40. Remove balance shaft and crankshaft.

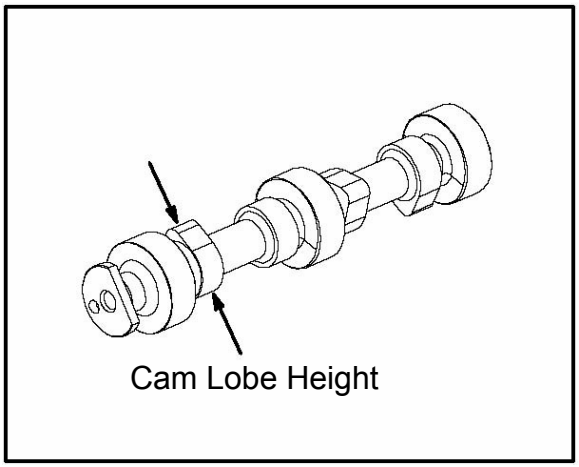


41. Remove and inspect crankshaft main journal bearings for abnormal wear. **It is recommended to replace the bearings anytime the engine is disassembled**.



Camshaft Inspection

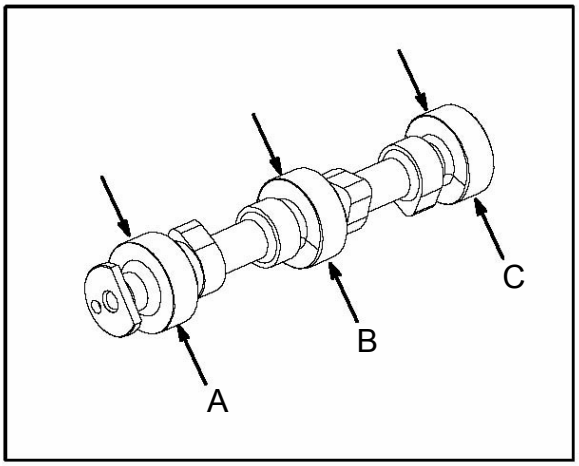
1. Thoroughly clean the cam shaft.
2. Visually inspect each cam lobe for wear or damage.
3. Measure height of each cam lobe using a micrometer. Compare to specification.



= In. / mm.

Cam Lobe Height
(Intake & Exhaust):
Std: 1.3334" (33.8674 mm)

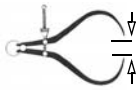
4. Measure camshaft journal outside diameters (O.D.).



= In. / mm.

Camshaft Journal O.D. :
A. (Mag): 1.654" ± .00039" (42 ± .010 mm)
B. (Ctr.): 1.634" ± .00039" (41.50 ± .010 mm)
C. (PTO): 1.614" ± .00039" (41 ± .010 mm)

5. Measure ID of camshaft journal bores.

 = In. / mm.
Camshaft Journal Bore I.D.: **(Mag): 1.656" ± 0.00039" (42.07 ± 0.010 mm)** **(Ctr.) 1.637" ± 0.00039" (41.58 ± 0.010 mm)** **(PTO) 1.617" ± 0.00039" (41.07 ± 0.010 mm)**

6. Calculate oil clearance by subtracting journal O.D.s from journal bore I.D.s. Compare to specification.

= In. / mm.
Calculated Camshaft Oil Clearance: **Std: 0.0027" (.070mm)** **Limit: .0039" (.10 mm)**

NOTE: Replace camshaft if damaged or if any part is worn past the service limit.

NOTE: Replace engine block if camshaft journal bores are damaged or worn excessively.

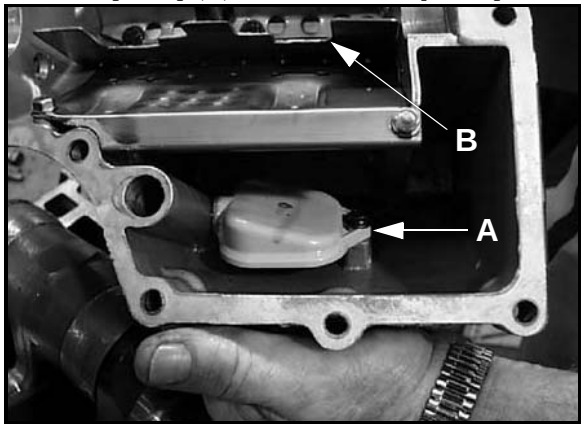
ENGINE REASSEMBLY

Crankcase Reassembly

CAUTION
After any reassembly or rebuild, the engine must be primed using the Oil Priming Adapter (PU-45778) and a 3/4-full oil filter before initial start-up (see “Oil Pump Priming”).

NOTE: Before assembly, clean bolts and bolt holes with Primer N (PN 2874275) to remove any debris. This will ensure proper sealing when installing bolts.

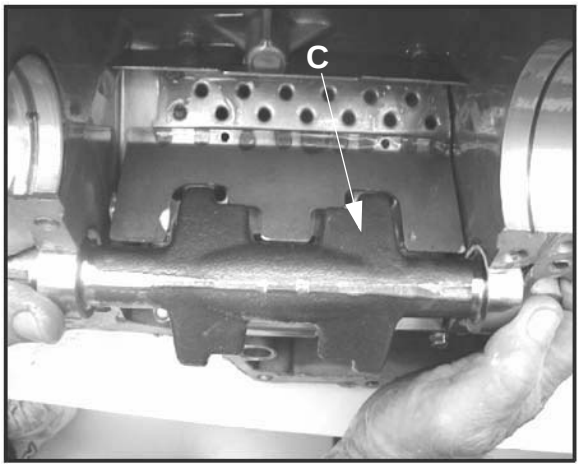
1. Install oil pick up (A), if removed. Torque to specification.



2. Install oil baffle weldment (B). Torque to specification.

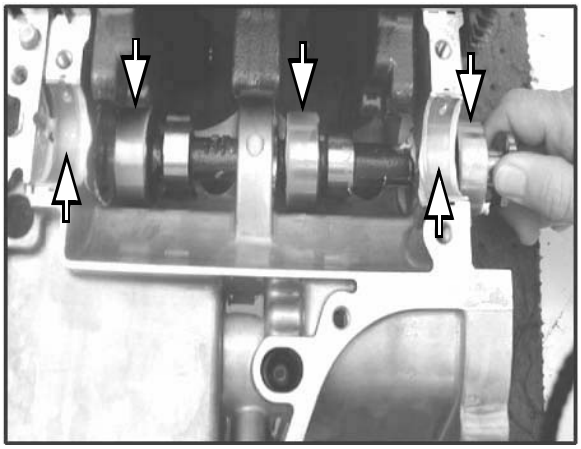
= T
Oil Baffle Weldment & Oil Pick Up Bolt Torque: **60 ± 6 in. lbs. (6.8 ± 0.68 Nm)**

3. Install the balance shaft. Inspect balance shaft clearance (C) in both gearcase halves. Rotate balance shaft to ensure there is clearance between it and the oil baffle weldment.

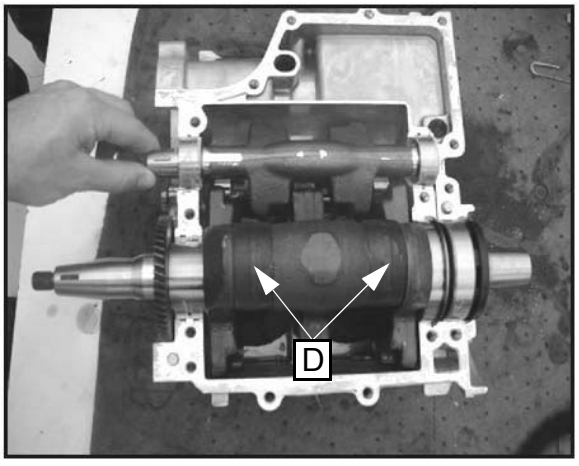


NOTE: Always install new balance shaft bearings.

4. Apply assembly lube to cam journals and balance shaft bearing surfaces of the MAG case halve. Install camshaft and balance shaft.

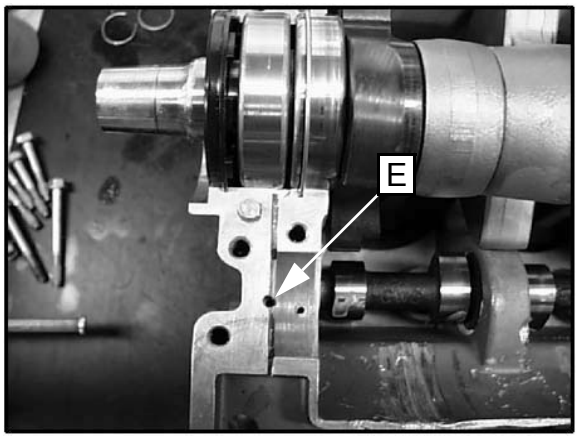


5. Install crankshaft assembly and apply engine oil to crank pins and rods (D). Apply assembly lube to the main journals and bearings.



6. Apply Crankcase Sealant **(PN 2871557)** to the top gearcase halve.

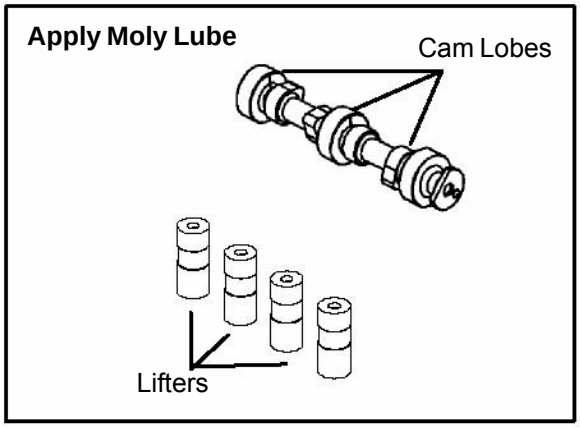
NOTE: Do not apply sealant to cam relief hole (E).



7. Assemble the crankcase halves. Apply LocTite™ 242 **(PN 2871949)** to the threads and pipe sealant to the bolt flanges. Torque bolts to specification following torque pattern at beginning of this chapter.

= T
Crankcase Bolt Torque: **22 + 2 ft. lbs. (30 + 3 Nm)** Torque in sequence

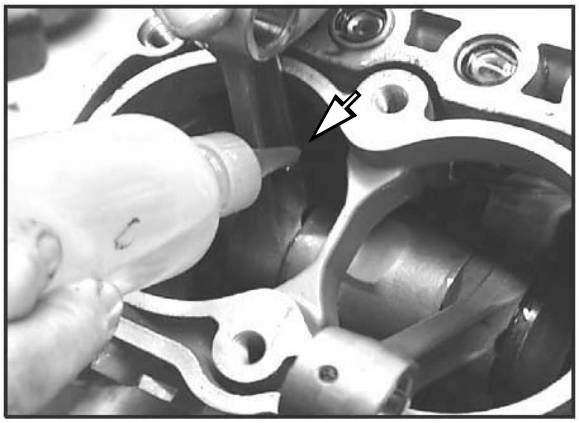
8. Lubricate cam lobes and valve lifters with Moly Lube Grease.



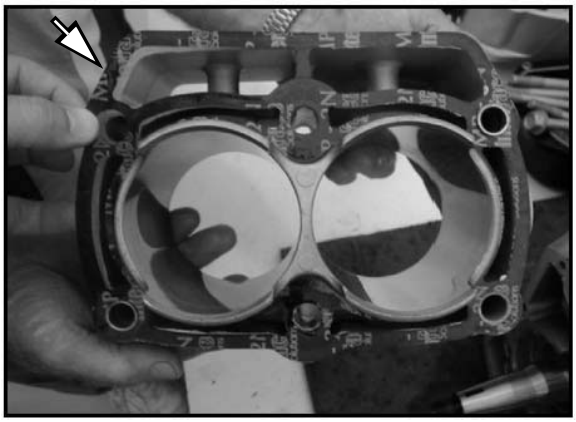
9. Lubricate lifters with engine oil and install in the original order as removed in disassembly. Apply Lubricant or Moly Lube to the ends of the lifters.

NOTE: Always replace the camshaft and lifters as a set.

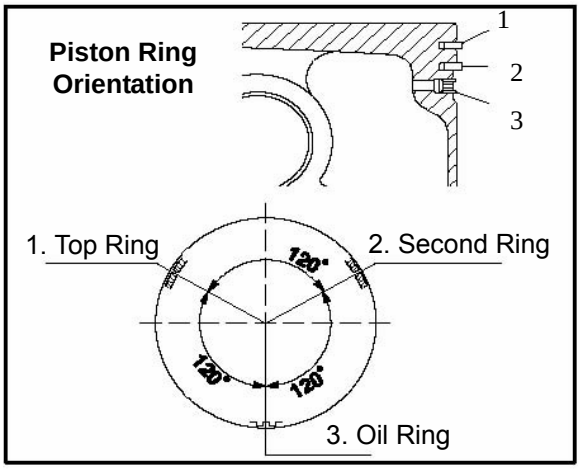
10. Lubricate connecting rods with 2W-50 synthetic engine oil.



11. Install new cylinder gasket on crankcase. Align gasket on the dowel pins for proper gasket alignment.



12. Orientate the piston rings on the piston before installation into the cylinders. Set the gaps of the rings every 120° (See Illustration Below).

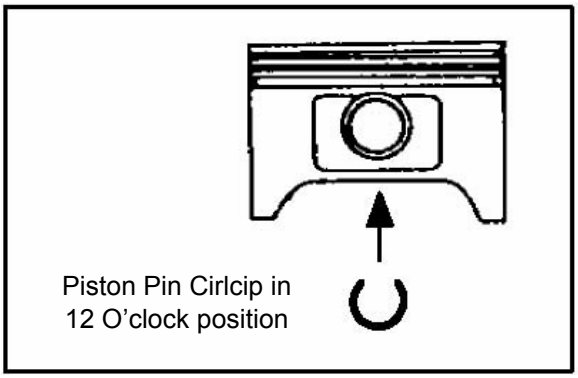


13. Install piston assemblies into cylinder aligning the piston pin holes, to ensure proper alignment of the pistons to the connecting rods upon assembly. Partially install the piston pins into the pistons.

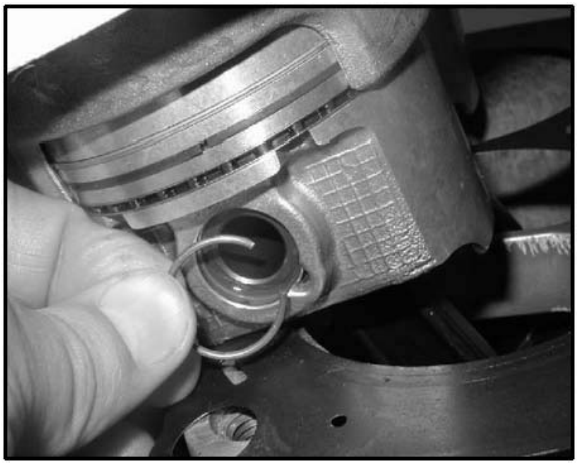
NOTE: To help align the pistons, slide a rod that is close to the same diameter as the wrist pin holes to properly align them in the cylinder.

14. Position cylinder and piston assemblies onto the connecting rods and push the piston pins through the piston and connecting rods.

15. Install the piston pin circlips. The circlip ends should be installed at the 12 O'clock position.

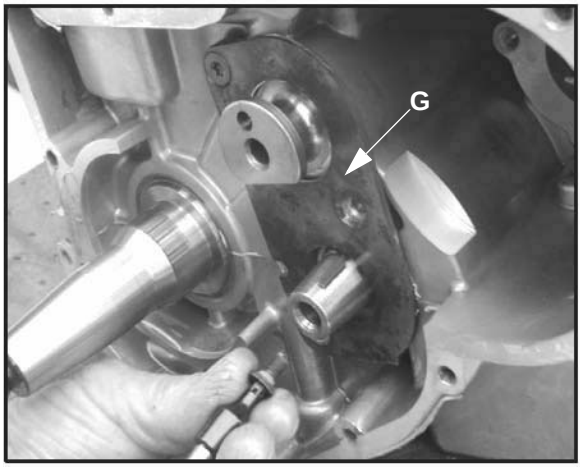


NOTE: While installing in piston circlips, cover all engine passages. The clip could fall into the engine during installation.



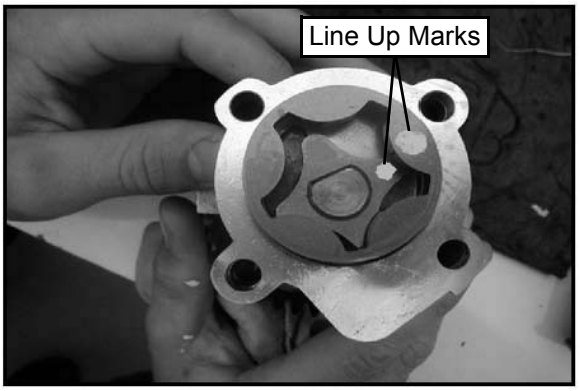
16. Install camshaft thrust plate (G) with new bolts. Torque bolts to specification.

NOTE: New bolts have patch lock on the threads and do not require Loctite™.



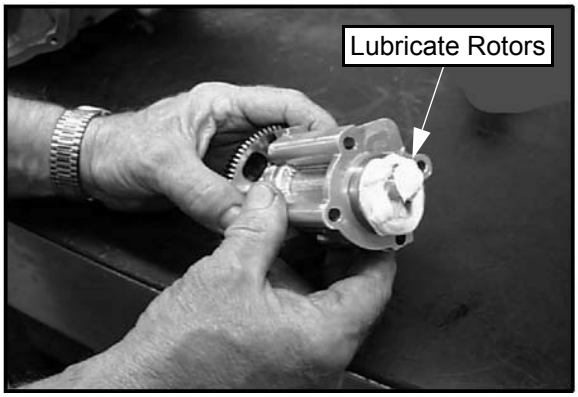
= T
Thrust Plate Screw Torque: **115 ± 12 in.lbs. (13 ± 1.35 Nm)**

17. Assemble rotors as marked when disassembled. Use a cleaner to remove the marks previously made on the rotors.



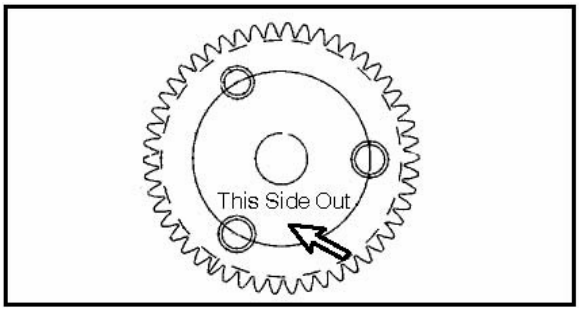
18. Apply assembly lube or oil to the rotors on the oil pump shaft.

NOTE: The application of lubrication aids in priming the oil pump during initial engine start up.



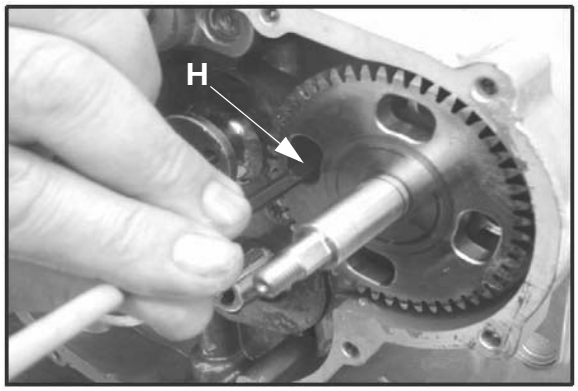
19. Align the bolt holes and install oil pump assembly into crankcase. Rotate the rotors in the housing during installation, as this checks for binding if new rotors are used.

NOTE: For assembly of the gears, the cam gear and the crankshaft gear are stamped with "This Side Out." This indicates the side of the gear that faces outward or away from the case.



NOTE: Before assembly, clean the bolts and bolt holes with Primer N (PN 2874275) to remove any debris. This will ensure proper sealing when installing bolts and new Loctite™.

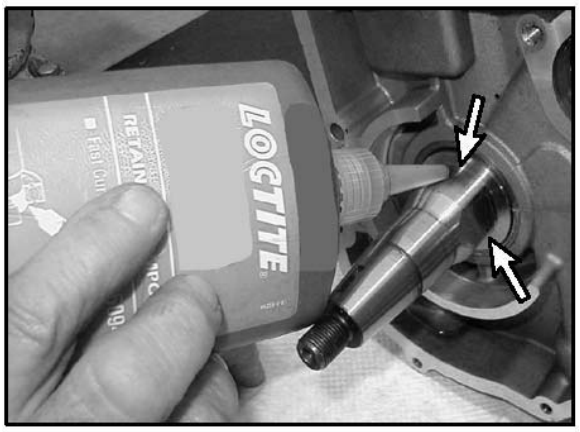
20. Install oil pump housing bolts (H). The new bolts contain patch lock, so Loctite™ is not needed on the new bolts. Torque bolts to specification and follow the torque sequence at beginning of the chapter.



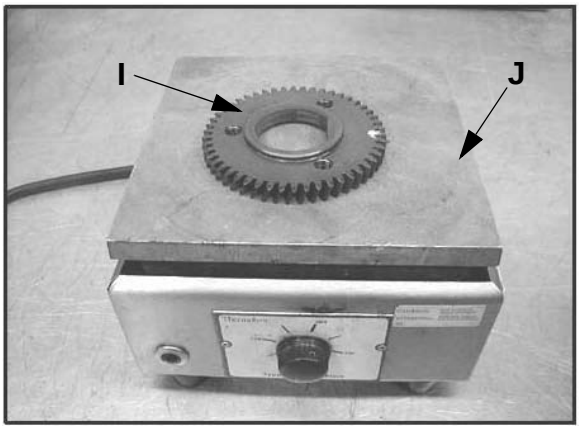
NOTE: Occasionally spin the oil pump when installing bolts to check for binding of the rotors.

= T
Oil Pump Bolt Torque: **84 ± 8 in.lbs. (9.50 ± 0.90 Nm)** * Torque in Sequence

21. Apply Loctite™ 242 (PN 2871949) to the crankshaft.



22. Before installing the crankshaft gear (I), heat the crankshaft gear to 250° F (121°C) on a hot plate (J).

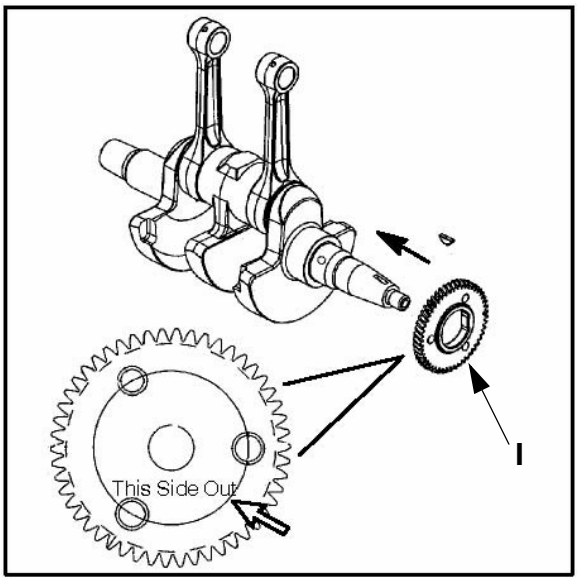


⚠ CAUTION
The crankshaft gear is extremely hot! Severe burns or injury can occur if the gear is not handled with extreme care and caution. Follow the procedure below to help ensure safety.

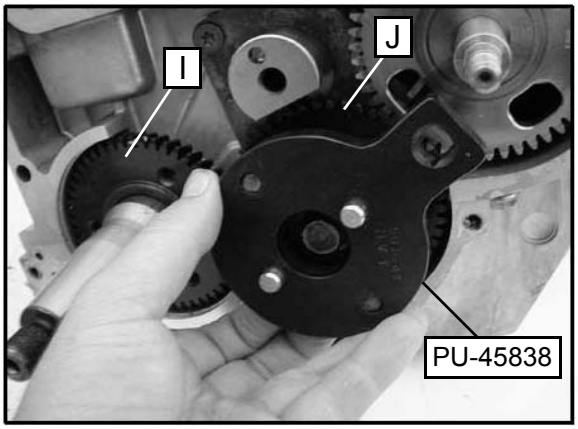
23. Use extreme caution when removing the crankshaft gear from the hot plate. Use a pair of pliers and leather gloves when handling the crankshaft gear.

24. Install the crankshaft gear (I) onto the crankshaft.

NOTE: For assembly of the gears, the cam gear and the crankshaft gear are stamped with This Side Out." This indicates the side of the gear that faces outward or away from the case.

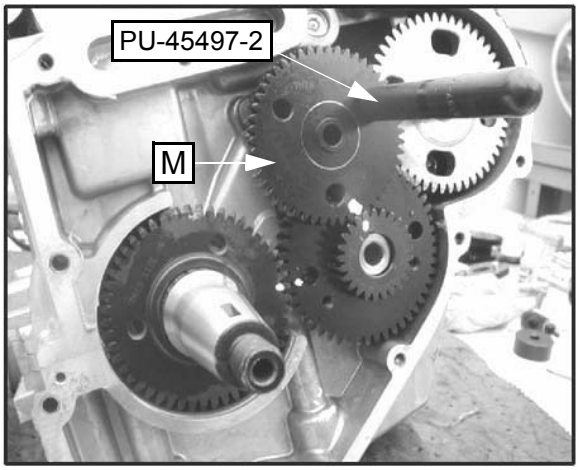


25. Install counter balance shaft gear (J) with new key, aligning timing marks with crankshaft gear (I). Install washer and bolt. Use the Gear Holder **(PU-45838).** Torque to specification.



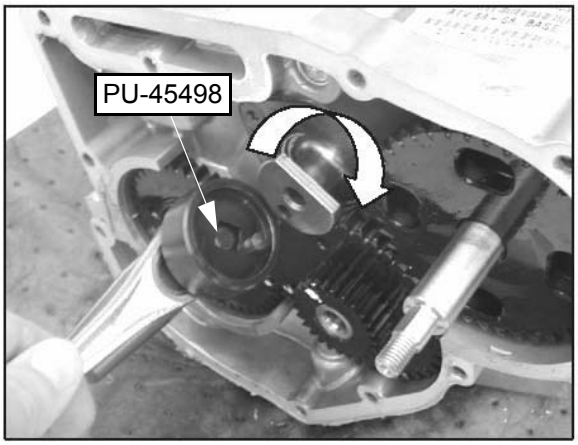
= T
Balance Shaft Gear Bolt Torque: **22 ± 2 ft. lbs. (30 ± 3 Nm)**

26. Use the Cam Gear Alignment Tool **(PU-45497-2)** to align the teeth of the cam gear (M). Install the cam gear (M) (with the Cam Gear Alignment Tool still in place) onto the camshaft. The timing marks on the camshaft gear should align with the keyway on the balance shaft gear.



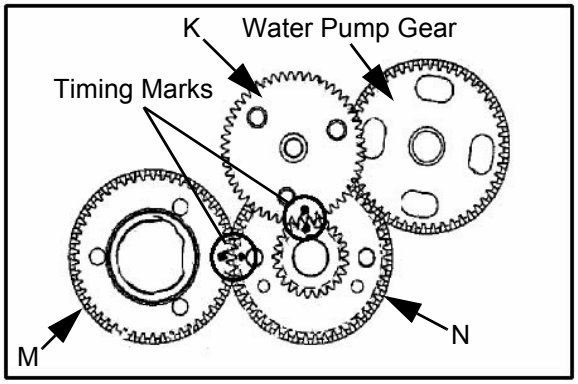
NOTE: If the timing mark on the camshaft gear does not align properly, remove the camshaft gear and tool. Use the Cam Spanner Wrench (PU-45498) to rotate the cam to the proper position.

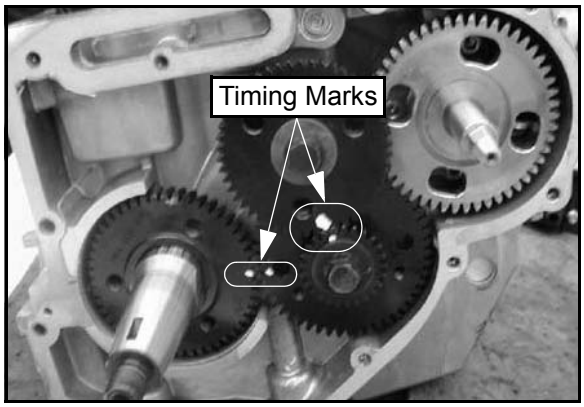
NOTE: Cam Spanner Wrench (PU-45498) is only needed to rotate the camshaft when the entire valve train is assembled.



27. Reinstall the camshaft gear; so the timing marks are properly aligned. Install the washer and bolt. Torque to specification.

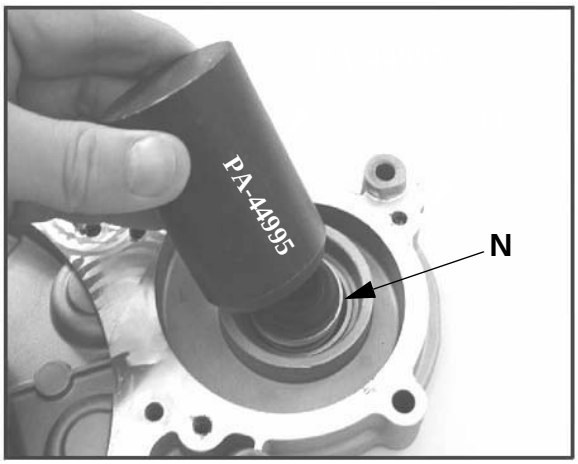
NOTE: Be sure all of the timing marks are properly aligned.





= T
Counterbalance Gear and Camshaft Gear Bolt Torque: **22 ± 2 ft. lbs. (30 ± 3 Nm)**

28. Before installing the gear / stator housing, replace the seals in the cover. Install a new water pump seal (N) into the gear / stator housing. Use the Water Pump Mechanical Seal Installer (PA-44995) to properly install the seal to the correct depth in the cover.

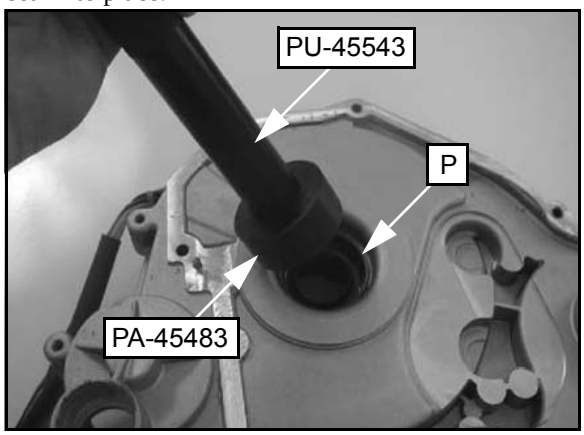


IMPORTANT: Due to seal design and construction, seals MUST be installed DRY (no lubricant) during assembly. Use of lubricants (oil, soapy water, etc.) will not allow the seal to wear-in and seal properly. Do not touch seal surface or allow seal surface to come in contact with contaminates during installation. Thoroughly clean parts, tools and hands before installation.

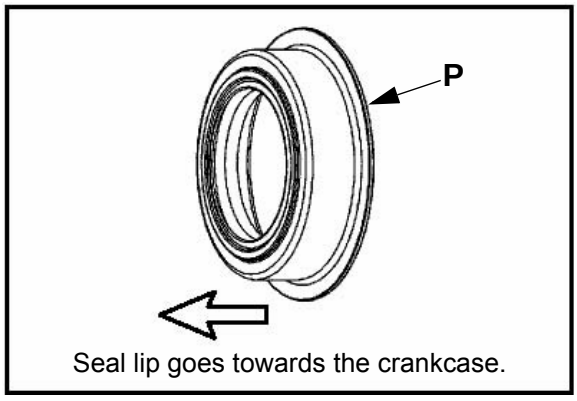
NOTE: To remove the water pump seal, the gear/ stator housing must be removed. The water pump seal cannot be removed or installed with the gear/ stator housing attached to the engine. Shaft damage will occur.

NOTE: Install the water pump seal (N) with the seal lip facing out (towards the crankcase). Use of a hydraulic press is recommended for this procedure.

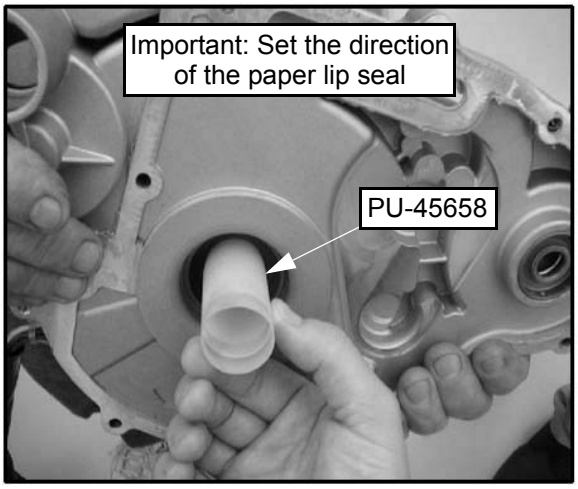
29. Install a new crankshaft seal (P) into the gear/stator housing cover. Use the Universal Driver Handle **(PU-45543)** and the Main Seal Installer **(PA-45483)** to seat the crankshaft seal into place.



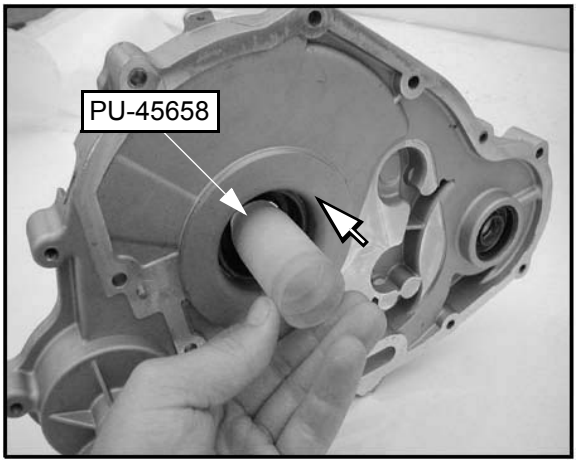
NOTE: Install the crankshaft seal (P) with the seal lip facing out (towards the crankcase).



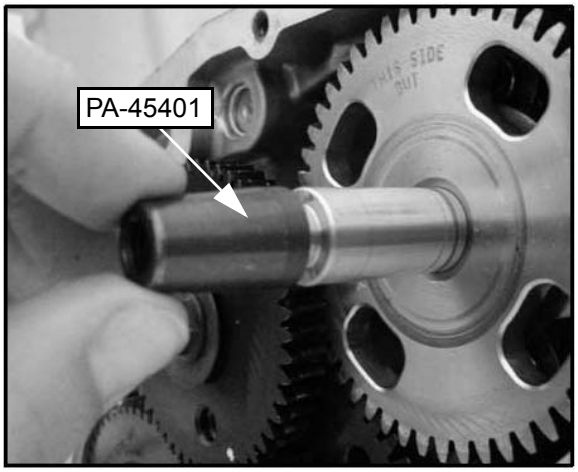
30. Once the crankshaft seal is installed into the gear / stator housing cover, set the direction of the paper lip by sliding the Main Crankshaft Seal Saver **(PA-45658)** into the crankshaft seal from the rubber lipped side to the paper lip side (back to front). Remove the tool.



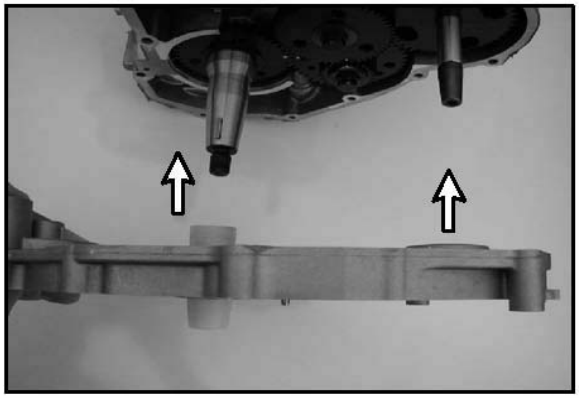
31. Carefully install the tapered end of the Crankshaft Seal Protection Tool **(PA-45658)** through the paper side of the crankshaft seal (back to front). Leave the seal protector installed in the crankshaft seal. Check the crankshaft seal lips to verify they have not been rolled or damaged.



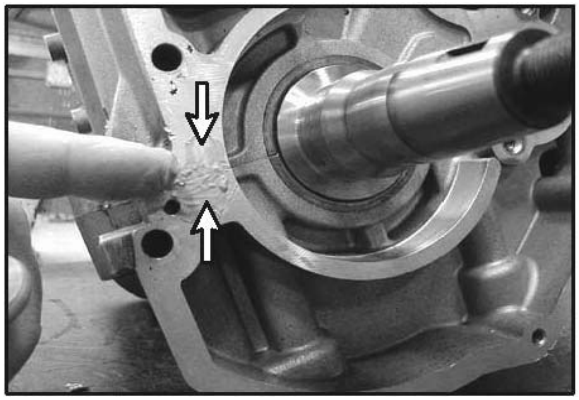
32. Before installing the gear/stator housing cover, install the Water Pump Seal Saver **(PA-45401)** onto the water pump shaft.

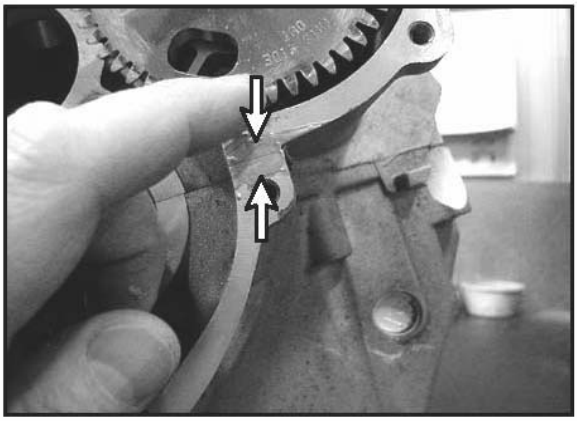


33. Install a NEW gasket to the gear/stator housing cover and crankcase. With the tools installed, carefully place the gear/stator housing cover over the protection tools.

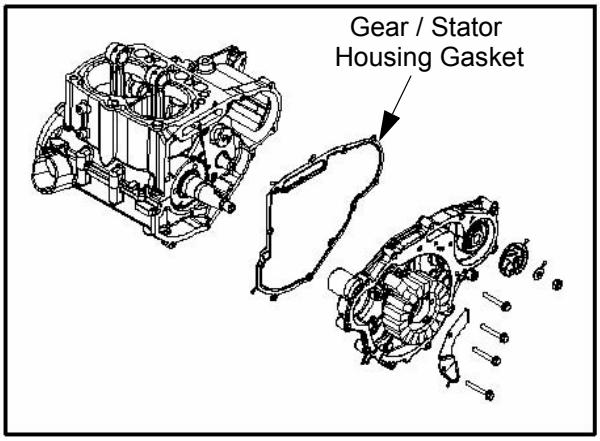


34. Apply Crankcase Sealant **(PN 2871557)** to the outside edges of the crankcase halves (see arrows), where the crankcases mate (see photos below). This helps to prevent coolant leakage.

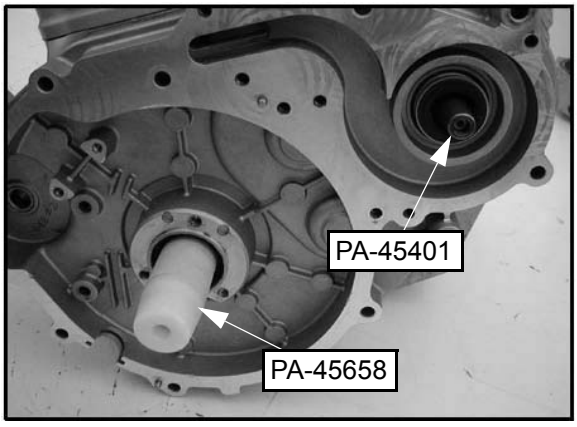




35. Install the gear/stator housing gasket onto he crankcase.



36. Secure the gear / stator housing cover to the crankcase with the cover bolts. Torque bolts in proper sequence to specification. Remove seal protectors from the shaft ends once the cover is secure.



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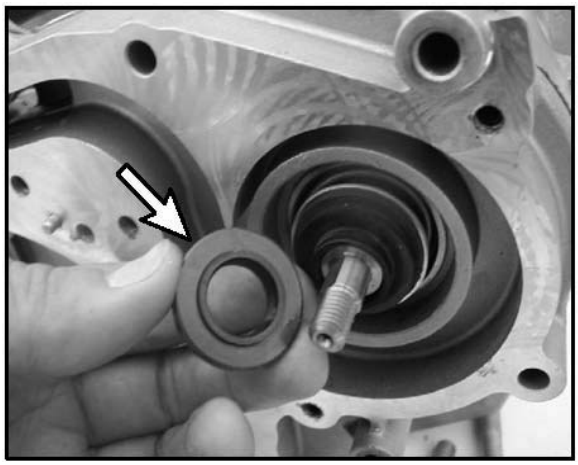
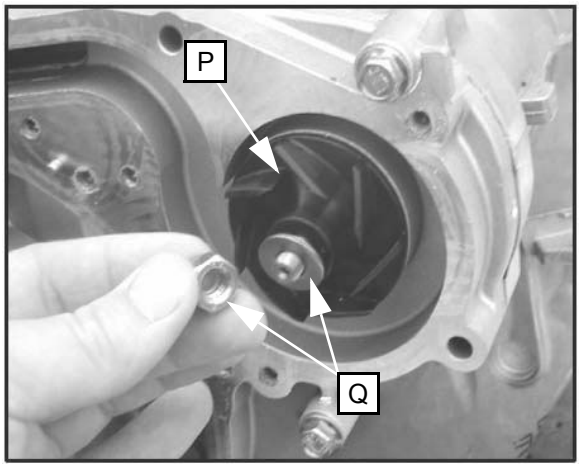
Gear/Stator Housing Bolt Torque: **96 ± 3 in. lbs. (10.85 ± 0.35 Nm)** *Torque in proper sequence

NOTE: Before assembly, clean the bolts and bolt holes with Primer N (PN 2874275) to remove any debris. This will ensure proper sealing when installing bolts.

37. Install shaft seal with ceramic surface facing inward.

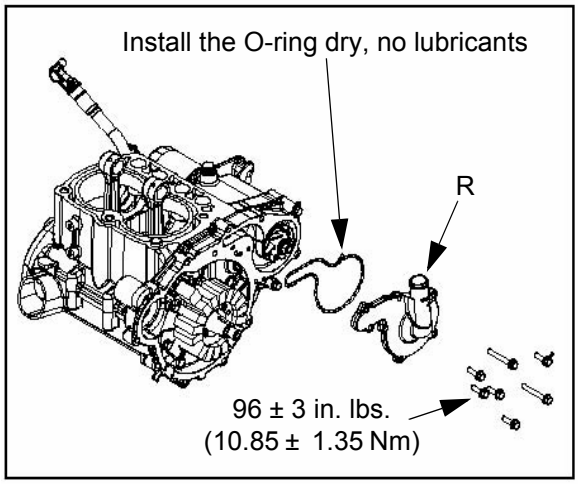


38. Install water pump impeller (P). **Secure the impeller with the washer and a new nylok nut (Q)**. Torque the nut to specification.



= T
Water Pump Impeller Nut Torque: **108 ± 6 in. lbs. (6.8 ± 0.68 Nm)**

39. Install water pump cover (R) with new O-ring seal. Torque bolts to specification in proper sequence (See front of this chapter).



= T
Water Pump Housing Bolt Torque: **96 ± 3 in. lbs. (10.85 ± 0.35 Nm)** *Torque in proper sequence

40. Sparingly apply Starter Drive Grease **(PN 2871423)** to the starter drive. Install the starter bendix.

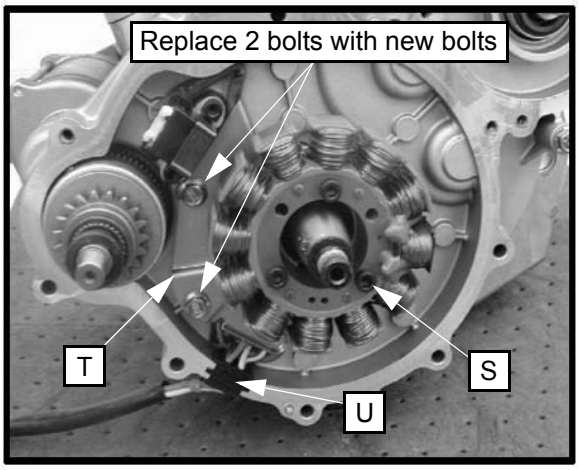
NOTE: There are thrust washers on both sides of starter drive.

Flywheel / Stator Installation

NOTE: Before assembly, clean the bolts and bolt holes with Primer N (PN 2874275) to remove any debris. This will ensure proper sealing when installing bolts.

1. Install stator assembly (S) and bolts. Torque bolts to specification.
2. Install the wire hold down bracket (T). Install two new wire hold down bolts. New bolts contain patch-lock. Torque bolts to specification, following the proper bolt torque sequence. Coat the stator wire grommet (U) with Nyogel™ Grease **(PN 2871329)**.

NOTE: Verify stator wires are routed properly under the wire hold down bracket.



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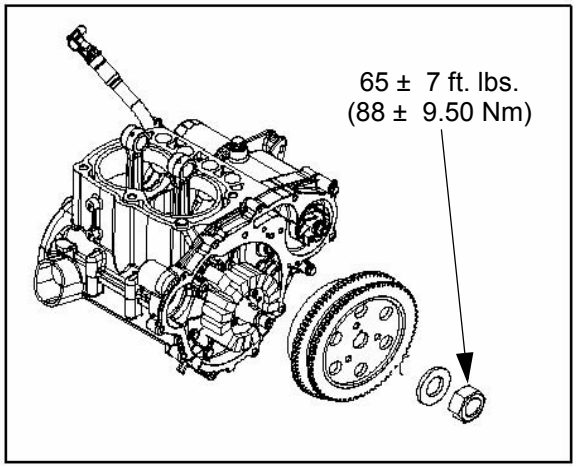
Stator Assembly Bolt Torque: **96 ± 3 in.lbs. (10.85 ± 0.35 Nm)**

3. Install the flywheel, washer, nut, and key. Torque flywheel nut to specification.



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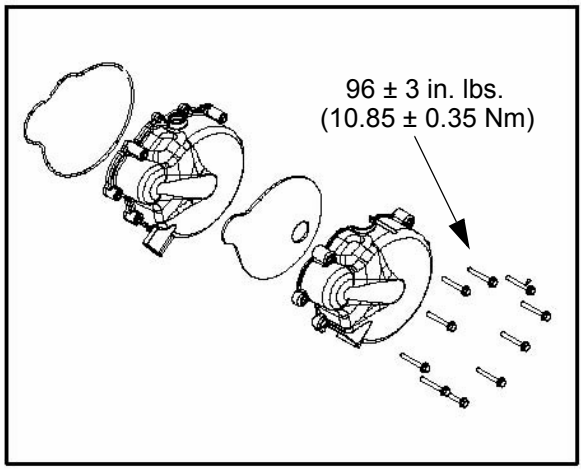
Flywheel Nut Torque **65 ± 7 ft.lbs. (88 ± 9.50 Nm)**

4. Install stator housing with new o-rings. Torque the bolts to specification and follow proper bolt torque sequence at the beginning of this chapter.



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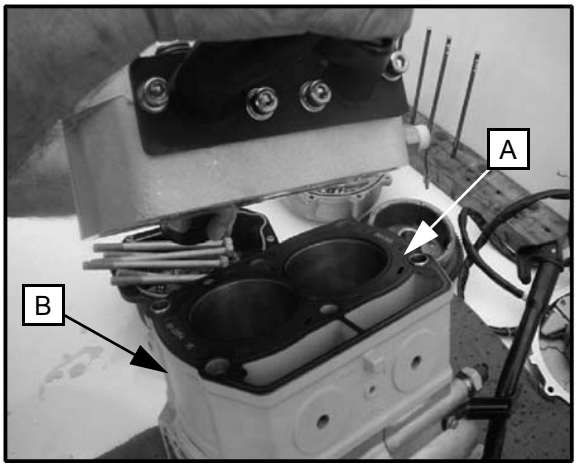
Stator Housing Bolt Torque: **96 ± 3 in. lbs. (10.85 ± 0.35 Nm)**

Cylinder Head Reassembly

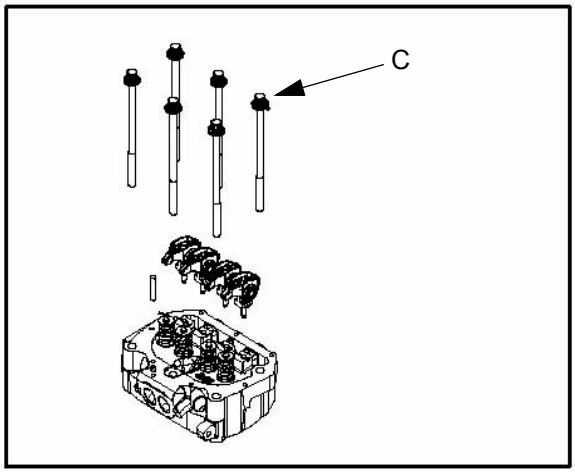
NOTE: Before reassembly, clean the bolts and bolt holes with Primer N (PN 2874275) to remove any debris. This will ensure proper sealing when installing bolts.

1. Install the head gasket (A) on the cylinder (B).



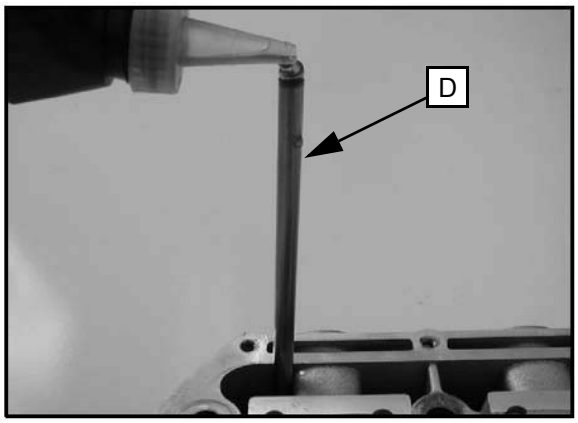
2. Install cylinder head on cylinder.

3. Lubricate threads and top of washers underside of bolt head with engine oil. Install head bolts (C) and torque to specification.

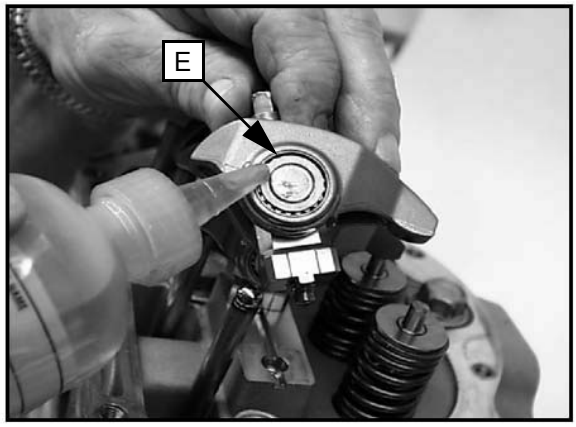


= T
Cylinder Head Bolt Torque: **Initial setting: 35± 4 ft. lbs. (47.5 ± 5.5 Nm)** **Allow to set for 1 minute, then turn additional 90° (1/4 turn)** ***Torque Bolts In Sequence**

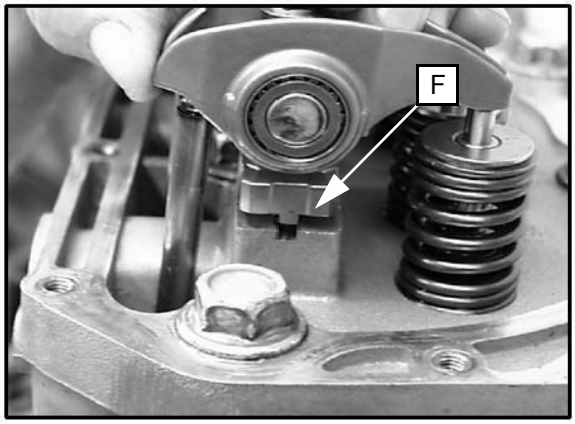
4. Lubricate push rods (D) and install into lifters.



5. Lubricate rockers (E) with engine oil.



6. Verify pushrods are engaged in lifters.
7. Install rockers. Be sure that tab of fulcrum (F) is seated in head stand-off. Torque bolts to specification.



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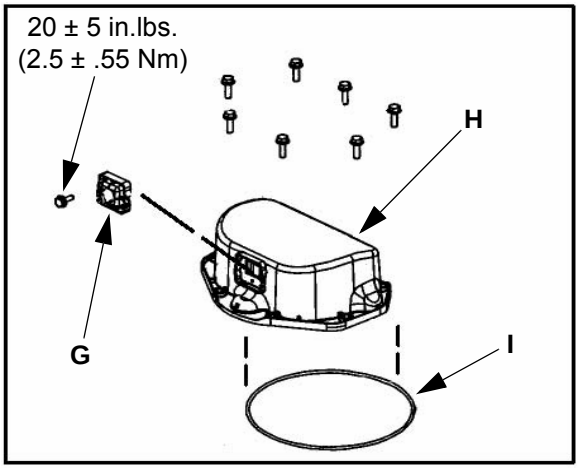
Rocker Arm Bolt Torque **22 + 2 ft. lbs. (30 ± 3 Nm)**

8. Install breather reed (G) into rocker cover (H). Lightly apply black RTV sealant to the outer edges of the breather reed. The reed has a tab and will assemble one-way only. Torque the breather bolts to specification.



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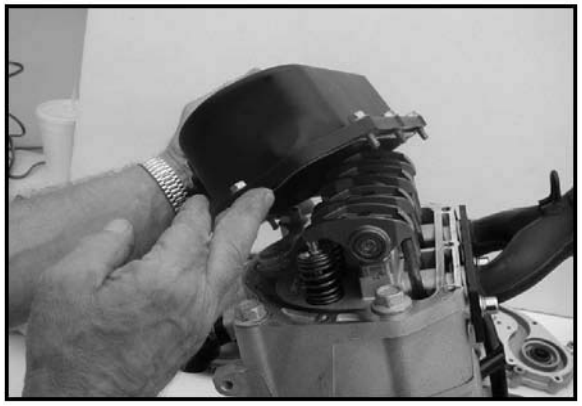
Breather Bolt Toque: **20 ± 5 in. lbs. (2.5± 0.55 Nm)**

NOTE: When applying RTV, do not get any RTV inside the reed assembly.

9. Place a new seal (I) into the bottom of the cover. Be sure the seal is seated into the cover properly.

IMPORTANT: Before assembly, clean the bolts and bolt holes with Primer N (PN 2874275) to remove any debris. This will ensure proper sealing when installing bolts.

10. Install rocker cover. Torque bolts to specification.



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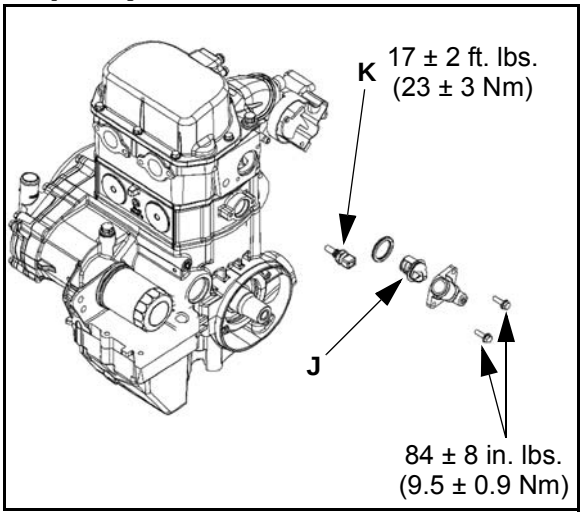
Rocker Cover Bolt Torque: **84 ± 8 in.lbs. (9.5 ± 0.9 Nm)** Torque in Sequence

11. Install thermostat (J), new O-ring, and thermostat housing. Torque to specification.



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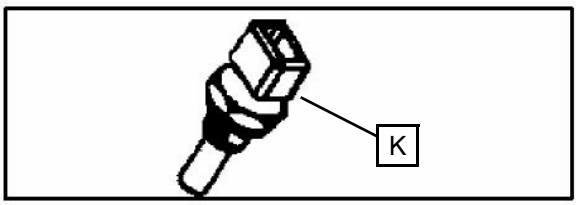
Thermostat Housing Bolt Torque: **84 ± 8 in. lbs. (9.5± 0.9 Nm)**

12. Install temperature sender (K) and torque to specification.



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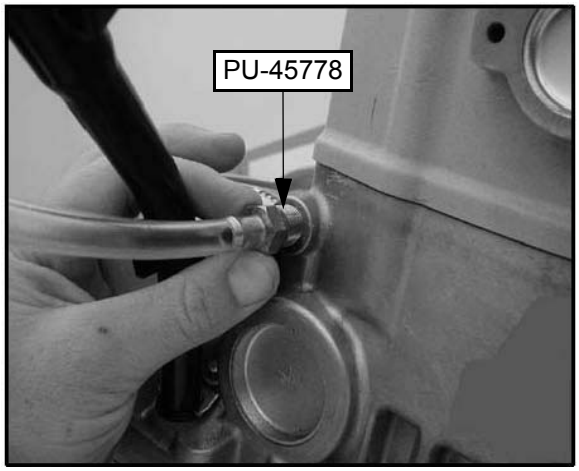
Temperature Sender Torque: **17 ± 2 ft.lbs. (23 ± 3 Nm)**

Oil Pump Priming

1. After the engine is completely assembled and ready for installation, the engine must be properly primed with Polaris PS-4 PLUS 2W-50 Synthetic Oil (PN 2876244). Fill the oil filter three-quarters full with Polaris PS-4 PLUS 2W-50 Synthetic Engine Oil (PN 2876244). Let the oil soak into the filter for 8-10 minutes. Install the filter onto the engine.

2. Remove primer plug from the engine. Install Oil System Priming Adapter **(PU-45778)** into the oil plug hole. Push 3-5 oz. (approx.) of Polaris PS-4 PLUS 2W-50 Synthetic into the adapter or until resistance is felt. Remove the adapter. Apply sealant to the plug threads. Install the plug and torque to specification.



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Primer Plug Torque **18 ± 2 ft.lbs. (24.4 ± 2.71 Nm)**

CAUTION
After any reassembly or rebuild, the engine must be primed using the Oil Priming Adapter (PU-45778) and a 3/4-full oil filter before initial start-up. Follow the steps in this section to properly prime the engine and aid proper engine break in. Failure to perform this procedure may cause internal engine damage on initial start-up.

Engine Break-In

Refer to “Engine Break-In Period” under “Engine Installation Notes” listed earlier in this chapter.

TROUBLESHOOTING

Engine

Spark Plug Fouling

- Spark plug cap loose or faulty
- Incorrect spark plug heat range or gap
- PVT system calibrated incorrectly/ components worn or mis-adjusted
- Fuel quality poor (old) or octane too high
- Low compression
- Restricted exhaust
- Weak ignition (loose coil ground, faulty coil, or stator)
- Restricted air filter (main or pre-cleaner) or breather system
- Improperly assembled air intake system
- Restricted engine breather system
- Oil contaminated with fuel

Engine Turns Over But Fails To Start

- No fuel
- Dirt in fuel line or filter
- Fuel will not pass through fuel valve
- Fuel pump inoperative/restricted
- Tank vent plugged or pinched
- Engine flooded
- Low compression (high cylinder leakage)
- No spark (Spark plug fouled) ignition component failure

Engine Does Not Turn Over

- Dead battery
- Starter motor does not turn
- Engine seized, rusted, or mechanical failure

Engine Runs But Will Not Idle

- Restricted carburetor pilot system
- Low compression
- Crankcase breather restricted

Engine Idles But Will Not Accelerate

- Spark plug fouled/weak spark
- Broken throttle cable
- Obstruction in air intake
- Air box removed (reinstall all intake components)
- Incorrect or restricted carburetor jetting
- Reverse speed limiter limiting speed
- Incorrect ignition timing
- Restricted exhaust system
- Cam worn excessively

Engine Has Low Power

- Spark plug fouled
- Cylinder, piston, ring, or valve wear or damage (check compression)
- PVT not operating properly
- Restricted exhaust muffler
- Cam worn excessively

Piston Failure - Scoring

- Lack of lubrication
- Dirt entering engine through cracks in air filter or ducts
- Engine oil dirty or contaminated

Excessive Smoke and Carbon Buildup

- Excessive piston-to-cylinder clearance
- Wet sumping
- Worn rings, piston, or cylinder
- Worn valve guides or seals
- Restricted breather
- Air filter dirty or contaminated

Piston Failure - Scoring

- Lack of lubrication
- Dirt entering engine through cracks in air filter or ducts
- Engine oil dirty or contaminated

Excessive Smoke and Carbon Buildup

- Excessive piston-to-cylinder clearance
- Wet sumping due to over-full crankcase
- Worn rings, piston, or cylinder
- Worn valve guides or seals
- Restricted breather
- Air filter dirty or contaminated

Low Compression

- Cylinder head gasket leak
- No valve clearance (cam wear)
- Cylinder or piston worn
- Piston rings worn, leaking, broken, or sticking
- Bent valve or stuck valve
- Valve spring broken or weak
- Valve not seating properly (bent or carbon accumulated on sealing surface)
- Rocker arm sticking

Backfiring

- Speed limiter system malfunction
- Fouled spark plug or incorrect plug or plug gap
- Exhaust system air leaks
- Exhaust system air leaks
- Ignition system faulty:
  Spark plug cap cracked / broken
  Ignition coil faulty
  Ignition switch circuit faulty
  Poor connections in ignition system
  Ignition timing incorrect
  Sheared flywheel key
- Valve sticking

Cooling System

Overheating

- Low coolant level
- Air in cooling system
- Wrong type/mix of coolant
- Faulty pressure cap or system leaks
- Restricted system (mud or debris in radiator fins causing restriction to air flow, passages blocked in radiator, lines, pump, or water jacket, accident damage)
- Lean mixture (restricted jets, vents, fuel pump or fuel valve)
- Fuel pump output weak
- Electrical malfunction
- Water pump failure/ Loose impeller
- Thermistor failure
- Cooling fan inoperative or turning too slowly (perform current draw test)
- Low oil level
- Spark plug incorrect heat range
- Faulty hot light circuit
- Thermostat stuck closed or not opening completely
- Radiator is missing its internal diverter plate not allowing coolant to flow through entire radiator

Temperature Too Low

- Thermostat stuck open

Leak at Water Pump Weep Hole

- Faulty water pump mechanical seal (coolant leak)
- Faulty pump shaft oil seal (oil leak)

NOTES

CHAPTER 4

ELECTRONIC FUEL INJECTION

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GENERAL INFORMATION

⚠ WARNING

* Gasoline is extremely flammable and explosive under certain conditions.
* EFI components are under high pressure. Verify system pressure has been relieved before disassembly.
* Never drain the fuel system when the engine is hot. Severe burns may result .
* Do not overfill the tank. The tank is at full capacity when the fuel reaches the bottom of the filler neck. Leave room for expansion of fuel.
* Never start the engine or let it run in an enclosed area. Gasoline powered engine exhaust fumes are poisonous and can cause loss of consciousness and death in a short time.
* Do not smoke or allow open flames or sparks in or near the area where refueling is performed or where gasoline is stored.
* If you get gasoline in your eyes or if you should swallowgasoline,seekmedicalattentionimmediately.
* If you spill gasoline on your skin or clothing, immediately wash with soap and water and change clothing.
* Always stop the engine and refuel outdoors or in a well ventilated area.

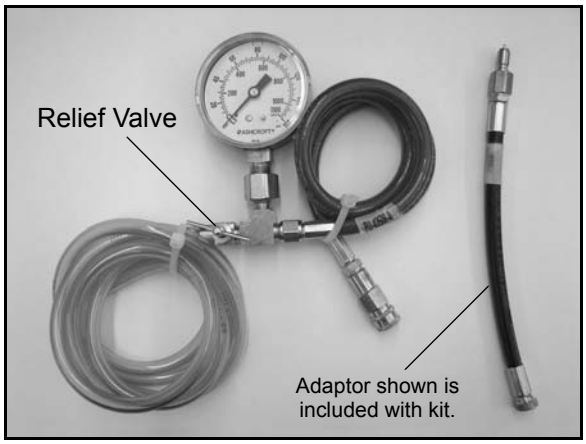
Special Tools

PART NUMBER	TOOL DESCRIPTION	
PU-43506-A	Fuel Pressure Gauge Kit	
PV-48656	Fuel Pressure Gauge Adaptor	
PU-47082	Throttle Position Sensor Tester	
4010264	TPS Tester Regulator	
PU-47063	Digital Wrench™ Diagnostic Software (Includes most recent version of software and a serial number)	
PU-47471	Digital Wrench™ SmartLink Module Kit (PU-47470, PU-47469, PU-47468)	
	PU-47470	Digital Wrench™ PC Interface Cable
	PU-47469	Digital Wrench™ Vehicle Interface Cable
	PU-47468	Digital Wrench™ SmartLink Module

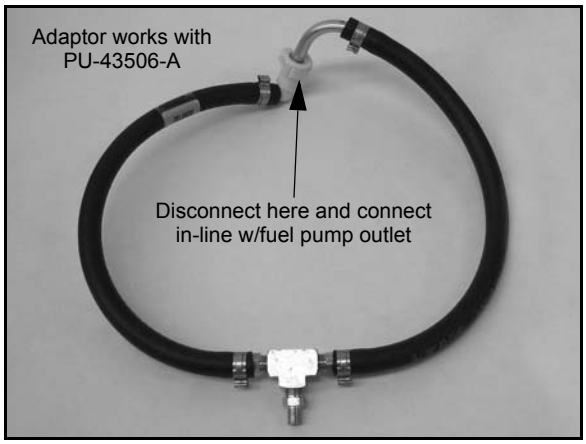
IMPORTANT: For the most recent information on Digital Wrench™ software and fileset downloads please visit the website: www.polaris.diagsys.com

Fuel Pressure Gauge Kit - PU-43506-A

IMPORTANT: The EFI fuel system remains under high pressure, even when the engine is not running. Before attempting to service any part of the fuel system, pressure must be relieved (if applicable). The Fuel Pressure Gauge Kit has an integrated pressure relief valve that can be used to bleed off pressure once you have completed the fuel pressure test.

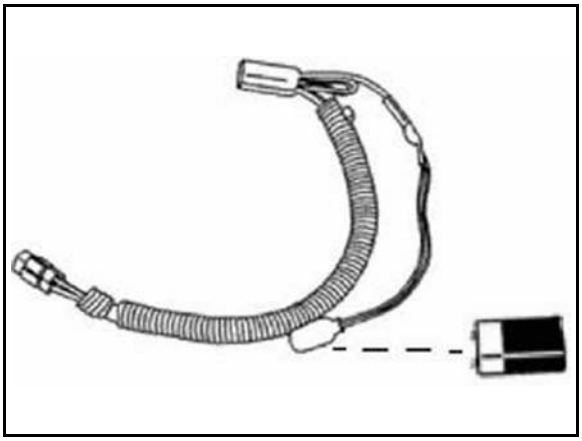


Fuel Pressure Gauge Adaptor - PV-48656



Throttle Position Sensor Tester - PU-47082

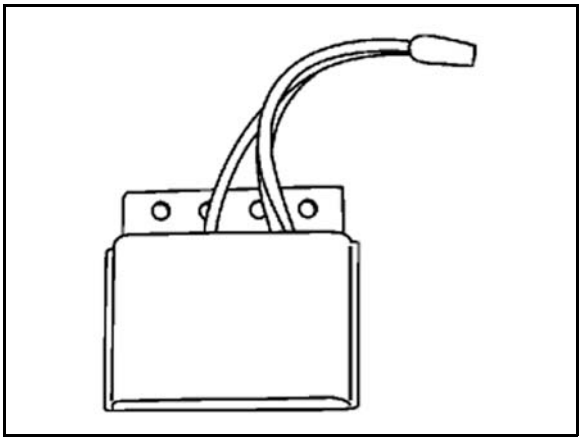
This tester allows the use of a digital multi-meter to test TPS function and perform the TPS Adjustment procedure.



NOTE: Voltage Regulator 4010264 is required if using TPS harness PU-47082. If your dealership sells Polaris snowmobiles, you may already have this regulator from TPS tool PN 2201519. If you do not have this regulator, you must order one from SPX at 1-800-328-6657.

TPS Tester Regulator - 4010264

This tester regulator regulates the 9 volt battery voltage to a 5 volt input, required when using the TPS harness PU-47082.



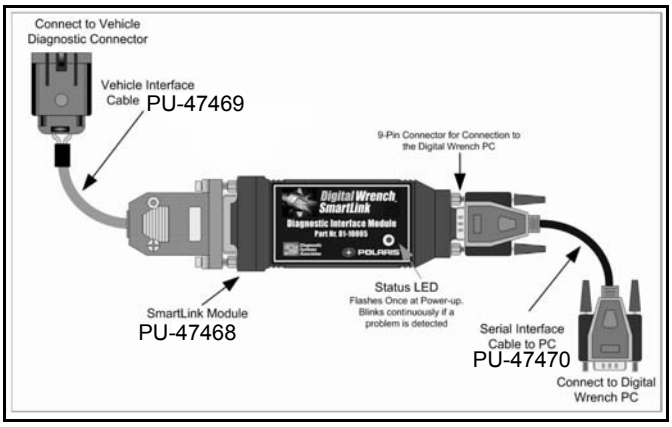
NOTE: If your dealership sells Polaris snowmobiles, you may already have this regulator from TPS tool PN 2201519. If you do not have this regulator, you must order one from SPX at 1-800-328-6657.

Digital Wrench™ Diagnostic Software PU-47063

This dealer-only software installs on laptop computers equipped with a CD drive and serial port connection, and is designed to replace multiple shop tools often used to test EFI components. It also includes step-by-step diagnostic procedures to aid technician repair and troubleshooting.

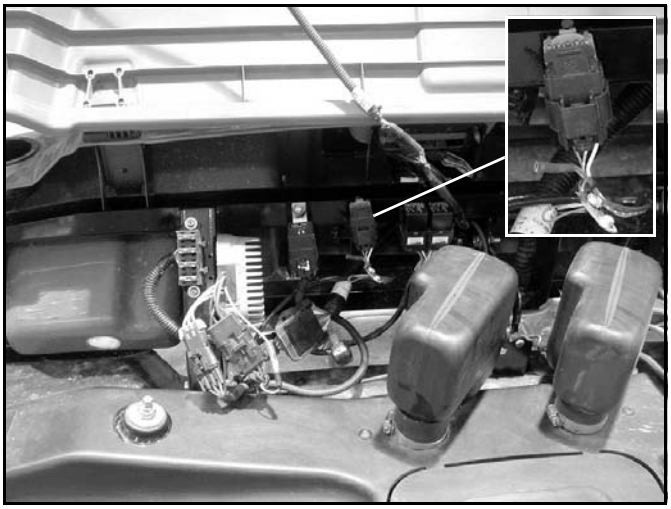
Digital Wrench™ SmartLink Module Kit - PU-47471

This module kit contains the necessary cables and hardware to communicate between the vehicle ECU and the Digital Wrench™ diagnostic software. Polaris dealers can also order the following separately: **SmartLink Module PU-47468**, **Vehicle Interface Cable PU-47469** and **PC Interface Cable PU-47470**. This module kit is used on all 8 pin connector-based Polaris EFI systems. This kit is available to Polaris dealers through our tool supplier, SPX (1-800-328-6657).



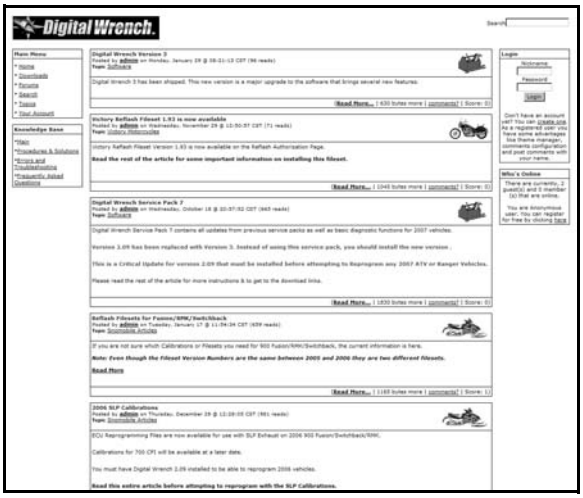
Digital Wrench™ - Diagnostic Connector

(Located under the hood as shown below)



Digital Wrench™ - Download Website

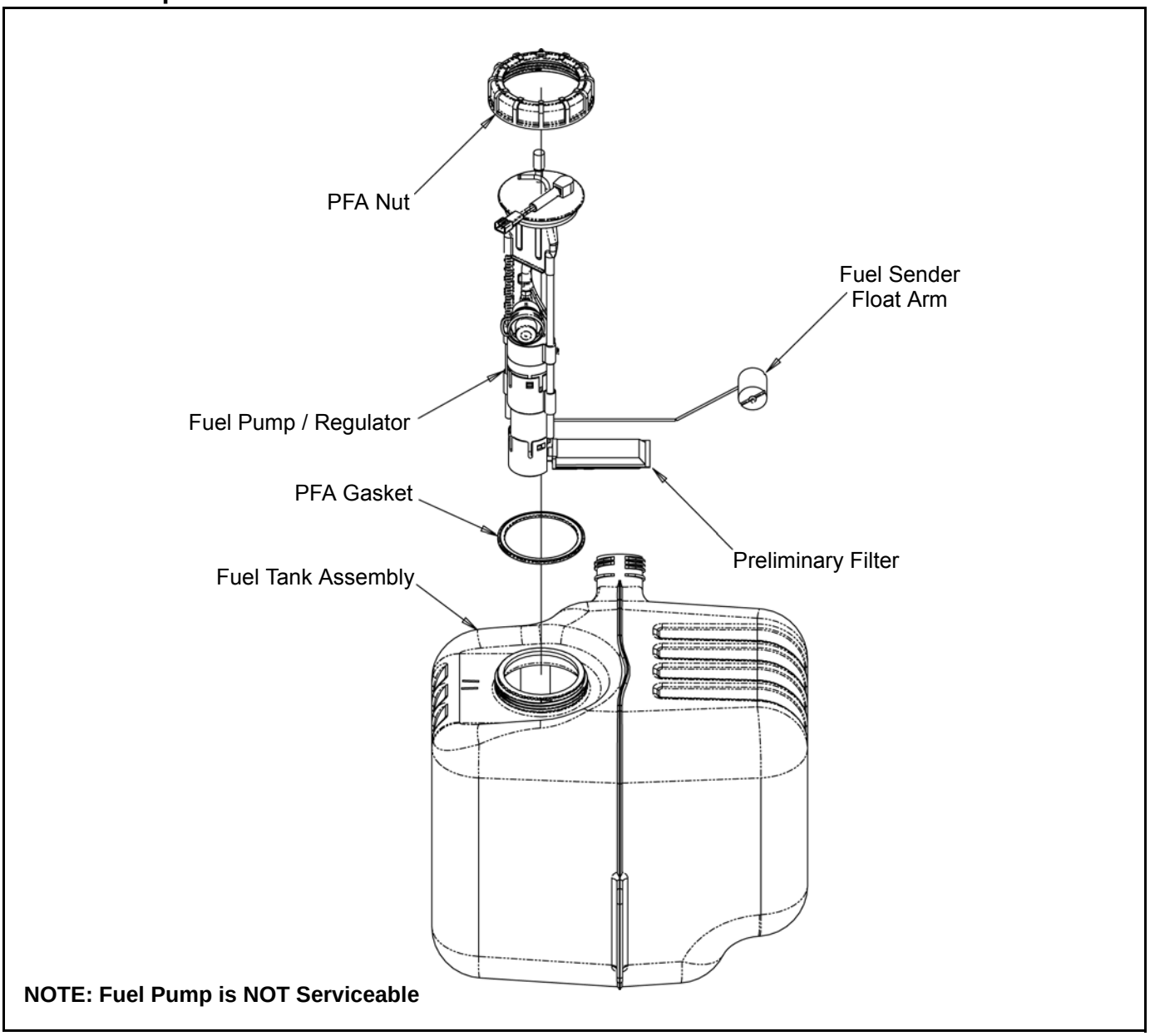
Located at: www.polaris.diagsys.com



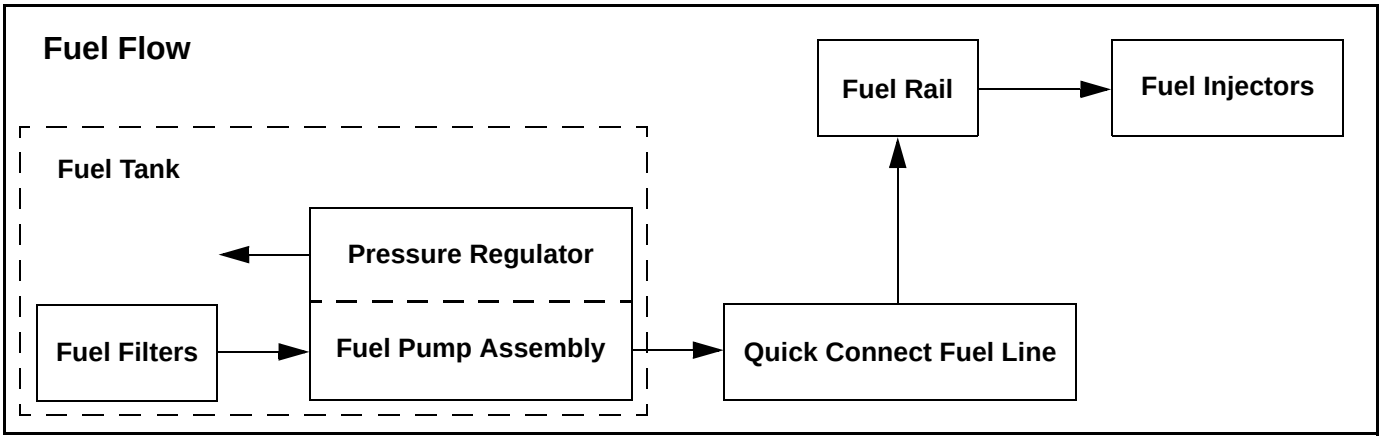
EFI Service Notes

- For more convenient and accurate testing of EFI components, it is recommended dealers utilize the Digital Wrench™ Diagnostic Software (dealer only), or testing may be done manually using the procedures provided.
- **80% of all EFI problems are caused by wiring harness connections.**
- For the purpose of troubleshooting difficult running issues, a known-good ECU from another Polaris *RANGER* 700 EFI of the same model may be used without damaging system or engine components.
- Never attempt to service any fuel system component while engine is running or ignition switch is "on."
- Cleanliness is essential and must be maintained at all times when servicing or working on the EFI system. Dirt, even in small quantities, can cause significant problems.
- Do not use compressed air if the system is open. Cover any parts removed and wrap any open joints with plastic if they will remain open for any length of time. New parts should be removed from their protective packaging just prior to installation.
- Clean any connector before opening to prevent dirt from entering the system.
- Although every precaution has been taken to prevent water intrusion failure, avoid direct water or spray contact with system components.
- Do not disconnect or reconnect the wiring harness connector to the control unit or any individual components with the ignition "on." This can send a damaging voltage spike through the ECU.
- Do not allow the battery cables to touch opposing terminals. When connecting battery cables attach the positive (+) cable to positive (+) battery terminal first, followed by negative (-) cable to negative (-) battery terminal.
- Never start the engine when the cables are loose or poorly connected to the battery terminals.
- Never disconnect battery while engine is running.
- Never use a battery boost-pack to start the engine.
- Do not charge battery with key switch "on."
- Always disconnect negative (-) battery cable lead before charging battery.
- Always unplug ECU from the wire harness before performing any welding on the unit.

Fuel Tank Exploded View

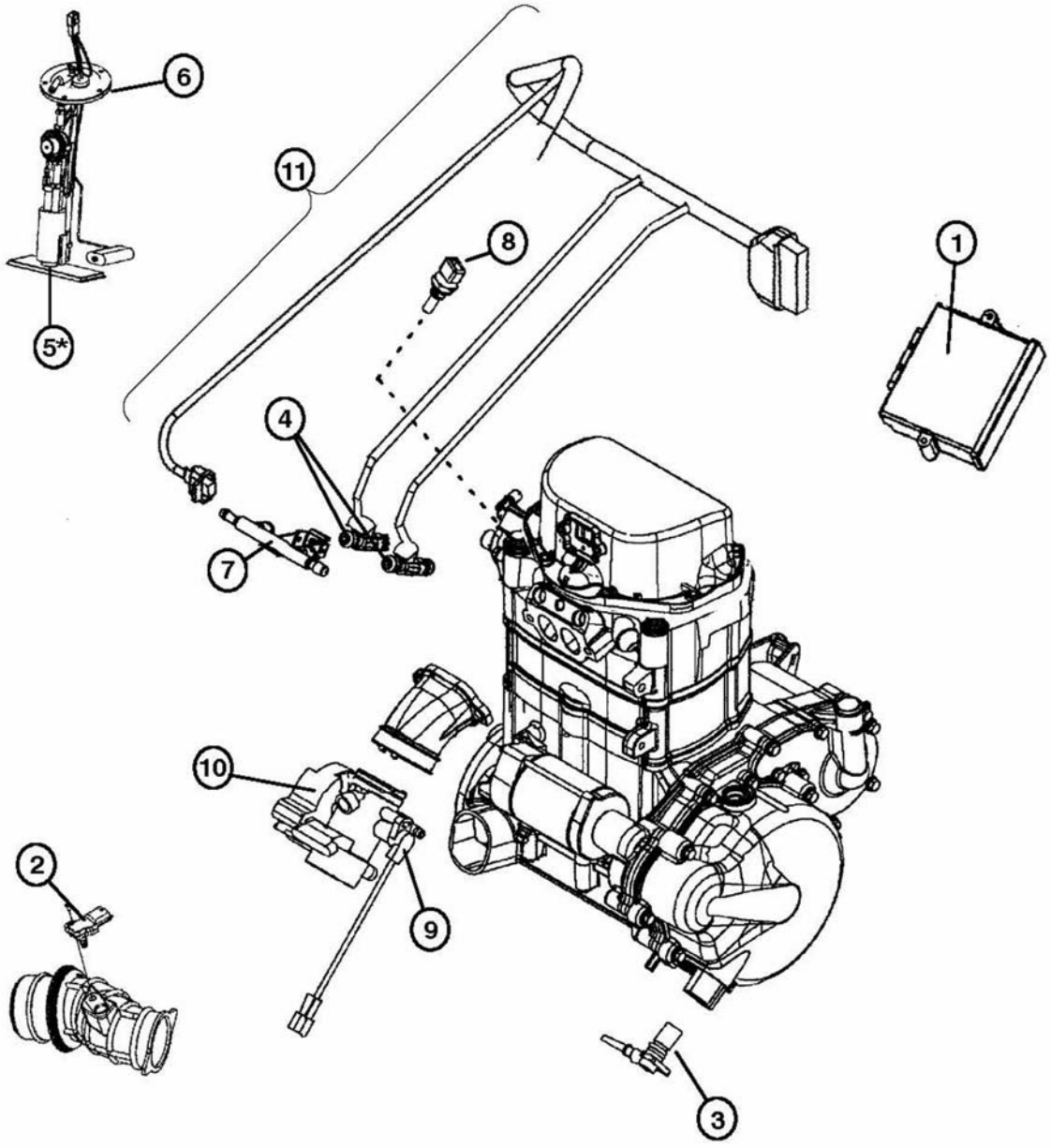


NOTE: Fuel Pump is NOT Serviceable



EFI System Exploded View

1. Electronic Control Unit (ECU)
2. Intake Air Temperature / Barometric Air Pressure Sensor (T-BAP)
3. Crankshaft Position Sensor (CPS)
4. Fuel Injectors
5. Fuel Filter
6. Fuel Pump / Regulator / Gauge Sender Asm. (Located in tank as an assembly)
7. Fuel Rail
8. Engine Coolant Sensor (ECT)
9. Throttle Position Sensor (TPS)
10. Throttle Body
11. Wire Harness (Part of main harness)



EFI System Component Locations

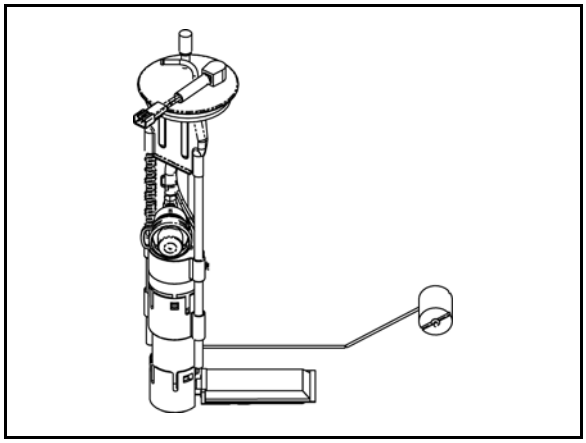
1. **Electronic Control Unit (ECU)**
   Located under the seat on the driver's side.

2. **Intake Air Temperature and Barometric Air Pressure Sensor (T-BAP)**
   Located in the rubber intake boot between the air box and throttle body.

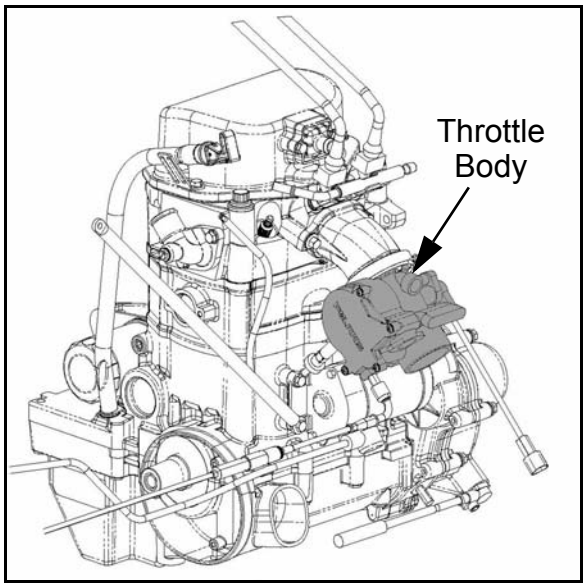
3. **Crankshaft Position Sensor (CPS)**
   Located in the magneto cover on the right-hand side of the engine.

4. **Fuel Injectors / Fuel Rail**
   Attached to the fuel rail located in the intake track of the cylinder head.

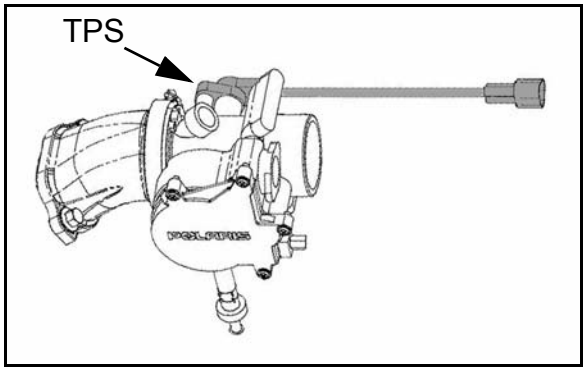
5. **Fuel Pump / Regulator / Fuel Gauge Sender Assembly**
   Located in fuel tank as an assembly.



6. **Throttle Body**



7. **Throttle Position Sensor (TPS)**
Located on the right-hand side of the throttle body.



8. **Engine Coolant Temperature Sensor (ECT)**
Located in the cylinder head.

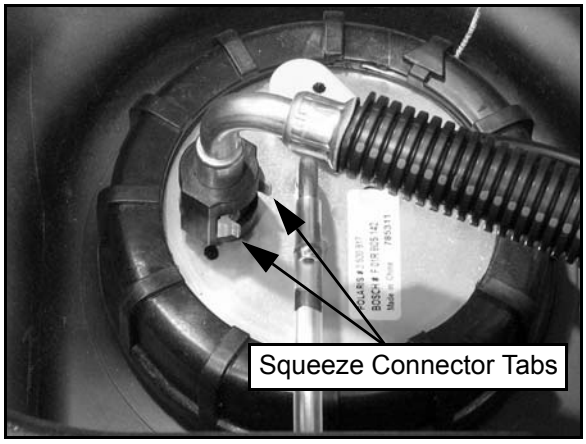
Fuel Lines - Quick Connect Removal / Installation

> **CAUTION**
>
> Verify fuel system has been depressurized before performing this procedure.

RANGER 700 EFI models use quick connect fuel lines. Refer to the steps for fuel line removal / installation:

1. Thoroughly clean the connector and place a shop towel around the fuel line to catch any dripping fuel.

2. Squeeze the connector tabs together and slide the green retainer forward.



3. Lift up on the fuel line to remove from the fuel pump outlet.

4. To install the line, verify the connector and fuel pump outlet are clean and free of debris.

5. Place the connector end over the fuel pump outlet and push the green retainer and tabs back into place.

6. Repeat this process to remove the fuel line from the fuel rail.

ELECTRONIC FUEL INJECTION

Principal Components

The Electronic Fuel Injection (EFI) system is a complete engine fuel and ignition management design. This system includes the following principal components:

- Fuel Pump
- Fuel Rail
- Fuel Line(s)
- Fuel Filter(s)
- Fuel Injectors
- Pressure Regulator
- Throttle Body / Intake Manifold
- Engine Control Unit (ECU)
- Ignition Coils
- Coolant Temperature Sensor
- Throttle Position Sensor (TPS)
- Crankshaft Position Sensor (CPS)
- Intake Air Temperature and Barometric Air Pressure Sensor (T-BAP)
- Wire Harness Assembly
- Check Engine Light

EFI Operation Overview

The EFI system is designed to provide peak engine performance with optimum fuel efficiency and lowest possible emissions. The ignition and injection functions are electronically controlled, monitored and continually corrected during operation to maintain peak performance.

The central component of the system is the Bosch Engine Control Unit (ECU) which manages system operation, determining the best combination of fuel mixture and ignition timing for the current operating conditions.

An in-tank electric fuel pump is used to move fuel from the tank through the fuel line and in-line fuel filter. The in-tank fuel pressure regulator maintains a system operating pressure of 39 psi and returns any excess fuel to the tank. At the engine, fuel is fed through the fuel rail and into the injectors, which inject into the intake ports. The ECU controls the amount of fuel by varying the length of time that the injectors are "on." This can range from 1.5-8.0 milliseconds depending on fuel requirements. The controlled injection of the fuel occurs each crankshaft revolution, or twice for each 4-stroke cycle. One-half the total amount of fuel needed for one firing of a cylinder is injected during each injection. When the intake valve opens, the fuel/air mixture is drawn into the combustion chamber, ignited and burned.

The ECU controls the amount of fuel being injected and the ignition timing by monitoring the primary sensor signals for air temperature, barometric air pressure, engine temperature, speed (RPM), and throttle position (load). These primary signals are compared to the programming in the ECU computer chip, and the ECU adjusts the fuel delivery and ignition timing to match the values.

During operation the ECU has the ability to re-adjust temporarily, providing compensation for changes in overall engine condition and operating environment, so it will be able to maintain the ideal air/fuel ratio.

During certain operating periods such as cold starts, warm up, acceleration, etc., a richer air / fuel ratio is automatically calculated by the ECU.

Initial Priming / Starting Procedure

NOTE: The injection system must be purged of all air prior to the initial start up, and / or any time the system has been disassembled.

If the EFI system is completely empty of fuel or has been disassembled and repaired:

1. Cycle the key switch from “OFF” to “ON” 6 times, waiting for approximately 3 seconds at each “ON” cycle to allow the fuel pump to cycle and shut down.
2. Once step 1 is completed, turn the key switch to “START” until the engine starts or 5 seconds has passed.
3. If the engine failed to start, repeat step 1 for 2 more cycles and attempt to start the engine.

If the engine fails to start, a problem may still exist, and should be diagnosed.

NOTE: Accurate testing of EFI components is recommended utilizing the Digital Wrench™ Diagnostic Software (dealer only).

ELECTRONIC CONTROL UNIT (ECU)

Operation Overview

The ECU is the brain or central processing computer of the entire EFI fuel/ignition management system. During operation, sensors continuously gather data which is relayed through the wiring harness to input circuits within the ECU. Signals to the ECU include: ignition (on/off), crankshaft position and speed (RPM), throttle position, engine coolant temperature, air temperature, intake manifold air pressure and battery voltage. The ECU compares the input signals to the programmed maps in its memory and determines the appropriate fuel and spark requirements for the immediate operating conditions. The ECU then sends output signals to set the injector duration and ignition timing.

During operation, the ECU continually performs a diagnostic check of itself, each of the sensors, and system performance. If a fault is detected, the ECU turns on the “Check Engine” light in the speedometer and stores the fault code in its fault memory. Depending on the significance or severity of the fault, normal operation may continue, or "Fail-Safe" operation (slowed speed, richer running) may be initiated. A technician can determine the cause of the “Check Engine” light by initiating the “Blink Code” sequence or by using Digital Wrench™. The ECU requires a minimum of 7.0 volts to operate. The memory in the ECU is operational the moment the battery cables are connected.

To prevent engine over-speed and possible failure, a rev-limiting feature is programmed into the ECU. If the maximum RPM limit (6200) is exceeded, the ECU suppresses the injection signals, cutting off the fuel flow. This process repeats it self in rapid succession, limiting operation to the preset maximum.

***RANGER* 700 EFI RPM Limit:**

Hard Limit - Injector suppression occurs

- High: 6200
- Low: 6200
- Neutral: 6200
- Reverse: 6200

Soft Limit - Timing suppression occurs

- High: None
- Low: 5900
- Neutral: 5900
- Reverse: 5900

ECU Service

Never attempt to disassemble the ECU. It is sealed to prevent damage to internal components. Warranty is void if the case is opened or tampered with in any way.

All operating and control functions within the ECU are pre-set. No internal servicing or readjustment may be performed. If a problem is encountered, and you determine the ECU to be faulty, contact the Polaris Service Department for specific handling instructions. Do not replace the ECU without factory authorization.

The relationship between the ECU and the throttle position sensor (TPS) is very critical to proper system operation. If the TPS is faulty, or the mounting position of the TPS to the throttle body is altered, the TPS must be adjusted.

For the purpose of troubleshooting, a known-good ECU from another Polaris ***RANGER*** 700 EFI of the same model may be used without system or engine component damage.

ECU Replacement

1. Remove the retaining screws (2) holding the ECU.
2. With the Ignition turned off, disconnect the wire harness from the ECU.
3. To install, reverse the procedures and tighten screws to specification.

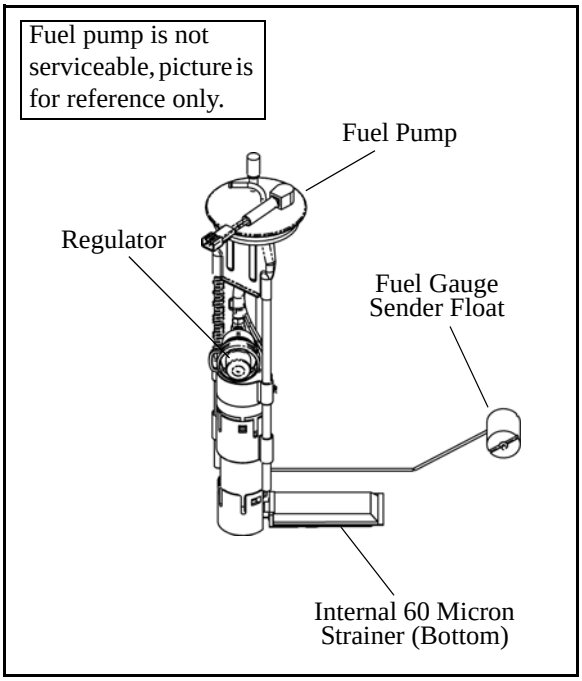
= T
ECU Retaining Screws **10 in. lbs. (1.1 Nm)**

FUEL PUMP

Operation Overview

NOTE: All EFI units utilize quick connect lines.

An electric fuel pump assembly is used to transfer fuel to the EFI system from inside the fuel tank. This assembly includes the fuel pump, regulator and fuel gauge sender. The pump is rated for a minimum output of 25 liters per hour at 39 psi and has a non-serviceable internal 60-micron filter.



When the key switch is turned to "ON", the ECU activates the fuel pump, which pressurizes the system for start-up.

The ECU switches off the pump preventing the continued delivery of fuel in these instances:

- If the key switch is not promptly turned to the "start" position.
- If the engine fails to start.
- If the engine is stopped with the key switch "ON" (as in the case of an accident).

In these situations, the “check engine” light will go on, but will turn off after 4 cranking revolutions if system function is OK. Once the engine is running, the fuel pump remains on.

Fuel Sender Test

If the fuel gauge reading on the instrument cluster is not working, or if the display reading differs in large comparison to the fuel in the tank, perform a resistance test on the fuel sender.

Disconnect the fuel pump / sending unit connection and measure the resistance between the Purple and Brown wires (see chapter 10 for further details). If out of specification, replace the fuel pump / tank assembly.

Fuel Sender Resistance Specifications:
Full: 90Ω
Empty: 5Ω

Fuel Pump Test

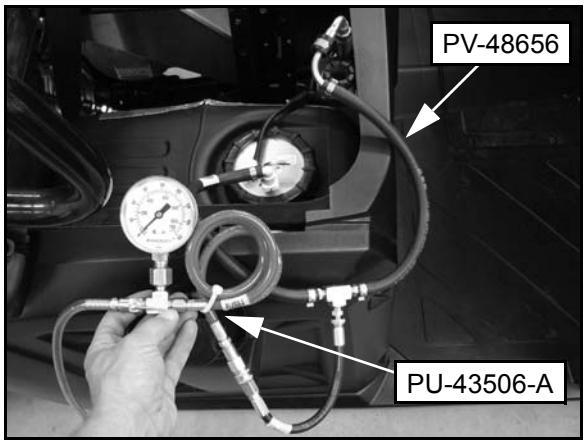
NOTE: The fuel pump/tank assembly is non-serviceable and must be replaced if determined to be faulty. If a fuel delivery problem is suspected, make certain the fuel pump is being activated by the ECU, all electrical connections are properly secured, the fuses are good, and a minimum of 7.0 volts is being supplied. If during starting the battery voltage drops below 7.0 volts, the ECU will fail to operate the system.

⚠ WARNING

Fuel is extremely flammable and may cause severe burns, injury, or death.
Do not use any device that produces a flame or electrical devices that may spark around fuel or fuel vapors.

1. Cover the fuel line connection with a shop towel and disconnect the fuel line from the fuel pump.
2. Install the Fuel Pressure Gauge Adaptor (PV-48656) in-line between the fuel pump outlet and fuel line.

3. Connect the hose from the Fuel Pressure Gauge Kit (PU-43506-A) to the test valve on the Fuel Pressure Gauge Adaptor. Route the clear hose into a portable gasoline container or the vehicle's fuel tank.



4. Turn on the key switch to activate the pump and check the system pressure on the gauge. If system pressure of 39 psi ± 3 is observed, the ignition switch, ECU, fuel pump, and pressure regulator are working properly. Turn the key switch off and depress the valve button on the tester to relieve the system pressure.

Fuel Pump Pressure: 39 psi. ± 3

NOTE: If the pressure is too high or too low, replace the fuel pump / tank assembly.

5. If the pump did not activate (Step 4), disconnect the plug from the fuel pump. Connect a DC voltmeter across terminals "A" and "C" in the plug on the vehicle harness side. Turn on the key switch and observe voltage to ensure a minimum of 7 volts is present.

NOTE: If the voltage was below 7 VDC, test battery, ignition switch, relay(s), wiring harness and ECU.

6. If the reading is between 7 and 14 volts, turn key switch off and connect an ohmmeter between the terminals "A" and "C"' in the plug on the pump harness to check for continuity within the fuel pump.

NOTE: If there was no continuity between the pump terminals, replace the fuel pump / tank assembly.

7. If voltage at the plug was within the specified range, and there was continuity across the pump terminals, reconnect the plug to the pump, making sure you have clean connections. Turn on the key switch and listen for the pump to activate.

NOTE: If the pump starts, verify you have the correct amount of fuel pressure.

NOTE: If the pump still does not operate, replace the fuel pump / tank assembly.

Fuel Pump / Tank Assembly Replacement

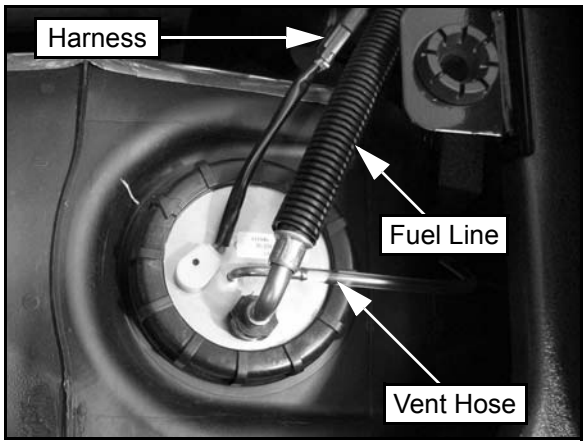
NOTE: All EFI units utilize quick connect fuel lines.

⚠ WARNING

Always wear safety goggles when working with high pressure or flammable fluids. Failure to do so could result in serious injury or complications.

NOTE: The fuel pump cannot be replaced as an individual part, the entire fuel pump and fuel tank is replaced as an assembly. Refer to your parts book for the proper part number.

1. Disconnect the negative battery cable.
2. Remove the seat.
3. Disconnect the fuel line from the fuel pump.



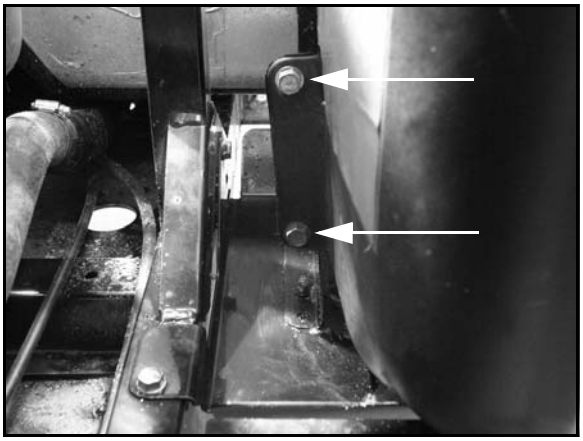
4. Disconnect the fuel pump electrical harness.
5. Remove the fuel tank vent hose

NOTE: A small amount of fuel may come out of the fuel line or tank. Plug the fuel line and tank inlet or use a shop towel during removal.

NOTE: Properly drain fuel into a suitable container.

6. Remove the RH rear fender and fuel cap.

7. Remove the two inner bolts that hold the fuel tank to the frame.



8. Remove the two outer lower bolts that hold the fuel tank to the frame.

9. Reinstall the fuel cap and carefully pull the fuel tank out the RH side of the frame.

WARNING

Wear safety goggles while performing this procedure, failure to do so could result in serious injuries.

Fuel Tank Installation

1. Reinstall the fuel pump / tank assembly.
2. Reinstall the four fuel tank mounting bolts that were removed.
3. Reconnect the electrical harness. Install the fuel line and vent line and verify they are secure.
4. Reinstall the RH rear fender.
5. Reconnect the negative battery cable. Test the fuel pump by turning on the key and listening for the pump to activate.

FUEL PRESSURE REGULATOR

Operation Overview

The fuel pressure regulator maintains the required operating system pressure of 39 psi + 3psi. A rubber-fiber diaphragm divides the regulator into two separate sections-, the fuel chamber and the pressure regulating chamber. The pressure regulating spring presses against the valve holder (part of the diaphragm), pressing the valve against the valve seat. The combination of atmospheric pressure and regulating spring tension equals the desired operating pressure. Any time the fuel pressure against the bottom of the diaphragm exceeds the desired (top) pressure, the valve opens, relieving the excess pressure, returning the excess fuel back to the tank.

Fuel Pressure Regulator Test

Refer to the “FUEL PUMP TEST” procedure.

See “Fuel Pump Test” on page 4.12.

Fuel Pressure Regulator Replacement

The regulator is a sealed, non-serviceable assembly. If it is faulty, the pump assembly must be replaced. Refer to the Fuel Pump / Tank Assembly Replacement procedure.

FUEL INJECTORS

Operation Overview

The fuel injectors mount into the intake manifold, and the fuel rail attaches to them at the top end. Replaceable O-rings on both ends of the injector prevent external fuel leaks and also insulate it from heat and vibration.

When the key switch is on, the fuel rail is pressurized, and voltage is present at the injector. At the proper instant, the ECU completes the ground circuit, energizing the injector. The valve needle in the injector is opened electromagnetically, and the pressure in the fuel rail forces fuel down through the inside. The "director plate" at the tip of the injector (see inset) contains a series of calibrated openings which directs the fuel into the intake port in a cone-shaped spray pattern.

The injector is opened and closed once for each crankshaft revolution, however only one-half the total amount of fuel needed for one firing is injected during each opening. The amount of fuel injected is controlled by the ECU and determined by the length of time the valve needle is held open, also referred to as the "injection duration" or "pulse width". It may vary in length from 1.5-8 milliseconds depending on the speed and load requirements of the engine.

Fuel Injector Service

Injector problems typically fall into three general categories-electrical, dirty / clogged, or leakage. An electrical problem usually causes one or both of the injectors to stop functioning. Several methods may be used to check if the injectors are operating.

- With the engine running at idle, feel for operational vibration, indicating that they are opening and closing.
- When temperatures prohibit touching, listen for a buzzing or clicking sound with a screwdriver or mechanic's stethoscope.
- Disconnect the electrical connector from an injector and listen for a change in idle performance (only running on one cylinder) or a change in injector noise or vibration.

NOTE: Do not apply voltage directly to the fuel injector(s). Excessive voltage will burn them out. Do not ground the injector(s) with the ignition on. Injector(s) will open/turn on if relay is energized.

If an injector is not operating, it can indicate either a bad injector, or a wiring/electrical connection problem. Check as follows:

Injector leakage is very unlikely, but in rare instances it can be internal (past the valve needle), or external (weeping around the injector body). The loss of system pressure from leakage can cause hot restart problems and longer cranking times.

Injector problems due to dirt or clogging are unlikely due to the design of the injectors, the high fuel pressure, the use of filters and the detergent additives in the gasoline. Symptoms that could be caused by dirty/clogged injectors include rough idle, hesitation/stumble during acceleration, or triggering of fault codes related to fuel delivery. Injector clogging is usually caused by a buildup of deposits on the director plate, restricting the flow of fuel, resulting in a poor spray pattern. Some contributing factors to injector clogging include; dirty air filters, higher than normal operating temperatures, short operating intervals and dirty, incorrect, or poor quality fuel. Cleaning of clogged injectors is not recommended; they should be replaced. Additives and higher grades of fuel can be used as a preventative measure if clogging has been a problem.

Fuel Injector Replacement

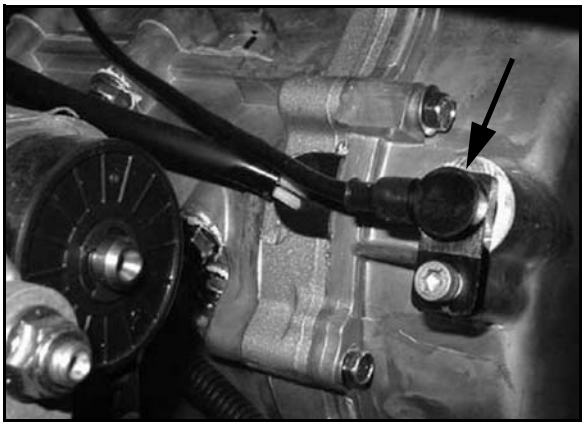
1. Thoroughly clean the area around the throttle body, intake boot and fuel injectors. Allow engine to cool.
2. Disconnect the fuel injector harness(s) as shown below.

3. Place a catch-container below the fuel line fitting at the fuel rail and remove the fuel line.
4. Remove the fuel rail mounting screw and carefully loosen / pull the rail away from the injectors.
5. Reverse the procedures to install the new injector(s) and reassemble. Use a new O-ring any time an injector is removed (replacement injectors include new O-rings). Lubricate O-rings lightly with oil to aid installation. Torque the fuel rail mounting screw to **16-20 ft. lbs. (22-27 Nm)**.

CRANKSHAFT POSITION SENSOR (CPS)

Operation Overview

The engine speed sensor is essential to engine operation, constantly monitoring the rotational speed (RPM) and position of the crankshaft.



A ferromagnetic 60-tooth ring gear with two consecutive teeth missing is mounted on the flywheel. The inductive speed sensor is mounted 1.0 ± 0.26 mm (0.059 ± 0.010 in.) away from the ring gear. During rotation, an AC pulse is created within the sensor for each passing tooth. The ECU calculates engine speed from the time interval between the consecutive pulses. The two-tooth gap creates an "interrupt" input signal, corresponding to specific crankshaft position for PTO cylinder. This signal serves as a reference for the control of ignition timing by the ECU. Synchronization of the CPS and crankshaft position takes place during the first two revolutions each time the engine is started. This sensor must be properly connected at all times. If the sensor fails or becomes disconnected for any reason, the engine will quit running.

CPS Test

The crankshaft position sensor is a sealed, non-serviceable assembly. If fault code diagnosis indicates a problem within this area, test and correct as follows:

1. Disconnect main harness connector from ECU.

2. Connect an ohmmeter between the pin terminals. A resistance value of 560Ω ± 10% at room temperature (20° C, 68° F) should be obtained. If resistance is correct, check the mounting, air gap, toothed ring gear (damage, runout, etc.), and flywheel key.

Crankshaft Position Sensor:
560Ω ± 10% (20° C, 68° F)

3. Disconnect speed sensor connector from wiring harness. (the connector with one heavy black lead) Viewing the connector with dual aligning rails on top, test resistance between the terminals. A reading of 560Ω ± 10% should again be obtained.

NOTE: If the resistance is incorrect, remove the screw securing the sensor to the mounting bracket and replace the sensor. If the resistance in step 2 was incorrect, but the resistance of the sensor alone was correct, test the main harness circuit between the sensor connector terminals and the corresponding pin terminals in the main connector. Correct any observed problem, reconnect the sensor, and perform step 2 again.

CPS Replacement

1. Disconnect sensor harness connector.

2. Using a 6 mm hex wrench, remove the retaining bolt and replace the sensor, using a light coating of oil on the o-ring to aid installation.

3. Torque the retaining bolt to specification.

= T

CPS Retaining Bolt Torque:
25 in. lbs. (2.8 Nm)

TEMPERATURE / BAROMETRIC AIR PRESSURE SENSOR (T-BAP)

Operation Overview

Mounted on the throttle body intake, the temperature and barometric air pressure sensor (T-BAP) performs two functions in one unit.

Air passing through the intake is measured by the T-BAP and relayed to the ECU. These signals, comprised of separate air temperature and barometric air pressure readings, are processed by the ECU and compared to its programming for determining the fuel and ignition requirements during operation.

T-BAP Test

The temperature and barometric air pressure sensor (T-BAP) is a non-serviceable item. If it is faulty, it must be replaced. This sensor requires a 5 Vdc input to operate, therefore the T-BAP sensor should only be tested using the Digital Wrench™ Diagnostic Software (dealer only). Refer to the EFI Diagnostic Software Manual for more information.

T-BAP Replacement

1. Disconnect sensor from engine harness.
2. Using a 10mm wrench, remove the retaining bolt and replace the sensor, using a light coating of oil on the o-ring to aid installation.
3. Torque the retaining bolt to specification.

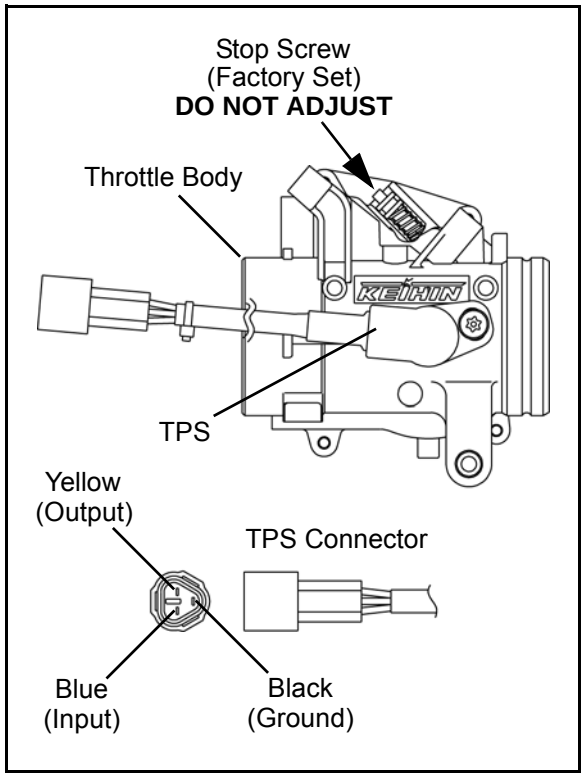
= T
T-BAP Retaining Bolt Torque: **29 in. lbs. (3.3 Nm)**

THROTTLE POSITION SENSOR (TPS)

Operation Overview

The throttle position sensor (TPS) is used to indicate throttle plate angle to the ECU.

Mounted on the throttle body and operated directly off the end of the throttle shaft, the TPS works like a rheostat, varying the voltage signal to the ECU in direct correlation to the angle of the throttle plate. This signal is processed by the ECU and compared to the internal pre-programmed "maps" to determine the required fuel and ignition settings for the amount of engine load.

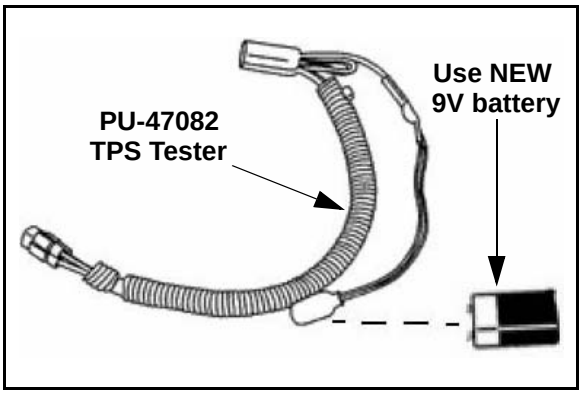


The correct position of the throttle body stop screw is established and set at the factory. DO NOT loosen the throttle body stop screw or alter its position in any manner. The stop screw controls the air flow calibration of the throttle body. If the stop screw is repositioned or adjusted, the throttle body assembly must be replaced.

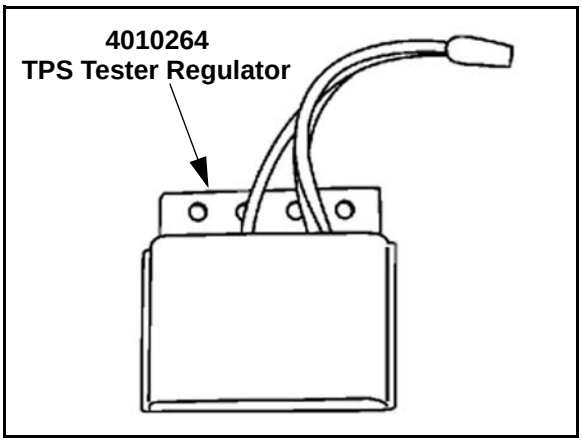
TPS Tester / Regulator

The throttle position sensor (TPS) reading can be checked by using the TPS Tester Adapter Harness **(PU-47082)** and TPS Tester Regulator **(4010264)**.

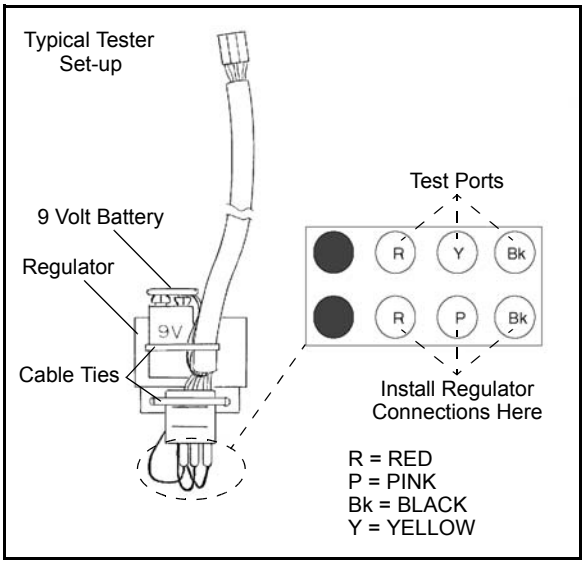
Set-up the TPS Tester Adapter Harness **(PU-47082)**, according to the instructions that accompanied the tester. Make sure the 9 Volt battery is new.



As mentioned in the instructions included with the tester, be sure the TPS Tester Adapter Harness is set up along with the TPS Tester Regulator **(4010264)**.



NOTE: If your dealership sells Polaris snowmobiles, you may already have this regulator from TPS Tester Kit (2201519). If you do not have this regulator, you must order one from SPX at 1-800-328-6657.

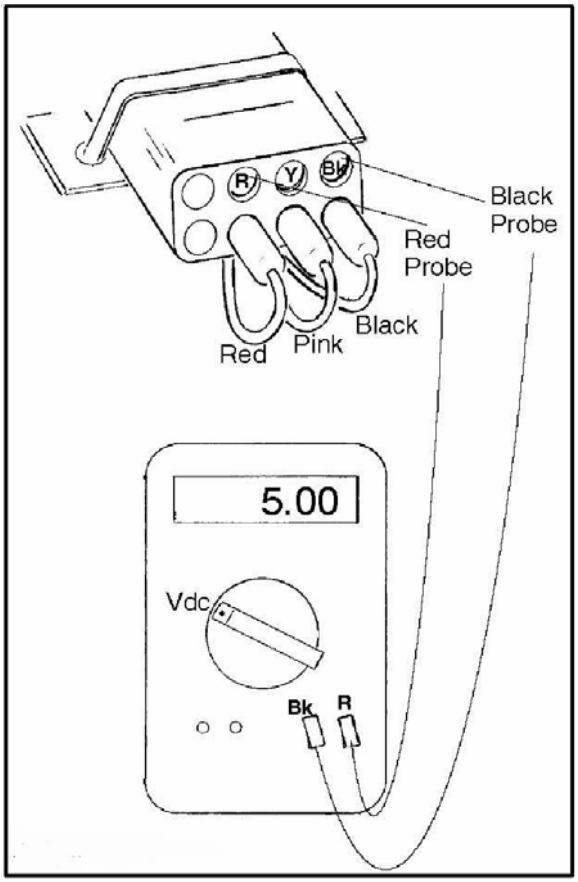


Verify TPS Tester Reference Voltage

A 5 volt reference voltage from the TPS Tester harness is required for the TPS test to be accurate. Refer to the instructions provided with the TPS Tester Adapter Harness **(PU-47082)** or follow the bullet point steps below to check reference voltage.

Reference Voltage Test:

- Insert black voltmeter probe into the **"Bk"** test port.
- Connect the red voltmeter probe into the **"R"** test port and verify the voltage is 4.99-5.01 Vdc. If this reading is low, verify the 9 volt battery is good or try a new 9 volt battery.

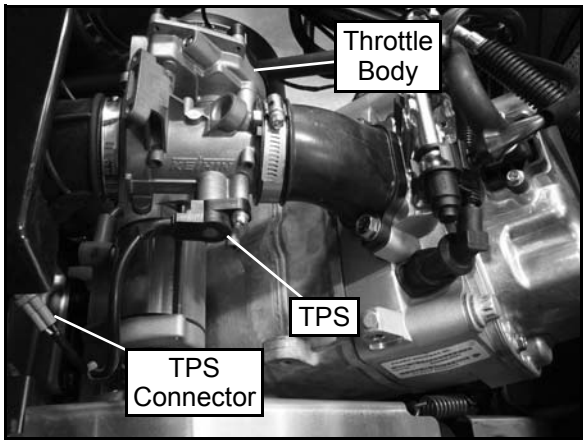


TPS Reference Voltage
5 Vdc Input

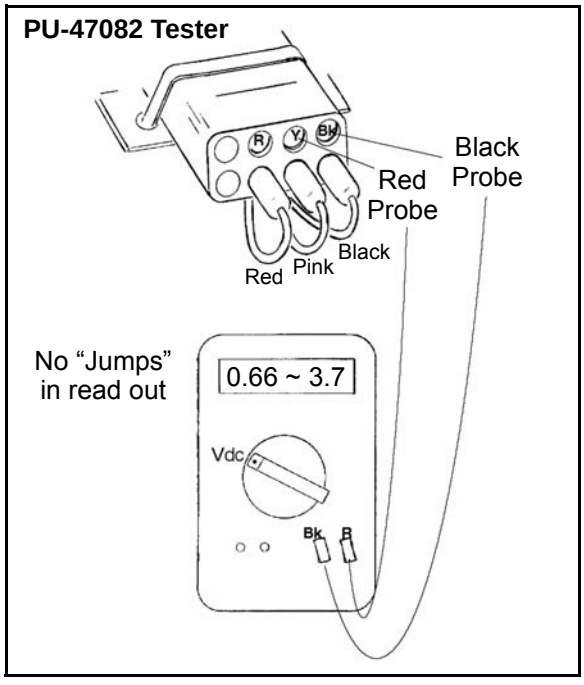
IMPORTANT: Always use a fresh 9 Volt battery.

Checking TPS Reading

1. Remove the lower seat base to access the sensor connector.
2. Assemble the TPS Tester according to the instructions. Refer to **"TPS Tester / Regulator"** for proper set-up and testing. Verify the 9 volt tester battery is new.
3. Disconnect the vehicle chassis harness from the TPS.



4. Plug the TPS Tester harness into the TPS harness.
5. Set your voltmeter to read Vdc. Connect the red voltmeter probe into the **"Y"** test port and the black voltmeter probe into the **"Bk"** test port.
6. Move the throttle open and closed slowly while reading the display. The voltage should increase and decrease smoothly without any "jumps" when the throttle is applied.



7. If voltage varies with throttle movement, continue on to Step 8. If the sensor did not function correctly, replace it.
8. Allow the throttle foot pedal to rest in the idle position. The voltmeter should read **.660 ± .010** volts.

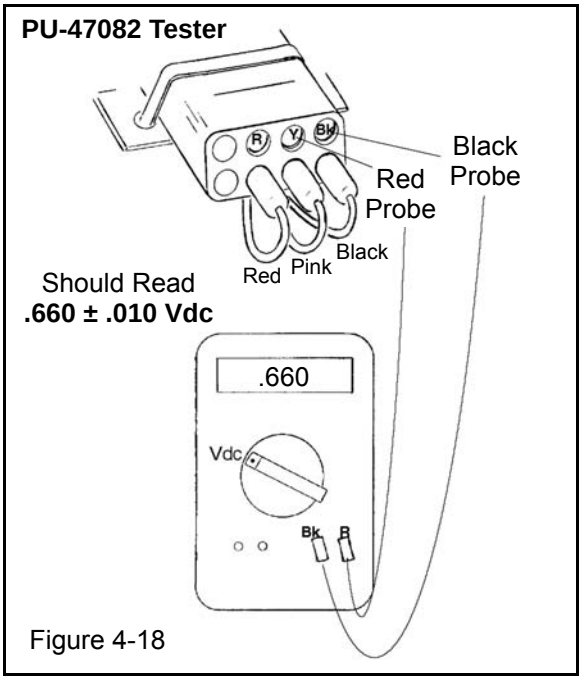


Figure 4-18

TPS Output Reading
.660 ± .010 Vdc

9. If the voltage does not read within the specification, proceed to the **"TPS Adjustment"** procedure. If the voltage reading is within specification, no adjustment is required.

TPS Adjustment

NOTE: This procedure should be performed after you have checked the TPS reading. Refer to "Checking TPS Reading" procedure before making any adjustments.

1. Make sure the TPS Tester harness is still connected to the TPS harness.
2. Loosen the mounting screw (B) holding the TPS to the throttle body (see Figure 4-19).
3. Rotate the TPS until your voltmeter reads **.660 ± .010** volts (see Figure 4-18).

TPS Output Reading
.660 ± .010 Vdc

4. Retighten the mounting screw, and verify the voltage did not change. If the voltage changed, repeat steps 2 - 4.
5. Reconnect the TPS harness to the vehicle harness.

TPS Replacement

NOTE: The correct position of the TPS angle on the throttle body is established and set at the factory. If the TPS is replaced, repositioned or loosened it must be recalibrated. Refer to the "TPS Adjustment" procedure.

1. Remove the lower seat base to access the TPS.
2. Disconnect the TPS harness connection (A).

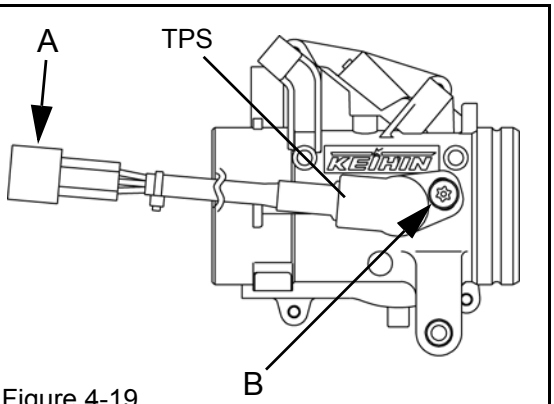


Figure 4-19

3. Remove the mounting screw (B) and replace the sensor.

NOTE: If replacing the TPS or throttle body, you must perform the "TPS Adjustment" procedure.

4. Refer to "**TPS Adjustment**" for setting the TPS voltage.

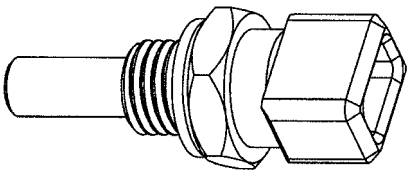
ENGINE COOLANT TEMPERATURE SENSOR (ECT)

Operation Overview

Mounted on the cylinder head, the engine temperature sensor measures coolant temperature. The engine temperature sensor is a Negative Temperature Coefficient (NTC) type sensor, as the temperature increases the resistance decreases.

Coolant passes through the cylinder and by the sensor probe, varying a resistance reading which is relayed to the ECU. This signal is processed by the ECU and compared to its programming for determining the fuel and ignition requirements during operation. The ECU also uses this signal to determine when to activate the fan during operation. If for any reason the engine temperature sensor circuit is interrupted, the fan will default to "ON".

ECT Sensor Test


Engine Coolant Temperature Sensor

To quickly rule out other components and wiring related to the ECT sensor, disconnect the harness from the ECT sensor. The fan should turn on. This indicates all other components are working properly.

Refer to Chapter 10 for ECT testing. Polaris dealers can also test the sensor by using the Digital Wrench™ Diagnostic Software (dealer only). Refer to the Digital Wrench™ User Guide for more information.

ECT Sensor Resistance Readings

Temperature °F (°C)	Resistance
68 °F (20 °C)	2.5 kΩ ± 6%
212 °F (100 °C)	186 Ω ± 2%

ECT Sensor Replacement

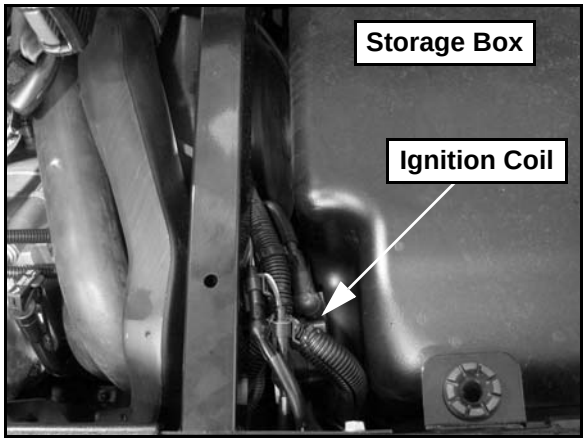
1. Drain coolant to level below sensor.
2. Disconnect sensor from engine harness.
3. Using a wrench, remove and replace the sensor, applying a light coating of thread sealant to aid installation.
4. Torque the sensor to **17 ft. lbs. (23 Nm)**.

= T
ECT Retaining Bolt Torque: **17 ft. lbs. (23 Nm)**

IGNITION COIL

Operation Overview

The ignition coil is used to provide high voltage to fire the spark plugs. When the ignition key is on, DC voltage is present in primary side of the ignition coil windings. During engine rotation, an AC pulse is created within the crankshaft position sensor for each passing tooth on the flywheel. The two-tooth gap creates an "interrupt" input signal, corresponding to specific crankshaft position for PTO cylinder. This signal serves as a reference for the control of ignition timing. The ECU then calculates the time interval between the consecutive pulses, and determines when to trigger the voltage spike that induces the voltage from the primary to the secondary coil windings to fire the spark plugs.



Ignition Coil Tests

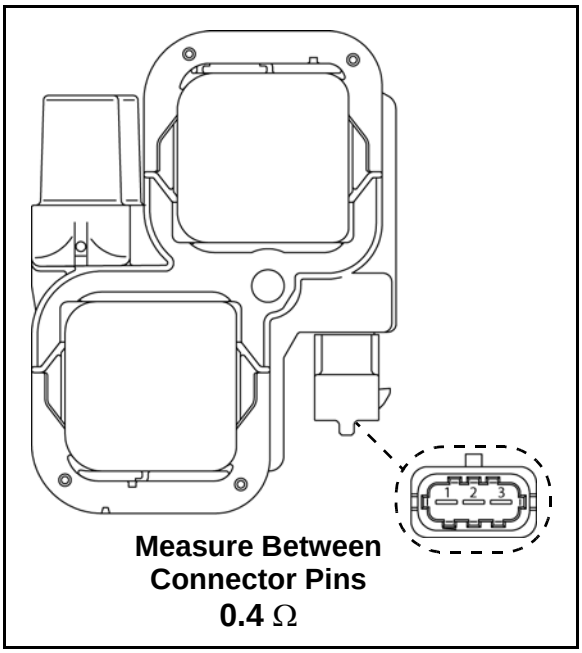
The ignition coil can be tested by using an ohm meter. Use the following illustration and specification table to test the ignition coil.

NOTE: The left hand storage compartment must be removed to properly access the ignition coil harness for testing purposes.

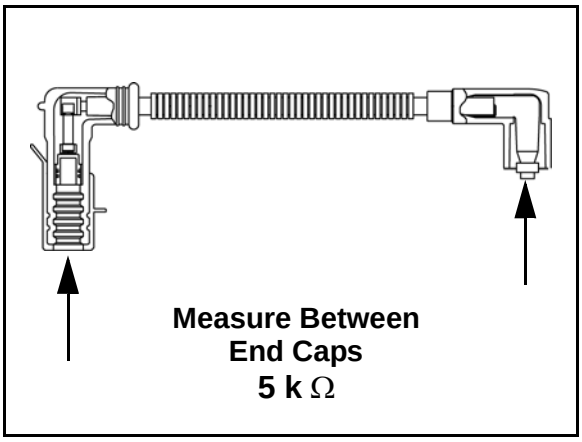
Ignition Coil Resistance Readings

Test	Pin Connection	Resistance
Primary	Between 1 & 2 Between 3 & 2	0.4 Ω
Secondary	Between High Tension Lead Ends	5 k Ω

Primary Test



Secondary Test



Ignition Coil / HT Lead Replacement

1. Remove the seat base and left hand storage compartment to access the ignition coil.
2. Disconnect the ignition coil harness and remove the high tension leads from the coil.
3. Remove the fastener retaining the coil and remove the coil from the vehicle. If replacing the high tension lead(s), remove the other end of the lead(s) from the spark plug.
4. Install the new ignition coil and/or high tension lead(s).

= T
Ignition Coil Retaining Bolt Torque: **75 in. lbs. (8.5 Nm)**

GENERAL TROUBLESHOOTING

Diagnostic "Blink Codes"

NOTE: The EFI diagnostic mode is intended to quickly view the cause of the "Check Engine" light.

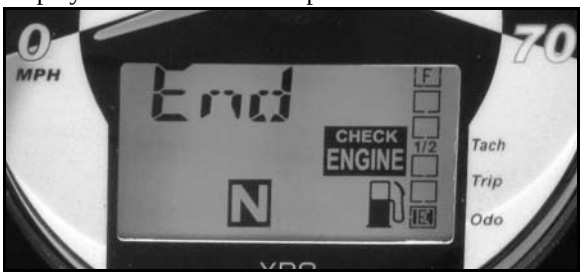
To recall blink codes (fail codes) from the ECU:

1. Verify the key switch is off and the transmission is in neutral with the parking brake applied.

2. Turn the key switch ON and OFF 3 times within 5 seconds and leave the key switch in the ON position on the third turn. The word "Wait" will appear as the ECU searches for blink codes.

3. Any "blink codes" stored in the ECU will display a numerical "blink code", one at a time, in numerical order, on the instrument cluster display.

4. The word "End" will display after all of the codes have been displayed or if no codes are present.



NOTE: To clear codes manually, disconnect the positive battery lead for 20 seconds.

DIAGNOSTIC "BLINK CODES" CHART

SAE CODE	BLINK CODE	NAME	CHECK ENGINE
P0335	21	Loss of Synchronization	Yes
P0122	22	TPS: Open or Short Circuit to Ground	Yes
P0123	22	TPS: Short Circuit to Battery	Yes
P0601	23	RAM Error: Defective ECU	Yes
P0914	25	Transmission Input: Invalid Gear	Yes
P0500	26	Vehicle Speed Sensor: Implausible	Yes
P0113	41	Intake Air Temp Sensor: Open or Short Circuit to +Sensor Voltage (ECU)	Yes
P0112	41	Intake Air Temp Sensor: Short Circuit to Ground	Yes
P0117	42	Engine Temperature Sensor Circuit: Short To Ground	Yes
P0118	42	Engine Temperature Sensor Circuit: Open or Short to Battery	Yes
P0107	45	Barometric Pressure Sensor: Circuit Low Input	Yes
P0108	46	Barometric Pressure Sensor: Circuit High Input	Yes
P1260	51	Injector 1: Open Load	Yes
P0261	51	Injector 1: Short Circuit to Ground	Yes
P0262	51	Injector 1: Short Circuit to Battery	Yes
P1263	52	Injector 2: Open Load	Yes
P0264	52	Injector 2: Short Circuit to Ground	Yes
P0265	52	Injector 2: Short Circuit to Battery	Yes
P0655	54	Engine Temperature Lamp: Open Load	Yes
P1657	54	Engine Temperature Lamp: Short Circuit to Ground	Yes
P1658	54	Engine Temperature Lamp: Short Circuit to Battery	Yes
P1651	55	Diagnostic Lamp: Open Load	Yes
P1652	55	Diagnostic Lamp: Short Circuit to Ground	Yes
P1653	55	Diagnostic Lamp: Short Circuit To Battery	Yes
P1231	56	Pump Relay: Open Load	Yes
P1232	56	Pump Relay: Short Circuit to Ground	Yes
P1233	56	Pump Relay: Short Circuit to Battery	Yes
P1480	58	Cooling Fan: Open Load	Yes
P1481	58	Cooling Fan: Short Circuit to Ground	Yes
P1482	58	Cooling Fan: Short Circuit to Battery	Yes

EFI Troubleshooting

Fuel Starvation / Lean Mixture

Symptoms: Hard start or no start, bog, backfire, popping through intake / exhaust, hesitation, detonation, low power, spark plug erosion, engine runs hot, surging, high idle, idle speed erratic.

- No fuel in tank
- Restricted tank vent, or routed improperly
- Fuel lines or fuel injectors restricted
- Fuel filter plugged
- Fuel pump inoperative
- Air leak in system
- Intake air leak (throttle shaft, intake ducts, airbox or air cleaner cover)
- Incorrect throttle stop screw adjustment

Rich Mixture

Symptoms: Fouls spark plugs, black, sooty exhaust smoke, rough idle, poor fuel economy, engine runs rough/ misses, poor performance, bog, engine loads up, backfire.

- Air intake restricted (inspect intake duct)
- Air filter dirty/plugged
- Poor fuel quality (old fuel)
- Fouled spark plug
- TPS setting incorrect
- Injector failure

Poor Idle

Symptom: Idle Too High (If greater than 1300 RPM when engine is warm)

- Throttle stop screw set incorrect
- Throttle cable sticking, improperly adjusted, routed incorrectly

Symptom: Idle Too Low (if less than 900 RPM when engine is warm)

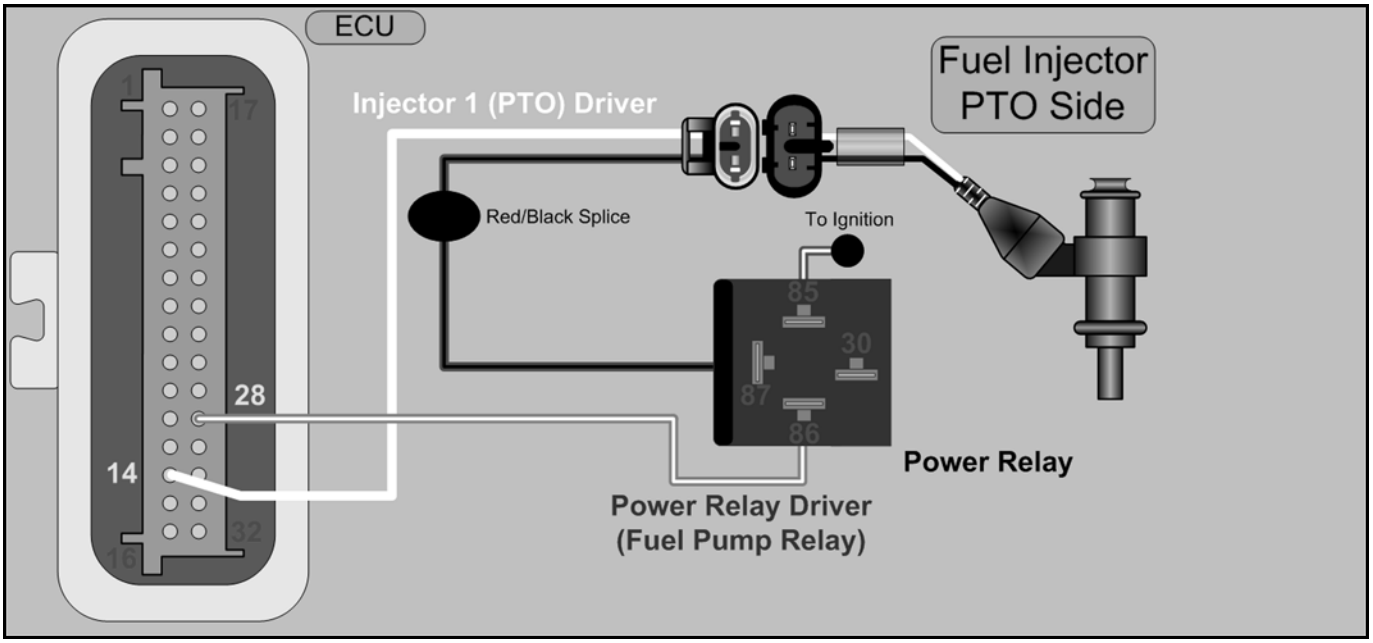
- Plugged air filter
- Leaking injector (rich condition)
- Belt dragging
- Throttle stop screw tampering

Symptom: Erratic Idle

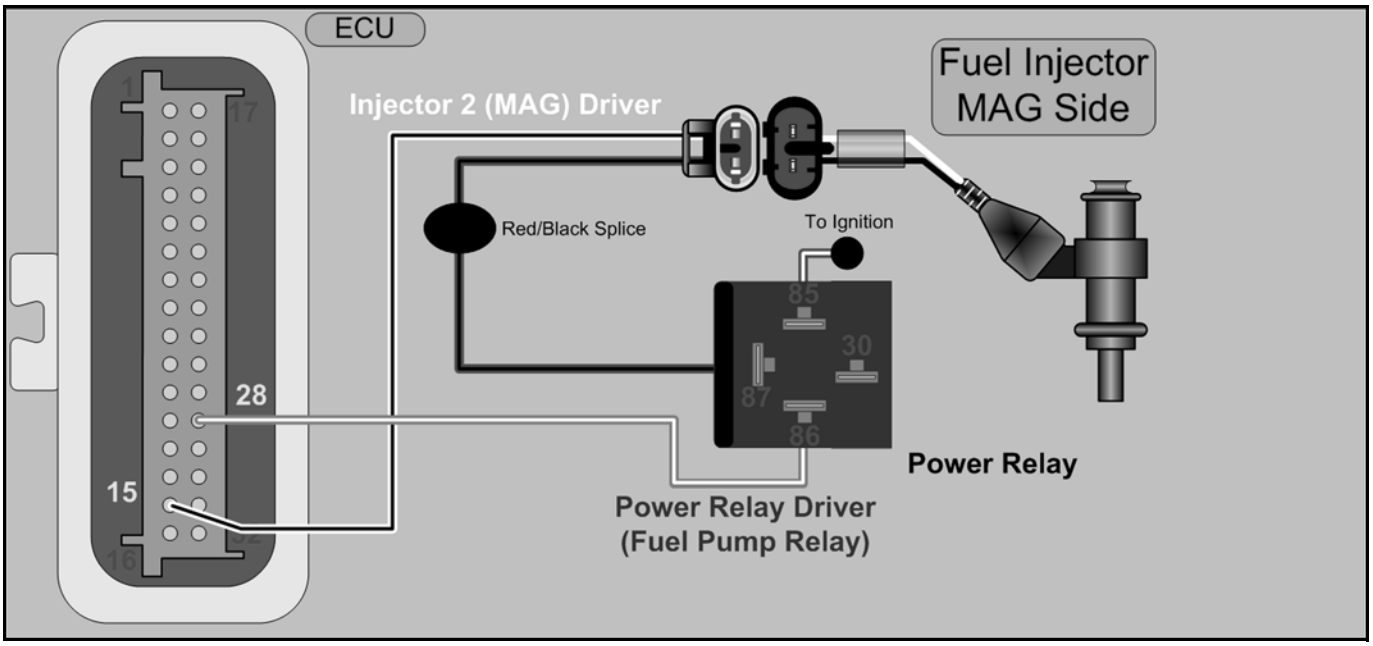
- Throttle cable incorrectly adjusted
- Air Leaks, dirty injector
- TPS damaged or adjusted
- Tight valves
- Ignition timing incorrect
- Belt dragging
- Dirty air cleaner
- Engine worn
- Spark Plug fouled
- Throttle stop screw set incorrectly (out of sync with ECU)

EFI SYSTEM BREAK-OUT DIAGRAMS

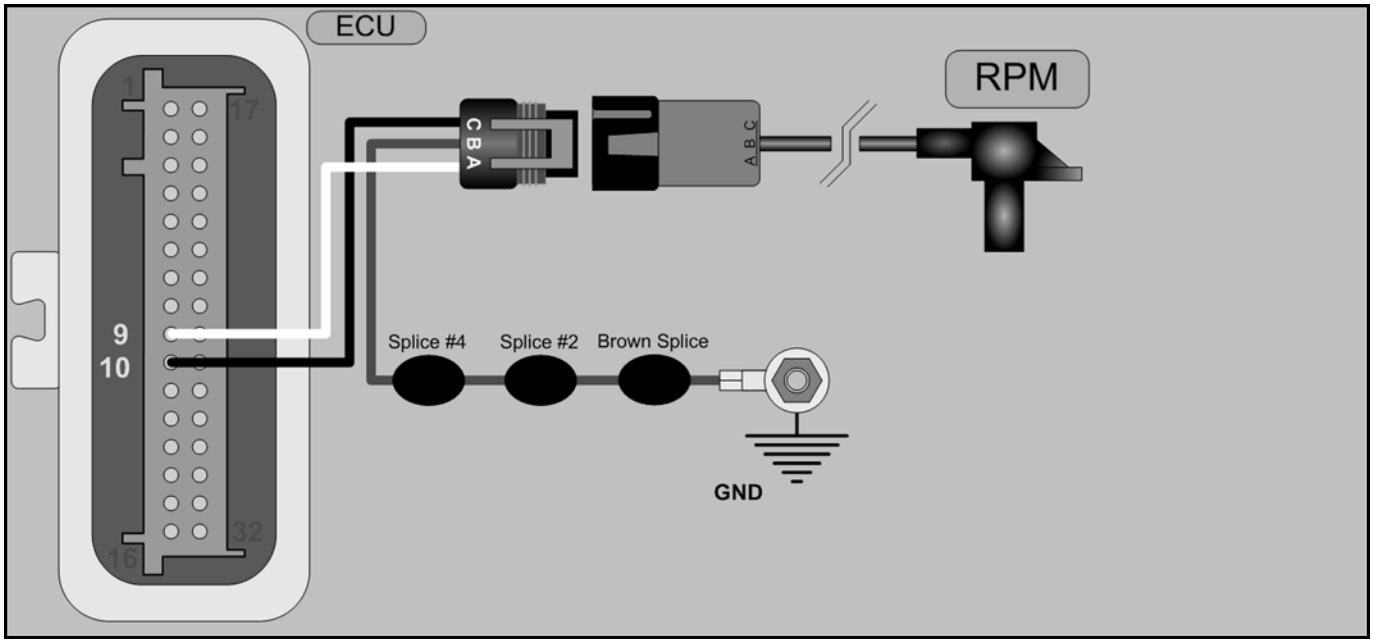
Fuel Injector Circuit (PTO)



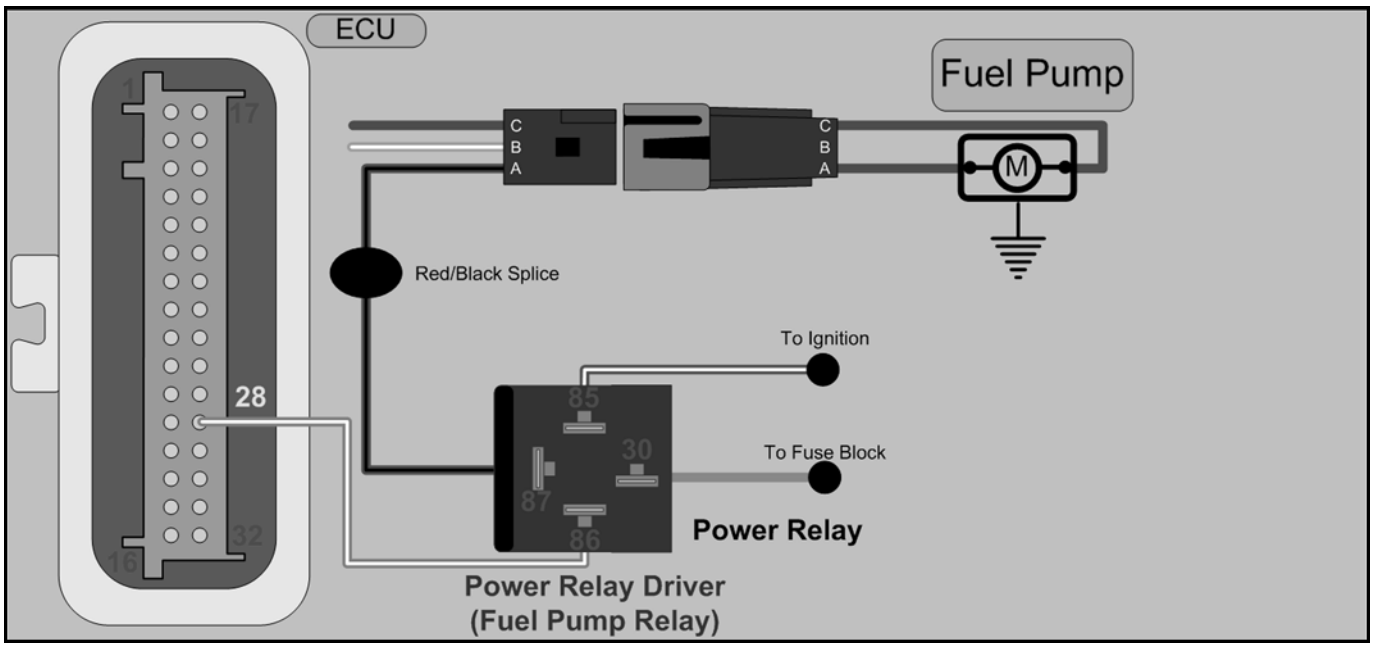
Fuel Injector Circuit (MAG)



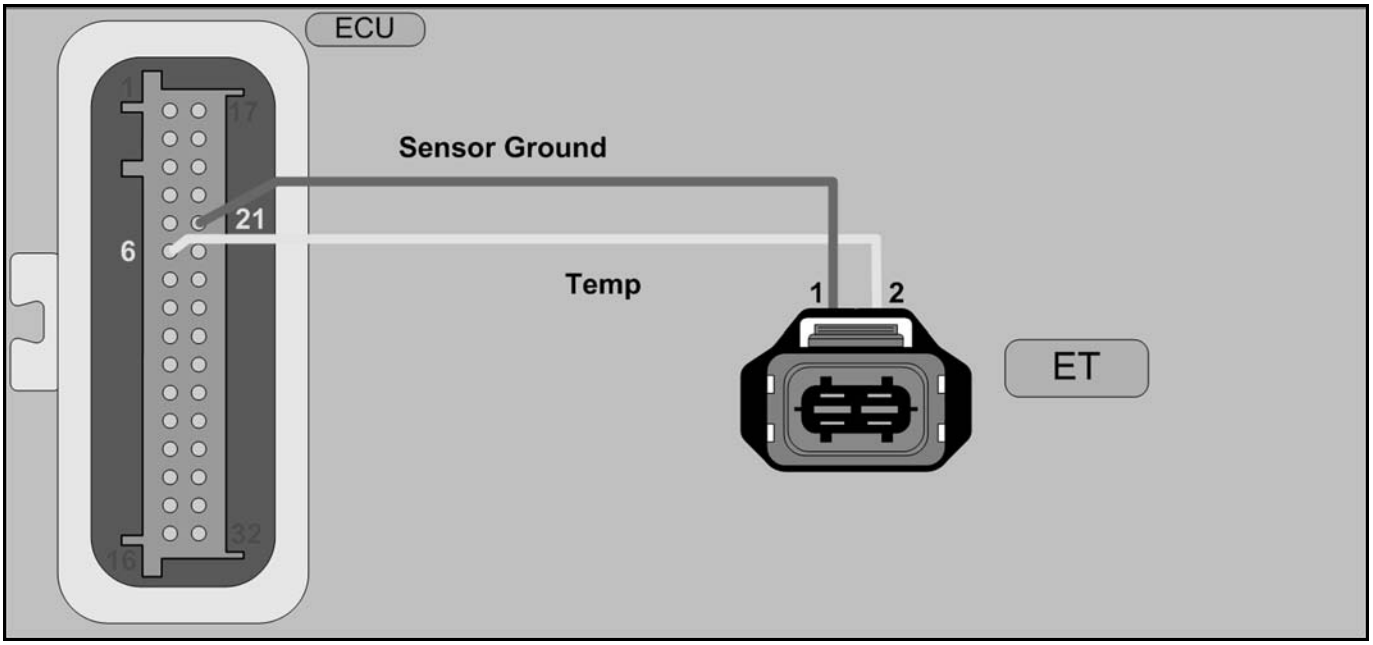
Crankshaft Position Sensor (CPS) Circuit



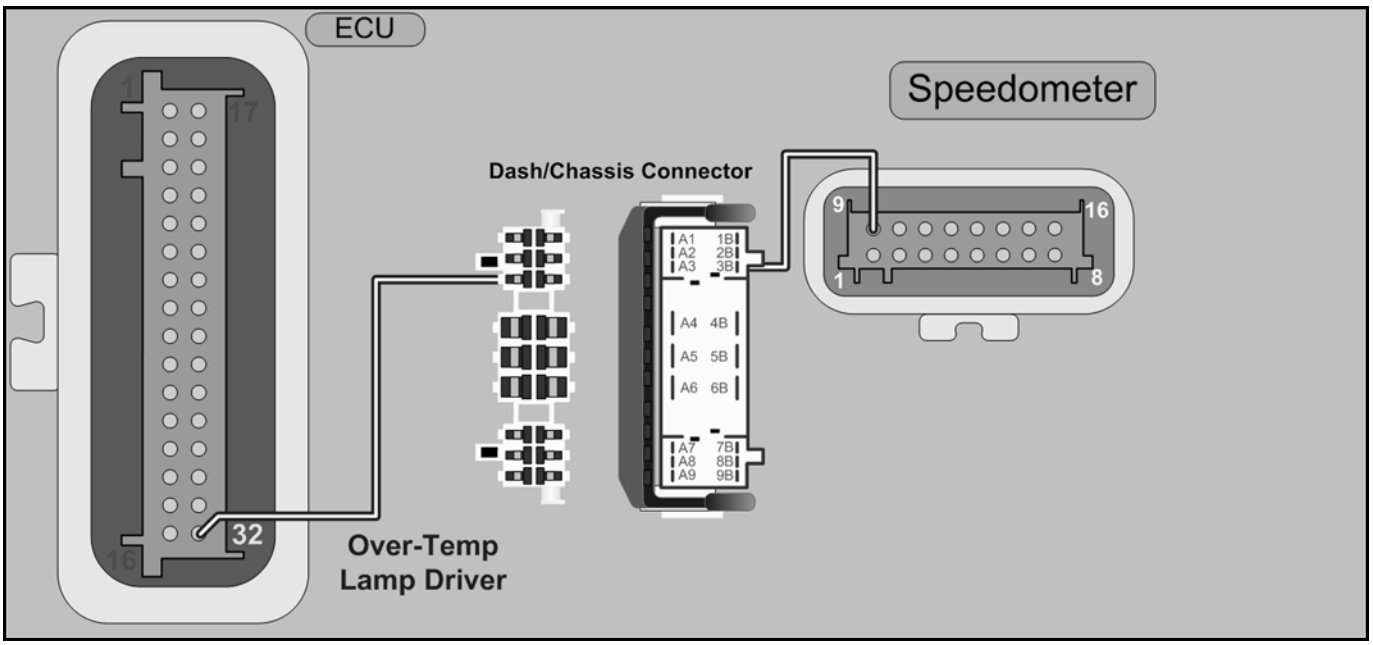
Fuel Pump Circuit



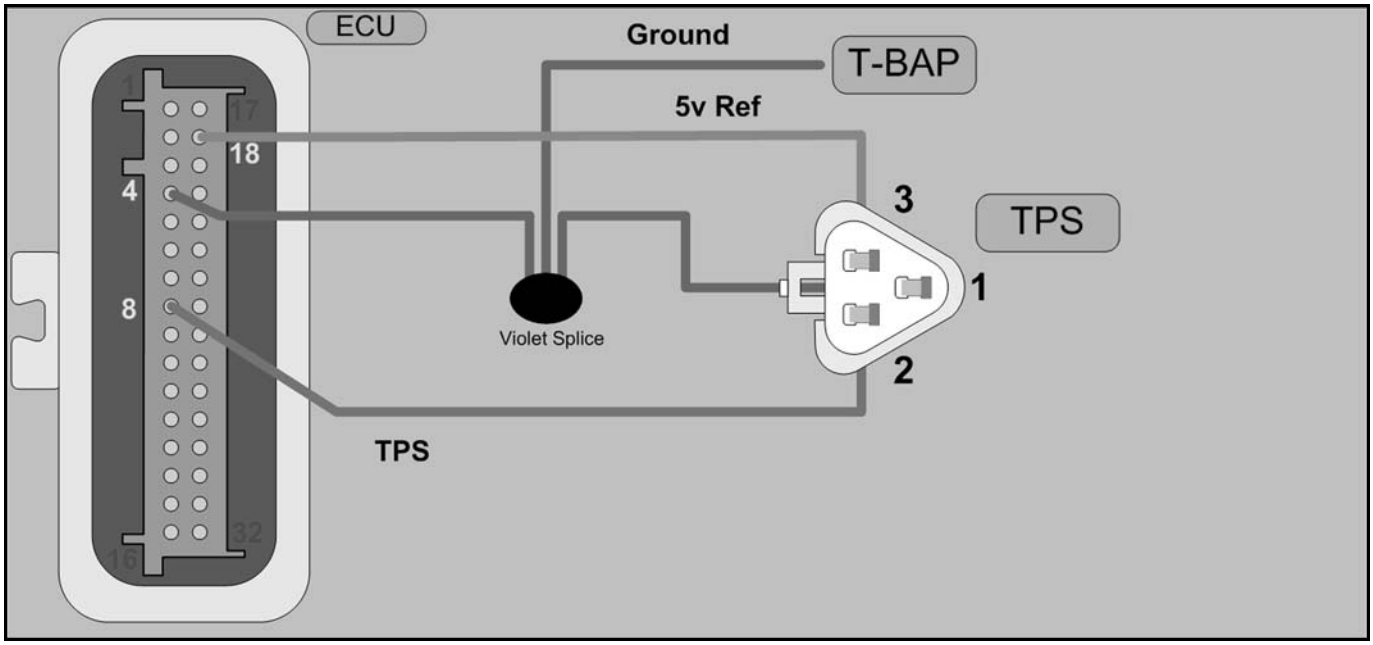
Engine Coolant Temperature Sensor (ECT)



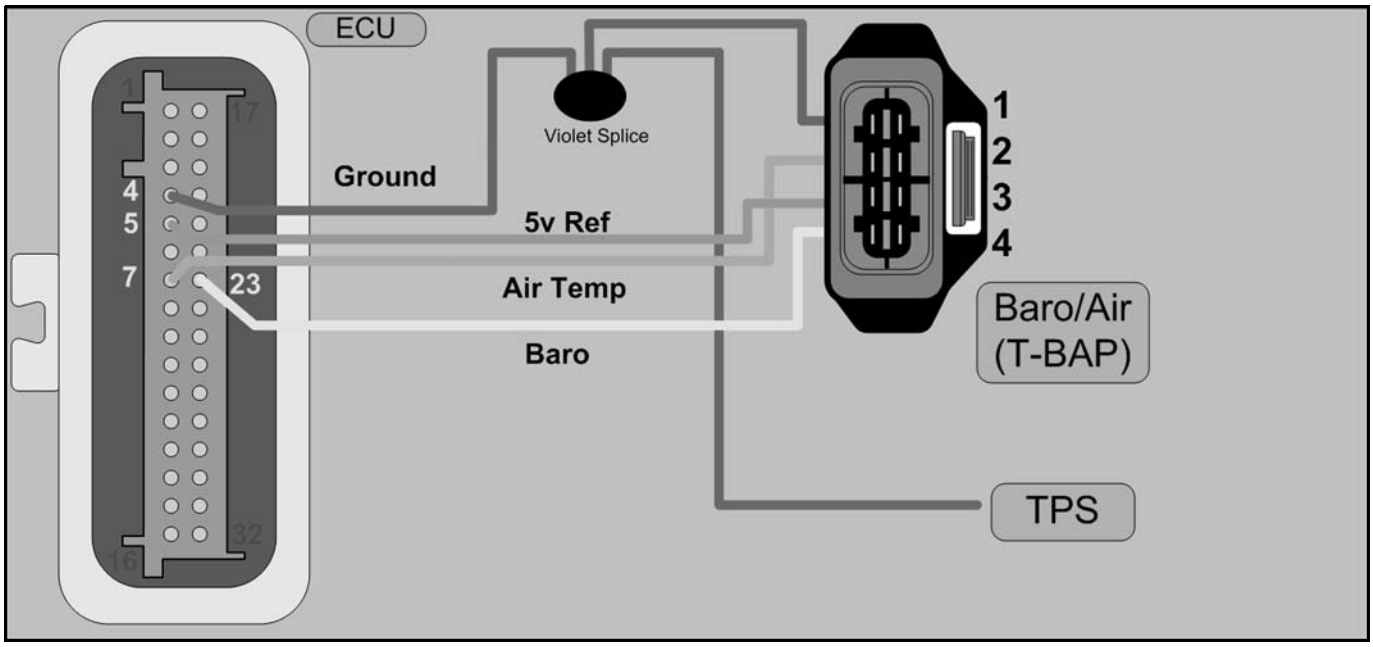
Temperature Overheat Indicator Lamp Circuit



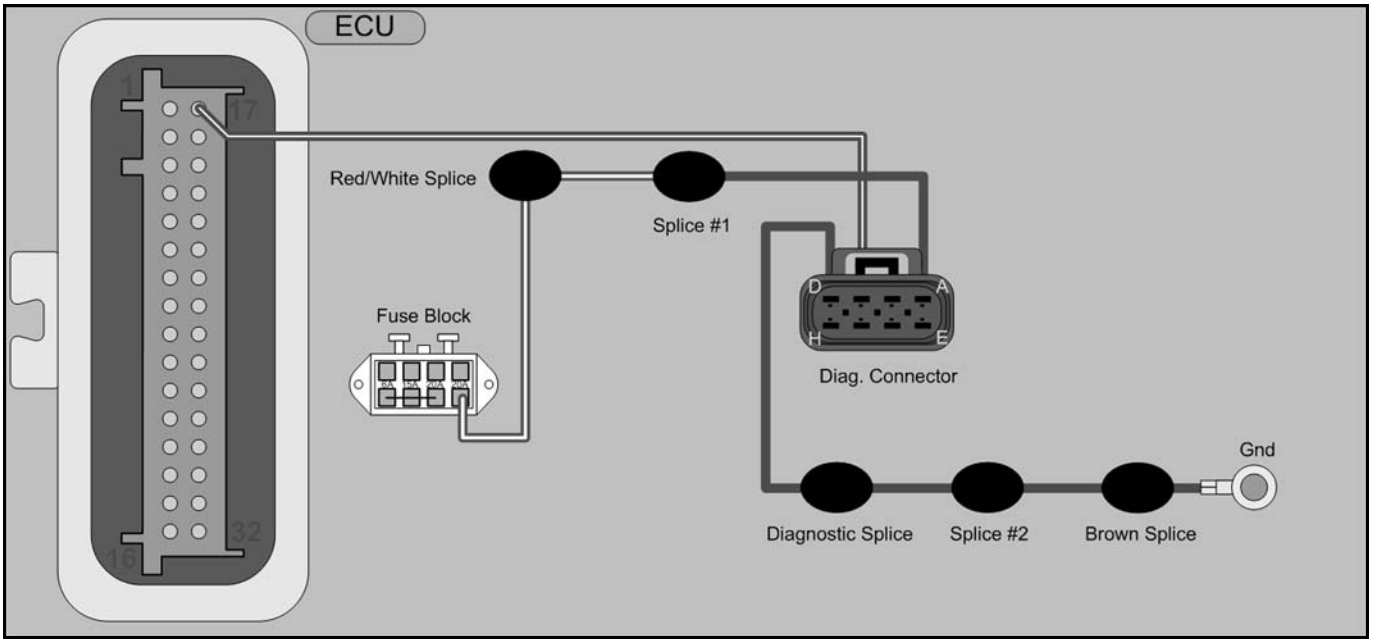
Throttle Position Sensor (TPS) Circuit



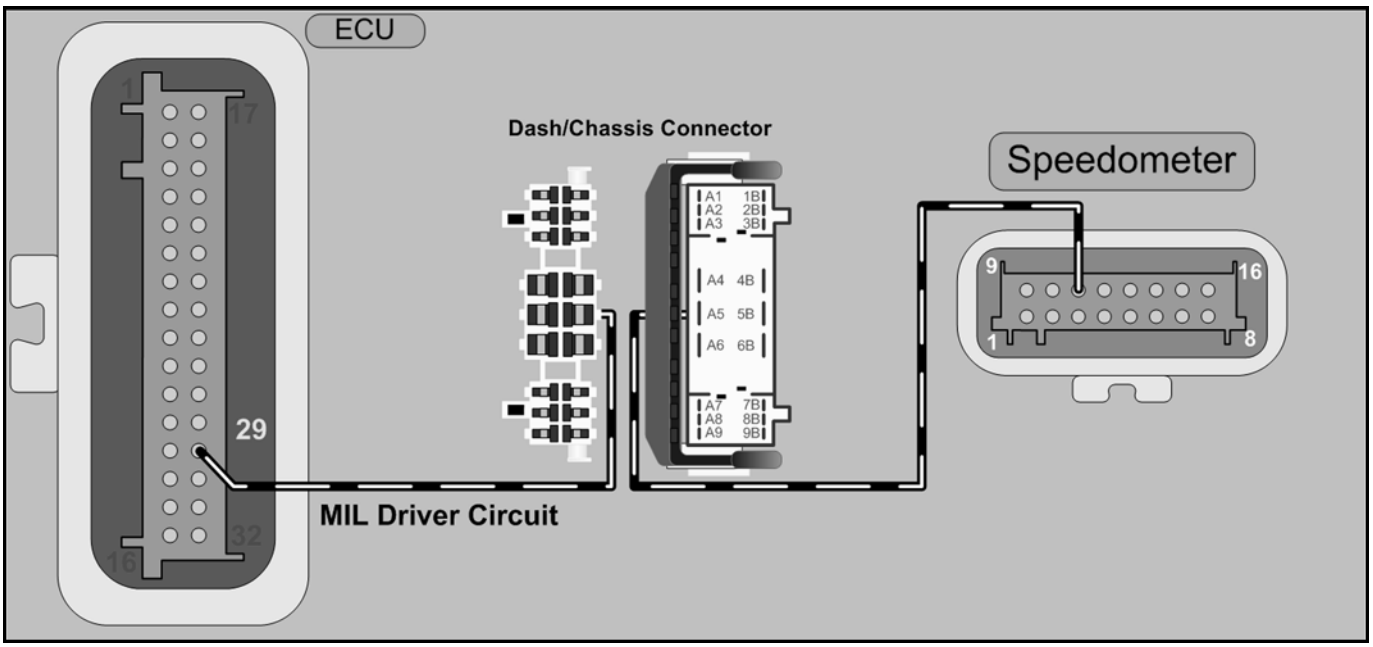
Air Temperature / Barometric Air Pressure Sensor (T-BAP) Circuit



Diagnostic Connector Circuit



Diagnostic Indicator Lamp Circuit



CHAPTER 5

BODY / STEERING / SUSPENSION

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TORQUE SPECIFICATIONS

ITEM	TORQUE VALUE ft.lbs. (Nm)
Front A-Arm Attaching Bolt	30 ft. lbs. (41 Nm)
Front A-Arm Ball Joint Stud Nut	30 ft. lbs. (41 Nm)
Front Wheel Hub Castle Nut	60 ft. lbs. (81 Nm)
Rear Shock Bolt (upper)	30 ft. lbs. (41 Nm)
Rear Shock Bolt (lower)	30 ft. lbs. (41 Nm)
Rear Wheel Hub Castle Nut	110 ft. lbs. (150 Nm)
Mid Half Shaft Castle Nut (6x6)	110 ft. lbs. (150 Nm)
Wheel Nuts (Cast Rims) Wheel Nuts (Steel Rims)	90 ft. lbs. (122 Nm) 35 ft. lbs. (47 Nm)
Upper / Lower Control Arm Mounting Bolt	30 ft. lbs. (41 Nm)
Mid Axle Upper / Lower Control Arm Mounting Bolt (6x6)	35 ft. lbs. (47 Nm)
Lower Middle Wheel Bearing Carrier Bolt (6x6)	35 ft. lbs. (47 Nm)
Lower Rear Wheel Bearing Carrier Bolt	30 ft. lbs. (41 Nm)
Upper Middle Wheel Bearing Carrier Bolt (6x6)	35 ft. lbs. (47 Nm)
Upper Rear Wheel Bearing Carrier Bolt	30 ft. lbs. (41 Nm)
Strut Rod Retaining Nut (Top)	15 ft. lbs. (21 Nm)
Strut Casting Pinch Bolt	17 ft. lbs. (23 Nm)
Tie Rod End Jam Nut	12-14 ft. lbs. (17-19 Nm
Tie Rod End Castle Nut	40 ft. lbs. (54 Nm)
Seat Belt to Seat Base	40 ft. lbs. (54 Nm)
Steering Wheel to Shaft	25-31 ft. lbs. (34-42 Nm)
Upper Steering Shaft to U-Joint Shaft	15-19 ft. lbs. (20-26 Nm)
Lower Steering Shaft to Box	30 ft. lbs. (41 Nm)
Steering Box	14-18 ft. lbs. (19-24 Nm)

NOTE: Refer to exploded views throughout this chapter for more torque specifications, component identification, and location of components.

SPECIAL TOOLS

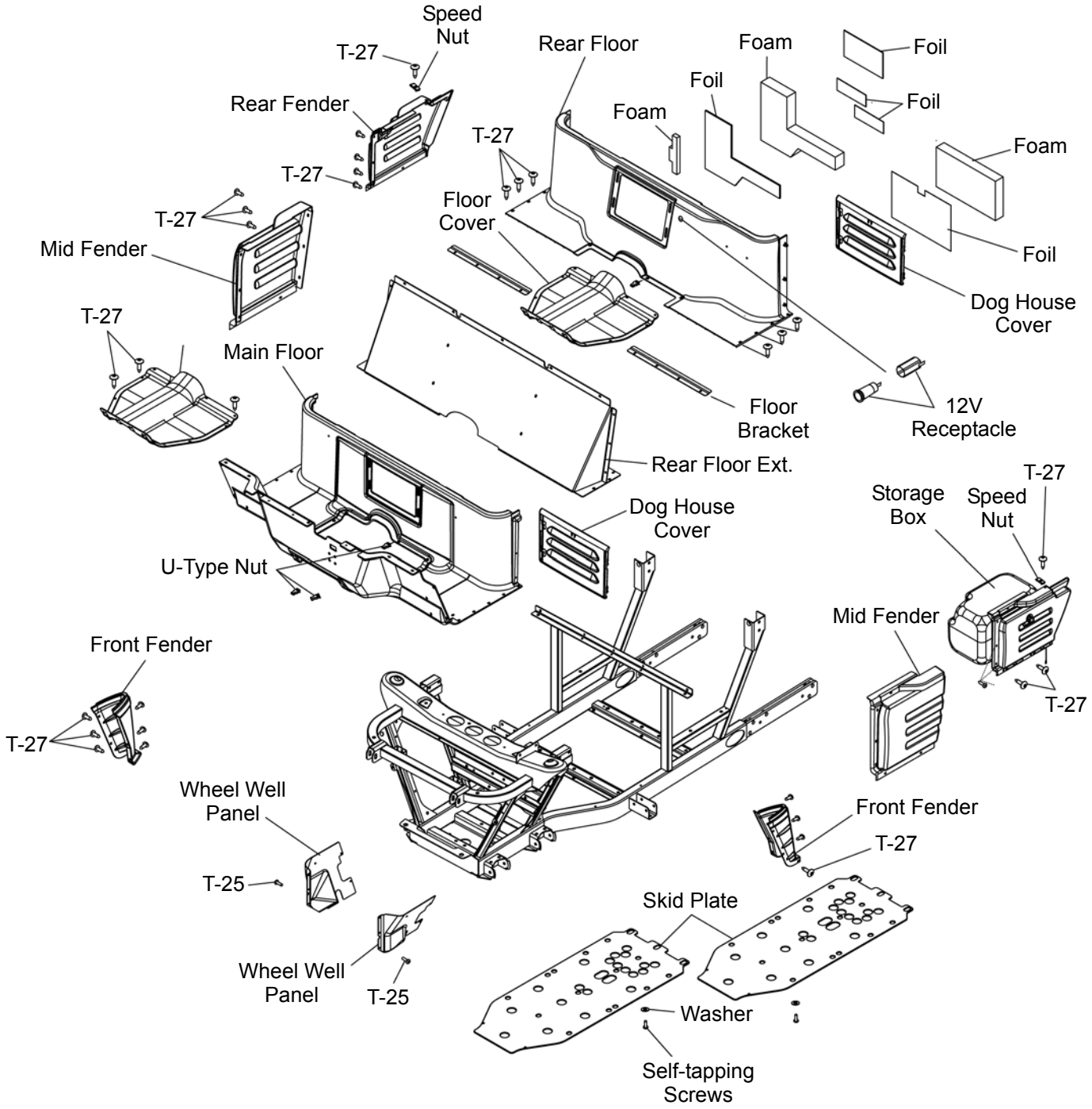
TOOL DESCRIPTION	PART NUMBER
Strut and Ball Joint Tool Set	2870871
Shock Spanner Wrench	2870872
Shock Spring Compressor Tool	2870623
Strut Spring Compressor Tool (LH)	2871573
Strut Spring Compressor Tool (RH)	2871574

BODY COMPONENT REMOVAL

Removal Procedures

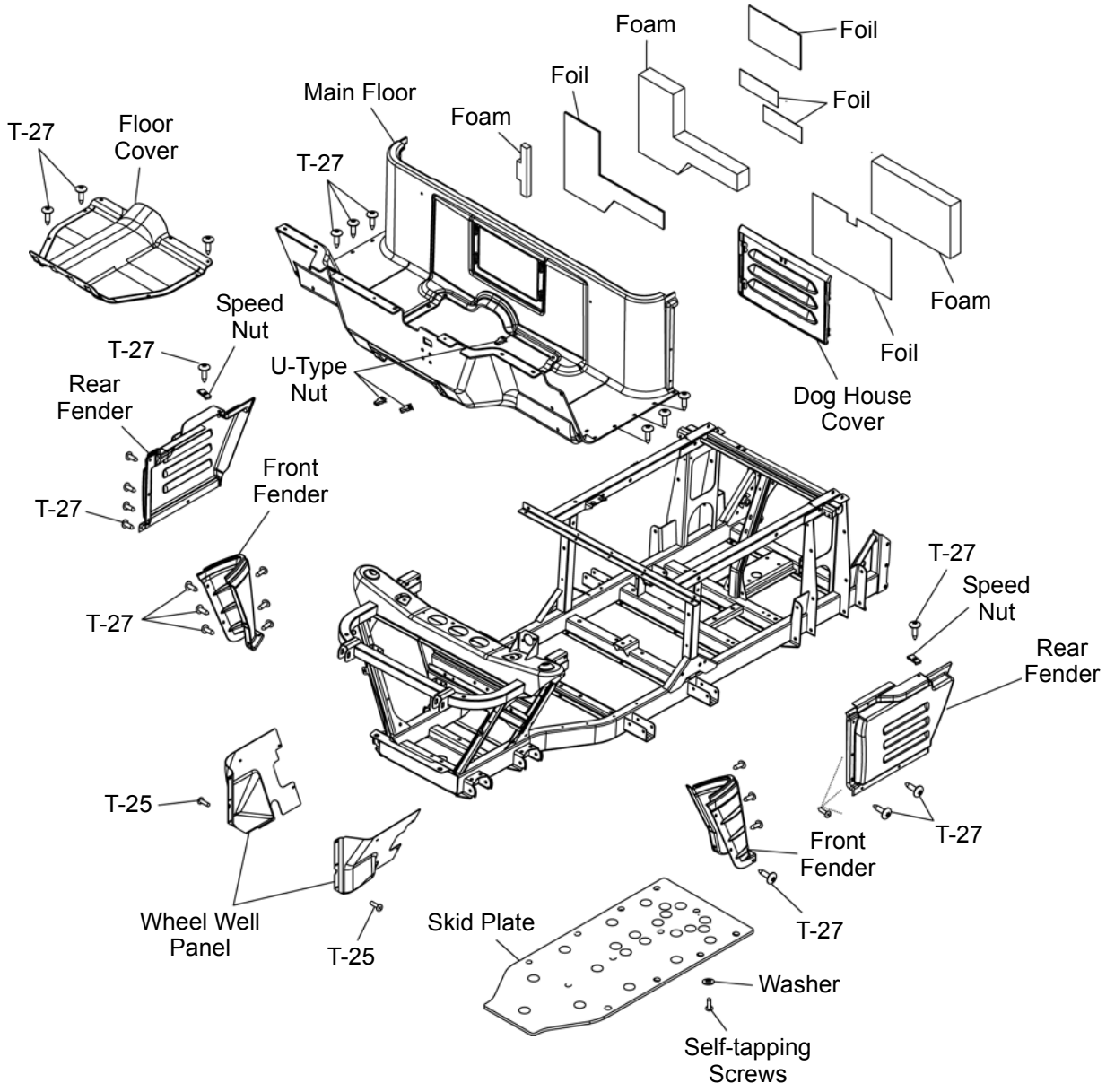
TO REMOVE:	PERFORM THESE STEPS:
SEAT	Pull up on front of seat and then pull forward
DASH	1. Remove the gear selector handle 2. Then remove the 4 screws that attach the hood to the dash 3. Remove the remaining dash screws that attach the *RANGER* emblem 4. Disconnect the dash component wires 5. Remove the steering wheel (1 nut)
HOOD	1. Disconnect headlights 2. Remove the 4 hinge screws
CAB	1. Remove seat back and seat base 2. Remove the bolts for the front mounts 3. Remove the bolts for the rear mounts
HOOD LINER	1. Remove liner darts and screws 2. Disconnect the wiring harnesses 3. Remove the air baffling boxes
FRONT BUMPER	1. Lift the hood 2. Remove the 3 front Torx screws from LH and RH wheel well panels 3. Remove the 2 top bumper mounting bolts 4. Remove the 3 lower bumper mounting bolts
CARGO BOX	1. Place box in the dump position 2. Remove the pin and clip from the shock at the cargo box 3. Disconnect light harnesses 4. Remove (2) screws holding hinge pins 5. Tap out hinge pins 6. Lift the box off the frame with assistance
FUEL TANK	1. Raise the cargo box 2. Disconnect the vent and fuel lines (note locations) 3. Disconnect electrical connection 4. Remove the RH rear fender and fuel cap 5. Remove the 2 inner bolts and 2 outer bolts that hold the tank to the frame 6. Carefully lift the tank out through the side
LH STORAGE BOX	1. Raise the cargo box 2. Remove the (2) bottom T27 Torx screws 3. Remove the (2) top T27 Torx screws 4. Remove the (3) T27 Torx screws on the front edge 5. Lift the storage box outward from frame

Lower Body, Floor and Fenders (4x4 CREW)



TORQUE SPECIFICATIONS
T-25 Screws: 20-30 in. lbs. (2-3.5 Nm)
T-27 Screws: 4-5 ft. lbs. (5-6 Nm)
Skid Plate Screws: 6-8 ft. lbs. (8-10 Nm)

Lower Body, Floor and Fenders (6x6)



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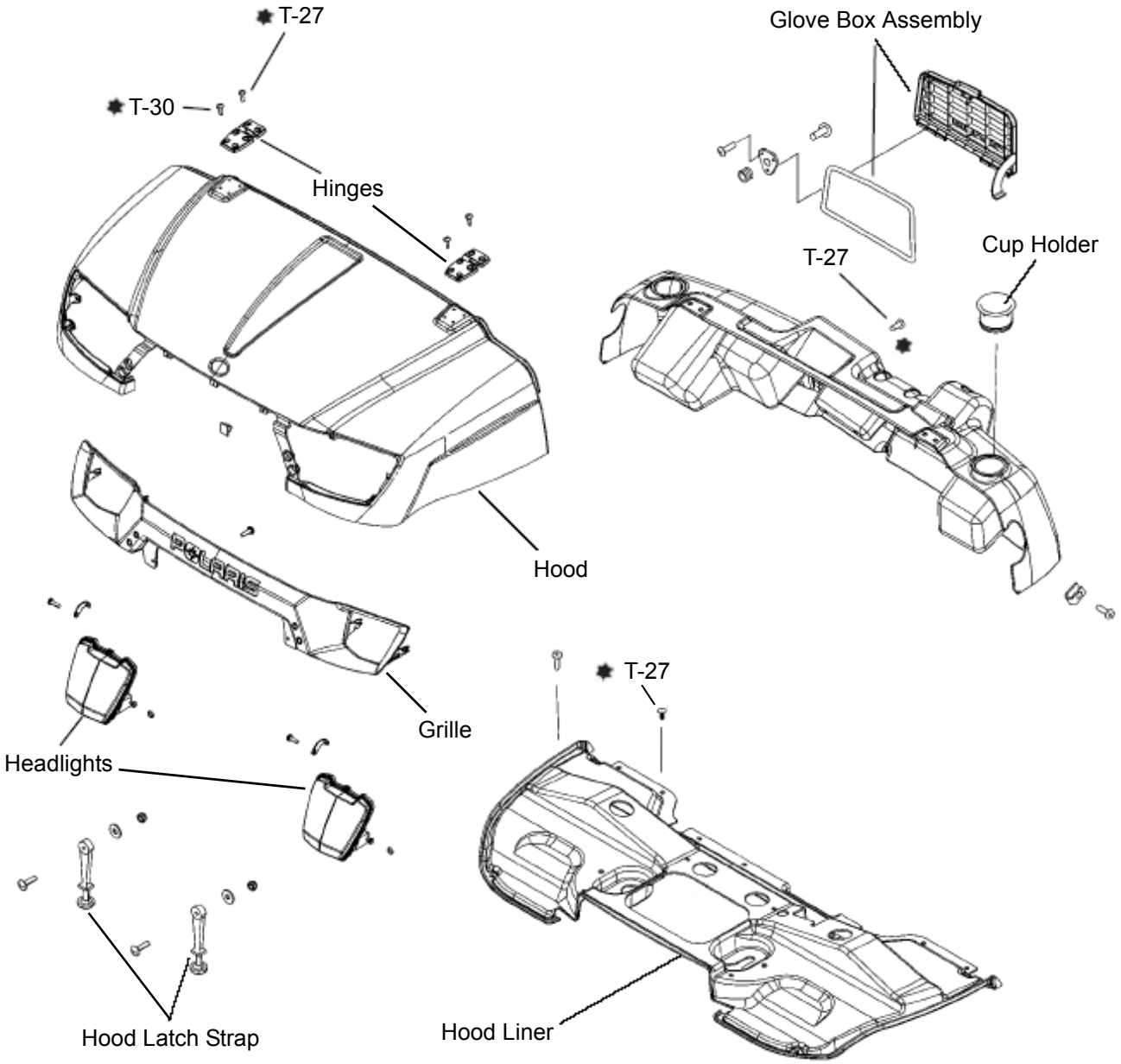
Hood / Dash Components



TORQUE SPECIFICATIONS
T-30 Screws: 8-10 in. lbs. (0.9-1 Nm)
T-27 Screws: 4-5 ft. lbs. (5-6 Nm)

Dash Instruments and Controls

A. Speedometer

B. Headlight Switch

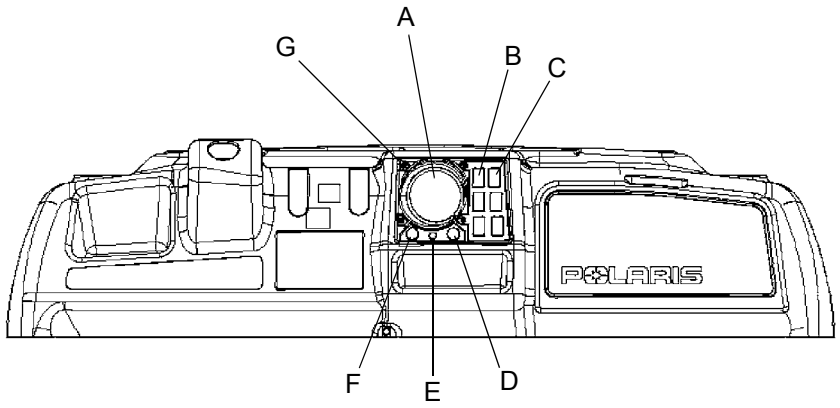
C. 2WD/AWD Switch

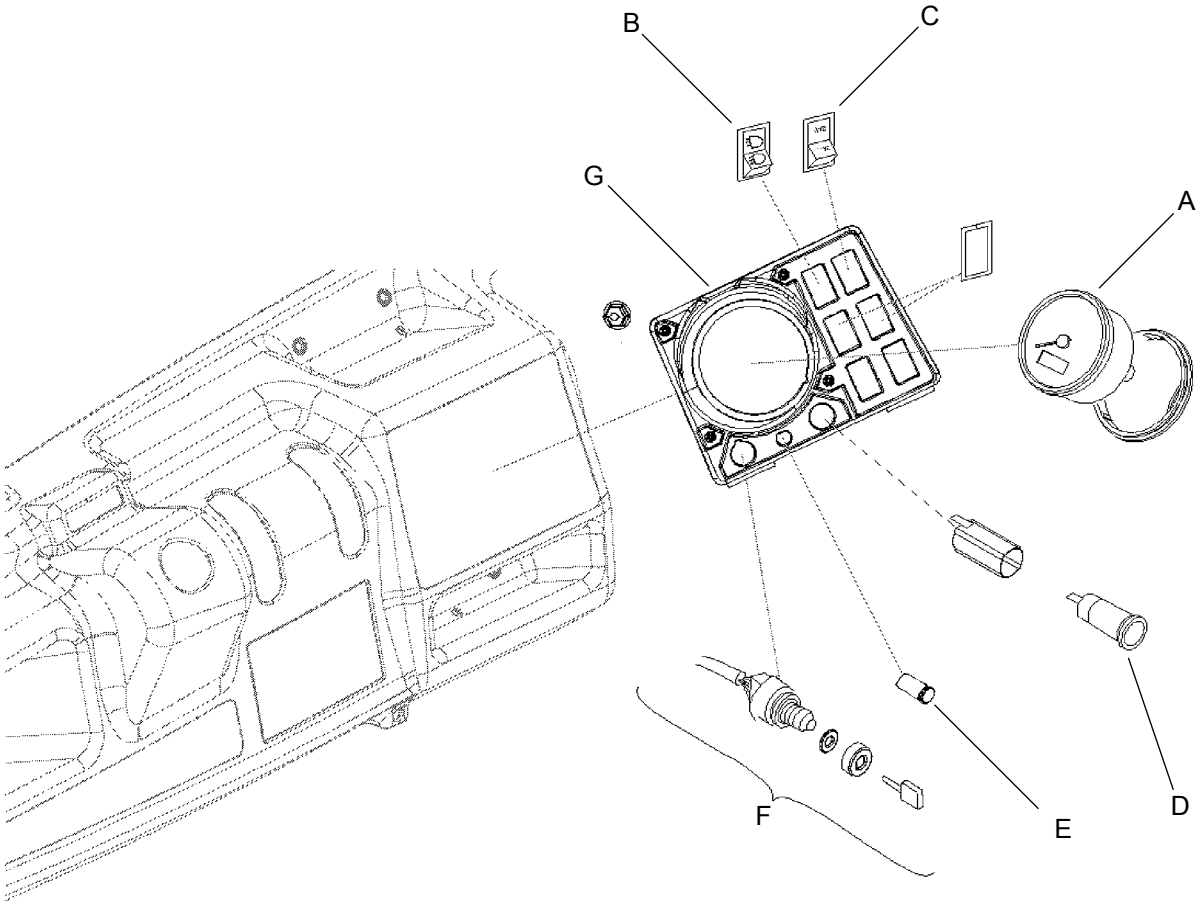
D. 12 Volt Accessory Receptacle

E. Speedometer “Mode” Button

F. Key Switch

G. Speedometer Mount Plate

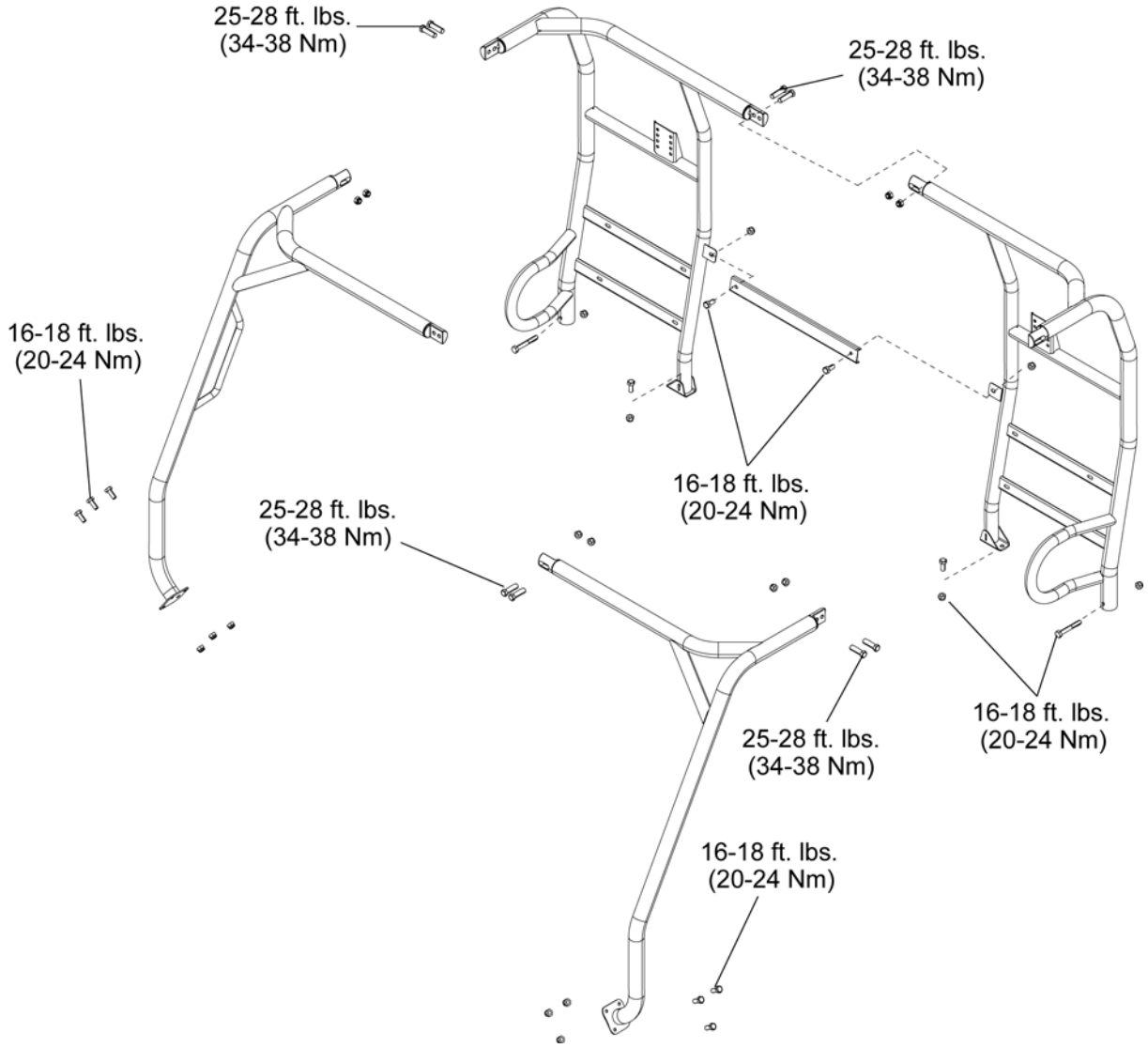




CAB FRAME

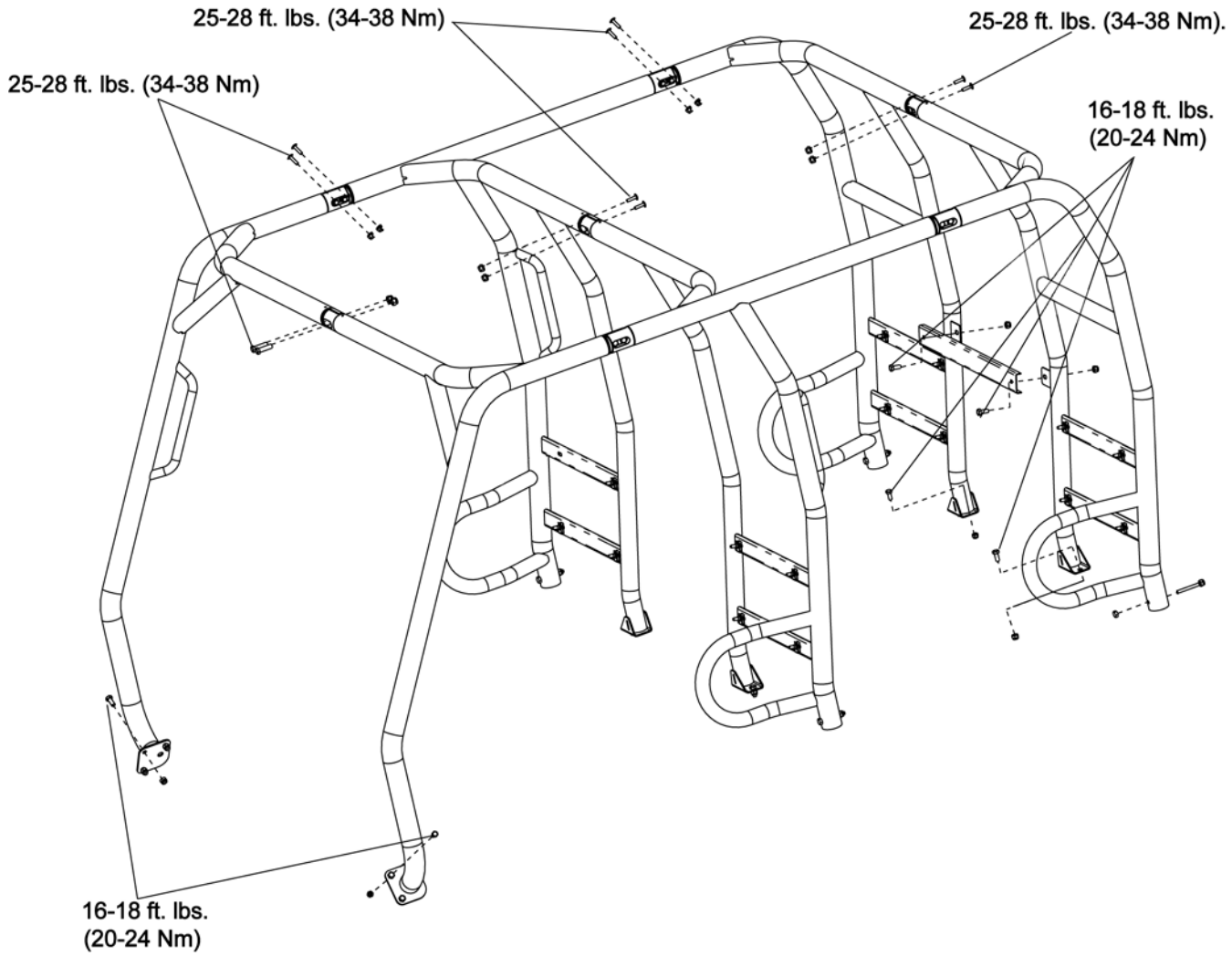
Assembly / Removal (6x6)

1. Assemble the two rear cab frames at the coupler joint and secure with two 3/8" screws and nuts. Assemble the front frame in same manner. Leave all fasteners finger tight.
2. Assemble the center cross bracket to the rear cab frame and secure with two 5/16”-18 x .75” hex bolts and nuts. Tighten 5/16" bolts to 16-18 ft. lbs. (20-24 Nm).
3. Assemble the front cab frame to the rear cab frame at both side coupler joints and secure with 3/8" screws and nuts. Leave all fasteners finger tight.
4. Place the assembled cab frame onto the vehicle and align the rear mount holes. Secure the rear of the frame using the two 5/16”-18 x 2.25” bolts and nuts on the outer tubes, and the two 5/16”-18 x .75” bolts and nuts on the inner mounts. Tighten all 5/16" bolts to 16-18 ft. lbs. (20-24 Nm). **NOTE:** Tighten all nuts finger tight, then tighten to specification.
5. Secure the front cab frame flanges to the vehicle with 5/16”-18 x .75” bolts and nuts. Tighten all 5/16" bolts to 16-18 ft. lbs. (20-24 Nm). **NOTE:** Tighten all nuts finger tight, then tighten to specification.
6. Tighten all 3/8" cab frame screws to 25-28 ft. lbs. (34-38 Nm).
7. Check all nuts and bolts for proper torque and installation. To remove the cab frame, reverse the installation instructions.



Assembly / Removal (4x4 CREW)

1. Assemble the two rear cab frames at the coupler joint and secure with two 3/8" screws and nuts. Assemble the center frame and the front frame in same manner. Tighten all 3/8" screws to 25-28 ft. lbs. (34-38 Nm).
2. Assemble the center cross bracket to the rear cab frame and secure with two 5/16”-18 x .75” hex bolts and nuts. Tighten the bolts to 16-18 ft. lbs. (20-24 Nm).
3. Assemble the front cab frame to the center cab frame at both side coupler joints and secure with 3/8" screws and nuts. Attach the center cab frame to the rear cab frame at both side coupler joints and secure with 3/8” screws and nuts. Tighten all 3/8" screws to 25-28 ft. lbs. (34-38 Nm).
4. Remove the storage box under the front seat.
5. Place the assembled cab frame onto the vehicle and align the rear and center mounting holes. Secure the rear and center of the frame using the 5/16”-18 x 2.25” bolts on the outer tubes and the 5/16”-18 x .75” bolts on the inner mounts. Tighten all 5/16" bolts to 16-18 ft. lbs. (20-24 Nm). **NOTE:** Tighten all nuts finger tight, then tighten to specification.
6. Secure the front flanges to the vehicle with 5/16”-18 x .75” bolts and nuts. Tighten all 5/16" bolts to 16-18 ft. lbs. (20-24 Nm). **NOTE:** Tighten all nuts finger tight, then tighten to specification.
7. Check all nuts and bolts for proper torque and installation. Replace the storage box back into position and fasten with four screws. To remove the cab frame, reverse the installation instructions.



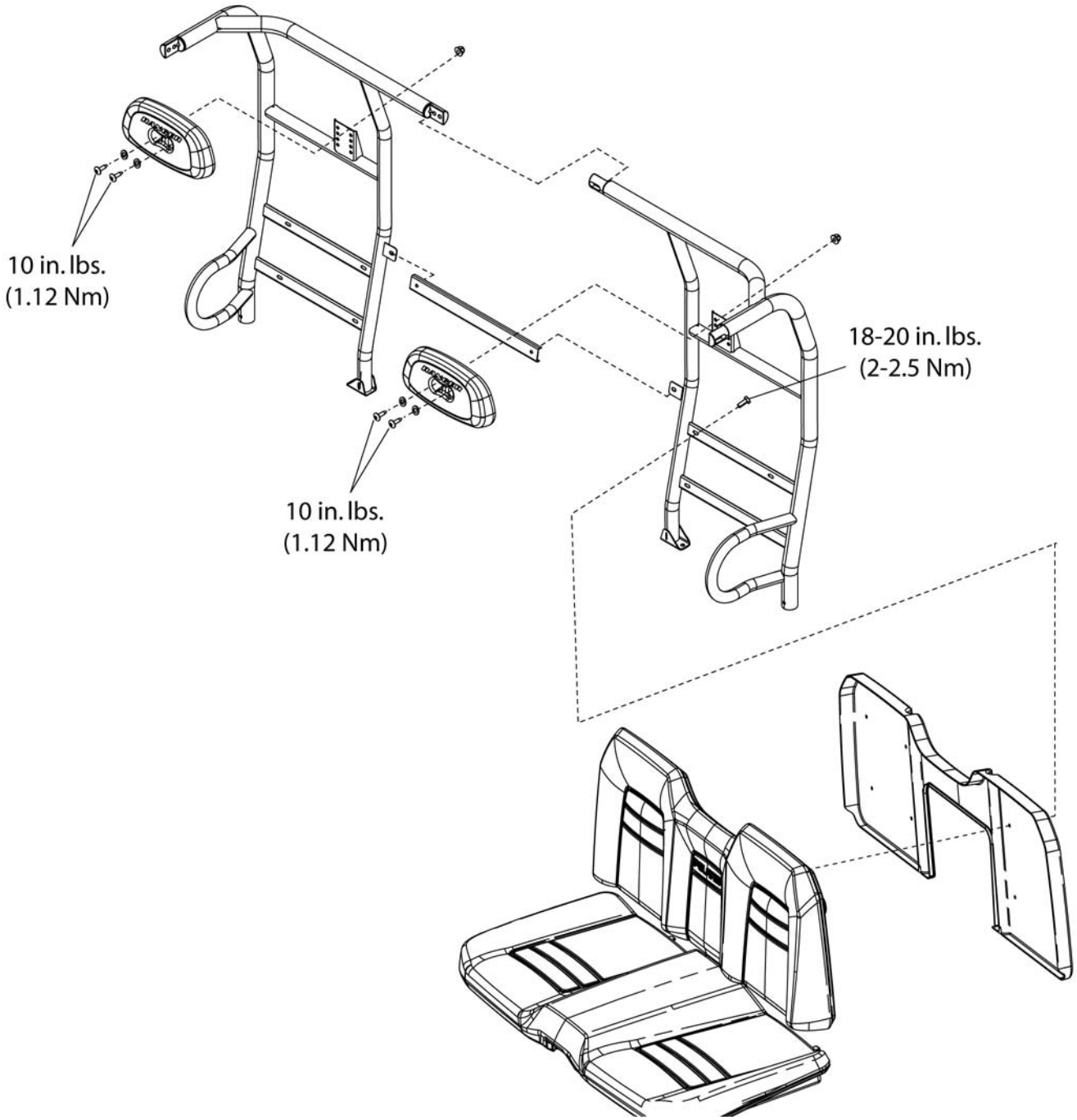
SEAT / HEAD REST

Seat Back / Head Rests

1. Fasten the seat back to the rear cab frame(s) using the Torx-head screws. **NOTE: For seats that have staples visible from the rear, the seat back cover will need to be placed between the rear cab frame and seat back assembly**. Tighten all Torx-head fasteners to 18-20 in. lbs. (2-2.5 Nm).

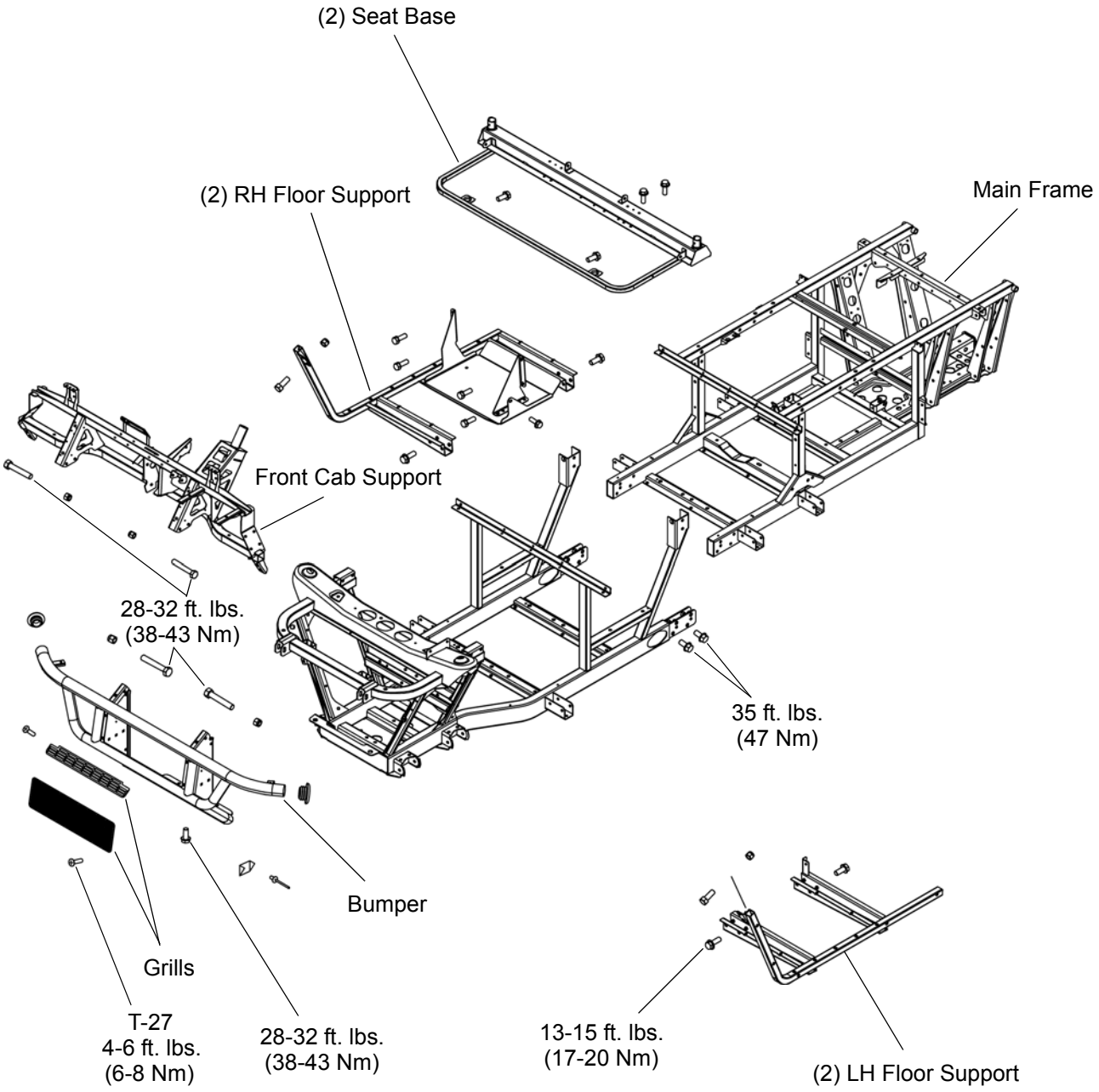
2. Install the headrests on the cab frame using 1/4”-20 x 1” bolts, washers, and 1/4”-20 Nyloc nuts. Place the washers between the bolt heads and headrest as shown below. Torque bolts to 10 in. lbs. (1.1 Nm).

3. Check all screws and fasteners for proper torque and installation.



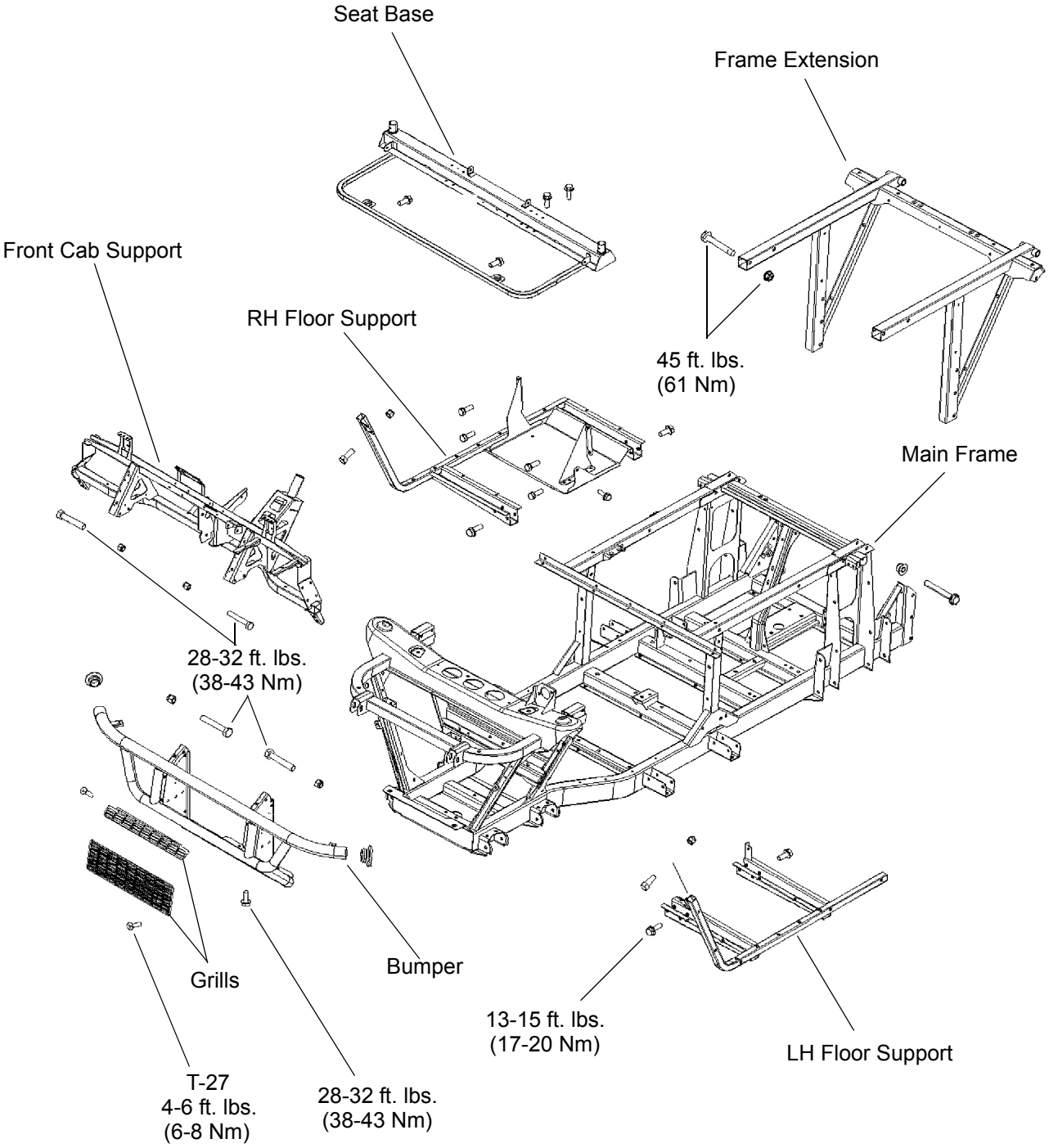
CHASSIS / MAIN FRAME (4X4 CREW)

Exploded View



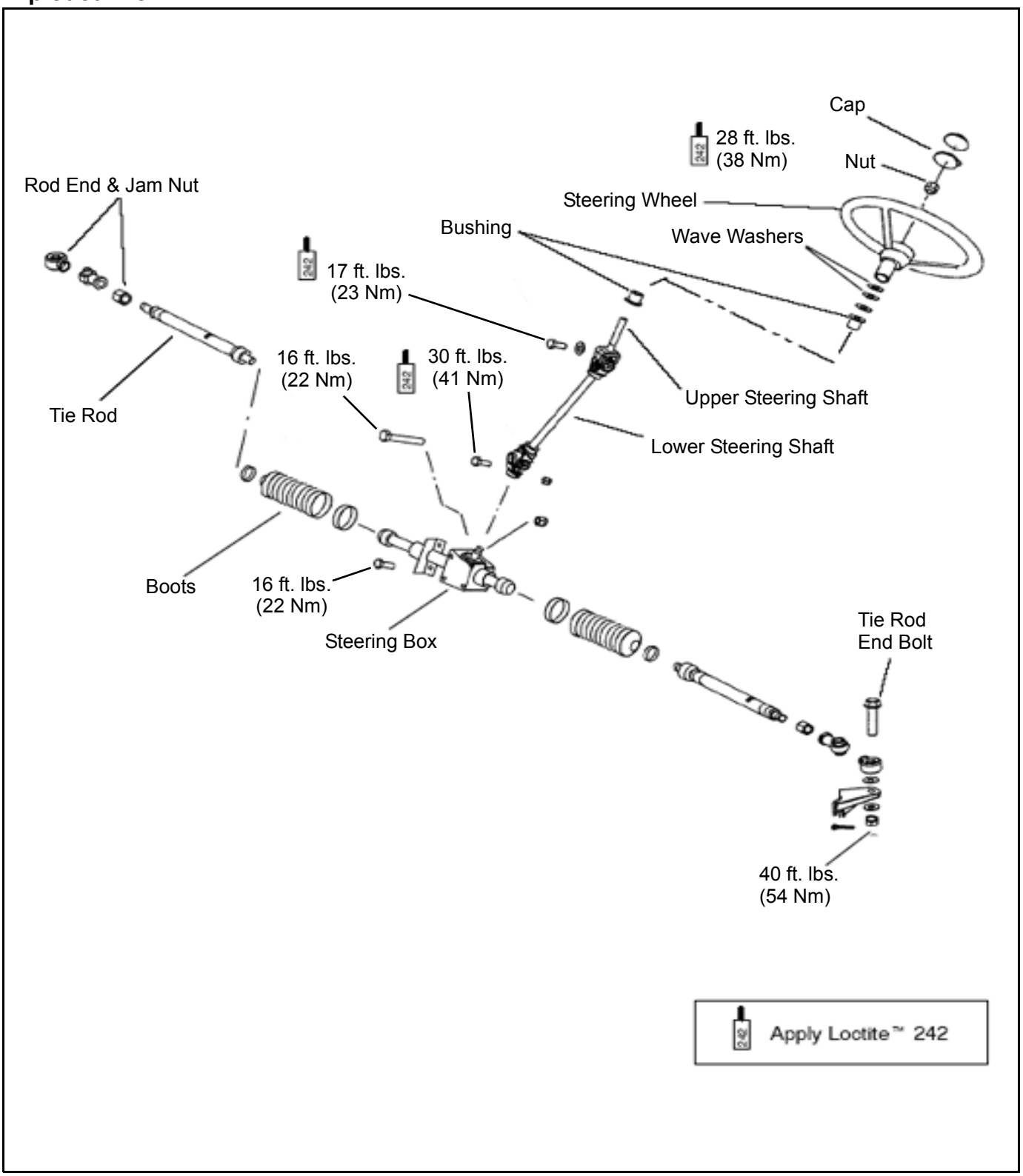
CHASSIS / MAIN FRAME (6X6)

Exploded View



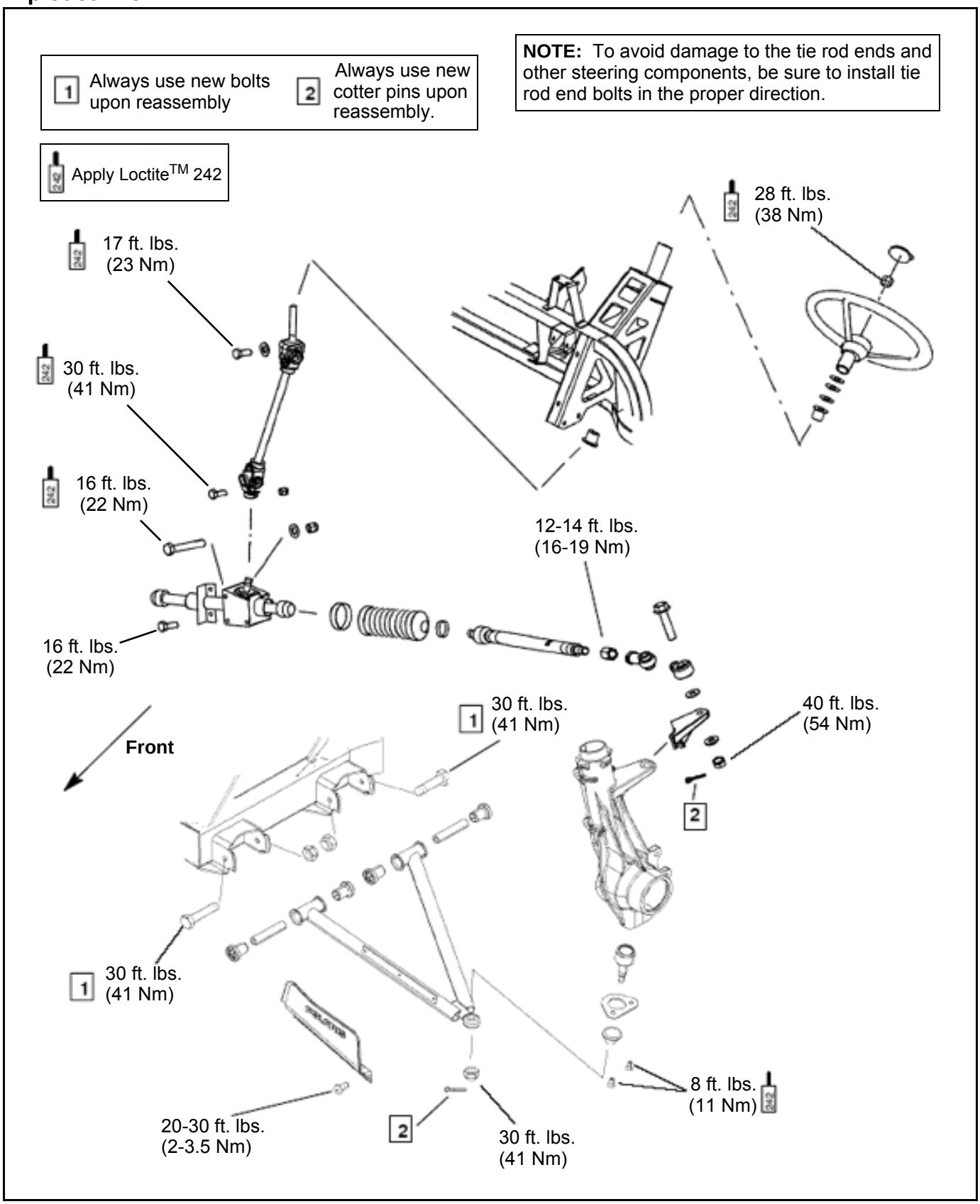
STEERING ASSEMBLY

Exploded View



STEERING AND SUSPENSION

Exploded View



FRONT A-ARM

Replacement

1. Elevate and safely support vehicle with weight removed from front wheel(s).
2. Remove cotter pin from ball joint stud at wheel end of A-arm and loosen nut until it is flush with end of stud.
3. Using a soft face hammer, tap nut to loosen A-arm from bolt. Remove nut and A-arm from hub strut assembly.
4. Loosen two bolts on A-arm bushing by alternating each about 1/3 of the way until A-arm can be removed.
5. Examine A-arm bushing and A-arm shaft. Replace if worn. Discard hardware.
6. Insert A arm bushings and A-arm shaft into new A-arm.

NOTE: On AWD models, install CV joint shields. See Illustration

7. Install new A-arm assembly onto vehicle frame. Torque new bolts to 30 ft. lbs. (41.4 Nm).

> **⚠ WARNING**
>
> The locking features on the existing bolts were destroyed during removal. DO NOT reuse old bolts. Serious injury or death could result if fasteners come loose during operation.

8. Attach A-arm to hub strut assembly. Tighten ball joint nut to 30 ft. lbs. (41 Nm). If cotter pin holes are not aligned, tighten nut slightly to align. Install a new cotter pin with open ends toward rear of machine. Bend both ends in opposite directions around nut.

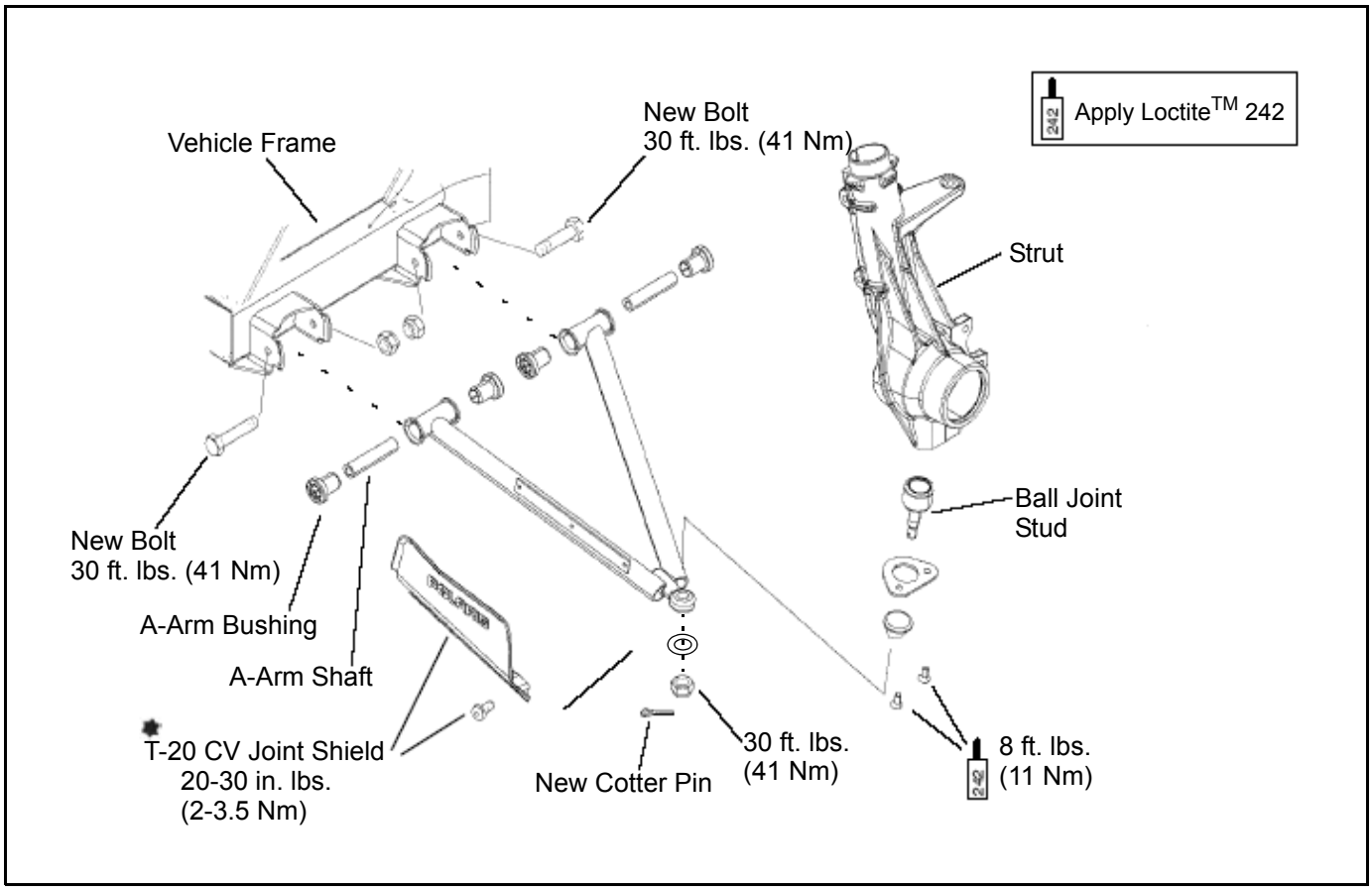
> **⚠ WARNING**
>
> Upon A-arm installation completion, test vehicle at low speeds before putting into regular service.

A-arm Attaching Bolt Torque:

30 ft. lbs. (41 Nm)

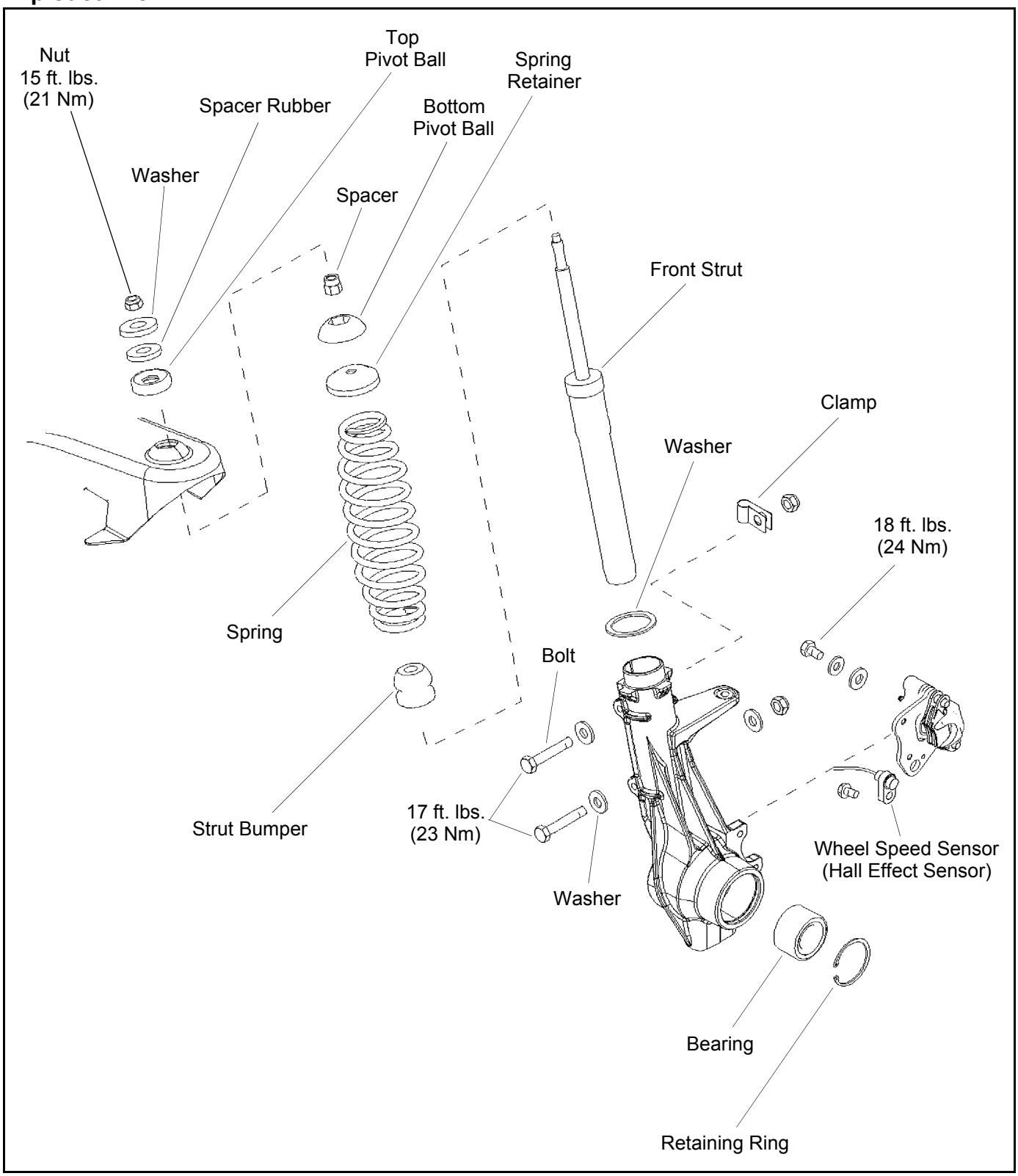
Ball Joint Stud Nut Torque:

30 ft. lbs. (41 Nm)



FRONT STRUT

Exploded View



Front Strut Cartridge Replacement

Refer to Front Strut Exploded View.

1. Hold strut rod and remove top nut.
2. Compress spring using strut spring compressor tools.

Strut Spring Compressor Tools

(PN 2871573) and (PN 2871574)

3. Remove upper strut pivot assembly.
4. Remove coil spring and collapse strut cartridge.
5. Remove two pinch bolts from strut casting.
6. Remove strut cartridge.
7. Install cartridge until bottomed in strut casting.
8. Install pinch bolts with wire clamp(s). Torque pinch bolts to 17 ft. lbs. (23 Nm).
9. Reassemble spring and top pivot assembly. Be sure all parts are installed properly and seated fully.
10. Torque strut rod nut to specification. Do not over torque nut.

Strut Rod Nut Torque

15 ft. lbs. (21 Nm)

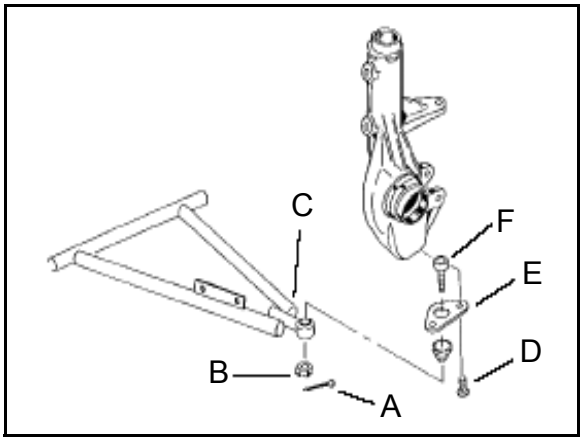
Ball Joint Replacement

1. Loosen front wheel nuts slightly.
2. Elevate and safely support machine under footrest/frame area.

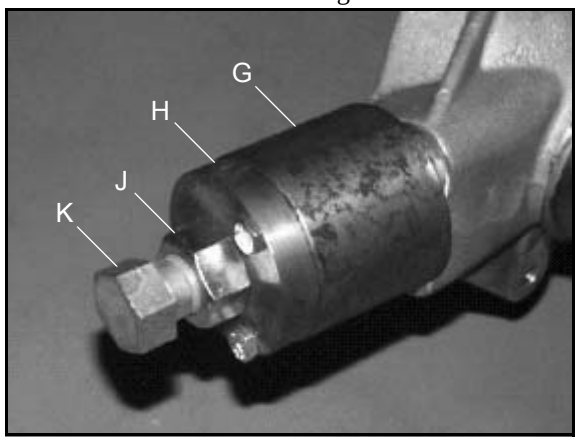
⚠ CAUTION

Serious injury may result if machine tips or falls. Be sure machine is secure before beginning this service procedure.

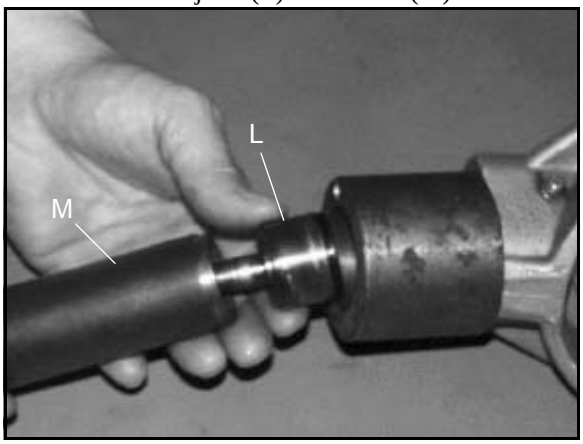
3. Remove wheel nuts and wheels.



4. Remove cotter pin (A) from ball joint castlenut.
5. Remove castle nut (B) and separate A-arm (C) from ball joint stud.
6. Remove screws (D) and ball joint retaining plate (E).
7. Using ball joint removal/installation tool kit (PN 2870871), remove ball joint (F) from strut housing.
   - Install puller guide (G) with extension cap (H).
   - Apply grease to extension cap and threads of puller bolt to ease removal.
   - Thread bolt (K) with nut (J) onto ball joint stud as shown.
   - Apply heat to ease removal.
   - Hold bolt (K) and turn nut (J) clockwise until ball joint is removed from strut housing.



8. To install new ball joint:
   - Remove extension cap and attach puller guide using short bolts provided in the kit.
   - Insert new ball joint (L) into driver (M).



   - Slide ball joint / driver assembly into guide.
   - Apply heat to ease installation.
   - Drive new joint into strut housing until fully seated.

9. Apply Loctite™ 242 (PN 2871949) to threads of retaining plate screws or install new screws with pre-applied locking agent. Torque screws to 8 ft. lbs. (11 Nm).
10. Install A-arm on ball joint and torque castle nut to 30 ft. lbs. (41 Nm).
11. Reinstall cotter pin with open ends toward rear of machine.

MID AXLE A-ARM (6X6)

Replacement

1. Elevate and safely support the center of the vehicle with weight removed from center wheel(s).
2. Remove the hub cap, cotter pin, spindle nut, wheel nuts, and wheel. Refer to Chapter 7 "MID DRIVE BEARING CARRIER / HUB REMOVAL" procedure.
3. Remove the bolts that secure the shock to the upper and lower mid A-arms.
4. Loosen two bolts on A-arm bushing by alternating each about 1/3 of the way until A-arm can be removed. Perform this procedure on the upper and lower mid A-arms.
5. Examine the A-arm bushing and A-arm shaft. Replace if worn. Discard hardware.
6. Insert A-arm bushings and A-arm shaft into new A-arm.
7. Install new lower mid A-arm assembly onto vehicle frame. Torque new bolts to 30 ft. lbs. (41 Nm).
8. Install a new upper mid A-arm assembly. Torque new bolts to 30 ft. lbs. (41 Nm).

⚠ WARNING

The locking features on the existing bolts were destroyed during removal. DO NOT reuse old bolts. Serious injury or death could result if fasteners come loose during operation.

9. Attach A-arm to wheel bearing carrier. Install the shock to the upper mid A-arm. Torque bolts as shown.
10. Locate grease fitting in center of A-arm tube and pump A-arm full of grease.

⚠ WARNING

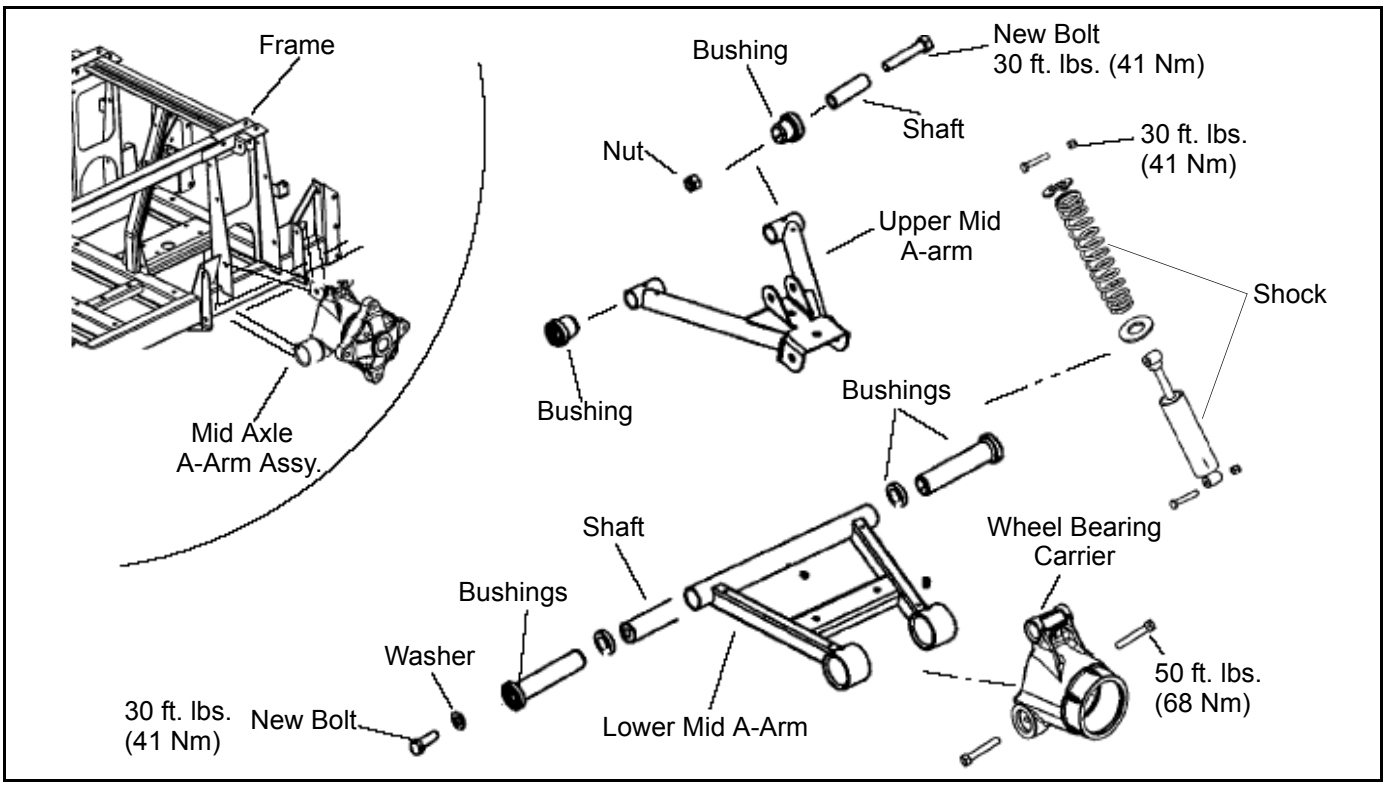
Upon A-arm installation completion, test vehicle at low speeds before putting into regular service.

***RANGER* 6X6 Mid Drive**

A-arm Attaching Bolt torque:
30 ft. lbs. (41 Nm)

Upper Bearing Carrier Bolt Torque:
30 ft. lbs. (41 Nm)

Lower Bearing Carrier Bolt Torque:
50 ft. lbs. (68 Nm)

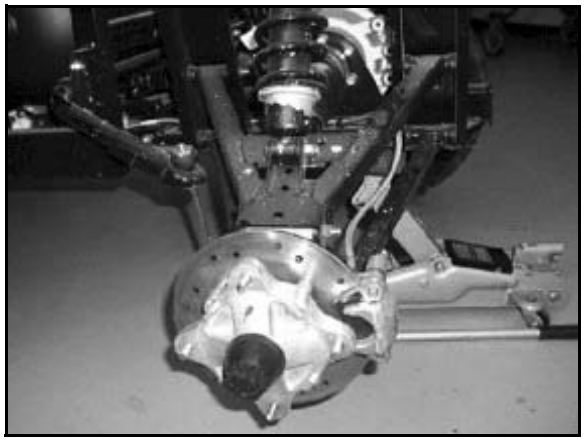


REAR A-ARM (4X4 CREW)

Replacement

NOTE: Use the exploded view on the next page as reference during the procedure.

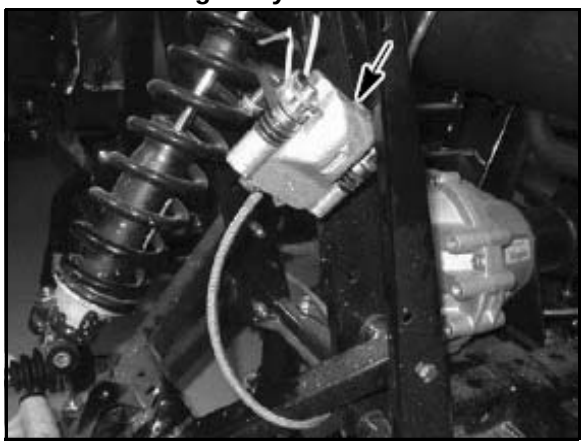
1. Elevate and safely support vehicle with weight removed from the rear wheel(s).
2. Remove the wheel nuts, washers, and wheel.



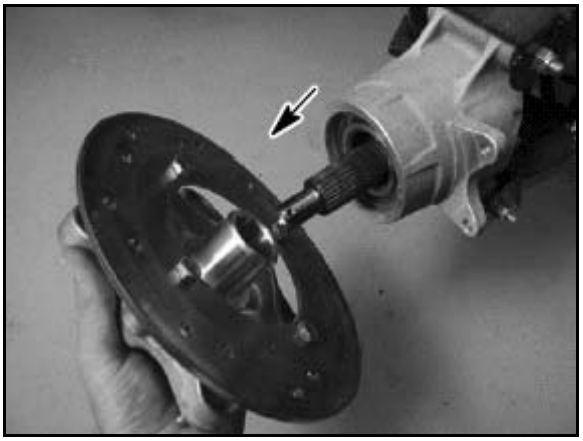
NOTE: To ease the removal of the spindle bolt, remove the hub cap and loosen the spindle bolts before removing the wheel.

3. Remove the hub cap, cotter pin, spindle bolt, and washer.
4. Remove the brake caliper. Suspend the brake caliper from the frame with a wire.

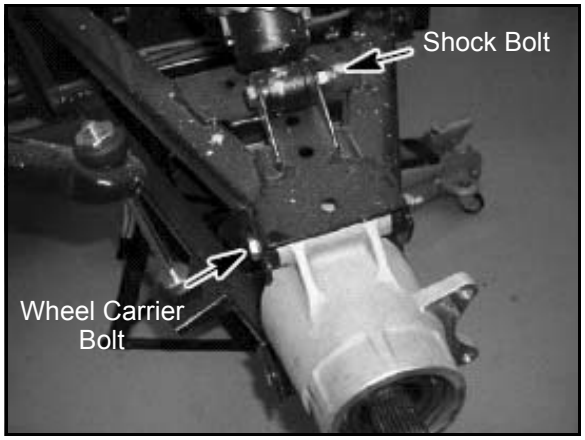
NOTE: Do not let the brake caliper hang from the brake line or damage may occur.



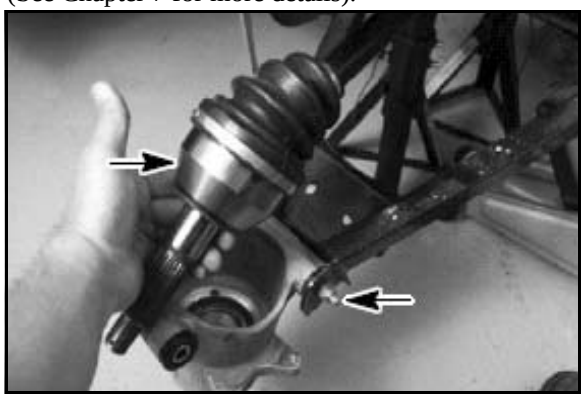
5. Remove the hub and brake disc assembly by sliding it off of the axle.



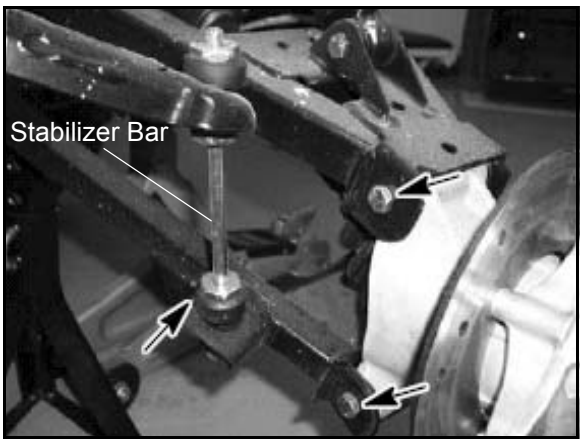
6. Remove the bolt that secures the shock and coil to the upper A-arm.
7. Remove the bolt that secures the wheel carrier to the upper A-arm.



8. Loosen two bolts that secure the A-arm to frame by alternating each about 1/3 of the way until A-arm can be removed. Perform this procedure on the upper A-arm. See exploded view, next page.
9. Examine the A-arm bushing and A-arm shaft. Replace if worn. Discard hardware.
10. To remove the lower control arm, the wheel bearing carrier needs to be removed. Remove the upper and lower wheel carrier bolts and slide the rear drive shaft from the carrier. (See Chapter 7 for more details).



11. Remove the bottom stabilizer bar nut.



12. Loosen two bolts that secure the A-arm bushing to frame by alternating each about 1/3 of the way until the A-arm can be removed. The lower A-arm should now be free to remove.

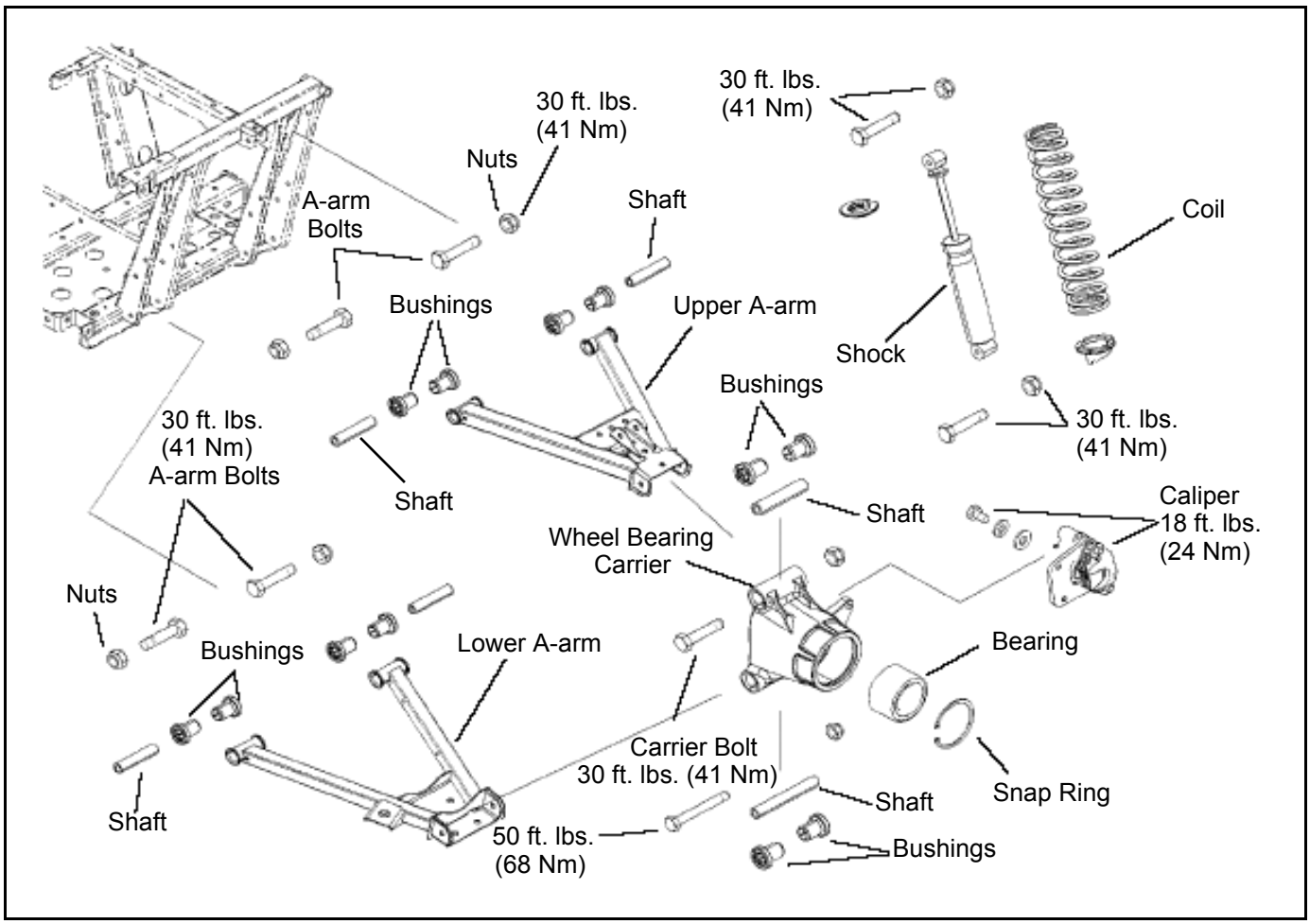
A-Arm Installation

13. Insert new A-arm bushings and new A-arm shaft into new A-arm.
14. Install new A-arm assembly onto vehicle frame. Torque new bolts to 30 ft. lbs. (41 Nm).

> **⚠ WARNING**
>
> The locking features on the existing bolts were destroyed during removal. DO NOT reuse old bolts. Serious injury or death could result if fasteners come loose during operation.

15. Attach A-arm to wheel bearing carrier. Torque upper and lower carrier bolts as shown.
16. Install the shock and tighten shock bolt to 30 ft.lbs. (41 Nm).
17. Re-install wheel and caliper. Refer to "Chapter 2" for wheel toque specifications.

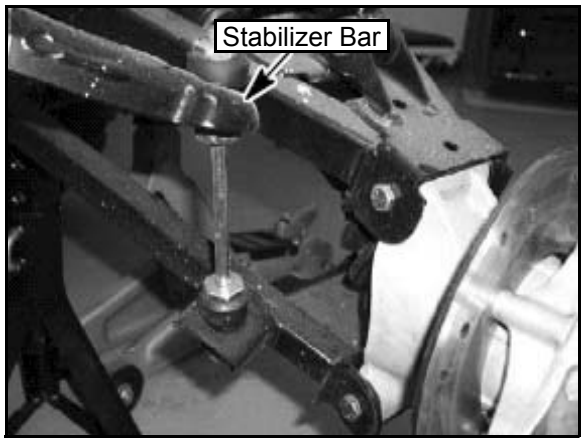
> **⚠ WARNING**
>
> Upon A-arm installation completion, test vehicle at low speeds before putting into regular service.



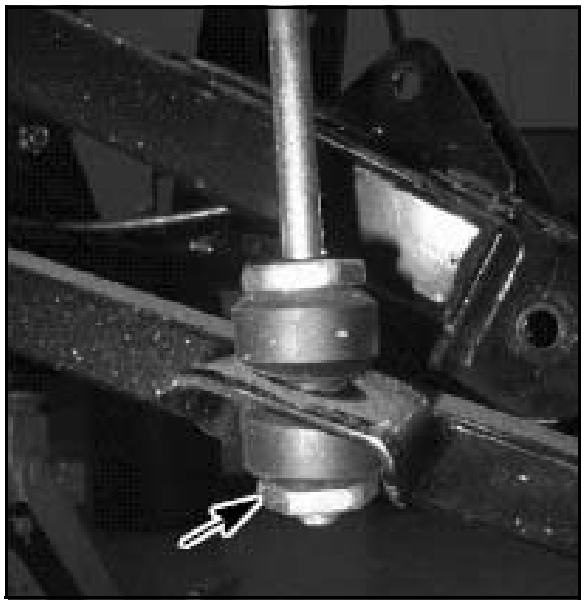
REAR STABILIZER BAR (4X4 CREW)

Removal / Installation

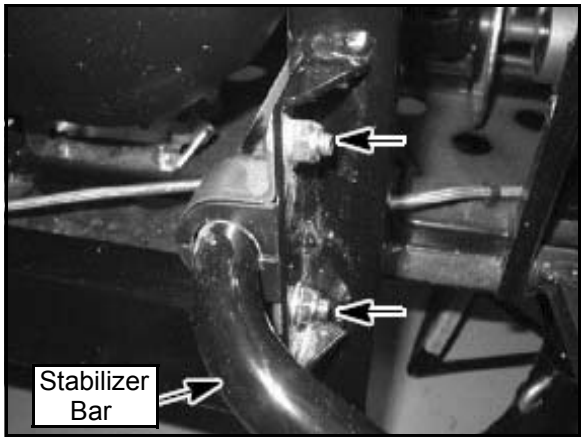
1. Elevate and safely support vehicle with weight removed from the rear wheel(s).
2. Remove the rear wheel to gain access to the stabilizer bar, each side.



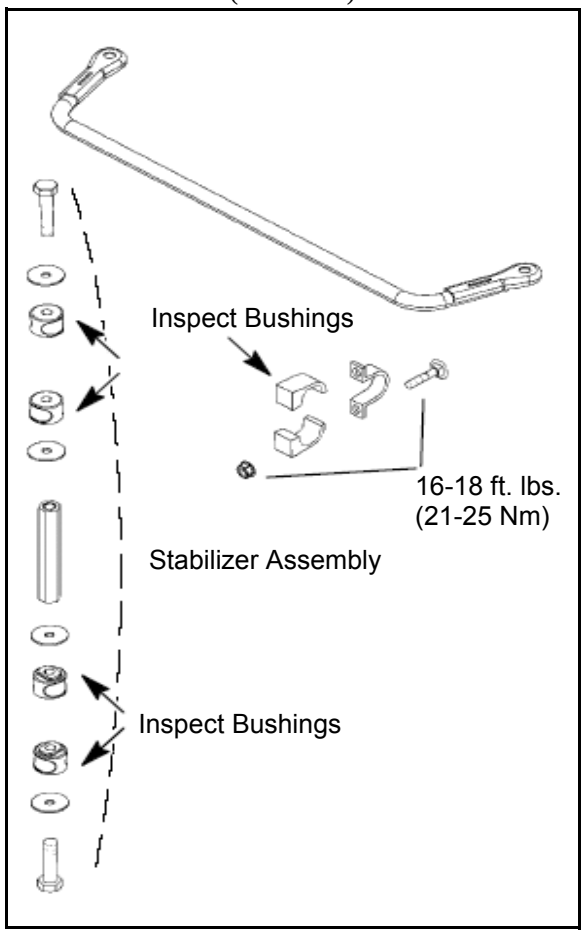
3. Remove the stabilizer bar nut from the lower A-arm on each side.



4. Remove the two bolts that secure the stabilizer bar to the main frame, each side.



5. Remove the stabilizer from the frame.
6. Inspect the stabilizer bar for straightness. Inspect the bushings and replace if needed.
7. Inspect the rubber bushings on the linkage rod and replace if needed.
8. Reverse the procedure for installation. Torque the stabilizer bolts to 16-18 ft.lbs. (21-25 Nm).



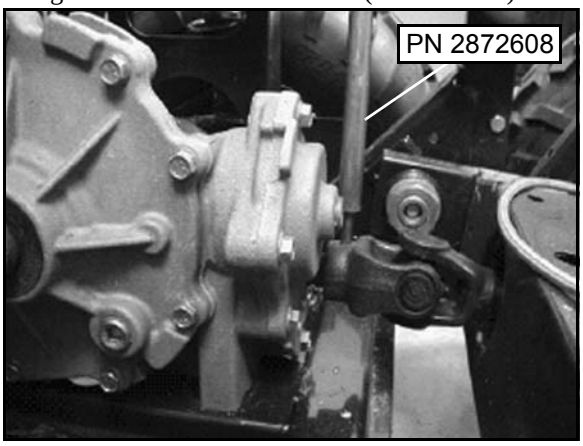
SWING ARM (6X6)

Removal

1. Support machine on a level surface.
2. Remove rear wheels.

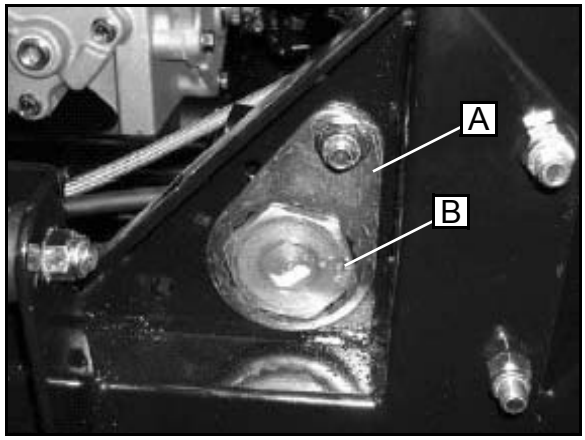
NOTE: The rear axle may be removed to ease the removal of the swing arm. Refer to Chapter 7, "REAR AXLE HOUSING REMOVAL/INSPECTION".

3. Support swing arm, remove rear axle shocks.
4. Drive spring pin out of rear propshaft at middle angle drive using the Roll Pin Removal Tool (PN 2872608).



NOTE: Use jacks and jackstands to help remove the swing arm assembly.

5. Remove the pivot bolt lock brackets (A), swing arm pivot bolts (B), bolts swing arm bushings, lower swing arm and rear axle.

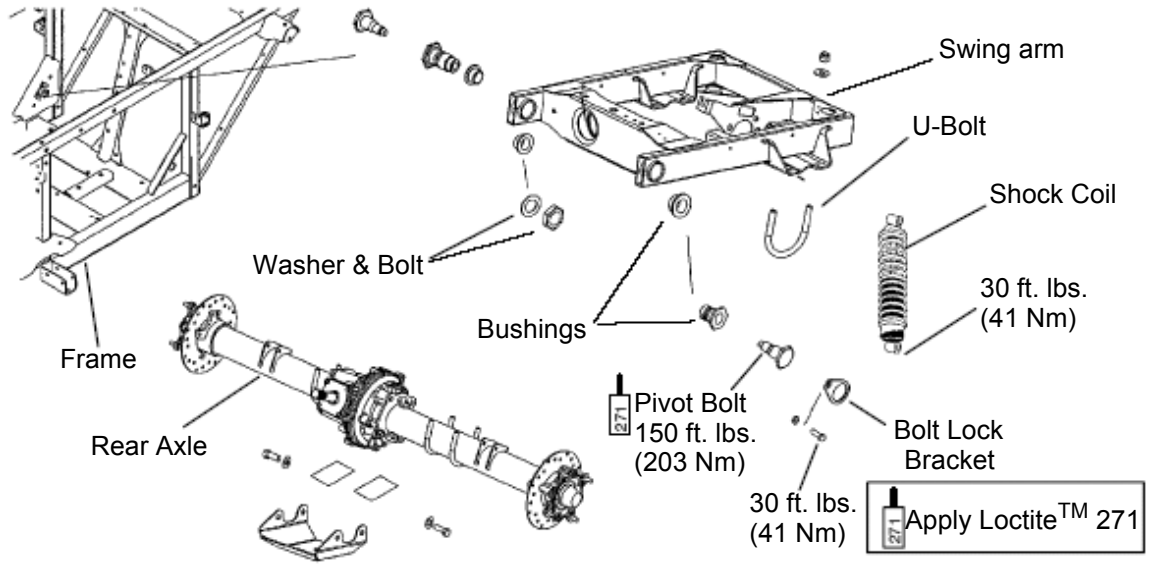


Installation

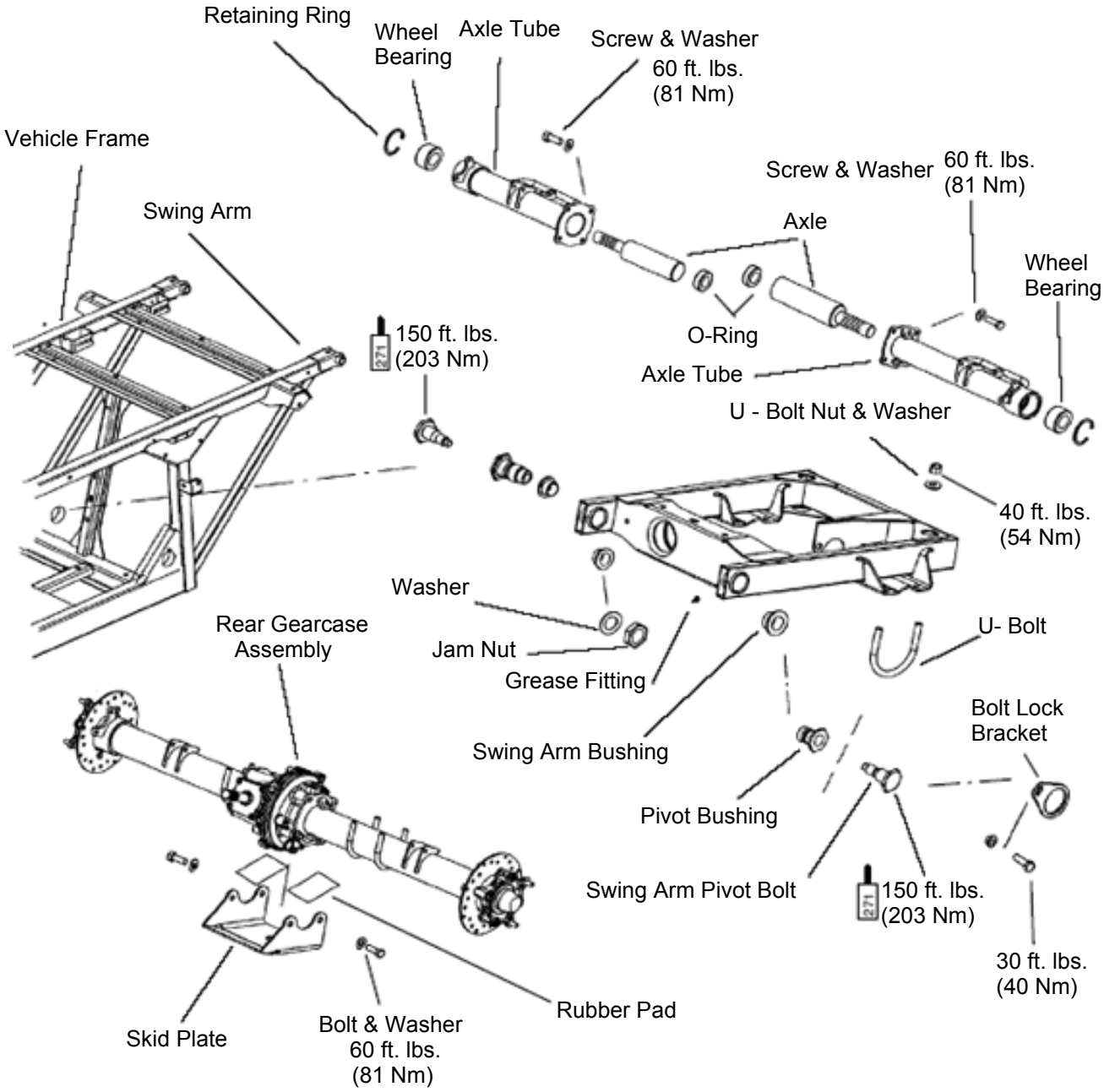
1. Raise swing arm assembly and align the drive shaft to the rear gearcase splined shaft (lube splines).
2. Insert new bushings, check pivot bolts for wear, replace if necessary, torque bolts to 150 ft. lbs (75.9 Nm). Install bolt lock brackets and bolts, torque to 30 ft. lbs. (41 Nm).
3. Install rear coil over shocks onto swing arm, torque bolts to 30 ft. lbs (41 Nm).
4. Install rear wheels, lower machine.
5. Insert new spring pin on rear propshaft.

Pivot Bolt and Nut Torque:
150 ft. lbs. (75.9 Nm)

Rear Shock Mount Bolt Torque:
30 ft. lbs. (41 Nm)



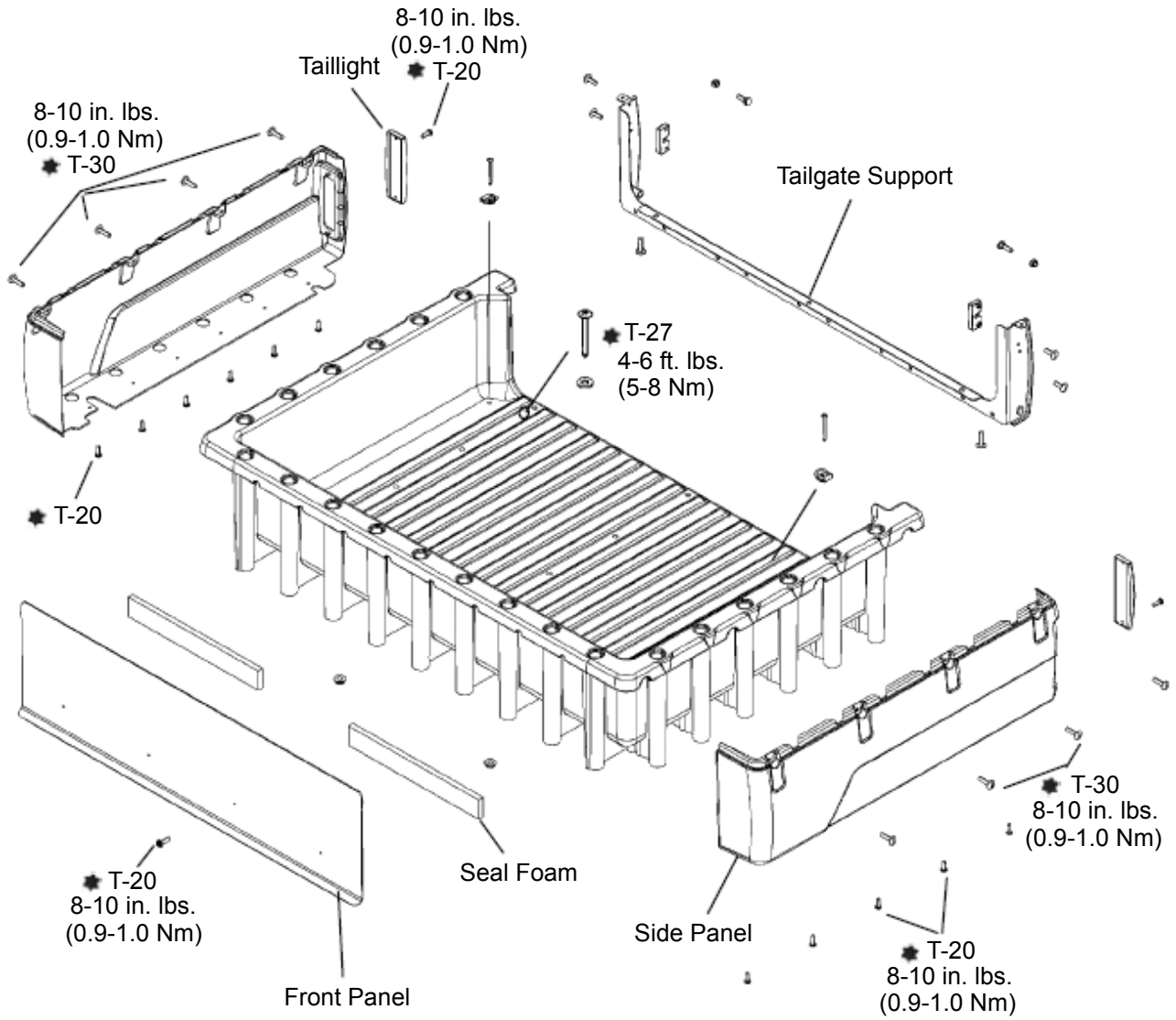
REAR DRIVE AXLE AND SWING ARM EXPLODED VIEW (6X6)



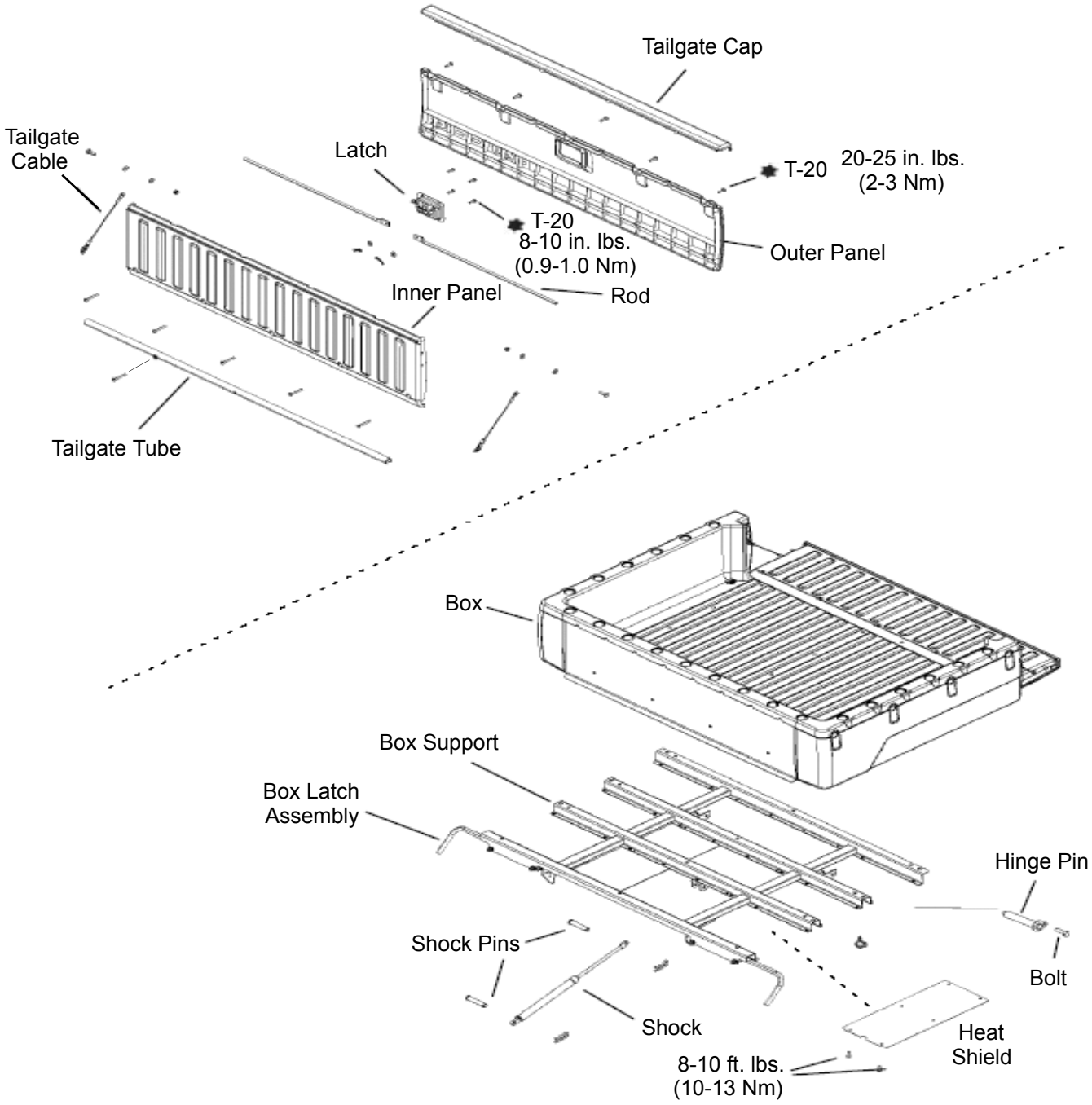
5

REAR CARGO BOX

Cargo Box - Panels



Cargo Box - Tailgate / Box Support

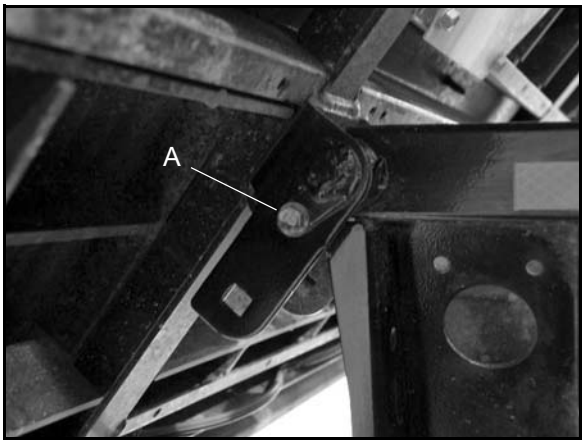


Box Removal

1. Lift the cargo box into the dump position.
2. Disconnect the rear wire harness attached to the tail lights.
3. Remove the upper clip and pin attaching the shock to the cargo box.

> **⚠ CAUTION**
>
> Safely support the box during the remainder of the removal process. The box is not as stable with the shock removed.

4. Remove the screw (A) that secures the hinge pin to the frame on both sides.



5. Remove the hinge pin from both sides.

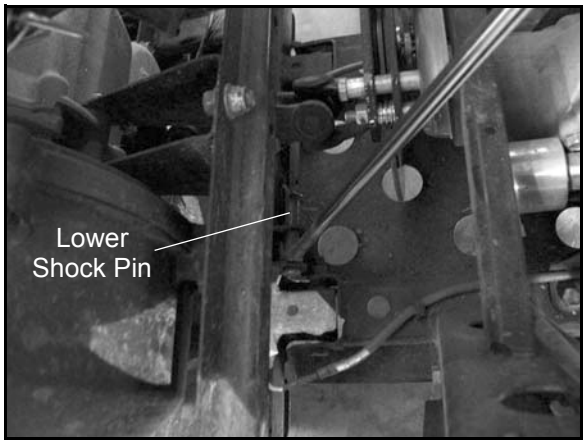
> **⚠ CAUTION**
>
> Safely support the box during the remainder of the removal process. The box is not as stable with the hinge pins removed.

6. With both hinge pins removed, remove the box from the frame. Two people maybe needed to remove the box from the frame.

> **⚠ CAUTION**
>
> Use caution when removing the box. It is recommended to have two people carefully remove the box from the frame.

Box Installation

1. If the shock was replaced, install the lower portion of the shock to the frame and secure it with the pin and clip.

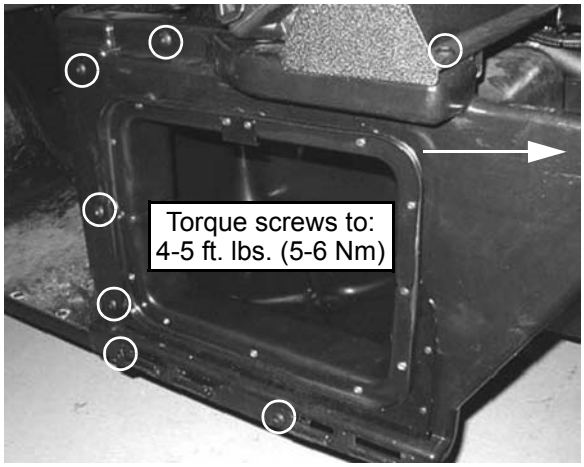


2. Place the cargo box onto the frame. Align the hinges of the box with the bracket on the frame.
3. Install the box hinges on both sides.
4. Secure the box hinges with the hinge screws on both sides.
5. With the hinges installed, attach the shock to the cargo box by inserting the pin and clip.
6. Lower the box and secure the latch.

STORAGE BOX (4X4 CREW)

Removal

1. Remove the two bottom T-27 torx screws.
2. Remove the two top T-27 torx screws.
3. Remove the three T-27 torx screws on the front edge.



4. Lift the storage box towards the rear of the frame for removal.

Installation

1. Install the storage box back into the frame assembly. Align all screw holes and ensure the storage box is properly fitted to the frame.
2. Install all of the T-27 torx screws that were removed. Torque screws to 4-5 ft.lbs. (5-6 Nm).

DECAL REPLACEMENT

Plastic polyethylene material must be “flame treated” prior to installing a decal to ensure good adhesion. The flame treating procedure can often be used to reduce or eliminate the whitish stress marks that are sometimes left after a fender or cab is bent, flexed, or damaged.

⚠ WARNING

The following procedure involves the use of an open flame. Perform this procedure in a well ventilated area, away from gasoline or other flammable materials.
Be sure the area to be flame treated is clean and free of gasoline or flammable residue.

To flame treat the decal area:

1. Pass the flame of a propane torch back and forth quickly over the area where the decal is to be applied until the surface appears slightly glossy. This should occur after just a few seconds of flame treating. Do not hold the torch too close to the surface. Keep the torch moving to prevent damage.
2. Apply the decal.

NOTE: Refer to your parts manual for decal part number.

NOTES

CHAPTER 6
CLUTCHING

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PVT SYSTEM FASTENER TORQUES 6.2
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SPECIAL TOOLS AND SUPPLIES

TOOL DESCRIPTION	PART NUMBER
Drive Clutch Puller	**2870506**
Clutch Holding Wrench	**9314177**
Clutch Holding Fixture	**2871358**
Drive Clutch Spider Removal and Install Tool	**2870341**
Roller Pin Tool	**2870910**
Clutch Bushing Replacement Tool Kit	**2871226**
Piston Pin Puller	**2870386**
Clutch Compression Tool	**8700220**
Clutch Bushing Replacement Tool Kit	**2871025**
Clutch Alignment Tool	**PA-49011**

SPECIAL SUPPLIES	PART NUMBER
Loctite™ 609	**N/A**
RTV Silicone Sealer	**8560054**

TORQUE SPECIFICATIONS

PVT System Fastener Torques

ITEM	TORQUE VALUE ft. lbs. (Nm)
Drive Clutch Retaining Bolt	47 ft. lbs. (64 Nm)
Driven Clutch Retaining Bolt	17 ft. lbs. (23 Nm)
PVT Inner Cover Bolts	12 ft. lbs. (16 Nm)
PVT Outer Cover Bolts	45-50 in. lbs (5-5.6 Nm)
Drive Clutch Spider	200 ft. lbs. (271 Nm)
Drive Clutch Cover Plate	90 in. lbs. (10 Nm)

PVT SYSTEM OVERVIEW

General Operation

⚠ WARNING

All PVT maintenance or repairs should be performed only by a certified Polaris Master Service Dealer (MSD) technician who has received the proper training and understands the procedures outlined in this manual. **Because of the critical nature and precision balance incorporated into the PVT components, it is absolutely essential that no disassembly or repair be made without factory authorized special tools and service procedures.**

The Polaris Variable Transmission (PVT) consists of three major assemblies:

1) The Drive Clutch

2) The Driven Clutch

3) The Drive Belt

The internal components of the drive clutch and driven clutch control engagement (initial vehicle movement), clutch upshift and backshift. During the development of a Polaris ATV, the PVT system is matched first to the engine power curve; then to average riding conditions and the vehicle's intended usage. Therefore, modifications or variations of components at random are never recommended. Proper clutch setup and careful inspection of existing components must be the primary objective when troubleshooting and tuning.

Drive Clutch Operation

Drive clutches primarily sense engine RPM. The two major components which control its shifting function are the shift weights and the coil spring. Whenever engine RPM is increased, centrifugal force is created, causing the shift weights to push against rollers on the moveable sheave, which is held open by coil spring preload. When this force becomes higher than the preload in the spring, the outer sheave moves inward and contacts the drive belt. This motion pinches the drive belt between the spinning sheaves and causes it to rotate, which in turn rotates the driven clutch.

At lower RPM, the drive belt rotates low in the drive clutch sheaves. As engine RPM increases, centrifugal force causes the drive belt to be forced upward on drive clutch sheaves.

Driven Clutch Operation

Driven clutches primarily sense torque, opening and closing according to the forces applied to it from the drive belt and the transmission input shaft. If the torque resistance at the transmission input shaft is greater than the load from the drive belt, the drive belt is kept at the outer diameter of the driven clutch sheaves.

As engine RPM and horsepower increase, the load from the drive belt increases, resulting in the belt rotating up toward the outer diameter of the drive clutch sheaves and downward into the sheaves of the driven clutch. This action, which increases the driven clutch speed, is called upshifting.

Should the throttle setting remain the same and the vehicle is subjected to a heavier load, the drive belt rotates back up toward the outer diameter of the driven clutch and downward into the sheaves of the drive clutch. This action, which decreases the driven clutch speed, is called backshifting.

In situations where loads vary (such as uphill and downhill) and throttle settings are constant, the drive and driven clutches are continually shifting to maintain optimum engine RPM. At full throttle a perfectly matched PVT system should hold engine RPM at the peak of the power curve. This RPM should be maintained during clutch upshift and backshift. In this respect, the PVT system is similar to a power governor. Rather than vary throttle position, as a conventional governor does, the PVT system changes engine load requirements by either upshifting or backshifting.

PVT Break-In (Drive Belt / Clutches)

A proper break-in of the clutches and drive belt will ensure a longer life and better performance. Break in the clutches and drive belt by operating at slower speeds during the 10 hour break-in period as recommended (see Chapter 3 “Engine Break-In Period” for break-in example). Pull only light loads. Avoid aggressive acceleration and high speed operation during the break-in period.

Maintenance / Inspection

Under normal use the PVT system will provide years of trouble free operation. Periodic inspection and maintenance is required to keep the system operating at peak performance. The following list of items should be inspected and maintained to ensure maximum performance and service life of PVT components. Refer to the troubleshooting checklist at the end of this chapter for more information.

1. **Belt Inspection, Drive to Driven Clutch Alignment, and Clutch Center Distance.**
2. **Drive and Driven Clutch Buttons and Bushings, Drive Clutch Shift Weights and Pins, Drive Clutch Spider Rollers and Roller Pins, Drive and Driven Clutch Springs.**
3. **Sheave Faces.** Clean and inspect for wear.
4. **PVT System Sealing.** Refer to appropriate illustrations on the following pages. The PVT system is air cooled by fins on the drive clutch stationary sheave. The fins create a low pressure area in the crankcase casting, drawing air into the system through an intake duct. The opening for this intake duct is located at a high point on the vehicle (location varies by model). The intake duct draws fresh air through a vented cover. All connecting air ducts (as well as the inner and outer covers) must be properly sealed to ensure clean air is being used for cooling the PVT system and also to prevent water and other contaminants from entering the PVT area. This is especially critical on units subjected to frequent water forging.

Overheating / Diagnosis

During routine maintenance, or whenever PVT system overheating is evident, it's important to check the inlet *and* outlet ducting for obstructions. Obstructions to air flow through the ducts will significantly increase PVT system operating temperatures. The vehicle should be operated in Low when plowing or pulling heavy loads, or if extended low speed operation is anticipated.

CLUTCH DRIVE BELT & COVER RELATED ISSUES: DIAGNOSIS	
Possible Causes	**Solutions / What to do**
Loading the vehicle into a truck or tall trailer when in high range.	Shift transmission to Low during loading of the vehicle to prevent belt burning.
Starting out going up a steep incline from a stopped position.	When starting out on an incline, use Low, or dismount the vehicle after first applying the park brake and perform the "K" turn.
Driving at low RPM or low ground speed (at approximately 3-7 MPH).	Drive at higher speed or use Low. The use of Low is highly recommended for cooler PVT operating temperatures and longer component life.
Insufficient warm-up of Utility Task Vehicles™ exposed to low ambient temperatures.	Warm engine at least 5 min., then with transmission in neutral, advance throttle to approx. 1/8 throttle in short bursts, 5 to 7 times. The belt will become more flexible and prevent belt burning.
Slow and easy clutch engagement.	Fast, effective use of the throttle for efficient engagement.
Towing/Pushing at low RPM/low ground speed.	Use Low only.
Plowing snow, dirt, etc./utility use.	Use Low only.
Stuck in mud or snow.	Shift the transmission to Low, carefully use fast, aggressive throttle application to engage clutch. **WARNING:** Excessive throttle may cause loss of control and vehicle overturn.
Climbing over large objects from a stopped position.	Shift the transmission to Low, carefully use fast, aggressive, brief throttle application to engage clutch. **WARNING:** Excessive throttle may cause loss of control and vehicle overturn.
Belt slippage from water or snow ingestion into the PVT system.	Shift the transmission to neutral. Using the throttle, vary the engine rpm from idle to full throttle. Repeat several times as required. During this procedure, the throttle should not be held at the full position for more than 10 seconds. Clutch seals should be inspected for damage if repeated leaking occurs.
Clutch malfunction.	For inspection of clutch components, please contact your Polaris dealer. Shift transmission to Low during loading of the vehicle to prevent belt burning.
Poor engine performance.	Fouled plugs, foreign material in gas tank, fuel lines, or carburetor. Contact you dealer for further service information.
GENERAL RANGE OPERATION GUIDELINES:	Low: Heavy pulling, basic operational speeds less than 7 MPH, riding through rough terrain (swamps, mountains, ect.), low ground speeds.
	High: High ground speeds, speeds above 7 MPH.

Operating in Low Gear

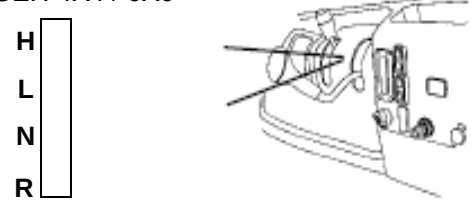
Low is the primary driving gear. Low should be used in ALL driving applications except for driving on hard packed level surfaces with light loads. In this circumstance, High may be used.

IMPORTANT: Using High for heavy loads, hilly terrain, or in wet, muddy conditions will increase the chance of drive belt burning.

1. Use Low as the primary driving gear for all *RANGER*s.

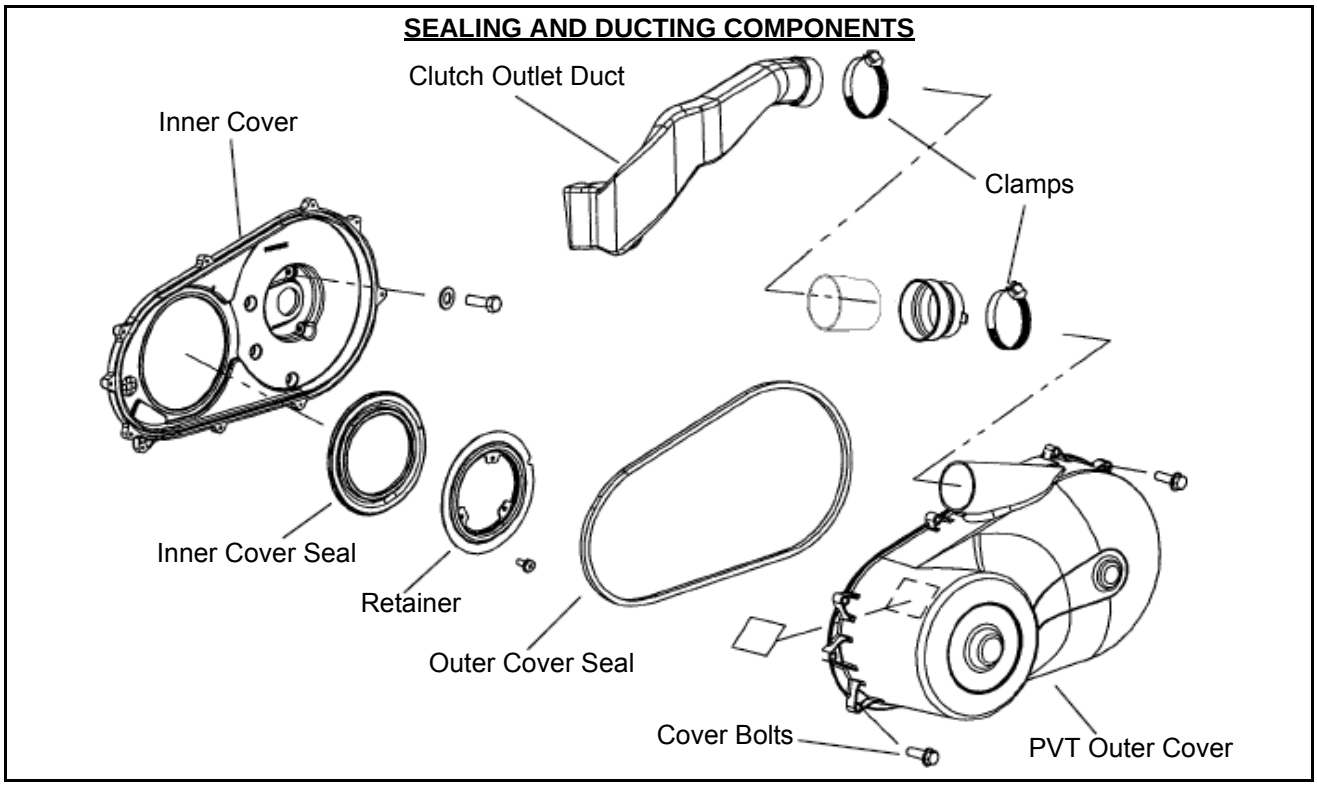
2. Use High only on hard packed, level surfaces with light loads.

RANGER 4X4 / 6X6



PVT SYSTEM SERVICE

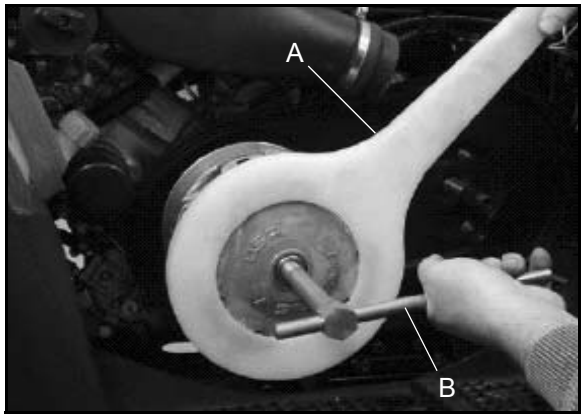
PVT Sealing, Guard, and Ducting Components



Disassembly

Some fasteners and procedures will vary. Refer to the appropriate parts manual for proper fasteners and fastener placement.

1. Remove seat.
2. Remove the LH storage box to gain access to PVT outer cover (see Chapter 5 for removal).
3. Remove PVT air outlet duct hose.
4. Remove outer PVT cover screws.
5. Mark the drive belt direction of rotation and remove drive belt. See “Drive Belt Removal”.

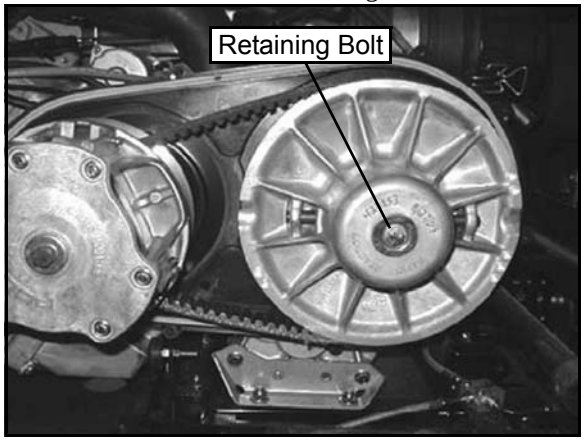


6. Install the Drive Clutch Holder (PN 9314177) (A).
7. Remove drive clutch retaining bolt and remove drive clutch using the Drive Clutch Puller (PN 2870506) (B).

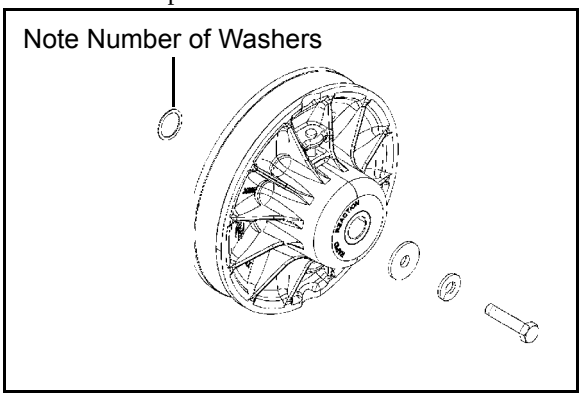
Drive Clutch Puller (PN 2870506)

Drive Clutch Holder (PN 9314177)

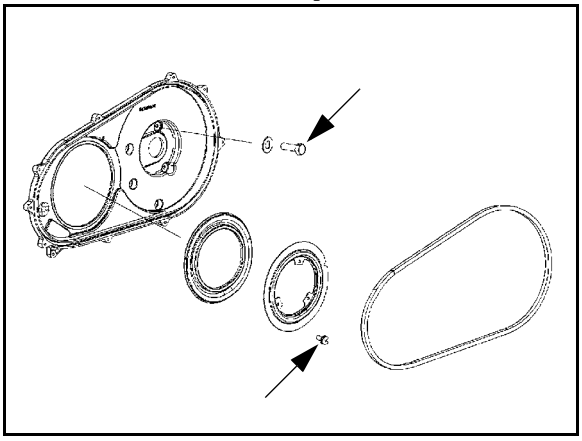
8. Remove the driven clutch retaining bolt and driven clutch.



9. Remove driven clutch alignment washer(s) from the transmission input shaft.



10. Remove screws and retainer plate.

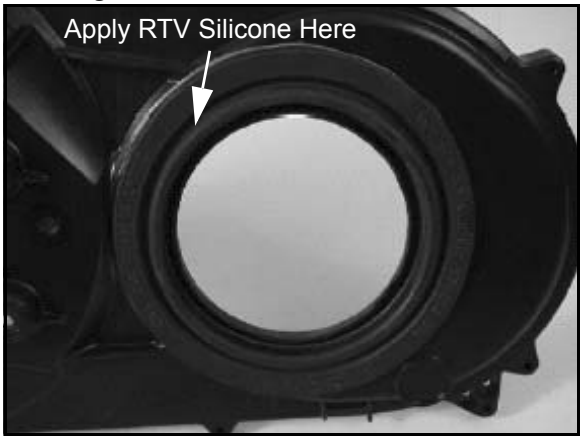


11. Remove inner cover retaining bolts at rear of cover.

12. Remove cover along with foam seal on back of cover or shaft.

Assembly

1. Inspect PVT inner cover-to engine seal. Replace if cracked or damaged.

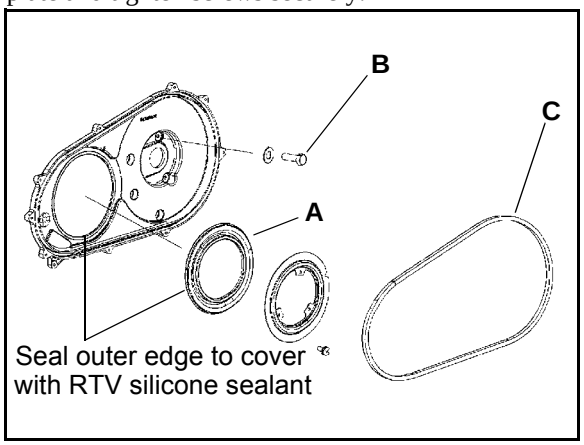


2. Place a new foam seal on transmission input shaft.

3. Apply RTV silicone sealant to outside edge of inner cover-to-engine seal, to ensure a water tight fit between the seal and the cover. Surfaces must be clean to ensure adhesion of silicone sealant.

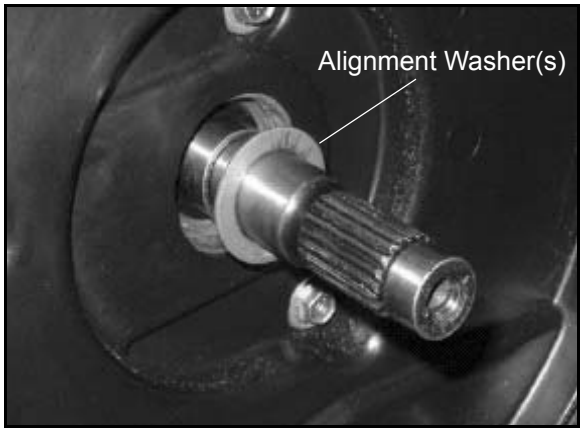
4. Reinstall cover and tighten rear cover bolts just enough to hold it in place.

5. Fit lip of inner cover seal (A) to engine. Install seal retainer plate and tighten screws securely.



6. Torque rear inner cover bolts (B) to specification.

7. Install clutch alignment washer(s) on transmission input shaft.



8. Clean splines inside driven clutch and on the transmission input shaft.

9. Apply a light film of grease to the splines on the shaft.

10. Install the driven clutch, washer, lock washer, and retaining bolt. Torque to specification.

11. Clean end of taper on crankshaft and the taper bore inside drive clutch.

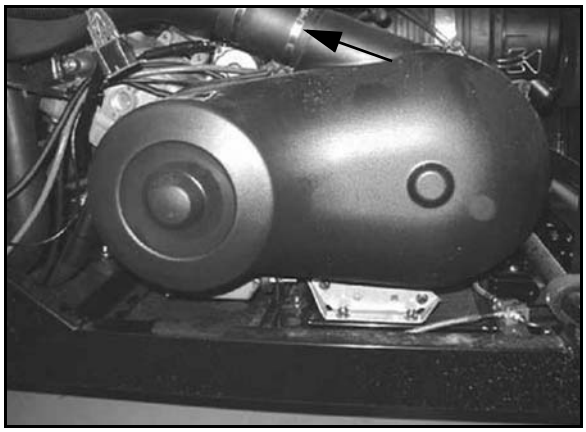
12. Install drive clutch and torque retaining bolt to specification.

13. Reinstall drive belt noting direction of rotation. If a new belt is installed, install so numbers can be easily read.

14. Replace PVT outer clutch cover rubber gasket.

15. Reinstall PVT outer clutch cover and secure with screws. Torque to 45-50 in. lbs. (5-5.6 Nm).

16. Install the PVT cover outlet duct and tighten the clamps.



Inner Cover Bolt Torque (Rear):
12 ft. lbs. (16.6 Nm)

Outer Cover Bolt Torque:
45-50 in.lbs. (5-5.6 Nm)

Driven Clutch Retaining Bolt Torque:
17 ft. lbs. (23.5 Nm)

Drive Clutch Retaining Bolt Torque:
47 ft. lbs. (64 Nm)

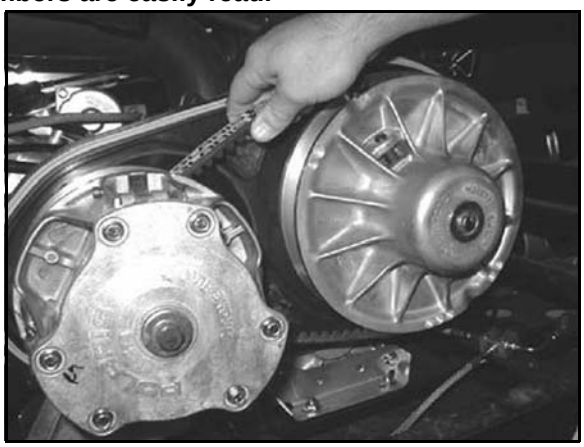
DRIVE BELT

Belt Removal

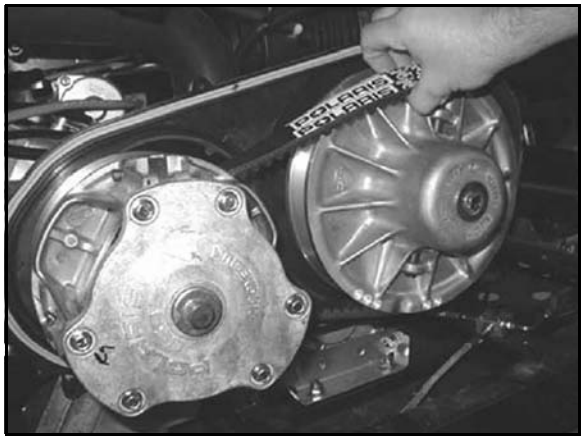
1. Remove outer PVT cover as described in PVT Disassembly.

2. Mark the drive belt direction of rotation so that it can be installed in the same direction.

NOTE: Belt is normally positioned so that part numbers are easily read.



3. To remove drive belt, put transmission in gear, apply brake, pull upward and rearward on belt to open driven clutch sheaves, pull out and down on belt to slip over the driven clutch outer sheave.



Belt Inspection

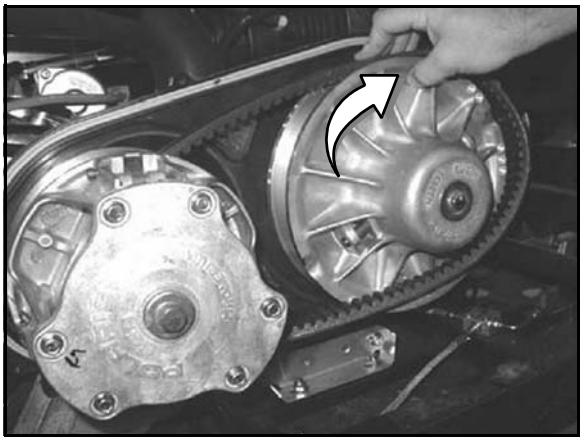
1. Inspect belt for hour glassing (extreme circular wear in at least one spot and on both sides of the belt). Hour glassing occurs when the drive train does not move and the drive clutch engages the belt.

2. Inspect belt for loose cords, missing cogs, cracks, abrasions, thin spots, or excessive wear. Compare belt measurements with a new drive belt. Replace if necessary.

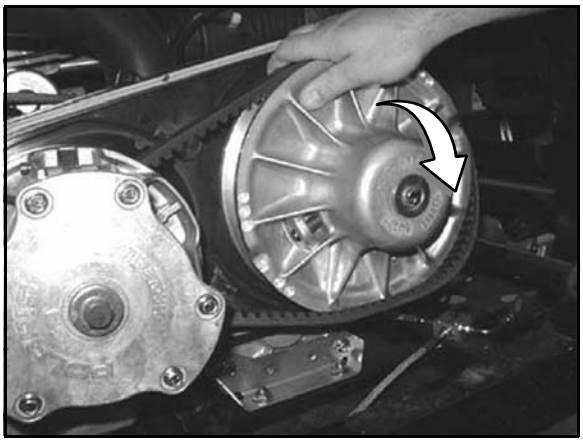
3. Belts with thin spots, burn marks, etc., should be replaced to eliminate noise, vibration, or erratic PVT operation. See the Troubleshooting Chart at the end of this chapter for possible causes.

Belt Installation

1. Loop belt over the drive clutch and over top of the driven sheave.



2. While pushing down on top of belt, turn the back or moveable driven sheave clockwise.



3. The belt then should be able to be pushed down into and between the sheaves.

Be sure to position belt so part number is easily read.

PVT Break-In (Drive Belt / Clutches)

A proper break-in of the clutches and drive belt will ensure a longer life and better performance. Break in the clutches and drive belt by operating at slower speeds during the 10 hour break-in period as recommended (see Chapter 3 “Engine Break-In Period” for break-in example). Pull only light loads. Avoid aggressive acceleration and high speed operation during the break-in period.

CLUTCH ALIGNMENT

Clutch Alignment Tool Use

Clutch alignment is controlled by the number of washers that are placed behind the driven clutch on the transmission input shaft. Adding washers behind the driven clutch will move the drive belt toward the moveable sheave of the drive clutch. Removing washers from behind the driven clutch will move the drive belt toward the stationary sheave of the drive clutch.

1. Remove the seat.

2. Remove the LH storage box to gain access to the outer PVT cover (see Chapter 5 for removal).

3. Loosen the hose clamp and remove the PVT air outlet duct hose from the outer PVT cover.

4. Remove all outer PVT cover screws and remove the cover.

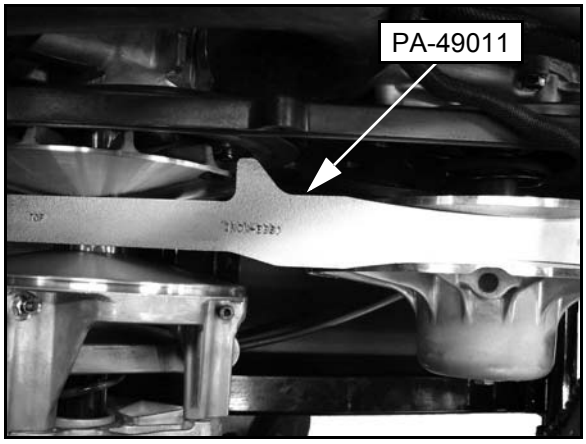
5. Mark the drive belt direction of rotation and remove drive belt (see “Drive Belt Removal”).

6. Install the Clutch Alignment Tool.

CLUTCH ALIGNMENT TOOL

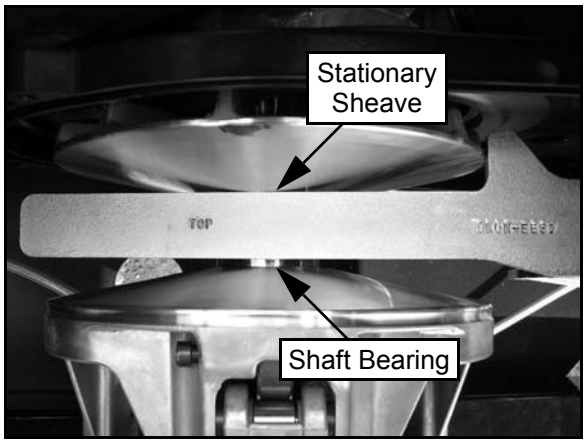
PA-49011

7. Place the alignment tool in the sheaves of the driven clutch and hold firmly as you rotate it down between the sheaves of the drive clutch.



Clutch Alignment Tool
PA-49011

8. As you rotate the tool down between the drive clutch sheaves, the tool should touch the clutch shaft bearing while maintaining a clearance of roughly .020" between the tool and stationary sheave of the drive clutch.



9. If the alignment tool hits the stationary sheave before it reaches the shaft bearing, the driven clutch will need to be spaced out to correct the alignment.

   • Remove the driven clutch. Add the required amount of alignment washers to obtain the correct measurement with the alignment tool. You may need to add more than one alignment washer.

Alignment Washers
(.030") PN: 7556454
(.060") PN: 7556120

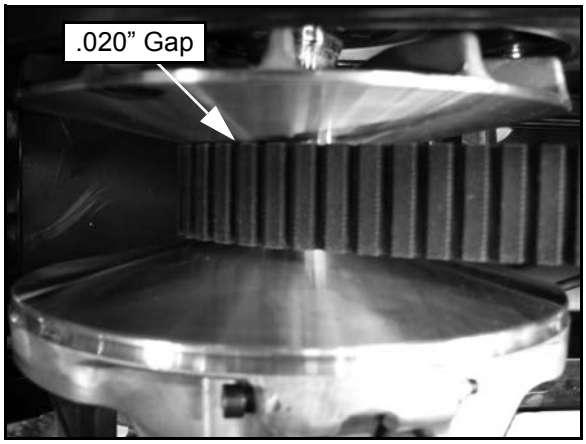
10. If the alignment tool touches the shaft bearing but has an excessive amount of clearance between the tool and stationary sheave, the driven clutch will need to be moved in to correct the alignment.

    • Remove the driven clutch. Remove the required amount of washers to obtain roughly .020" clearance between the tool and stationary sheave.

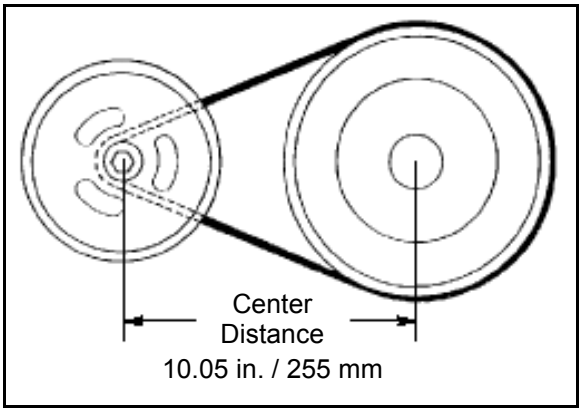
NOTE: The number of washers behind the driven clutch will vary between vehicles.

IMPORTANT: It may not be possible to achieve perfect alignment with the tool as previously described, because of the thickness of the alignment washers. It is better to have clearance between the tool and stationary sheave of the drive clutch than to have the tool touch the stationary sheave before it touches the shaft bearing.

11. After completing the clutch alignment procedure, the belt should ride in the drive clutch with an approximate .020" gap between the belt and stationary sheave and a larger gap of approximately .130" between the belt and moveable sheave.



CLUTCH CENTER DISTANCE



DRIVE CLUTCH SERVICE

Spring Specifications

The drive clutch spring has two primary functions:

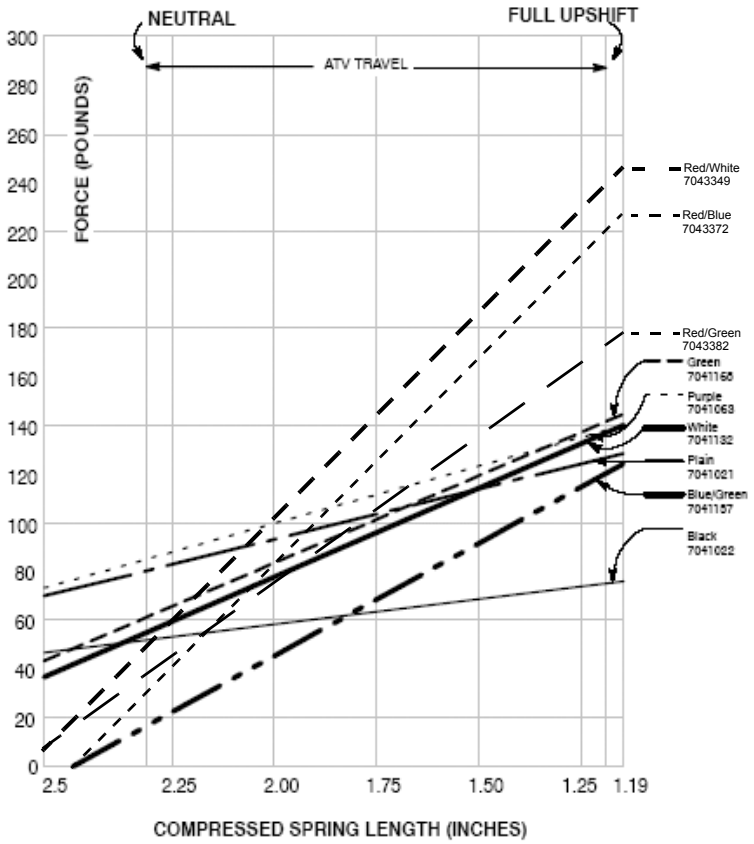
1. To control clutch engagement RPM. The springs which have a higher rate when the clutch is in neutral will increase clutch engagement RPM.

2. To control the rate at which the drive belt moves upward in the drive clutch sheaves. This is referred to as drive clutch upshift.

There are other components which control upshift, but the spring is one of the primary components in insuring optimum performance. It is very important that the spring is of the correct design and is in good condition.

⚠ CAUTION

Never shim a drive clutch spring to increase its compression rate. This may result in complete stacking of the coils and subsequent clutch cover failure.



The drive clutch spring is one of the most critical components of the PVT system. It is also one of the easiest to service. Due to the severe relaxation the spring is subject to during operation, it should always be inspected for tolerance limits during any clutch operation diagnosis or repair.

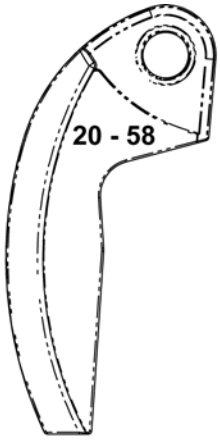
With the spring resting on a flat surface, measure its free length from the outer coil surfaces as shown. Refer to the spring specification chart for specific free length measurements and tolerances. Also check to see that spring coils are parallel to one another. Distortion of the spring indicates stress fatigue, requiring replacement.

Primary Clutch Springs

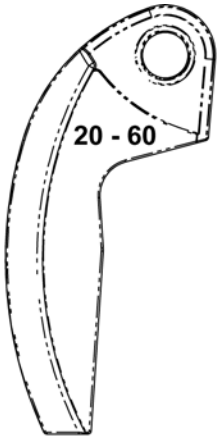
PART NUMBER	COLOR CODE	WIRE DIAMETER	FREE LENGTH ± .125”
7041021	Plain	.157"	4.38"
7041022	Black	.140"	4.25"
7041063	Purple	.168"	4.37"
7041132	White	.177"	2.92"
7041157	Blue / Green	.177"	2.53"
7041168	Green	.177"	3.05"
7043349	Red / White	.200"	2.58"
7043372	Red / Blue	.187"	2.56"
7043382	Red / Green	.177"	2.63"

Shift Weights

Shown below are the shift weights which have been designed for the PVT system. These shift weights have many factors designed into them for controlling engagement RPM and shifting patterns. Shift weights should not be changed or altered without first having a thorough understanding of their positioning and the effects they may have on belt to sheave clearance, clutch balance and shifting pattern.



PN 5631215



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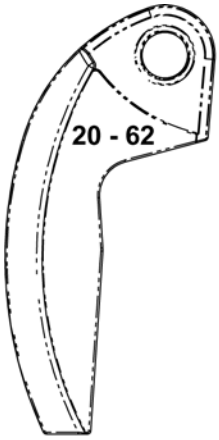

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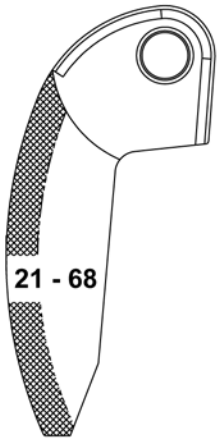
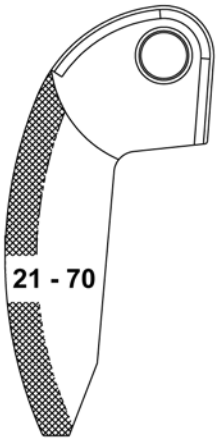


PN 5632128



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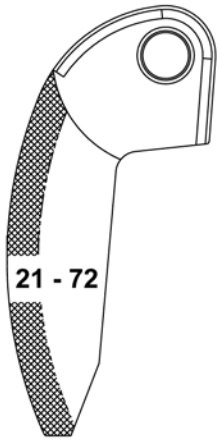
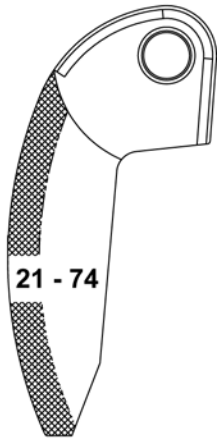
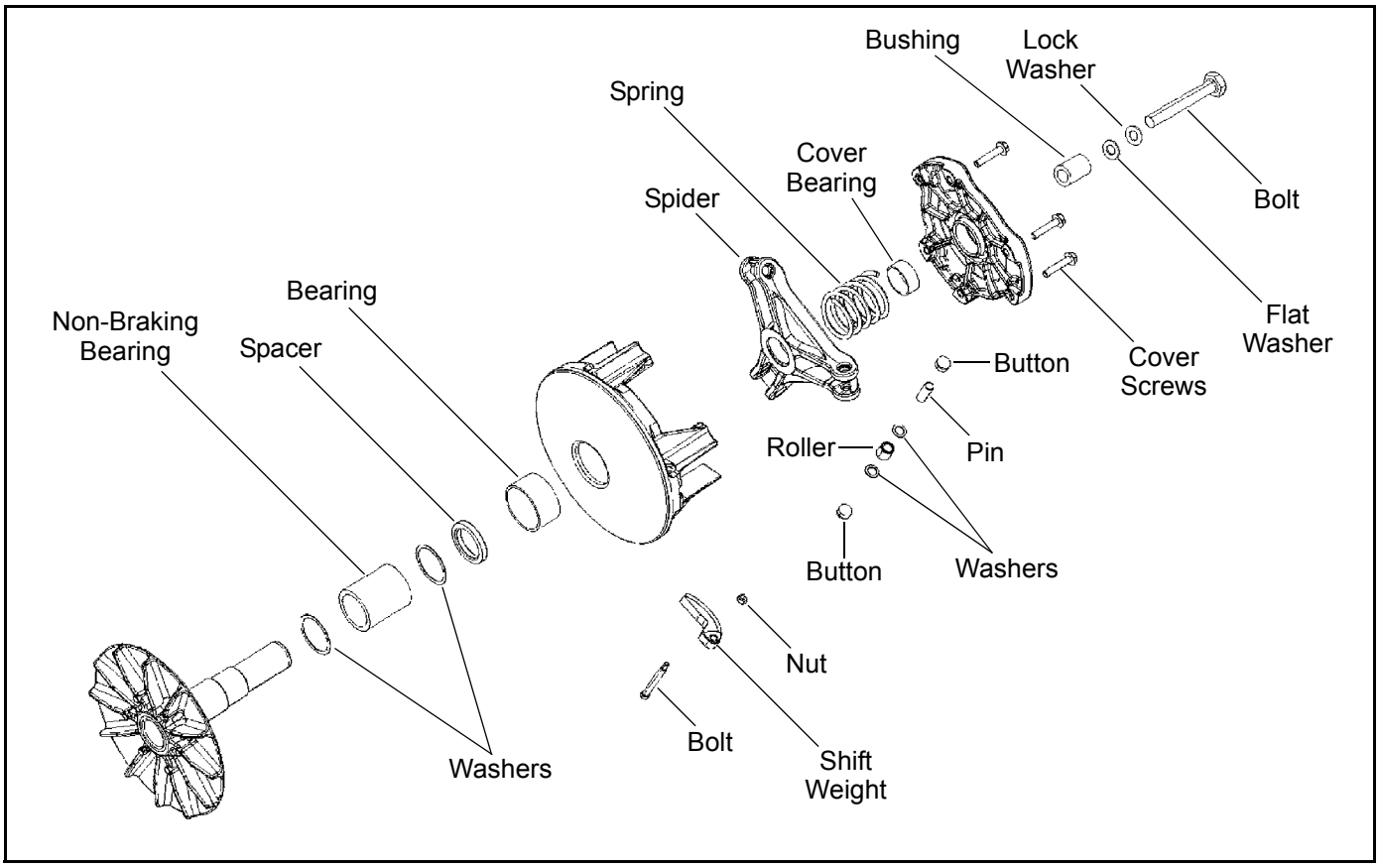


PN 5632119



PN 5632117

Exploded View

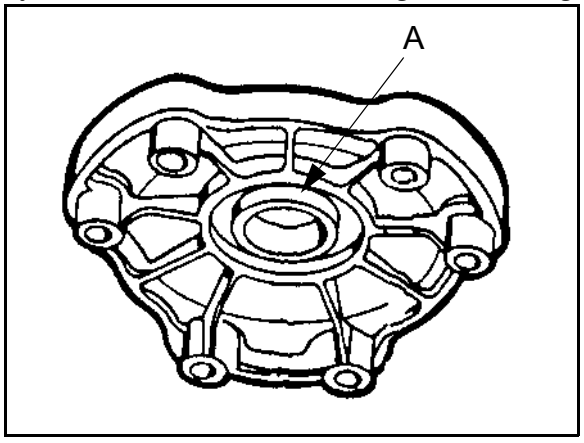


Clutch Disassembly

1. Using a permanent marker, mark the cover, spider, and moveable and stationary sheaves for reference, as the cast in X's may not have been in alignment before disassembly.

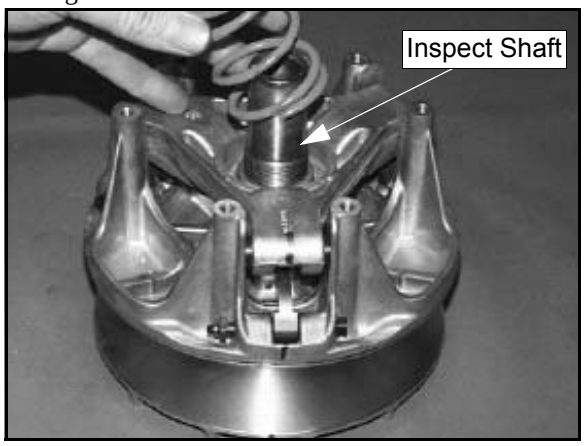
2. Remove cover bolts evenly in a cross pattern and remove cover plate.

3. Inspect cover bushing (A). The outer cover bushing is manufactured with a Teflon™ coating. Wear is determined by the amount of Teflon™ remaining on the bushing.



Cover Bushing Inspection: Replace the cover bushing if more brass than Teflon™ is visible on the bushing. Refer to bushing replacement in this chapter.

4. Inspect area on shaft where bushing rides for wear, galling, nicks, or scratches. Replace clutch assembly if worn or damaged.



5. Remove and inspect the clutch spring. See "Drive Clutch Spring Specifications" for spring inspection.

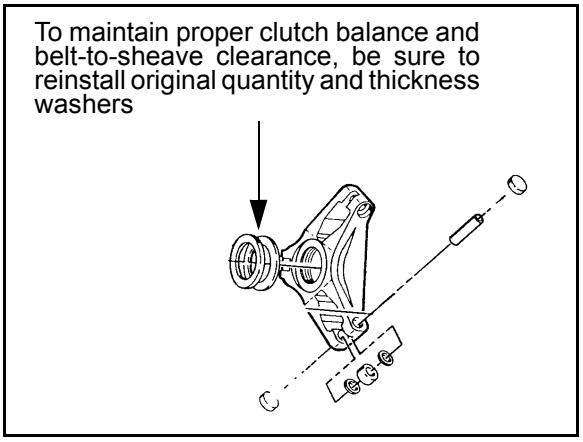
Spider Removal

1. Install clutch in holding fixture (PN 2871358) and loosen the spider (counterclockwise) using Clutch Spider Removal Tool (PN 2870341).

Clutch Holding Fixture:
(PN 2871358)

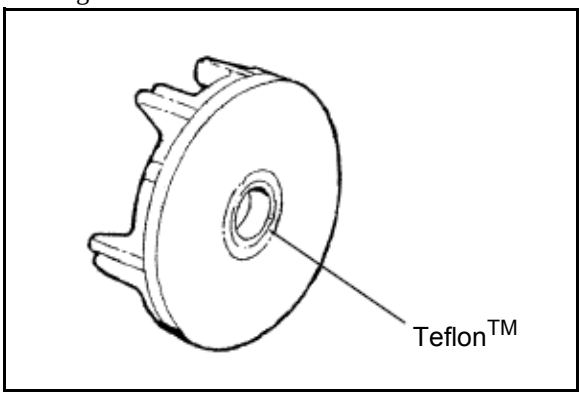
Spider Removal Tool:
(PN 2870341)

NOTE: It is important that the same number and thickness of washers are reinstalled beneath the spider during assembly. Be sure to note the number and thickness of these washers.



Moveable Sheave Bushing Inspection

2. Inspect the Teflon™ coating on the moveable sheave bushing.



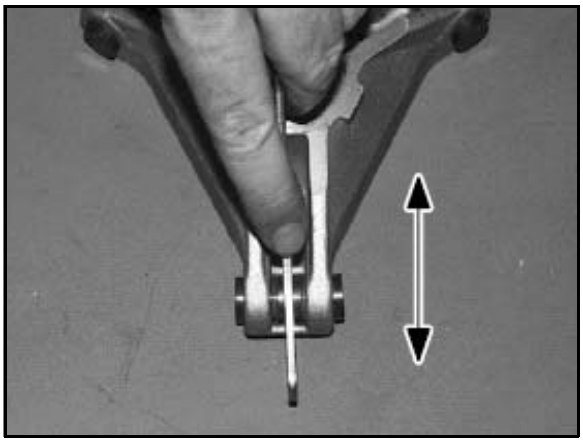
Moveable Sheave Bushing Inspection:

Replace the cover bushing if more brass than Teflon is visible on the bushing. Refer to bushing replacement in this chapter.

6

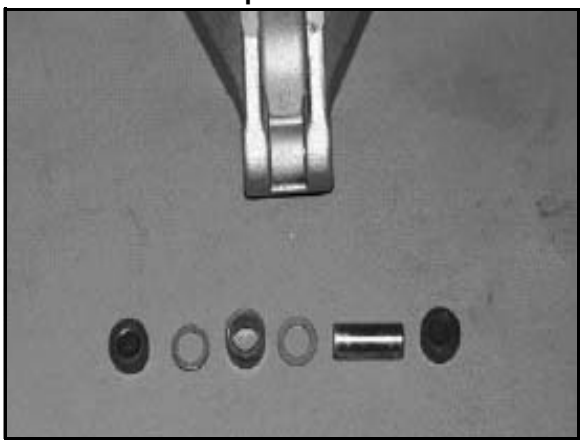
Roller, Pin, and Thrust Washer Inspection

1. Inspect all rollers, bushings and roller pins by pulling a flat metal rod across the roller. Turn roller with your finger. If you notice resistance, galling, or flat spots, replace rollers, pins and thrust washers in sets of three. Also inspect to see if roller and bushing are separating. Bushing must fit tightly in roller. Use the Roller Pin Tool (PN 2870910) to replace rollers and pins. Take care not to damage roller bushing or bearing surface of the new pin during installation.



2. Rubber backed buttons can be used in all *RANGER* clutches if the hollow roller pin is changed to the solid roller pin.

NOTE: The rubber side of the button is positioned toward the solid roller pin.



Button To Tower Clearance Inspection

1. Inspect for any clearance between spider button to tower. If clearance exists, replace all buttons and inspect surface of towers. See “Spider Removal” procedure.

Button to Tower Clearance:
000-.001”

2. Inspect sheave surfaces. Replace the entire clutch if worn, damaged or cracked.

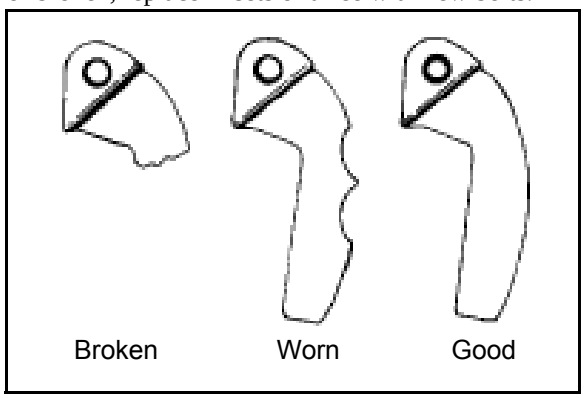
Shift Weight Inspection

⚠ WARNING

The clutch assembly is a precisely balanced unit. Never replace parts with used parts from another clutch assembly!

1. If clutch is not disassembled, inspect as shown, using a clutch holding tool to compress the moveable sheave. The contact surface of the weight should be smooth and free of dents or gall marks.

2. Remove shift weight bolts and weights. Inspect as shown. The contact surface of the weight should be smooth and free of dents or gall marks. Inspect the weight pivot bore and pivot bolts for wear or galling. If weights or bolts are worn or broken, replace in sets of three with new bolts.

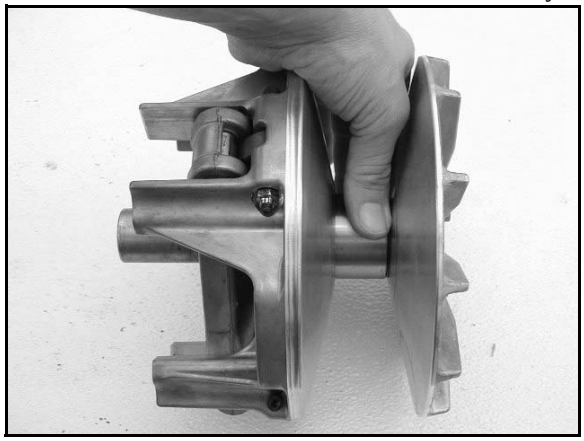


NOTE: A damaged shift weight is usually caused by a damaged or stuck roller in the spider assembly. See "Roller, Pin and Thrust Washer Inspection".

Bearing Inspection

1. Rotate non-braking clutch bearing in both clockwise and counter-clockwise directions. The non-braking bearing should rotate both directions on the shaft with only a slight amount of drag.

2. Verify there is no binding or rough spots. If problems are noted in either direction, continue with disassembly.

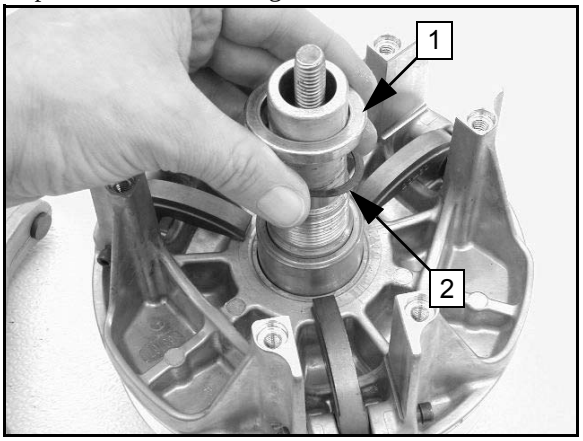


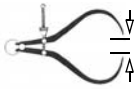
Clutch Inspection

NOTE: Remove cover, spring, and spider following instructions for drive clutch removal, then proceed as follows:

1. Remove the moveable sheave spacer (1) and the thrust washer (2). Visually inspect the washer for damage.

2. Measure the thickness and compare to specification. Replace if worn or damaged.

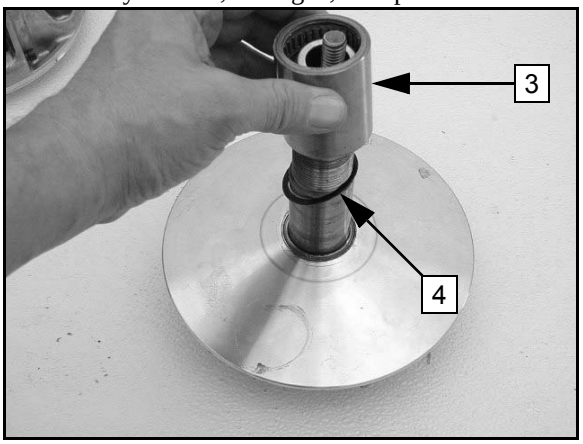


 **= In. / mm.**

Thrust Washer Thickness
Standard: .030" (.76mm)
Service Limit: .025" (.64mm)

3. Remove the moveable clutch sheave.

4. Lift bearing (3) and thrust washer (4) off shaft. Replace as an assembly if worn, damaged, or if problems were noted.



5. Inspect surface of shaft for pitting, grooves, or damage. Measure the outside diameter and compare to specifications. Replace the drive clutch assembly if shaft is worn or damaged.

= In. / mm.

Shaft Diameter:
Standard: 1.3745 - 1.375 (
Service Limit: 1.3730”

6. Visually inspect PTFE thrust washer for damage. Measure the thickness and compare to specification. Replace if worn or damaged.

= In. / mm.

PTFE Washer Thickness
Standard: .030” (.76mm)
Service Limit: .025” (.64mm)

Moveable Sheave Bushing Inspection

Inspect the Teflon™ coating (arrow) on the moveable sheave bushing. Inspect both sheaves for signs of wear, grooving or cracking. De-glaze sheave surfaces with a 3M™ Scotch-Brite Pad if needed.

Moveable Sheave Bushing Inspection: Replace the cover bushing if more brass than Teflon™ is visible on the bushing. Refer to bushing replacement in this chapter.

Bushing Service

IMPORTANT: Special Tools Required

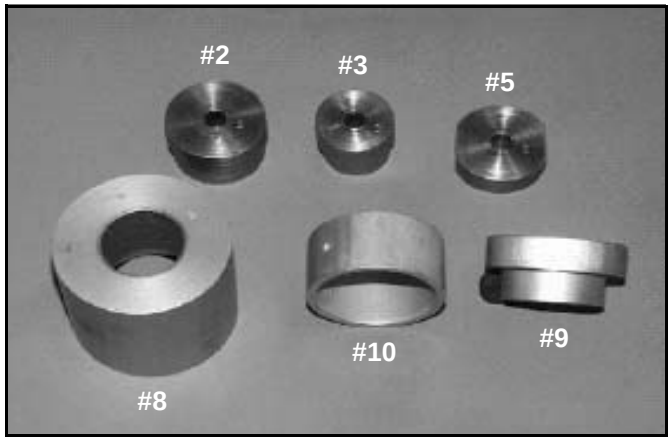
EBS Clutch Bushing Tool Kit - 2201379

Item	Qty.	Part Description	Part #
A, B	1	EBS Puller Tool	5132027
C	1	EBS Puller Nut	5132501
D	1	EBS Main Adapter	5132029
E	1	EBS Bushing Removal Tool	5132028
--	1	Instructions	9915111

Additional Special Tools

Qty.	Part Description	Part #
1	Clutch Bushing Replacement Tool Kit	2871226
1	Piston Pin Puller	2870386

***Clutch Bushing Replacement Tool Kit (PN 2871226)**



Item	Qty.	Part Description	Part #
#2	1	P-90 Drive/Driven Clutch Bushing Install Tool	5020628
#3	1	Drive Clutch Cover Bushing Removal/ Installation Tool (all clutches)	5020629
#5	1	P-90 Driven Clutch Cover Bushing Removal Tool	5020631
#8	1	Main Puller Adapter	5020632
#9	1	Adapter Reducer	5010279
#10	1	Number Two Puller Adapter	5020633

NOTE: Bushings are installed at the factory using Loctite™. In order to remove bushings it will be necessary to apply heat evenly to the area around each bushing. Clean all residual Loctite™ from bushing bore prior to installing new bushing.

⚠ CAUTION

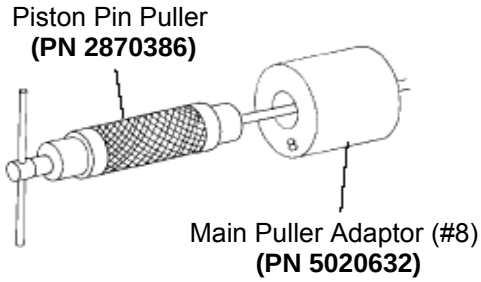
Clutch components will be hot! In order to avoid serious burns, wear insulated gloves during the removal process.

Moveable Sheave - Bushing Removal

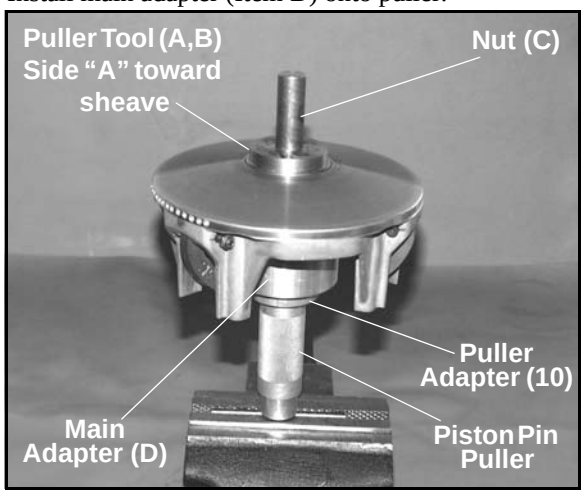
1. Remove clutch as outlined previously in this chapter.
2. Install handle end of the Piston Pin Puller **(PN 2870386)** securely into bench vise and lightly grease puller threads.

Piston Pin Puller (PN 2870386)

3. Remove nut from puller rod and set aside.



4. Install puller adapter (Item 10 from kit **PN 2871226**).
5. Install main adapter (Item D) onto puller.



6. With towers pointing toward the vise, slide sheave onto puller rod.
7. Install removal tool (Item A, B) into center of sheave with "A side" toward sheave.

NOTE: Use Bushing Tool PA-47336.

8. Install nut (C) onto end of puller rod and hand tighten. Turn puller barrel to increase tension on sheave if needed. Using a hand held propane torch, apply heat around outside of bushing until tiny smoke tailings appear.

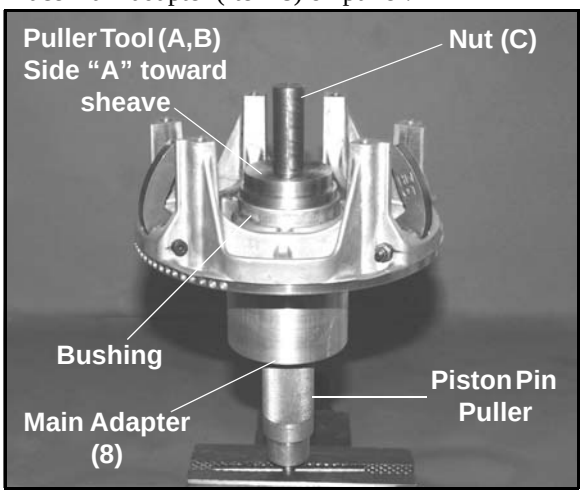
9. Turn sheave counterclockwise on puller rod until it comes free. Lift sheave off puller.

10. Remove nut from puller rod and set aside.

11. Pull bushing removal tool and adapter from puller rod. Remove bushing from tool and discard.

Drive Clutch Bushing Installation

1. Place main adapter (Item 8) on puller.



2. Apply Loctite™ 609 evenly to bushing bore inside moveable sheave.

3. Set bushing in place on sheave.

4. Insert installation puller tool (Item A/B) with "A" side down, into center of bushing.
NOTE: 700 EFI Clutch - Use **Bushing Tool PA-47336**.

5. With towers pointing upward, slide sheave, bushing and tool onto puller rod.

6. Install nut on puller rod and hand tighten. Turn barrel to apply additional tension if needed.

7. Turn sheave counterclockwise, making sure bushing is drawn straight into bore. Continue until bushing is seated.

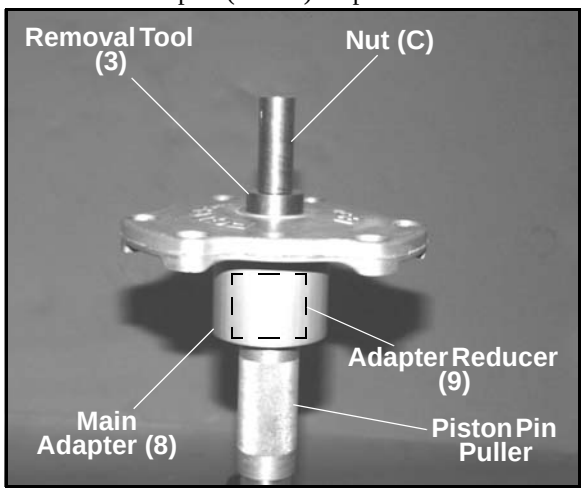
8. Remove nut from puller rod and set aside.

9. Remove sheave from puller.

10. Remove installation tool.

Cover Bushing Removal

1. Install main adapter (Item 8) on puller.



2. Install adapter reducer (Item 9).

3. From outside of clutch cover, insert removal tool (Item 3) into cover bushing.

4. With inside of cover toward vise, slide cover onto puller.

5. Install nut onto puller rod and hand tighten. Turn puller barrel to increase tension as needed.

6. Turn clutch cover counterclockwise on puller rod until bushing is removed and cover comes free.

7. Remove nut from puller rod and set aside.

8. Remove bushing and bushing removal tool from puller. Discard bushing.

Cover Bushing Installation

1. Apply Loctite™ 609 evenly to bushing bore in cover.

2. Working from inside of cover, insert new bushing and bushing installation tool into center of clutch cover.

3. With main adapter on puller, insert cover onto puller rod, placing outside of cover toward vise.

4. Install nut on rod and hand tighten. Turn puller barrel to apply more tension if needed.

5. Turn clutch cover counterclockwise on puller rod until bushing is seated.

6. Remove nut from puller rod. Take installation tool and clutch cover off rod.

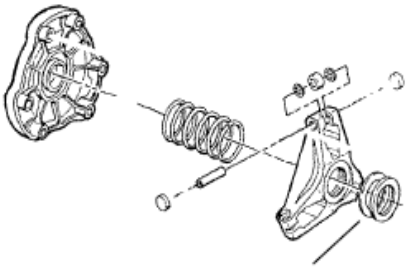
Clutch Assembly

NOTE: It is important that the same number and thickness of washers are reinstalled beneath the spider during assembly. The Teflon bushings are self-lubricating.

> ⚠ CAUTION
>
> **Do not apply oil or grease to the bushings.**

Reassemble the drive clutch in the following sequence. Be sure the "X", or the marks that were made earlier are aligned during each phase of assembly.

1. Install moveable sheave onto fixed sheave.
2. Install spider spacers. Use same quantity and thickness as were removed.



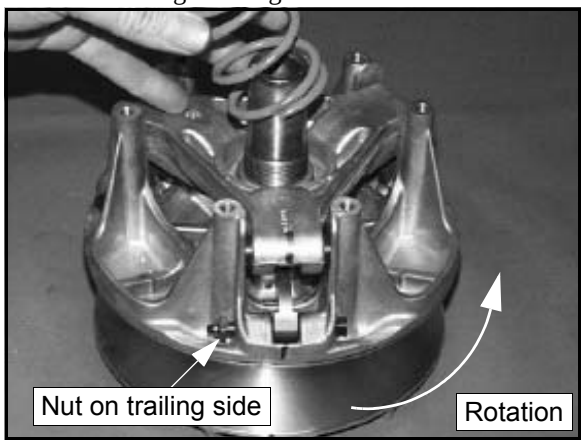
Spacer washers

3. Compress spider buttons for each tower and install spider, making sure that "X", or the marks that were made earlier, on spider aligns with "X", or the marks that were made earlier, in moveable sheave.
4. Torque spider to specification using the holding fixture and spider tool. Torque with smooth motion to avoid damage to the stationary sheave.

> = T
>
> Spider Torque:
> **200 ft. lbs. (271 Nm)**

> ⚠ CAUTION
>
> Be sure the spider spacer washers are fully seated in the recessed area in the spider. Any misalignment will alter clutch balance. Inverting the clutch while initially tightening the spider will help position the washers.

5. Install shift weights using new lock nuts on the bolts.

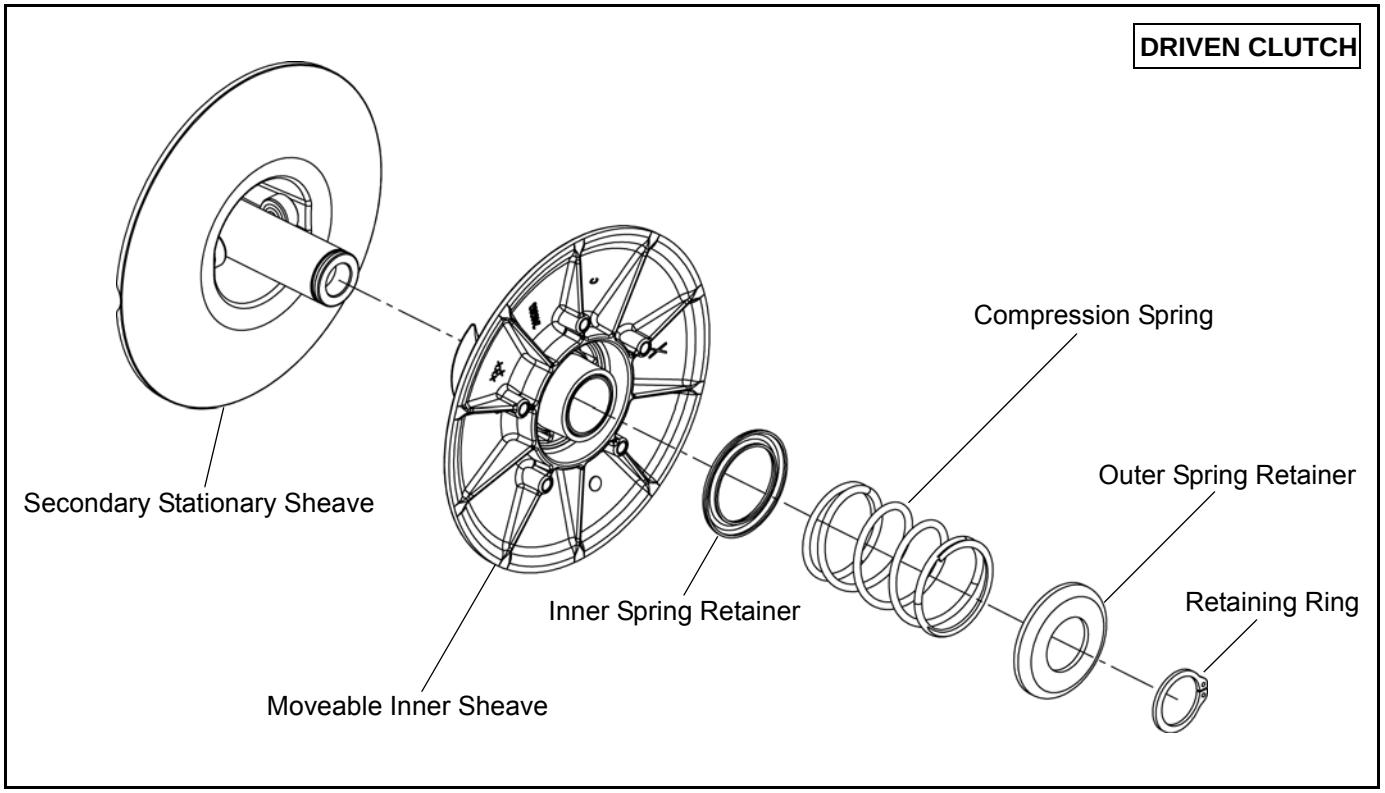


6. Reinstall clutch spring.
7. Reinstall cover, aligning "X" mark with other marks.
8. Torque cover bolts evenly to specification.

> = T
>
> Cover Screw Torque:
> **90 in. lbs. (10.4 Nm)**

DRIVEN CLUTCH SERVICE

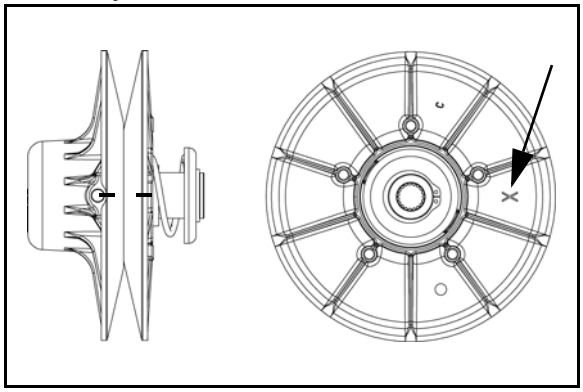
Exploded View



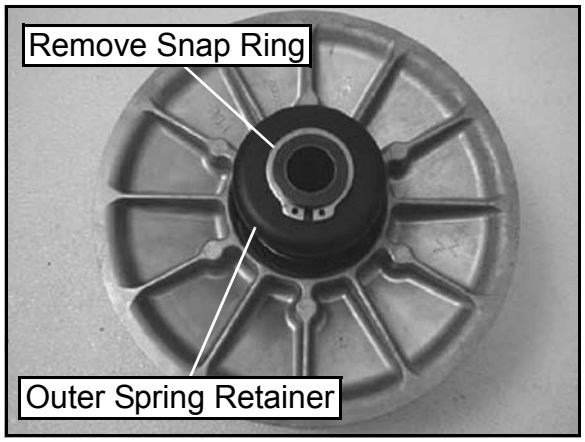
Clutch Disassembly / Inspection

> **⚠ CAUTION**
>
> Wear eye protection when removing snap ring to prevent serious personal injury.
> Use caution when removing, the snap ring pressure is loaded by the compression spring.

1. Remove driven clutch from the transmission input shaft.
2. Mark the position of the clutch sheaves before disassembly or use the X's on the sheaves for reference. This aids in reassembly and maintains clutch balance after reassembly.

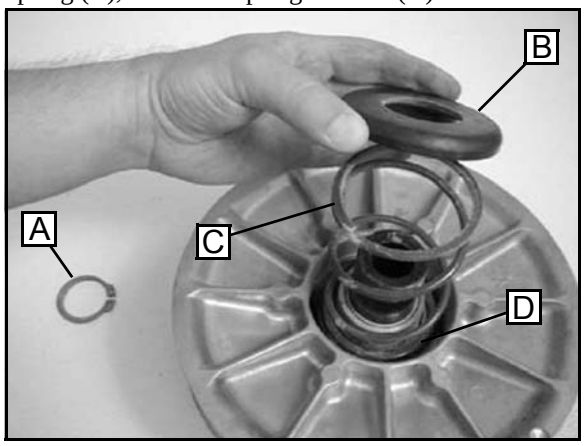


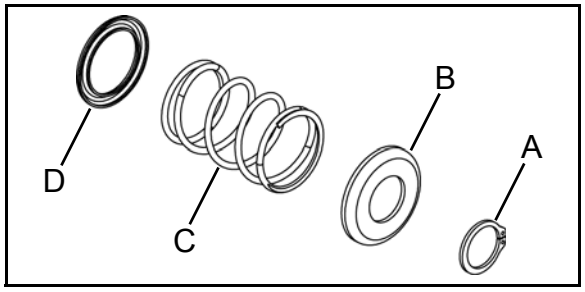
3. Place the clutch into the Clutch Compression Tool **PN 8700220**. Using Compression Extensions **PN PS-45909**, apply and hold downward pressure on the outer spring retainer. Carefully remove the snap ring. Remember the outer spring retainer contains strong spring pressure.



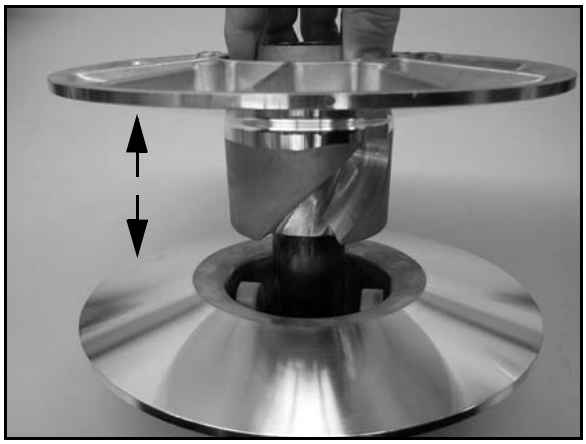
NOTE: Spring is compression only and has no torsional wind.

4. With the snap ring (A) removed and spring pressure relieved, remove the outer spring retainer (B), compression spring (C), and inner spring retainer (D).

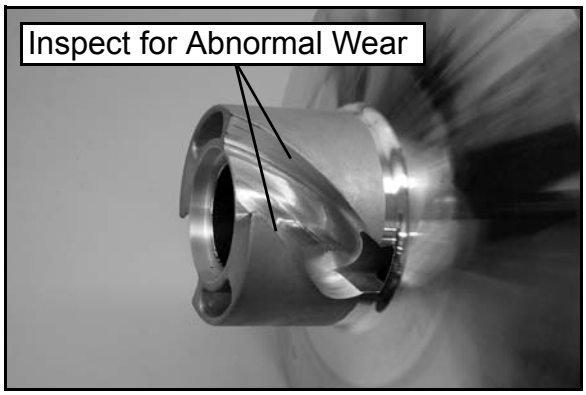




5. Separate the two clutch sheaves.

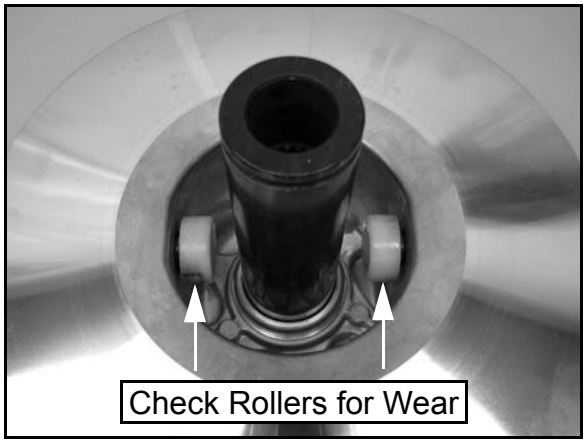


6. Inspect the helix on the moveable sheave.

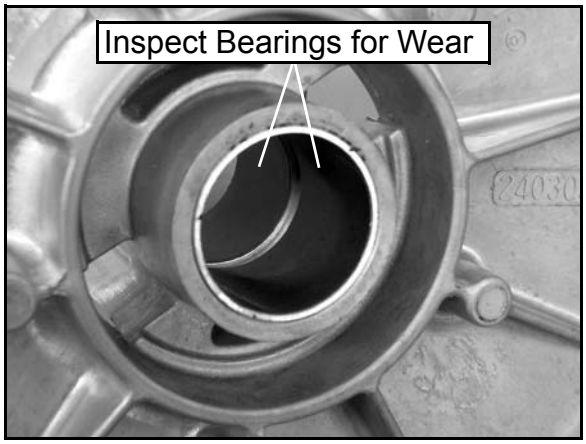


7. Remove the inner spring retainer from the inner sheave. Inspect for wear and replace as needed.

8. Check the rollers in the stationary sheave for wear. If rollers are worn, a new driven clutch assembly may be needed.



9. Inspect the bearings inside the moveable sheave.



Moveable Sheave Bearing Inspection: Replace the bearing if more brass than Teflon™ is visible on the bearing.

10. Inspect the Teflon™ coating on the moveable sheave bearings.

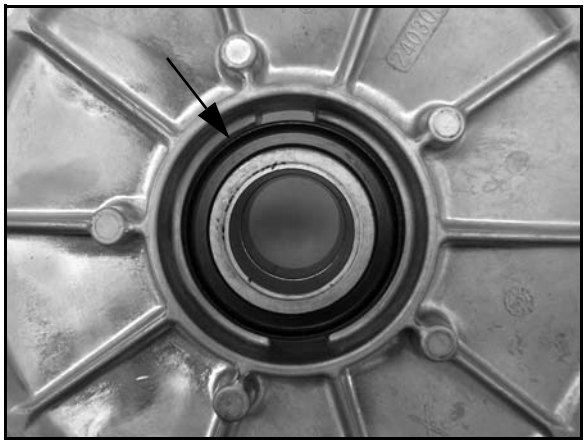
11. Inspect driven clutch sheave faces for wear or damage.

12. Clean and inspect splines on helix and transmission input shaft.

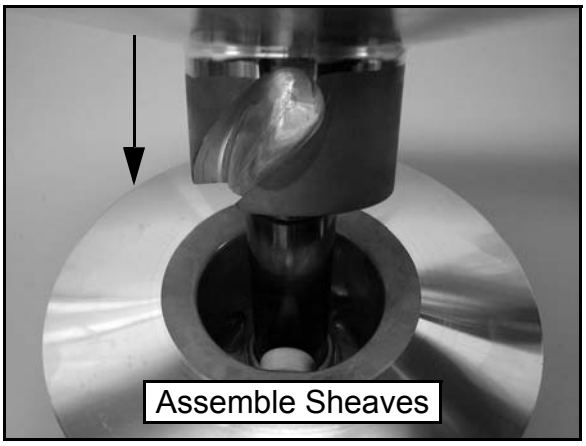
13. Lube splines with a light film of grease. **Do not lubricate the bearings!**

Clutch Assembly

1. Install the inner spring retainer if removed. **Do not apply oil or grease to the bearings.**



2. Align the "X" marks on each of the sheaves during reassembly.

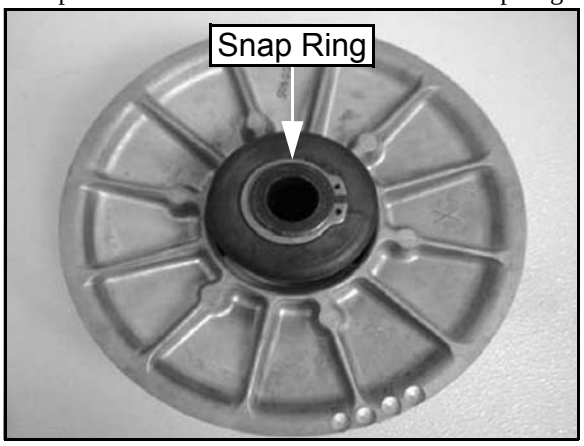


3. Install spring into inner retainer.

4. Install outer retainer on top of spring.

5. Place the clutch into Clutch Compression Tool **PN 8700220**. Using Compression Extensions **PN PS-45909**, apply and hold downward pressure on the outer spring retainer. Carefully install the snap ring.

6. Compress the outer retainer and install the snap ring.



TROUBLESHOOTING

Situation	Probable Cause	Remedy
Engine RPM below specified operating range, although engine is properly tuned.	-Wrong or broken drive clutch spring.	-Replace with recommended spring.
	-Drive clutch shift weight too heavy.	-Install correct shift weight kit to match engine application.
	-Driven clutch spring broken or installed in wrong helix location.	-Replace spring; refer to proper installation location.
Erratic engine operating RPM during acceleration or load variations.	-Drive clutch binding.	A. Disassemble drive clutch; inspect shift weights for wear and free operation. B. Clean and polish stationary shaft hub; reassemble clutch without spring to determine problem area.
	-Belt worn unevenly - thin / burnt spots.	Replace belt.
	-Driven clutch malfunction.	A. Replace ramp buttons. B. Inspect movable sheave for excessive bushing clearance.
	-Sheave face grooved.	-Replace the clutch.
Engine RPM above specified operating range.	-Incorrect drive clutch spring (too high spring rate).	-Install correct recommended spring.
	-Drive clutch shift weights incorrect for application (too light).	-Install correct recommended shift weights.
	-Drive clutch binding.	-Disassemble and clean clutch, inspecting shift weights and rollers. Reassemble without the spring and move sheaves through entire range to further determine probable cause.
	-Driven clutch binding.	-Disassemble, clean, and inspect driven clutch, noting worn sheave bushing and ramp buttons and helix spring location.
	-Converter sheaves greasy; belt slipage.	-Clean sheaves with denatured alcohol or brake cleaner, install new belt.
Harsh drive clutch engagement.	-Drive belt worn too narrow.	-Replace belt.
	-Excessive belt / sheave clearance with new belt.	-Perform belt / sheave clearance adjustment with shim washers beneath spider.
Drive belt turns over	-Wrong belt for application.	-Replace with correct belt.
	-Clutch alignment out of spec.	-Adjust clutch alignment.
	-Engine mount broken or loose.	-Inspect / adjust or replace.
Belt burnt, thin spots	-Abuse (continued throttle application when vehicle is stationary, excess load)	-Caution operator to operate machine within guidelines.
	-Dragging brake	-Vehicle operated with park brake on. Inspect brake system.
	-Slow, easy clutch engagement	-Fast, effective use of throttle for efficient engagement.

Troubleshooting, Continued.....

Situation	Probable Cause	Remedy
PVT cover overheating (melting)	-Plugged air intake or outlet. -Belt slippage due to water, oil, grease, etc., rubbing on cover. -Clutches or weight being applied to cover while in operation. -High vs. low range.	-Clear obstruction -Inspect system. Clean , repair or replace as necessary. Seal PVT system ducts. -Remove weight. Inform operator. -Instruct operator on guidelines for operation in proper driving range for different terrain as outlined in Owner's Safety and Maintenance Manual.
Water ingestion	-Cover seals or ducts leaking -Operator error	-Find leak and repair as necessary. -Instruct operator on guidelines for operation in wet terrain as outlined in Owner's Safety and Maintenance Manual.
Belt slippage	-Belt worn out -Water ingestion -Belt contaminated with oil or grease	-Replace belt. -Inspect and seal PVT system. -Inspect and clean.
PVT noise	-Belt worn or separated, thin spots, loose belt -Broken or worn clutch components, cover hitting clutches	-Replace belt. -Inspect and repair as necessary.
Engagement erratic or stabby	-Thin spots on belt, worn belt -Drive clutch bushings stick	-Replace belt. Refer to belt burnt troubleshooting and instruct operator. -Inspect and repair clutches.

CHAPTER 7
FINAL DRIVE

SPECIAL TOOLS 7.3
TORQUE SPECIFICATIONS. 7.3
WHEEL, HUB, AND SPINDLE TORQUE TABLE. 7.3
FRONT HUB 7.3
HUB REMOVAL / INSPECTION. 7.3
HUBSTRUT BEARING REPLACEMENT 7.4
HUB INSTALLATION 7.5
FRONT HUB EXPLODED VIEW 7.6
FRONT DRIVE SHAFT 7.7
REMOVAL 7.7
DRIVE SHAFT / CV JOINT HANDLING TIPS 7.8
OUTER CV JOINT / BOOT REPLACEMENT. 7.8
INNER PLUNGING JOINT / BOOT REPLACEMENT 7.10
EXPLODED VIEW 7.11
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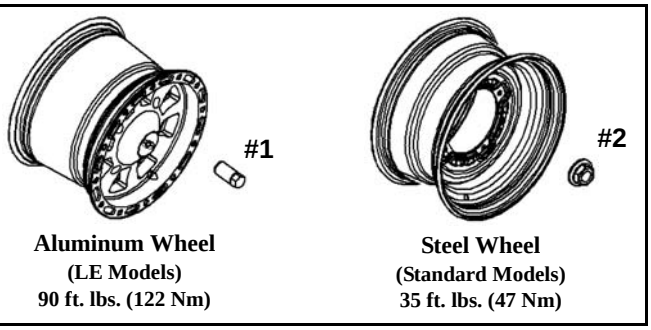
SPECIAL TOOLS

PART NUMBER	TOOL DESCRIPTION
2872608	Roller Pin Removal Tool
8700226	CV Boot Clamp Pliers
PU-48951	Axle Boot Clamp Tool

TORQUE SPECIFICATIONS

Wheel, Hub, and Spindle Torque Table

ITEM	NUT TYPE	SPECIFICATION
Aluminum Wheels (Cast)	Lug Nut (1)	90 ft. lbs. (122 Nm)
Steel Wheels (Black / Camo)	Flange Nut (2)	35 ft. lbs. (47 Nm)
Front Spindle Nut	-	70 ft. lbs. (95 Nm)
Rear & Middle Hub Retaining Nut	-	110 ft. lbs. (150 Nm)



Aluminum Wheel
(LE Models)
90 ft. lbs. (122 Nm)

Steel Wheel
(Standard Models)
35 ft. lbs. (47 Nm)

FRONT HUB

Hub Removal / Inspection

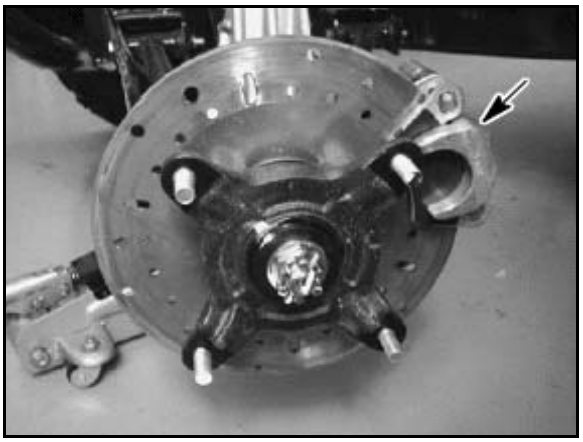
1. Elevate front end and safely support machine under footrest / frame area.

> **⚠ CAUTION**
>
> Serious injury may result if machine tips or falls. Be sure machine is secure before beginning this service procedure. Wear eye protection when removing bearings and seals.

2. Check bearings for side play by grasping the tire / wheel firmly and checking for movement. Grasp the top and bottom of the tire. The tire should rotate smoothly without binding or rough spots.

3. Remove wheel nuts, washers, and wheel.

4. Remove the two brake caliper attaching bolts.
CAUTION: Do not hang the caliper by the brake line. Use wire to hang the caliper to prevent possible damage to the brake line.



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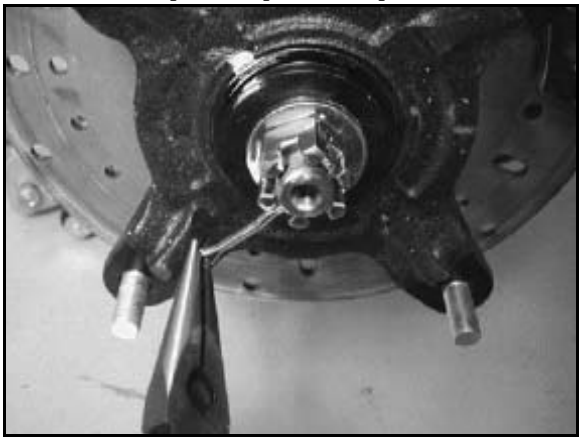
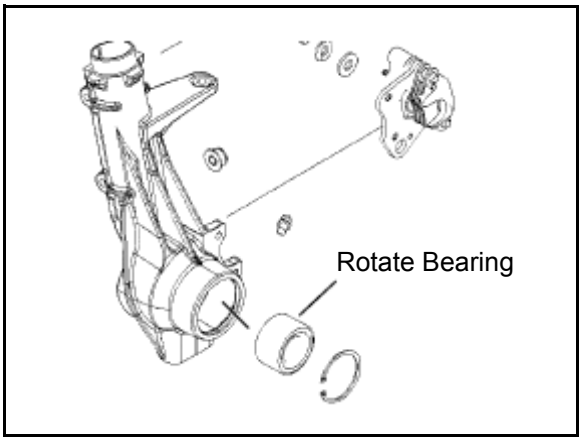
5. Remove hub cap, cotter pin, front spindle nut, and washer.



6. Rotate each bearing by hand and check for smooth rotation. Visually inspect bearing for moisture, dirt, or corrosion. Replace bearing if moisture, dirt, corrosion, or roughness is evident.



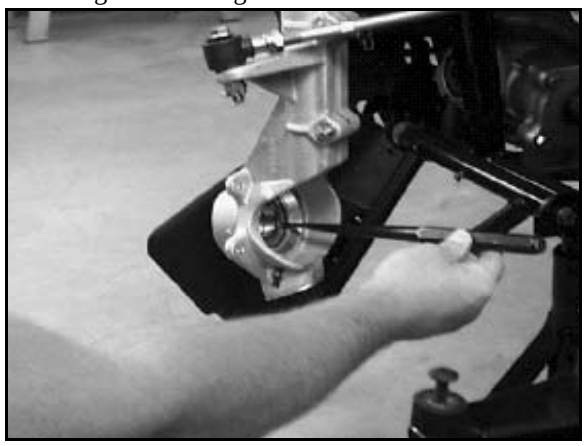
Hubstrut Bearing Replacement

Bearing Removal

1. Remove outer snap ring.

2. From the back side, tap on the outer bearing race with a drift punch in the reliefs as shown in Step 3.

3. Drive bearing out evenly by tapping on outer race only. Once bearing is at bottom of casting, support casting on outer edges so bearing can be removed.

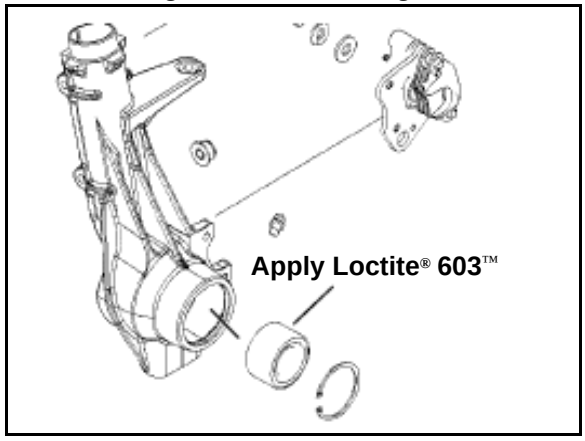


NOTE: Due to extremely close tolerances and minimal wear, the bearings must be inspected visually, and by feel. While rotating bearings by hand, inspect for rough spots, discoloration, or corrosion. The bearings should turn smoothly and quietly, with no detectable up and down movement and minimal movement sideways between inner and outer race.

4. Inspect bearing hubstrut housing for scratches, wear or damage. Replace hubstrut housing if damaged.

Bearing Installation

5. Thoroughly clean the hubstrut housing and the outer race on the new bearing. Be sure that all oil residue has been removed from each surface.
6. Apply **Loctite® 603™** retaining compound to the outer circumference of the new bearing race and carefully install the new bearing into the strut housing.

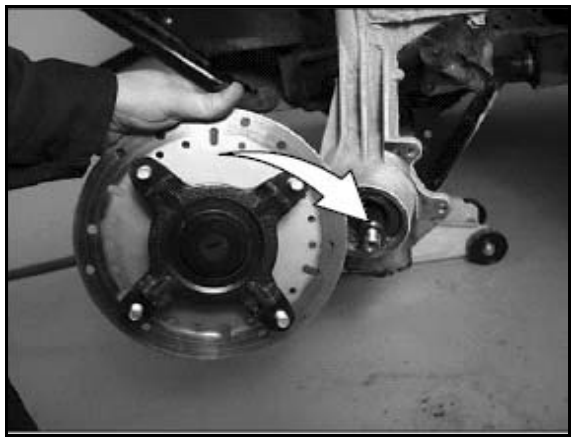


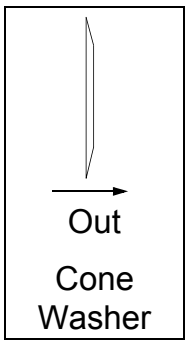
NOTE: Use care to not allow any of the Loctite® compound to get in the bearing.

7. Wipe the housing clean of any excess compound and install the retaining ring.

Hub Installation

1. Inspect the hubstrut bearing surface for wear or damage.
2. Apply grease to drive axle spindle.
3. Install spindle through the backside of the hubstrut. Install the hub onto the spindle.
4. Apply grease to washer and install with domed side out.



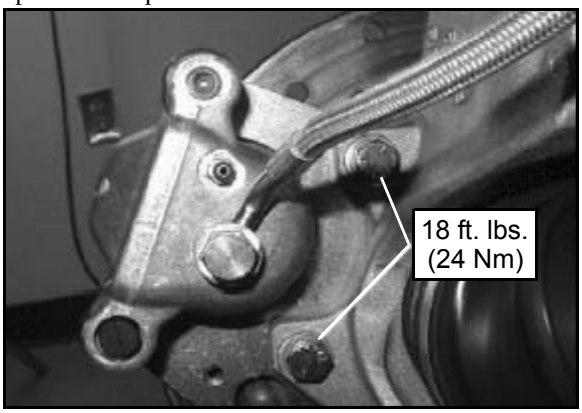


5. Install spindle nut and tighten to specification.

Spindle Nut Torque:

70 ft. lbs. (95 Nm)

6. Install a new cotter pin. Tighten nut slightly if necessary to align cotter pin holes.
7. Rotate wheel and check for smooth operation. Bend both ends of cotter pin around end of spindle in different directions.
8. Install hub cap.
9. Rotate hub. It should rotate smoothly without binding or rough spots or side play.
10. Install brake caliper using new bolts. Tighten bolts to specified torque.

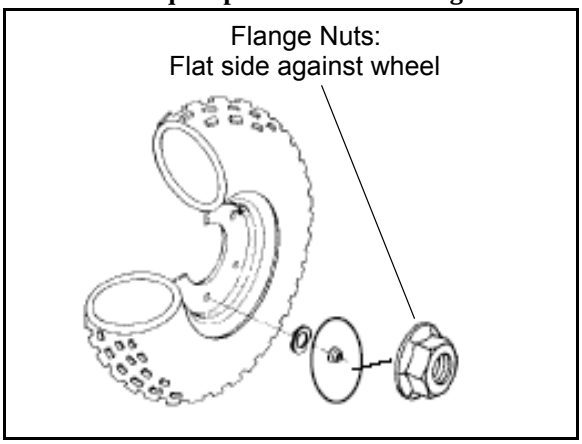


Brake Caliper Bolt Torque
18 ft. lbs. (24 Nm)

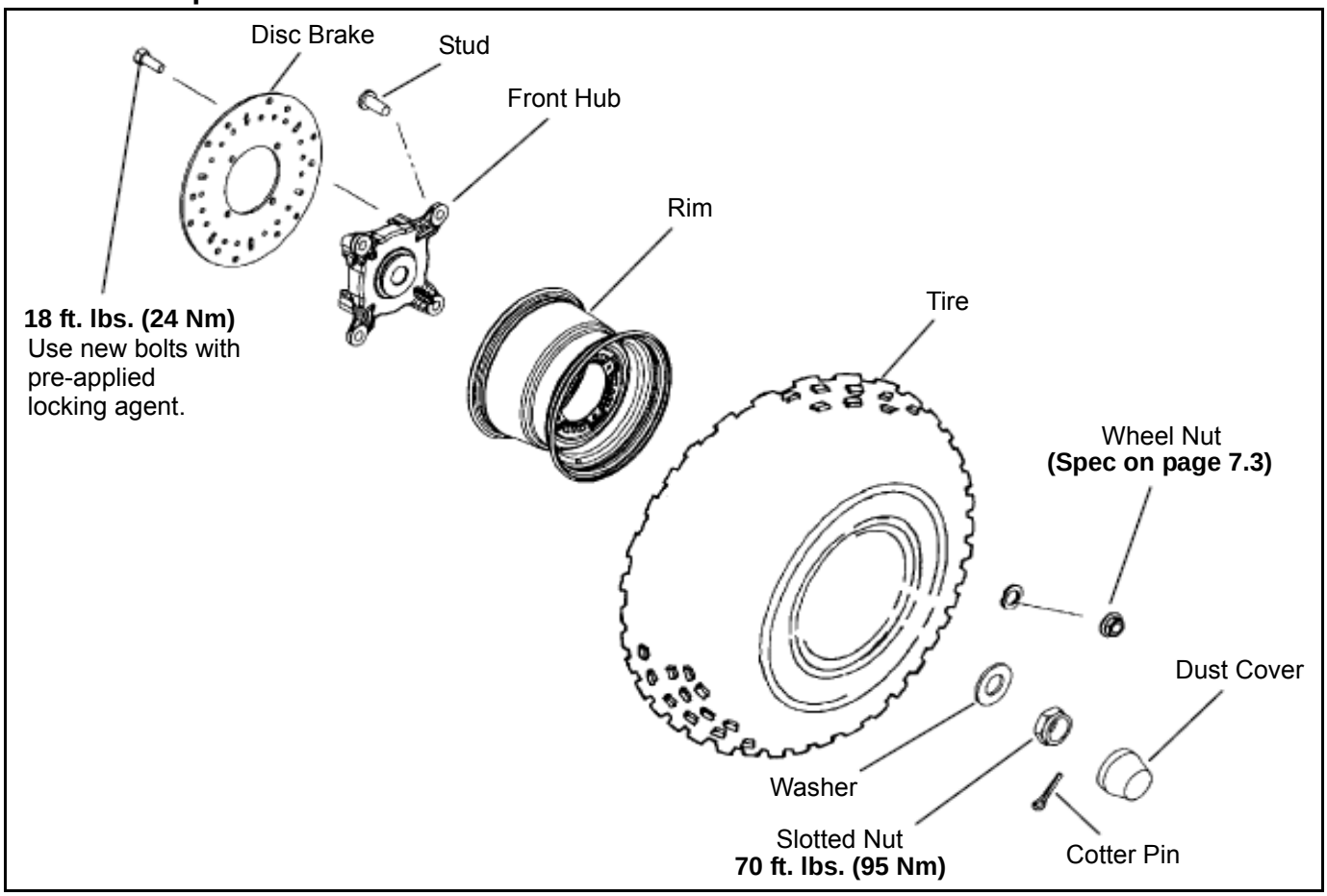
⚠ CAUTION

New bolts have a pre-applied locking agent which is destroyed upon removal. Always use new brake caliper mounting bolts upon assembly.

11. Install wheel, washers, wheel nuts, and tighten evenly in a cross pattern to specified torque.
Refer to "Torque Specifications" on Page 7.3



Front Hub Exploded View



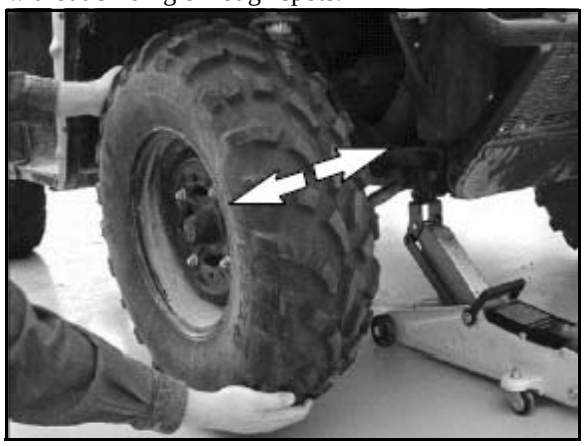
FRONT DRIVE SHAFT

Removal

1. Elevate front of vehicle and safely support machine under the frame area.

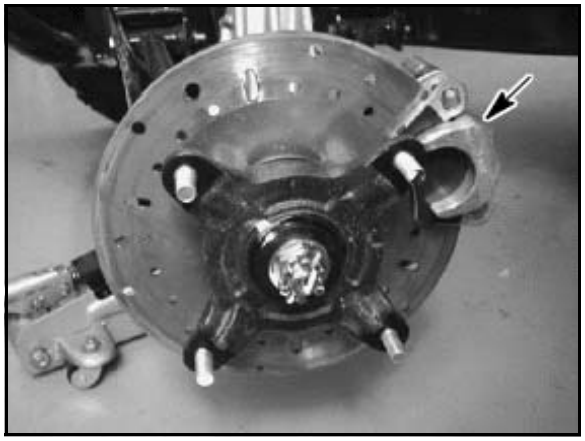
> **⚠ CAUTION**
>
> Serious injury may result if machine tips or falls. Be sure machine is secure before beginning this service procedure. Wear eye protection when removing bearings and seals.

2. Check bearings for side play by grasping tire / wheel firmly and checking for movement. It should rotate smoothly without binding or rough spots.



3. Remove the (4) wheel nuts and remove the front wheel.

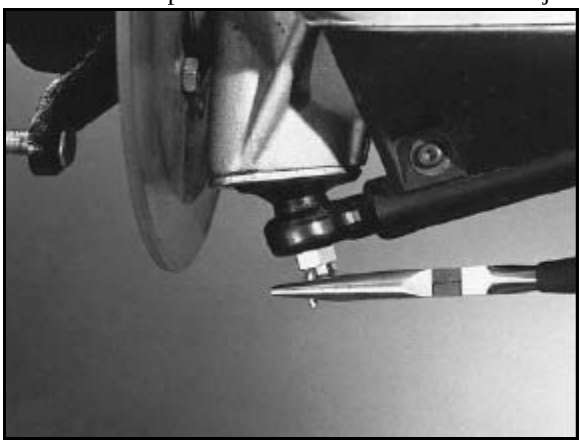
4. Remove the two brake caliper mounting bolts.
CAUTION: Do not hang the caliper by the brake line. Use wire to hang the caliper to prevent possible damage to the brake line.



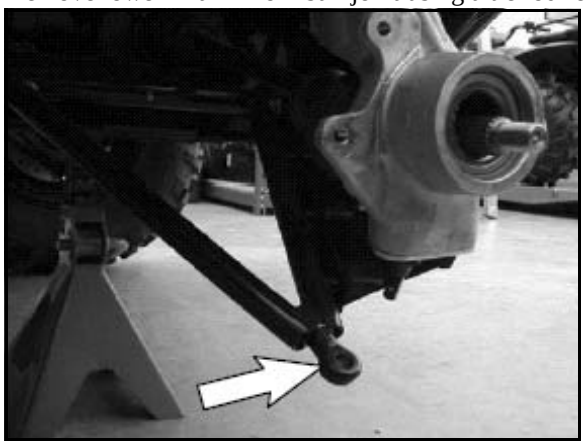
5. Remove and discard the cotter pin, then remove the front hub castle nut.

6. Remove the front wheel hub.

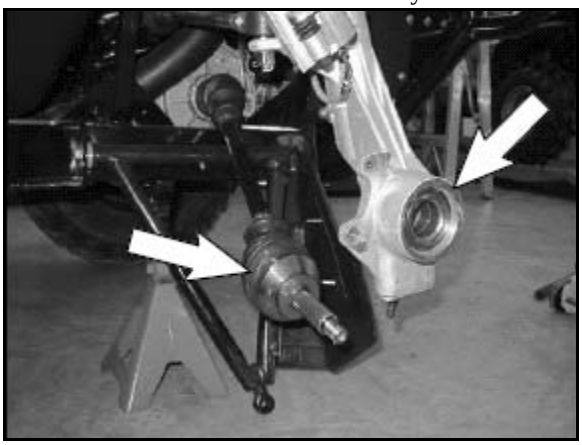
7. Remove cotter pin and castle nut from A-arm ball joint.



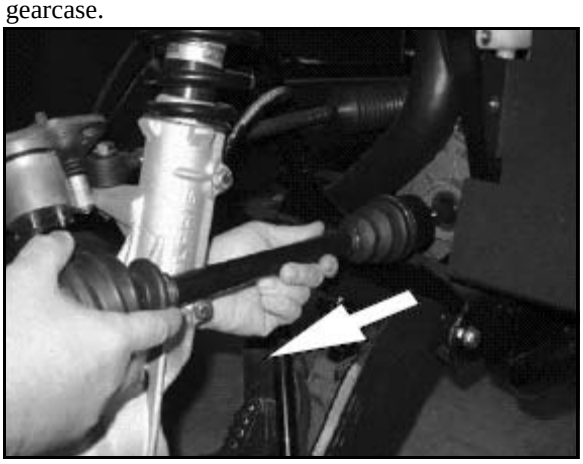
8. Remove lower A-arm from ball joint using a tie rod fork.



9. Pull strut assembly out while pivoting front drive shaft downward until it clears strut assembly.



10. With short sharp jerks, remove drive shaft from front gearcase.



Drive Shaft / CV Joint Handling Tips

Care should be exercised during drive shaft removal or when servicing CV joints. Drive shaft components are precision parts.

Cleanliness and following these instructions is very important to ensure proper shaft function and a normal service life.

- The complete drive shaft and joint should be handled by getting hold of the interconnecting shaft to avoid disassembly or potential damage to the drive shaft joints.
- Over-angling of joints beyond their capacity could result in boot or joint damage.
- Make sure surface-ground areas and splines of shaft are protected during handling to avoid damage.
- Do not allow boots to come into contact with sharp edges or hot engine and exhaust components.
- The drive shaft is not to be used as a lever arm to position other suspension components.
- Never use a hammer or sharp tools to remove or to install boot clamps.
- Be sure joints are thoroughly clean and that the proper amount and type of grease is used to refill when joint boots are replaced and when joints are cleaned. Refer to text for grease capacity of CV joints and CV joint boots.

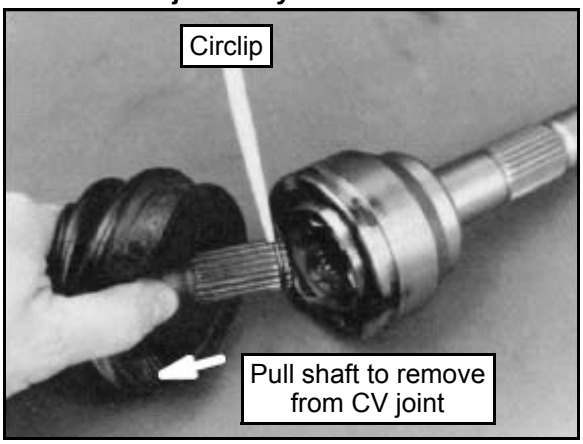
Outer CV Joint / Boot Replacement

1. Remove the front drive shaft from the vehicle (see "FRONT DRIVE SHAFT - Removal").
2. Remove and discard the boot clamps.

CV Boot Clamp Pliers
Earless Type: 8700226

3. Remove the large end of the boot from the CV joint and slide the boot back.
4. Use a soft-faced hammer or brass drift to separate the CV joint from the drive shaft.

NOTE: If using a brass drift, be sure to tap on the inner race of the joint only.



5. Make sure the circlip remains on the shaft and not left in the joint. Discard the circlip.
6. Remove the boot from the drive shaft.

⚠ CAUTION

Complete disassembly of the CV joint is NOT recommended. The internal components are a precision fit and develop their own characteristic wear patterns. Intermixing the internal components could result in looseness, binding, and/or premature failure of the joint.

IMPORTANT: If the grease in the joint is obviously contaminated with water and/or dirt, the joint should be replaced.

7. Thoroughly clean the joint with an appropriate solvent and dry the joint to prevent any residual solvent from being left in the joint upon reassembly.

8. Visually inspect the joint by tilting the inner race to one side to expose each ball. Severe pitting, galling, play between the ball and its cage window, any cracking or damage to the cage, pitting or galling or chips in raceways call for joint replacement.

NOTE: Shiny areas in ball tracks and on the cage spheres are normal. Do not replace CV joints because parts have polished surfaces. Replace CV joint only if components are cracked, broken, worn or otherwise unserviceable.

9. Clean the splines on the end of the shaft and apply a light coat of grease prior to reassembly.

10. Slide the small boot clamp and boot (small end first) onto the drive shaft and position the boot in it's groove machined in the shaft.

11. Install a NEW circlip on the end of the shaft.

12. Grease the joint with the special CV joint grease provided in the boot replacement kit. Fill the cavity behind the balls and the splined hole in the joint's inner race. Pack the ball tracks and outer face flush with grease. Place any remaining grease into the boot.

⚠ CAUTION

The grease provided in the replacement kit is specially formulated for wear resistance and durability. DO NOT use substitutes or mix with other lubricants.

NOTE: The amount of grease that's provided is pre-measured, so use all the grease.

Boot Replacement Grease Requirement:

Grease Only Service Kits
PN 1350059 - 20g
PN 1350046 - 30g
PN 1350047 - 50g

Outer CV Joint Capacity: 150g

13. Slide the joint onto the drive shaft splines and align the circlip with the lead-in chamfer on the inner race of the joint.

14. Use a soft-faced hammer to tap the joint onto the drive shaft until it locks into place.

15. Pull on the joint to make sure it is securely locked into place.

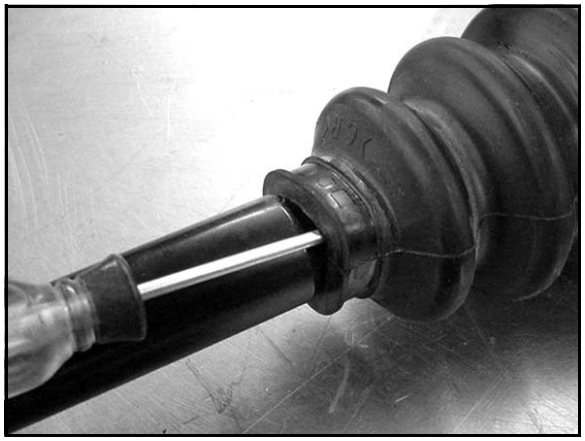
16. Remove excess grease from the CV joint's external surfaces and place the excess grease in the boot.

17. Pull the boot over the joint and position the boot lips into the grooves on the joint housing and shaft. Make sure the boot is not dimpled or collapsed.

18. Install and secure the CV boot with the large clamp using the "earless" clamp pliers.

CV Boot Clamp Pliers
Earless Type: 8700226

19. While pulling out on the CV shaft, fully extend the CV joint and slide a straight O-ring pick or a small slotted screw driver between the small end of the boot and the shaft. This will allow the air pressure to equalize in the CV boot in the position that the joint will spend most of its life. Before you remove your instrument, be sure the small end of the boot is in its correct location on the shaft.



20. Install and secure the small clamp on the boot using the "earless" clamp pliers.

CV Boot Clamp Pliers
Earless Type: 8700226

Inner Plunging Joint / Boot Replacement

1. Remove the front drive shaft from the vehicle (see "FRONT DRIVE SHAFT - Removal").

2. Remove and discard the boot clamps.

CV Boot Clamp Pliers
Earless Type: 8700226

3. Remove the large end of the boot from the plunging joint and slide the boot back.

4. Use a soft-faced hammer or brass drift to separate the plunging joint from the drive shaft.

NOTE: If using a brass drift, be sure to tap on the inner race of the joint only.

5. Make sure the circlip remains on the shaft and not left in the joint. Discard the circlip.

6. Remove the boot from the drive shaft.

⚠ CAUTION

Complete disassembly of the plunging joint is NOT recommended. The internal components are a precision fit and develop their own characteristic wear patterns. Intermixing the internal components could result in looseness, binding, and/or premature failure of the joint.

IMPORTANT: If the grease in the joint is obviously contaminated with water and/or dirt, the joint should be replaced.

7. Thoroughly clean the joint with an appropriate solvent and dry the joint to prevent any residual solvent from being left in the joint upon reassembly.

8. Visually inspect the joint by tilting the inner race to one side to expose each ball. Severe pitting, galling, play between the ball and its cage window, any cracking or damage to the cage, pitting or galling or chips in raceways call for joint replacement.

9. Clean the splines on the end of the shaft and apply a light coat of grease prior to reassembly.

10. Slide the small boot clamp and boot (small end first) onto the drive shaft and position the boot in it's groove machined in the shaft.

11. Install a NEW circlip on the end of the shaft.

12. Grease the joint with the special CV joint grease provided in the boot replacement kit. Fill the cavity behind the balls and the splined hole in the joint's inner race. Pack the ball tracks and outer face flush with grease. Place any remaining grease into the boot.

⚠ CAUTION

The grease provided in the replacement kit is specially formulated for wear resistance and durability. DO NOT use substitutes or mix with other lubricants.

NOTE: The amount of grease that's provided is pre-measured, so use all the grease.

Boot Replacement Grease Requirement:

Grease Only Service Kits
PN 1350059 - 20g
PN 1350046 - 30g
PN 1350047 - 50g

Inner Plunging Joint Capacity: 150g

13. Fully compress the joint and push the drive shaft firmly into the inner race.

14. Align the circlip with the lead-in chamfer.

15. Use a soft-faced hammer to tap the joint onto the drive shaft until it locks into place.

16. Pull on the joint to make sure it is securely locked into place.

17. Remove excess grease from the plunging joint's external surfaces and place the excess grease in the boot.

18. Pull the boot over the joint and position the boot lips into the grooves on the joint housing and shaft. Make sure the boot is not dimpled or collapsed.

19. Install and secure the small clamp on the boot using the "earless" clamp pliers.

CV Boot Clamp Pliers
Earless Type: 8700226

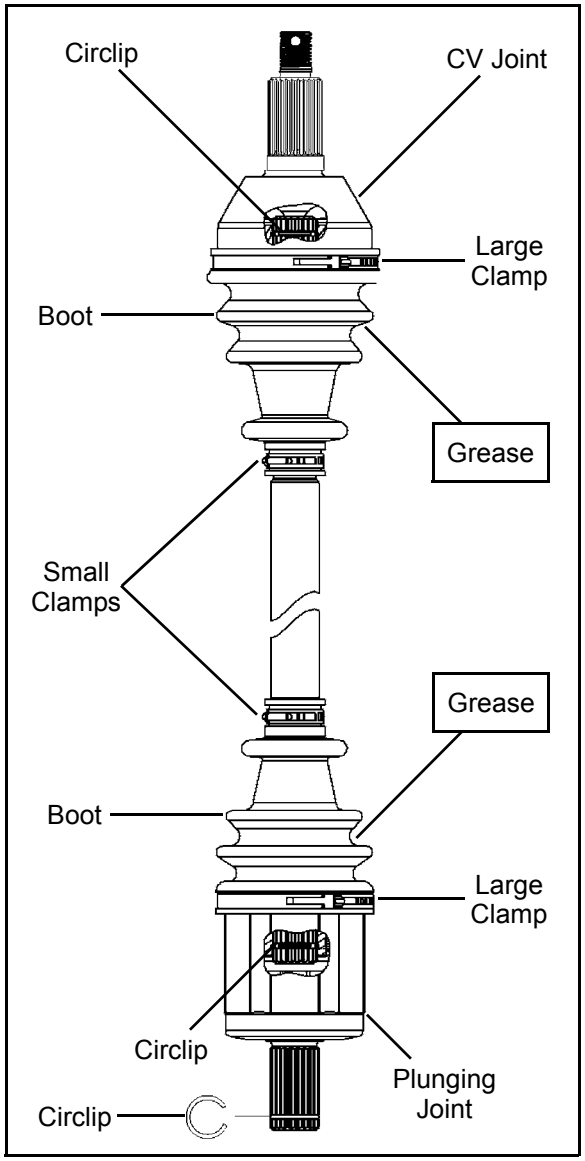
20. Pull out on the drive shaft to center the joint in the housing. Slide a straight O-ring pick or a small slotted screw driver between the large end of the boot and the joint housing and lift up to equalize the air pressure in the boot.

21. Position the boot lip in its groove. Install and secure the boot with the large clamp using the "earless" clamp pliers.

CV Boot Clamp Pliers
Earless Type: 8700226

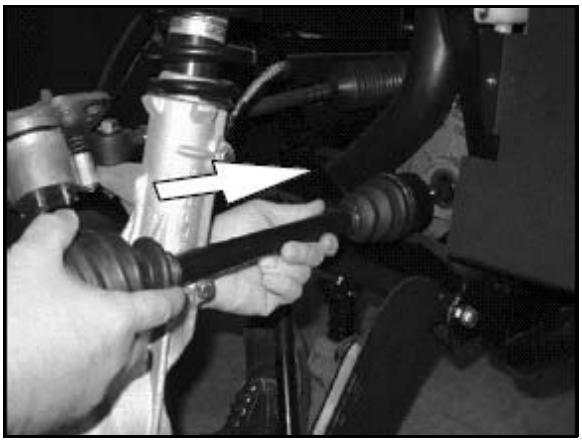
Exploded View

NOTE: Refer the "Electronic Parts Catalog" for required parts to service the drive shaft. Some drive shafts have "Boot Replacement Kits" that include a new boot, clamps, and the required amount of grease.



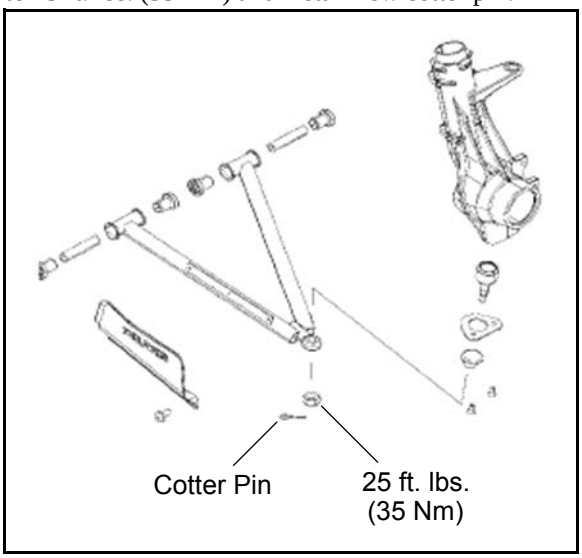
Installation

1. Install new spring ring on drive shaft. Apply an anti-seize compound to splines. Align splines of drive shaft with front gearcase and install by lightly tapping on drive shaft with rubber faced hammer.



2. Install drive shaft in strut.

3. Install the lower A-arm onto the lower ball joint, torque nut to 25 ft. lbs. (35 Nm) and install new cotter pin.



4. Install hub and tighten spindle nut to 70 ft. lbs. (95 Nm).

Front Spindle Nut Torque

70 ft. lbs. (95 Nm)

FRONT PROPSHAFT

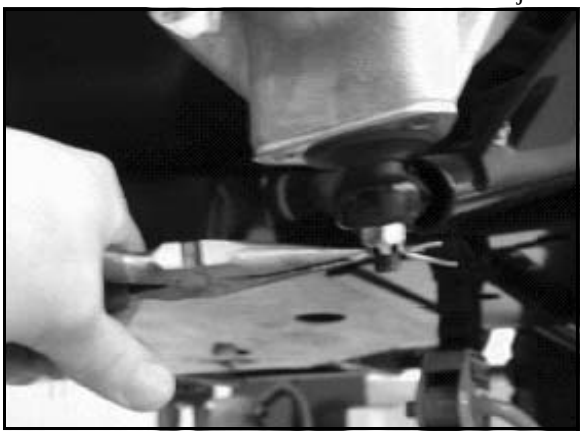
6x6 Removal

1. Elevate and safely support vehicle under the frame. The use of a vehicle hoist is recommended for this procedure.

> **⚠ CAUTION**
>
> Serious injury may result if machine tips or falls. Be sure machine is secure before beginning this service procedure. Wear eye protection when removing bearings and seals.

NOTE: To ease roll pin removal, access the roll pin through the skid plate hole. Proceed to step 4 if you are able to access the roll pin through the skid plate.

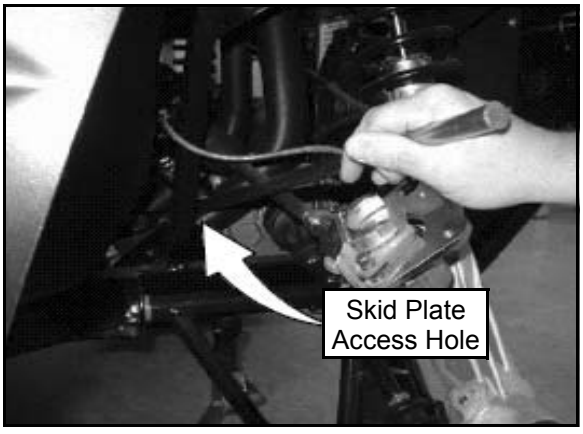
2. Remove wheel nuts and wheel.
3. Remove cotter pin and nut from the lower A-arm ball joint and then remove the lower A-arm from the ball joint.



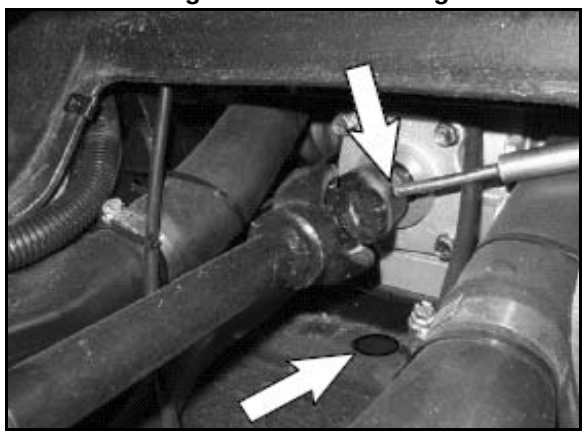
4. Use the Roll Pin Removal Tool (PN 2872608), to drive out the roll pin from prop shaft.

Roll Pin Removal Tool (PN 2872608)

5. Slide prop shaft back and away from front gearcase, then pull the shaft sharply forward to remove it from the transmission shaft.



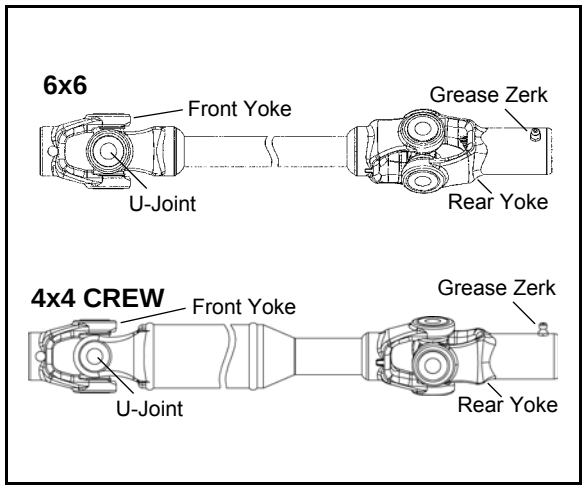
NOTE: Remove the drive shaft floor cover to help align the roll pin removal tool. The drive shaft can be removed through the floor covering.



4x4 CREW Removal

1. Follow steps 1-5 of the "6x6 Removal" procedure.
2. Remove the additional drive shaft floor cover located in the rear passenger floor area.
3. Remove both seats and the storage box from under the front seat.
4. Remove the RH rear fender and the heat shield mounted on the exhaust header pipe to allow enough clearance to remove the propshaft.
5. Remove the propshaft out the rear RH side of the vehicle.

Front Propshaft Components

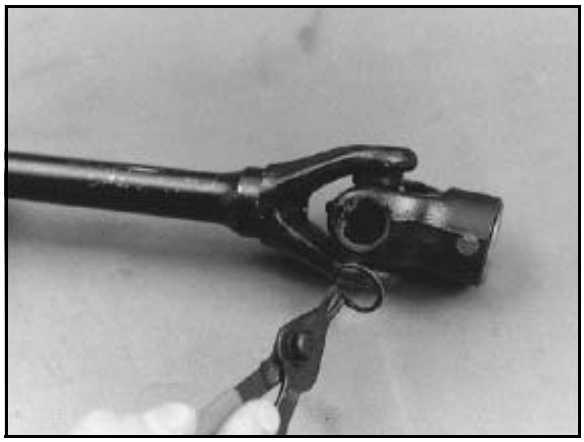


PROPSHAFT U-JOINT SERVICE

Disassembly

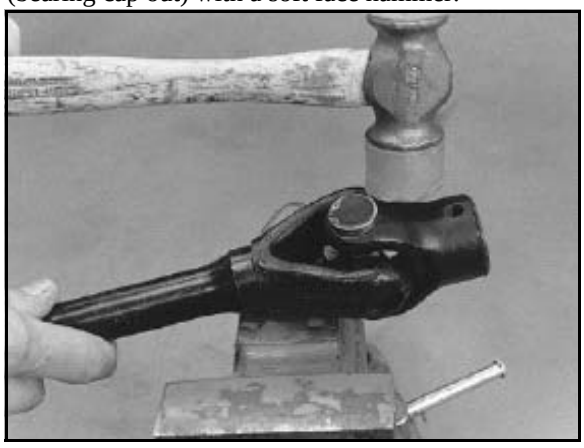
1. Remove internal or external snap ring from all bearing caps.

> ⚠ CAUTION
>
> Always wear eye protection.



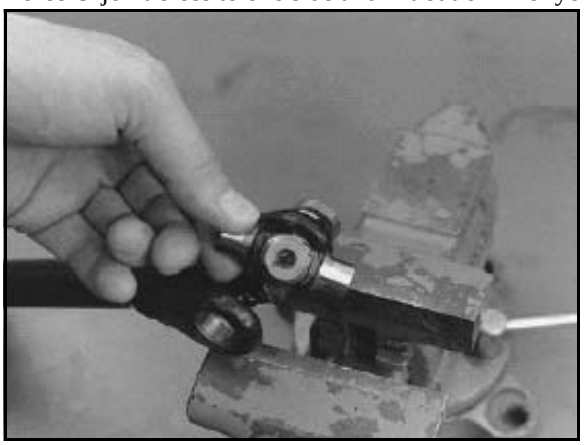
NOTE: If yoke or bearing is removed, cross bearing must be replaced. Note orientation of grease fitting and mark inner and outer yoke for correct re-positioning during installation.

2. Support inner yoke as shown and drive outer yoke down (bearing cap out) with a soft face hammer.



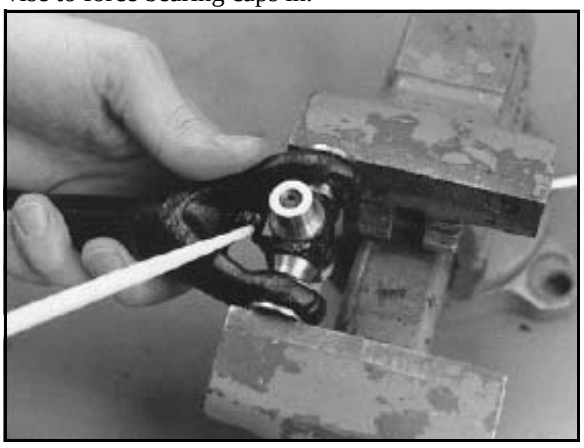
3. Support U-joint in vise as shown and drive inner yoke down to remove remaining bearing caps.

4. Force U-joint cross to one side and lift out of inner yoke.

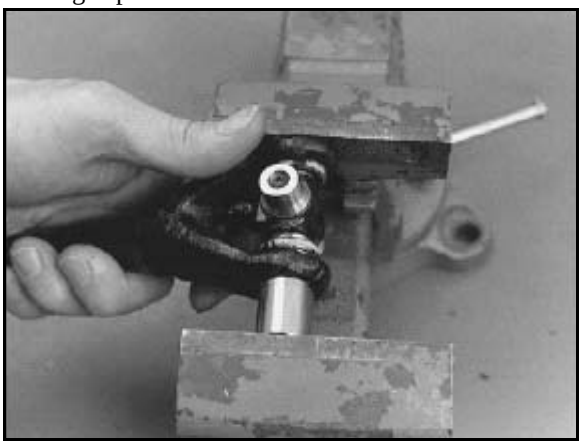


Assembly

1. Install new bearing caps in yoke by hand. Carefully install U-joint cross with grease fitting properly positioned inward toward center of shaft. Take care not to dislodge needle bearings upon installation of cross joint. Tighten vise to force bearing caps in.



2. Using a suitable arbor, fully seat bearing cap in one side. Continually check for free movement of bearing cross as bearing caps are assembled.

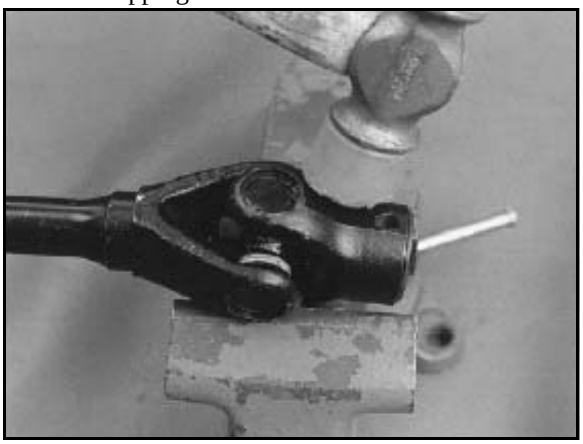


3. Install snap ring to contain bearing cap just installed. Repeat procedure for other side.

4. Install outer yoke, aligning marks made before disassembly.

5. Repeat Steps 1-3 to install bearing caps on outer yoke.

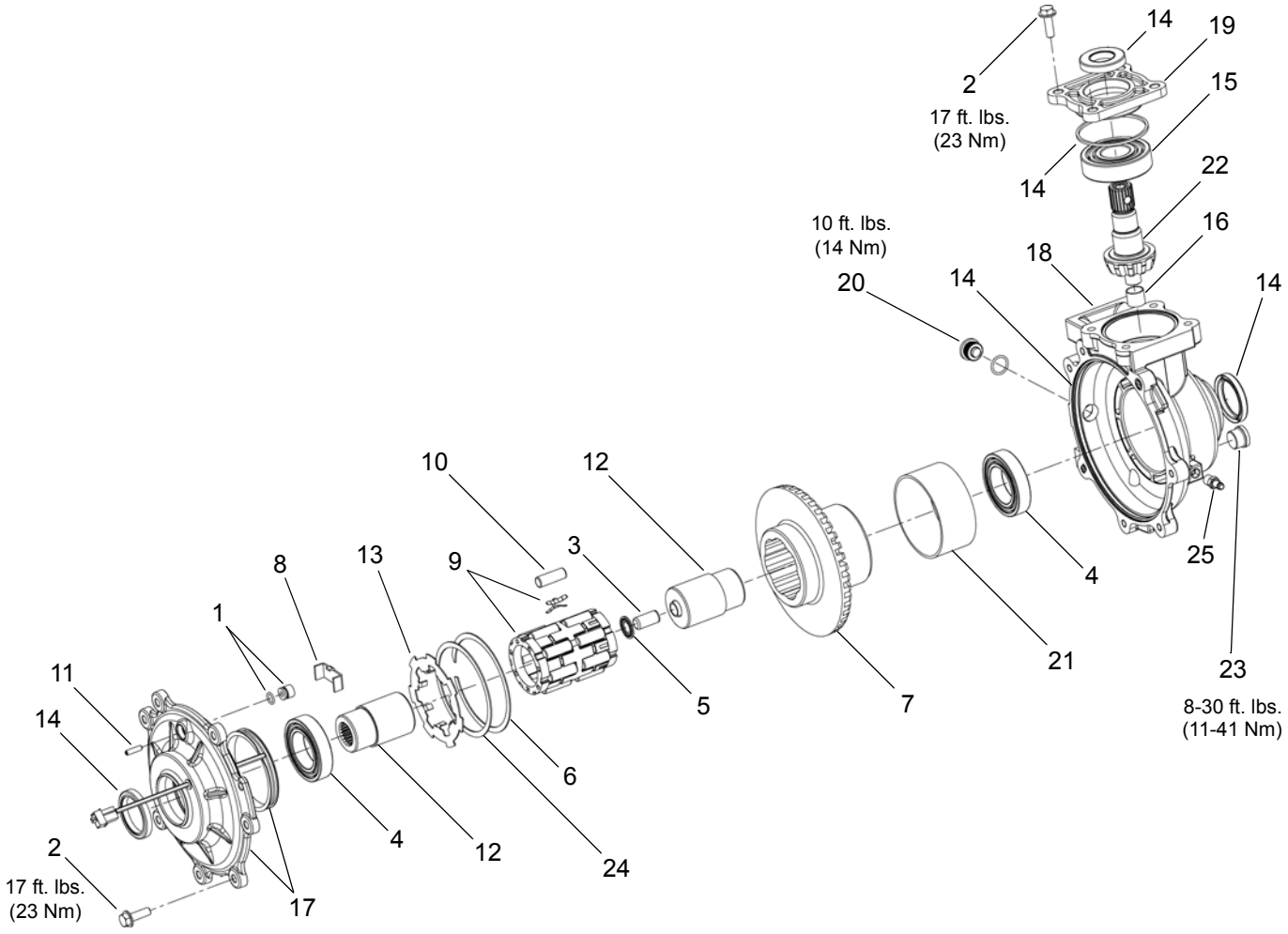
6. Seat all bearing caps against snap rings by supporting cross shaft and tapping on each corner as shown.



7. When installation is complete, yokes must pivot freely in all directions without binding. If the joint is stiff or binding, tap the yoke lightly to center the joint until it pivots freely in all directions.

FRONT GEARCASE / CENTRALIZED HILLIARD

Centralized Hilliard Exploded View



REF#	DESCRIPTION	QTY	REF#	DESCRIPTION	QTY
1	Thrust Button Asm. w/O-ring	1	14	Seal Kit (Includes O-rings and Seals)	1
2	Screw (5/16-18)	11	15	Roller Ball Bearing	1
3	Dowel Pin	1	16	Bushing	1
4	Roller Ball Bearing	2	17	Cover Plate Asm. w/Coil	1
5	Thrust Needle Bearing	1	18	Gearcase LH	1
6	Internal Retaining Ring	1	19	Input Cover	1
7	Clutch Housing / Ring Gear	1	20	Magnetic Drain Plug Asm.	1
8	Thrust Plate	1	21	Bushing	1
9	Roll Cage Asm. (Includes H-Springs)	1	22	Pinion Shaft Asm	1
10	Rollers	14	23	Fill Plug	1
11	Set Screw	1	24	Gear Spacer	1
12	Race / Output Hub Asm.	2	25	Vent Fitting	1
13	Armature Plate	1			

All Wheel Drive Operation

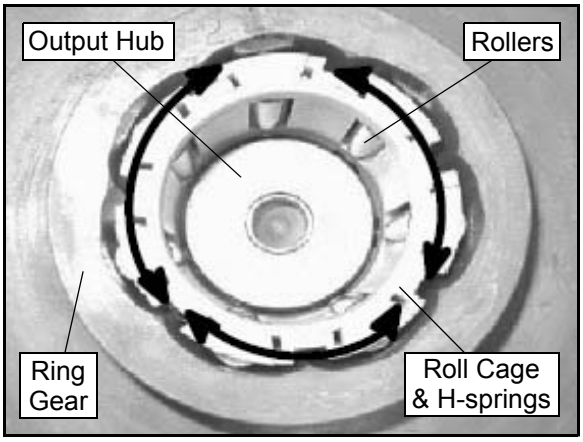
The AWD switch may be turned on or off while the vehicle is moving, however, AWD will not enable until the engine RPM drops below 3100. Once the AWD is enabled, it remains enabled until the switch is turned off.

Engage the AWD switch before getting into conditions where the front wheel drive may be needed. If the rear wheels are spinning, release the throttle before switching to AWD.

> **⚠ CAUTION**
>
> Switching to AWD while the rear wheels are spinning may cause severe drive shaft and gearcase damage. Always switch to AWD while the rear wheels have traction or are at rest.

With the AWD switch off, the vehicle drives through the rear wheels only (2 wheel drive). When the AWD is enabled, the front drive acts as an on-demand AWD system. This means, the front drive will engage once the rear wheels have lost traction, and will remain engaged until the torque requirement goes away (i.e. rear wheels regain traction).

AWD Engagement: When the AWD switch is activated, the AWD coil is powered by a 12 Vdc input which creates a magnetic field. This magnetic field attracts an armature plate that is keyed to the roll cage. When the ring gear and roll cage are spinning (vehicle is moving), the energized coil and armature plate will apply drag to the roll cage that indexes the rollers inside the ring gear to an engagement position. While in the engagement position, the front drive will be in an "over-running" condition (not engaged), until the rear wheels lose traction. Once the rear wheels begin to lose traction, the front drive will engage by coupling the output hubs to the ring gear via the rollers. The front drive will remain engaged until the torque requirement goes away (i.e. rear wheels regain traction).



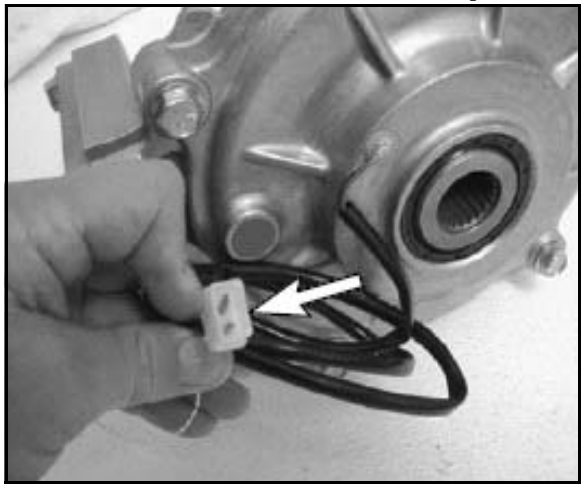
> **⚠ CAUTION**
>
> If the rear wheels are spinning, release the throttle before turning the AWD switch on. If AWD is engaged while the wheels are spinning, severe drive shaft and clutch damage could result.

AWD Disengagement: Once the rear wheels regain traction, the front wheels will return to the "over-running" condition. The vehicle is now back to rear wheel drive until the next loss of rear wheel traction occurs.

AWD Diagnosis

Symptom: AWD Will Not Engage

1. Check the gearcase coil resistance. To test the coil resistance, measure between the Grey and Brown/White wires. The measurement should be within specification.



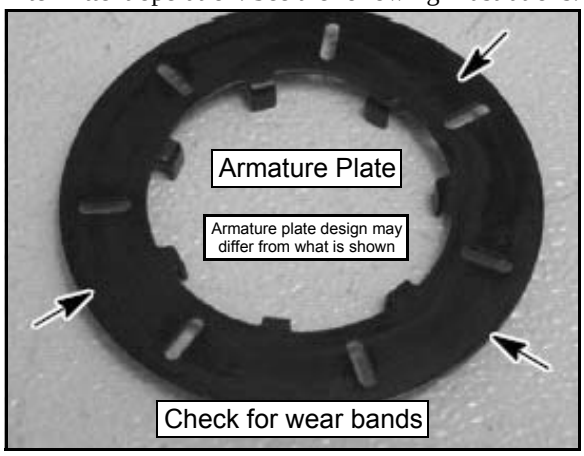
Front Gearcase Coil Resistance:

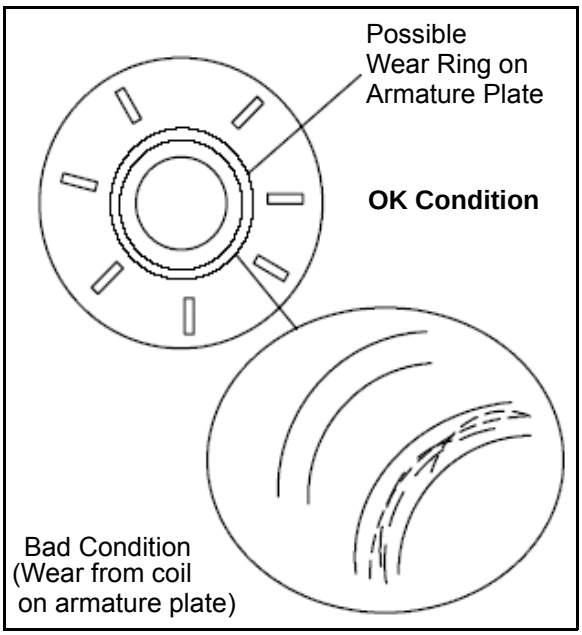
21.6 - 26.4 Ohms

2. Turn the ignition and AWD switches on and place gear selector in High or Low gear. Check for minimum battery voltage at the Gray and Brown/White chassis wires that power the coil. A minimum of 11 Vdc should be present.

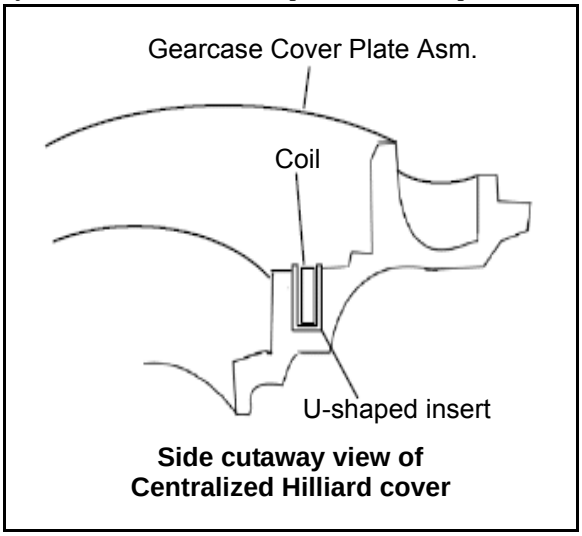
3. If electrical tests are within specification, remove gearcase (see "Gearcase Removal") and inspect components.

4. Inspect the armature plate for a consistent wear pattern. There should be two distinct wear bands (one band inside the other). If only one band of wear is present (or if there is wear between the two bands), inspect the coil area as indicated in Step 5. A wear band with an interrupted wear mark may indicate a warped plate, which may cause intermittent operation. See the following illustrations:



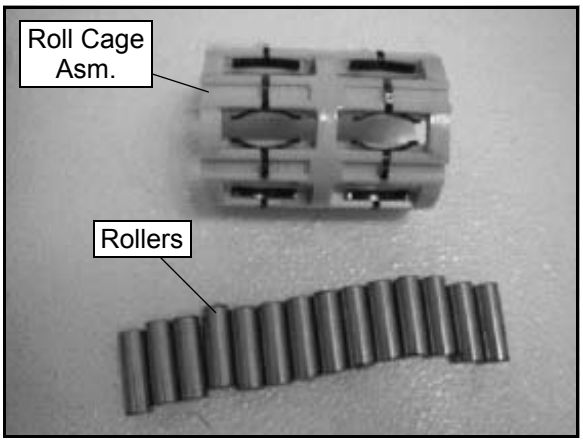


5. Check to make sure the coil is seated in the U-shaped insert that is pressed into the gearcase cover. The top of the coil should be seated below the U-shaped insert. The U-shaped insert controls the pole gap. If the top of the coil is above the surface of the U-shaped insert it raises the armature plate, thereby increasing pole gap. If the pole gap increases the coil will not be strong enough to engage the AWD system. If this is found, replace the cover plate assembly.



Side cutaway view of Centralized Hilliard cover

6. Inspect the rollers for nicks and scratches. The rollers must slide up, down, in and out freely within the roll cage sliding surfaces and H-springs.



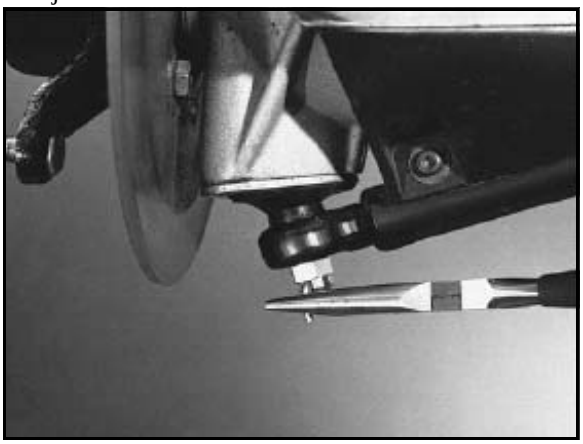
7. Inspect the roll cage assembly for cracks or excessive wear. If damaged, replace the roll cage assembly.

Gearcase Removal

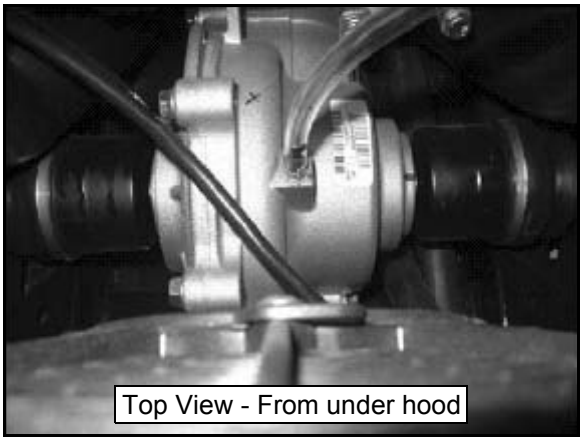
1. Stop engine, place machine in gear and set parking brake.
2. Loosen right front wheel nuts slightly.
3. Elevate and support machine under footrest/frame area.

> **⚠ CAUTION**
>
> Serious injury may result if machine tips or falls. Be sure machine is secure before beginning this service procedure. Wear eye protection when removing and installing bearings and seals.

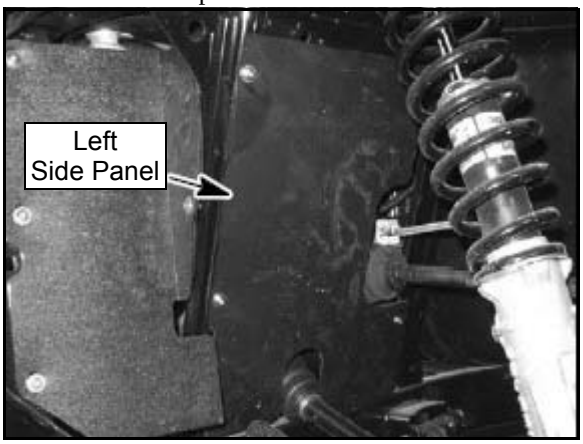
4. Remove right wheel nuts and wheel.
5. Remove cotter pin, lower ball joint nut, and A-arm from ball joint.



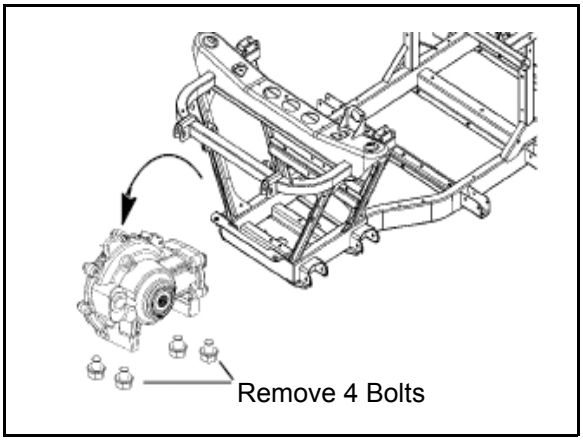
6. Repeat Step 1 through Step 5 on the opposite side.
7. Pull each axle out from the front gearcase, refer to the "FRONT DRIVE SHAFT REMOVAL" procedure earlier in this chapter.
8. The front gearcase and drive shafts can be accessed from both sides of the vehicle and limited access from the top.



9. Remove the access panel on the side of the vehicle. T-25 screws secure the panel to the frame.



10. Remove the roll pin from the front drive shaft.Remove the front drive shaft from the front gearcase splines.
11. Remove bolts securing bottom of gearcase to frame. Remove vent line. Remove gearcase from right side of frame.



Gearcase Disassembly / Inspection

1. Drain and properly dispose of used oil. Remove any metal particles from the drain plug magnet.

2. Remove bolts and output shaft cover.

3. Check the gearcase coil resistance. The resistance value should meet the specifications listed below.

NOTE: To test the gearcase coils resistance, use the coil harness. The gearcase coils should measure between 22.8 ohms and 25.2 ohms.

4. Remove output shaft assembly

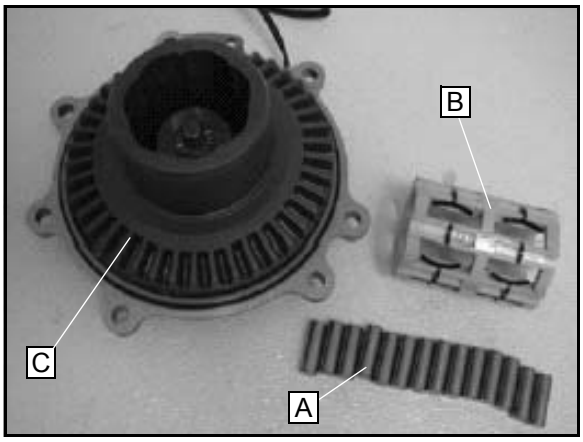
NOTE: Be careful not to misplace the thrust bearing located between the two output shafts.

5. Clean all parts and inspect spacers for wear. Inspect ring gear for chipped, broken, or missing teeth.

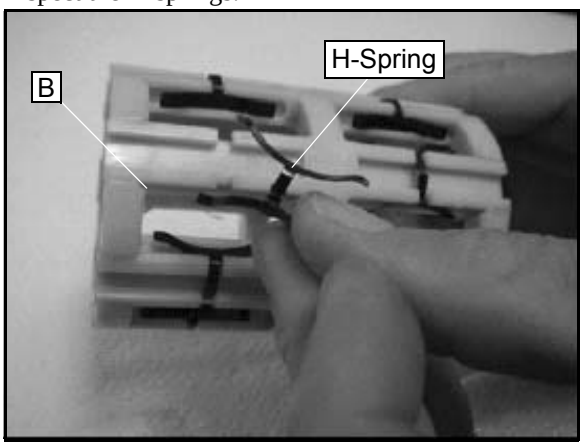
6. Remove the roll cage assembly, rollers, and H-springs.

7. Thoroughly clean all parts. Inspect the rollers (A) for nicks and scratches. The rollers must slide up and down freely within the roller cage surfaces (B).

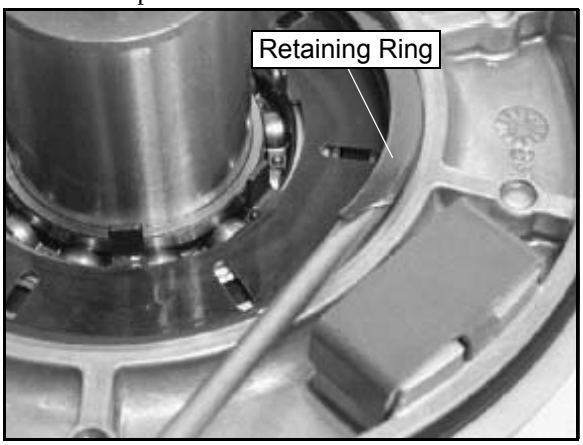
8. Inspect the ring gear (C) for consistent wear patterns. The surfaces should be free of nicks and scratches.



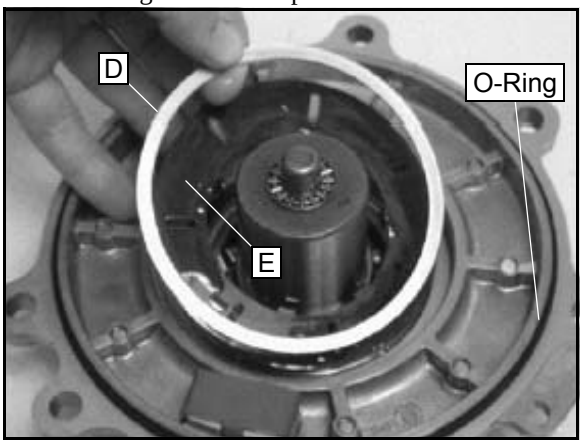
9. Inspect roll cage (B) sliding surface. This surface must be clean and free of nicks, burrs or scratches. Remove and inspect the H-springs.



10. Use a flat head screwdriver to remove the retaining ring from the output cover.

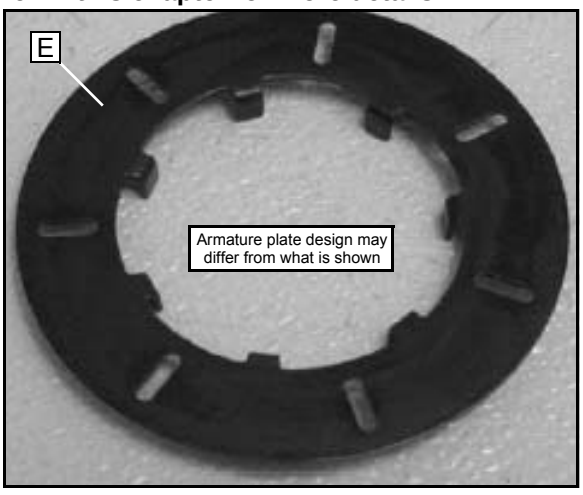


11. Remove the spacer washer (D), armature plate (E), and rubber O-ring from the output cover.

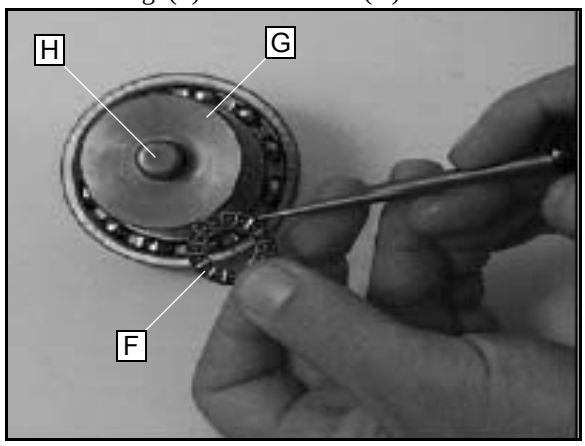


12. Inspect the armature plate (E) for a consistent wear pattern. Uneven wear of the armature plate (E) indicates a warped plate, which may cause intermittent operation.

NOTE: See "FRONT GEARCASE DIAGNOSIS" earlier in this chapter for more details.



13. Remove the output hub (G) from the cover. remove the thrust bearing (F) from the output hub (G). Inspect the thrust bearing (F) and the dowel (H).

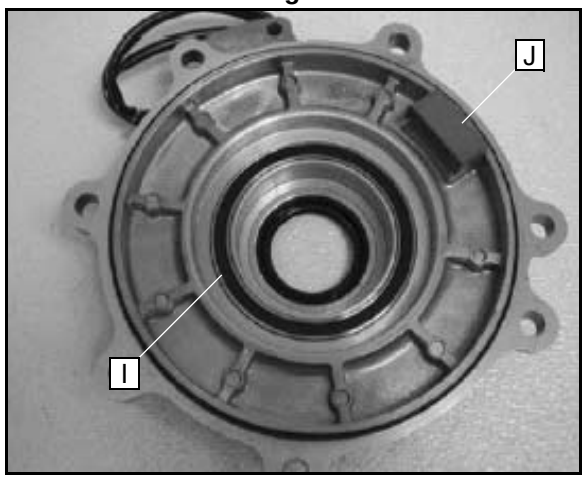


14. Inspect the magnetic coil (I) in the output housing.

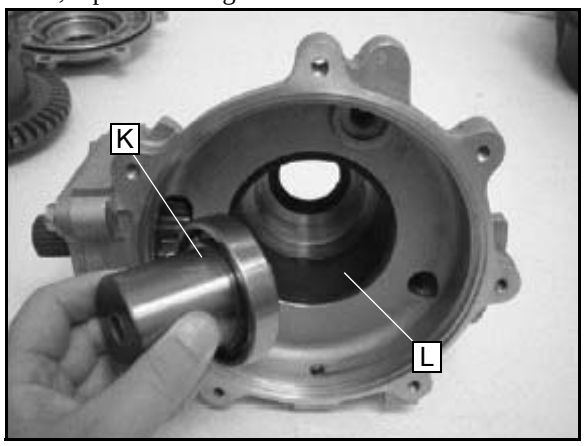
NOTE: See "FRONT GEARCASE DIAGNOSIS" earlier in this chapter for more details on the coil.

15. Inspect the back lash pad (J) for excessive wear.

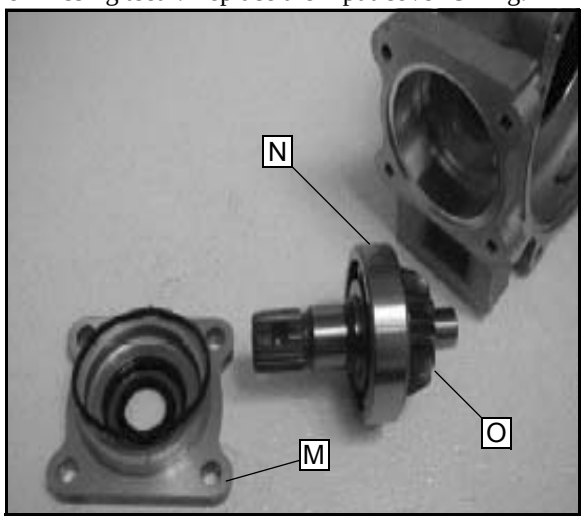
NOTE: The backlash for the centralized hilliard is set at the factory. No adjustment is required, unless the front cover needs to be replaced, or the back lash pad screw is removed. See the "Backlash Pad Adjustment" procedure later in this chapter for details on backlash setting.



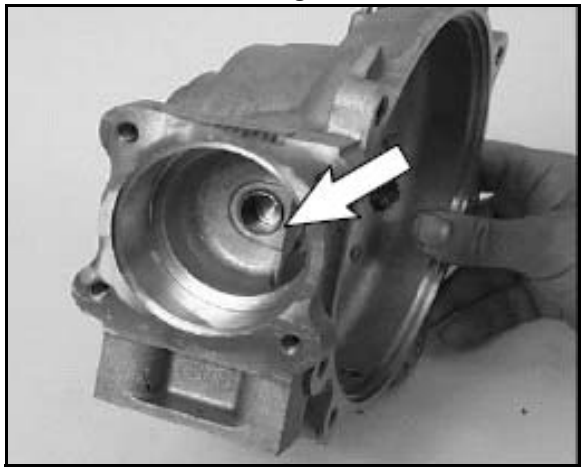
16. Remove the other output hub (K) from the main gearcase. Inspect the inner bearing (L) for wear. If there is excessive wear, replace bearing as needed.



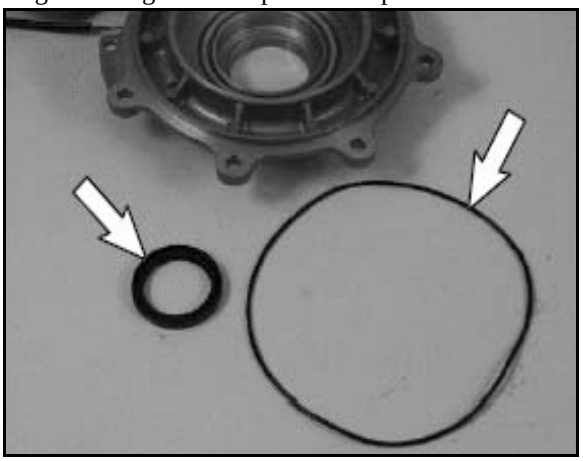
17. Remove the input cover (M), bearing (N), and the pinion gear (O). Inspect the pinion gear (O) for chipped, broken, or missing teeth. Replace the input cover O-ring.



18. Inspect the output shaft bushing. Replace as needed. Clean the inside surfaces of both gearcase halves.



19. Install new seals into the gearcase housing and use new O-rings for the gearcase input and output covers.



Gearcase Reassembly / Inspection

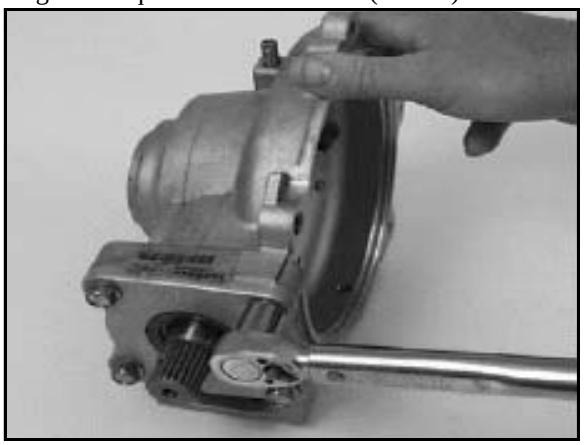
1. As mentioned in the disassembly section, replace all O-rings, seals, and worn components.

2. Press the pinion shaft seal into the pinion cover, until the seal is flush with the sealing surface.

3. Inspect bearings on output and pinion shafts. To replace, press new bearing on to shaft.

NOTE: Due to extremely close tolerances and minimal wear, the bearings must be inspected visually, and by feel. While rotating bearings by hand, inspect for rough spots, discoloration, or corrosion. The bearings should turn smoothly and quietly, with no detectable up and down movement and minimal movement side to side.

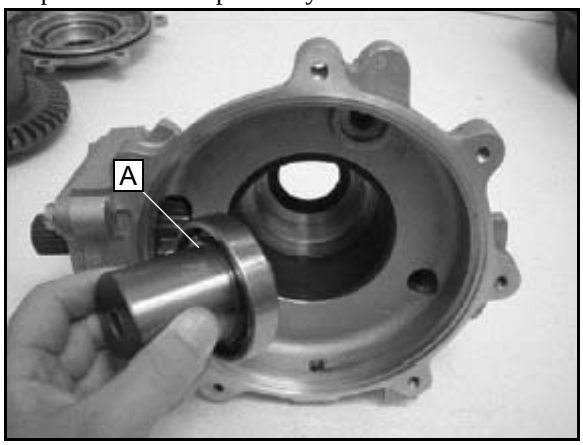
4. Install pinion shaft, bearing, and input cover with new o-ring and torque bolts to 17 ft. lbs. (23 Nm).



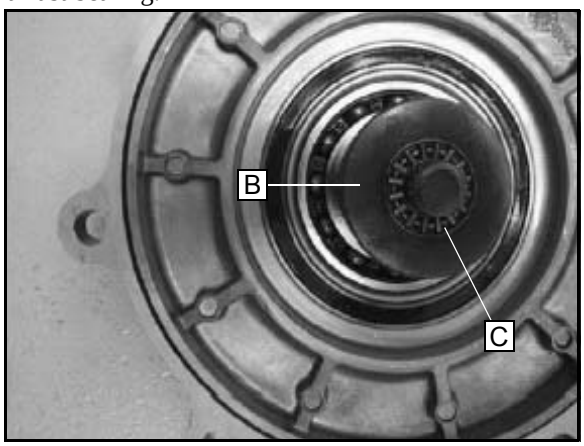
Input Cover Bolts Torque:

17 ft. lbs. (23 Nm)

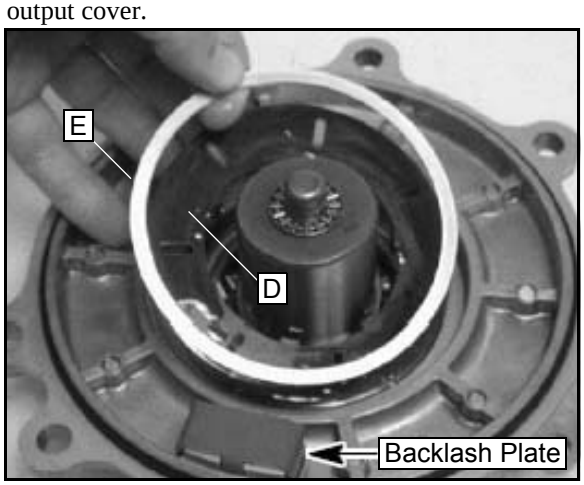
5. Install the output hub (A) into the gearcase housing. The output hub should spin freely.



6. Install the other output hub (B) and thrust bearing (C) into the output cover. Apply a small amount of grease onto the thrust bearing.

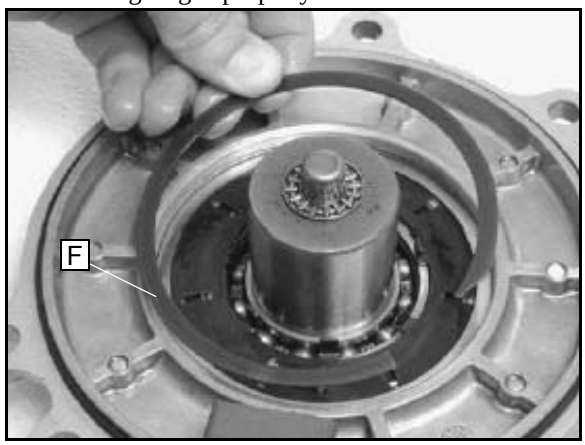


7. Install the armature plate (D) and spacer washer (E) into the output cover.

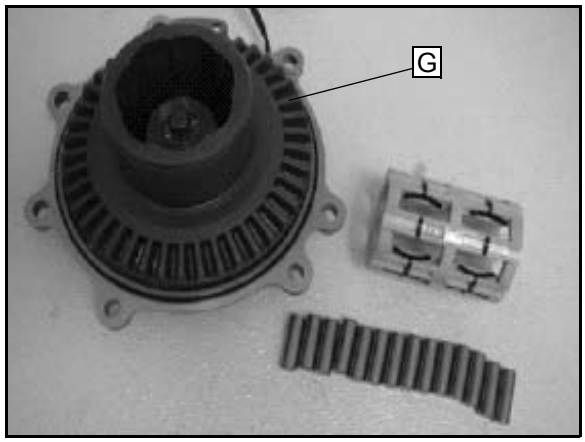


NOTE: Be sure backlash plate is in place.

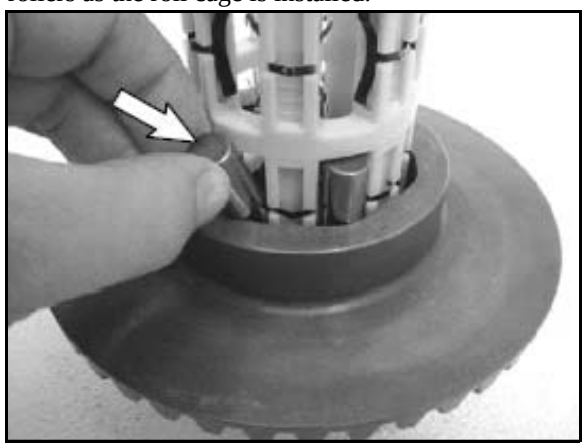
8. Install the retaining ring (F) into the output cover. Be sure the retaining ring is properly seated into the cover.



9. Install the ring gear (G) onto the output hub on the output cover.

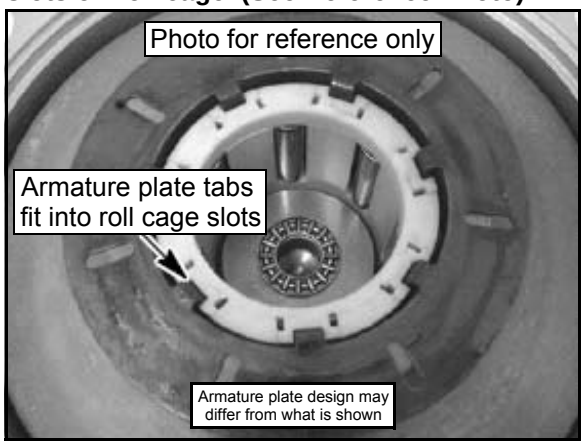


10. Install the rollers and roll cage into the ring gear. Insert the rollers as the roll cage is installed.



11. Install the output cover assembly onto the main gearcase.

NOTE: Be sure armature plate tabs are placed into the slots on roll cage. (See Reference Photo)



NOTE: This photo is for reference only, the armature plate is actually installed in the output cover.

12. Install output cover with new O-ring and torque bolts to 17 ft. lbs. (23 Nm).

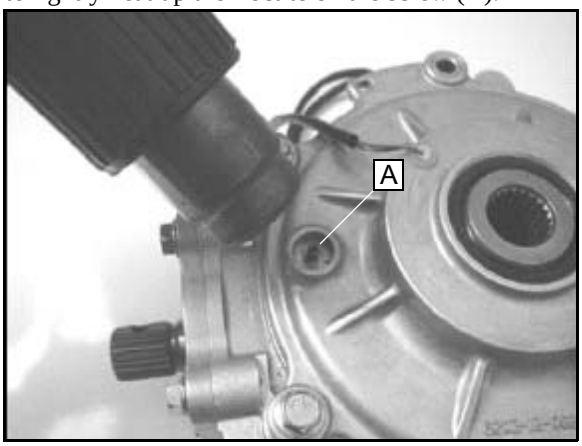
NOTE: Be sure the square O-ring is placed flat on the cover surface. If the O-ring is twisted fluid leakage may occur.

Cover Bolts Torque:

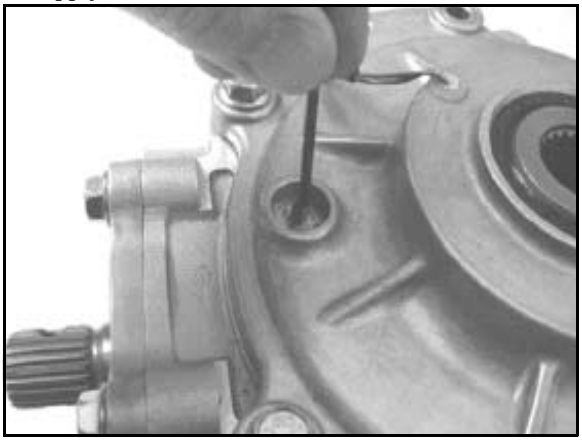
17 ft. lbs. (23 Nm)

Backlash Pad (Thrust Pad) Adjustment

1. Lay the gearcase on the side with the output cover facing up.
2. The backlash screw has Loctite applied to it. Use a heat gun to lightly heat up the Loctite on the screw (A).



3. Using a hex wrench, turn the back-lash screw out 3-4 turns. Re-apply red Loctite onto the bottom screw threads.



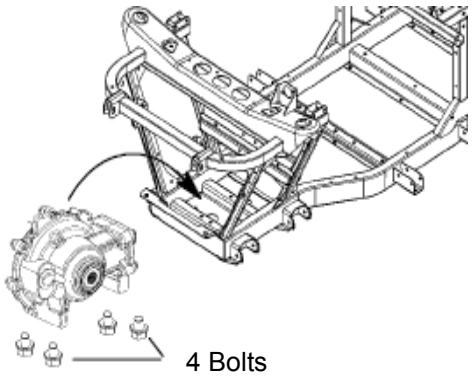
4. Turn the screw in until it is lightly seated, then turn the screw out 1/4 turn.
5. Set the gearcase upright. Rotate the pinion shaft at least 4 times. This ensures the ring gear completes one full rotation.

6. If a tight spot is felt during rotation, loosen the backlash screw another 1/8 turn. Perform the previous step again. Repeat this procedure until the pinion shaft rotates smoothly 4 times (1 revolution of ring gear).

Gearcase Installation

1. To install gearcase, reverse removal procedure.Use new spring pin in front prop shaft.

2. Torque mounting bolts to 30 ft.lbs. (41 Nm).



= T

Front Housing Mount Bolt Toque:
30 ft. lbs. (41 Nm)

3. Add the proper lubricant to the front gearcase. Check drain plug for proper torque. Refer to Chapter 2 for fluid fill and change information.

=

Premium Demand Drive Fluid
(PN 2871654)

Front Housing Capacity:
5 fl. oz. (148 ml)

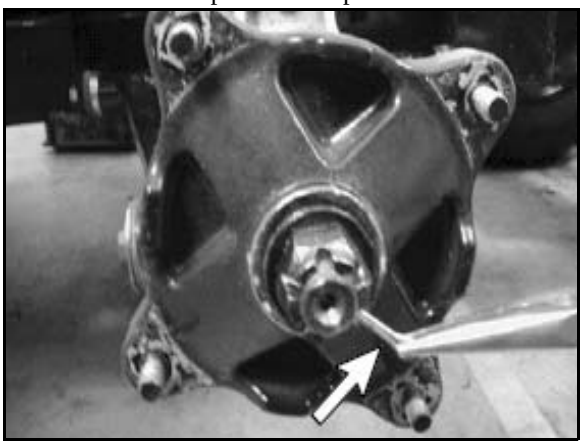
MID DRIVE HUB / BEARING CARRIER (6X6)

Removal

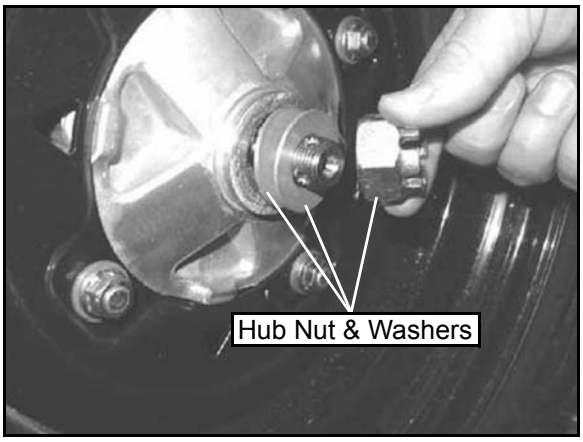
1. Lock the emergency parking brake. Safely raise the center of the machine with a floor jack. Raise the machine just enough to remove the middle wheel.

2. Remove the four wheel nuts and wheel.

3. Remove the hub cap and cotter pin.

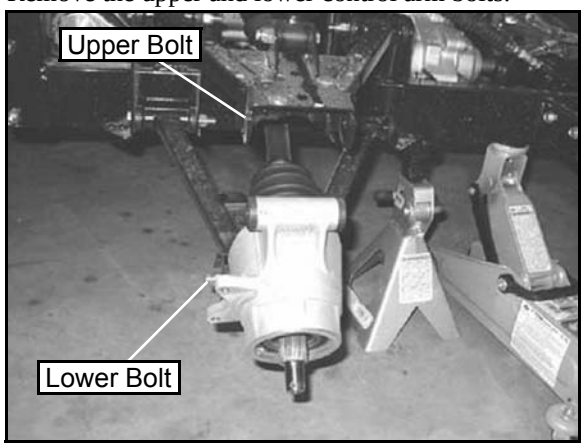


4. Remove the hub nut, domed washer, and flat washer.

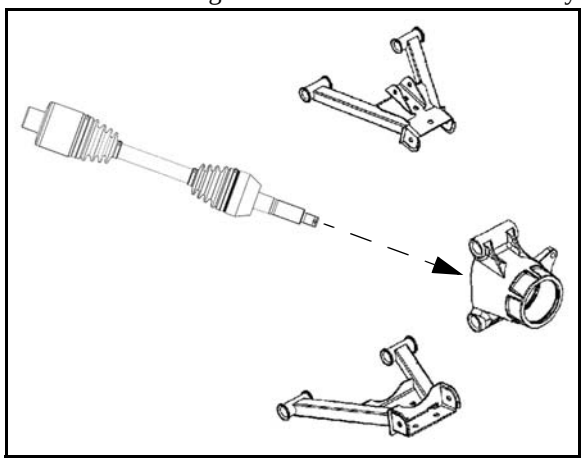


5. Remove the hub from the axle shaft.

6. Remove the upper and lower control arm bolts.



7. Remove the bearing carrier from the A-arm assembly.



Hub Disassembly

1. Remove outer snap ring (A).

2. From the back side, tap on the outer bearing race with a drift punch in the reliefs as shown in Figure 7.24.

NOTE: Drive bearing out evenly by tapping on outer race only. Once bearing is at bottom of casting, support casting on outer edges so bearing can be removed.

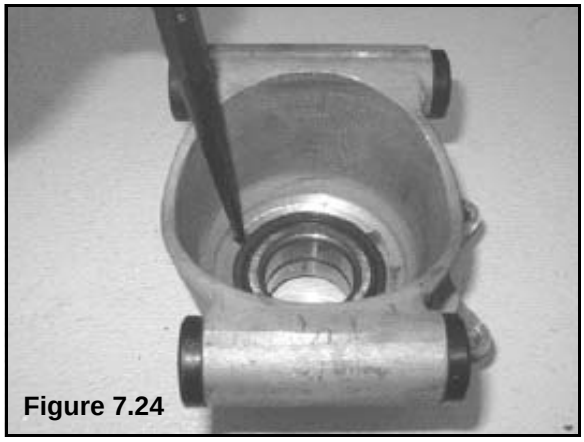


Figure 7.24

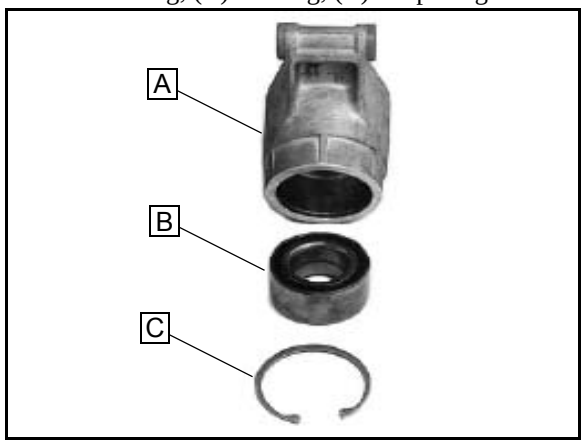
3. Inspect the bearing.

NOTE: Due to extremely close tolerances and minimal wear, the bearings must be inspected visually, and by feel. While rotating bearings by hand, inspect for rough spots, discoloration, or corrosion. The bearings should turn smoothly and quietly, with no detectable up and down movement and minimal movement sideways between inner and outer race.

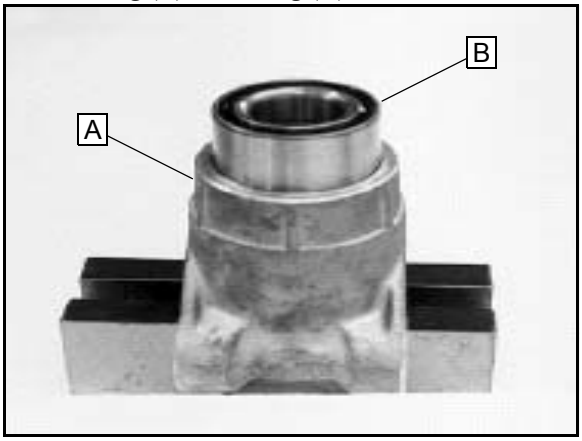
4. Inspect bearing housing for scratches, wear or damage. Replace housing if damaged.

Hub Assembly

1. Support bottom of bearing carrier housing. (A) Bearing Carrier Housing; (B) Bearing; (C) Snap Ring

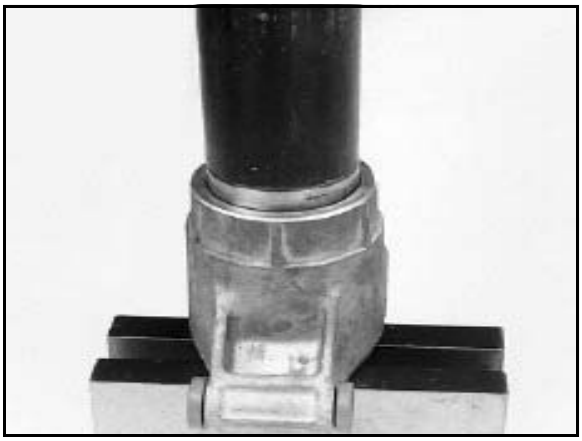


2. Start bearing (B) in housing (A).



3. Press bearing into place until outer race bottoms on housing.

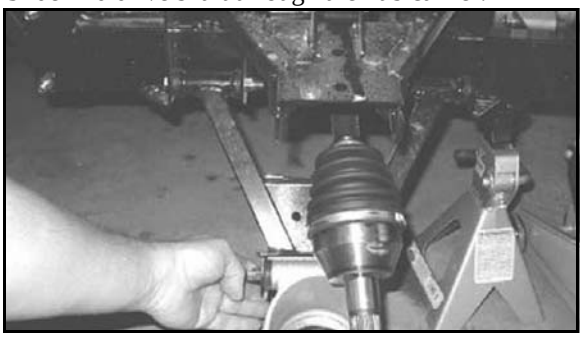
> **⚠ CAUTION**
>
> Use an arbor and press only on the outer race, as bearing damage may occur.



4. Install snap ring into groove.

Hub Installation

1. Install hub carrier to lower A-arm. Hand tighten lower A-arm bolt.
2. Slide mid drive shaft through the hub carrier.

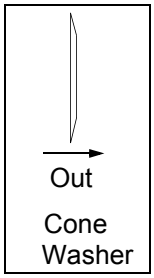


3. Install upper A-arm bolt and torque both upper and lower bolts.

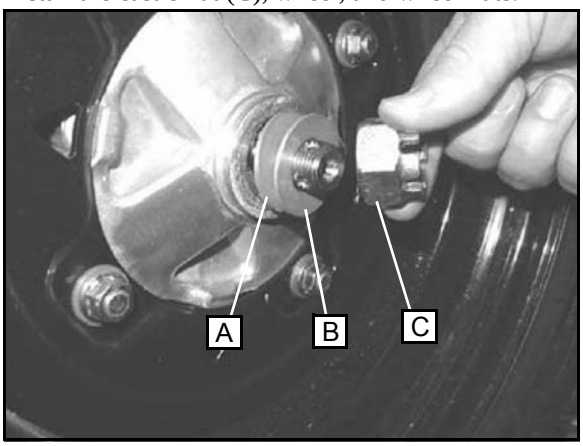
Lower Control Arm Bolt Torque:
35 ft. lbs. (47 Nm)

Upper Control Arm Bolt Torque:
35 ft. lbs. (47 Nm)

4. Pull drive shaft outward and install hub onto drive shaft splines. Apply Anti-Seize compound to the axle splines.
5. Install the flat washer (A) and cone washer (B) with domed side facing outward. (Refer to next photo)



6. Install the castle nut (C), wheel, and wheel nuts.



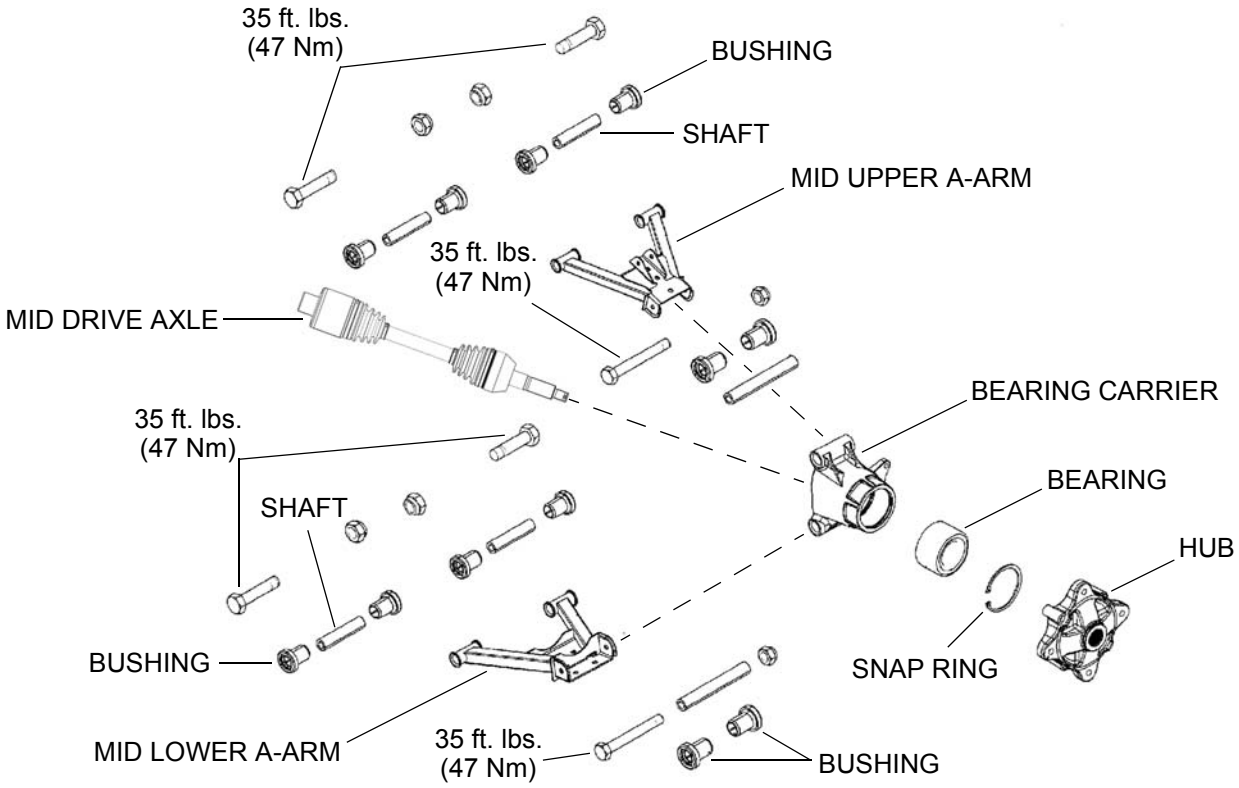
7. Remove jackstand and torque mid hub nut to 110 ft. lbs. (149 Nm) and wheel nuts to 35 ft. lbs. (47 Nm).

Mid Hub Nut Torque:
110 ft. lbs. (149 Nm)

Mid Wheel Nut Torque
35 ft. lbs. (47 Nm)

8. Install a new cotter pin. Tighten nut slightly to align holes if required.
9. Install hub cap.

Mid Drive Exploded View

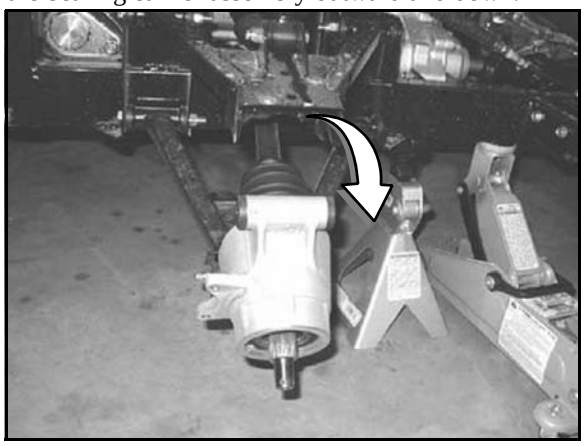


MID DRIVE SHAFT (6X6)

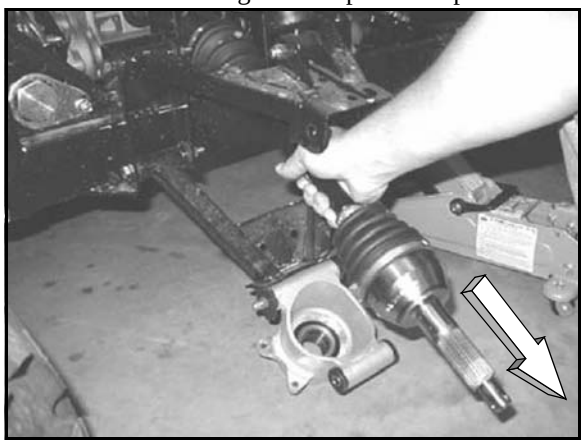
Removal

1. Repeat Steps 1-7 in the "Mid Drive Hub / Bearing Carrier Removal" section.

2. Slide the middle axle out of the bearing carrier by pulling the bearing carrier assembly outward and down.



3. Pull the middle axle straight out from the frame. The axle will slide off the mid gearcase splined output shaft.

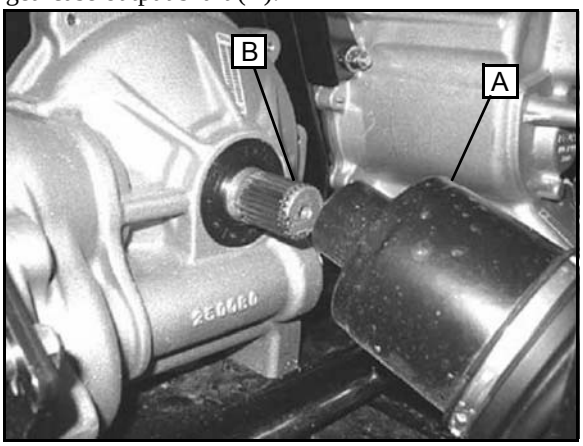


Disassembly / Assembly

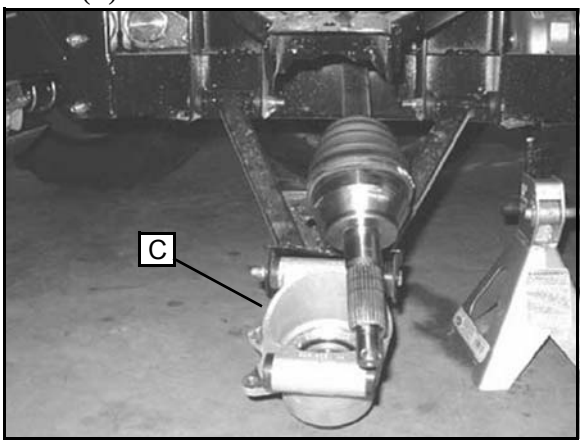
NOTE: For mid drive shaft service information, see "REAR DRIVE SHAFT (4X4 CREW) - CV Joint / Boot Replacement"

Installation

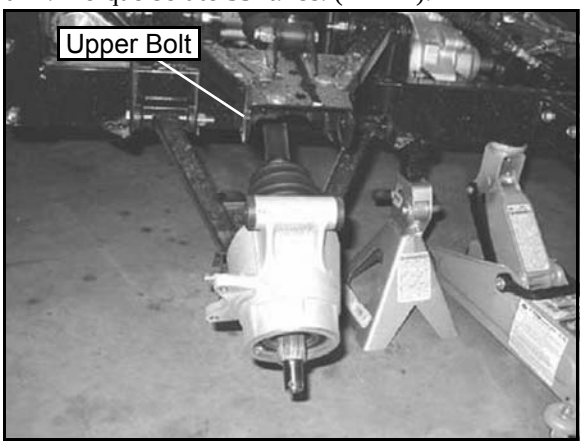
1. Apply Anti-Seize compound onto the mid gearcase output shaft splines. Slide mid drive shaft (A) onto the mid gearcase output shaft (B).



2. Install the outer end of the mid drive shaft into the hub carrier (C).



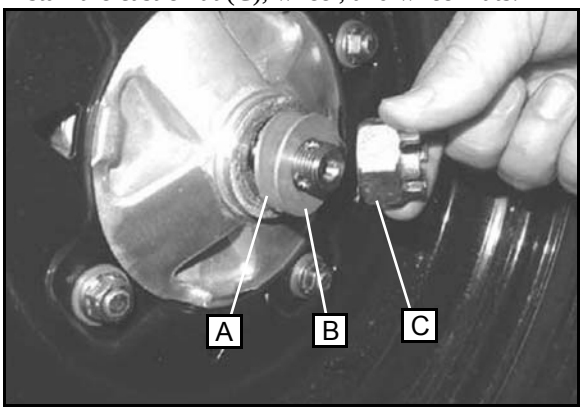
3. Lift hub carrier into place and install bolt to upper control arm. Torque bolt to 35 ft. lbs. (47 Nm).



4. Pull drive shaft outward and install hub onto drive shaft splines. Apply Anti-Seize compound to the axle splines.

5. Install the flat washer (A) and cone washer (B) with domed side facing outward. (Refer to next photo)

6. Install the castle nut (C), wheel, and wheel nuts.



7. Remove jackstand and torque mid hub nut to 110 ft. lbs. (149 Nm) and wheel nuts to 35 ft. lbs. (47 Nm).

Mid Hub Nut Torque:
110 ft. lbs. (149 Nm)

Mid Wheel Nut Torque
35 ft. lbs. (47 Nm)

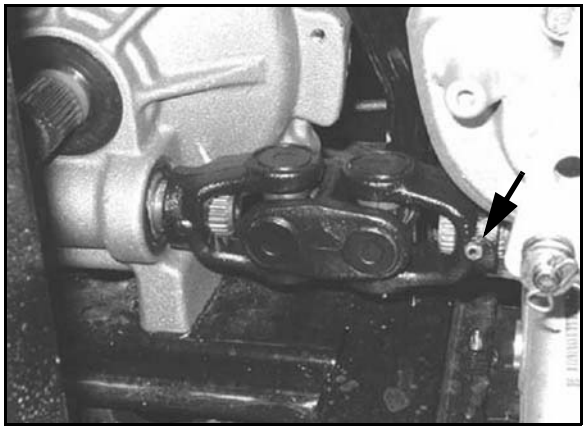
8. Install a new cotter pin. Tighten nut slightly to align holes if required.

9. Install hub cap.

MID PROPSHAFT (6X6)

Removal

1. Use the Roll Pin Removal Tool (**PN 2872608**), to remove the roll pin from prop shaft at rear of transmission.



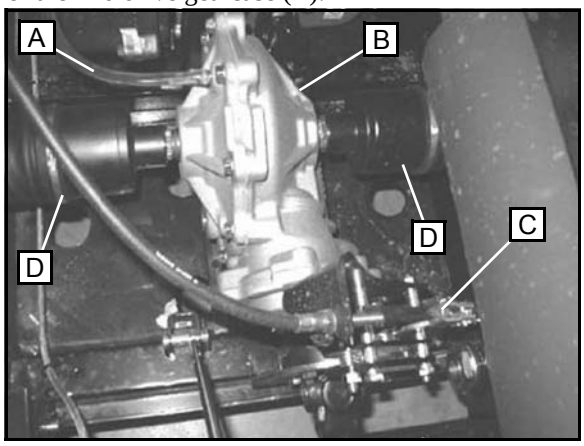
2. The transmission or middle differential mounting will have to be loosened to allow the propshaft to slide off of the transmission output shaft.

MID DRIVE GEARCASE (6X6)

Gearcase Removal

NOTE: To ease the removal of the middle axle gearcase, remove the box from the frame. Refer to the Box Removal Procedure in Chapter 5.

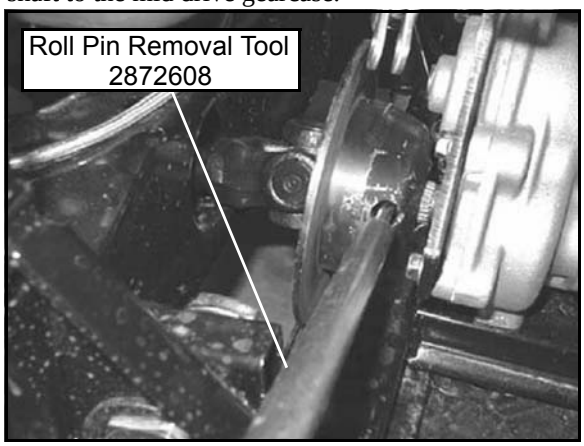
1. Remove the vent line clamp and vent line (A) from the top of the mid drive gearcase (B).



2. Remove the mid drive shafts (D). Repeat steps 1-3 in the "Mid Drive Shaft Removal" section.

3. Remove the parking brake caliper (C), refer to Chapter 9, "Parking Brake Caliper Service - Caliper Removal".

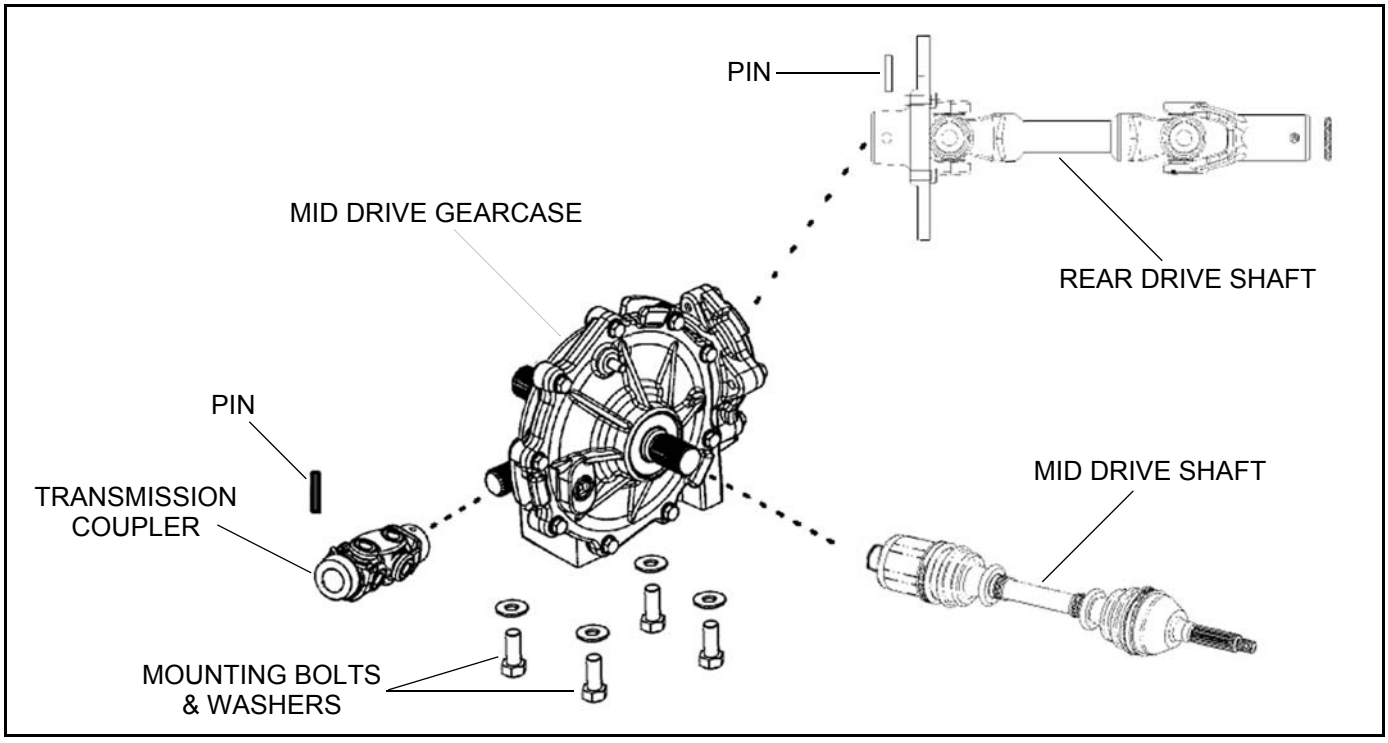
4. Use the Roll Pin Removal Tool (PN 2872608) to remove the roll pins that secure the rear prop shaft and middle prop shaft to the mid drive gearcase.



NOTE: If the rear drive shaft does not slide off the mid gearcase output shaft, compress the rear suspension and the rear drive shaft will move back.

5. Remove the four bolts and washers that secure the gearcase to the frame. The bolts are accessible through the skid plate on the bottom of the frame.

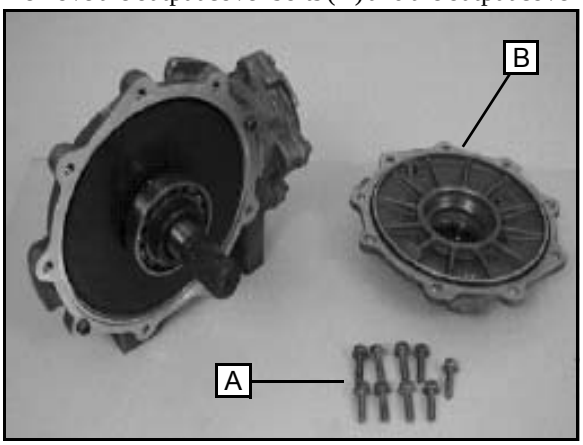
6. With the drive shafts removed from the mid gearcase, lift the gearcase out of the frame.



Gearcase Disassembly

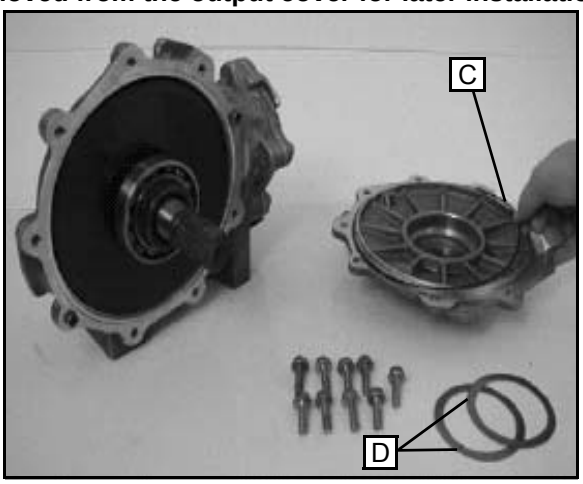
1. Drain the oil from the mid drive gearcase. Properly dispose of the oil.

2. Remove the output cover bolts (A) and the output cover (B).

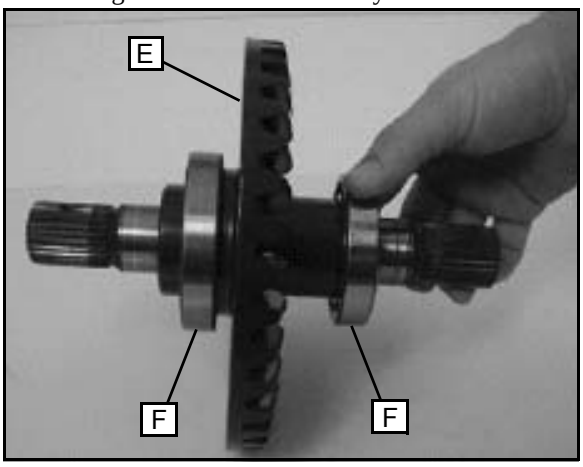


3. Remove the O-ring (C) and two shims (D) from the output cover.

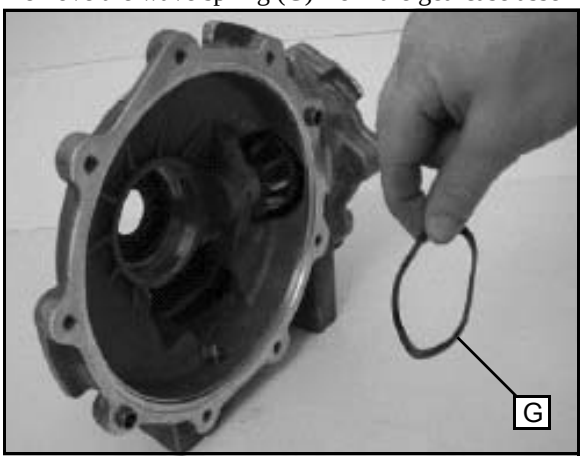
NOTE: The two shims are different of thickness. Be sure to note the placement of the shims as they are removed from the output cover for later installation.



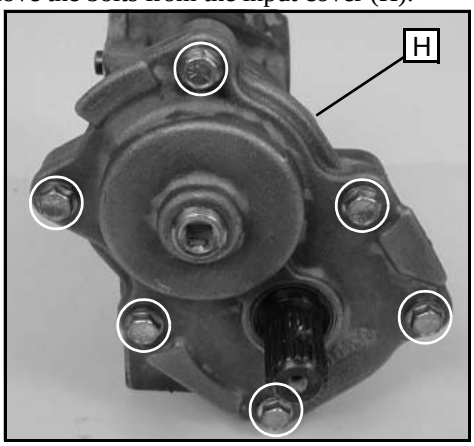
4. Remove the output shaft and ring gear assembly (E) from the gearcase. Inspect the ring gear for abnormal wear, broken, or chipped teeth. Inspect and spin the bearings (F), the bearings should rotate smoothly.



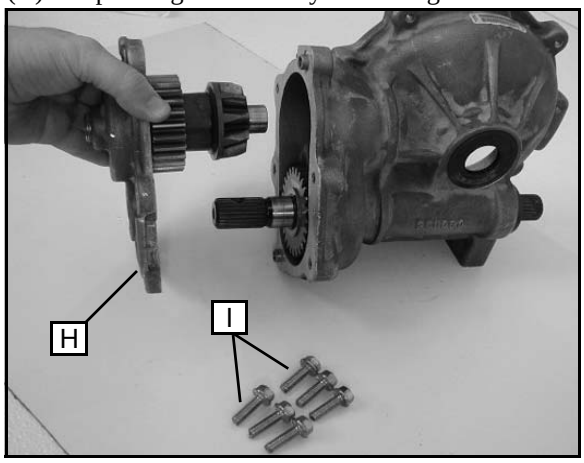
5. Remove the wave spring (G) from the gearcase assembly.



6. Remove the bolts from the input cover (H).

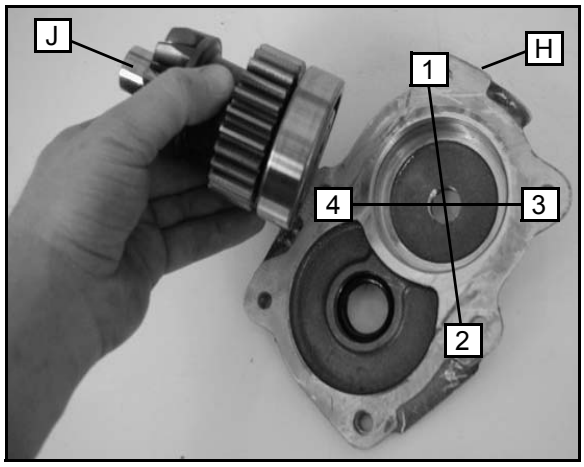


7. Remove the input cover bolts (I). Remove the input cover (H) and pinion gear assembly from the gearcase.

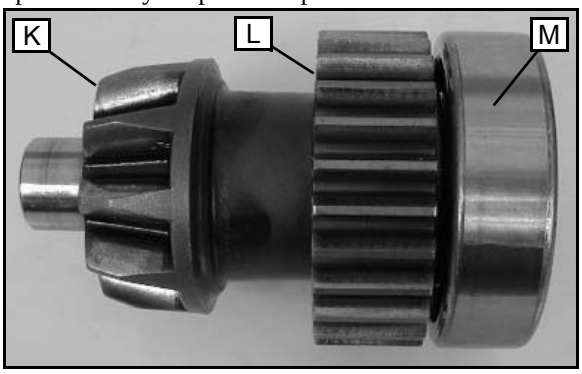


8. Remove the pinion gear assembly (J) from the front cover (H). If the pinion gear does not come loose from the front cover, use the following steps to aid in removal:

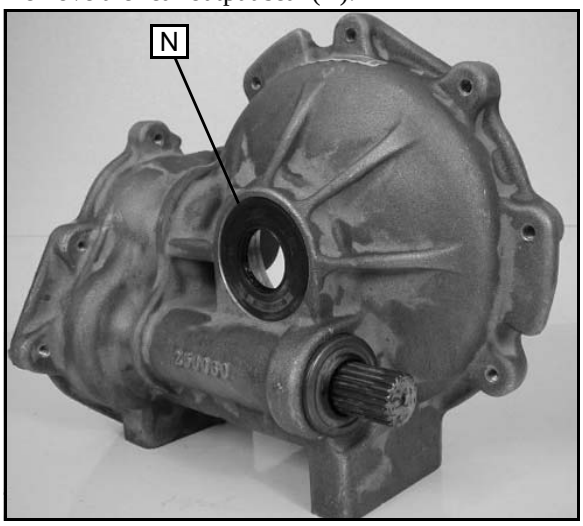
   - Hold the pinion gear assembly
   - Use a rubber mallet to lightly tap around the bearing cup of the front cover
   - Tap the front cover in an X pattern (follow the pattern in the photo on the right), until the pinion gear assembly comes loose



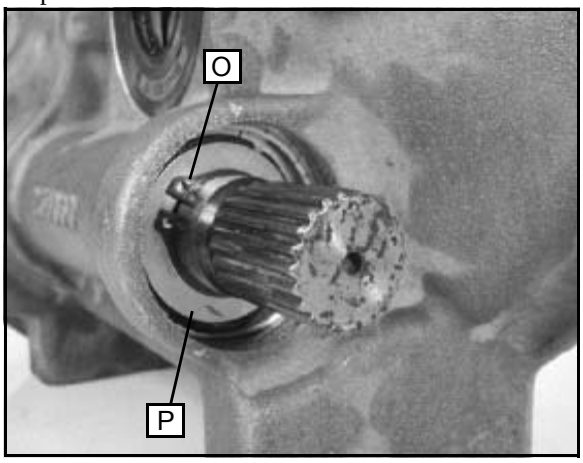
9. Inspect the pinion gear (K) and 26T output gear (L) for nics or uneven wear. Inspect the bearing (M), the bearing should spin smoothly. Replace the parts as needed.



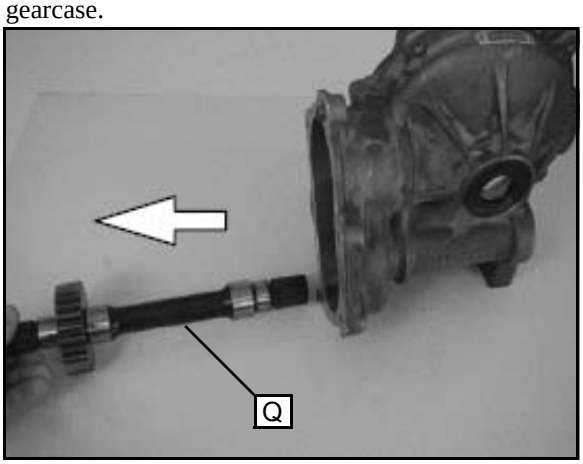
10. Remove the rear output seal (N).



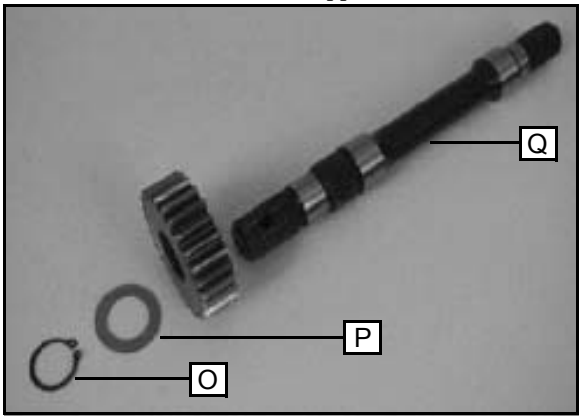
11. Remove the retaining ring (O) and shim (P) from the rear output thru shaft.



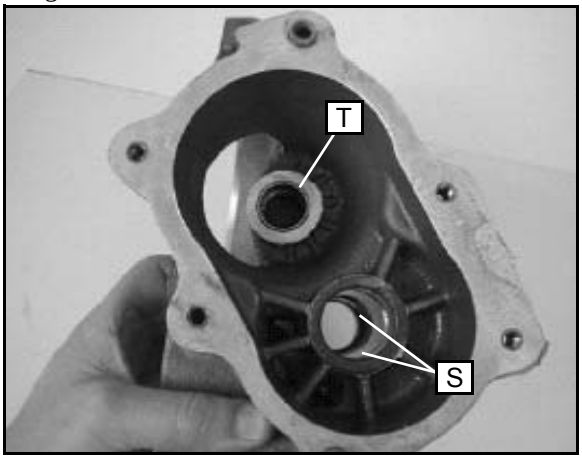
12. Carefully pull the output thru shaft (Q) through the gearcase.

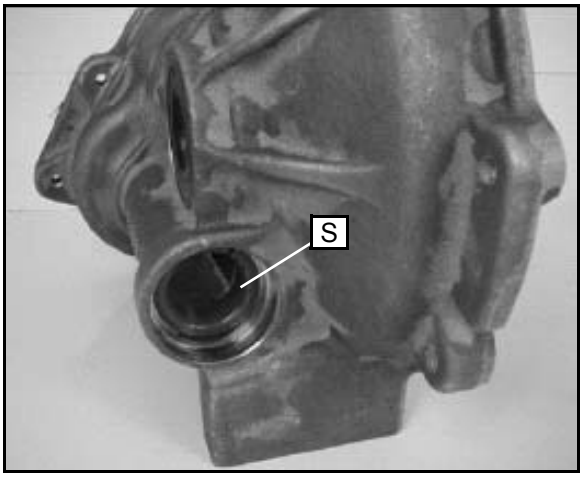


13. Remove the retaining ring (O), shim (P), and input gear (R) from the output shaft (Q). Inspect the input gear for abnormal wear, broken, or chipped teeth.

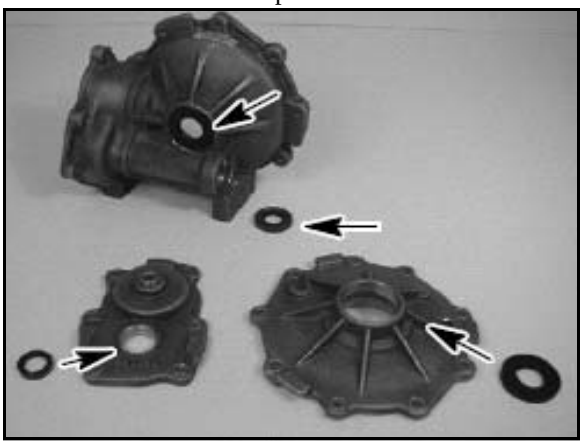


14. Inspect the two flange bearings (S) inside the gearcase. Inspect the pinion shaft bushing (T) for wear that is inside the gearcase.



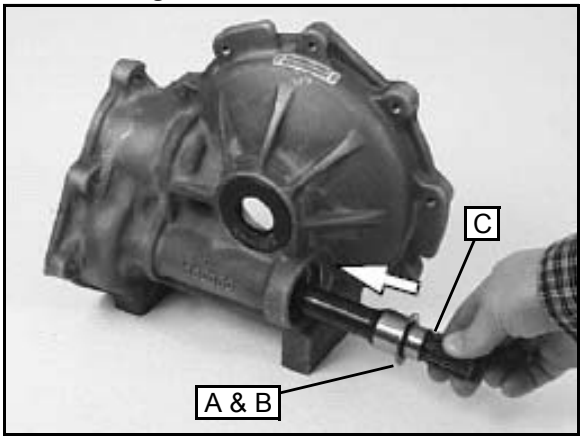


15. Replace all O-ring, seals, and worn components. Replace the seals as shown in the photo.

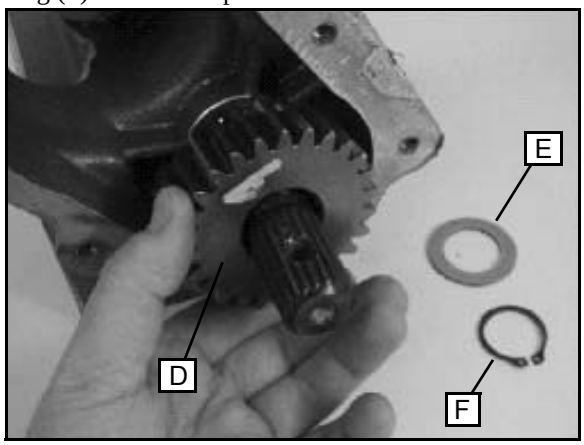


Gearcase Assembly

1. Install the shim (A) and a new retaining ring (B) onto the output end of the output shaft (C). Install the output thru shaft into the gearcase.

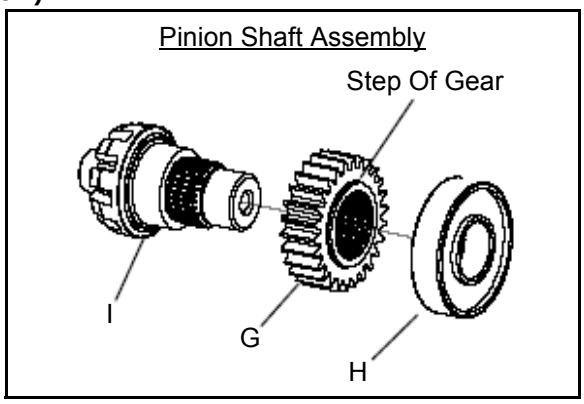


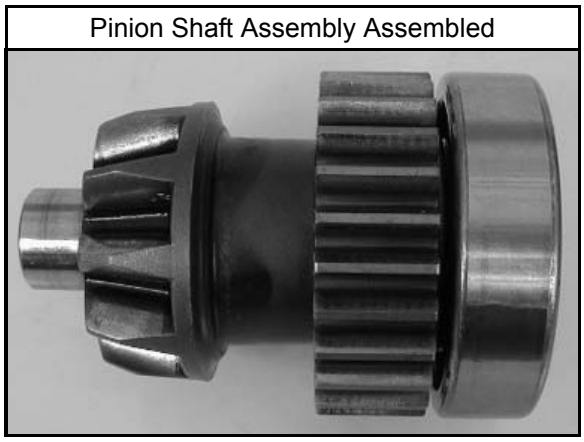
2. Install the 26T input gear (D), shim (E), and a new retaining ring (F) onto the output shaft.



3. Assemble the pinion shaft assembly (if previously disassembled). Install the 26T gear (G) and bearing (H) onto the pinion shaft (I).

NOTE: When replacing the 26T output, be sure the step of the gear is facing towards the bearing (see below).

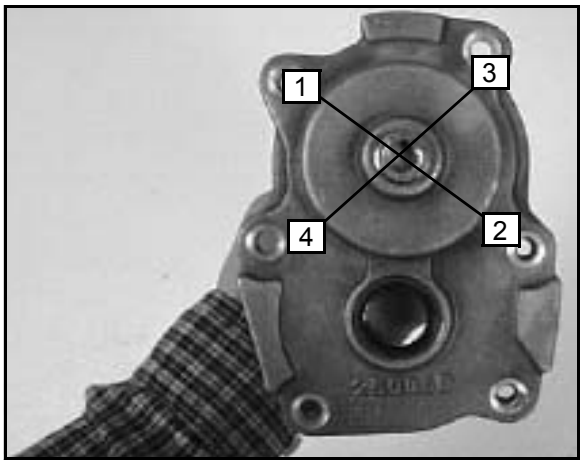




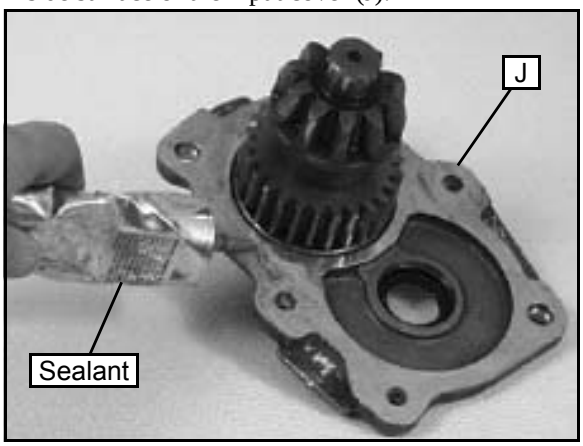
4. Install the pinion shaft assembly into the input cover.

NOTE: Alignment of the pinion shaft bearing into the input cover maybe be difficult. If needed, use the following steps to aid in installation:

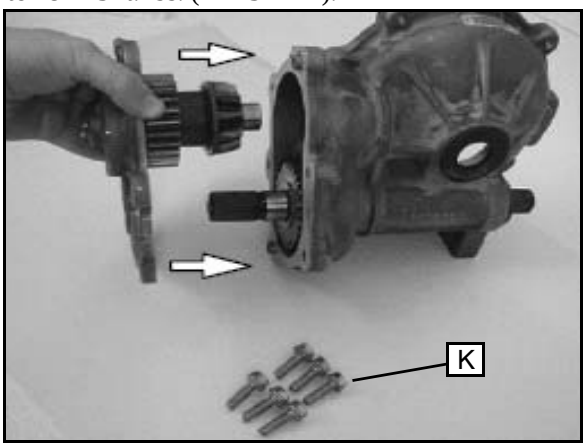
- Hold the pinion gear assembly
- Use a rubber mallet to lightly tap on the front of the input cover, around the bearing cup
- Tap the front cover in an X pattern (follow the pattern in the photo on the right), until the pinion gear assembly comes loose



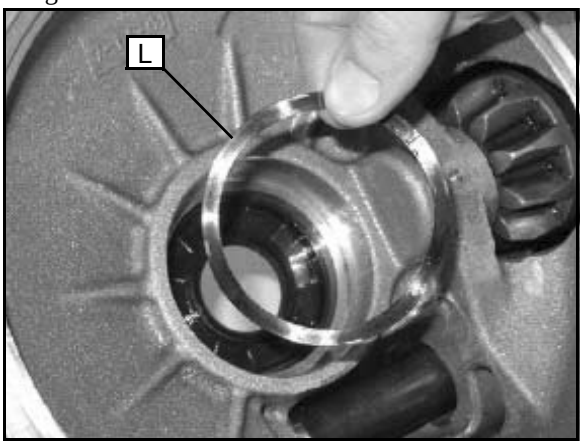
5. Apply Polaris Crankcase Sealant (PN 2871557) to the inside surface of the input cover (J).



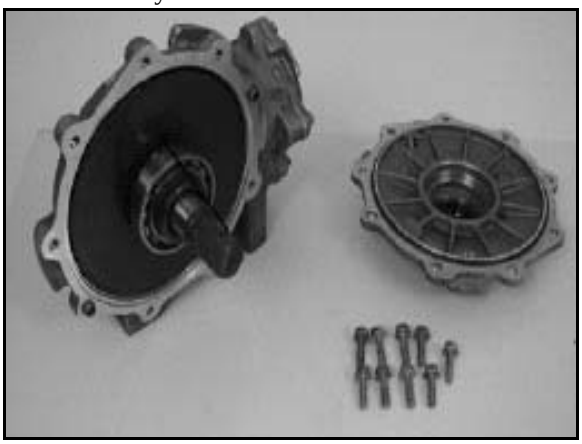
6. Install the pinion shaft assembly and input cover onto the gearcase. Install the input cover bolts (K). Torque the bolts to 18 - 23 ft. lbs. (24 - 31 Nm).



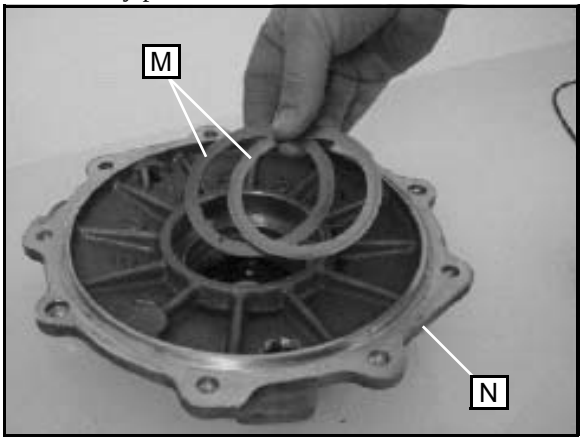
7. Install the wave spring (L) into the gearcase assembly. Be sure the wave spring is fully seated into the bearing cup of the gearcase.



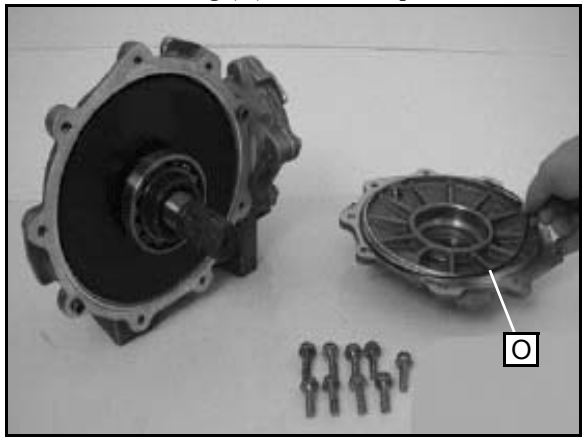
8. Install the output shaft and ring gear into the gearcase. Be sure the 10T input pinion gear and the output pinion gear mesh smoothly.



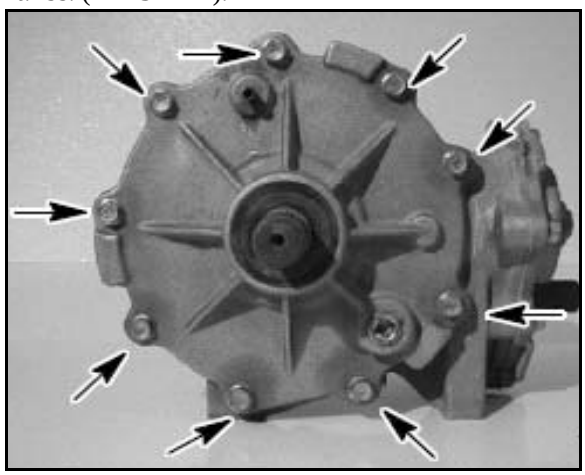
9. Install the shims (M) into the output cover (N). Install the shims in the order that they were removed during the disassembly process.



10. Install a new O-ring (O) onto the output cover.



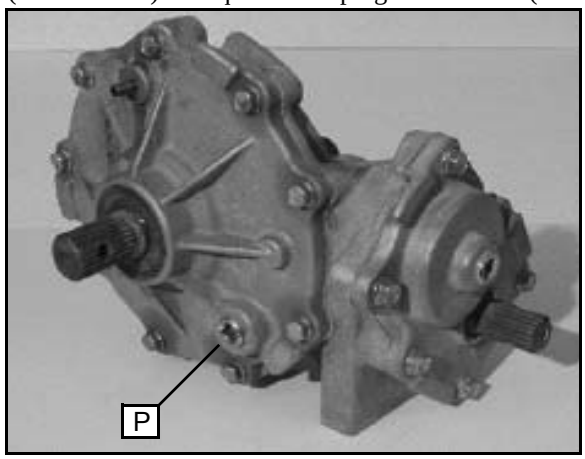
11. Carefully install the output cover onto the gearcase. Install the output cover bolts. Torque the bolts to 18 - 23 ft. lbs. (24 - 31 Nm).



Input Cover Bolt Torque:

18 - 23 ft. lbs. (24 - 31 Nm)

12. Remove the fill plug (P) and fill the mid gearcase with 6.75 oz. (200 ml) of Polaris ATV Angle Drive Fluid (PN 2871653). Torque the fill plug to 14 ft. lbs. (19 Nm).



Middle Gearcase Specifications:

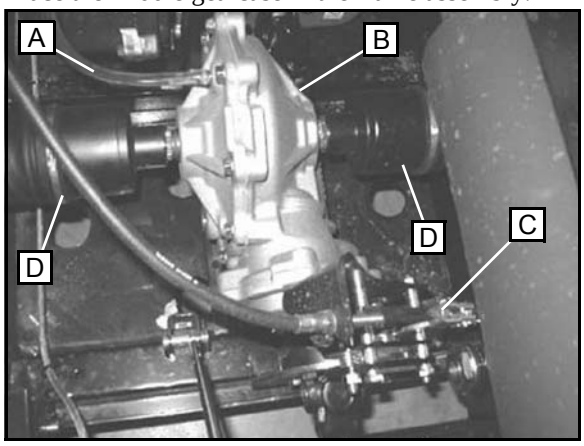
Capacity: 6.75 oz. (200 ml)

Specified Lubricant: ATV Angle Drive Fluid (PN 2871653)

Fill Plug Torque: 14 ft. lbs. (19 Nm)

Gearcase Installation

1. Place the middle gearcase in the frame assembly.



2. Attach the mid and rear prop shafts to the mid gearcase, but do not install the new roll pins yet.

3. Install the four middle drive gearcase bolts. Torque the bolts to 30 ft. lbs. (41 Nm) in a cross pattern.

4. Install a new roll pins into the mid and rear prop shafts and middle gearcase input and rear output shafts.

5. Install the mid drive shafts (D) onto the mid gearcase (B).

6. Install the vent tube (A) and clamp.

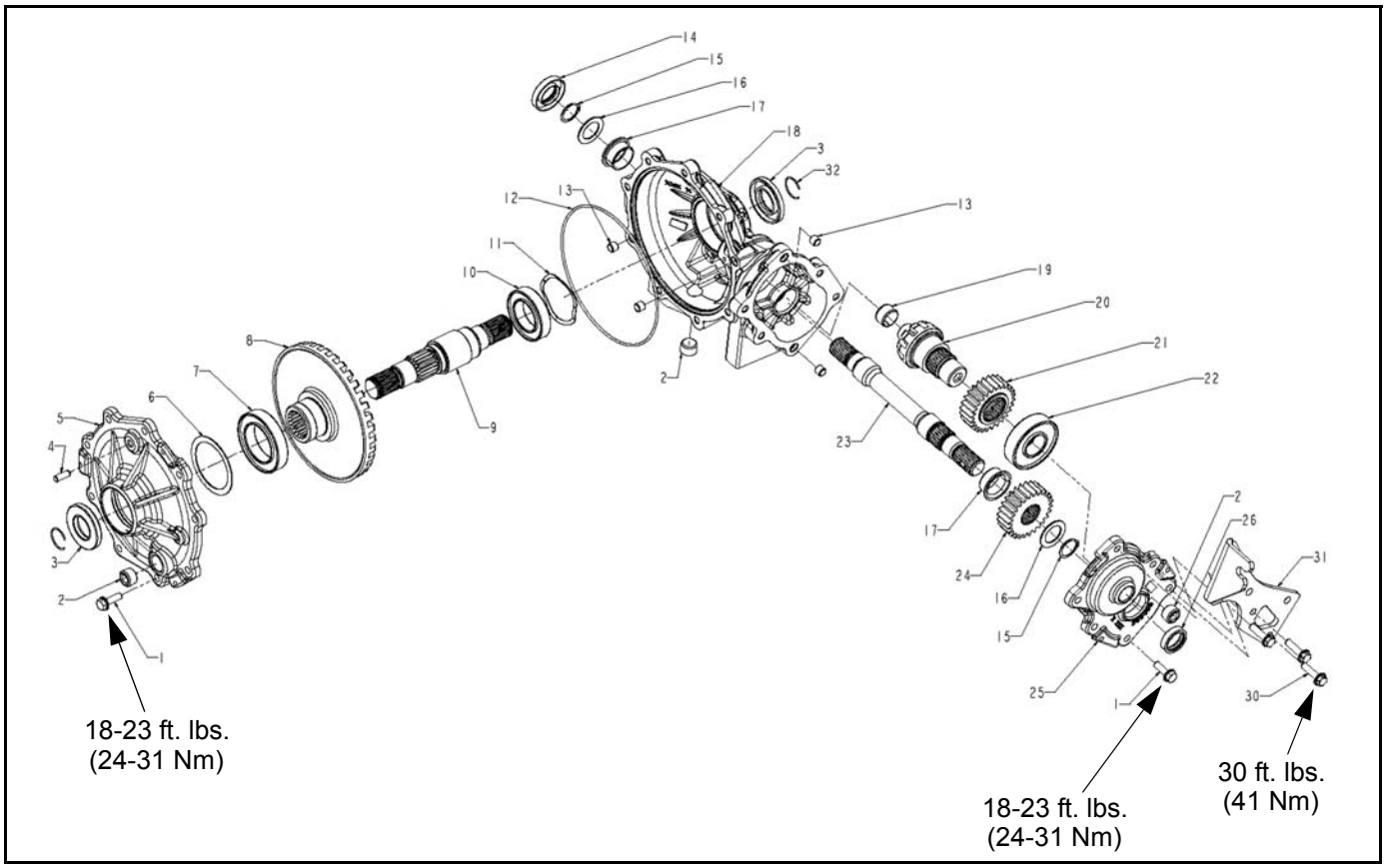
7. Lift bearing carrier into place and install bolt to upper control arm. Torque bolt to 35 ft. lbs. (47 Nm). Refer to the "MID DRIVE SHAFT INSTALLATION" section for more details.

8. Install hub, flat washer, domed washer (domed side out) and nut. Torque center nut to 110 ft. lbs. (149 Nm). Install new cotter pin and hub cap.

9. Install rear wheel and torque wheel nuts to specification.

10. Install the parking brake caliper (C), refer to Chapter 9, "Parking Brake Caliper Service - Caliper Installation"

Mid Gearcase Exploded



REF#	DESCRIPTION	QTY	REF#	DESCRIPTION	QTY
1	Screw (5/16-18 x 1.0)	12	16	Washer, Thrust	2
2	Plug, Square Socket	3	17	Bearing, Plain Flanged	2
3	Seal, Dual Lip	2	18	Gearcase	1
4	Tube, Vent 1/4” Hose	1	19	Bushing	1
5	Cover, Output	1	20	Pinion, 10T	1
6	Shim	1	21	Gear, 26T Output	1
7	Bearing, Ball	1	22	Bearing, Ball	1
8	Gear, Ring 37T	1	23	Shaft, Output Thru	1
9	Shaft, Output	1	24	Gear, 26T Input	1
10	Bearing, Ball	1	25	Cover, Input	1
11	Spring, Wave	1	26	Seal, Triple Lip	1
12	O-Ring	1	30	Bolt, (5/16-18 x 1.25)	3
13	Pipe, Knock	4	31	Bracket, Caliper Mount	1
14	Seal, Triple Lip	1	32	Ring, Hog	2
15	Ring, Retaining	2			

REAR HUB / BEARING CARRIER (4X4)

Hub Inspection

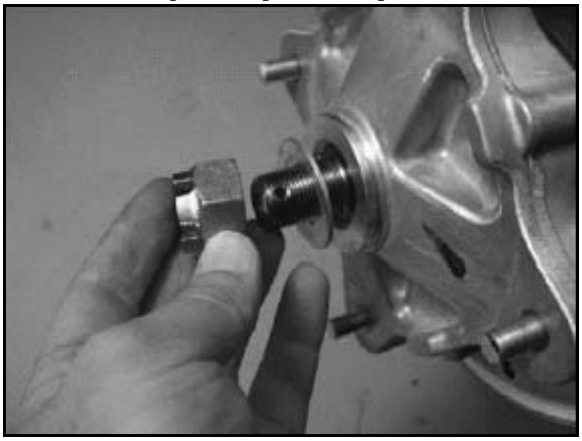
1. Support machine securely with rear wheels elevated.
2. Grasp wheel / hub and check for movement.
3. If movement is detected, inspect hub, hub nut torque and bearing condition and correct as necessary.

> **⚠ CAUTION**
>
> Serious injury may result if machine tips or falls. Be sure machine is secure before beginning this service procedure. Wear eye protection when removing bearings and seals.

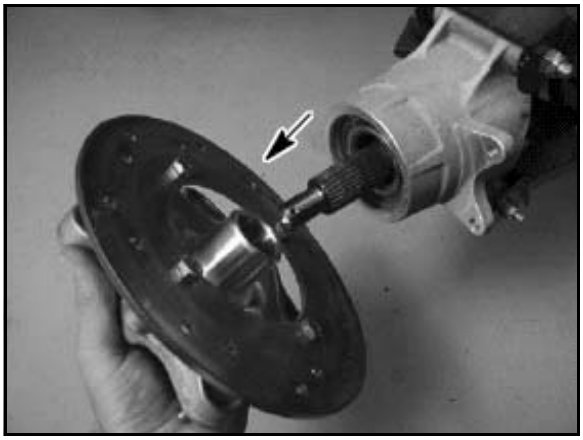
Hub Removal

1. Elevate rear end and safely support machine under main frame area.
2. Check bearings for side play by grasping the tire / wheel firmly and checking for movement. Grasp the top and bottom of the tire. The tire should rotate smoothly without binding or rough spots.
3. Remove wheel nuts and wheel.
4. Remove the two brake caliper attaching bolts.
   CAUTION: Do not hang the caliper by the brake line. Use wire to hang the caliper to prevent possible damage to the brake line.

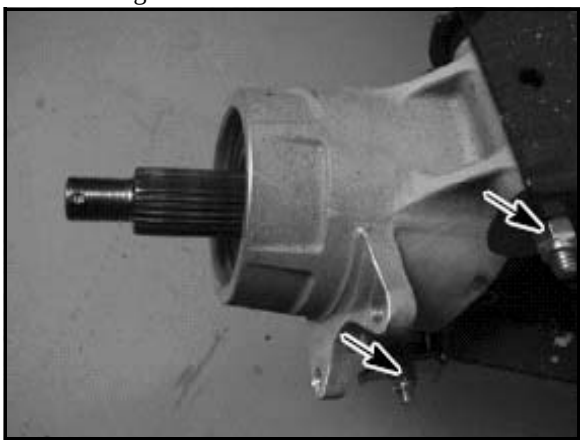
5. Remove hub cap, cotter pin, front spindle nut, and washer.



6. Slide the rear hub from the rear drive axle.



7. Remove the upper and lower control arm bolts from the rear hub / bearing carrier.



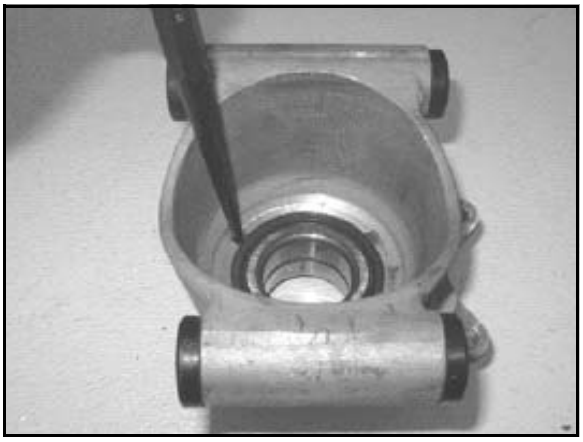
8. Remove the bearing carrier. Inspect the bearing again for smoothness and side to side movement, replace as needed.

Hub Disassembly

1. Remove outer snap ring (A).

2. From the back side, tap on the outer bearing race with a drift punch in the reliefs as shown.

NOTE: Drive bearing out evenly by tapping on outer race only. Once bearing is at bottom of casting, support casting on outer edges so bearing can be removed.



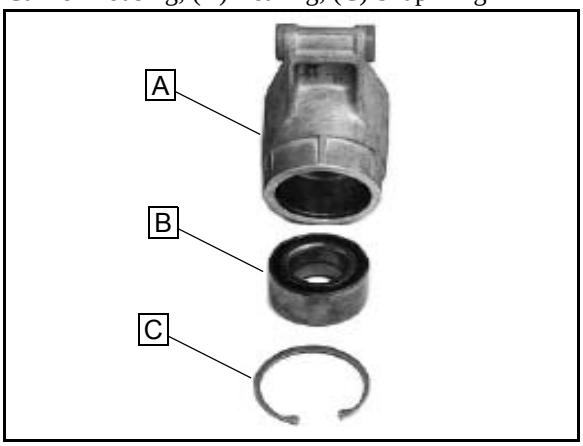
3. Inspect the bearing.

NOTE: Due to extremely close tolerances and minimal wear, the bearings must be inspected visually, and by feel. While rotating bearings by hand, inspect for rough spots, discoloration, or corrosion. The bearings should turn smoothly and quietly, with no detectable up and down movement and minimal movement sideways between inner and outer race.

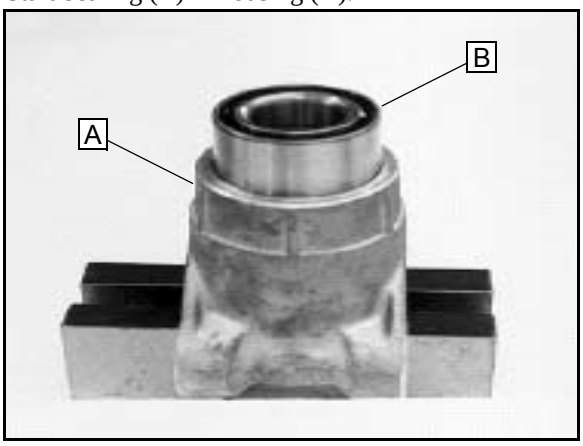
4. Inspect bearing housing for scratches, wear or damage. Replace housing if damaged.

Hub Assembly

1. Support bottom of bearing carrier housing. (A) Bearing Carrier Housing; (B) Bearing; (C) Snap Ring

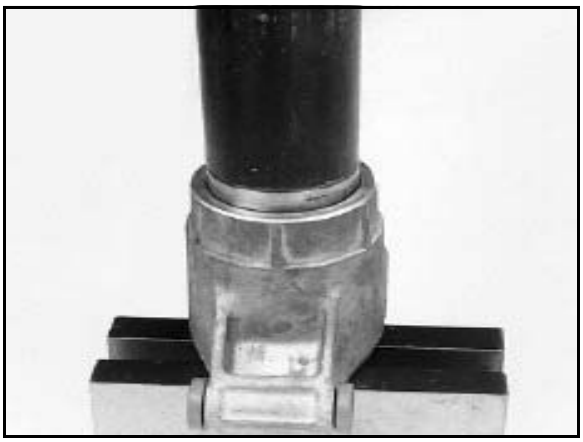


2. Start bearing (B) in housing (A).



3. Press bearing into place until outer race bottoms on housing.

> **⚠ CAUTION**
>
> Use an arbor and press only on the outer race, as bearing damage may occur.



4. Install snap ring into groove.

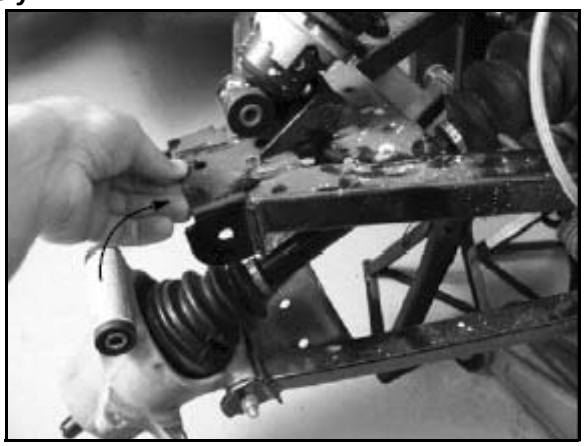
Hub Installation

1. Start the wheel bearing carrier onto the drive shaft.

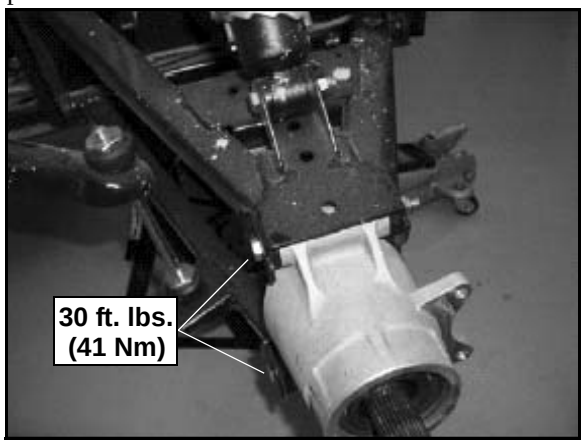
2. Align the bottom of carrier housing and lower control arm. Slide the lower control arm bushings into place. Secure with the lower control arm bolt.

3. With the drive shaft placed in the wheel bearing carrier, align the carrier with the top control arm. Secure with the upper control arm bolt.

NOTE: The lower shock bolt may need to be removed to allow the upper A-arm to move more freely.

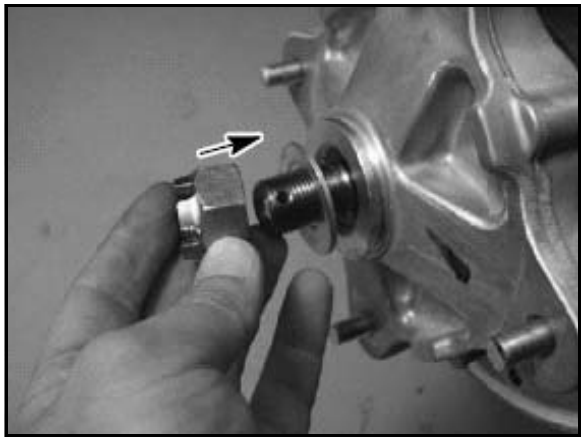


4. Torque the top and bottom A-arm bolts as shown in the photo.



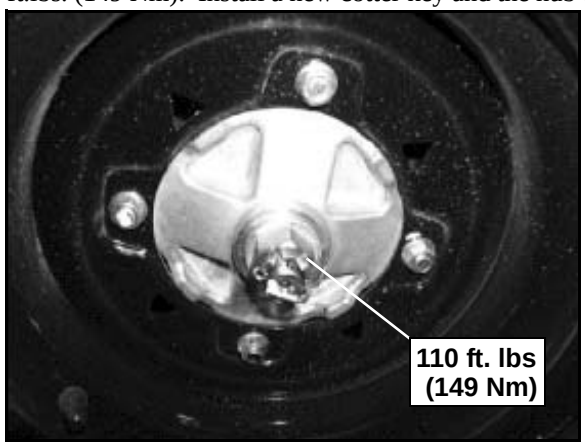
5. Install the hub assembly onto the rear drive axle.

6. Install the washer with domed side out. Install the spindle retainer nut.

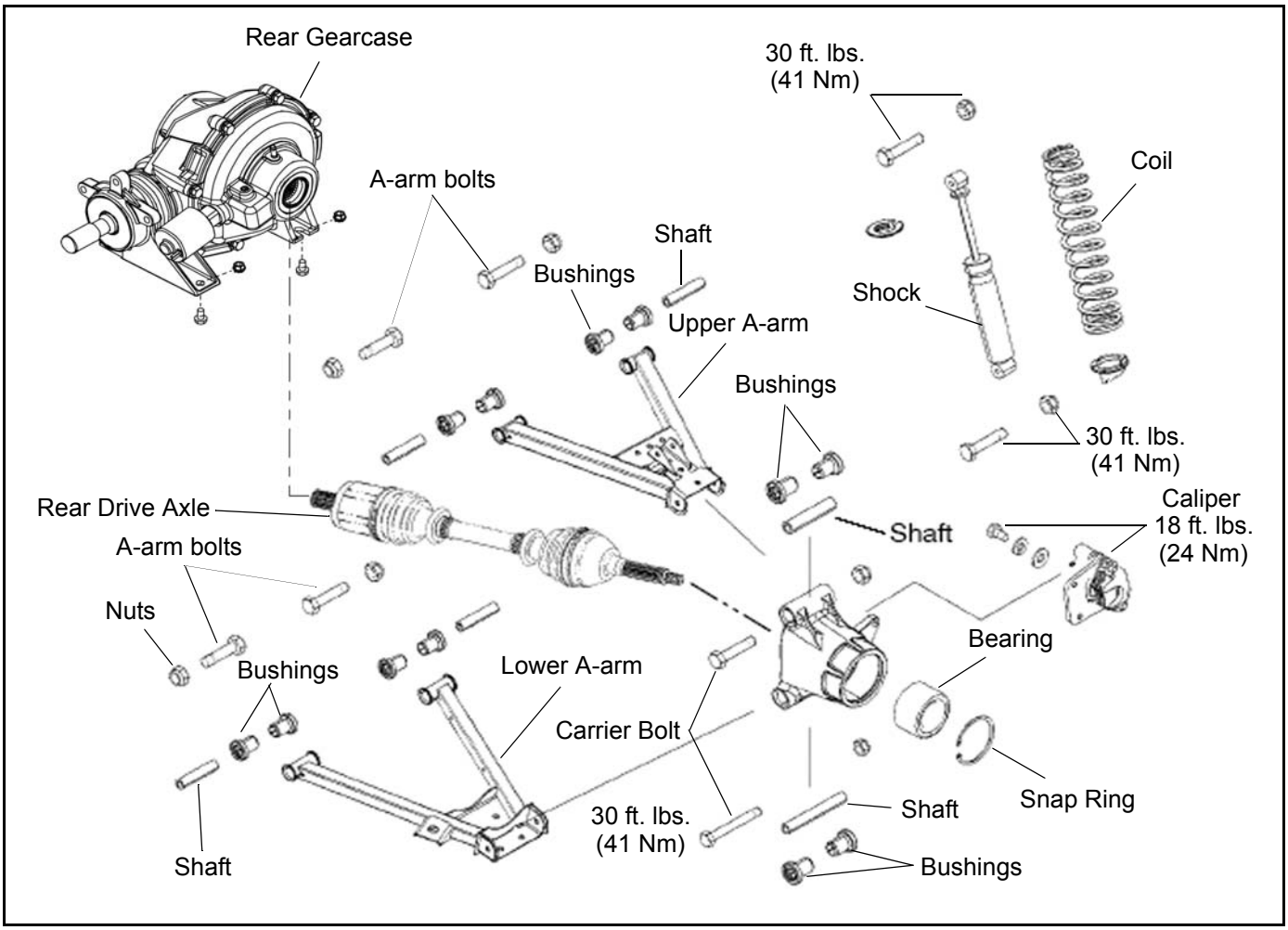


7. Install the wheel, washers, and wheel nuts. Torque wheel nuts to specification. See “Torque Specifications” table on page 7.3.

8. Lower the vehicle. Torque the spindle retaining nut to 110 ft.lbs. (149 Nm). Install a new cotter key and the hub cap.



Exploded View



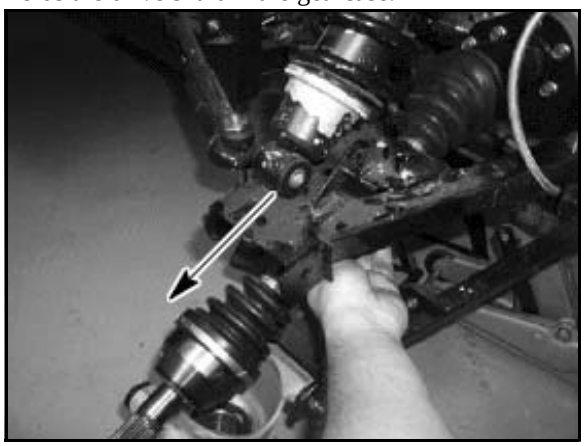
REAR DRIVE SHAFT (4X4 CREW)

Removal

1. Repeat all steps of the “Rear Hub / Bearing Carrier, Hub Removal” section.

2. Remove upper carrier bolt. Slide the rear drive shaft out of the bearing carrier by pulling the bearing carrier assembly outward and tipping it down to remove the shaft.

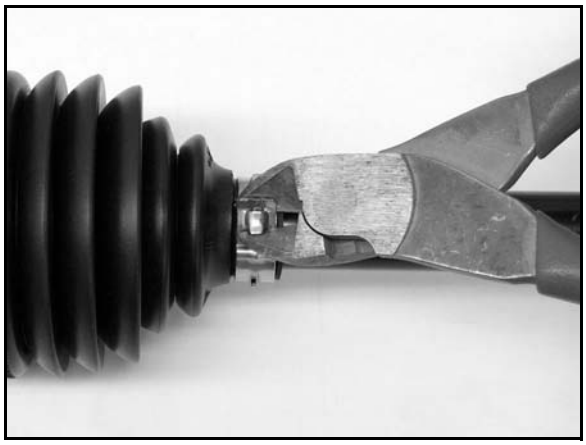
3. Pull the rear drive shaft straight out of the frame. Use short sharp jerks to free the circlip from the gearcase. The circlip holds the drive shaft in the gearcase.



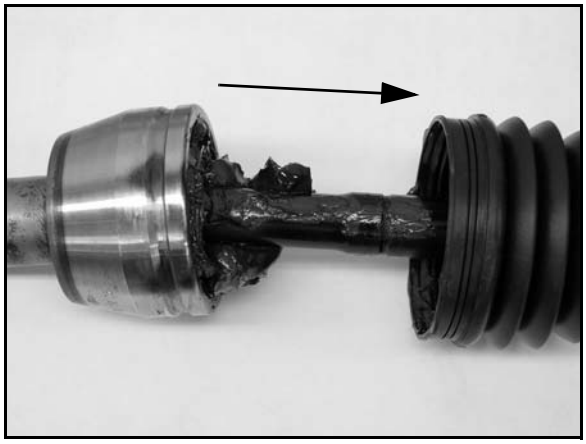
4. Inspect the axle splines and CV boots for any damage.

Outer CV Joint / Boot Replacement

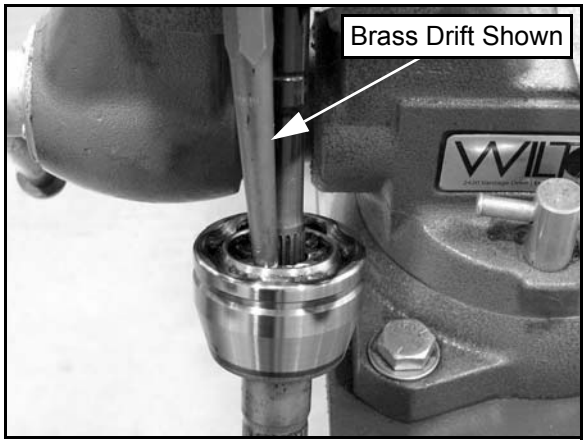
1. Using a side cutters, cut away and discard the boot clamps.



2. Remove the large end of the boot from the CV joint and slide the boot down the shaft.

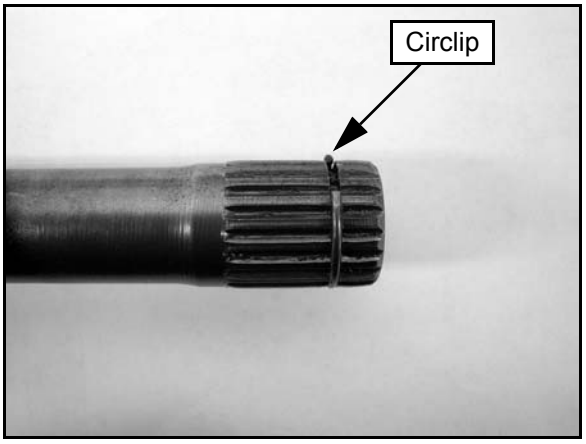


3. Clean the grease from the face of the joint.
4. Place the drive shaft in a soft-jawed vise.
5. Using a soft-faced hammer, or brass drift, strike the inner race of the joint to drive the joint off the drive shaft. Be sure to tap evenly around the joint to avoid binding.



IMPORTANT: Tap on inner race only!

6. Make sure the circlip is on the shaft and not left in the joint.



7. Remove the CV boot from the shaft.

> **⚠ CAUTION**
>
> Complete disassembly of the CV joint is NOT recommended. The internal components are a precision fit and develop their own characteristic wear patterns. Intermixing the internal components could result in looseness, binding, and/or premature failure of the joint.

IMPORTANT: If the grease in the joint is obviously contaminated with water and/or dirt, the joint should be replaced.

8. Thoroughly clean the joint with an appropriate solvent and dry the joint to prevent any residual solvent from being left in the joint upon reassembly.

9. Visually inspect the joint by tilting the inner race to one side to expose each ball. Severe pitting, galling, play between the ball and its cage window, any cracking or damage to the cage, pitting or galling or chips in raceways call for joint replacement.

NOTE: Shiny areas in ball tracks and on the cage spheres are normal. Do not replace CV joints because parts have polished surfaces. Replace CV joint only if components are cracked, broken, worn or otherwise unserviceable.

10. Clean the splines on the end of the shaft and apply a light coat of grease prior to reassembly.

11. Slide the small boot clamp and boot (small end first) onto the drive shaft and position the boot in it's groove machined in the shaft.

12. Install a NEW circlip on the end of the shaft.

13. Grease the joint with the special CV joint grease provided in the boot replacement kit. Fill the cavity behind the balls and the splined hole in the joint's inner race. Pack the ball tracks and outer face flush with grease. Place any remaining grease into the boot.

> **⚠ CAUTION**
>
> The grease provided in the replacement kit is specially formulated for wear resistance and durability. DO NOT use substitutes or mix with other lubricants.

NOTE: The amount of grease that's provided is pre-measured, so use all the grease.

Boot Replacement Grease Requirement:

Grease Only Service Kits
PN 1350059 - 20g
PN 1350046 - 30g
PN 1350047 - 50g

Outer CV Joint Capacity: 90g

14. Slide the joint onto the drive shaft splines and align the circlip with the lead-in chamfer on the inner race of the joint.

15. Use a soft-faced hammer to tap the joint onto the drive shaft until it locks into place.

16. Pull on the joint to make sure it is securely locked in place.

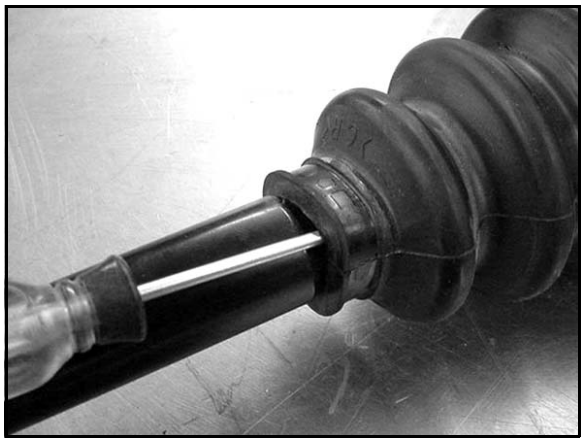
17. Remove excess grease from the CV joint's external surfaces and place the excess grease in the boot.

18. Pull the boot over the joint and position the boot lips into the grooves on the joint housing and shaft. Make sure the boot is not dimpled or collapsed.

19. Install and tighten the large clamp using the Axle Boot Clamp Tool (PU-48951).

Axle Boot Clamp Tool
PU-48951

20. While pulling out on the CV shaft, fully extend the CV joint and slide a straight O-ring pick or a small slotted screw driver between the small end of the boot and the shaft. This will allow the air pressure to equalize in the CV boot in the position that the joint will spend most of its life. Before you remove your instrument, be sure the small end of the boot is in its correct location on the shaft.

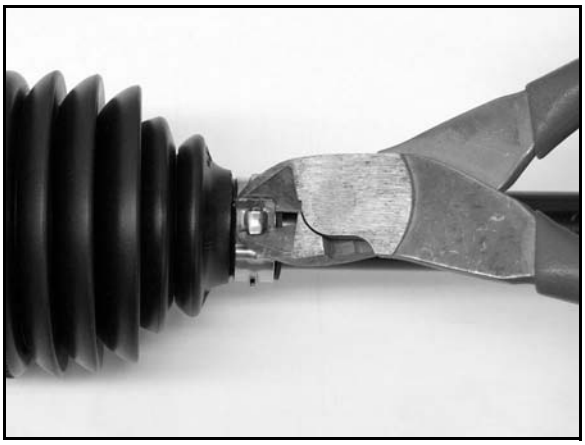


21. Install and tighten the small clamp on the boot using the Axle Boot Clamp Tool (PU-48951).

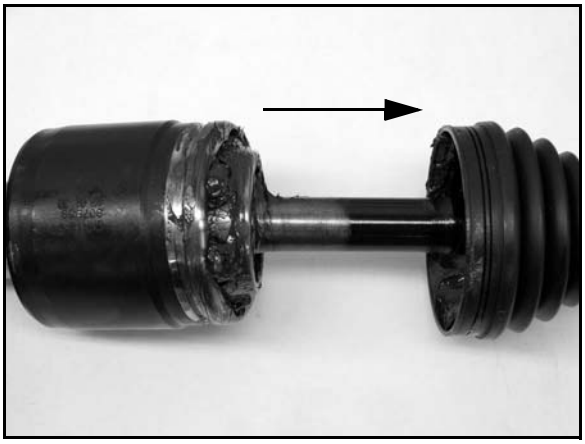
Axle Boot Clamp Tool
PU-48951

Inner Plunging Joint / Boot Replacement

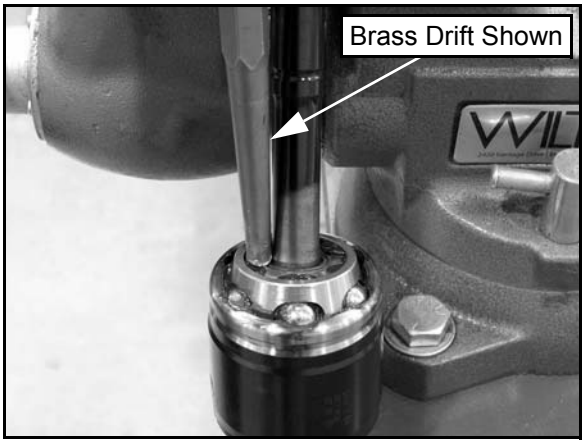
1. Using a side cutters, cut away and discard the boot clamps.



2. Remove the large end of the boot from the plunging joint and slide the boot down the shaft.

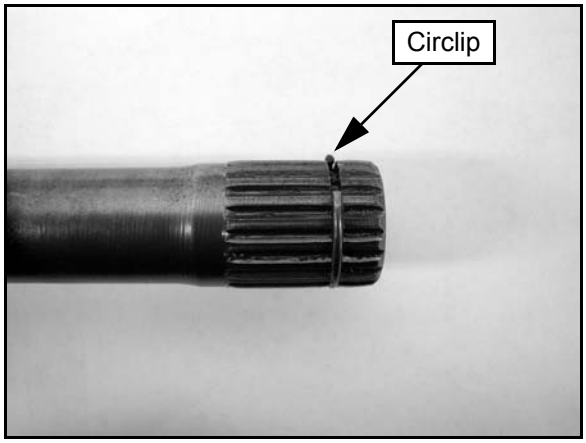


3. Clean the grease from the face of the joint.
4. Place the drive shaft in a soft-jawed vise.
5. Using a soft-faced hammer, or brass drift, strike the inner race of the joint to drive the joint off the drive shaft. Be sure to tap evenly around the joint to avoid binding.



IMPORTANT: Tap on inner race only!

6. Make sure the circlip is still on the shaft and not left in the joint.



7. Remove the boot from the shaft.

⚠ CAUTION

Complete disassembly of the plunging joint is NOT recommended. The internal components are a precision fit and develop their own characteristic wear patterns. Intermixing the internal components could result in looseness, binding, and/or premature failure of the joint.

IMPORTANT: If the grease in the joint is obviously contaminated with water and/or dirt, the joint should be replaced.

8. Thoroughly clean the joint with an appropriate solvent and dry the joint to prevent any residual solvent from being left in the joint upon reassembly.
9. Visually inspect the joint for damage. Replace if needed.
10. Clean the splines on the end of the shaft and apply a light coat of grease prior to reassembly.
11. Slide the small boot clamp and boot (small end first) onto the drive shaft and position the boot in its groove machined in the shaft.

12. Install a NEW circlip on the end of the shaft.

13. Grease the joint with the special CV joint grease provided in the boot replacement kit. Fill the cavity behind the balls and the splined hole in the joint's inner race. Pack the ball tracks and outer face flush with grease. Place any remaining grease into the boot.

> ⚠ CAUTION
>
> The grease provided in the replacement kit is specially formulated for wear resistance and durability. DO NOT use substitutes or mix with other lubricants.

NOTE: The amount of grease that's provided is pre-measured, so use all the grease.

Boot Replacement Grease Requirement:

Grease Only Service Kits
PN 1350059 - 20g
PN 1350046 - 30g
PN 1350047 - 50g

Inner Plunging Joint Capacity: 100g

14. Fully compress the joint and push the drive shaft firmly into the inner race.

15. Align the circlip with the lead-in chamfer.

16. Use a soft-faced hammer to tap the joint onto the drive shaft until you reach the end of the splines and the joint locks in place.

17. Pull on the joint to test that the circlip is seated and that the joint is securely fastened to the shaft.

18. Remove excess grease from the plunging joint's external surfaces and place the excess grease in the boot.

19. Pull the boot over the joint and position the boot lips into the grooves on the joint housing and shaft. Make sure the boot is not dimpled or collapsed.

20. Install and tighten the small clamp using the Axle Boot Clamp Tool (PU-48951).

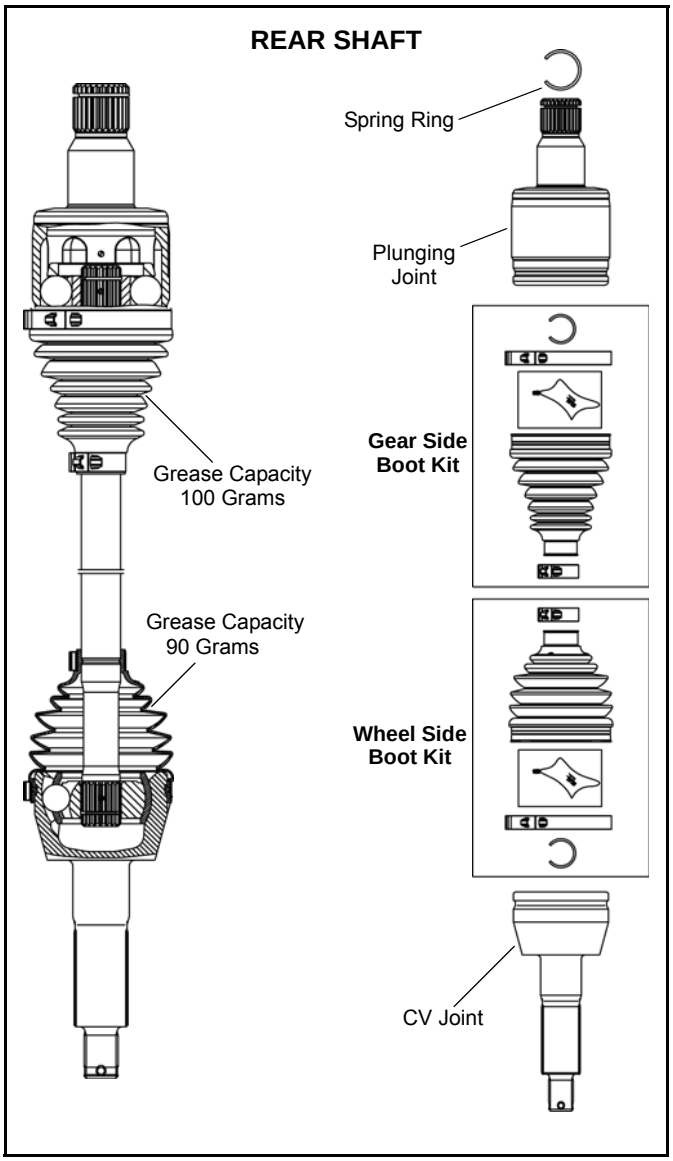
Axle Boot Clamp Tool
PU-48951

21. Pull out on the drive shaft to center the joint in the housing. Slide a straight O-ring pick or a small slotted screw driver between the large end of the boot and the joint housing and lift up to equalize the air pressure in the boot.

22. Position the boot lip in its groove. Install and tighten the large clamp using the Axle Boot Clamp Tool (PU-48951).

Axle Boot Clamp Tool
PU-48951

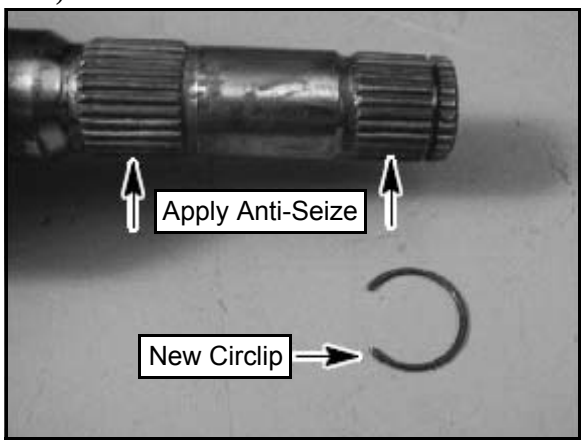
Drive Shaft Exploded View



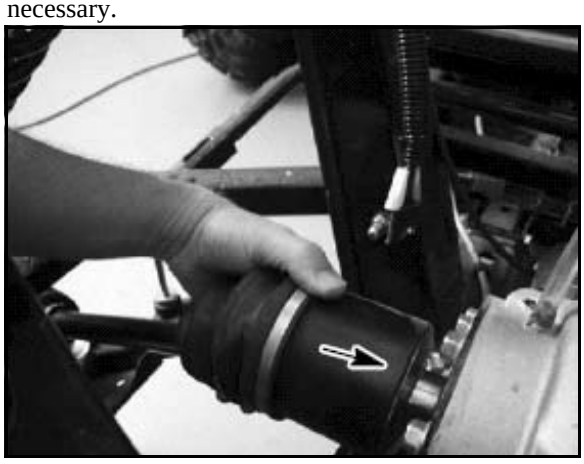
Installation

1. Slide the rear drive axle into the bearing carrier hub.

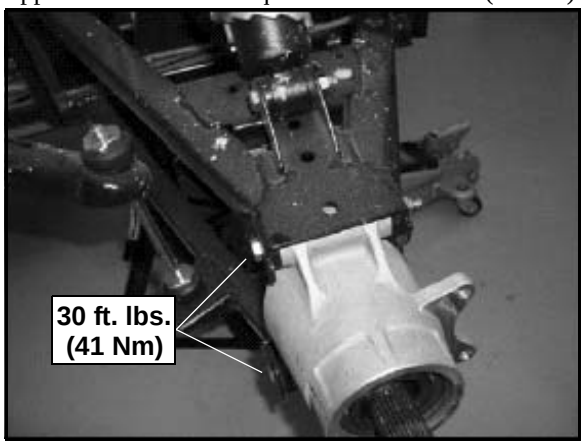
2. Install a new circlip onto the rear drive shaft. Apply Anti-Seize Compound onto the rear drive shaft splines (both ends).



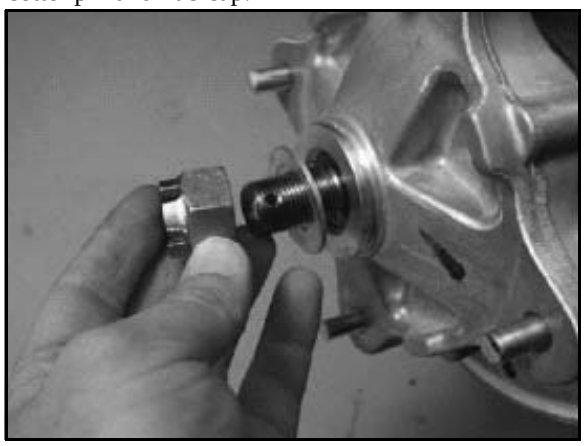
3. Reinstall the rear drive shaft into the rear gearcase. Be sure the circlip is securely fit into the rear gearcase. Use a rubber mallet to tap on the outboard end of the drive shaft if necessary.



4. Lift bearing carrier into place and install the bolt into the upper control arm. Torque bolt to 30 ft. lbs. (41 Nm).



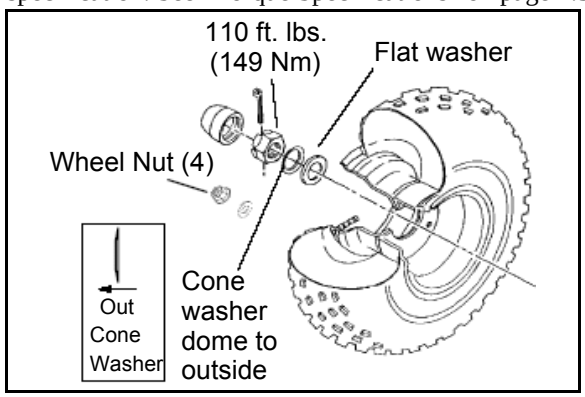
5. Install hub, domed washer (domed side out) and nut. Torque rear spindle nut to 110 ft. lbs. (149 Nm). Install new cotter pin and hub cap.



Rear Hub Nut Torque:

110 ft. lbs. (149 Nm)

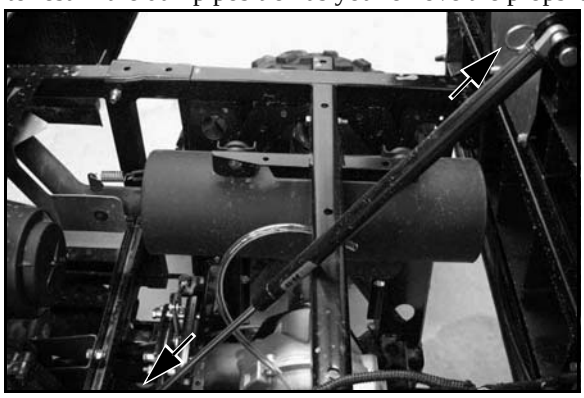
6. Install rear wheel and torque washers and wheel nuts to specification. See "Torque Specifications" on page 7.3.



REAR PROPSHAFT (4X4 CREW)

Removal

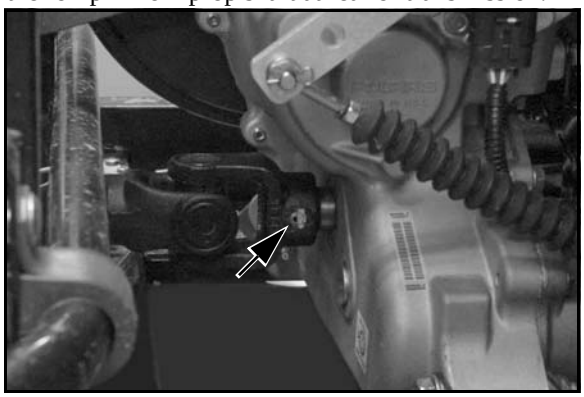
1. Remove the pin clips from upper and lower cargo box shock pins and remove shock. Carefully allow cargo box to rest in the dump position as you remove the propshaft.



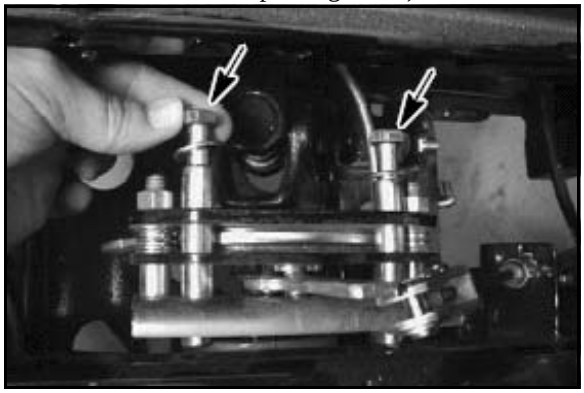
⚠ WARNING

Support the cargo box while the shock is removed to prevent injury or damage.

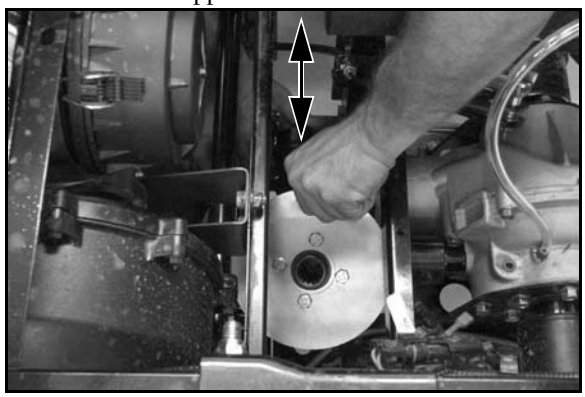
2. Use the Roll Pin Removal Tool (PN 2872608), to remove the roll pin from prop shaft at rear of transmission.



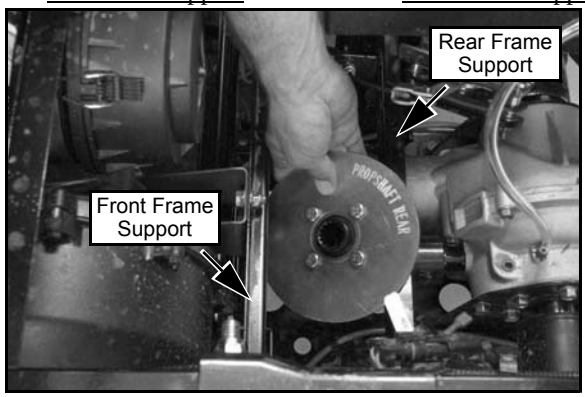
3. Remove the two bolts that secure the rear parking brake caliper. Suspend the brake caliper assembly from the frame with a piece of wire. (Refer to Chapter 9 for more information on the rear parking brake)



4. Slide the propshaft off the transmission shaft and rear gearcase input shaft. Orientate the shaft so that it's parallel with the frame supports as shown below.

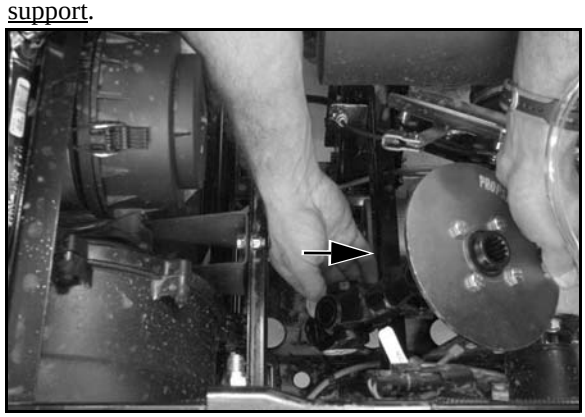


5. Remove the shaft by placing the brake disc over the top of the rear frame support and under the front frame support.



Installation

1. When installing the propshaft, ensure that the shaft is touching the rear frame support and reinstall the shaft the same way it was removed with the brake disc over the top of the rear frame support and under the front frame support.

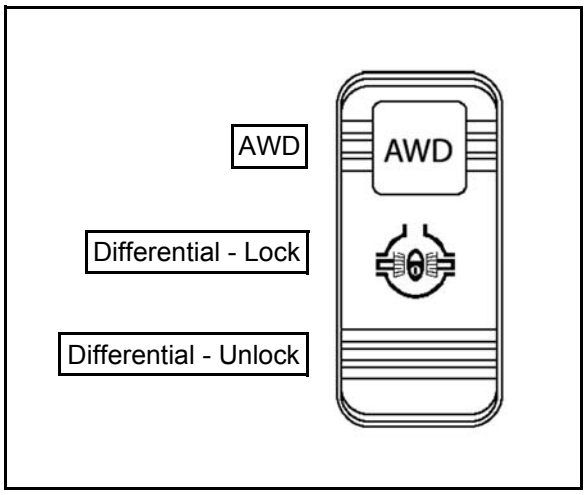


2. Slide the shaft onto the rear gearcase input shaft and then slide it onto the transmission shaft.
3. Install a new roll pin into the propshaft
4. Install the parking brake caliper and torque mounting bolts to **18 ft. lbs. (24 Nm)**.
5. Install cargo box shock, mounting pins and pin clips.

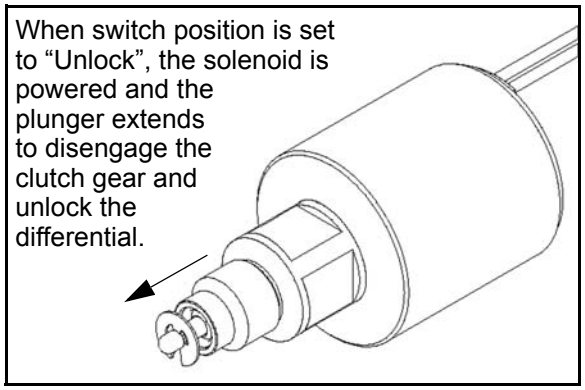
REAR GEARCASE (4X4 CREW)

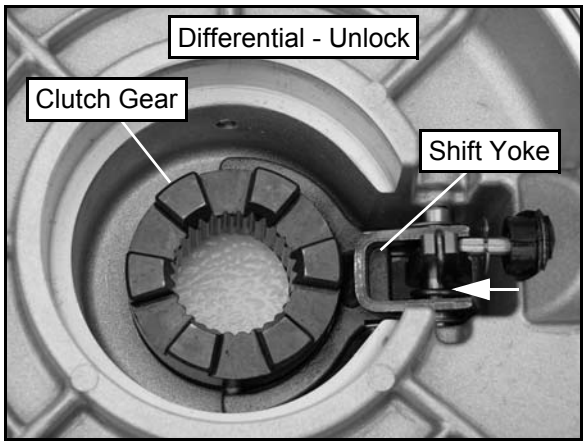
General Operation

The *RANGER* rear gearcase has three traction operational modes: AWD, Differential Lock, and Differential Unlock. Locking the rear differential is beneficial in low traction and rough terrain conditions. Unlocking the rear differential makes maneuvering easier and minimizes damage to turf and sensitive terrains.

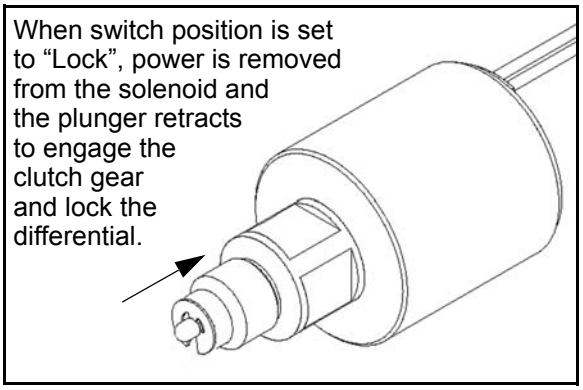


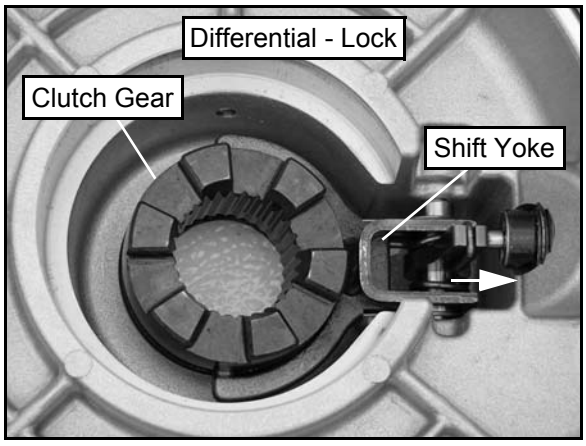
When "Differential-Unlock" is selected on the switch, the rear differential becomes unlocked for tighter turns. An electrical solenoid mounted in the rear gearcase housing actuates the shift yoke. The solenoid plunger extends out to move the shift yoke and slides the clutch gear away from the engagement dogs that are attached to the differential gear assembly. This unlocks the rear differential.



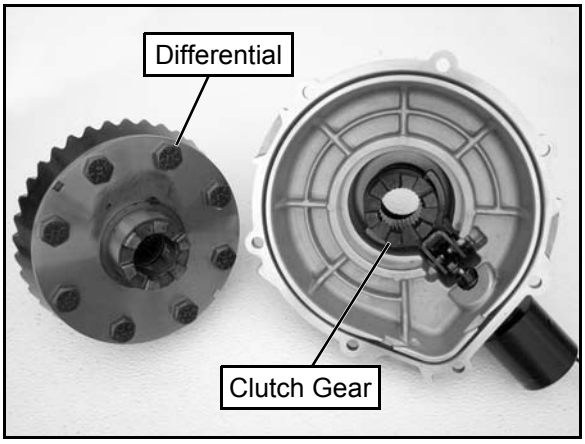


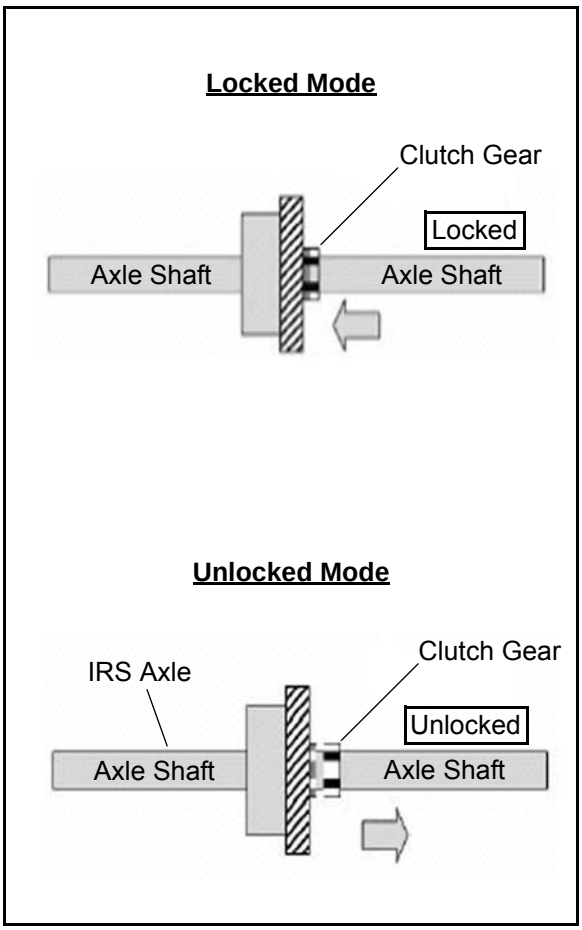
When "Differential-Lock" is selected on the switch, power is removed from the electrical solenoid allowing the solenoid plunger to retract. Spring tension moves the shift yoke back into place and engages the clutch gear into the engagement dogs that are attached to the differential gear assembly, locking the rear differential as a solid rear axle.





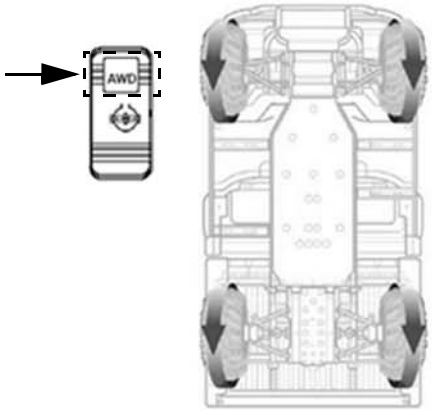
When the clutch gear is unlocked the rear drive shafts are dependent on the differential allowing tighter turns. When it's locked it becomes a solid rear axle increasing traction.





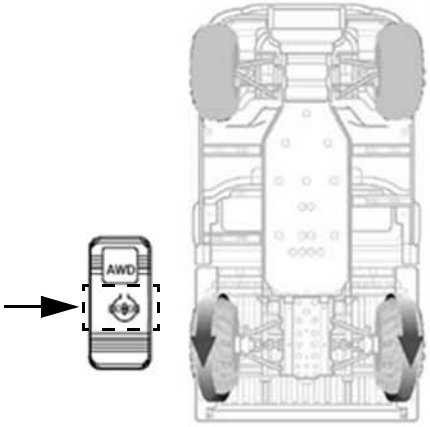
Operation Modes

AWD Mode



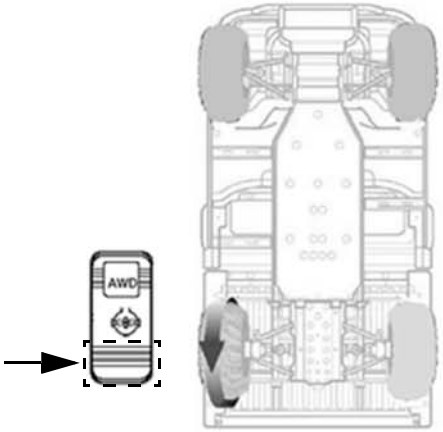
Rear Wheels rotate at same speed.
Front Wheels rotate at same speed when AWD activated.

Differential Locked



Both rear wheels rotate at same speed.

Differential Unlocked



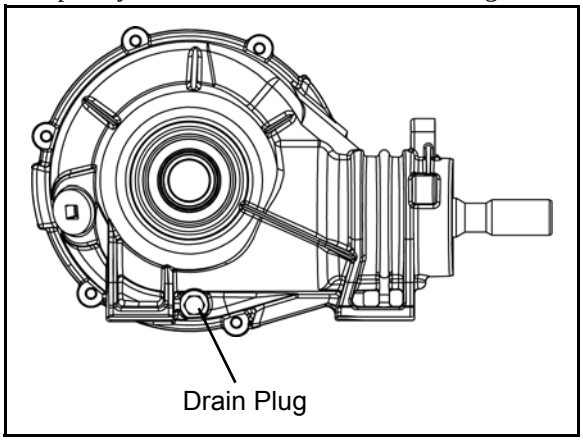
Rear wheels can rotate at different speeds.
(Allows for sharper turning)

Gearcase Removal

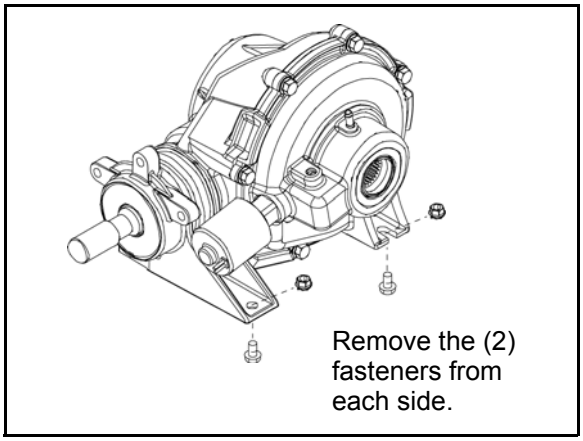
1. Follow "Rear Drive Shaft Removal" procedure to remove the rear drive shafts from each side of the rear differential.

2. Disconnect the differential solenoid 2-wire harness.

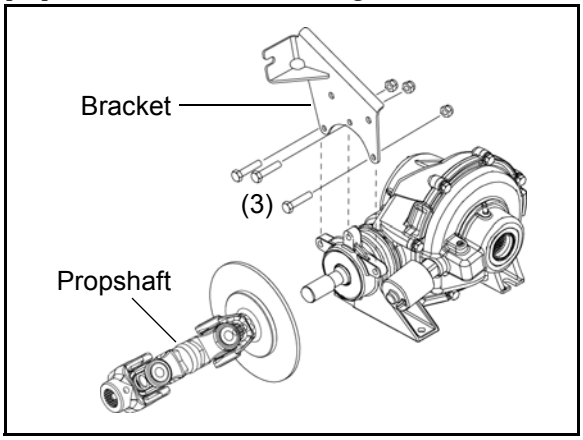
3. Completely drain the lubricant from the rear gearcase



4. Remove the four bolts that secure the rear gearcase to the frame.



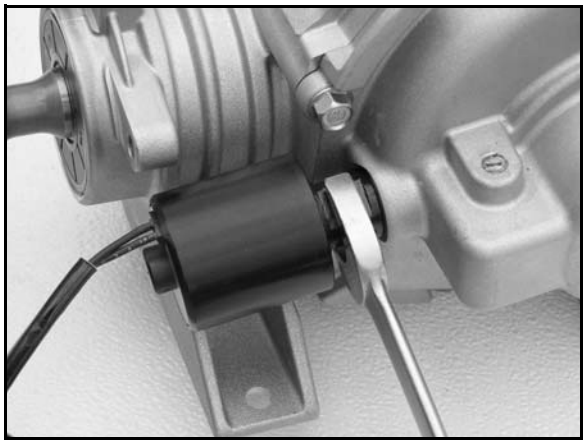
5. Remove the (3) fasteners retaining the parking brake caliper bracket to the rear gearcase and carefully pull the rear gear case assembly from the frame. Allow the rear propshaft to slide off of the rear gearcase shaft.



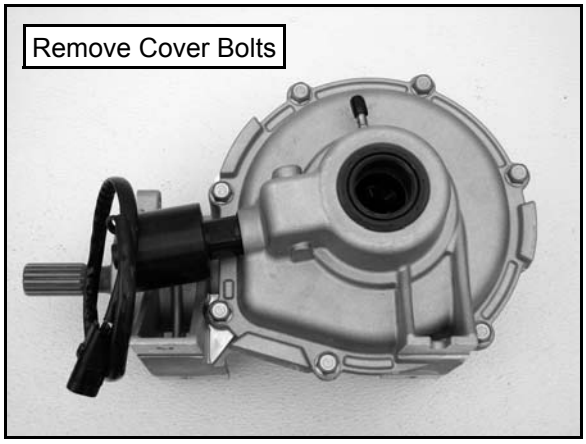
Gearcase Disassembly

IMPORTANT: The pinion gear assembly is NOT intended to be disassembled from the case, as it requires special OEM tooling in order to properly reassemble. If there is any damage to the pinion gear, bearings or case, the assembly must be replaced. Pinion and ring gear shimming information is NOT provided due to OEM manufacturing requirements.

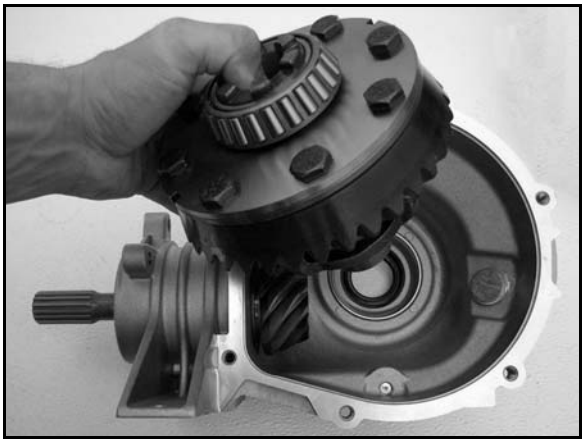
1. Remove the differential solenoid from the gearcase cover if servicing the solenoid, shift lever, shift lever spring, or shift yoke. If none of these items are being serviced, the solenoid can remain installed in the gearcase cover.



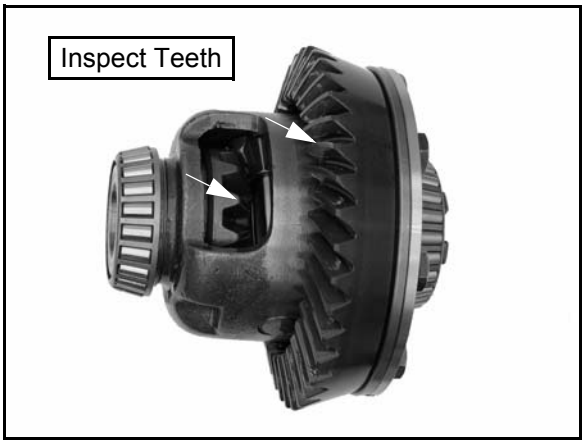
2. Remove the (7) bolts that secure the cover to the housing.



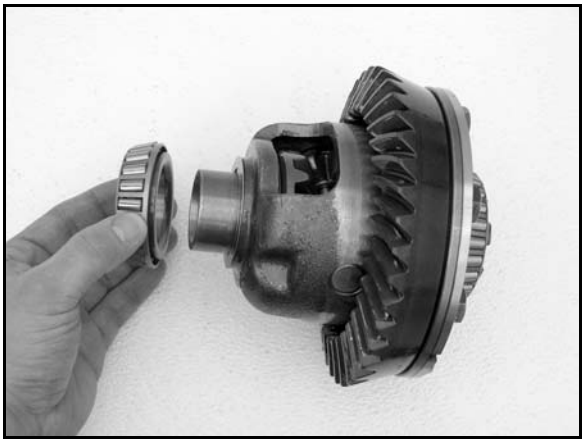
3. Remove the differential assembly from the housing.



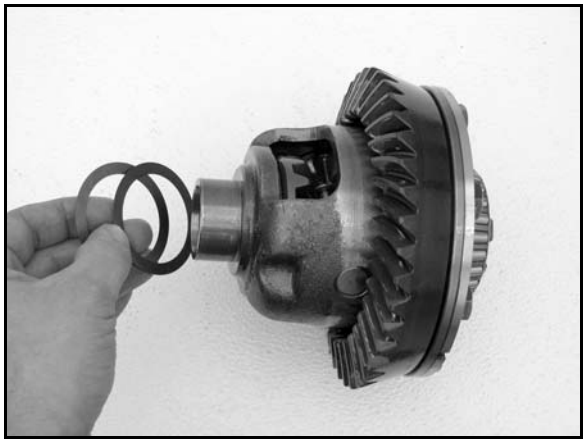
4. Inspect the bevel gear teeth for chipped, worn, or broken teeth.



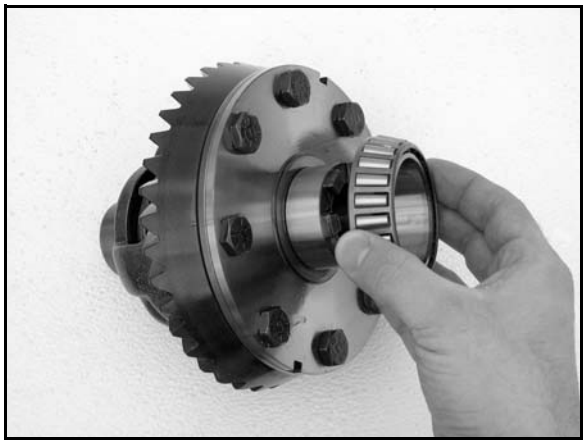
5. Remove the small bearing from the differential assembly. Inspect the bearing for smoothness and wear.



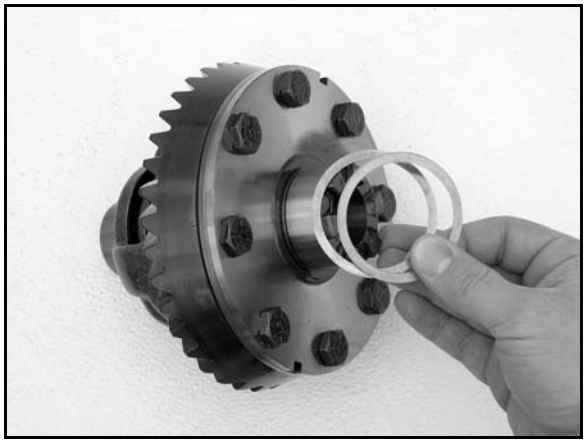
6. Remove the shims from the differential assembly. Be sure to keep the shims together for reassembly.



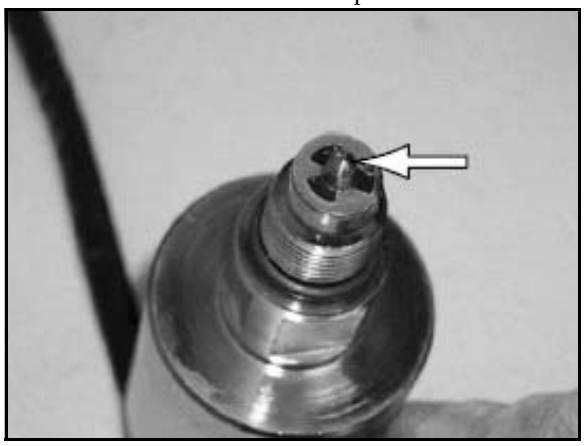
7. Remove the large bearing from the differential assembly. Inspect the bearing for smoothness and wear.



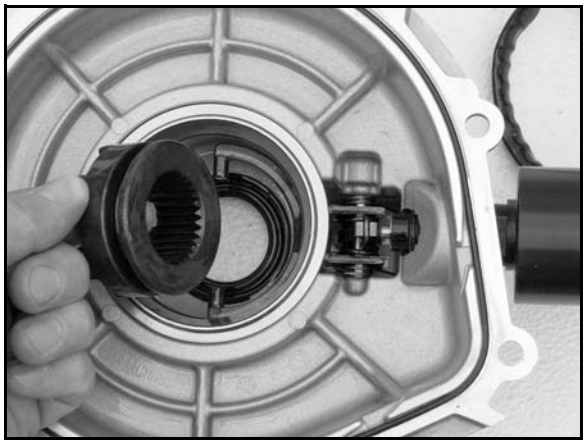
8. Remove the shims from the differential assembly. Be sure to keep the shims together for reassembly.



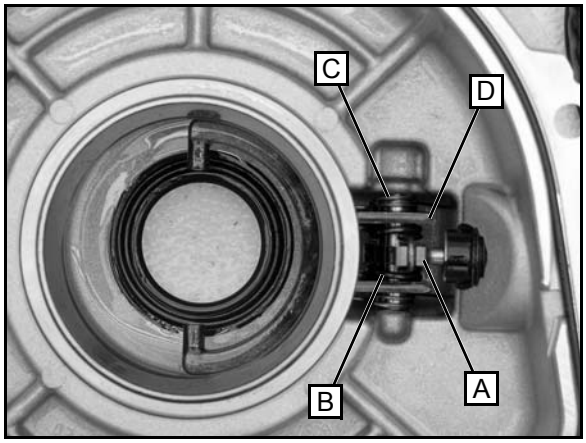
9. If the solenoid was removed for servicing, inspect the tip of the solenoid for wear. If the tip of the solenoid is flattened the solenoid must be replaced.



10. Remove the clutch gear from the gearcase cover.

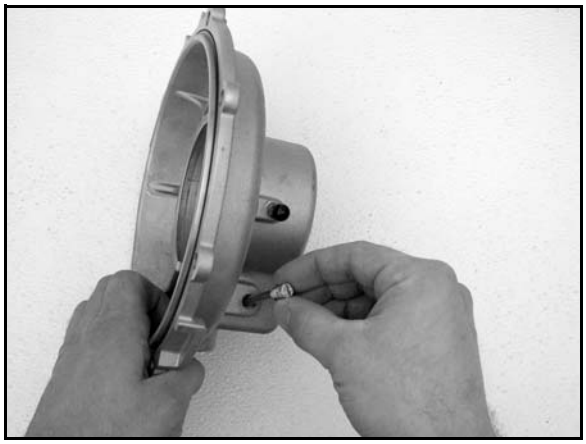


11. Inspect the shift lever (A), shift lever spring (B), shift return springs (C), and shift yoke (D) for excessive wear or damage. If disassembly is required proceed to the next step. If no disassembly is required proceed to "Rear Gearcase Assembly."

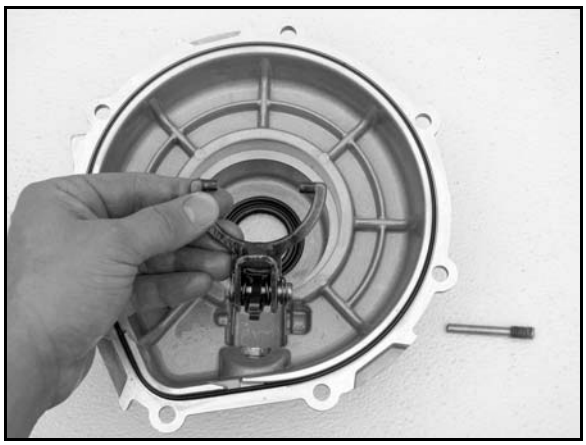


12. Loosen the lock assembly pin.

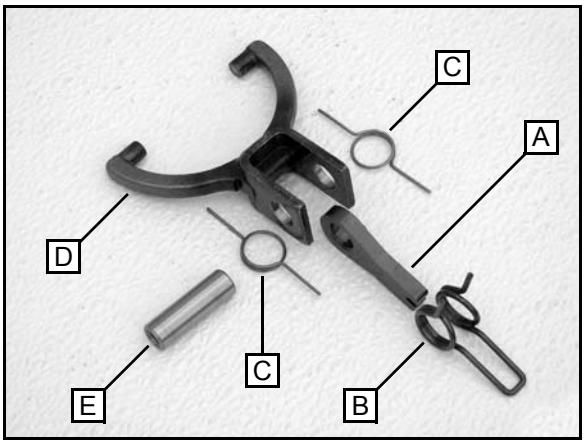
13. Remove the pin from the gearcase cover.



14. Carefully remove the shift yoke assembly from the gearcase cover.



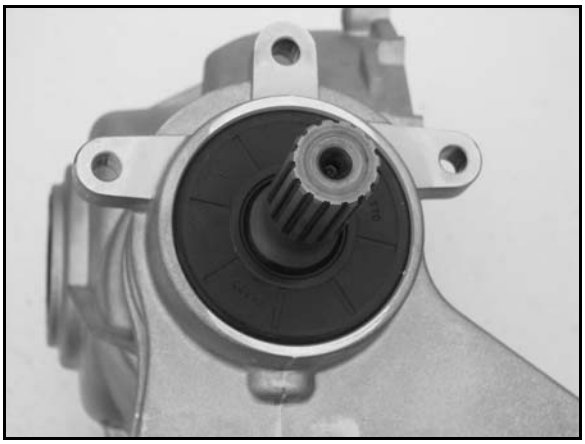
15. Inspect the shift lever (A), shift lever spring (B), shift return springs (C), shift yoke (D), and lock pin bushing (E). Inspect the components for excessive wear or damage and replace as needed.



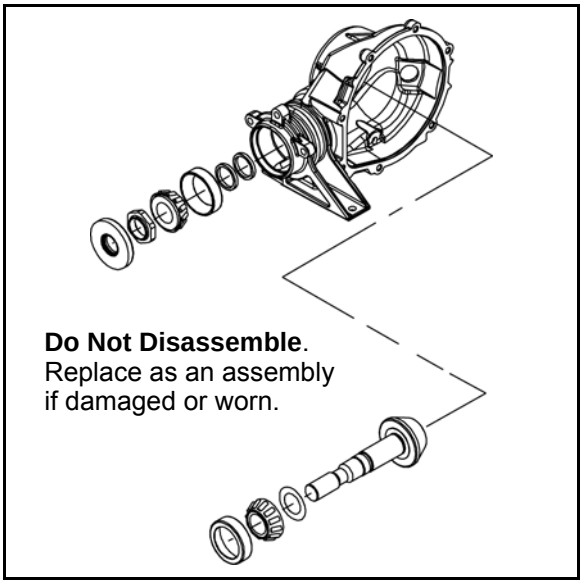
Rear Gearcase Assembly

NOTE: Grease all seals and O-rings with Polaris All Season Grease (PN 2871322) upon assembly.

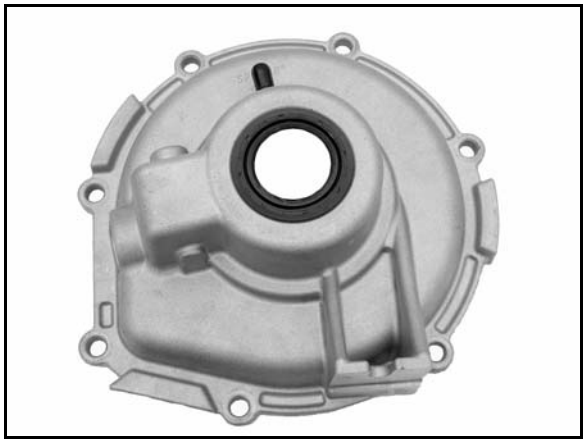
1. Remove the pinion shaft oil seal using a seal puller and replace with a new seal.



NOTE: The pinion gear assembly is NOT intended to be disassembled from the case, as it requires special OEM tooling in order to properly reassemble. If there is any damage to the pinion gear, bearings or case, the assembly must be replaced.

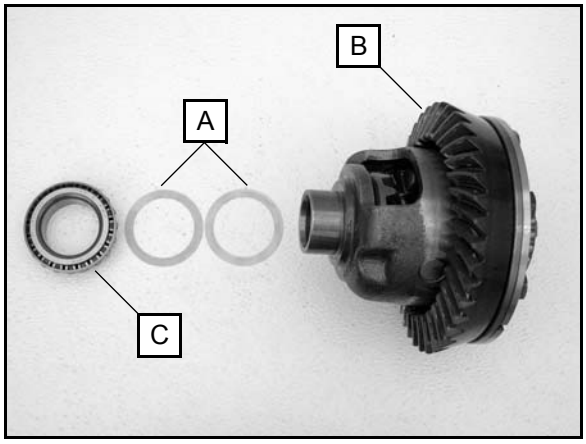


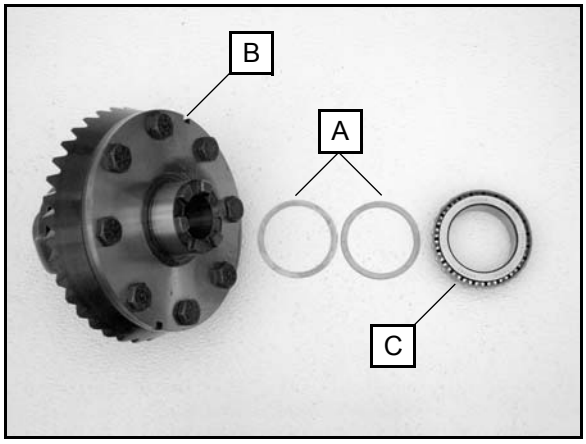
2. Replace the drive shaft oil seals located in the main gearcase and gearcase cover



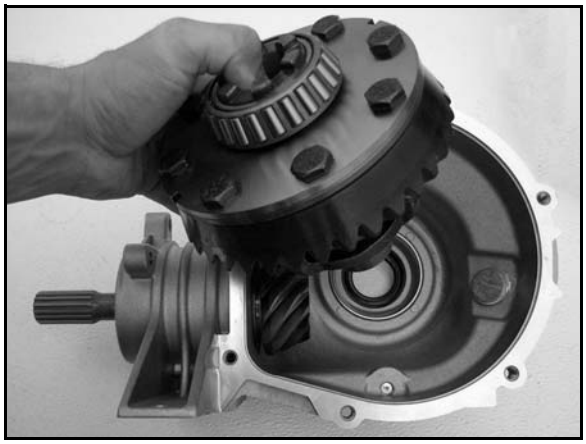
3. Replace all worn components.

4. Install the original shims (A) onto the differential assembly (B) on both sides. Install the bearings (C), replace with new bearings if needed.

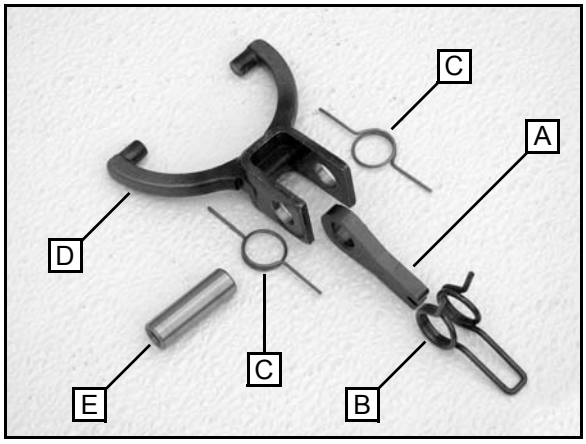




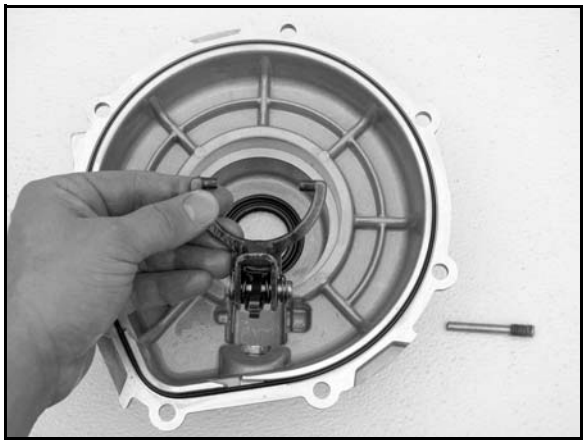
5. Install the differential assembly into the carrier housing.



6. If previously removed; assembly the shift lever (A), shift lever spring (B), shift return springs (C), shift yoke (D), and lock pin bushing (E).

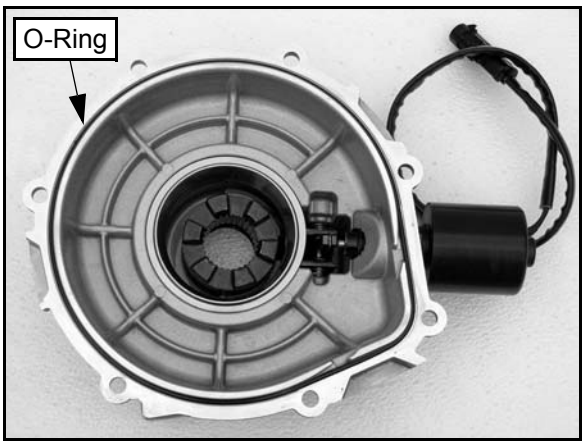


7. Carefully install the shift yoke assembly into the gearcase cover.

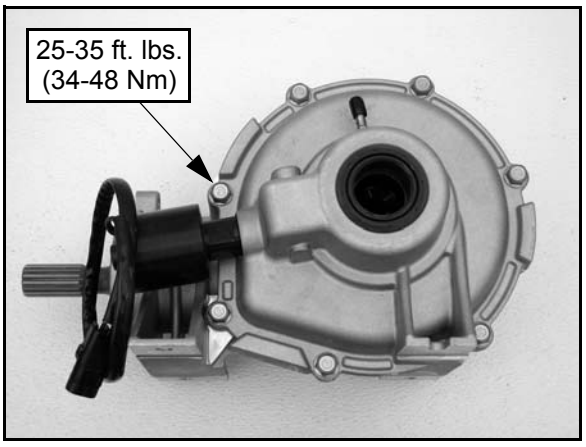


8. Install the lock assembly pin and tighten.

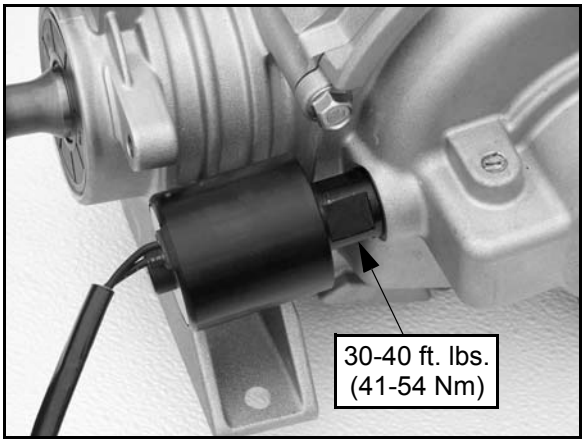
9. Install the new lightly greased O-ring onto the carrier cover.



10. Assemble the gearcase halves and install the (7) bolts that secure the cover to the housing. Torque the bolts in a criss cross pattern to **25-35 ft. lbs. (34-48 Nm)**.



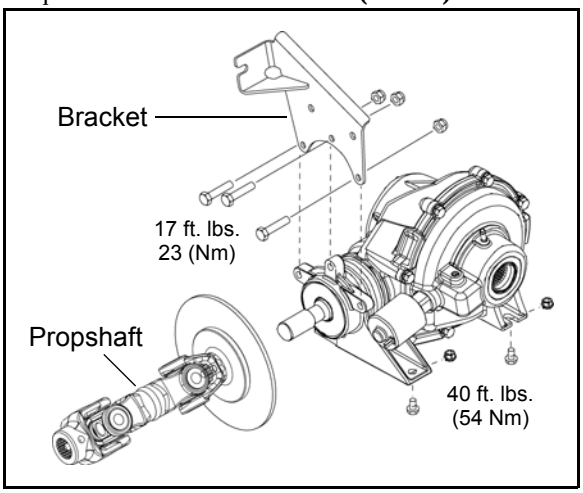
11. If previously removed, install the differential solenoid into the carrier cover. Torque solenoid to **30-40 ft. lbs. (41-54 Nm)**.



Rear Gearcase Installation

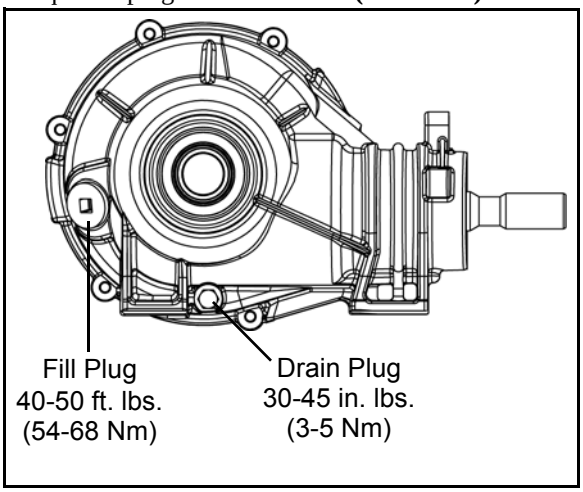
1. Place the differential assembly into the frame. Slide the rear propshaft onto the rear gearcase input shaft.

2. Install the (4) gearcase mounting fasteners and torque the fasteners to **40 ft. lbs. (54 Nm)**.
3. Install the parking brake caliper bracket fasteners and torque the fasteners to **17 ft. lbs. (23 Nm)**.



4. Reverse the removal procedure for the rest of the installation.

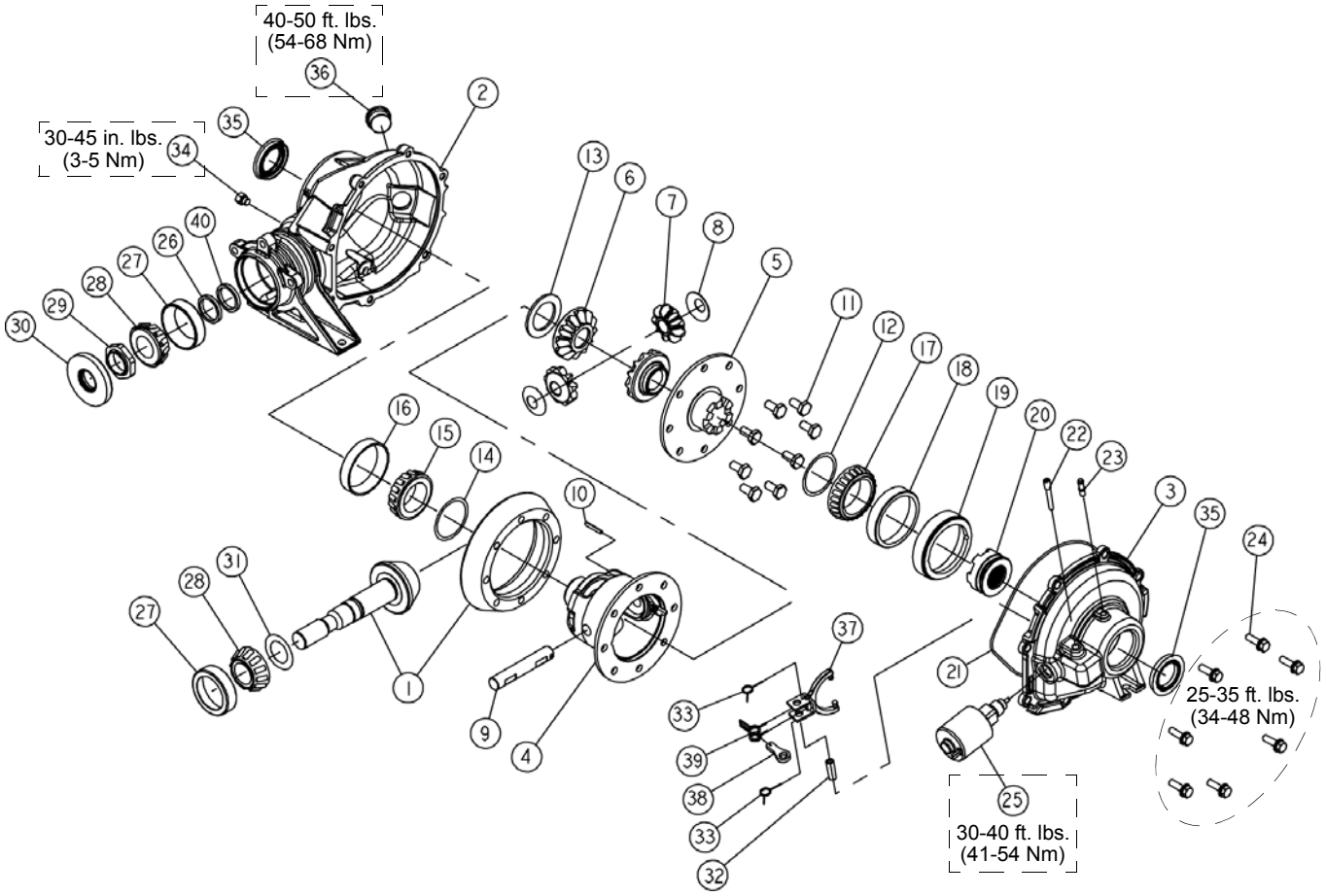
5. Add Polaris ATV Angle Drive Fluid (PN 2871653) to rear carrier. Refer to maintenance information in Chapter 2 for more details. Torque drain plug to **30-45 in. lbs. (3-5 Nm)**. Torque fill plug to **40-50 ft. lbs. (54-68 Nm)**.



Rear Gearcase Capacity:

18 fl. oz. (532 ml)

Rear Gearcase Exploded View (4x4 CREW)



REF#	DESCRIPTION	QTY	REF#	DESCRIPTION	QTY	REF#	DESCRIPTION	QTY
1	Hypoid Gear Assembly	1	15	Bearing Cone - Diff	1	29	Pinion Nut	1
2	Carrier Housing Half	1	16	Bearing Cup - Diff	1	30	Oil Seal - Pinion	1
3	Carrier Cover Half	1	17	Bearing - Roller	1	31	Pinion Thrust-Washer	AR
4	Diff Case Half	1	18	Bearing - Cup	1	32	Lock Pin Bushing	1
5	Diff Case Cover Half	1	19	Bearing Assembly - Collar	1	33	Shift Return Spring	2
6	Diff Side Gear	2	20	Clutch Gear	1	34	Drain Plug	1
7	Diff Pinion Mate Gear	2	21	O-Ring - Housing Halves	1	35	Oil Seal - Shaft	2
8	Pinion Mate Thrust-Washer	2	22	Lock Assembly Pin	1	36	Fill Plug	1
9	Diff Cross Pin	1	23	Vent Tube	1	37	Shift Yoke	1
10	Diff Roll Pin	1	24	Flanged Hex Bolt - Housing	7	38	Shift Lever	1
11	Hex Bolt - Ring Gear	8	25	Diff Solenoid	1	39	Shift Lever Spring	1
12	Diff Case Thrust-Washer	AR	26	Spacer - Kit	AR	40	Pinion Spacer	1
13	Side Gear Thrust-Washer	1	27	Bearing Cup - Pinion	2			
14	Diff Case Thrust-Washer	AR	28	Bearing Cone - Pinion	2			

REAR AXLE / GEARCASE SERVICE (6X6)

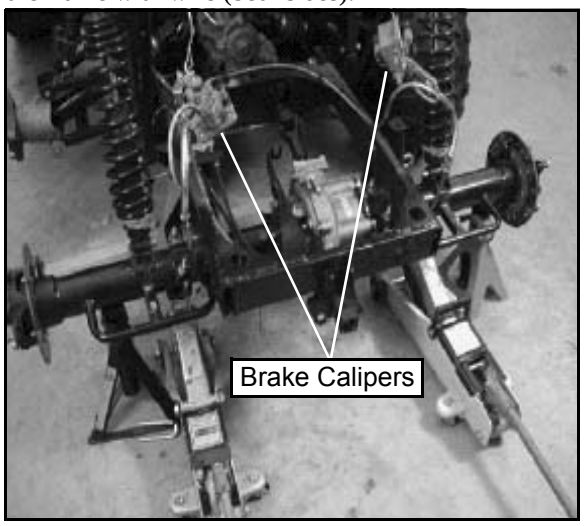
Rear Axle Removal

1. Jack up vehicle and support on frame and swing arm.

> **⚠ CAUTION**
>
> Serious injury could occur if machine tips or falls.

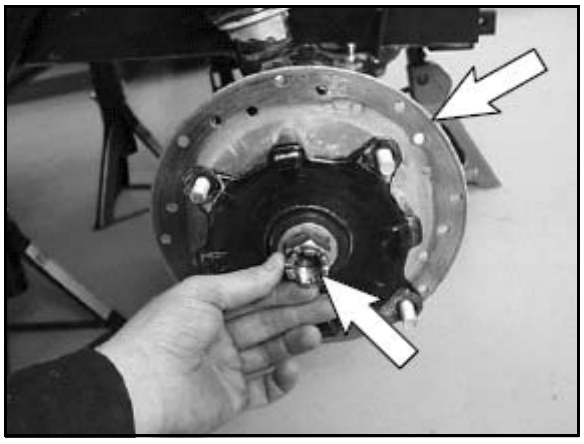
2. Remove rear wheels.

3. Remove the brake calipers. Suspend the brake calipers from the frame with wire (both sides).



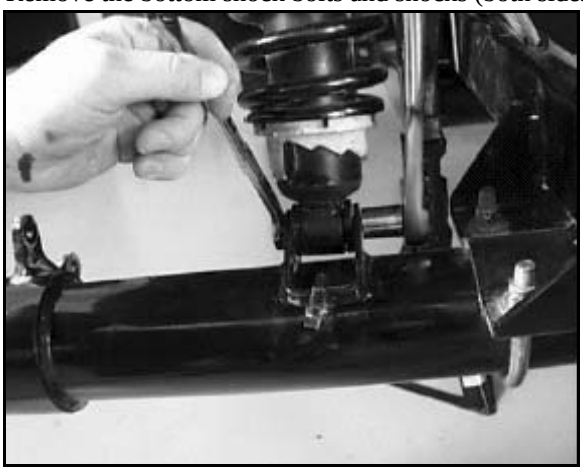
4. Remove the hub cover, cotter pin, spindle nut and washer (both sides).

5. Pull the hub off of the axle.

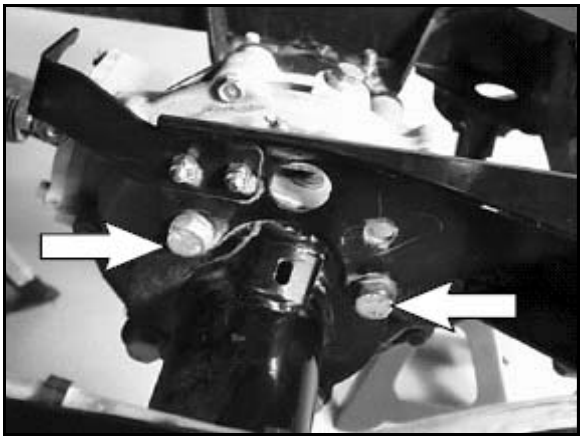


6. Remove the hose clamp from the rear gearcase breather hose. Remove the breather hose.

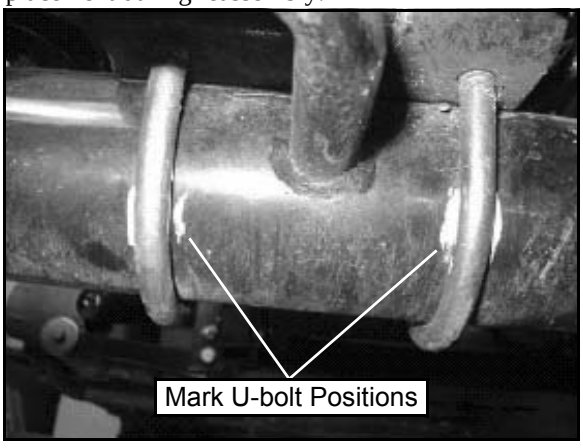
7. Remove the bottom shock bolts and shocks (both sides).



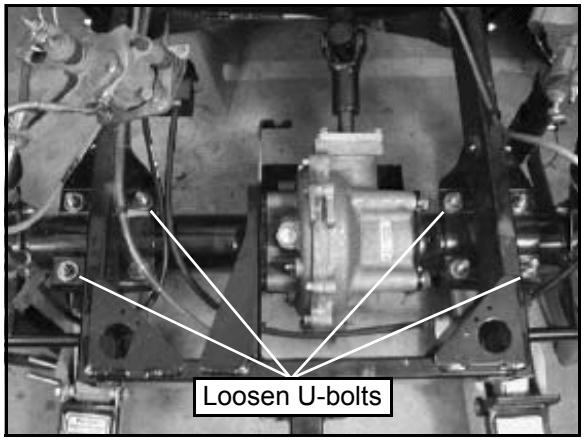
8. Remove the two bolts that secure the rear axle housing to the frame.



9. Mark the positions of the four U-bolts that secure the axle to the frame. This will aid with proper U-bolt and axle placement during reassembly.

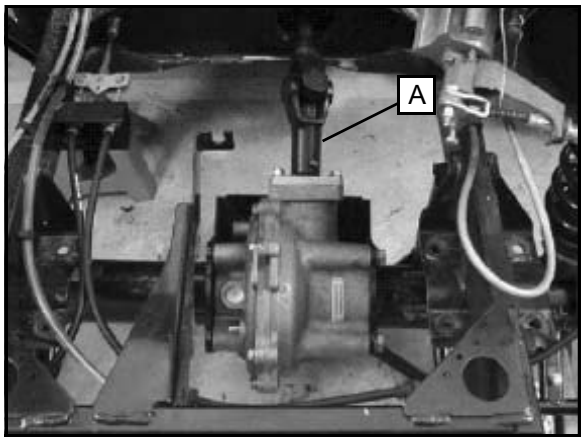


10. Loosen the four U-bolts. Loosen each U-bolt nut a few turns at a time, this will reduce stress on all of the U-bolts during U-bolt removal.



11. With the U-bolts removed, carefully lower the rear axle assembly from the frame. Pull the axle assembly out from the frame.

NOTE: The drive shaft yolk (A) slides off of the rear gearcase.

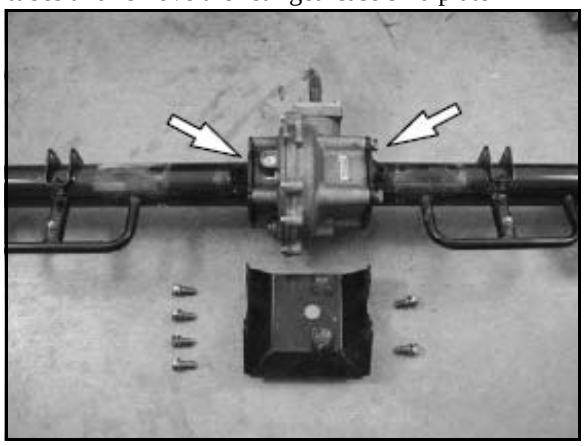


NOTE: Use caution when removing the rear axle assembly. Extra jacks maybe needed to lower the rear axle assembly safely.

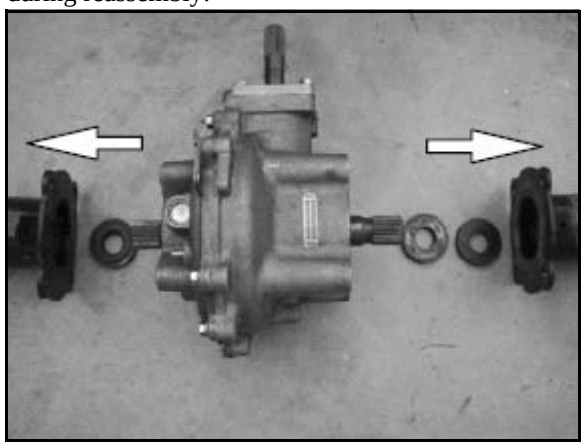
Axle Tube Removal

1. Place the rear axle assembly on a clean surface.

2. Remove the bolts that secure the rear gearcase to the axle tubes and remove the rear gearcase skid plate



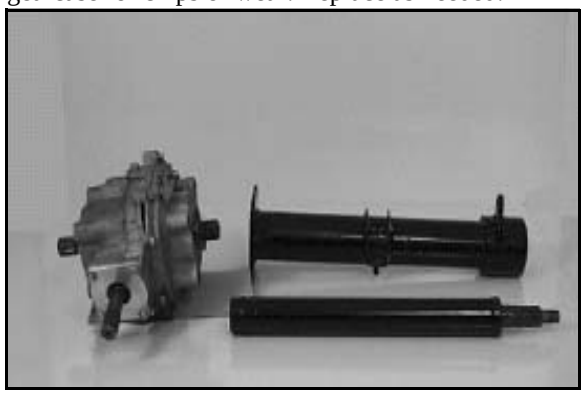
3. Remove the axle and axle tube's from the rear gearcase. Note the placement of the axle spacer seals for placement during reassembly.



4. Slide the axles out of each axle tube.

NOTE: Make note of the side each axle was removed.

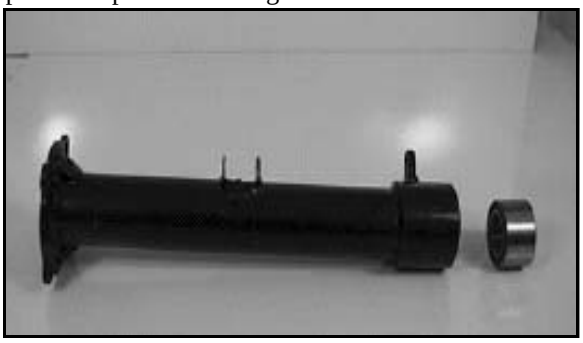
5. Inspect the splines on the axle ends and the splines on rear gearcase for chips or wear. Replace as needed.



Axle Tube Bearing Replacement

1. Remove the retaining ring from the axle tube.

2. Remove the bearings from the axle tube with a bearing puller. Inspect the bearing contact surfaces in the axle tube.



3. Install the new bearing using a press.

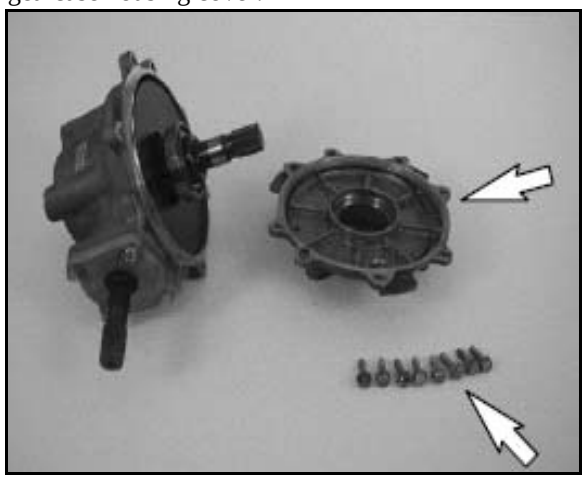
NOTE: The bearing should be properly lubricated before installation.

4. Reinstall the retaining ring.

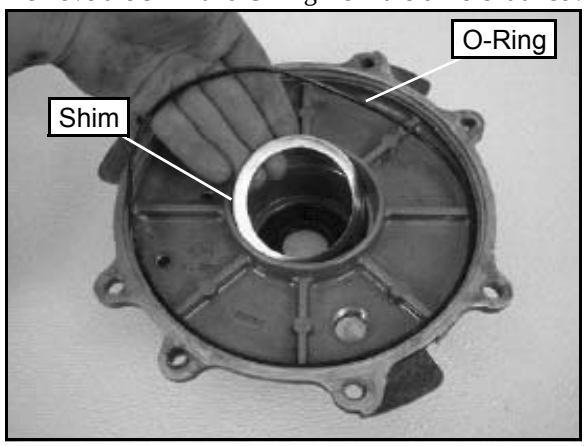
Gearcase Disassembly / Inspection

1. Drain and properly dispose of used oil.

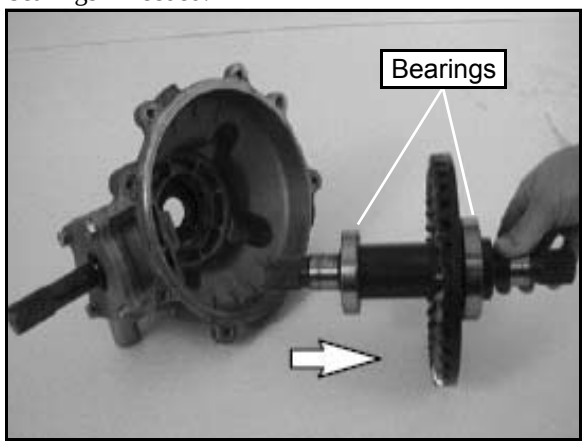
2. Remove the differential housing cover bolts and the gearcase housing cover.



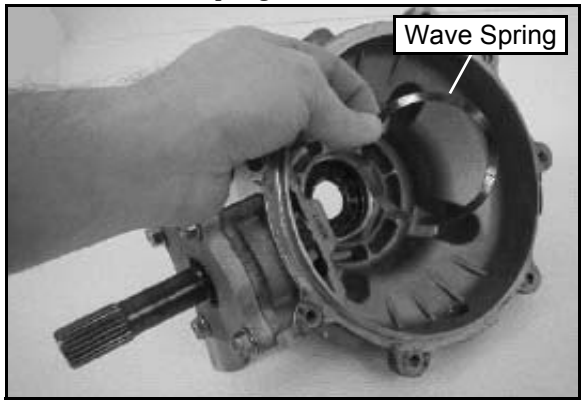
3. Remove the shim and O-ring from the differential cover.



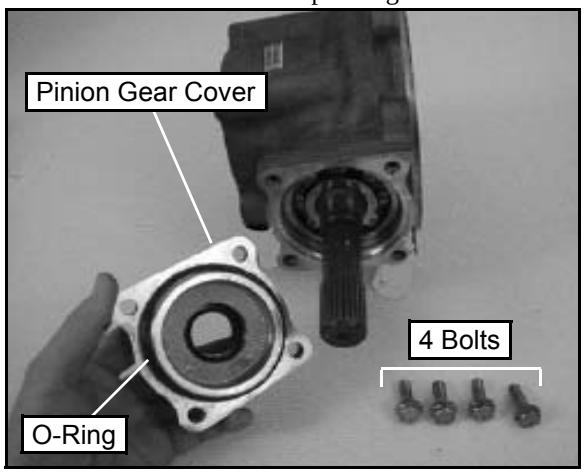
4. Remove the output shaft and ring gear from the differential. Inspect the ring gear for abnormal wear, broken, or chipped teeth. Inspect the bearings for wear. Spin the bearings by hand, the bearings should roll smoothly. Replace the bearings if needed.



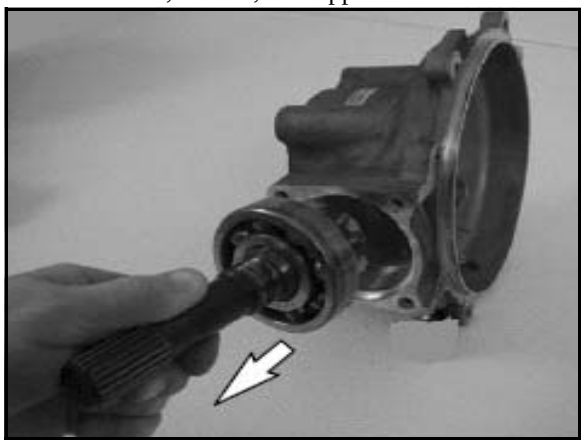
5. Remove the wave spring from the differential assembly.



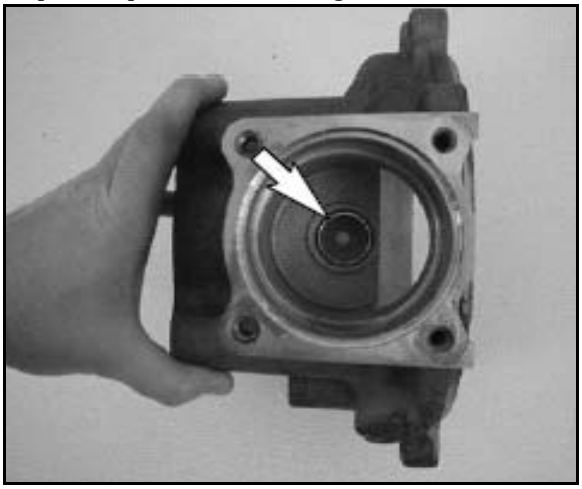
6. Remove the four bolts that secure the pinion gear cover to the differential. Remove the pinion gear cover and O-ring.



7. Remove the pinion shaft from the differential. Inspect for abnormal wear, broken, or chipped teeth.

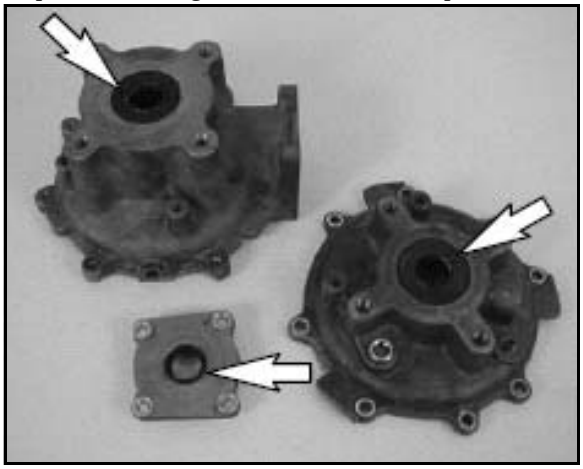


8. Inspect the pinion shaft bushing for wear.



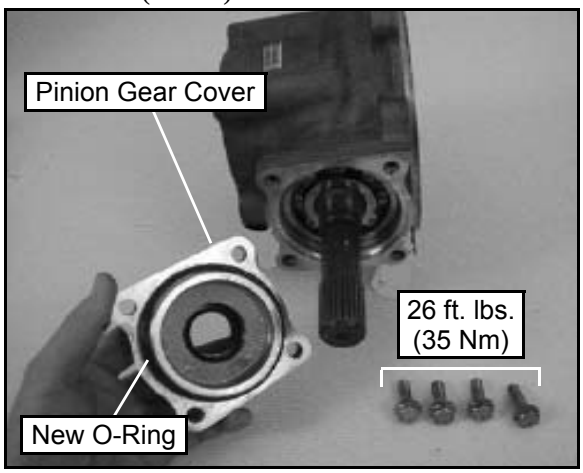
Gearcase Assembly

1. Replace all O-rings, seals, and worn components.



2. Install the pinion shaft into the differential housing.

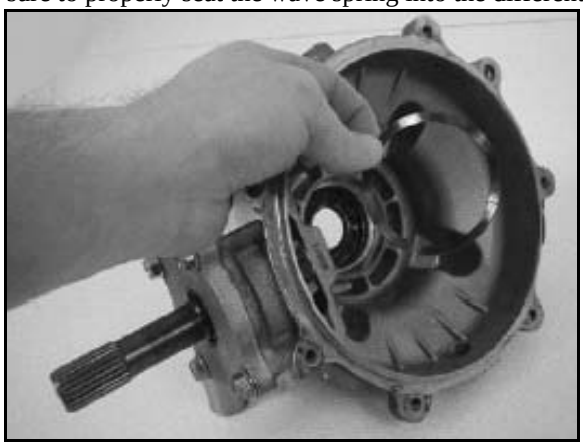
3. Replace the pinion shaft cover O-ring and install the cover. Install the four pinion shaft cover bolts and torque the bolts to 26 ft. lbs. (35 Nm).



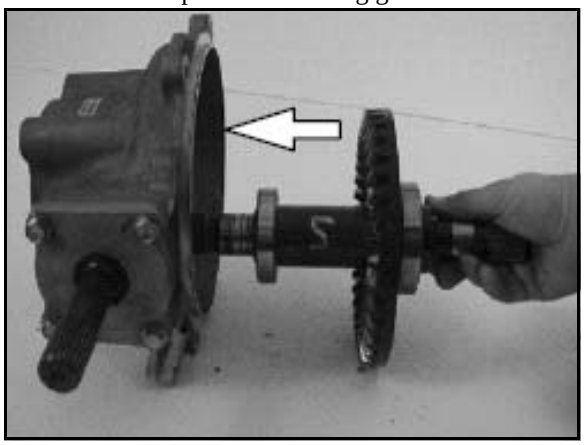
Pinion Shaft Cover Bolt Torque:

26 ft. lbs. (35 Nm)

4. Install the wave spring into the differential assembly. Be sure to properly seat the wave spring into the differential.

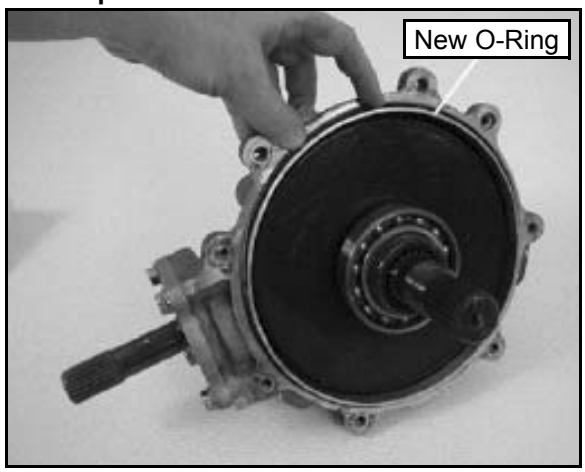


5. Reinstall the output shaft and ring gear.

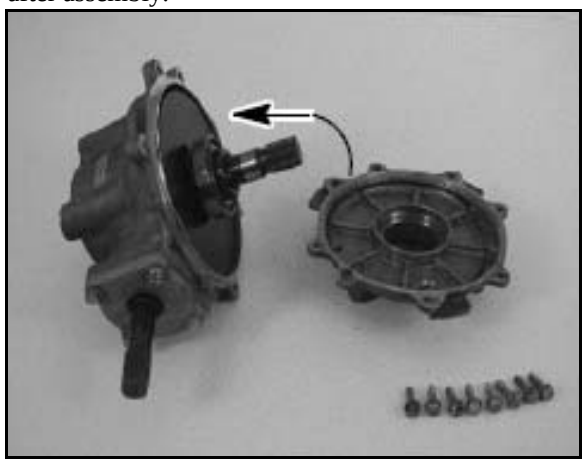


6. Install a new O-ring onto the lip of the gearcase housing.

NOTE: The O-ring is a smaller diameter than the gearcase. Use two hands to work the O-ring onto the gearcase lip.



7. Install the output cover onto the differential assembly.
8. The output cover must be properly aligned and installed straight with the differential when installed. This will ensure that the O-ring is not damaged during output cover installation. This also helps to prevent any gearcase leaks after assembly.



9. Torque the output cover bolts to 30 ft. lbs. (41 Nm).

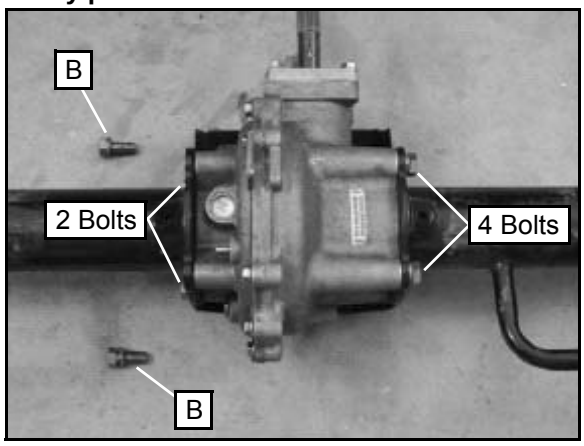
Output Cover Bolt Torque

30 ft. lbs. (41 Nm)

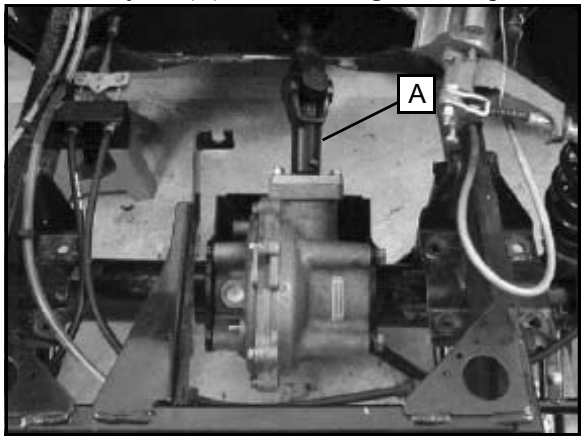
Gearcase / Axle Installation

1. Lube the splines of the rear gearcase with anti-seize.
2. Reinstall the axle spacer seals. Reinstall the axle onto the rear gearcase (both sides) Reinstall the axle tube over the axle and attach it to the gearcase.
3. Install and tighten the four bolts onto the right side of the gearcase. Install and tighten the two bottom bolts to the left side of the gearcase. Do not torque the bolts.

NOTE: The two top gearcase / axle tube bolts (B) on the left side are installed into the frame later in this assembly procedure.



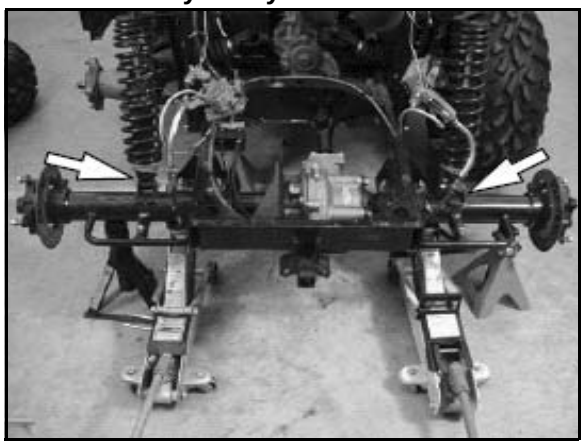
4. Fit the rear axle assembly up to the frame. Slide the rear drive shaft yoke (A) onto the rear gearcase input shaft.



5. Fit the rear axle assembly up to frame. Attach the rear axle assembly to the shocks. Leave the shock bolts finger tight until assembly is complete.

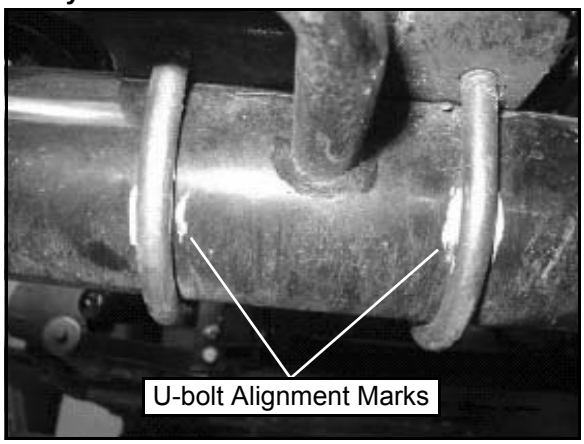
NOTE: Use a jack or another person to assist with the rear axle assembly installation.

NOTE: Use caution when removing the rear axle assembly. Extra jacks maybe needed to raise the rear axle assembly safely.



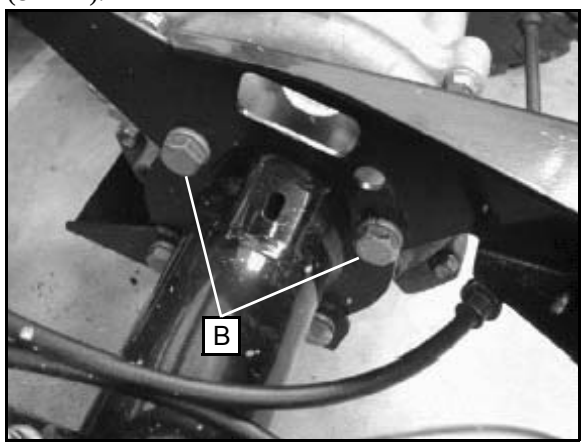
6. Install the four U-bolts. Align the U-bolts with the white marks previously made on the axle tube for proper rear axle alignment.

NOTE: Use a floor jack to help align the rear axle assembly for the U-bolt installation.



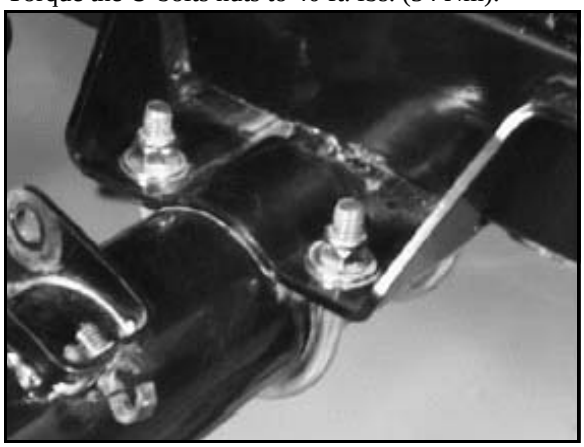
7. Install the U-bolt nuts, but do not tighten the nuts.

8. Install the two frame to gearcase bolts (B). Torque the gearcase bolts on both sides of the gearcase to 60 ft. lbs. (81 Nm).



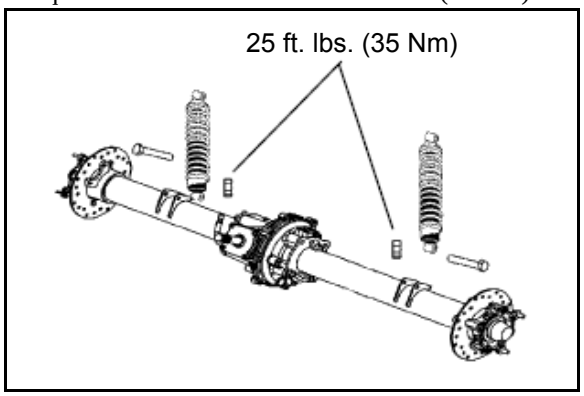
Axle Tube to Gear Case Bolt Torque: 60 ft. lbs. (81 Nm)

9. Torque the U-bolts nuts to 40 ft. lbs. (54 Nm).



U-Bolt Nut Torque:
40 ft. lbs. (54 Nm)

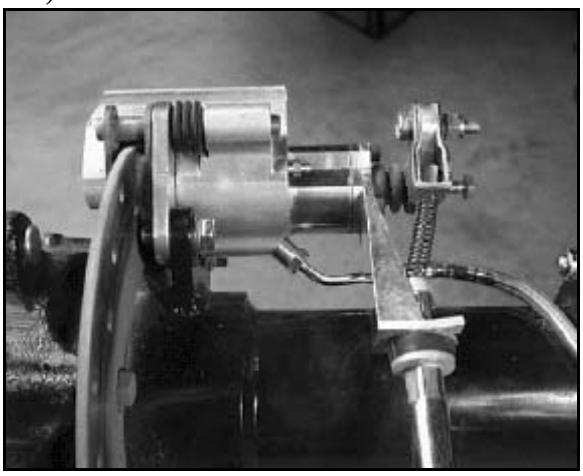
10. Torque the rear shock bolts to 25 ft. lbs. (35 Nm).



Rear Coil Over Shock Bolt Torque
25 ft. lbs. (35 Nm)

11. Reinstall the vent hose and clamp to the rear gearcase housing.
12. Apply anti-seize to the splines of the axle. Reinstall the hub onto the axle. Reinstall the domed washer, and spindle nut onto the axle.

13. Install the brake caliper. Torque the bolts to 18 ft. lbs. (24.8 Nm).



Brake Caliper Torque:
18 ft. lbs. (24.8 Nm)

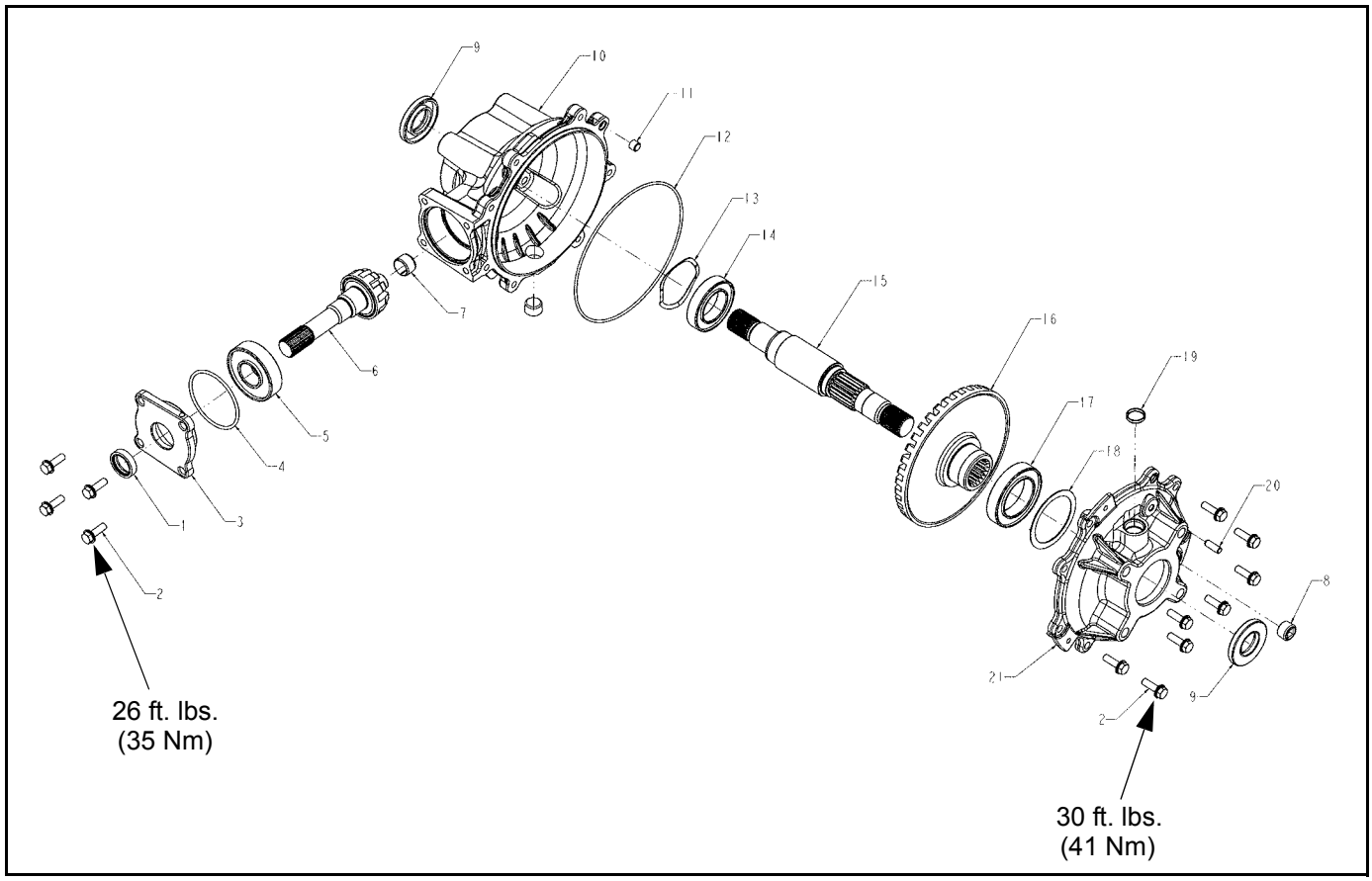
14. Install the tire and four wheel nuts. Torque the castle nut and the wheel nuts to specifications.

Rear Hub Nut Torque
110 ft. lbs. (149 Nm)

Rear Wheel Nut Torque
35 ft. lbs. (47 Nm)

15. Install a new cotter pin. Tighten nut slightly to align holes if required. Install the hub cap.

Rear Gearcase Exploded View (6x6)



REF#	DESCRIPTION	QTY	REF#	DESCRIPTION	QTY
1	Seal, Triple Lip	1	12	O-Ring	1
2	Screw (5/16-18 x 1.0)	12	13	Spring, Wave	1
3	Cover, Input	1	14	Bearing, Ball	1
4	O-Ring	1	15	Shaft, Output	1
5	Bearing, Ball	1	16	Gear, Ring 37T	1
6	Pinion, 10T	1	17	Bearing, Ball	1
7	Bearing, Plain	1	18	Shim	1
8	Plug, Square Socket	2	19	Plug, Expansion	1
9	Seal, Dual Lip	2	20	Tube, Vent 1/4” Hose	1
10	Gearcase, Rear Housing	1	21	Cover, Output	1
11	Pipe, Knock	1			

NOTES

CHAPTER 8
TRANSMISSION

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8

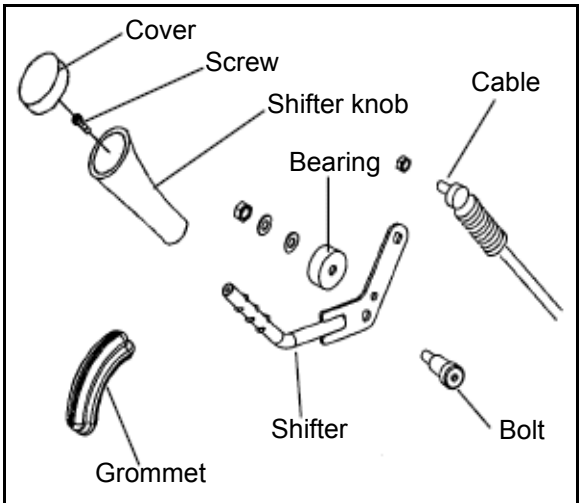
TORQUE SPECIFICATIONS

ITEM	TORQUE VALUE
Transmission Fill Plug	10-14 ft. lbs. (14-19 Nm)
Transmission Drain Plug	10-14 ft. lbs. (14-19 Nm)
Transmission Case Bolts	27-34 ft. lbs. (37-46 Nm)
Bell Crank Nut	12-18 ft. lbs. (16-24 Nm)
Bell Crank Gear Cover	7-9 ft. lbs. (10-12 Nm)
Transmission Mounting Bolts	25 ft. lbs. (35 Nm)
Transmission Lubricant / Amount	AGL Gearcase Lube 43.6 oz. (1290 ml)

SHIFT LEVER

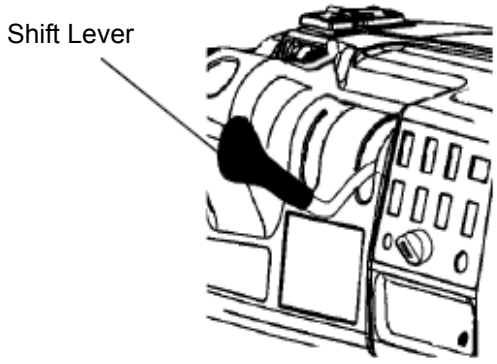
Removal

1. Disconnect linkage cable from shifter.
2. Remove one bolt attaching the gear shift selector mount to machine frame.



Shift Lever Breakdown

3. Remove the shift lever cover and then remove the screw. Pull off the shifter knob.



Shift Lever Location

4. Lift the gear shift selector out of mounting bracket and away from frame.

Installation

1. Repeat the steps in reverse order to install the gear shift selector.

SHIFT LINKAGE

Inspection

Linkage rod adjustment is necessary when symptoms include:

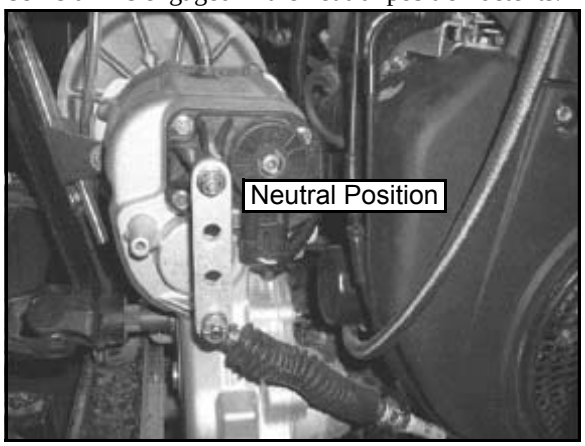
- No All Wheel Drive light
- Noise on deceleration
- Inability to engage a gear
- Excessive gear clash (noise)
- Shift selectors moving out of desired range

NOTE: Remove necessary components to gain access to shift linkage cable ends (i.e. exhaust heat shield, exhaust pipe, etc.).

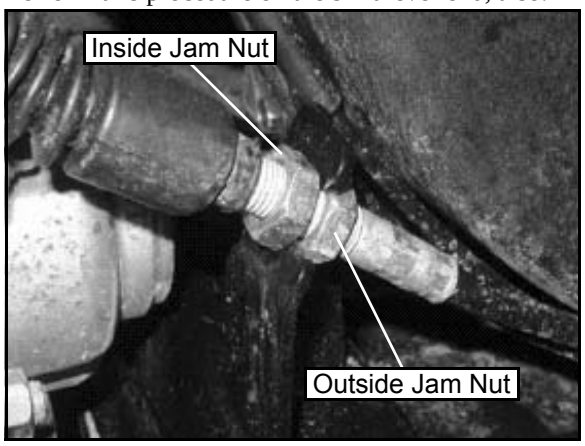
1. Inspect shift linkage cable, clevis pins, and pivot bushings and replace if worn or damaged.
2. Be sure idle speed is adjusted properly.

Adjustment

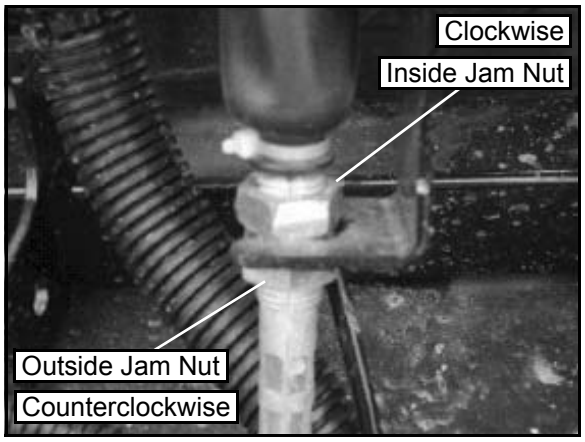
1. Place gear selector in neutral. Make sure the transmission bell crank is engaged in the neutral position detents.



2. With two wrenches loosen the outside jam nut counterclockwise. Turn the outside jam nut 1 1/2 turns. Perform this procedure on the shift lever end, also.



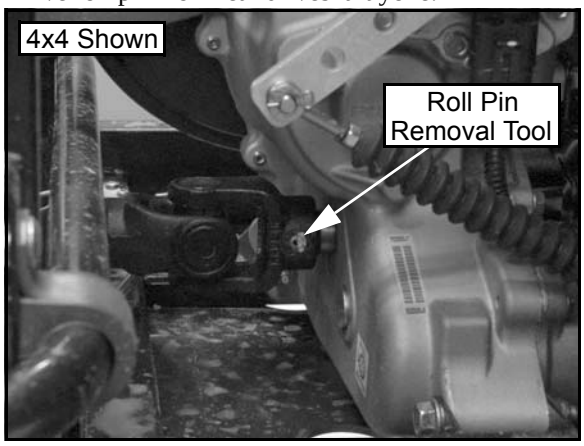
3. After turning the outside jam nut 1 1/2 turns. Hold the outside jam nut with a wrench and tighten the inside jam nut clockwise, until it is tight against the bracket.
4. Repeat Step 4 and Step 5 until the proper adjustment is made for the transmission cable.
5. Use this procedure to loosen or tighten the shift linkage cable as needed.



TRANSMISSION SERVICE

Transmission Removal

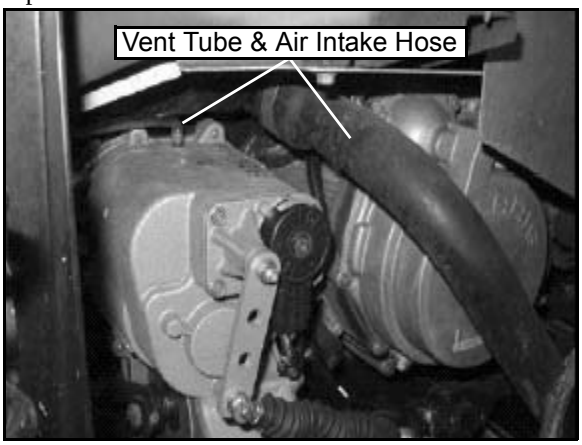
1. Remove the PVT system from the left side of the transmission.
2. Drive roll pin from rear driveshaft yoke.



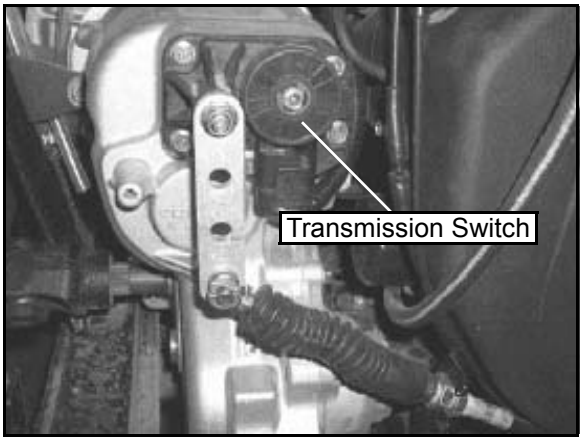
Roll Pin Removal Tool (PN 2872608)

NOTE: The front output shaft yolk slides off during the transmission removal.

3. Remove the air intake hose from the air box that is located above the transmission. Place the hose to the side, this eases the transmission removal. Remove the vent hose from the top of the transmission.

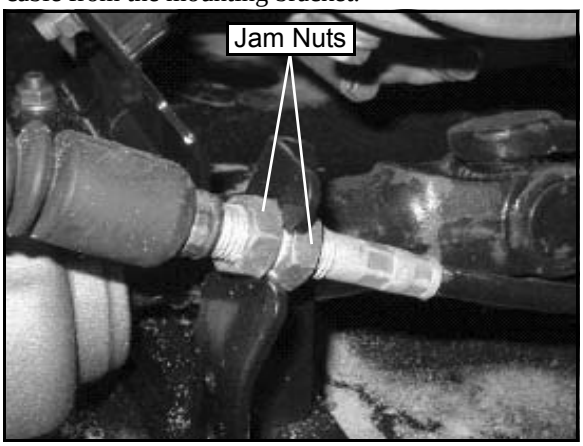


4. Disconnect the transmission switch.



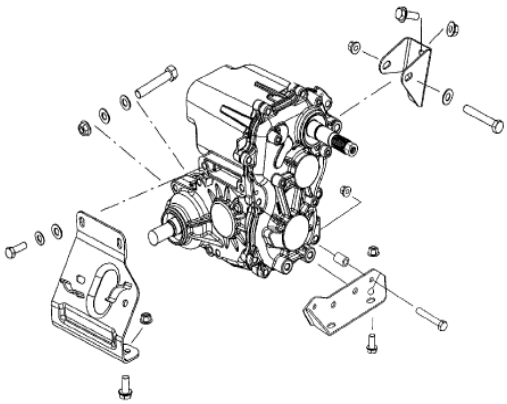
5. Remove the cotter pin from the shift linkage rod. Remove the shift linkage rod and a washer from the bellcrank.

6. Loosen the jam nuts for the transmission cable. Remove the cable from the mounting bracket.



7. Remove the mounting bolts from the transmission mounting on both sides of the transmission.

General Transmission Mounting

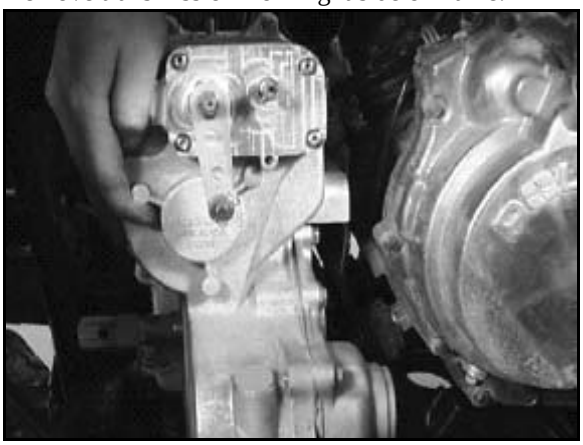


8. Remove the four bottom transmission to frame bolts.

9. Remove the rear transmission to frame bolt.

10. Remove front transmission-to-engine mount bolt.

11. Remove transmission from right side of frame.

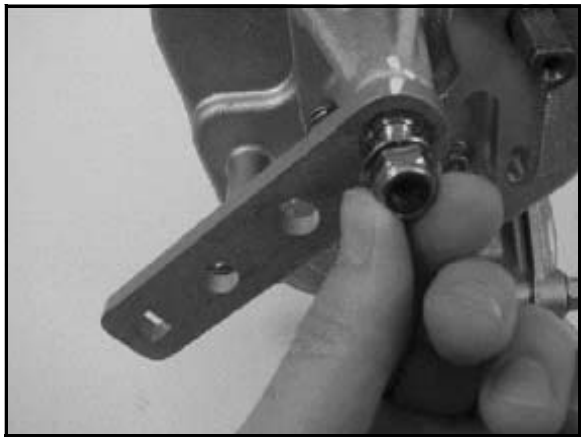


Transmission Disassembly

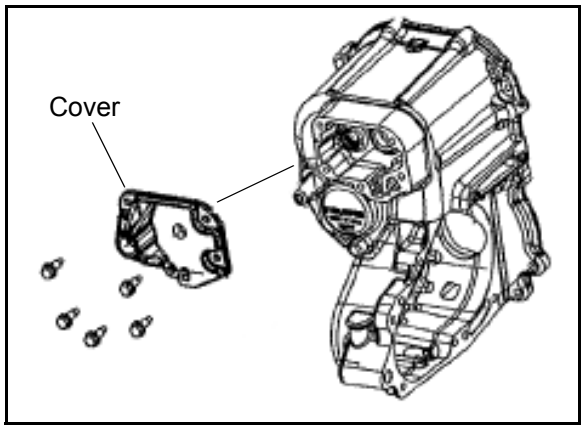
NOTE: Refer to the exploded view at the end of this chapter.

1. Place the bellcrank in neutral position.

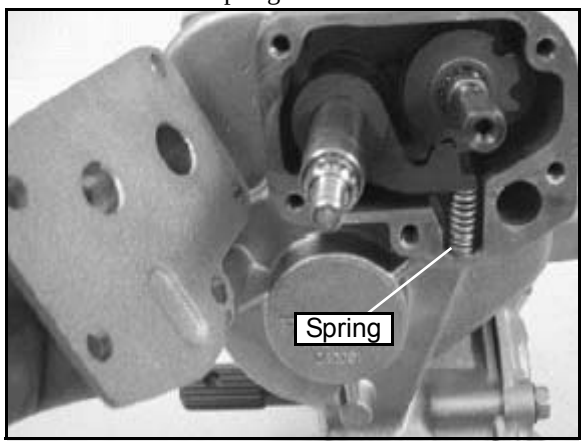
2. Remove the nut, and washer that secure the bell crank. Remove the bellcrank.



3. Remove the five bolts that secure the cover and remove the cover from the transmission.

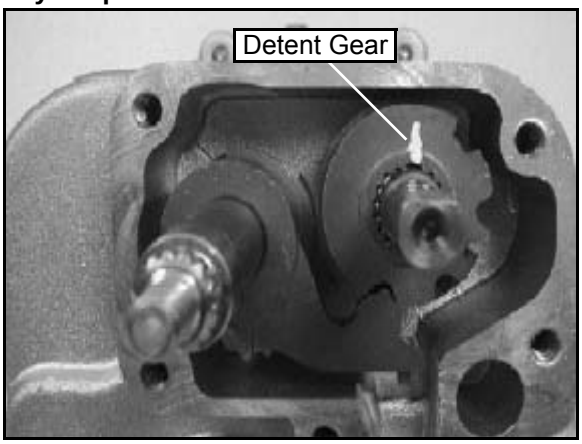


4. Remove the detent spring.



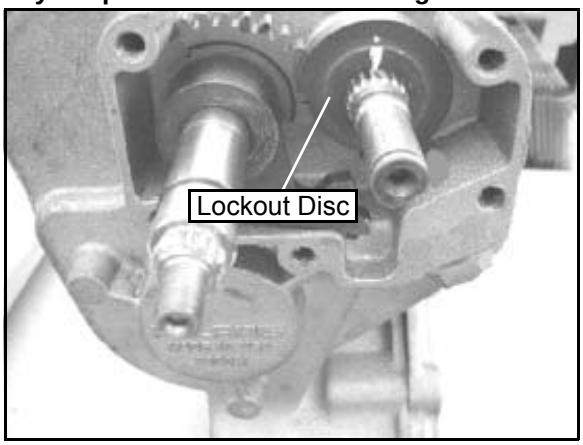
5. Mark the detent gear with a white pen. Remove the detent gear from the case.

NOTE: It may be helpful to place a mark just above the keyed spline.



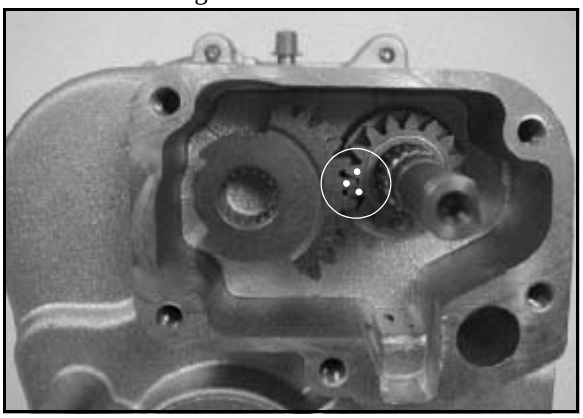
6. Mark the lockout disc, this will indicate which side of the disc faces outward during assembly. Remove the disc.

NOTE: It may be helpful to place a mark just above the keyed spline. Note the raised edge on the detent.



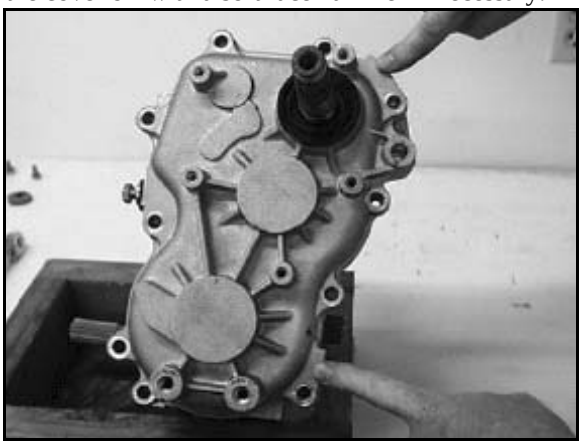
7. Remove the shift shaft and detent lever.

8. Note the transmission gear position and mark the two shift gears before removing them to aid with reassembly. Remove the shift gears from the case.

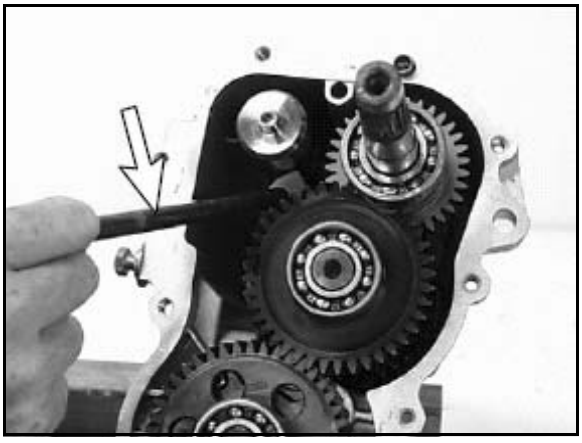


NOTE: Depending on what gear the transmission is in upon disassembly, the stamped timing marks may not be lined up. To avoid confusion, mark the two gears as described in Step 8.

9. Remove the bolts on the LH transmission case cover. Tap the cover off with a soft face hammer if necessary.

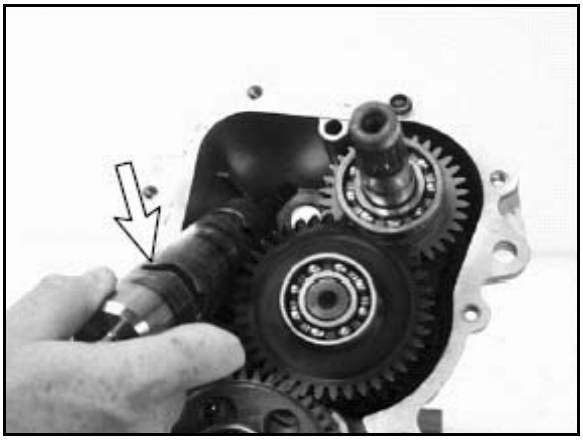


10. Lift shift rail 0.5”-1” (12.70-25.40 mm). Then rotate the shift rail / forks and shift drum, so the forks’ pins disengage from the drum.

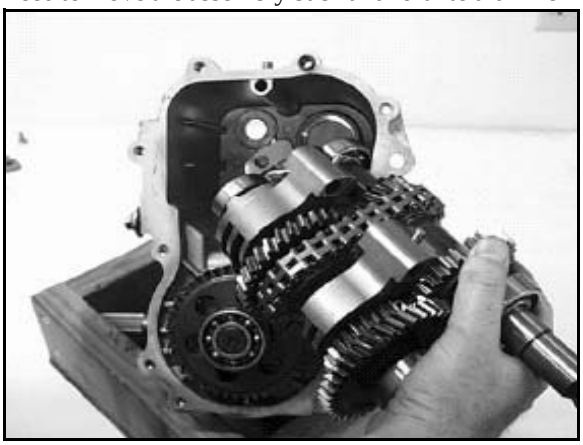


11. Remove the shift drum.

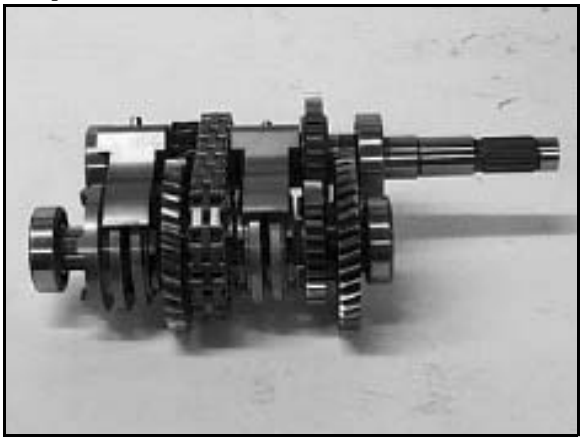
NOTE: You may have to tap the shift drum from the backside of the case to aid in removal.



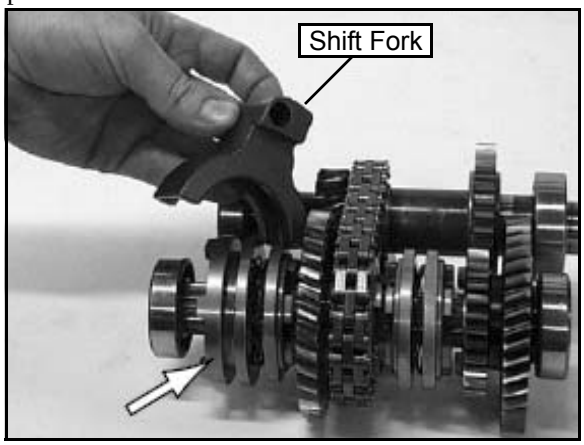
12. Remove the upper gear cluster and shift forks. You may need to move the assembly back and forth to aid in removal



13. Set the upper gear cluster on a flat surface and inspect the components.

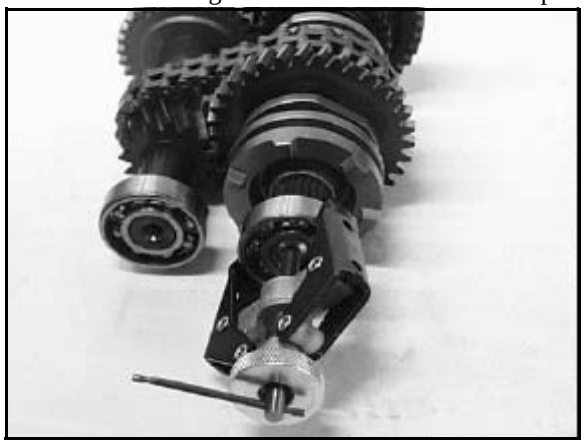


14. Remove the shift forks from the assembly. Note the correct position of each fork.

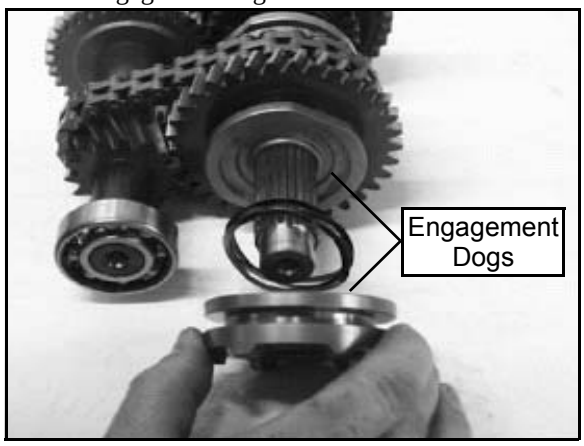


NOTE: The picture above depicts a transmission with a "Park" engagement dog on the end of the shaft instead of a regular engagement dog. The transmission will have a regular engagement dog in the location indicated by the arrow in the photo.

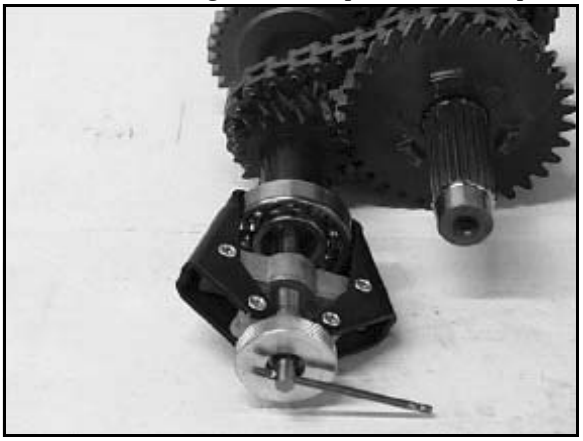
15. Remove the bearing from the reverse shaft with a puller.



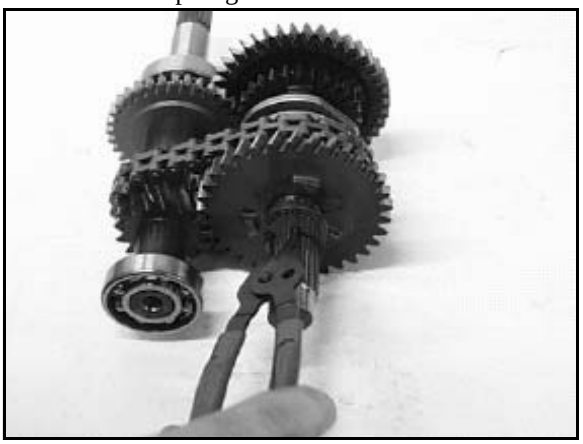
16. Remove the engagement dog. Remove the wave spring and reverse engagement dog.



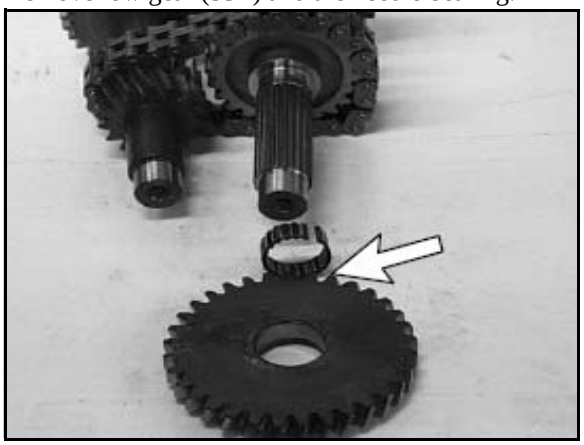
17. Remove the bearing from the input shaft with a puller.



18. Remove the snap ring and washer from the reverse shaft.

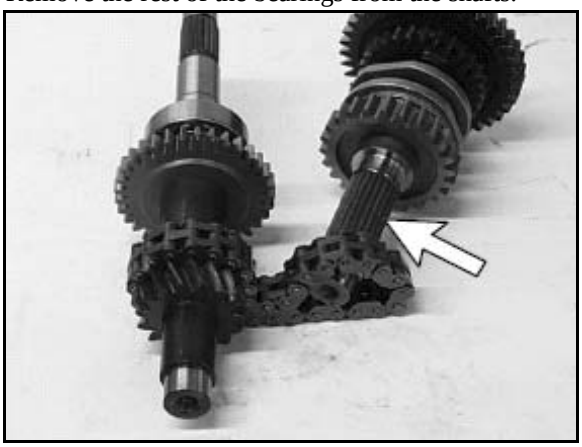


19. Remove low gear (33T) and the needle bearing.

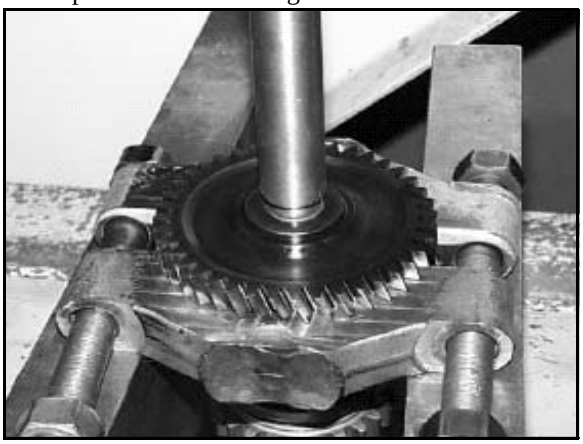


20. Remove the reverse gear shaft.

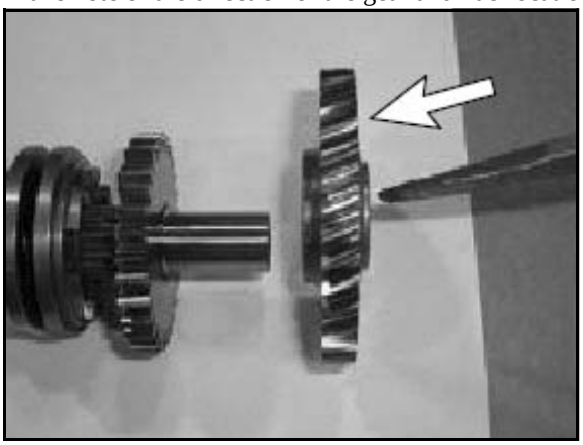
21. Remove the rest of the bearings from the shafts.



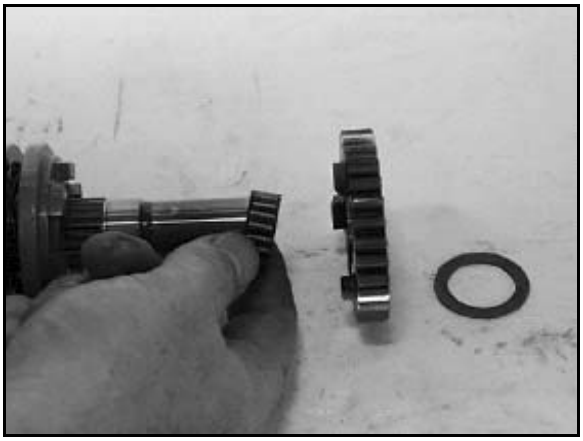
22. Use a press to remove the gear from the shaft.



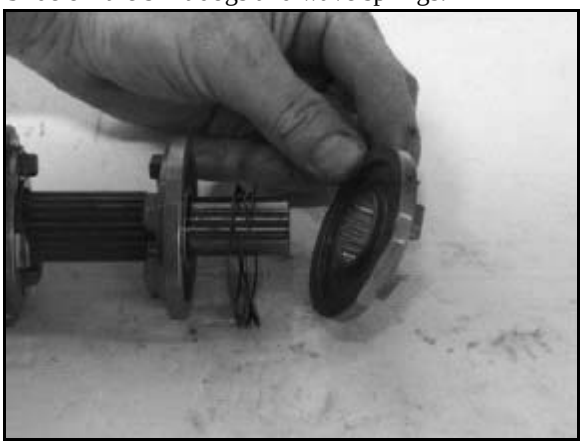
23. Make note of the direction of the gear and hub location.



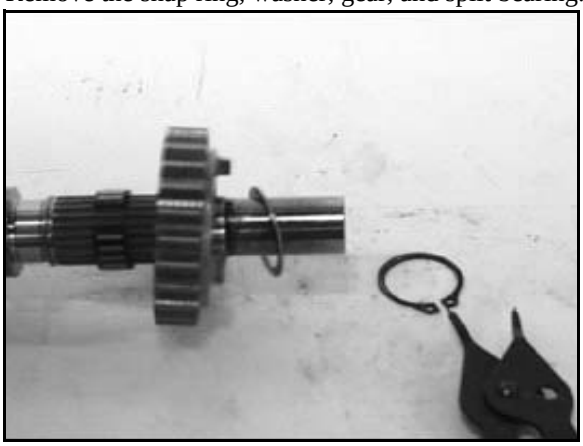
24. Remove the gear, split bearing, and washer from the reverse shaft.



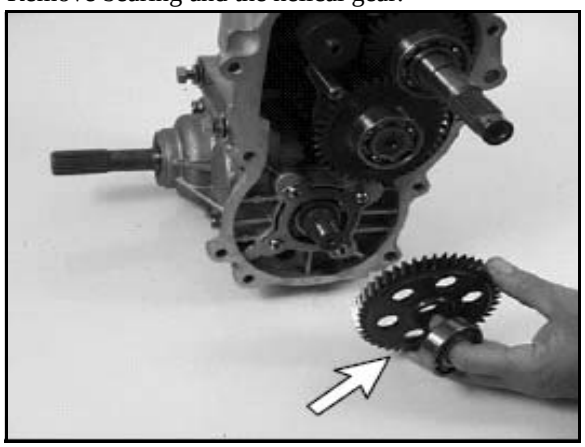
25. Slide off the shift dogs and wave springs.



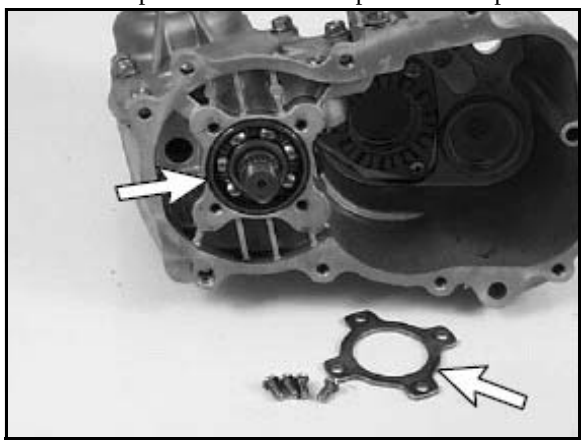
26. Remove the snap ring, washer, gear, and split bearing.



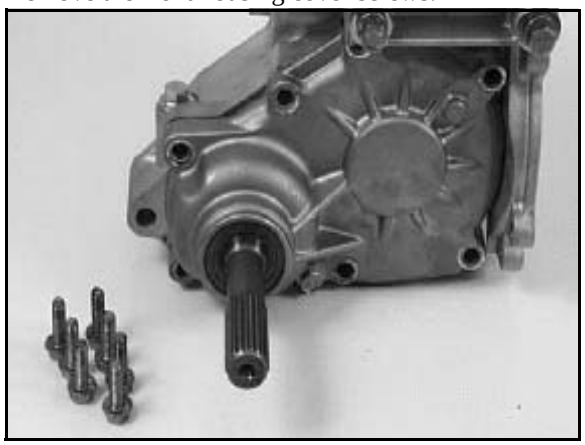
27. Remove bearing and the helical gear.



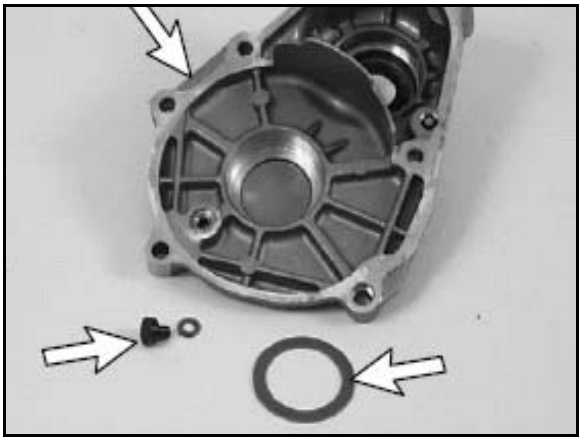
28. Remove the pinion shaft retainer plate and the pinion shaft.



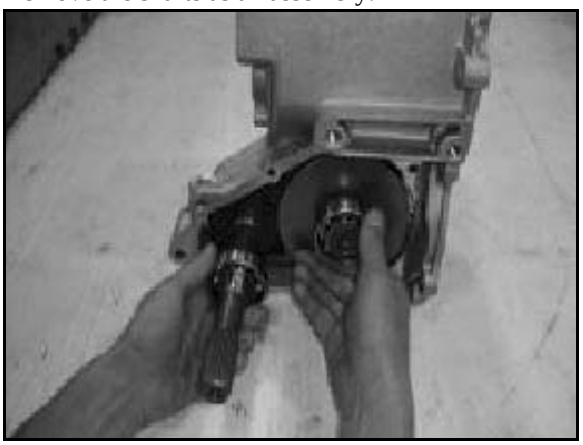
29. Remove the front housing cover screws.



30. Remove the front housing cover, shim, thrust button, and thrust button shim.



31. Remove the shafts as an assembly.

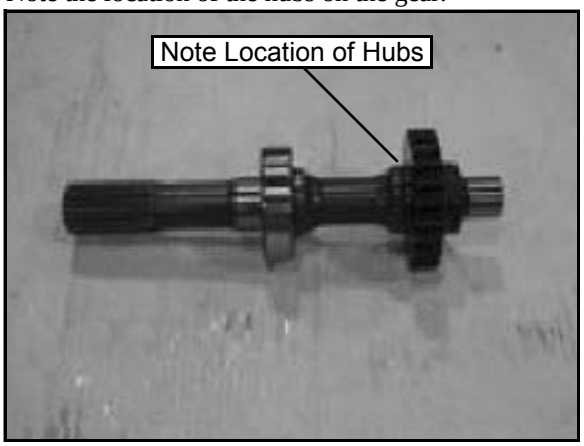


32. Remove the silent chain from the assembly for shaft inspection.

33. Clean all components in a parts washer and inspect for wear.

34. Inspect engagement dogs of gears and replace if edges are rounded.

35. Inspect gear teeth for wear, cracks, chips or broken teeth. Note the location of the hubs on the gear.



36. Remove seals from transmission case.

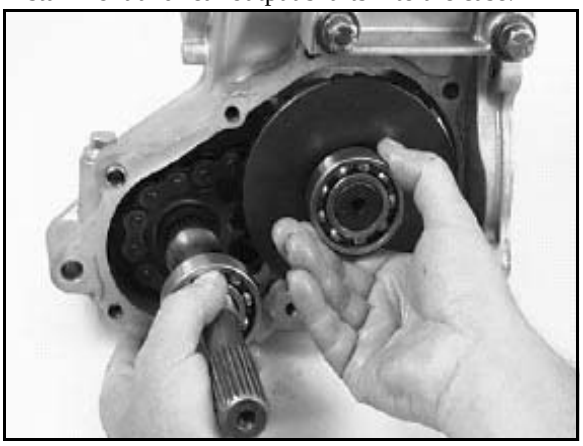
IMPORTANT: New seals should be installed after the transmission is completely assembled.

37. Inspect bearings for smooth operation. Check for excessive play between inner and outer race.

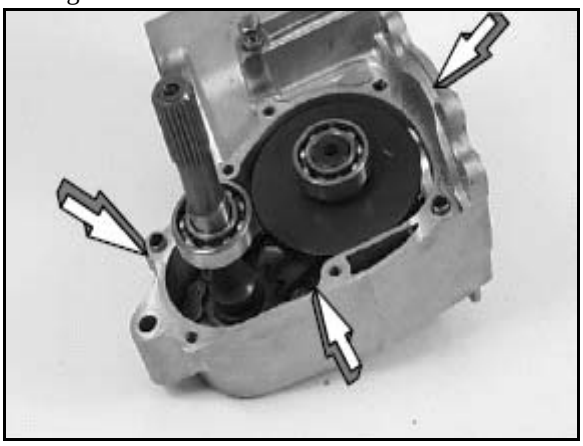
Transmission Assembly

1. Reinstall the chain onto the front output shaft and rear output shaft.

2. Install front and rear output shafts into the case.



3. Before installing the cover make sure the sealing surfaces are clean and dry, and shafts are fully seated in the transmission case. Apply Polaris Crankcase Sealant to the mating surfaces.

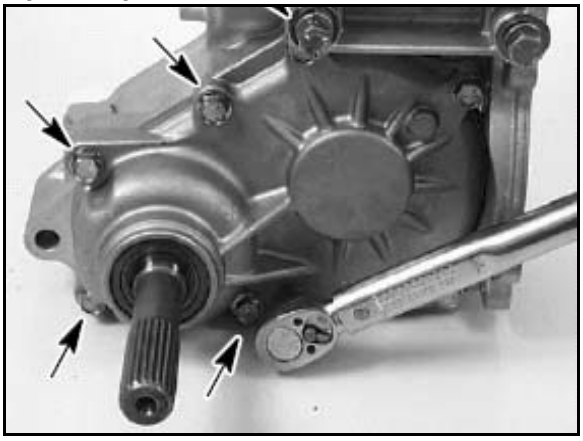


Crankcase Sealant

(PN 2871557)

4. Reinstall the thrust button shim, thrust button, and other shims into the cover. Reinstall cover and torque bolts in a criss-cross pattern in 3 steps to 27-34 ft. lbs. (37-46 Nm).

NOTE: Make sure that the case locating pins (knock pipes) are in place.



Front Cover Bolt Torque:

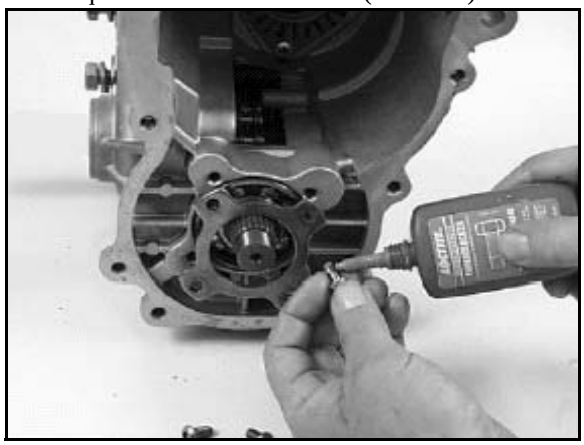
27-34 ft. lbs. (37-46 Nm)

5. Apply grease to the seal lips. Apply electricians tape or somehow cover the splines of the shaft to protect the seal lips during installation. Install new front and rear output shaft seals.

6. Install pinion shaft with bearing.

7. Install retainer plate with flat side toward bearing.

8. Apply Loctite™ 262 (Red) (PN 2871951) to screw threads and torque screws to 6-12 ft. lbs. (8-16 Nm).

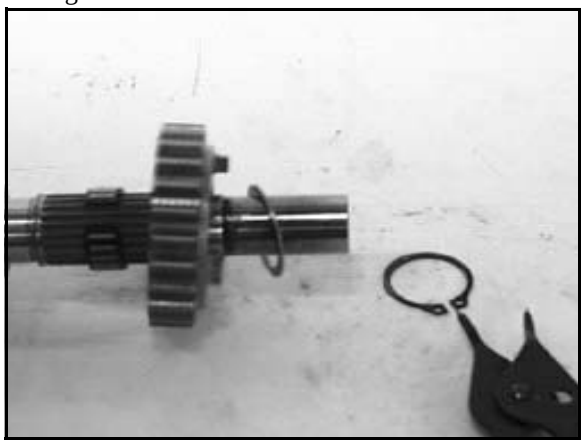


Pinion Retainer Plate Bolt Torque:

6-12 ft. lbs. (8-16 Nm)

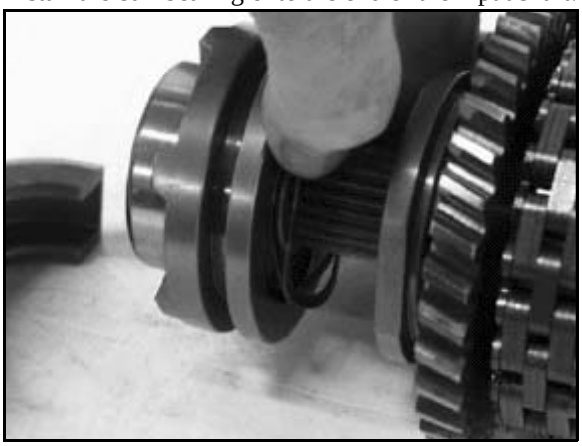
9. Install a new needle bearing, the 24T reverse sprocket, washer, and a new snap ring. Install the shift dogs and wave spring. Install the washer, a new needle bearing and the high gear. Install the press fit gear and ball bearing.

10. Install a new snap ring at this time. When installing the new snap ring, open the snap ring just far enough to go over the shaft, to avoid stressing the snap ring. If the snap ring is overstressed it could come off the shaft and cause internal damage to the transmission.



11. Slide the reverse shaft assembly through the silent chain.

12. Install a new needle bearing, the low gear, the thrust washer and the snap ring. Use of a new snap ring is recommended.
13. Install the engagement dogs, wave springs, and bearing.
14. Install the ball bearing onto the end of the input shaft.

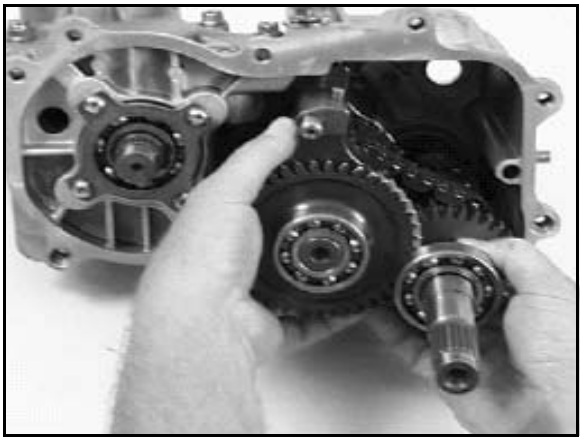


15. As the engagement dogs are installed onto the shaft, place the wave springs into the spring groove. Keep the spring in place while the fork is being installed on the shaft and while placing the shafts into the case.

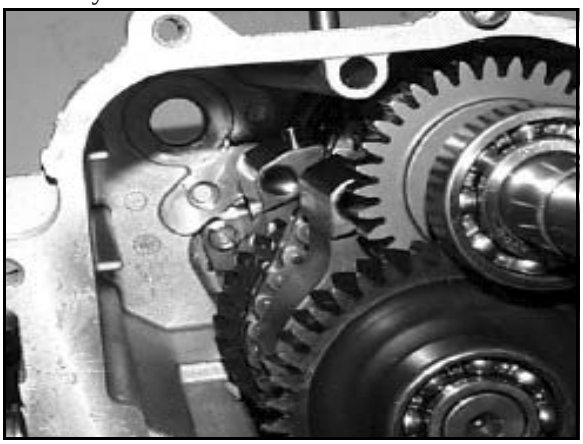
NOTE: Use caution when installing the fork, the spring can easily fall out.

NOTE: Installing the shift rail will aid in keeping the shift forks, shift dogs, and the springs in place.

16. Carefully install the shaft assembly and gear cluster as a unit into their respective bearing case recesses. Tap with a soft face hammer to seat shaft assemblies.



17. Position the shift forks up and so the pins point toward the 9 o'clock position, before installing the shift drum assembly.

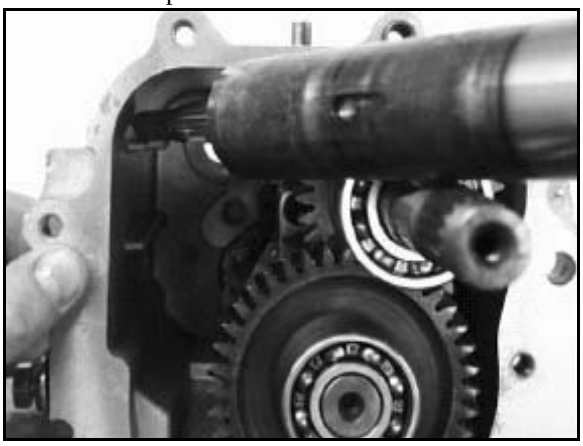


18. Replace and grease the O-ring's on the shift drum before installation.

19. Install the shift drum into the case.

NOTE: Make sure shift shaft pins are properly positioned in the slot on selector arms.

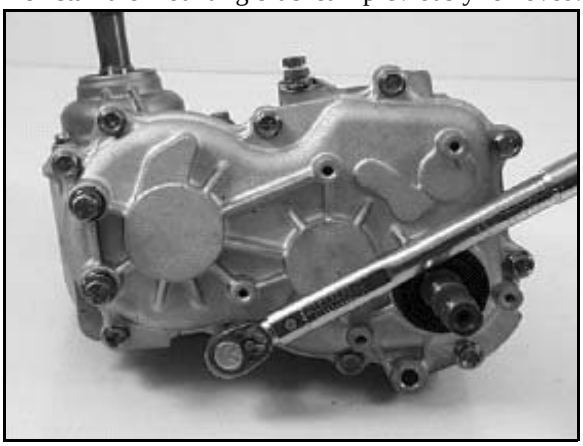
20. Lift the shift rail slightly and rotate the rail/fork assembly so it meshes with the tracks on the shift drum. Be sure the wave springs are properly in place and that the shift rail is seated into the pocket on the backside of the case.



21. Install the helical gear and bearing onto the pinion shaft.

22. Clean the mating surfaces of the case and cover. Apply Crankcase Sealant (PN 2871557) to the mating surfaces. Be sure the locating pins (knock pipes) are in place. Reinstall cover and torque bolts in a criss-cross pattern in 3 steps to 27-34 ft. lbs. (37-46 Nm).

23. Reinstall the mounting bracket if previously removed.

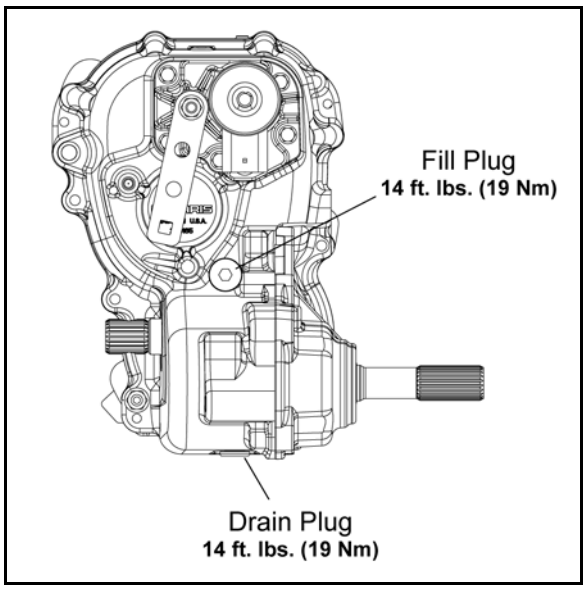


Front Cover Bolt Torque:

27-34 ft. lbs. (37-46 Nm)

24. Grease the seal lips of the input shaft seal. Apply electricians tape or somehow cover the splines of the shaft to protect the seal lips during installation. Install new input shaft seal.

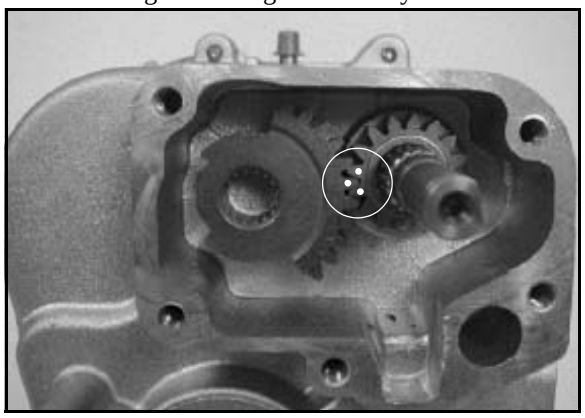
25. Install drain plug with a new sealing washer. Torque drain plug to 10-14 ft. lbs. (14-19 Nm).



Drain Plug Torque:

10-14 ft. lbs. (14-19 Nm)

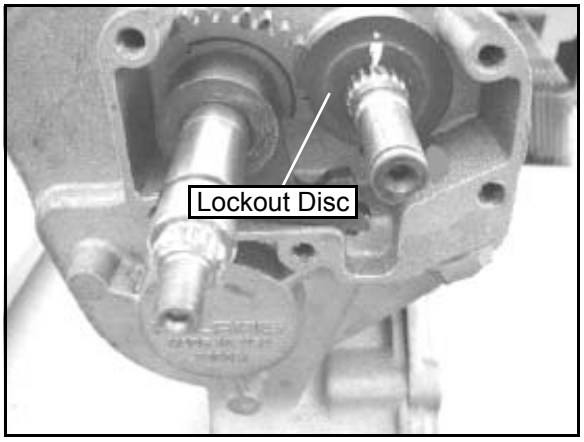
26. Place a small amount of grease (PN 2871551) into the pocket before installing the sector gear. Install the shift gear (16T) on the shift drum shaft. Install the sector gear in the bushing pocket on the left side. Align the timing marks you made on the gears during disassembly.



IMPORTANT: Note the location of the skip tooth on the splines. Apply a light coating of grease on the gear teeth.

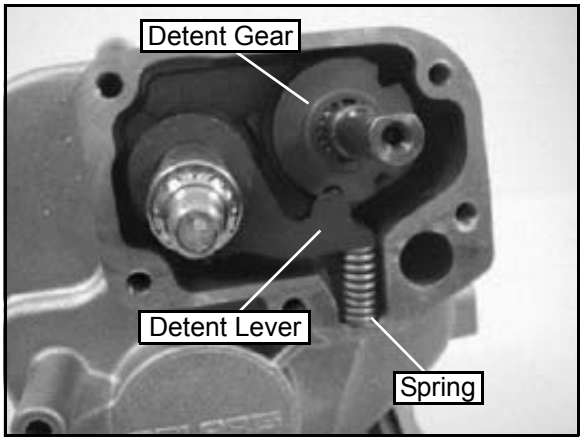
27. Install the shift shaft along with the detent lever.

28. Install the lockout disc with the raised edge facing outward. Use the white mars that was previously applied for reference.

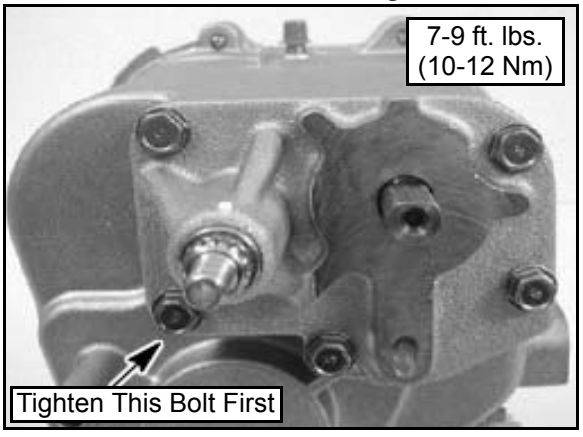


29. Install the detent gear with the raised edge facing outward. Note the keyed spline on the end of the shaft.

30. Install the detent lever spring. Install a new o-ring onto the shift shaft after the detent lever is assembled to the shaft. Place a small amount of grease on the small O-ring on the shift shaft and on the detent gear. Grease the o-ring on the end of the shift drum.



31. Install the cover and hand tighten all of the bolts. Tighten the bolt indicated in the picture below first and torque the bolt to 7-9 ft. lbs. (10-12 Nm). This helps to align the cover and shaft to ensure smoother shifting.

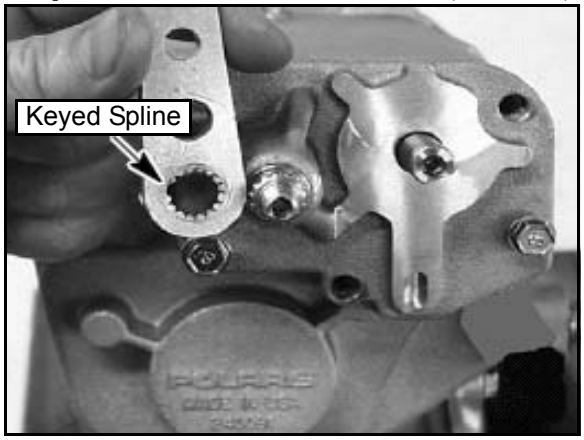


32. Torque the remaining bolts to 7-9 ft.lbs. (10-12 Nm).

Cover Bolt Torque:

7-9 ft. lbs. (10-12 Nm)

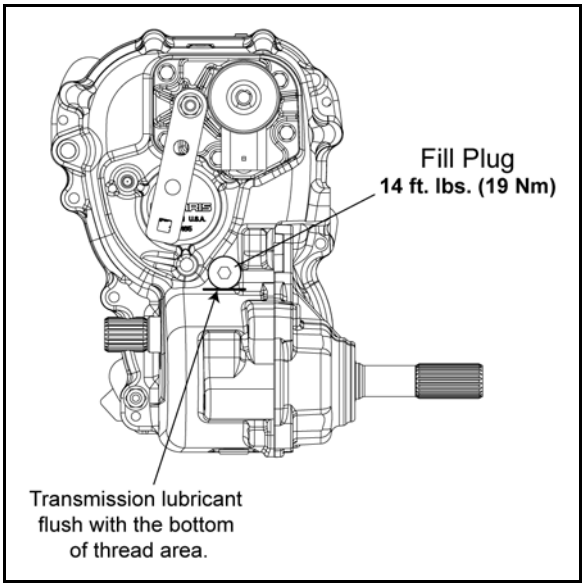
33. Install a new bellcrank onto the shift shaft. Note the keyed spline on the bellcrank and shaft. Install the washer and nut. Torque the bellcrank nut to 12-18 ft. lbs. (16-24 Nm).

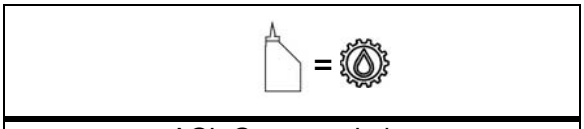


Bellcrank Nut Torque:

12-18 ft. lbs. (16-24 Nm)

34. Install transmission and add Polaris AGL Gearcase Lubricant (PN 2873602).

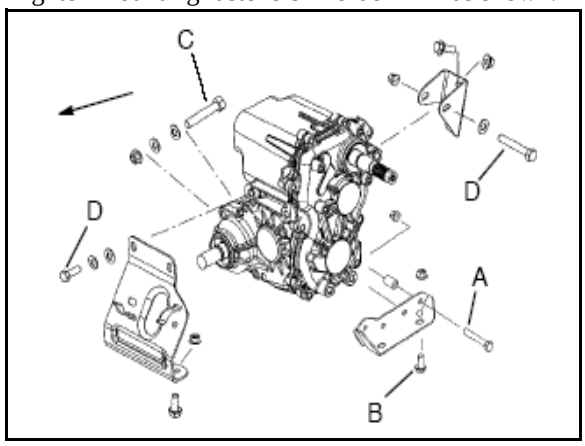




AGL Gearcase Lube
43.6 oz. (1290 ml)

Transmission Installation

1. Install transmission from right side of vehicle.
2. Align the front input shaft to the front propshaft yoke on the vehicle and install the propshaft.
3. Align the rear output shaft to the mid or rear propshaft yoke and roll pin hole.
4. Slide the mid or rear propshaft onto the rear output shaft and drive a NEW roll pin into the propshaft yoke.
5. Position transmission in frame.
6. Loosely install the front transmission to frame bolts.
7. Loosely install the rear transmission to frame bolt.
8. Loosely install the three bottom transmission to frame bolts.
9. Tighten mounting fasteners in order A-D as shown.



Transmission Mounting Bolts Torque

25 ft. lbs. (34.5 Nm)

NOTE: Be sure to tighten the lower transmission bolts first, this ensures that the transmission is tight against the lower frame and helps to properly align the transmission.

10. If torque stop was removed, set clearance to .060-.080 in. (1.52-2.03 mm).
11. Reinstall the shift linkage rod, the air intake hose, and the vent hose on top of the transmission.

NOTE: Align clutches as outlined in Chapter 6.

12. Refer to Chapter 6 for PVT installation.

TROUBLESHOOTING

Troubleshooting Checklist

Check the following items when shifting difficulty is encountered.

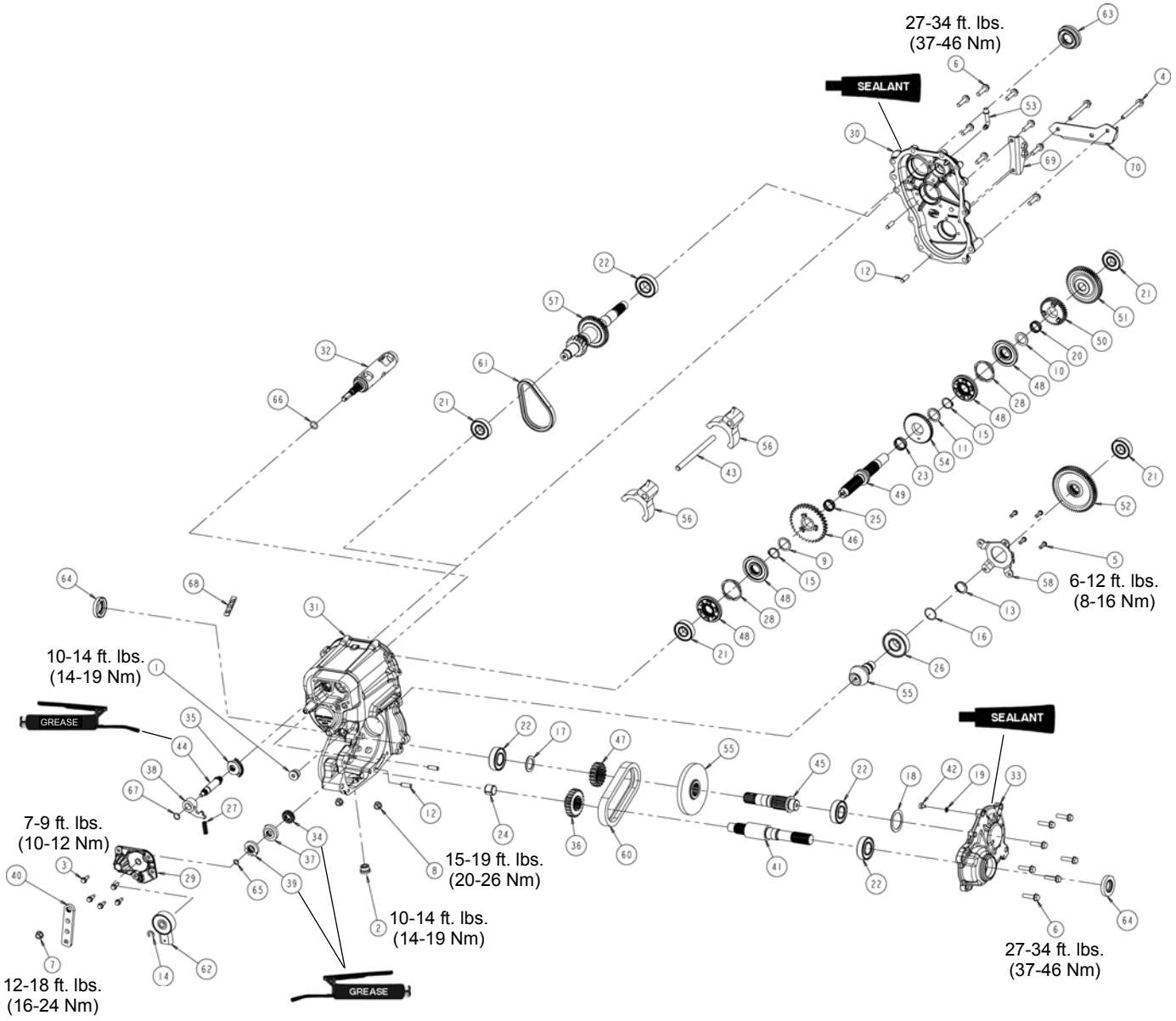
- Idle speed adjustment
- PVT alignment
- Transmission oil type/quality
- Transmission torque stop adjustment (where applicable)
- Engine torque stop adjustment (where applicable)
- Drive belt deflection
- Loose fasteners on rod ends
- Loose fasteners on selector box
- Worn rod ends, clevis pins, or pivot arm bushings
- Linkage rod adjustment and rod end positioning
- Shift selector rail travel
- *Worn, broken or damaged internal transmission components

NOTE: To determine if shifting difficulty or problem is caused by an internal transmission problem, isolate the transmission by disconnecting linkage rod from transmission bellcrank. Manually select each gear range at the transmission bellcrank, and test ride vehicle. If it functions properly, the problem is outside the transmission.

If transmission problem remains, disassemble transmission and inspect all gear dogs for wear (rounding), damage. Inspect all bearings, circlips, thrust washers and shafts for wear.

TRANSMISSION EXPLODED VIEW

Exploded View



FOR REASSEMBLY

GREASE — Apply White Lithium Based Grease.

SEALANT — Apply Polaris Crankcase Sealant.

Apply Loctite™ 262 to the bolt threads.

Exploded View, Continued

Ref.	Qty.	Description	Ref.	Qty.	Description
1.	1	Plug, Fill	36.	1	Sprocket, 22T
2.	1	Plug, Drain, Magnetic	37.	1	Lockout Disc
3.	5	Screw, Self-Tapping 1/4-20	38.	1	Detent Pawl
4.	2	Screw, 5/16-18	39.	1	Detent Star
5.	4	Screw, 1/4-20	40.	1	Bellcrank, Shift Drum
6.	15	Screws, Self-Tapping 5/16-18	41.	1	Output Shaft, Front Main
7.	1	Nut, Nylon Lock	42.	1	Thrust Button
8.	2	Nut, Nylon Lock	43.	1	Rail, Shift Shaft
9.	1	Washer	44.	1	Shift Shaft
10.	1	Washer	45.	1	Output Shaft, Rear Main
11.	1	Washer	46.	1	Gear, 33T
12.	4	Dowel Pin	47.	1	Sprocket, 19T
13.	1	Retaining Ring, External	48.	4	Engagement Dog, 6 Face
14.	1	Retaining Ring, External	49.	1	Reverse Shaft
15.	2	Retaining Ring, External	50.	1	Gear, 33T
16.	1	Spacer	51.	1	Gear, Mid-Output, 47T
17.	1	Thrust Washer	52.	1	Gear, Mid-Output, 60T
18.	1	Shim	53.	1	Vent Tube
19.	1	Shim	54.	1	Sprocket, 38T
20.	1	Needle Bearing	55.	1	Gear Set, 10T/31T
21.	4	Ball Bearing	56.	2	Shift Fork w/Pin
22.	4	Ball Bearing	57.	1	Input Shaft, 37/19/15
23.	1	Needle Bearing	58.	1	Cover, Center Drive Bearing
24.	1	Plain Bearing	59.	-	N/A
25.	1	Needle Bearing	60.	1	Silent Chain, 11W/40P
26.	1	Ball Bearing	61.	1	Chain
27.	1	Spring, Compression	62.	1	Switch, 6-Pin Rotary
28.	2	Spring, Wave	63.	1	Seal, Dual Lip
29.	1	Cover, Sector Gear	64.	2	Seal, Triple Lip
30.	1	Cover, LH Input	65.	1	O-Ring
31.	1	Gearcase, Main	66.	1	O-Ring
32.	1	Shift Drum	67.	1	O-Ring
33.	1	Cover, Output	68.	-	N/A
34.	1	Sector Gear, 16T	69.	1	Bracket, Torque Stop
35.	1	Sector Gear, 31T	70.	1	Bracket, Transmission Mount

NOTES

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BRAKES

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GENERAL SPECIFICATIONS

FRONT BRAKE SYSTEM		
Item	**Standard**	**Service Limit**
Front Brake Pad Thickness	.298 ± .007" / 7.56 ± .178 mm	.180" (4.6 mm)
Front Brake Disc Thickness	.158" (4.01mm)	.140" (3.56mm)
Front Brake Disc Runout	-	.010" (.254mm)

REAR BRAKE SYSTEM		
Item	**Standard**	**Service Limit**
Rear Brake Pad Thickness	.298 ± .007"/ 7.56 ± .178 mm	.180" (4.6 mm)
Rear Brake Disc Thickness	.188" (4.78 mm)	.170" (4.32 mm)
Park Brake Pad Thickness	Inboard - .304” (7.72 mm) Outboard - .360” (9.14 mm)	.240" (6.1 mm) .310” (7.87 mm)
Park Brake Disc Thickness	0.150” - 0.164” (3.81 - 4.16 mm)	.140" (3.56 mm)
Rear Brake Disc Runout	-	.010" (.254 mm)

TORQUE SPECIFICATIONS

Item	Torque ft. lbs.	Torque Nm
Front Caliper Mounting Bolts	18	24
Rear Caliper Mounting Bolts	18	24
Parking Brake Mounting Bolts	18	24
Parking Brake Assembly Bolts	25	34
Brake Line Flare Fittings	12-15	16-20
Brake Line Banjo Bolts (All)	15	20
Front Brake Disc to Hub Bolts	18	24
Rear Brake Disc to Hub Bolts	28	38
Brake Switch	12-15	16-20
Master Cylinder Clevis Nut	9-13	12-18

SPECIAL TOOLS

Part Number	Tool Description
2870975	Mity Vac™ Pressure Test Tool

BRAKE SYSTEM SERVICE NOTES

Disc brake systems are light weight, low maintenance, and perform well in the conditions this vehicle will routinely encounter. There are a few things to remember when replacing disc brake pads or performing brake system service to ensure proper system function and maximum pad service life.

- Optional pads are available to suit conditions in your area. Select a pad to fit riding style and environment.
- Do not over-fill the master cylinder fluid reservoir.
- Make sure the brake pedal returns freely and completely.
- Adjust stop pin on front caliper after pad service.
- Check and adjust master cylinder reservoir fluid level after pad service.
- Make sure atmospheric vent on reservoir is unobstructed.
- Test for brake drag after any brake system service and investigate cause if brake drag is evident.
- Make sure caliper moves freely on guide pins (where applicable).
- Inspect caliper piston seals for foreign material that could prevent caliper pistons from returning freely.
- Perform a brake burnishing procedure after installing new pads to maximize service life.
- DO NOT lubricate or clean the brake components with aerosol or petroleum products. Use only approved brake cleaning products.

BRAKE NOISE TROUBLESHOOTING

Dirt or dust buildup on the brake pads and disc is the most common cause of brake noise (squeal caused by vibration). If cleaning does not reduce the occurrence of brake noise, Permatex™ Disc Brake Quiet (PN 2872113) can be applied to the back of the pads. Follow directions on the package. This will keep pads in contact with caliper piston(s) to reduce the chance of squeaks caused by dirt or dust.

Brake Noise Troubleshooting	
Possible Cause	**Remedy**
Dirt, dust, or imbedded material on pads or disc	Spray disc and pads with CRC Brakeleen™ or an equivalent non-flammable aerosol brake cleaner. Remove pads and/or disc hub to clean imbedded material from disc or pads.
Pad(s) dragging on disc (noise or premature pad wear) because of improper adjustment Master cylinder reservoir overfilled Master cylinder compensating port restricted Master cylinder piston not returning completely Caliper piston(s) not returning Operator error (riding the brake)	Adjust pad stop (front calipers) Set to proper level Clean compensating port Inspect. Repair as necessary Clean piston(s) seal Educate operator
Loose wheel hub or bearings	Check wheel and hub for abnormal movement.
Brake disc warped or excessively worn	Replace disc
Brake disc misaligned or loose	Inspect and repair as necessary
Noise is from other source (axle, hub, disc or wheel)	If noise does not change when brake is applied check other sources. Inspect and repair as necessary
Wrong pad for conditions	Change to a softer or harder pad

HYDRAULIC BRAKE SYSTEM OPERATION

The Polaris brake system consists of the following components or assemblies: brake pedal, master cylinder, hydraulic brake lines, brake calipers, brake pads, and brake discs, which are secured to the drive line.

When the foot activated brake lever is applied it applies pressure on the piston within the master cylinder. As the master cylinder piston moves inward it closes a small opening (compensating port) within the cylinder and starts to build pressure within the brake system. As the pressure within the system is increased, the pistons located in the brake calipers move outward and apply pressure to the moveable brake pads. These pads contact the brake discs and move the calipers in their floating bracket, pulling the stationary side pads into the brake discs. The resulting friction reduces brake disc and vehicle speed.

The friction applied to the brake pads will cause the pads to wear. As these pads wear, the piston within the caliper moves further outward and becomes self adjusting. Fluid from the reservoir fills the additional area created when the caliper piston moves outward.

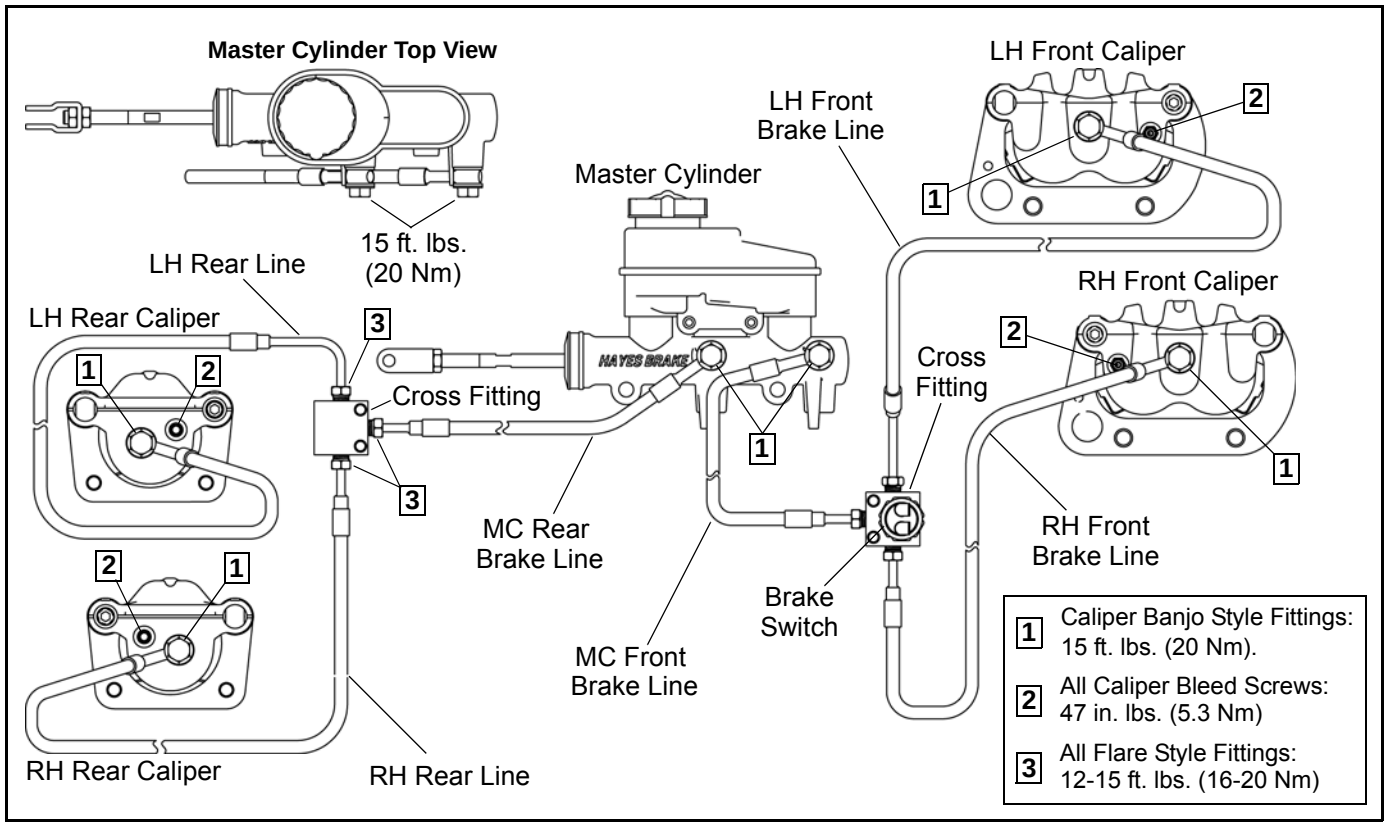
Brake fluid level is critical to proper system operation. Too little fluid will allow air to enter the system and cause the brakes to feel spongy. Too much fluid could cause brakes to drag due to fluid expansion.

Located within the master cylinder is the compensating port which is opened and closed by the master cylinder piston assembly. As the temperature within the hydraulic system changes, this port compensates for fluid expansion or contraction. Due to the high temperatures created within the system during heavy braking, it is very important that the master cylinder reservoir have adequate space to allow for fluid expansion. **Never overfill the reservoir! Do not fill the reservoir beyond the MAX LEVEL line!**

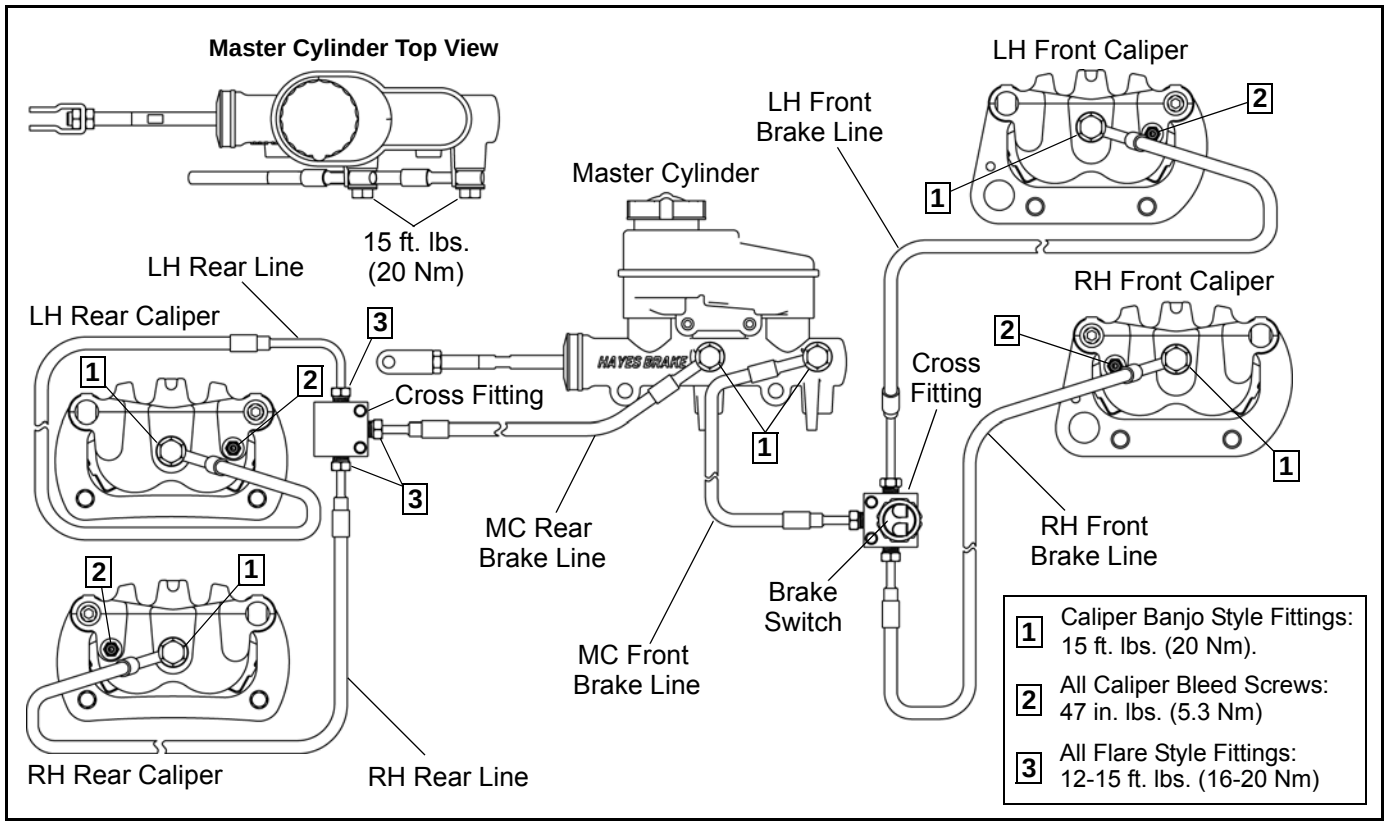
When servicing Polaris brake systems use only **Polaris DOT 4 Brake Fluid (PN 2872189)**. **WARNING:** Once a bottle is opened, use what is necessary and discard the rest in accordance with local laws. Do not store or use a partial bottle of brake fluid. Brake fluid is hygroscopic, meaning it rapidly absorbs moisture. This causes the boiling temperature of the brake fluid to drop, which can lead to early brake fade and the possibility of serious injury.

BRAKE SYSTEM EXPLODED VIEW

6x6



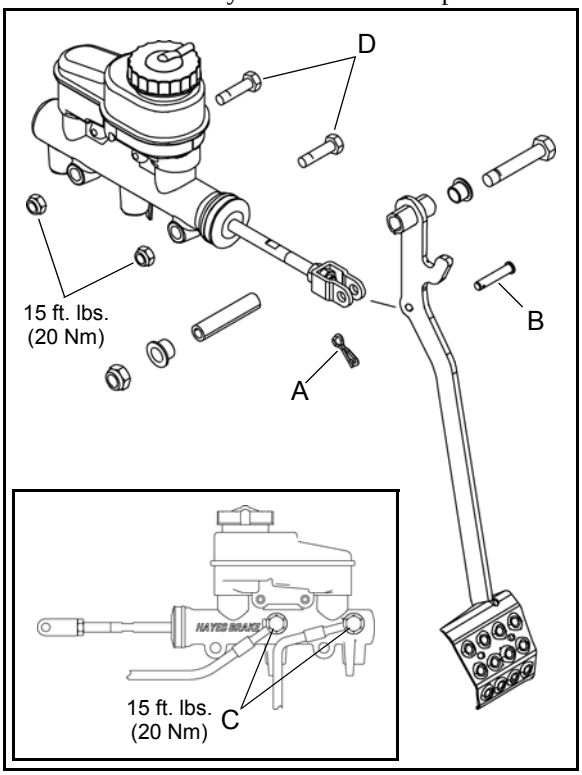
4x4 CREW



MASTER CYLINDER

Removal

1. Open the hood. Locate the master cylinder.
2. Remove the retaining clip (A) from the clevis pin (B) that attaches the master cylinder to the brake pedal lever.



3. Place a container to catch brake fluid under the master cylinder brake line banjo bolts (C).

NOTE: Dispose of brake fluid properly and do not re-use.

> **CAUTION**
>
> Brake fluid will damage finished surfaces. Do not allow brake fluid to come in contact with finished surfaces.

4. Loosen the banjo bolts (C) for the brake lines and allow fluid to drain.

NOTE: Make note of front and rear brake line locations to master cylinder.

5. Remove the two mounting bolts (D) that secure the master cylinder to the frame.

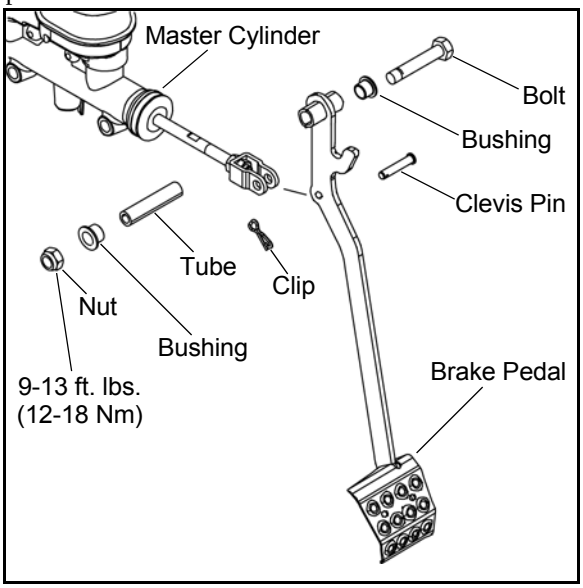
Installation

1. Reverse Steps 1-5 for master cylinder installation. **Refer to the torque specifications in the illustration.** After installing the foot brake check pedal freeplay. Pedal freeplay should not exceed .090" (2.29 mm).

FOOT BRAKE PEDAL

Pedal Removal

1. Open the hood. Locate the master cylinder.
2. Remove the nut, bushing, tube, and bolt from the brake pedal.



3. Remove the retaining clip and clevis pin from the master cylinder to remove the brake pedal.

Pedal Installation

1. Reverse Steps 1-3 for foot brake installation. **Torque the clevis nut to 9-13 ft. lbs. (12-18 Nm)**. After installing the foot brake check pedal freeplay. Pedal freeplay should not exceed .090" (2.29 mm).

Brake Pedal Freeplay:

.090" (2.29 mm)

BRAKE BLEEDING / FLUID CHANGE

NOTE: When bleeding the brakes or replacing the fluid always start with the furthest caliper from the master cylinder.

> ⚠ CAUTION
>
> Always wear safety glasses.

> ⚠ CAUTION
>
> Brake fluid will damage finished surfaces. Do not allow brake fluid to come in contact with finished surfaces. This procedure should be used to change fluid or bleed brakes during regular maintenance.

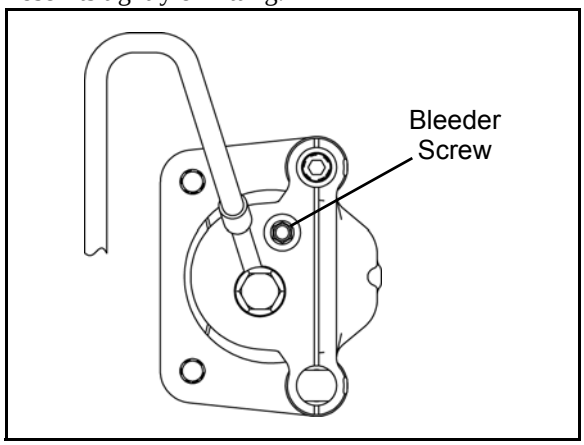
1. Clean master cylinder reservoir cover thoroughly.
2. Remove cover from reservoir.
3. If changing fluid, remove old fluid from reservoir with a Mity Vac™ pump or similar tool.

Mity Vac™ (PN 2870975)

4. Add brake fluid to the indicated MAX level of reservoir.

Polaris DOT 4 Brake Fluid (P/N 2872189)

5. Begin bleeding procedure with the caliper that is farthest from the master cylinder. Install a box end wrench on caliper bleeder screw. Attach a clean, clear hose to fitting and place the other end in a clean container. Be sure the hose fits tightly on fitting.



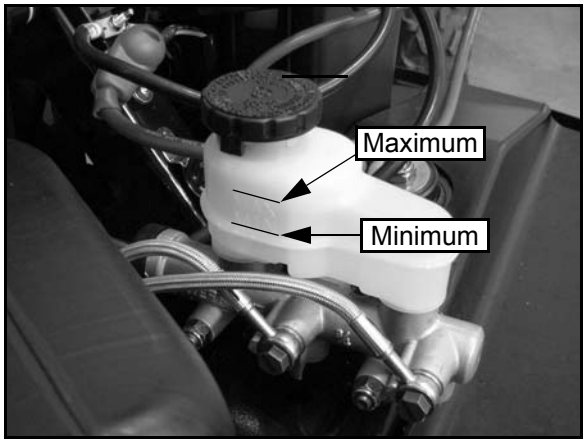
6. Have an assistant slowly pump foot pedal until pressure builds and holds.
7. Hold brake pedal on to maintain pedal pressure, and open bleeder screw. Close bleeder screw and release foot pedal.

NOTE: Do not release foot pedal before bleeder screw is tight or air may be drawn into master cylinder.

8. Repeat procedure until clean fluid appears in bleeder hose and all air has been purged. Add fluid as necessary to maintain level in reservoir.

> ⚠ CAUTION
>
> Maintain at least 1/2"(1.27 cm) of brake fluid in the reservoir to prevent air from entering the master cylinder.

9. Tighten bleeder screw and torque to **47 in. lbs. (5.3 Nm)** and remove bleeder hose.
10. Repeat procedure Step 5 through Step 9 for the remaining calipers.
11. Add brake fluid to MAX level inside reservoir.



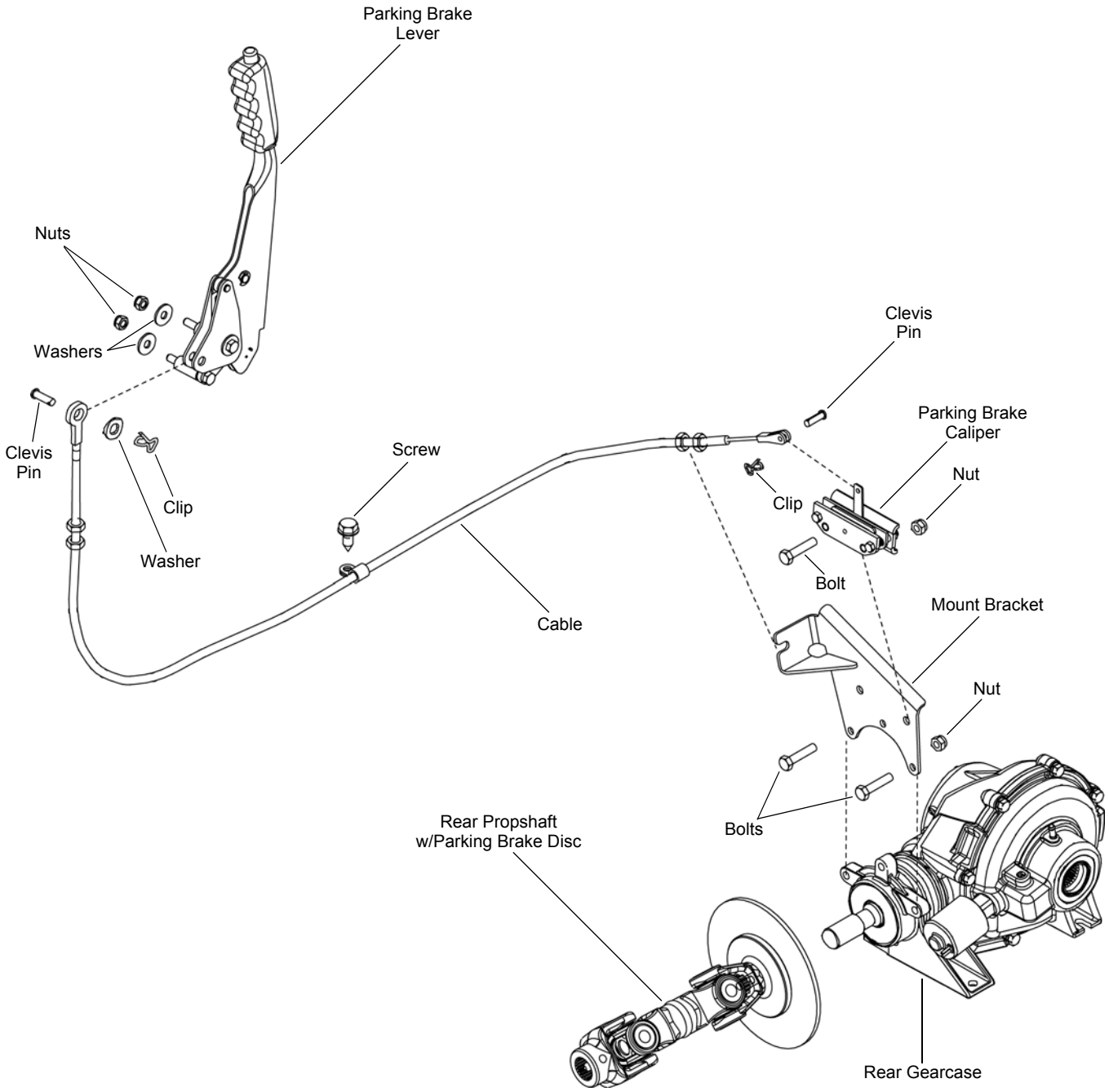
Master Cylinder Fluid Level

Between the MIN and MAX line shown on the reservoir.

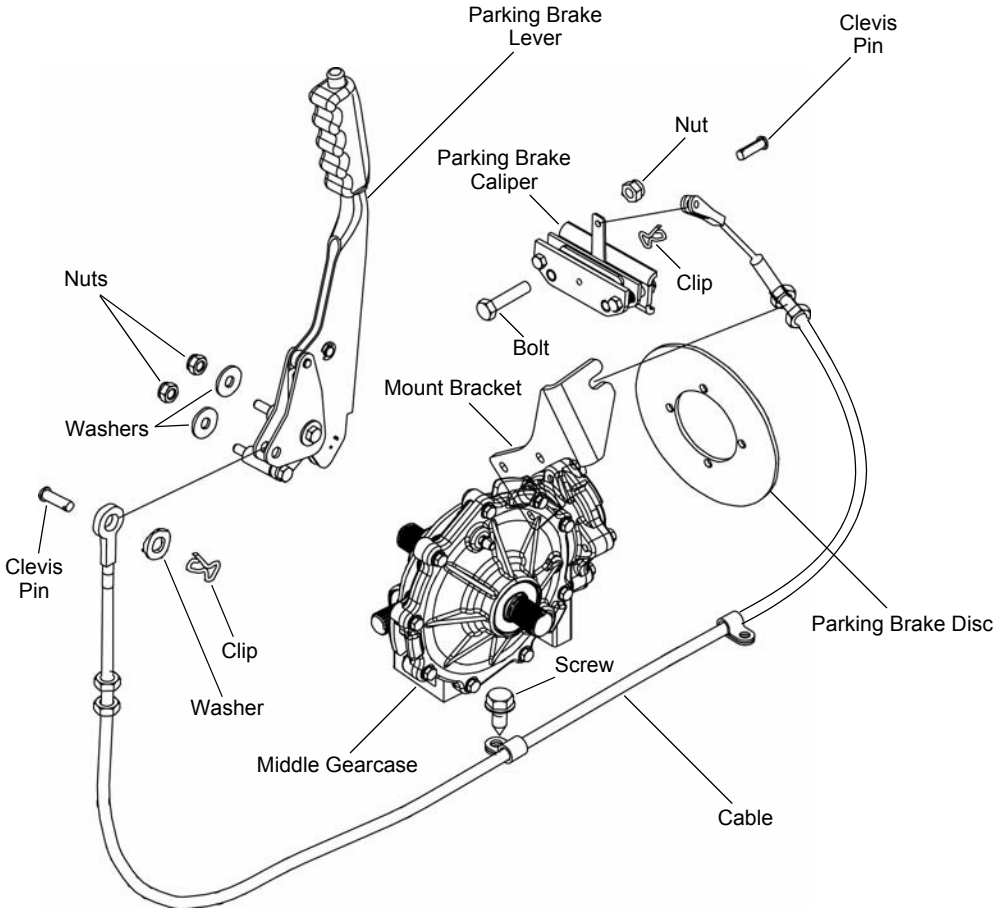
12. Install master cylinder reservoir cover.
13. Field test machine at low speed before putting into service. Check for proper braking action and pedal reserve. With pedal firmly applied, pedal reserve should be no less than 1/2"(1.3 cm).
14. Check brake system for fluid leaks.

PARKING BRAKE

Exploded View (4x4 CREW)

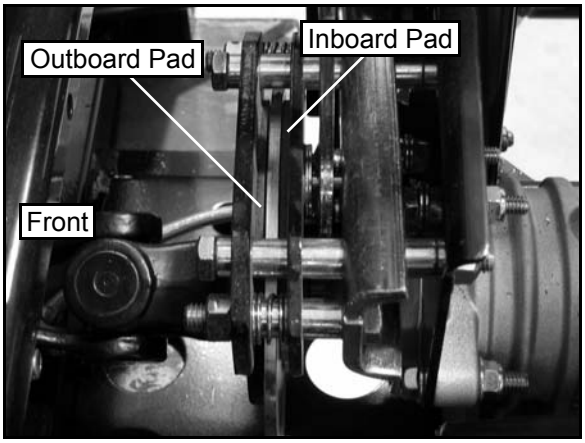


Exploded View (6x6)



Inspection

1. Inspect the parking brake cable and brake pads on the caliper assembly located on the rear propshaft.
   See **"Parking Brake Caliper Service"** for brake pad replacement information.



Cable Tension Adjustment

When the parking brake is fully engaged and the parking brake indicator is illuminated, engine speed is limited to 1300 RPM in all gears, including neutral. If throttle is applied, this limiting feature prevents operation, which protects the parking brake pads from excessive wear.

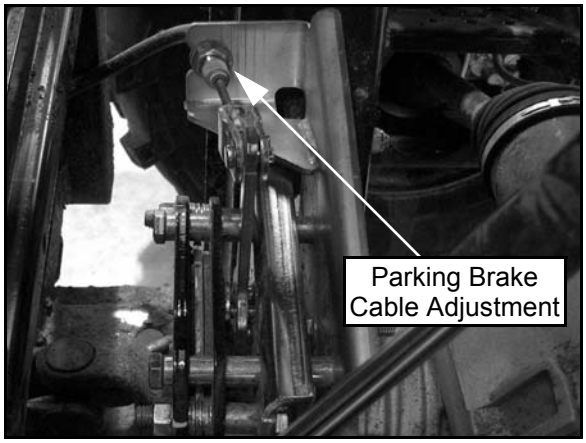
NOTE: Inspect the parking brake cable tension after the first 25 hours of operation and every 100 hours of operation afterwards to ensure proper cable tension.

Loss of tension in the parking brake cable will cause illumination of the parking brake light and activation of the limiting feature. If this occurs, inspect and adjust parking brake cable tension. If performing this service is difficult due to conditions or location, open the hood and temporarily disconnect the parking brake connector. Reconnect the connector as soon as practicable and adjust the parking brake cable to proper tension.

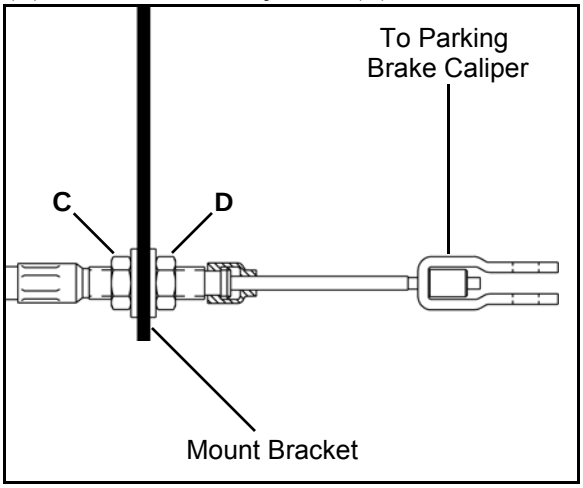
1. Pull back on the parking brake lever (located in the dash).
2. After 2 to 3 clicks the "(P)" brake light should illuminate on the instrument cluster and the wheels of the vehicle should not rotate when turning by hand. After 8 full clicks of lever travel, the vehicle should not roll while parked.
3. If the vehicle moves, adjustment is necessary.
4. Adjust the parking brake cable where the cable attaches to the caliper mount bracket located on the rear gearcase (mid gearcase on 6x6 models).

Adjustment Procedure

1. Place the vehicle in neutral on a flat level surface.
2. Carefully lift the rear of the vehicle off the ground and stabilize on jack stands.
3. Locate the parking brake cable adjustment area where the cable attaches to the caliper mount bracket on the rear gearcase.



4. Use two open-end wrenches and loosen the outer jam nut (D). Back out the outer jam nut (D) 1 1/2 turns.



5. Now hold the outer jam nut (D) and turn in the inner jam nut (C) clockwise, until the jam nut is tight against the bracket.
6. Repeat Step 4 and Step 5 until the proper adjustment is obtained for the parking brake.

NOTE: See Chapter 10 for more information on the parking brake switch.

PARKING BRAKE CALIPER SERVICE

Exploded View

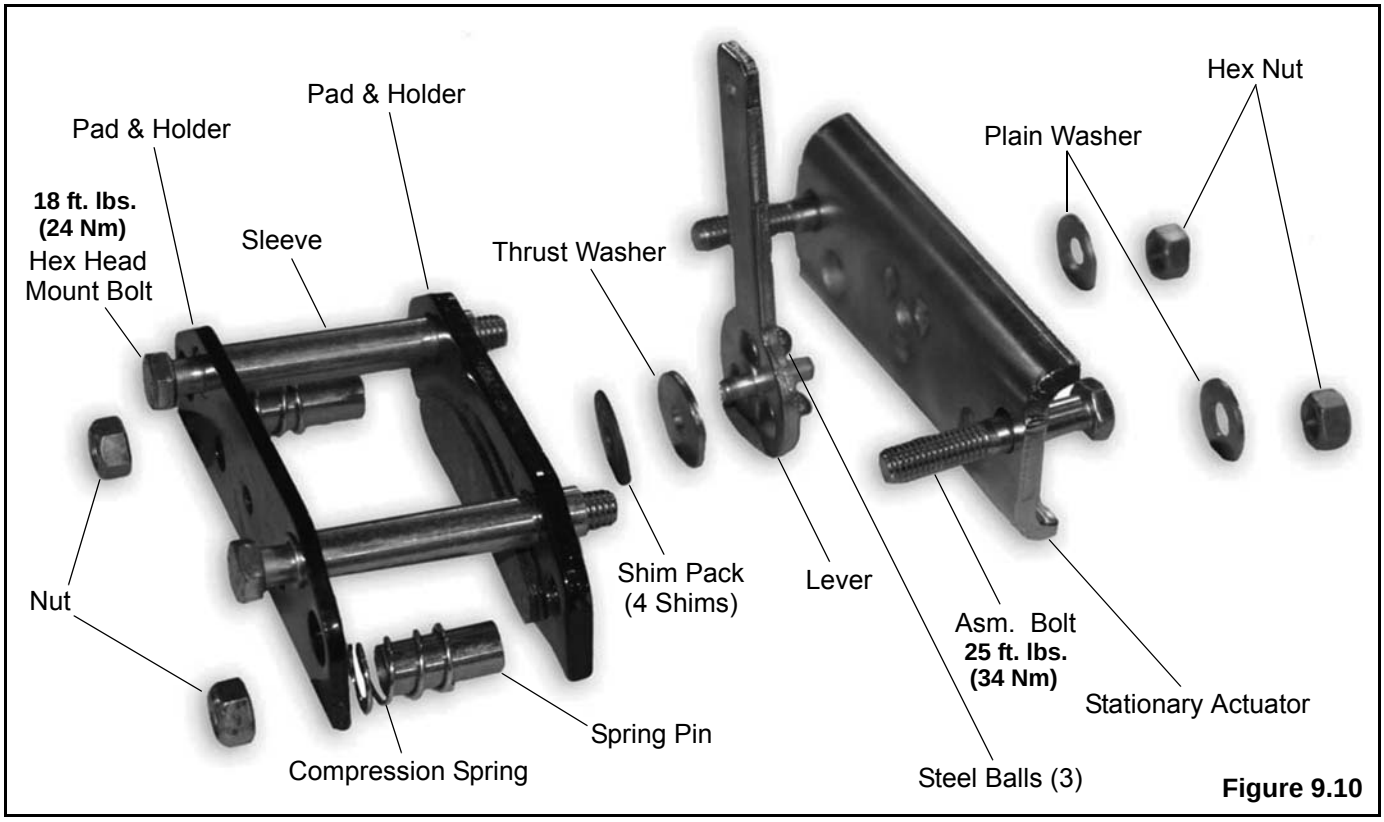
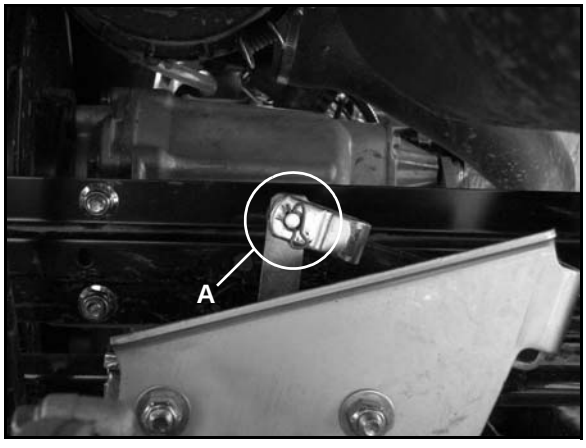


Figure 9.10

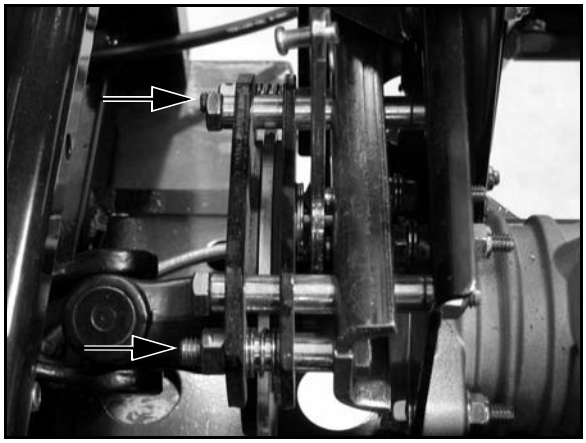
Caliper Removal

NOTE: Do not get oil, grease, or fluid on the parking brake pads. Damage to or contamination of the pads may cause the pads to function improperly.

1. Remove the clip pin and pin (A) from the parking brake cable.

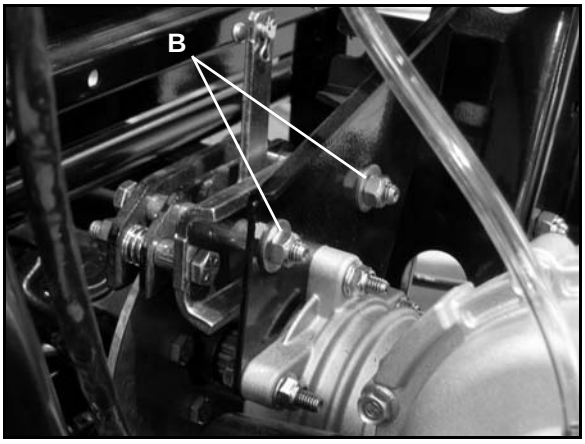


2. If replacing the brake pads, slightly loosen the caliper assembly bolts before removing the complete caliper assembly. This will ease the caliper disassembly procedure later.



NOTE: Be sure the parking brake is not engaged.

3. Loosen the two brake caliper mounting bolts (B) in equal increments.

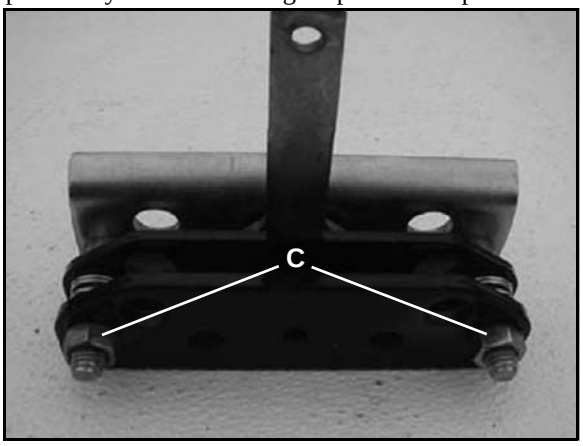


4. Remove the mounting bolts from the mount bracket and lift the parking brake caliper assembly out of the vehicle.

Caliper Disassembly / Inspection

NOTE: The parking brake caliper is replaced as an assembly. Refer to the "Electronic Parts Catalog" for information.

5. Remove the two caliper assembly nuts (C) that were previously loosened during Step 2 of "Caliper Removal".



6. Slide the brake pads and springs from the assembly.

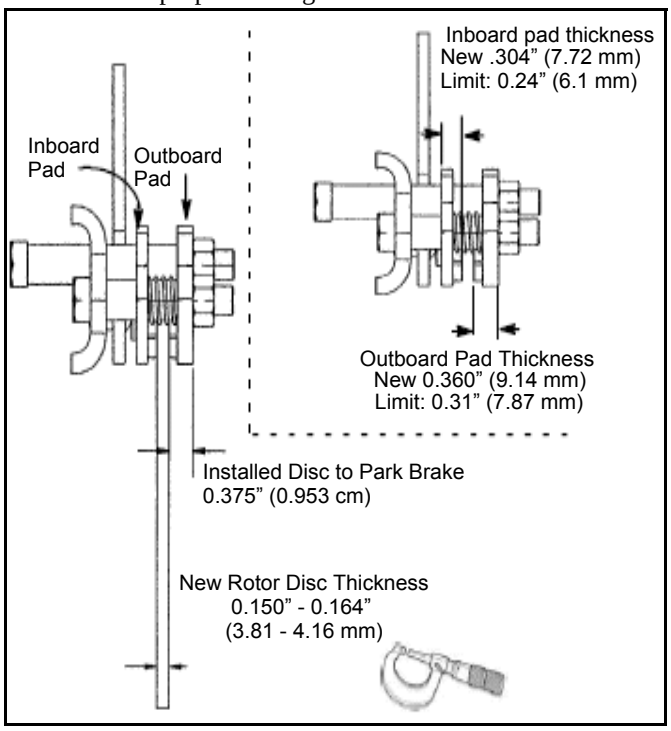
NOTE: Retain the lever and ball bearings for reassembly.

7. Inspect the brake pads linings for excessive wear. Replace as needed.

8. Check the three steel balls for any signs of cracking. Replace as needed.

9. Check ball seats in lever and stationary actuator. If excessively worn, replace parts as needed.

10. Measure the thickness of the rear caliper parking brake pads. Replace assembly or pads as needed. See illustration below for proper readings.



New Brake Pad Installation

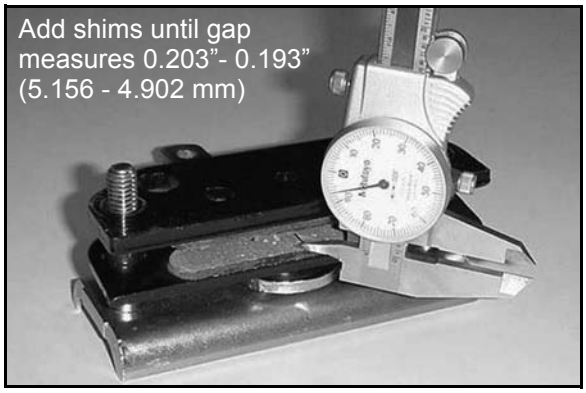
NOTE: Parking Brake Pads can be replaced by ordering one of the following kits:

PN 2203148 - Brake Pad and Shim Kit

PN 2203147 - Brake Pad Kit

There may be more parts in the service kit than your brake requires. Check the parts list included with the kit for the exact quantities.

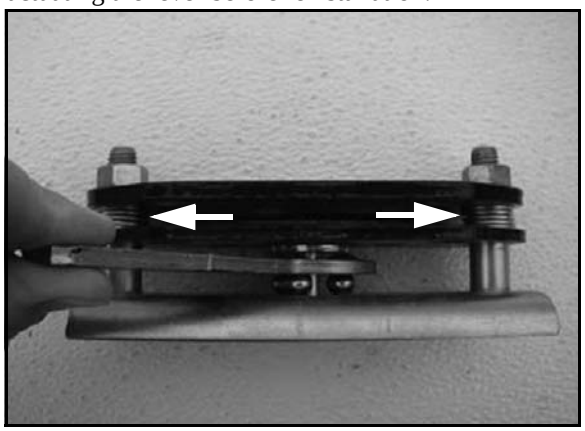
1. Using the stationary actuator, assemble the caliper components as shown below. Do not install the springs or shims yet. Measure the gap for the brake disc. Disassemble and add shims between thrust washer and the inside brake pad as needed to close the gap to 0.203"-0.193" (5.156-4.902 mm). For shim location, see **Figure 9.10** on page 11.



2. Once you have determined the correct amount of shims to use, install the assembly bolts through the sleeves. Install the nuts and the correct amount of shims, the inner brake pad, springs, and outer brake pad. Torque the assembly nuts to **25 ft. lbs. (34 Nm)**.

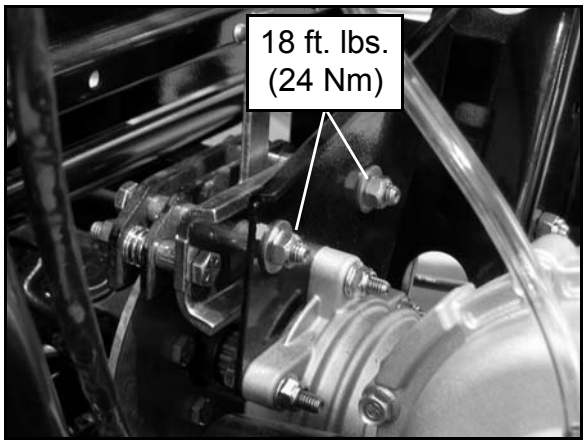
= T
Parking Brake Caliper - Assembly Bolts: **25 ft. lbs. (34 Nm)**

3. Ensure the parking brake assembly functions properly by actuating the lever before reinstallation.



Caliper Installation

1. Install the parking brake assembly into place. Tighten the two mounting bolts in increments for proper installation.



2. Torque the two mounting bolts to **18 ft. lbs. (24 Nm)**.

= T
Parking Brake Caliper - Mounting Bolts: **18 ft. lbs. (24 Nm)**

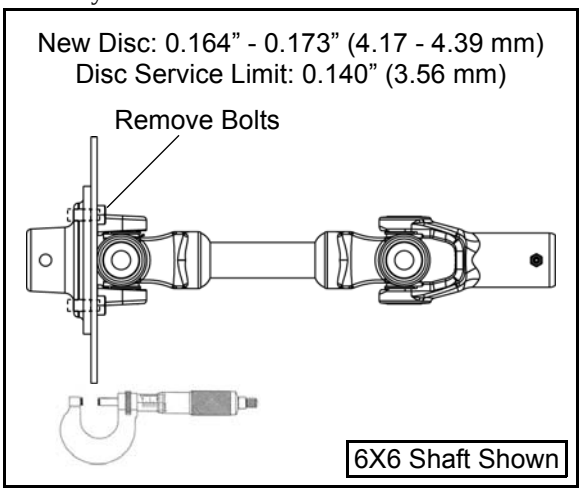
3. Install the cable, pin, and clip pin. Test the park brake for proper function.

PARKING BRAKE DISC SERVICE

Disc Inspection / Removal

1. Measure the parking brake disc with a micrometer. If the thickness of the disc is less than specified, replace the rear propshaft / disc assembly.

2. Follow the appropriate rear prop shaft removal procedure listed in Chapter 7 to remove the rear prop shaft / disc assembly.



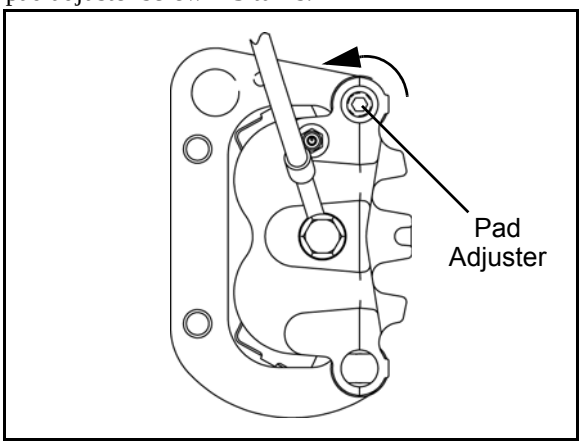
FRONT BRAKE PADS

Pad Removal

1. Elevate and support front of vehicle.

> **⚠ CAUTION**
>
> Use care when supporting vehicle so that it does not tip or fall.
> Severe injury may occur if machine tips or falls.

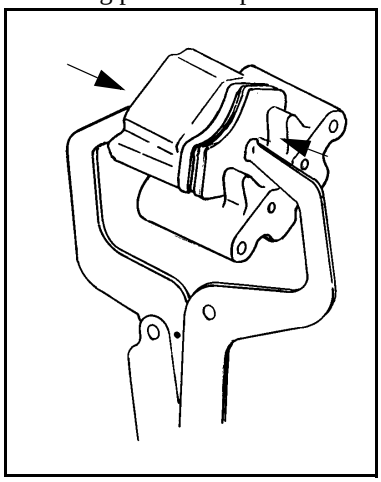
2. Remove the wheel nuts, washers and front wheel. Loosen pad adjuster screw 2-3 turns.



3. Remove the upper and lower caliper mounting bolts and remove the caliper from the front hub.

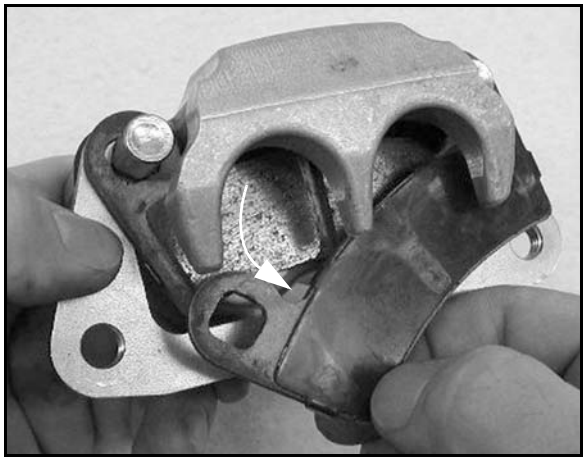
NOTE: When removing caliper, use care not to damage brake line. Support caliper so to avoid kinking or bending brake line.

4. Push caliper piston into caliper bore slowly using a C-clamp or locking pliers with pads installed.



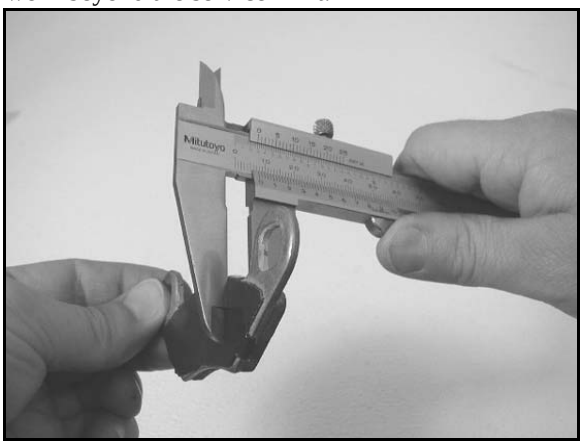
NOTE: Brake fluid will be forced through compensating port into master cylinder fluid reservoir when piston is pushed back into caliper. Remove excess fluid from reservoir as required.

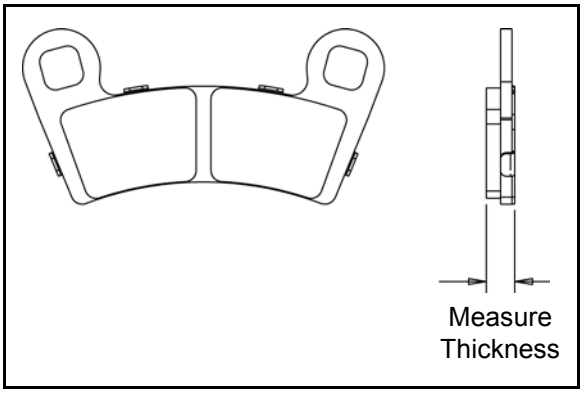
5. Push mounting bracket inward and slip outer brake pad past edge. Then remove inner pad.



Pad Inspection

1. Measure the thickness of the pad material. Replace pads if worn beyond the service limit.

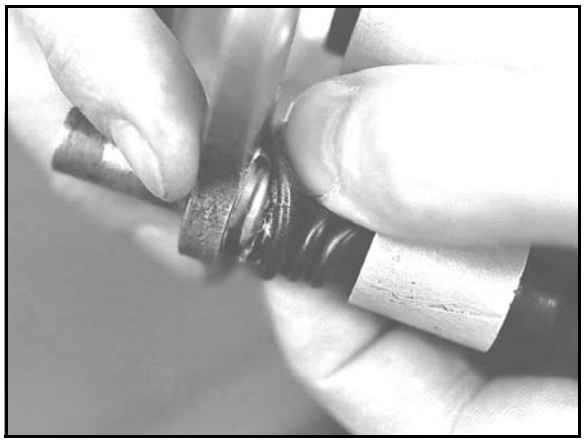




Front Brake Pad Thickness
New: .298 ± .007" (7.56 ± .178 mm)
Service Limit: .180" (4.6 mm)

Pad Assembly / Installation

1. Lubricate mounting bracket pins with a light film of Polaris Premium All Season Grease (**PN 2871423**), and install rubber dust boots.

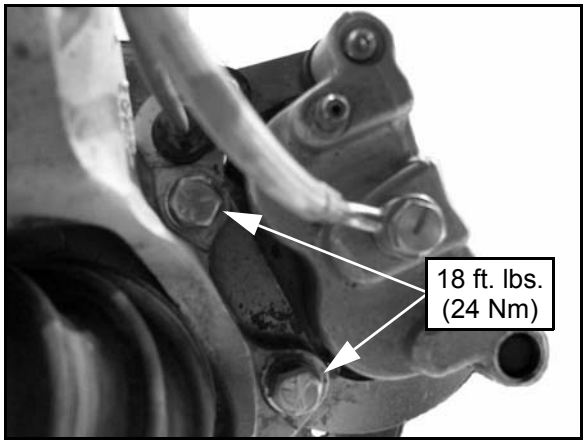


2. Compress mounting bracket and make sure dust boots are fully seated. Install pads with friction material facing each other.

⚠ WARNING

If brake pads are contaminated with grease, oil, or liquid soaked do not use the pads. Use only new, clean pads.

3. Install caliper onto front hub and torque mounting bolts.



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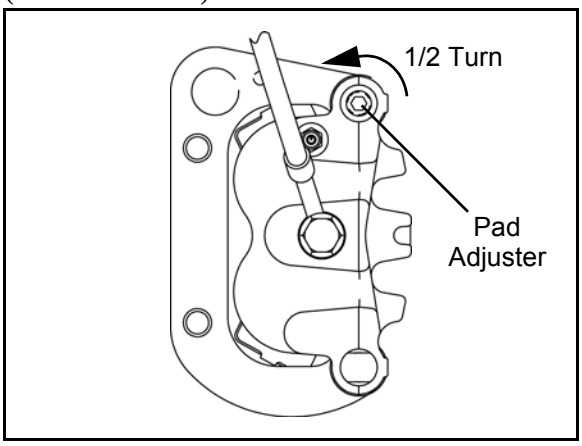
Front Caliper Mount Bolt Torque:
18 ft. lbs. (24 Nm)

4. Slowly pump the brake pedal until pressure has been built up. Maintain at least 1/2, (12.7 mm) of brake fluid in the reservoir to prevent air from entering the brake system.

5. Install the pad adjuster set screw and turn clockwise until stationary pad contacts disc, then back off 1/2 turn (counterclockwise).



6. Verify fluid level in reservoir is up to MAX line inside reservoir and install reservoir cap.

Master Cylinder Fluid

Up to MAX line inside reservoir

7. Install wheel and torque wheel nuts to specification (see "Chapter 2 - Maintenance").

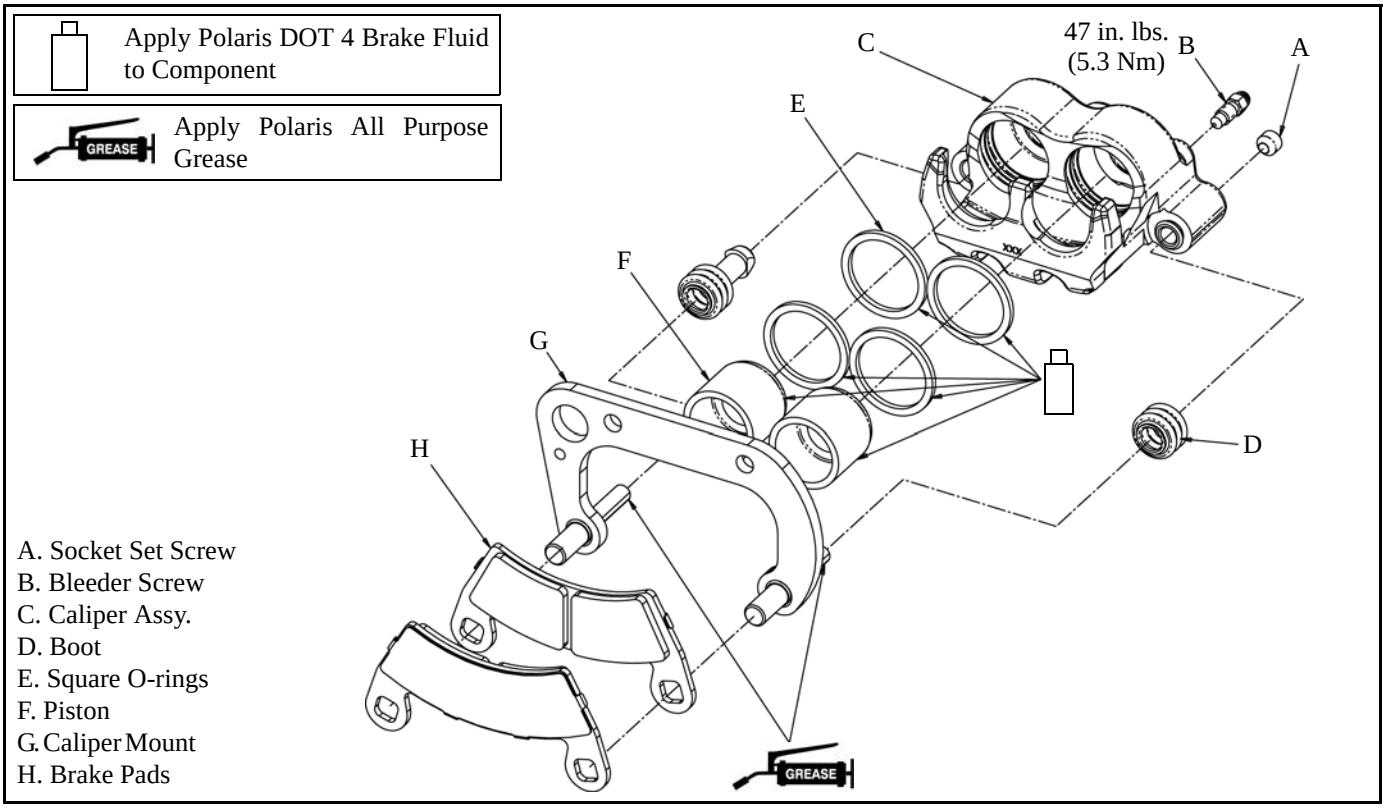
Brake Burnishing Procedure

It is required that a burnishing procedure be performed after installation of new brake pads to extend service life and reduce noise.

Start machine and slowly increase speed to 30 mph. Gradually apply brakes to stop machine. Allow pads and disc to cool sufficiently during the procedure. Do not allow pads or disc to become hot or warping may result. Repeat this procedure 10 times.

FRONT CALIPER SERVICE

Caliper Exploded View

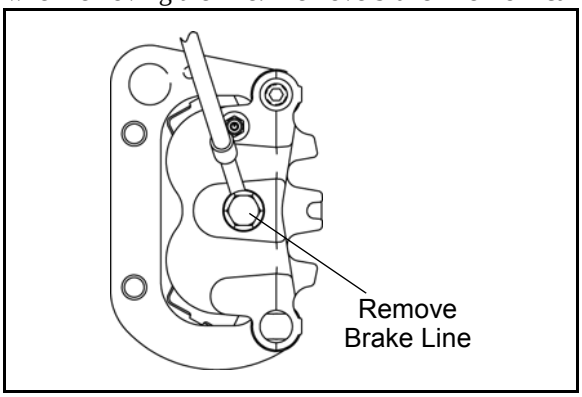


Caliper Removal

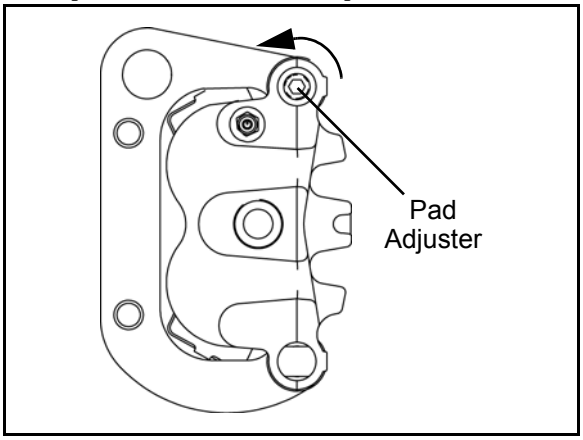
1. Elevate and safely support the front of the vehicle.
2. Remove the (4) wheel nuts and the front wheel.

> **⚠ CAUTION**
>
> Use care when supporting vehicle so that it does not tip or fall. Severe injury may occur.

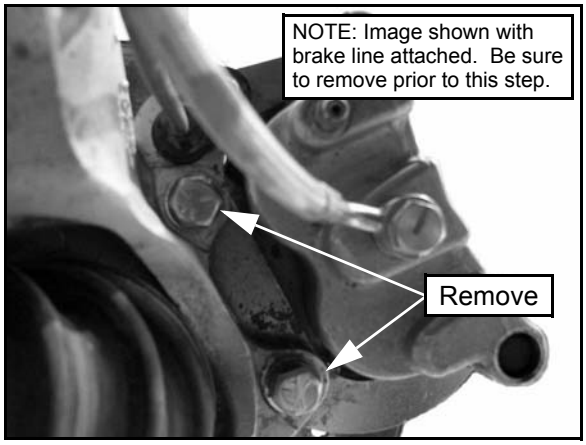
3. Clean caliper area before removal.
4. Place a container below the caliper to catch brake fluid when removing the line. Remove brake line from caliper.



5. Loosen brake pad adjustment set screw 2-3 turns to allow brake pad removal after the caliper is removed.

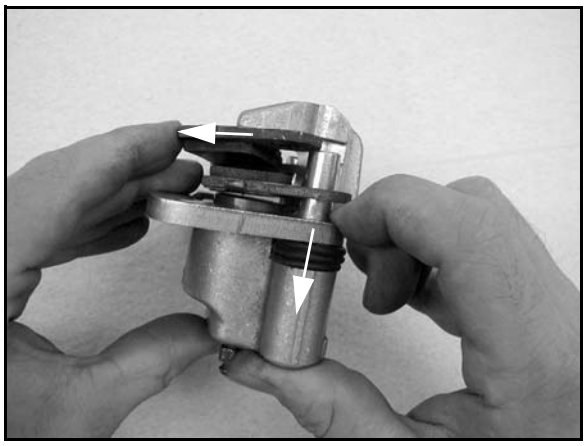


6. Remove the two caliper mounting bolts and remove the caliper assembly from the front strut.

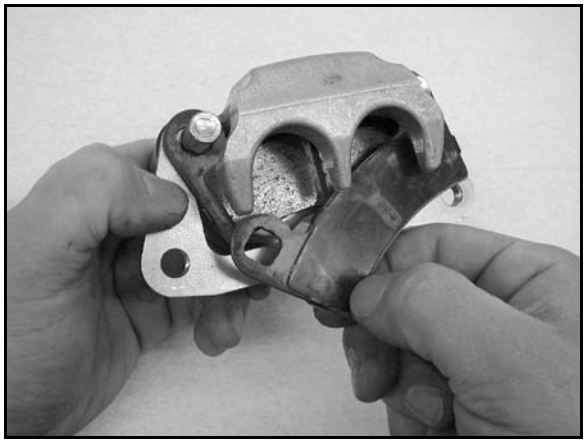


Caliper Disassembly

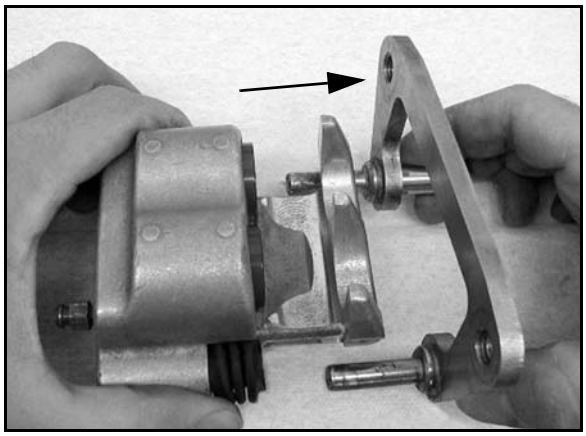
1. Push brake pad retainer pin inward and slip brake pads past the edge.



2. Remove both brake pads from the caliper.



3. Remove mounting bracket, pin assembly and dust boot.



4. Thoroughly clean the brake caliper before disassembly and prepare a clean work area to disassemble the caliper.

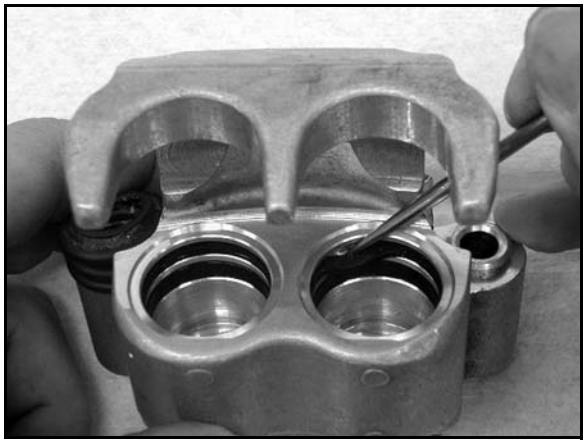
5. Use low pressure compressed air to remove the pistons from the caliper.

CAUTION
Use caution and always wear safety glasses when working with compressed air.

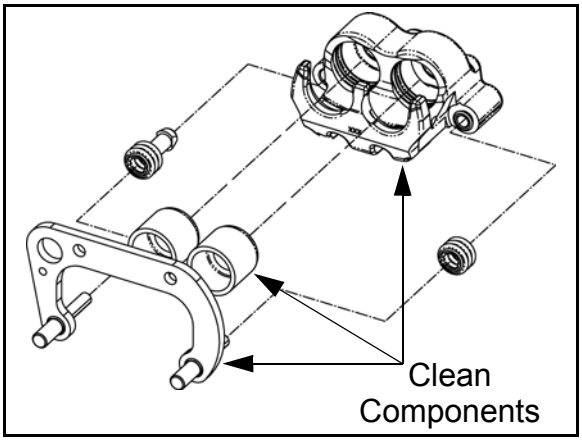
6. While holding the caliper and covering the pistons with a shop towel, carefully apply compressed air to the brake line inlet to force the pistons out from the caliper.

IMPORTANT: Do not remove the caliper pistons with a pliers. The piston sealing surfaces will become damaged if a pliers is used.

7. Once the pistons are removed, use a pick to carefully remove the square O-rings from the caliper. O-rings should be replaced during caliper service.



8. Clean the caliper body, piston, and retaining bracket with brake cleaner or alcohol.



NOTE: Be sure to clean seal grooves in caliper body.

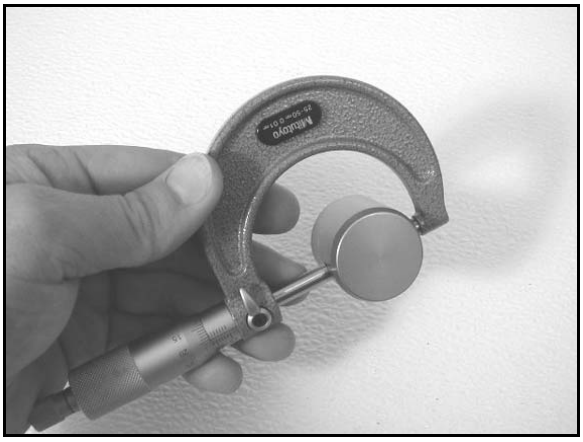
Caliper Inspection

1. Inspect caliper body for nicks, scratches, pitting or wear. Measure bore size and compare to specifications. Replace if damaged or worn beyond service limit.

= In. / mm.

Caliper Piston Bore I.D.:
Std: 1.373” (34.87 mm)
Service Limit: 1.375” (34.93 mm)

2. Inspect piston for nicks, scratches, pitting or wear. Measure piston diameter and replace if damaged or worn beyond service limit.



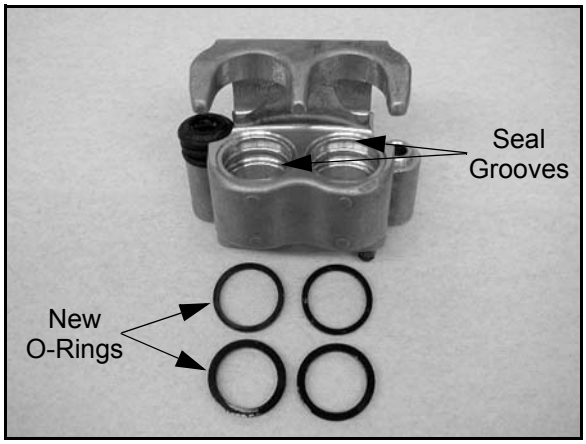
= In. / mm.

Caliper Piston O.D.:
Std: 1.370” (34.80 mm)
Service Limit: 1.368” (34.75 mm)

3. Inspect the brake disc and pads as outlined in this chapter.

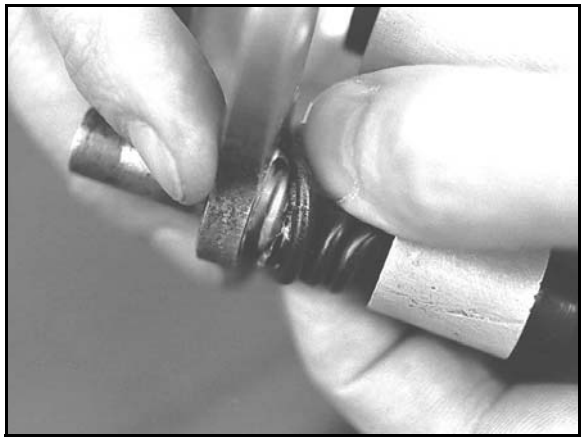
Caliper Assembly

1. Install new O-rings in the caliper body. Be sure the grooves are clean and free of residue or brakes may drag upon assembly.



2. Coat pistons with clean Polaris DOT 4 Brake Fluid. Install pistons with a twisting motion while pushing inward. Piston should slide in and out of bore smoothly, with light resistance.

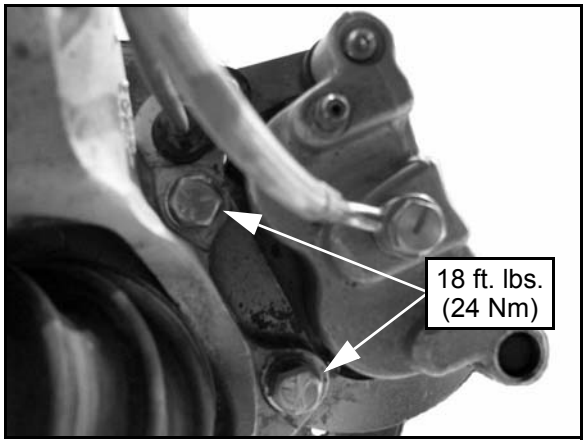
3. Lubricate the mounting bracket pins with Polaris Premium All Season Grease (**PN 2871423**), and install the rubber dust seal boots.



4. Compress the mounting bracket and make sure the dust seal boots are fully seated. Install the brake pads. Clean the disc and pads with brake parts cleaner or denatured alcohol to remove any dirt, oil or grease.

Caliper Installation

1. Install caliper and torque mounting bolts to specification.



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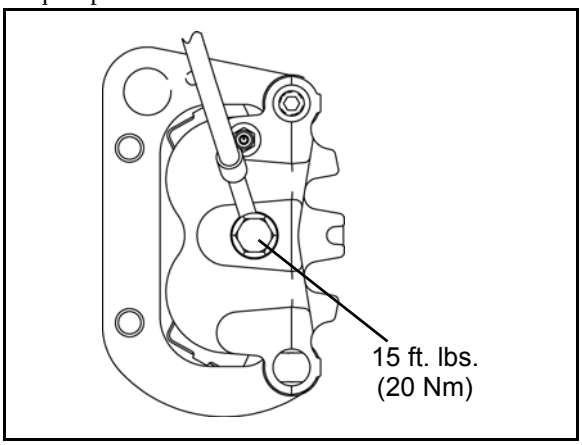
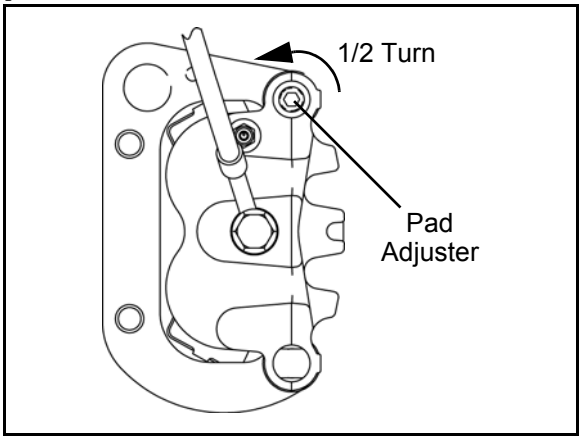
Front Caliper Mount Bolt Torque: **18 ft. lbs. (24 Nm)**

2. Install brake line and torque the banjo bolt to the proper torque specification.



3. Install the pad adjustment screw and turn until stationary pad contacts disc, then back off 1/2 turn.



4. Perform brake bleeding procedure as outlined earlier in this chapter.

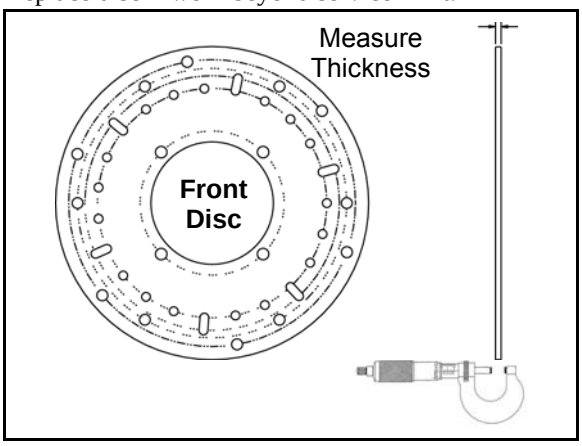
5. Install wheel and torque wheel nuts to specification (see Chapter 2).

NOTE: If new brake pads are installed, brake burnishing is recommended (see "FRONT BRAKE PADS - Brake Burnishing Procedure").

FRONT BRAKE DISC

Disc Inspection

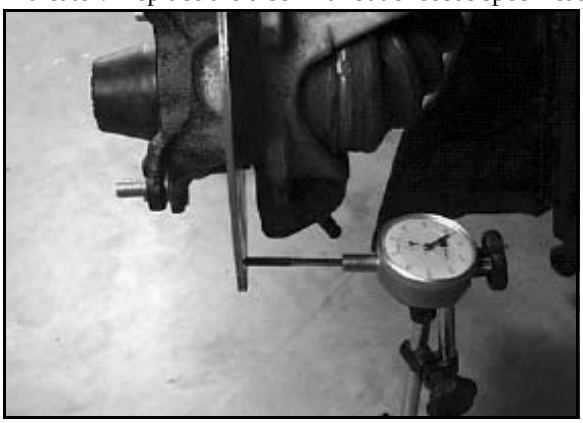
1. Visually inspect disc for scoring, scratches, or gouges. Replace the disc if any deep scratches are evident.
2. Use a 0-1" micrometer and measure the disc thickness at eight different points around the pad contact surface. Replace disc if worn beyond service limit.



Brake Disc Thickness
New .158" (4.01 mm)
Service Limit .140" (3.56 mm)

Brake Disc Thickness Variance
Service Limit: .002" (.051 mm)
difference between measurements

3. Mount dial indicator as shown to measure disc runout. Slowly rotate the disc and read total runout on the dial indicator. Replace the disc if runout exceeds specification.

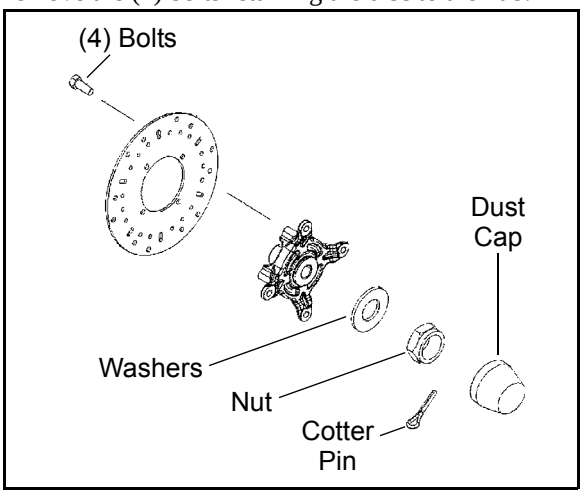


Brake Disc Runout

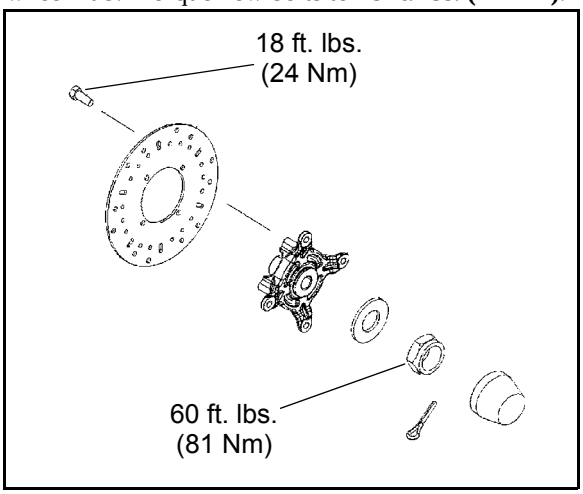
Service Limit .010" (.254 mm)

Disc Replacement

1. Remove front brake caliper (see "Front Caliper Service").
2. Remove dust cap, cotter pin, castle nut and washers.
3. Remove the wheel hub assembly from the vehicle and remove the (4) bolts retaining the disc to the hub.



4. Clean the wheel hub mating surface and install new disc on wheel hub. Torque new bolts to **18 ft. lbs. (24 Nm)**.



⚠ CAUTION

Always use new brake disc mounting bolts. The bolts have a pre-applied locking agent which is destroyed upon removal.

5. Install wheel hub assembly, washers, and castle nut. Torque castle nut to **60 ft. lbs. (81 Nm)** and install a new cotter pin before installing the dust cap.
6. Install front brake caliper (see "Front Caliper Service"). Follow bleeding procedure outlined earlier in this chapter.
7. Field test unit for proper braking action before putting into service. Inspect for fluid leaks and firm brakes. Make sure the brake is not dragging when pedal is released. If the brake drags, re-check assembly and installation.

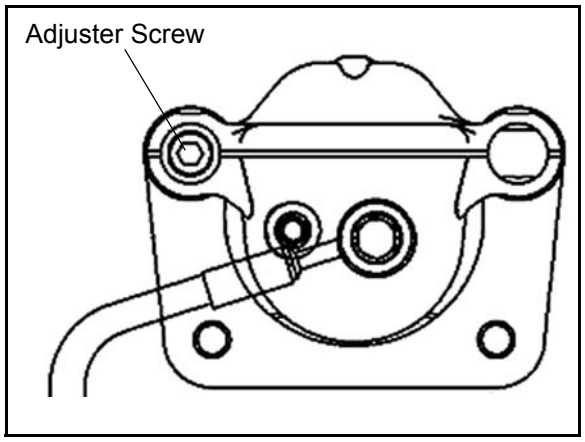
REAR BRAKE PADS (6X6)

Pad Removal

1. Elevate and support rear of machine.

> **⚠ CAUTION**
>
> Use care when supporting vehicle so that it does not tip or fall. Severe injury may occur if machine tips or falls.

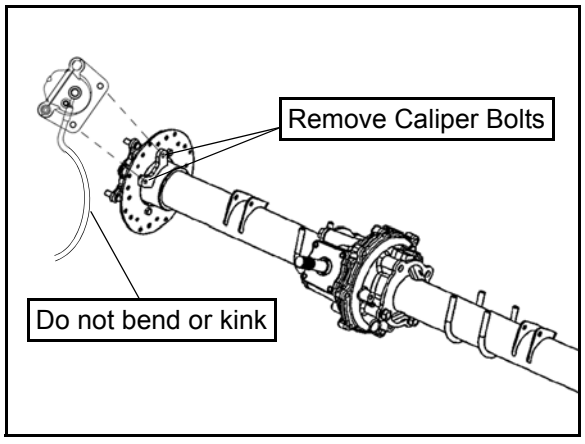
2. Remove the rear wheel. Loosen pad adjuster screw 2-3 turns.



3. Clean caliper area before removal.

4. Remove caliper mounting bolts and lift caliper off of disc.

NOTE: When removing caliper, be careful not to damage brake line. Support caliper so as not to kink or bend brake line.

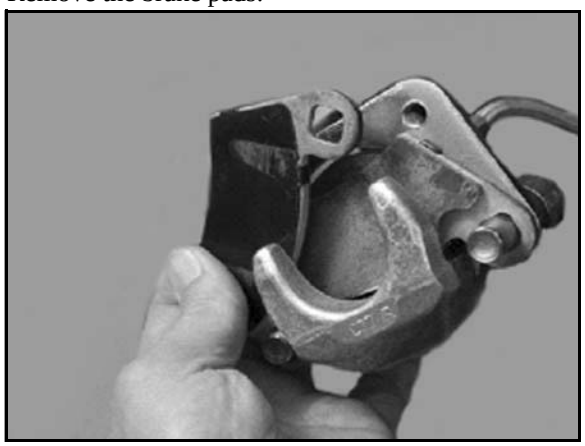


Pad Inspection

1. Push caliper piston into caliper bore slowly with pads installed.

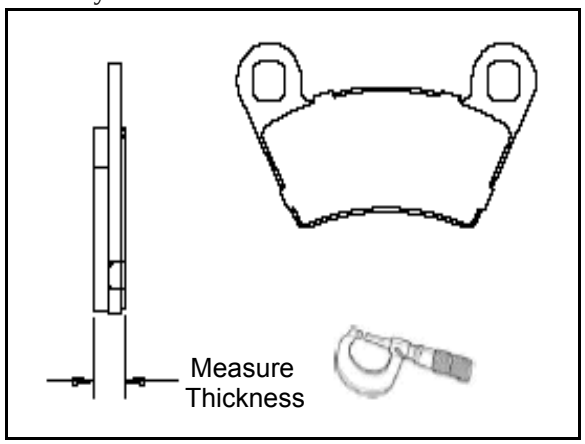
NOTE: Brake fluid will be forced through compensating port into master cylinder fluid reservoir when piston is pushed back into caliper. Remove excess fluid from reservoir as required.

2. Remove the brake pads.



3. Clean the caliper with brake cleaner or alcohol.

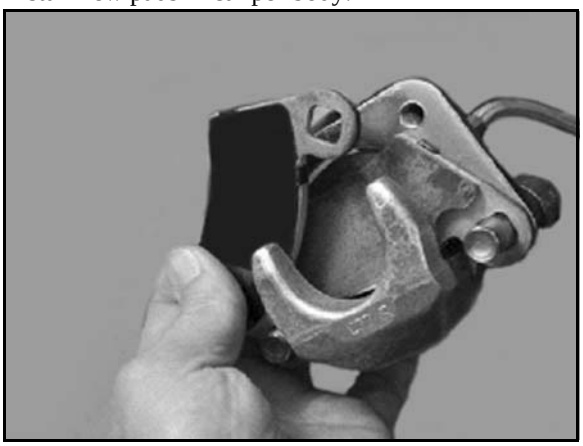
4. Measure the thickness of the pad material. Replace pads if worn beyond the service limit.



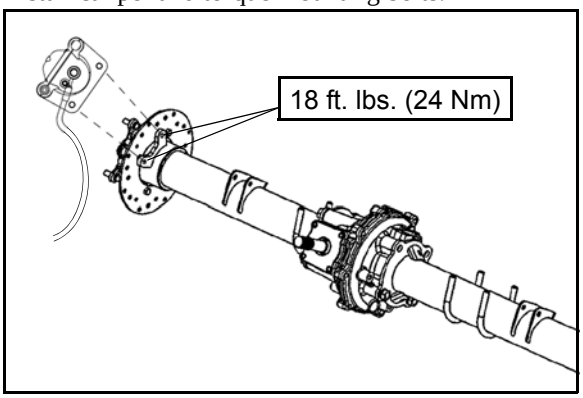
Rear Brake Pad Thickness
New .298 + .007" (7.56 + .178 mm)
Service Limit .180" (4.6 mm)

Pad Installation

1. Install new pads in caliper body.



2. Install caliper and torque mounting bolts.



Rear Brake Caliper Mounting Bolt:

Torque 18 ft. lbs. (24 Nm)

3. Turn adjuster screw back in finger tight using a hex wrench.
4. Slowly pump the brake pedal until pressure has been built up. Maintain at least 1/2"(12.7 mm) of brake fluid in the reservoir to prevent air from entering the master cylinder.

REAR BRAKE PADS (4X4 CREW)

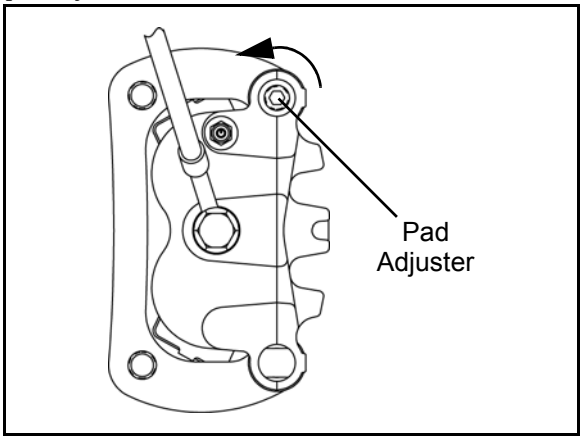
Pad Removal

1. Elevate and support rear of vehicle.

⚠ CAUTION

Use care when supporting vehicle so that it does not tip or fall.
Severe injury may occur if machine tips or falls.

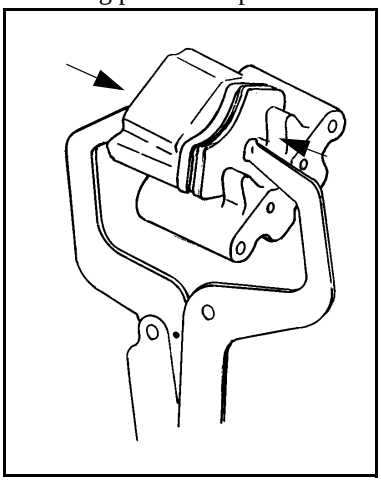
2. Remove the wheel nuts, washers and rear wheel. Loosen pad adjuster screw 2-3 turns.



3. Remove the upper and lower caliper mounting bolts and remove the caliper from the front hub.

NOTE: When removing caliper, use care not to damage brake line. Support caliper so to avoid kinking or bending brake line.

4. Push caliper piston into caliper bore slowly using a C-clamp or locking pliers with pads installed.

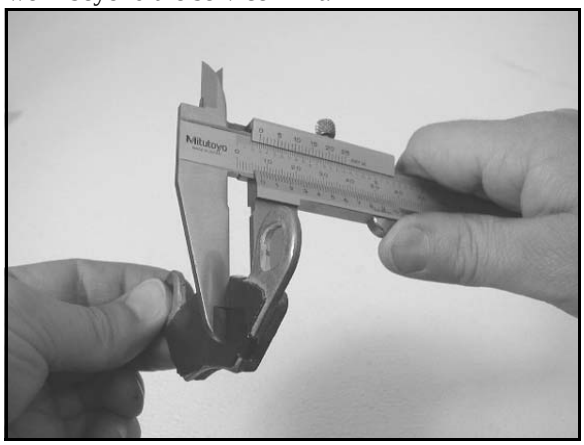


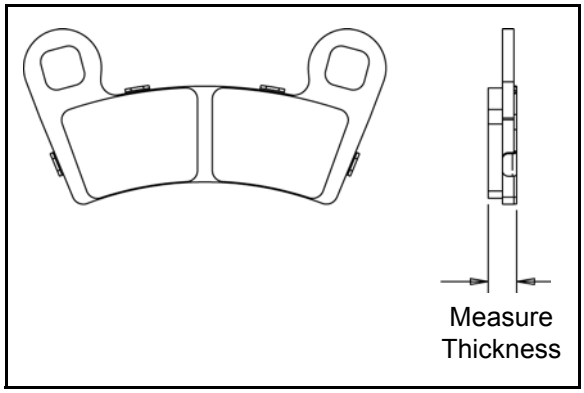
NOTE: Brake fluid will be forced through compensating port into master cylinder fluid reservoir when piston is pushed back into caliper. Remove excess fluid from reservoir as required.

5. Push mounting bracket inward and slip outer brake pad past edge. Then remove inner pad.

Pad Inspection

1. Measure the thickness of the pad material. Replace pads if worn beyond the service limit.

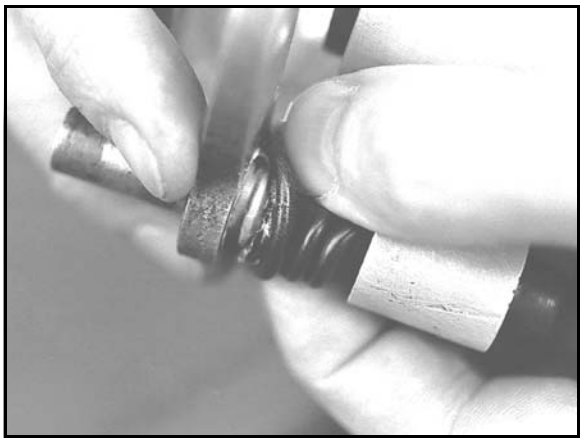




Front Brake Pad Thickness
New: .298 ± .007" (7.56 ± .178 mm)
Service Limit: .180" (4.6 mm)

Pad Assembly / Installation

1. Lubricate mounting bracket pins with a light film of Polaris Premium All Season Grease (**PN 2871423**), and install rubber dust boots.

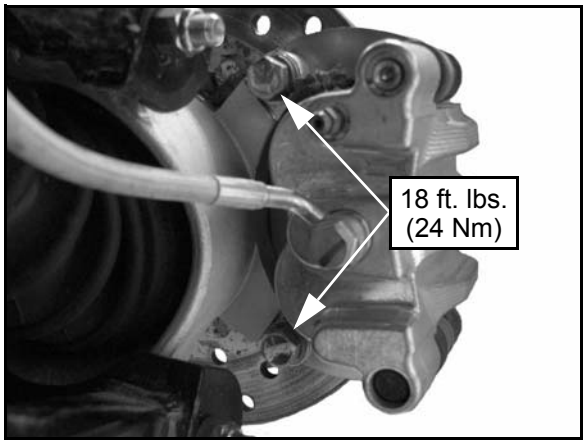


2. Compress mounting bracket and make sure dust boots are fully seated. Install pads with friction material facing each other.

⚠ WARNING

If brake pads are contaminated with grease, oil, or liquid soaked do not use the pads. Use only new, clean pads.

3. Install caliper onto rear hub and torque mounting bolts.



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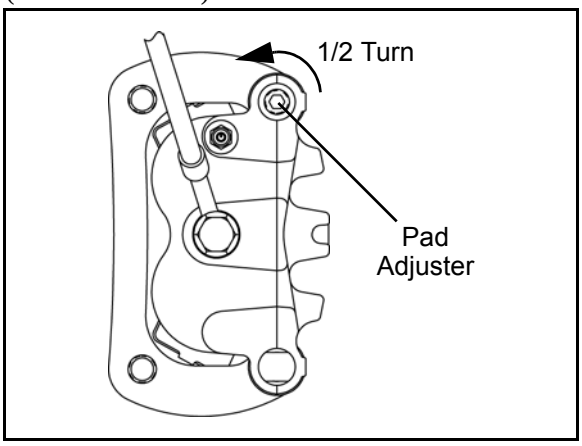
Front Caliper Mount Bolt Torque:
18 ft. lbs. (24 Nm)

4. Slowly pump the brake pedal until pressure has been built up. Maintain at least 1/2, (12.7 mm) of brake fluid in the reservoir to prevent air from entering the brake system.

5. Install the adjustment set screw and turn clockwise until stationary pad contacts disc, then back off 1/2 turn (counterclockwise).



6. Verify fluid level in reservoir is up to MAX line inside reservoir and install reservoir cap.

Master Cylinder Fluid

Up to MAX line inside reservoir

7. Install wheel and torque wheel nuts to specification (see "Chapter 2 - Maintenance").

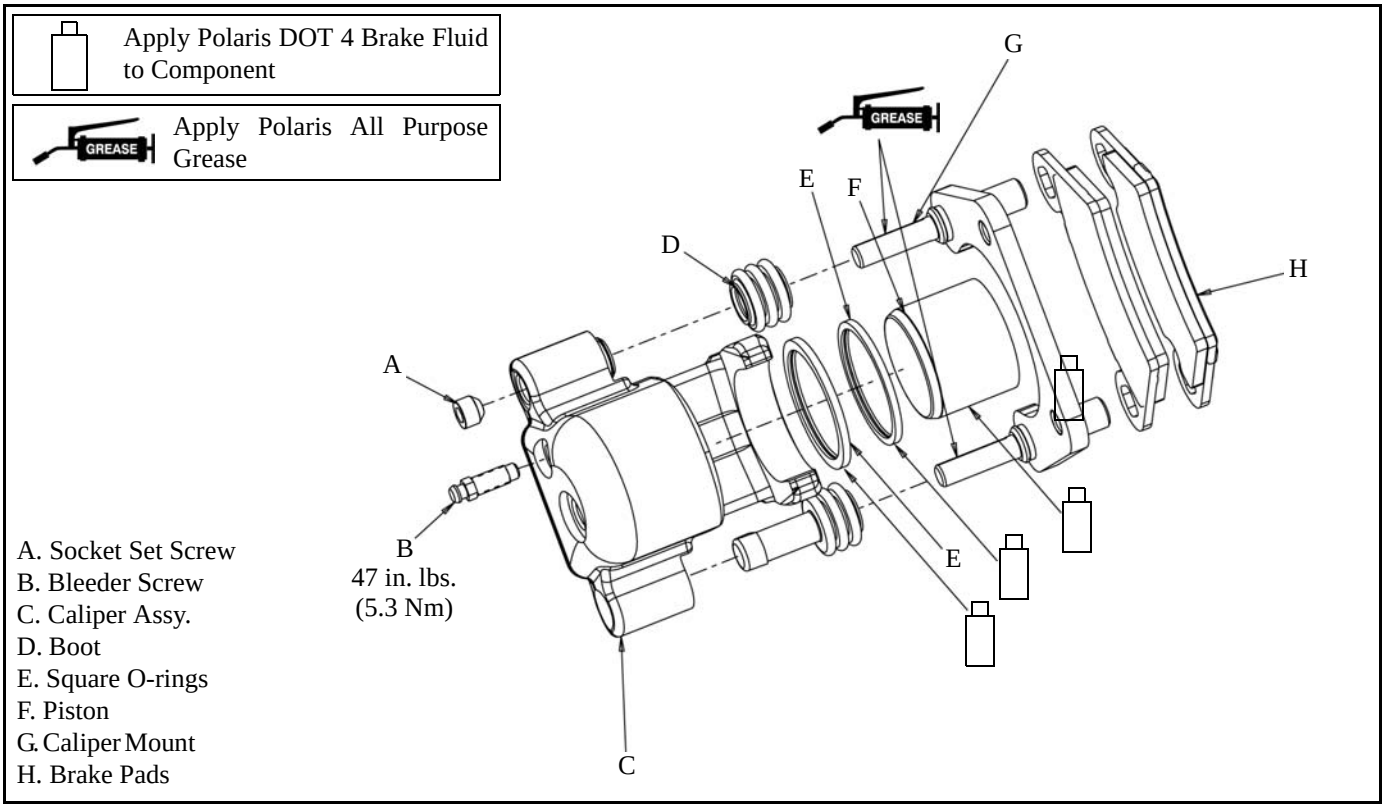
Brake Burnishing Procedure

It is required that a burnishing procedure be performed after installation of new brake pads to extend service life and reduce noise.

Start machine and slowly increase speed to 30 mph. Gradually apply brakes to stop machine. Allow pads and disc to cool sufficiently during the procedure. Do not allow pads or disc to become hot or warping may result. Repeat this procedure 10 times.

REAR CALIPER SERVICE (6X6)

Rear Caliper Exploded View

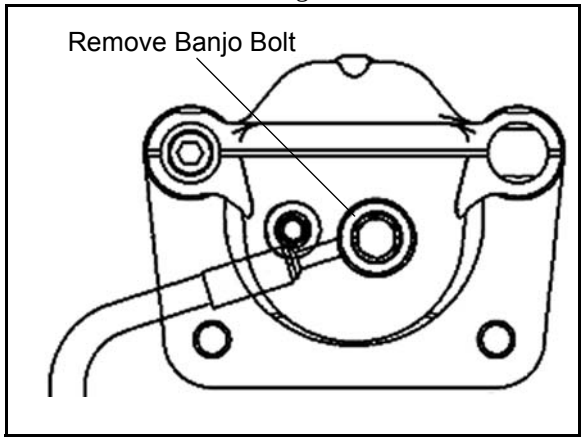


Caliper Removal

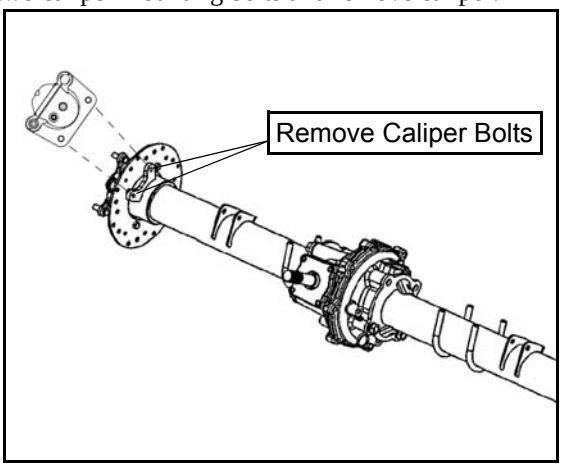
1. Safely support the rear of the machine.

> **CAUTION**
>
> Use care when supporting vehicle so that it does not tip or fall. Severe injury may occur if machine tips or falls.

2. Use a wrench to remove the brake line. Place a container to catch brake fluid draining from brake lines.



3. After the fluid has drained into the container, remove the two caliper mounting bolts and remove caliper.



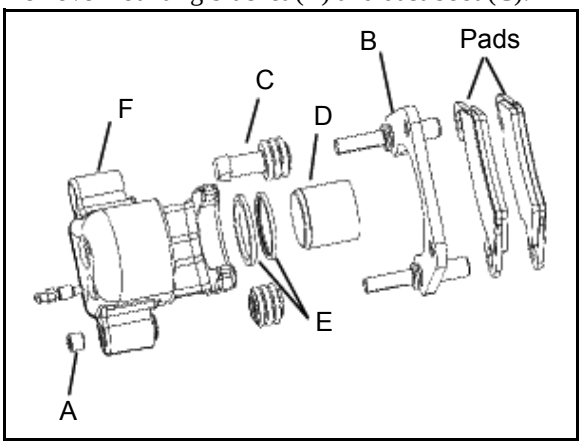
4. Clean disc, caliper body, and pistons with brake cleaner or alcohol.

Caliper Disassembly

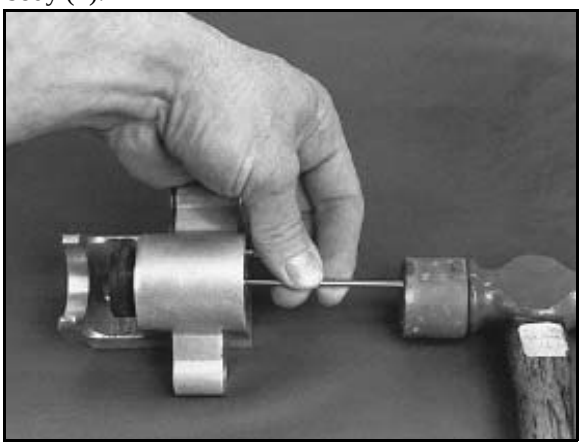
1. Remove brake pad adjuster screw (A).

2. Push upper pad retainer pin inward and slip brake pads past edge, if pads are still installed.

3. Remove mounting bracket (B) and dust boot (C).



4. Remove piston (D) and square O-rings (E) from the caliper body (F).

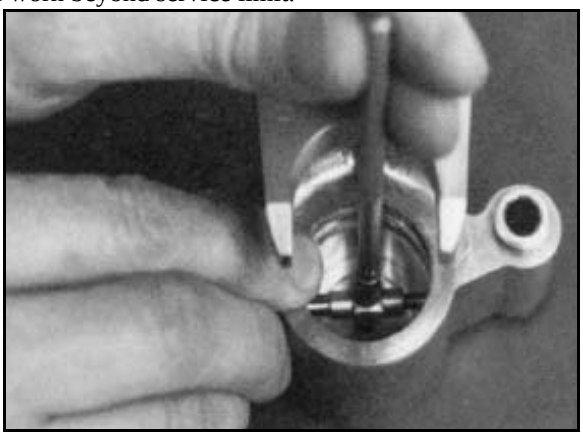


5. Clean the caliper body, piston, and retaining bracket with brake cleaner or alcohol.

NOTE: Be sure to clean seal grooves in caliper body.

Caliper Inspection

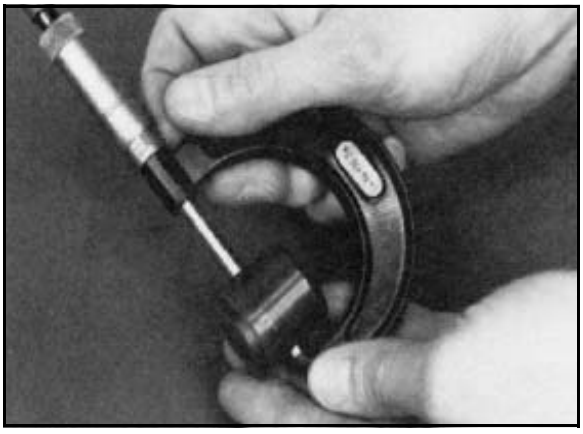
Inspect caliper body for nicks, scratches or wear. Measure bore size and compare to specifications. Replace if damage is evident or if worn beyond service limit.



= In. / mm.

Caliper Piston Bore I.D.:
Std: 1.505” (38.23 mm)
Service Limit: 1.507” (38.28 mm)

6. Inspect piston for nicks, scratches, wear or damage. Measure diameter and replace if damaged or worn beyond service limit.



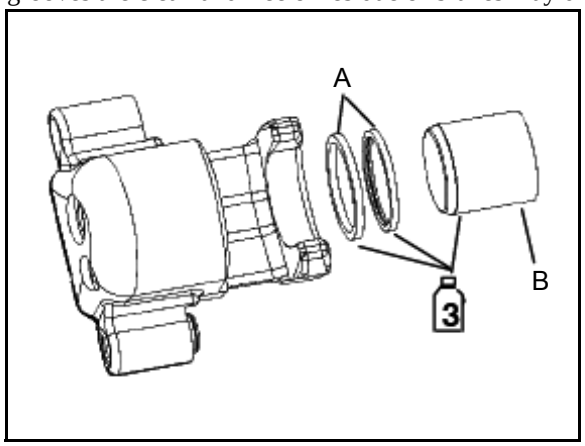
= In. / mm.

Caliper Piston O.D.:
Std: 1.500” (38.10 mm)
Service Limit: 1.498” (38.05 mm)

7. Inspect the brake disc and pads as outlined for brake pad replacement in this chapter.

Caliper Assembly

1. Install new square O-rings (A) in caliper body. Be sure the grooves are clean and free of residue or brakes may drag.



2. Coat the piston with clean DOT 4 Brake Fluid (PN 2872189). Install piston (B) with a twisting motion while pushing inward. Piston should slide in and out of bore smoothly, with light resistance.

3. Lubricate the mounting bracket pins with Polaris Premium All Season Grease, and install the rubber dust seal boots.

Polaris Premium All Season Grease

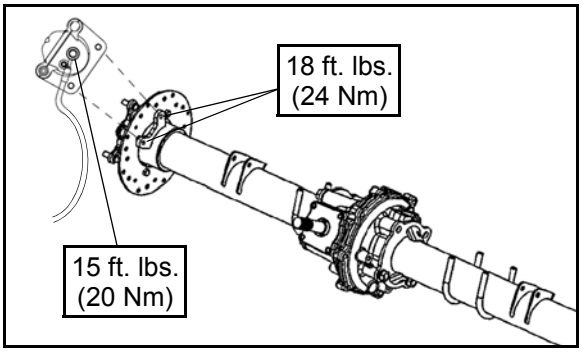
(PN 2871423)

4. Compress the mounting bracket and make sure the dust seals are fully seated. Install the brake pads. Clean the disc and pads with brake parts cleaner or denatured alcohol to remove any dirt, oil or grease.

Caliper Installation

1. Install the rear caliper with the mounting bolts. Torque mounting bolts to 18 ft.lbs. (24 Nm).

2. Install brake line banjo bolt. Torque banjo bolt to 15 ft. lbs. (20 Nm).



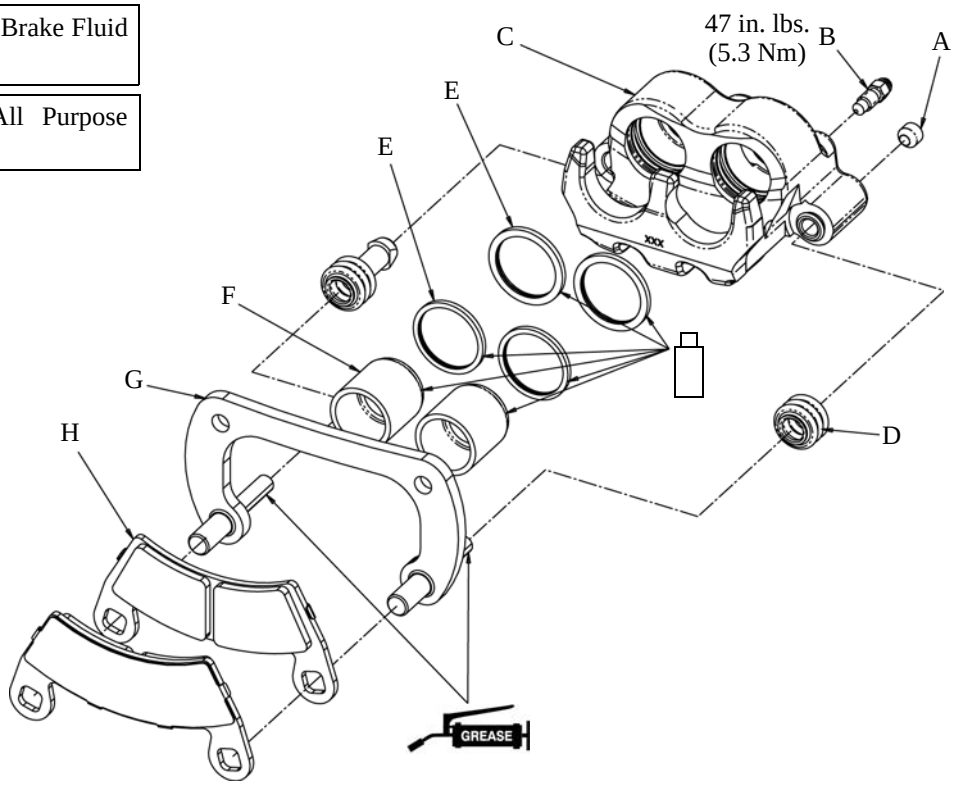
3. Install rear wheel and wheel nuts. Carefully lower vehicle.

REAR CALIPER SERVICE (4X4 CREW)

Rear Caliper Exploded View

Apply Polaris DOT 4 Brake Fluid to Component

Apply Polaris All Purpose Grease



A. Socket Set Screw
B. Bleeder Screw
C. Caliper Assy.
D. Boot
E. Square O-rings
F. Piston
G. Caliper Mount
H. Brake Pads

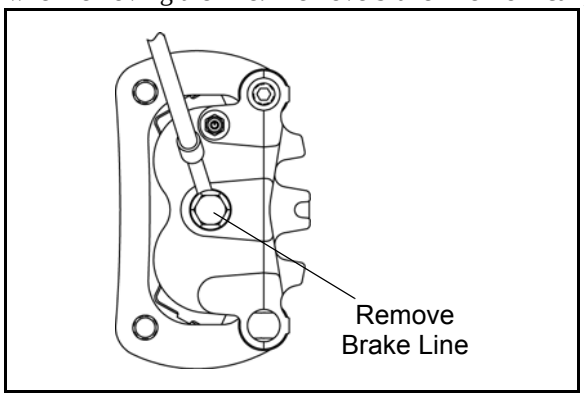
Caliper Removal

1. Elevate and safely support the rear of the vehicle.
2. Remove the (4) wheel nuts, (4) washers and rear wheel.

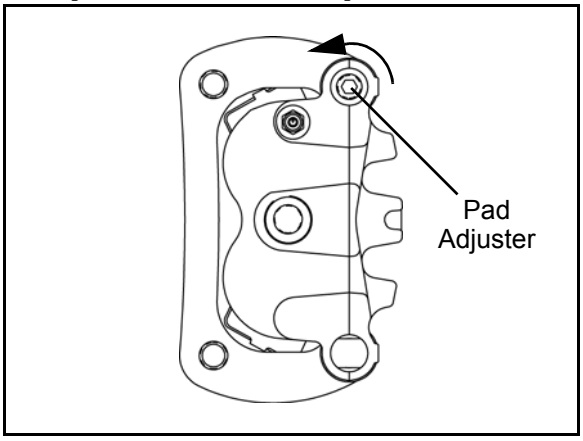
⚠ CAUTION

Use care when supporting vehicle so that it does not tip or fall. Severe injury may occur.

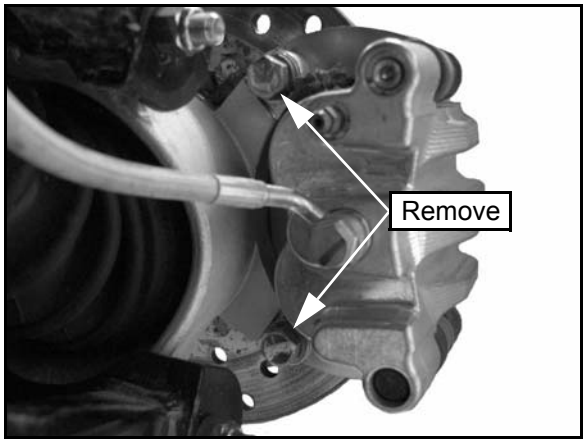
3. Clean caliper area before removal.
4. Place a container below the caliper to catch brake fluid when removing the line. Remove brake line from caliper.



5. Loosen brake pad adjustment set screw 2-3 turns to allow brake pad removal after the caliper is removed.

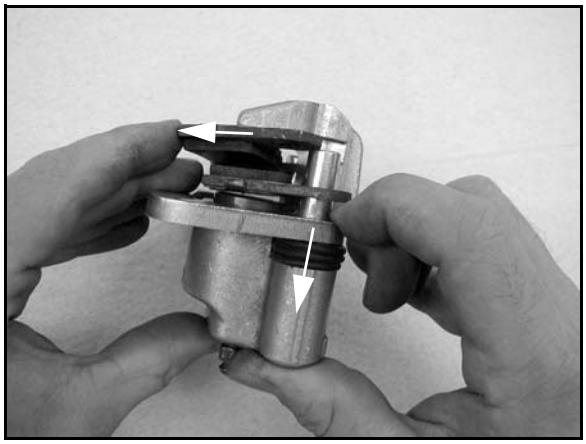


6. Remove the two caliper mounting bolts and remove the caliper assembly from the rear hub.

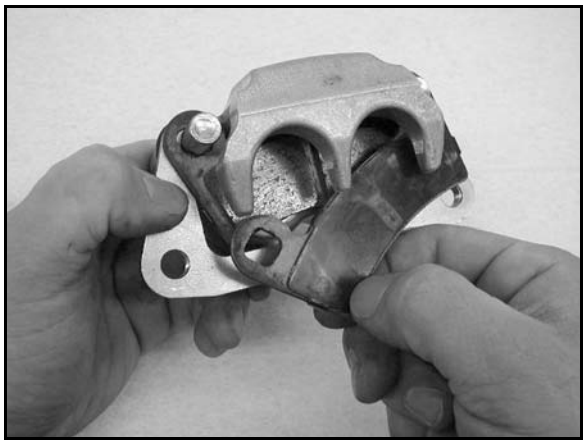


Caliper Disassembly

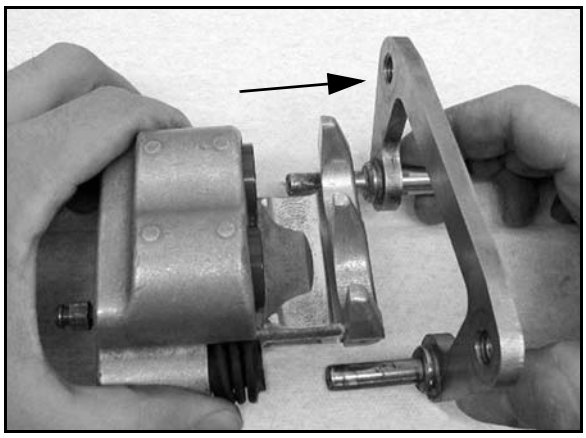
1. Push brake pad retainer pin inward and slip brake pads past the edge.



2. Remove both brake pads from the caliper.



3. Remove mounting bracket, pin assembly and dust boot.



4. Thoroughly clean the brake caliper before disassembly and prepare a clean work area to disassemble the caliper.

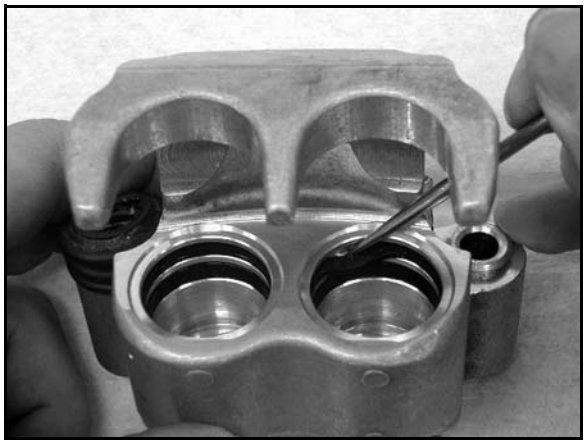
5. Use low pressure compressed air to remove the pistons from the caliper.

CAUTION
Use caution and always wear safety glasses when working with compressed air.

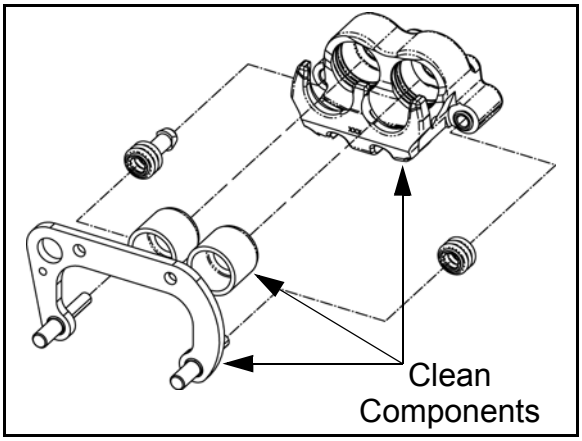
6. While holding the caliper and covering the pistons with a shop towel, carefully apply compressed air to the brake line inlet to force the pistons out from the caliper.

IMPORTANT: Do not remove the caliper pistons with a pliers. The piston sealing surfaces will become damaged if a pliers is used.

7. Once the pistons are removed, use a pick to carefully remove the square O-rings from the caliper. O-rings should be replaced during caliper service.



8. Clean the caliper body, piston, and retaining bracket with brake cleaner or alcohol.



NOTE: Be sure to clean seal grooves in caliper body.

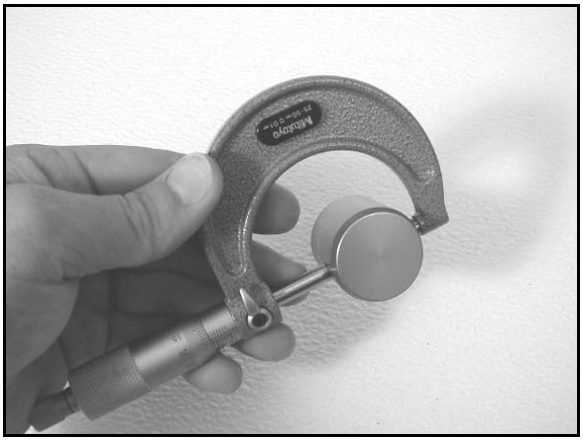
Caliper Inspection

1. Inspect caliper body for nicks, scratches, pitting or wear. Measure bore size and compare to specifications. Replace if damaged or worn beyond service limit.

= In. / mm.

Caliper Piston Bore I.D.:
Std: 1.192” (30.28 mm)
Service Limit: 1.194” (34.33 mm)

2. Inspect piston for nicks, scratches, pitting or wear. Measure piston diameter and replace if damaged or worn beyond service limit.



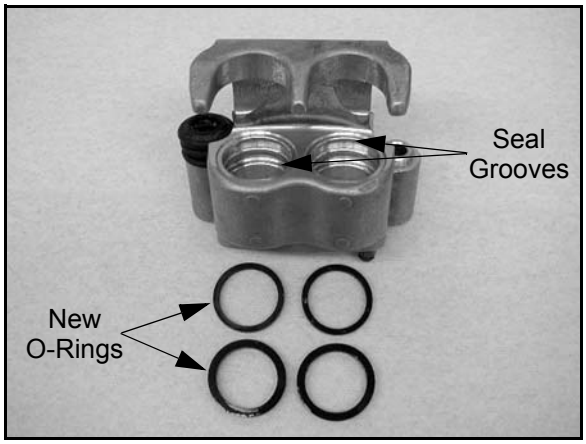
= In. / mm.

Caliper Piston O.D.:
Std: 1.186” (30.12 mm)
Service Limit: 1.184” (30.07 mm)

3. Inspect the brake disc and pads as outlined in this chapter.

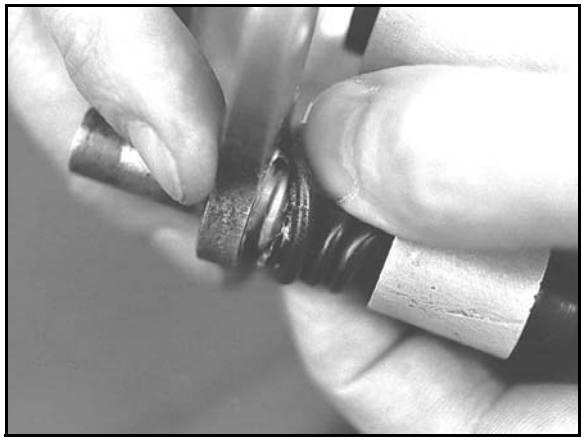
Caliper Assembly

1. Install new O-rings in the caliper body. Be sure the grooves are clean and free of residue or brakes may drag upon assembly.



2. Coat pistons with clean Polaris DOT 4 Brake Fluid. Install pistons with a twisting motion while pushing inward. Piston should slide in and out of bore smoothly, with light resistance.

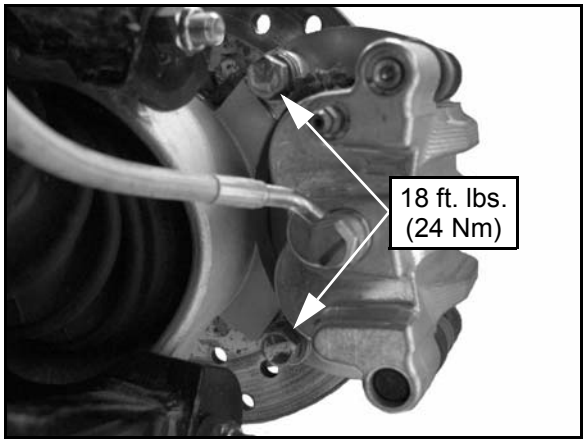
3. Lubricate the mounting bracket pins with Polaris Premium All Season Grease (**PN 2871423**), and install the rubber dust seal boots.



4. Compress the mounting bracket and make sure the dust seal boots are fully seated. Install the brake pads. Clean the disc and pads with brake parts cleaner or denatured alcohol to remove any dirt, oil or grease.

Caliper Installation

1. Install caliper and torque mounting bolts to specification.



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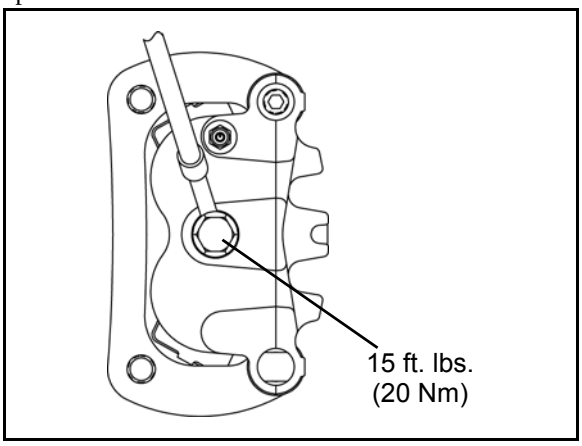
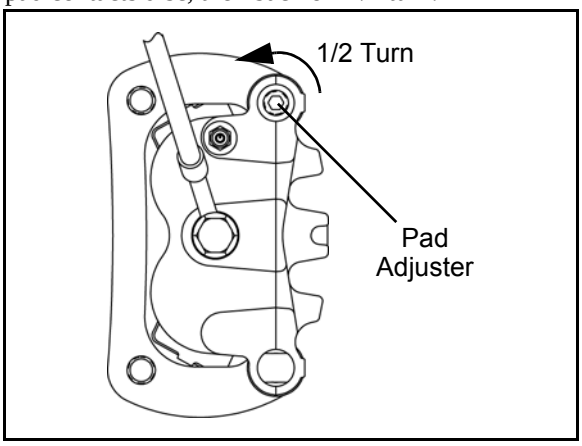
Rear Caliper Mount Bolt Torque: **18 ft. lbs. (24 Nm)**

2. Install brake line and tighten securely with a line wrench. Torque the banjo bolt brake line(s) to the proper torque specification.



3. Install the pad adjustment screw and turn until stationary pad contacts disc, then back off 1/2 turn.



4. Perform brake bleeding procedure as outlined earlier in this chapter.

5. Install wheel and torque wheel nuts to specification (see Chapter 2).

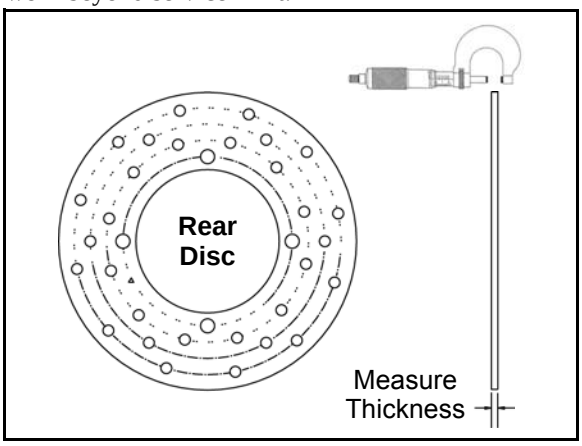
NOTE: If new brake pads are installed, brake burnishing is recommended (see "REAR BRAKE PADS - Brake Burnishing Procedure").

REAR BRAKE DISC

Disc Inspection

1. Visually inspect disc for scoring, scratches, or gouges. Replace the disc if any deep scratches are evident.

2. Use a 0-1"micrometer and measure disc thickness at 8 different points around perimeter of disc. Replace disc if worn beyond service limit.



Brake Disc Thickness
New .188" (4.78 mm)
Service Limit .170" (4.32 mm)

Brake Disc Thickness Variance

Service Limit .002" (.051 mm)
difference between measurements

3. Mount a dial indicator and measure disc runout. Slowly rotate the disc and read total runout on the dial indicator. Replace the disc if runout exceeds specification.

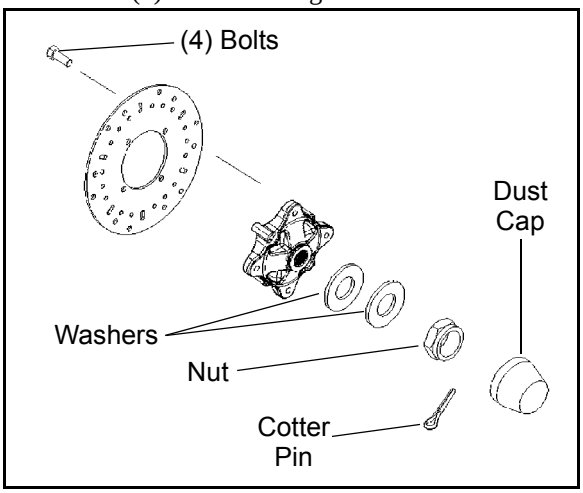
Brake Disc Runout
Service Limit .010" (.254 mm)

Disc Replacement

1. Remove rear brake caliper (see "REAR CALIPER SERVICE").

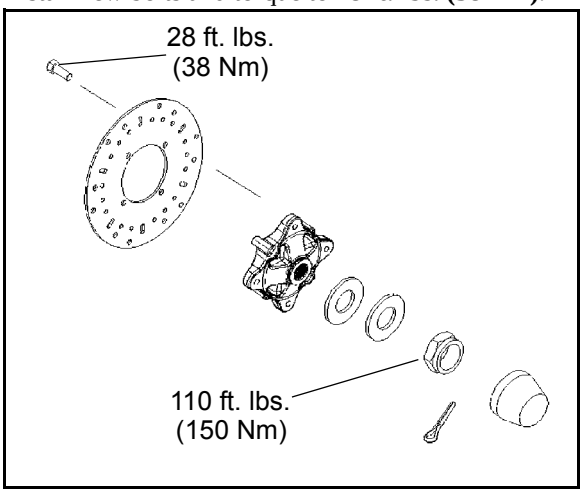
2. Remove dust cap, cotter pin, castle nut and washers.

3. Remove the wheel hub assembly from the vehicle and remove the (4) bolts retaining the disc to the hub.



4. Clean the wheel hub mating surface and install new disc on wheel hub.

5. Install new bolts and torque to **28 ft. lbs. (38 Nm)**.



⚠ CAUTION

Always use new brake disc mounting bolts. The bolts have a pre-applied locking agent which is destroyed upon removal.

6. Install wheel hub assembly, washers, and castle nut. Torque castle nut to **110 ft. lbs. (150 Nm)** and install a new cotter pin before installing the dust cap.

7. Install rear brake caliper (see "REAR CALIPER SERVICE"). Follow the bleeding procedure outlined earlier in this chapter.

8. Field test unit for proper braking action before putting into service. Inspect for fluid leaks and firm brakes. Make sure the brake is not dragging when pedal is released. If the brake drags, re-check assembly and installation.

TROUBLESHOOTING

Brakes Squeal / Poor Brake Performance

- Air in system
- Water in system (brake fluid contaminated)
- Caliper/disc misaligned
- Caliper dirty or damaged
- Brake line damaged or lining ruptured
- Worn disc and/or friction pads
- Incorrectly adjusted stationary pad
- Worn or damaged master cylinder or components
- Damaged break pad noise insulator

Pedal Vibration

- Disc damaged
- Disc worn (runout or thickness variance exceeds service limit)

Caliper Overheats (Brakes Drag)

- Compensating port plugged
- Pad clearance set incorrectly
- Parking brake lever incorrectly adjusted
- Brake pedal binding or unable to return fully
- Parking brake left on
- Residue build up under caliper seals
- Operator riding brakes

Brakes Lock

- Alignment of caliper to disc
- Caliper pistons sticking
- Improper assembly of brake system components

NOTES

CHAPTER 10
ELECTRICAL

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GENERAL INFORMATION

Special Tools

Part Number	Tool Description
PV-43568	Fluke™ 77 Digital Multimeter
2870630	Timing Light
2870836	Battery Hydrometer
2460761	Hall Sensor Probe Harness
2871745	Static Timing Light Harness
PU-47063	Digital Wrench™ Diagnostic Software
PU-47471	Digital Wrench™ SmartLink Module Kit

Electrical Service Notes

Keep the following notes in mind when diagnosing an electrical problem:

- Refer to wiring diagram for stator and electrical component resistance specifications.
- When measuring resistance of a component that has a resistance value under 10 Ohms, remember to subtract meter lead resistance from the reading. Connect the leads together and record the resistance. The resistance of the component is equal to tested value minus the lead resistance.
- Become familiar with the operation of your meter. Be sure leads are in the proper jack for the test being performed (i.e. 10A jack for current readings). Refer to the Owner's Manual included with your meter for more information.
- Voltage, amperage, and resistance values included in this manual are obtained with a Fluke™ 77 Digital Multimeter (PV-43568). This meter is used when diagnosing electrical problems. Readings obtained with other meters may differ.
- Pay attention to the prefix on the multimeter reading (K, M, etc.) and the position of the decimal point.
- For resistance readings, isolate the component to be tested. Disconnect it from the wiring harness or power supply.

Under-Hood Components

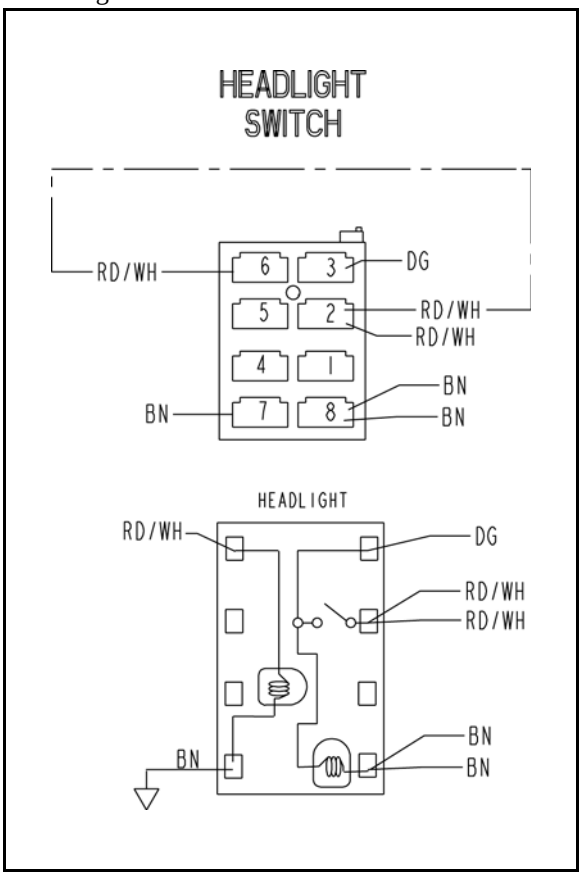
The following components can be accessed under the hood.

- Voltage Regulator
- Battery
- Battery Cables
- Terminal Block
- Starter Solenoid
- Starter Diode
- Relays
- Fuses
- Digital Wrench Diagnostic Connector
- Speedometer
- Speedometer Mode Switch
- AWD/2WD/TURF Switch
- Headlight Switch
- 12 VDC Accessory Power Point
- Ignition Switch
- Parking Brake Switch

SWITCHES / CONTROLS

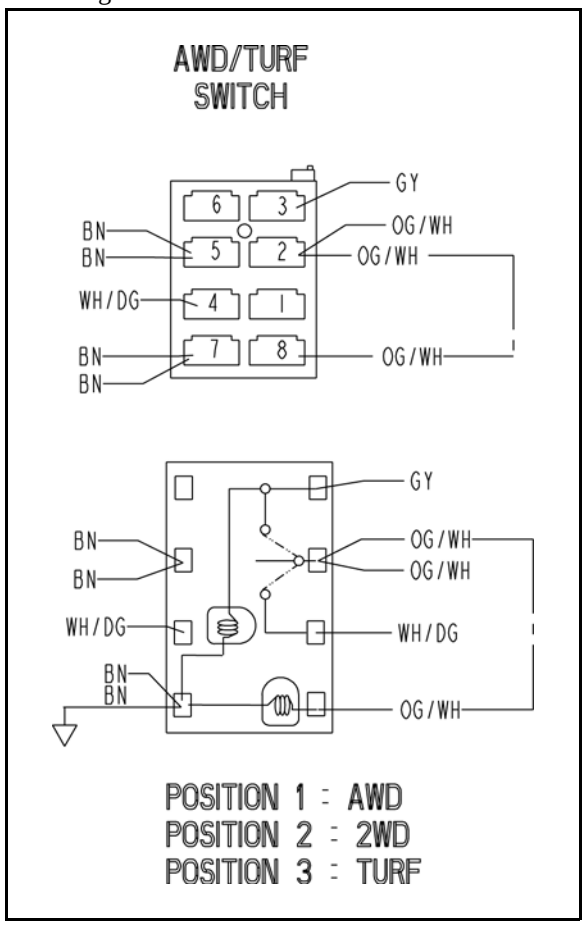
Headlight Switch

1. Lift the front hood.
2. The wires are located on the back side of the instrument panel.
3. Disconnect the headlight switch harness (Brown, Green, and Red/White), by depressing the connector lock and pulling on the connector. Do not pull on the wiring.
4. Inspect the switch connections and test the switch for continuity at the appropriate pin terminals as shown in the following illustration.



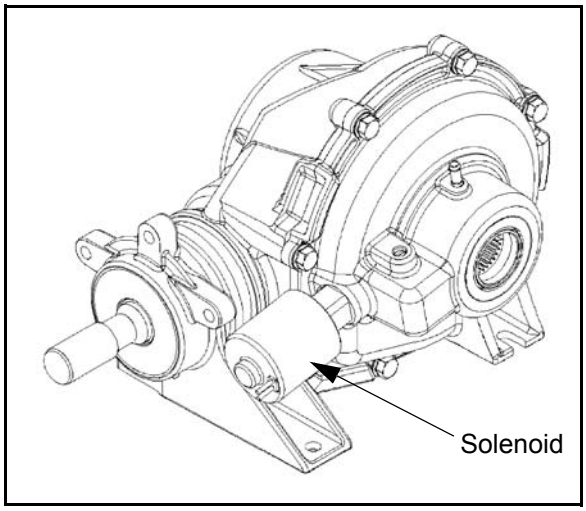
AWD / 2WD / TURF Switch (4x4 CREW)

1. Lift the front hood.
2. The wires are located on the back side of the instrument panel.
3. Disconnect the switch harness (Grey, Orange/White, Brown, White/Green), by depressing the connector lock and pulling on the connector. Do not pull on the wiring.
4. Inspect the switch connections and test the switch for continuity at the appropriate pin terminals as shown in the following illustration.



Differential Solenoid (4x4 CREW)

The differential solenoid is located on the rear gear case. The solenoid actuates an engagement dog, which locks and unlocks the rear carrier. (Refer to Chapter 7 for more information on rear carrier operation.)



Differential Solenoid Circuit Operation

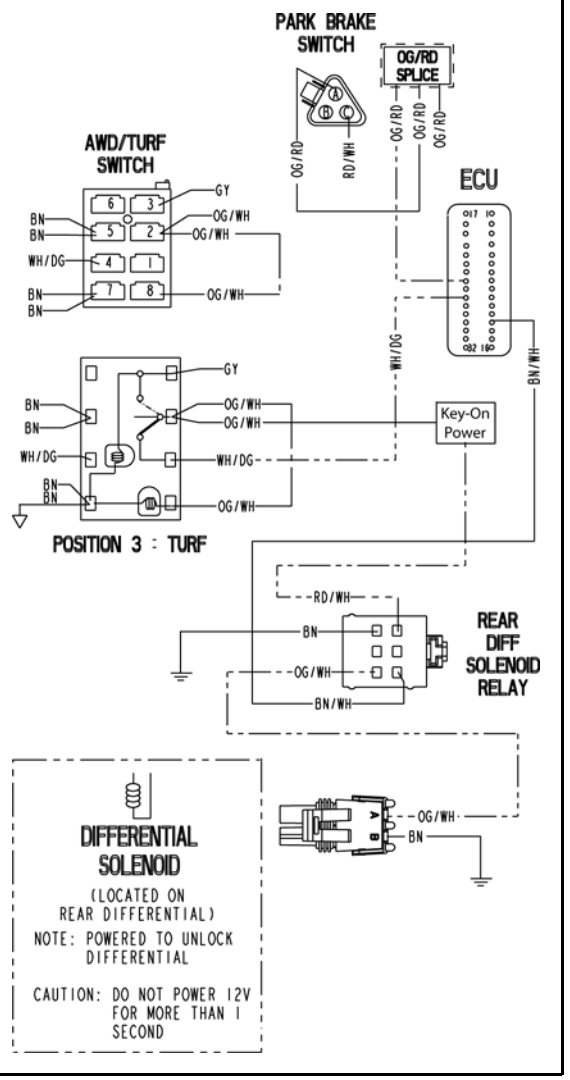
The rear differential solenoid relay is located under the hood.

Power is present at the **AWD / 2WD / Turf Switch** when the ignition key is turned "ON".

When the switch is pushed to activate "**Turf**" mode, power is sent from the **AWD / 2WD / Turf Switch** to the **ECU.**

Depending on vehicle speed, gear position criteria and parking brake input, the **ECU** provides a ground path for the **Rear Diff Solenoid Relay** allowing it to enable the differential solenoid. **NOTE: The Rear Differential will not unlock if the parking brake is set.**

Rear Differential Solenoid Circuit



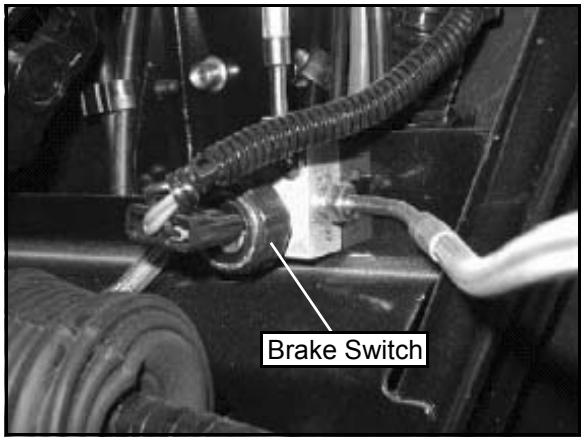
If the rear carrier fails to switch from operational modes:

- Check the connector located under the left rear fender. Look for loose wires or bad connections.
- Check for power from the connector, to ensure the solenoid has power to be activated.
- Check the **AWD / 2WD / TURF Switch** wires for loose connections.
- Remove solenoid from carrier and ensure the solenoid plunger is actuating.

> **⚠ CAUTION**
>
> Do not power the solenoid with 12 Volts for more than 1 second, or damage may occur to the solenoid.

Brake Light Switch

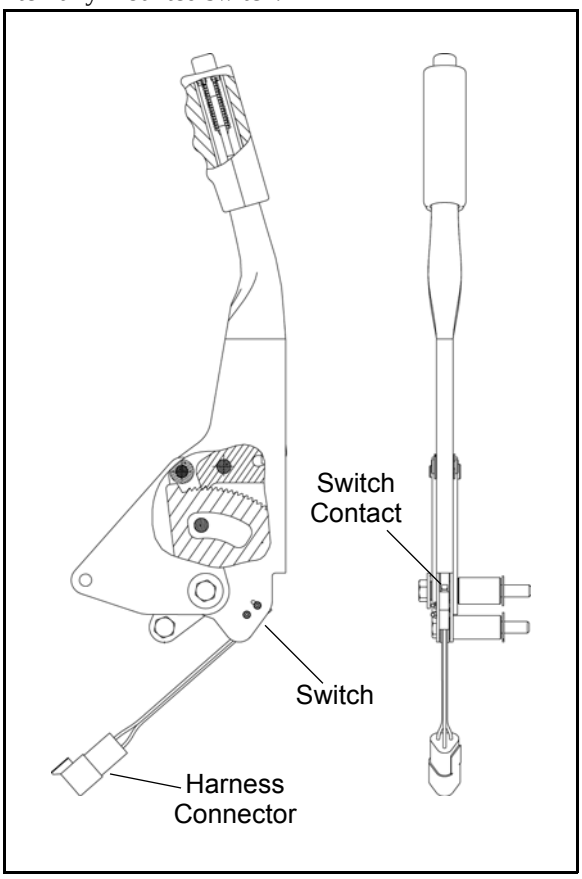
1. The brake light switch is located near the steering gearbox along the frame. The brake pressure switch is installed into this block.



2. Disconnect wire harness from switch.
3. Connect an ohmmeter across switch contacts. Reading should be infinite (OL).
4. Apply foot brake and check for continuity between switch contacts. If there is no continuity or greater than .5 ohms resistance when the brake is applied with slight pressure, first clean the switch contacts and re-test. Replace switch if necessary.

Parking Brake Switch

The parking brake switch is located within the parking brake lever. Follow the parking brake lever under the dash to locate the internally mounted switch.



The switch remains in the "open" position when the park brake lever is not applied.

When the parking brake lever is applied, the switch makes contact and sends voltage to the ECU and Speedometer to illuminate the "Park Brake Indicator" near the top-center of the instrument cluster.

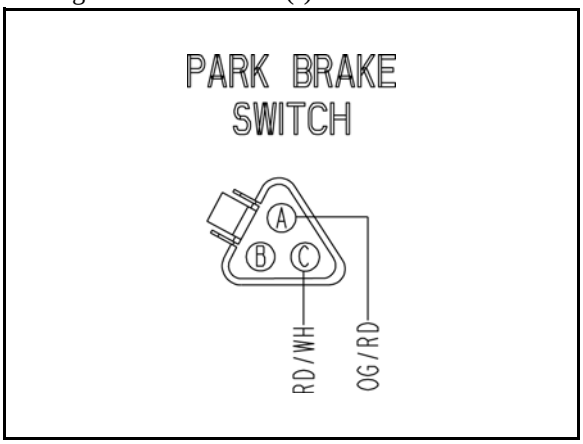
NOTE: If the parking brake is applied the ECU will rev limit the engine at 1300 RPM until the parking brake is released. This feature has been added to prevent drive-away with the parking brake applied.

If trying to perform an engine diagnostic running test with the parking brake applied, disconnect the switch harness connector to allow the engine to rev higher than 1300 RPMs.

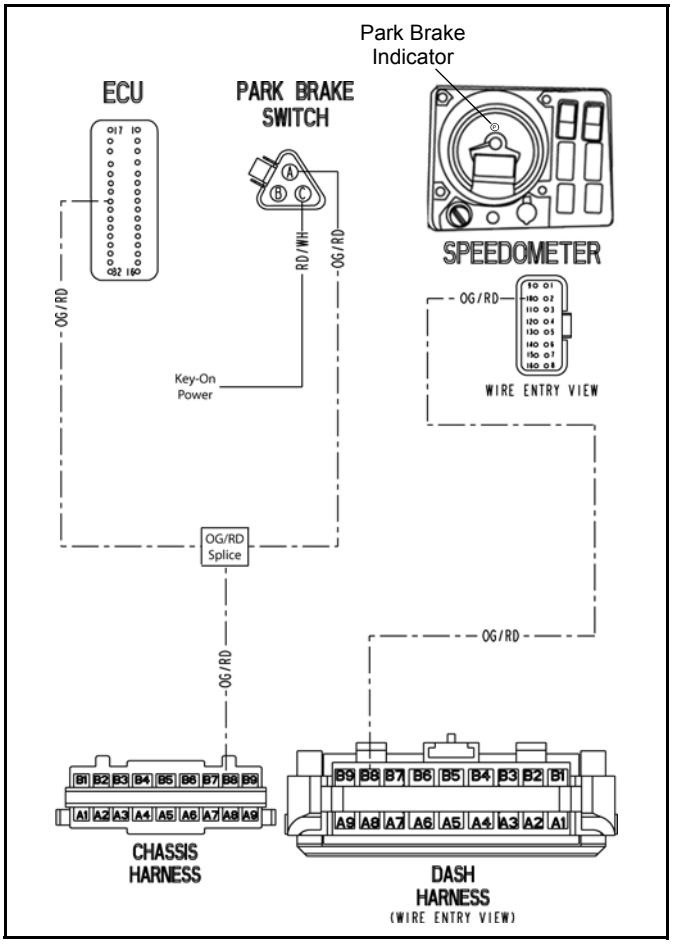
Testing The Parking Brake Switch

1. Disconnect the harness connector at the parking brake switch (Orange/Red and Red/White wires).

2. Place the ohmmeter leads onto terminal leads A and C. The reading should be infinite (•).



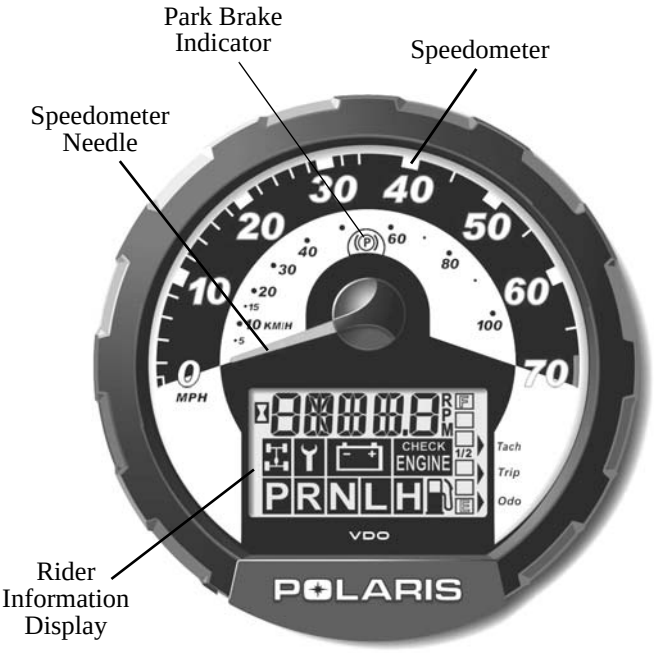
3. Apply the parking brake. Continuity should now exist between the switch terminals A and C. If no continuity exists when the parking brake is applied, try to clean the switch terminals and re-test. Replace switch if necessary.



INSTRUMENT CLUSTER

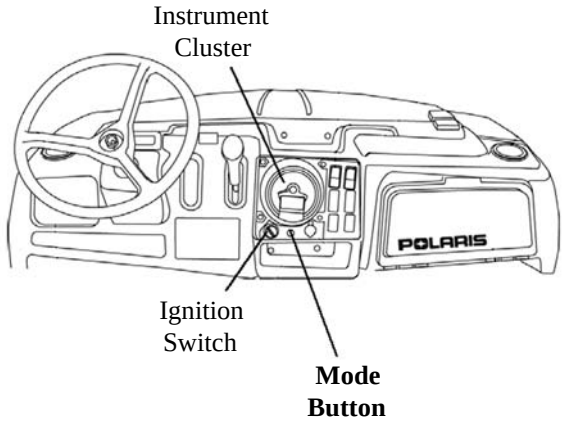
Overview

The *RANGER* instrument cluster senses vehicle speed from the right front wheel. The instrument cluster measures distance in miles as well as time, hours of operation and engine RPM.



NOTE: In addition to showing vehicle speed, the speedometer needle flashes when a low fuel condition exists.

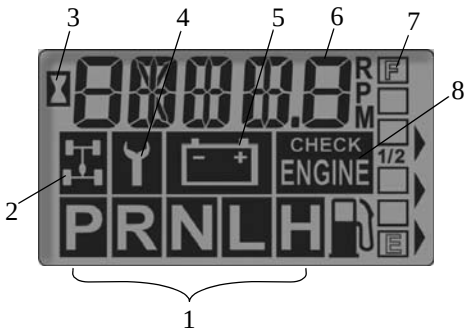
NOTE: Use the "Mode Button" shown below to toggle between Instrument Cluster display screens.



Rider Information Display

The rider information display is located in the instrument cluster. All segments will light up for 2.5 seconds at start-up.

NOTE: If the instrument cluster fails to illuminate, a battery over-voltage may have occurred and the instrument cluster may have shut off to protect the electronic speedometer.



1. **Gear Indicator** - This indicator displays gear shifter position.
   H = High Gear
   L = Low Gear
   N = Neutral
   R = Reverse Gear

2. **AWD Indicator** - This indicator illuminates when the AWD switch is in the AWD position.

3. **Engine Hour Display Indicator**

4. **Service Interval / Diagnostic Mode Indicator**

5. **Low Battery and Over Voltage** - This warning usually indicates that the vehicle is operating at an RPM too low to keep the battery charged. It may also occur when the engine is at idle and high electrical load (lights, cooling fan, accessories) is applied. Drive at a higher RPM or recharge the battery to clear the warning.

6. **Odometer/Tachometer/Tripmeter/ Hour Meter/Clock**

7. **Fuel Gauge** - The segments of the fuel gauge show the level of fuel in the fuel tank. When the last segment clears, a low fuel warning is activated. All segments will flash, FUEL will display in the LCD, and the speedometer needle will blink. Refuel immediately.

8. **Check Engine Warning Indicator** - This indicator serves two purposes. The word HOT displays if the engine overheats. It also appears if an EFI-related fault occurs. Do not operate the vehicle if this warning appears. Serious engine damage could result.

Standard Display Modes

Use the yellow mode button located under the speedometer to toggle through the mode options.

Odometer Mode

The odometer records the miles traveled by the vehicle.

Trip Meter Mode

The trip meter records the miles or kilometers traveled by the vehicle on each trip if it's reset before each trip. To reset the trip meter, select the trip meter mode. Press and hold the mode button until the display reads 0.

NOTE: In the Rider Information Display, the trip meter display contains a decimal point, but the odometer displays without a decimal point.

Hour Meter Mode

This mode logs the total hours the engine has been in operation.

Tachometer Mode

The engine RPM is displayed digitally.

NOTE: Small fluctuations in the RPM from day to day may be normal because of changes in humidity, temperature and elevation.

Clock Mode

The clock displays time in a 12-hour format. To reset the clock, see “Clock Screen” in the “Diagnostic Display Mode” section.

Diagnostic Display Mode

The wrench icon will display when the gauge is in the diagnostic mode. To exit the diagnostic mode, turn the key switch off and on. Any movement of the tires will also cause the gauge to exit the diagnostic mode.

To enter the diagnostics mode:

1. Turn the key switch off and wait 10 seconds.
2. Lock the parking brake.
3. Place the transmission in neutral.
4. Hold the mode button and turn the key switch to the “ON” position. Release the mode button as soon as the display is activated.
5. Use the mode button to toggle through the diagnostic screens.

Clock Screen

To reset the clock:

1. Enter the diagnostic mode.
2. Toggle to the clock screen.
3. Press and hold the mode button until the hour display flashes. Release the button.
4. Press and release the mode button once to advance the setting by one hour. Press and hold the mode button to advance the hours quickly.
5. When the desired hour is displayed, wait approximately four seconds, until the minute display flashes.
6. When the display stops flashing, the mode has been set.
7. Use the same procedure to reset the minutes.

Battery Voltage Screen

View this screen to check battery voltage level.

Tachometer Screen

View the tachometer to check engine speed.

AWD Diagnostic Screen

The gauge indicates whether or not current is flowing through the AWD coil.

Gear Circuit Diagnostic Screen

This screen displays the resistance value (in ohms) being read at the gear switch input of the gauge.

NOTE: A 10 - 20% variance from these readings is within normal parameters.

Programmable Service Interval

When the hours of engine operation equal the programmed service interval setting, the wrench icon will flash for 5 seconds each time the engine is started. When this feature is enabled, it provides a convenient reminder to perform routine maintenance.

NOTE: The service interval is programmed to 50 hours at the factory.

To enable or disable the service interval:

1. Enter the diagnostic mode.
2. Toggle to the service interval screen.
3. Press and hold the mode button for about seven (7) seconds, until either ON or OFF appears in the Rider Information Display, depending on your preference.

To reset the service interval:

1. Enter the diagnostic mode.
2. Toggle to the service interval screen.
3. Press and hold the mode button for 2-3 seconds, until the wrench icon flashes. Release the button.
4. Press and release the mode button once to advance the setting by one hour. Press and hold the mode button to advance the hours quickly.

NOTE: If you scroll past the intended number, press and hold the button until the hours cycle back to zero.

5. When the desired setting is displayed, wait until the wrench icon stops flashing. The new service interval is now programmed.

Miles / Kilometers Toggle

The display in the tripmeter and odometer can be changed to display either standard or metric units of measurement.

1. Enter the diagnostic mode.
2. Toggle to the screen that displays either kilometers (KM) or miles (MP).
3. Press and hold the mode button until the letters flash, then press and release the button once. When the display stops flashing, the mode has been set.

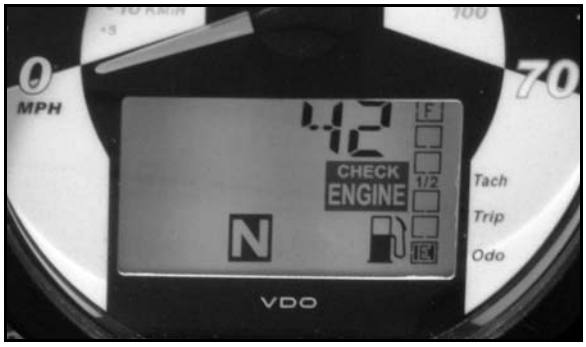
Viewing Diagnostic Codes

Use the following procedure to view diagnostic blink codes (failure codes) from the EFI module:

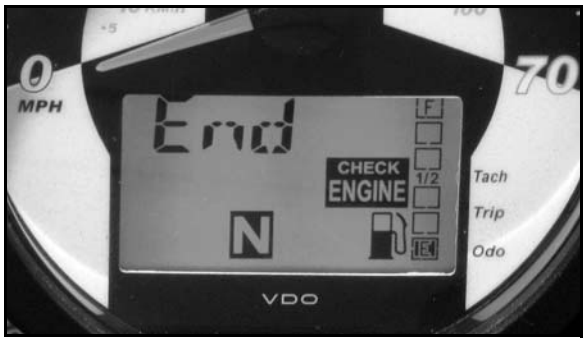
NOTE: Refer to Chapter 4 "Electronic Fuel Injection" for a complete list of Diagnostic Blink Codes.

1. Engage the parking brake.
2. Stop the engine.
3. Turn the key switch to the ON position.
4. Turn the key switch off and on three times in less than five seconds, then leave the switch on. The word "Wait" will appear on the screen along with a flashing "Check Engine" light.

5. Any blink code numbers stored in the EFI module will display, one at a time, on the screen.
   Example below shows a Blink Code of "42".



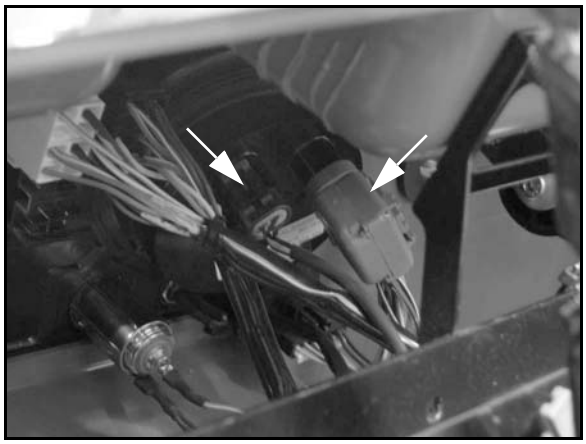
6. The number "61" and/or the word "End" displays after all codes have been transmitted.



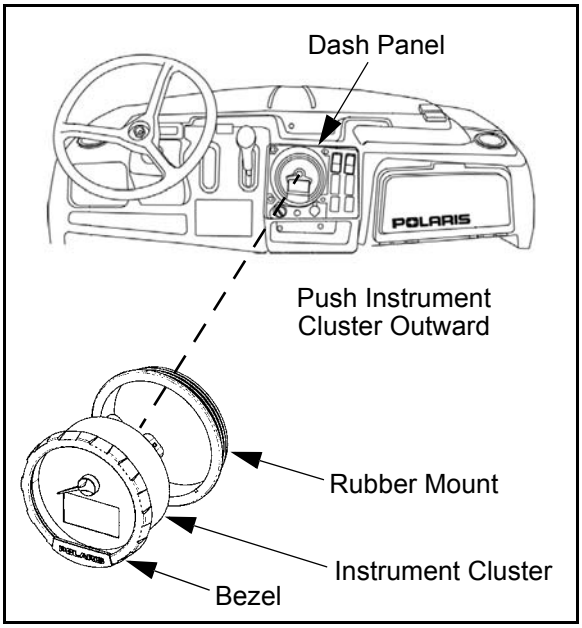
Instrument Cluster Removal

NOTE: Do not allow alcohol or petroleum products to come in contact with the instrument cluster lens.

1. Lift the hood and disconnect the wire connectors from the back side of the instrument cluster.



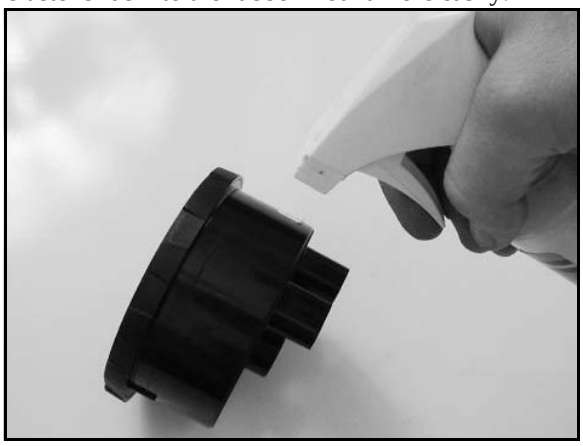
2. Push the instrument cluster out from the back side of the dash panel, while securely holding the panel and rubber mount.



NOTE: Do not remove the rubber mount from the dash panel. Only remove the rubber mount if necessary. The bezel is a snap-on assembly and is a serviceable part.

Instrument Cluster Installation

1. Spray a soap and water mixture onto the outer surface area of the instrument cluster. This will help the instrument cluster slide into the rubber mount more easily.

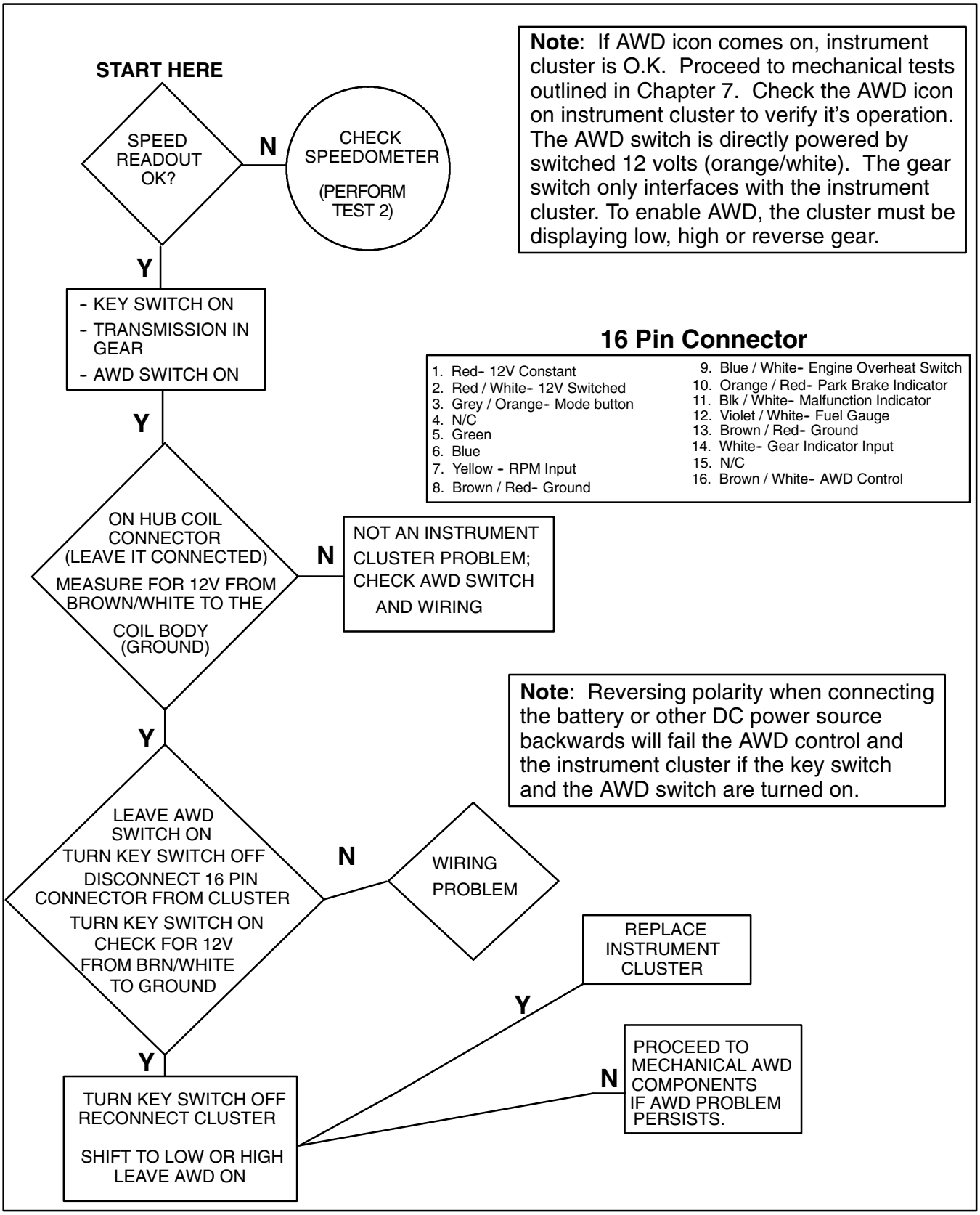


2. Be sure the rubber mount inside the pod is fully installed and that the indexing key on the rubber mount is lined up with the keyway in the dash panel.

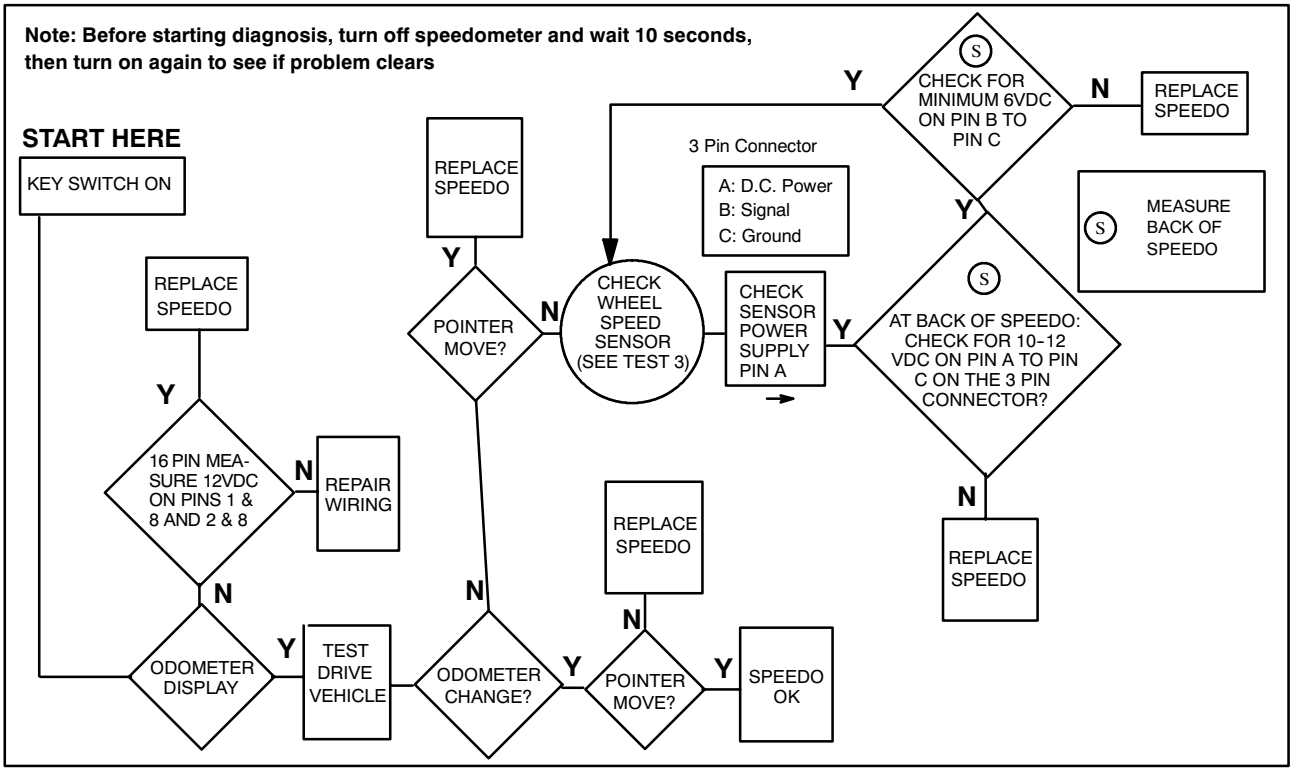
3. Hold the dash panel securely and insert the instrument cluster into the dash panel. Twist the instrument cluster gently in a clockwise motion to properly seat the instrument cluster into the pod assembly. Apply pressure on the bezel while pressing down on the instrument cluster.

INSTRUMENT CLUSTER TROUBLESHOOTING TESTS

Test 1 - No All Wheel Drive



TEST 2 - No Display



TEST 3 - Wheel Speed Sensor

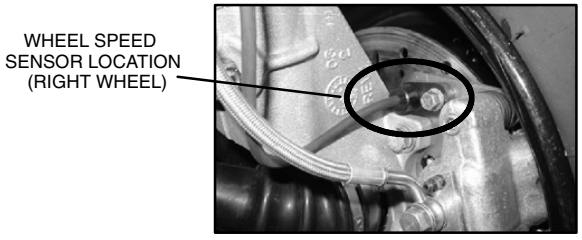
WHEEL SPEED SENSOR

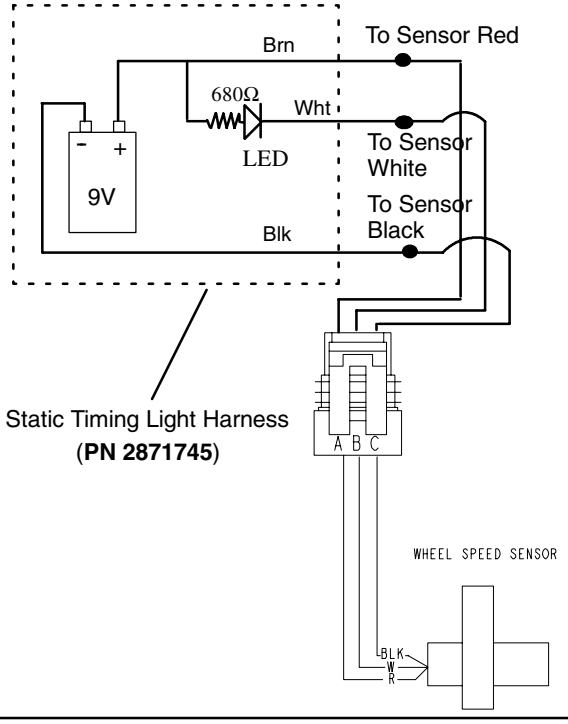
Tools Required:

- Static Timing Light Harness **(PN 2871745)**
- Hall Sensor Probe Harness **(PN 2460761)** or equivalent jumper wires.

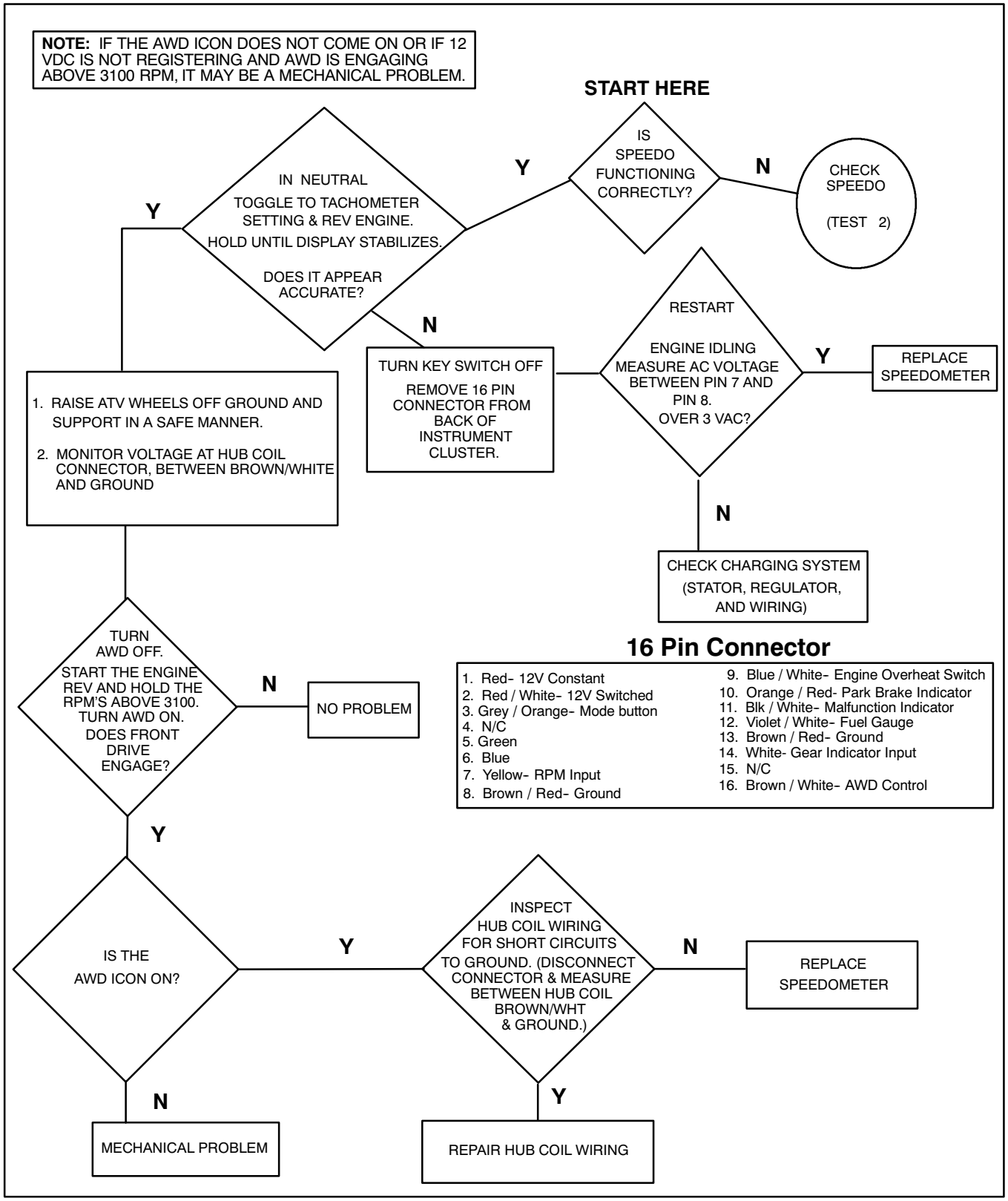
To test wheel speed sensor:

1. Disconnect 3 Pin connector from speedometer.
2. Connect wires from test light to sensor 3 Pin connector as shown at right, using the Hall Sensor Probe Harness **(PN 2460761)** or jumper leads.
3. Elevate front right side of vehicle until tire is off the ground.
4. Slowly turn right front wheel while observing the test light.
5. If light flashes, sensor is O.K. Be sure connections are good and 9 volt battery is in good condition.

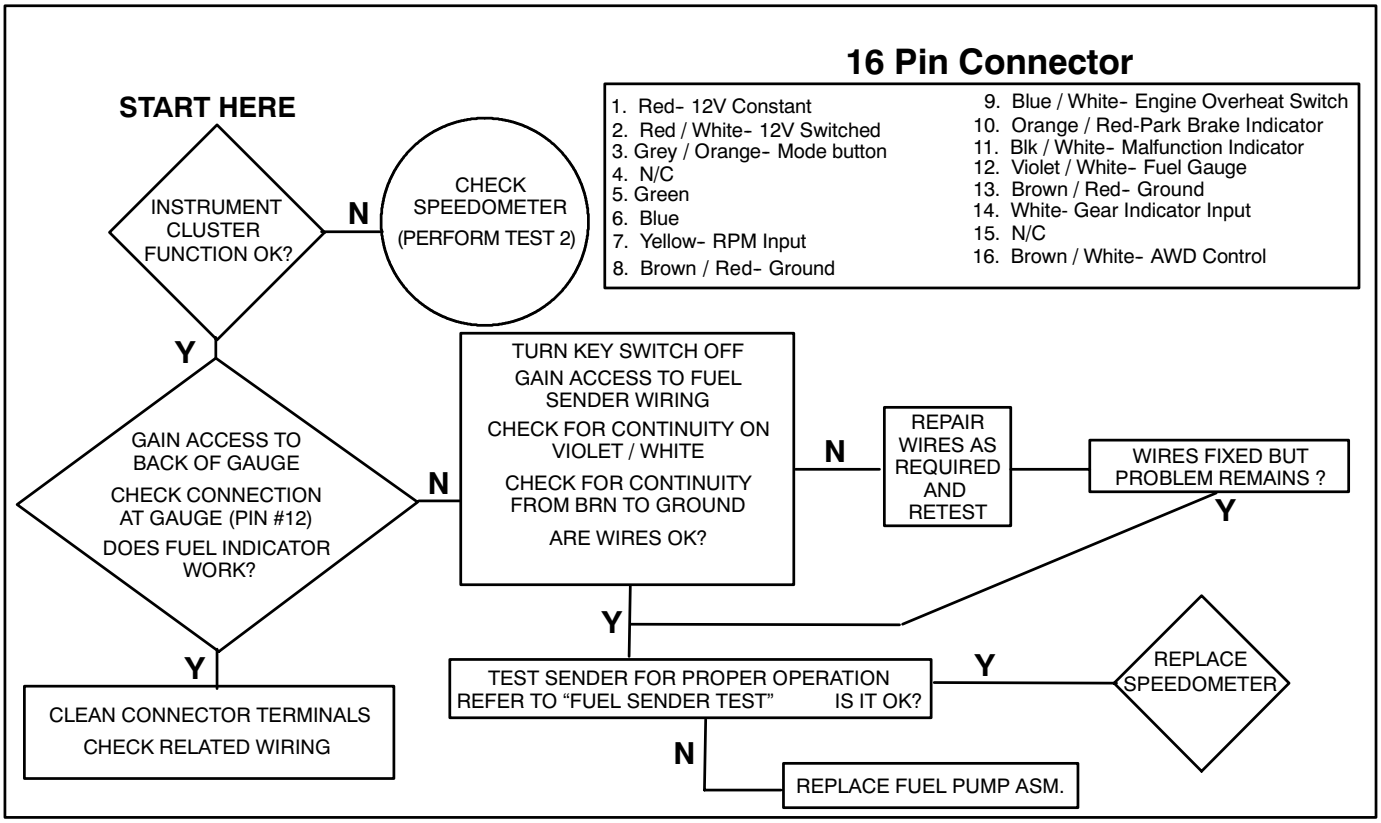




TEST 4 - No AWD Hub Safety Limiter



TEST 5 - Fuel Gauge Display Not Working



TEST 6 - Shift Indicator Not Working (Transmission Switch)

Operation:

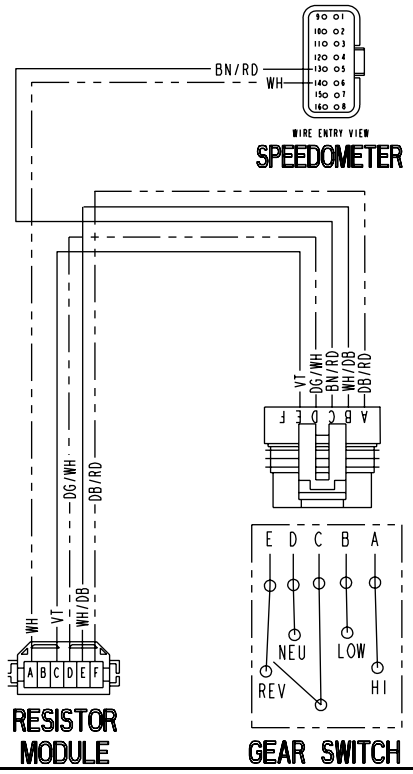
The Instrument cluster sends a signal through the White wire to the resistor module. This signal completes it's path on the Brown/Red wire through the transmission switch. Depending on the transmission switch position, the Instrument Cluster interprets the resistance reading and displays the corresponding shift position on the LCD screen.

Testing:

Use the diagram provided to test the continuity loop at each of the shift points with a multi-meter. **NOTE:** *The Instrument cluster contains this diagnostic feature.*

16 Pin Connector

1. Red- 12V Constant
2. Red / White- 12V Switched
3. Grey / Orange- Mode button
4. N/C
5. Green
6. Blue
7. Yellow- RPM Input
8. Brown / Red- Ground
9. Blue / White- Engine Overheat Switch
10. Orange / Red- Park Brake Indicator
11. Blk / White- Malfunction Indicator
12. Violet / White- Fuel Gauge
13. Brown / Red- Ground
14. White- Gear Indicator Input
15. N/C
16. Brown / White- AWD Control



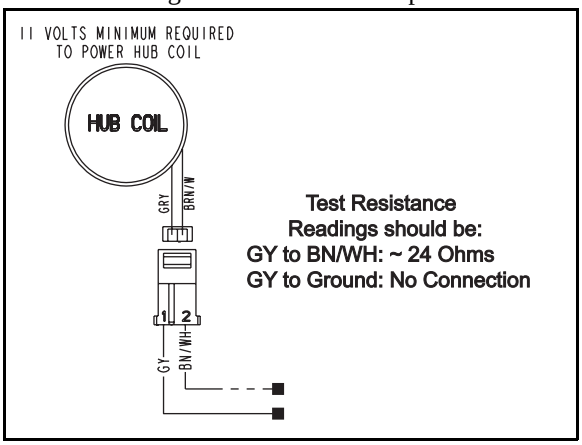
ALL WHEEL DRIVE (AWD) COIL

Operation Overview

- When the AWD switch is “ON”, 12 VDC power is present at the hub coil.
- If the criteria is met, the instrument cluster provides a ground path at pin #16 (Brown/White wire). When this occurs the AWD icon should display in the instrument cluster.
- The AWD system must be grounded to operate.

Diagnosing System Failures

- Verify the AWD switch is functional and that a minimum of 11 volts is present at the hub coil.
- Verify the AWD hub coil is functional. Test the AWD hub coil using an ohm meter. See specifications below:



AWD Hub Coil Resistance:
24 Ω ± 5%

- Verify the wiring harness, wiring, connectors, connector pins and grounds are undamaged, clean and connected properly.
- Verify continuity of wire connections with a volt/ohm meter.

IMPORTANT: Verify all wires and wiring connections have been tested properly with a known good volt/ohm meter before suspecting a component failure. 80% of all electrical issues are caused by bad/failed connections and grounds.

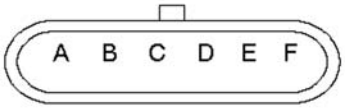
GEAR POSITION INDICATOR SWITCH

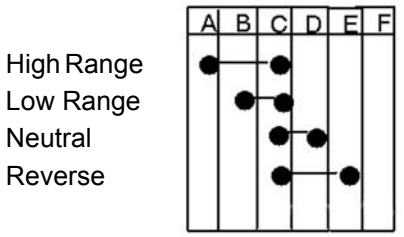
Test Diagram

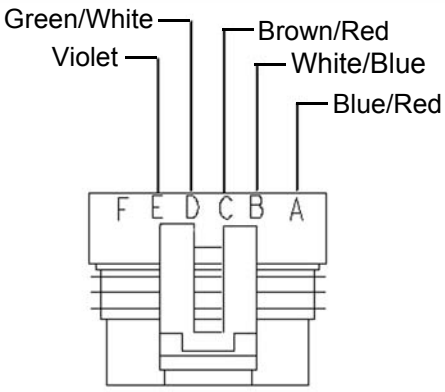
NOTE: Also see “INSTRUMENT CLUSTER TROUBLESHOOTING” for switch circuit.

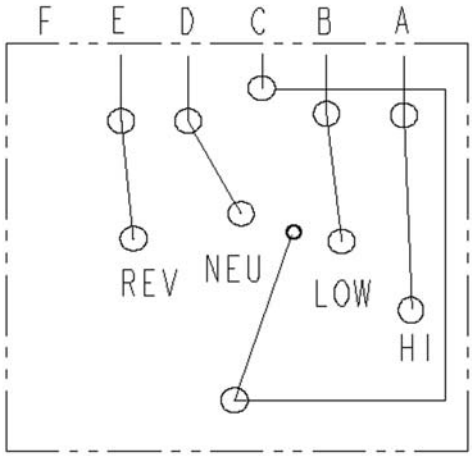
TRANSMISSION SWITCH

High / Low / Neutral / Reverse Switch







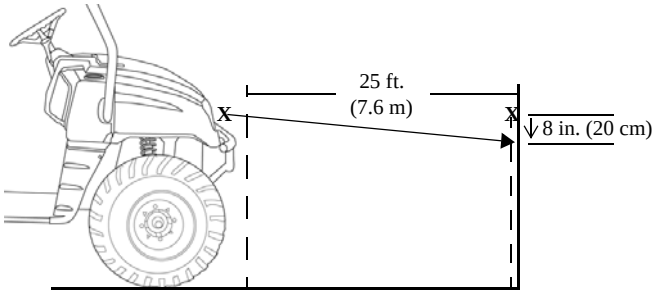


HEADLIGHTS

Headlight Adjustment

The headlight beam is adjustable.

1. Place the vehicle on a level surface with the headlight approximately 25 ft. (7.6 m) from a wall.



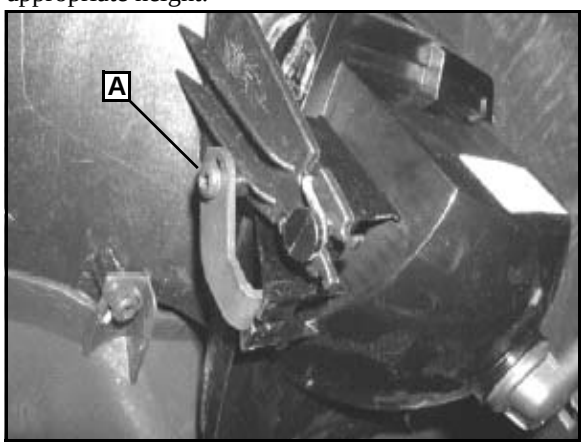
2. Measure the distance from the floor to the center of the headlight and make a mark on the wall at the same height.

3. With the machine in Neutral and parking brake applied, start the engine and turn the headlight switch to high beam.

4. The most intense part of the headlight beam should be aimed 8 in. (20 cm) below the mark placed on the wall in Step 2.

NOTE: Rider weight must be included in the seat while performing this procedure.

5. Adjust the beam to the desired position by loosening the adjustment screw (A) and moving the lamp to the appropriate height.



6. Adjust the beam to desired position. Repeat the procedure to adjust the other headlight.

⚠ WARNING

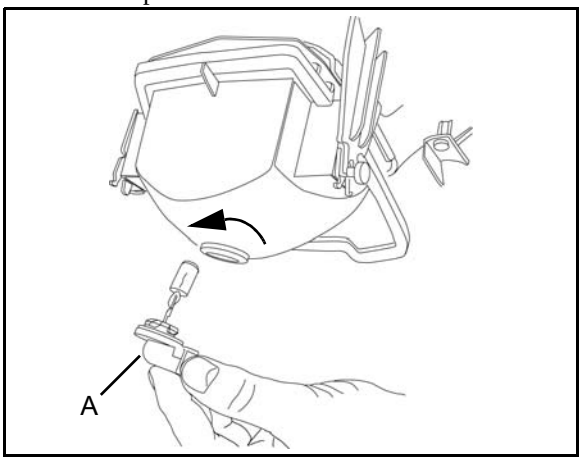
Due to the nature of light utility vehicles and where they are operated, headlight lenses become dirty. Frequent washing is necessary to maintain lighting quality. Riding with poor lighting can result in severe injury or death.

Headlight Bulb Replacement

1. Open the hood.

2. Unplug the headlight bulb (A) from the wiring harness. Be sure to pull on the connector, not on the wiring.

3. Turn the lamp counterclockwise to remove it.



4. Insert new bulb. Reinstall the harness assembly into the headlight assembly.

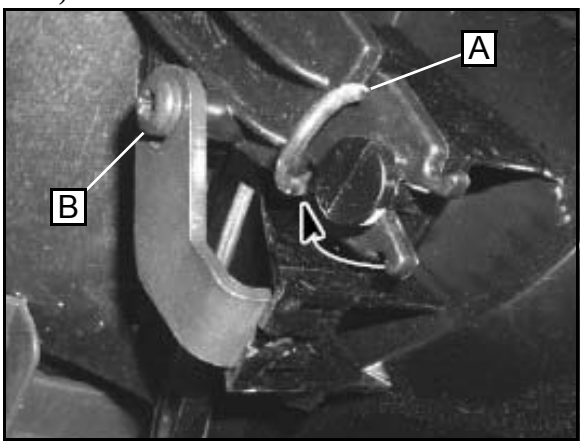
NOTE: Make sure the tab on the lamp locates properly in the housing.

Headlight Housing Removal

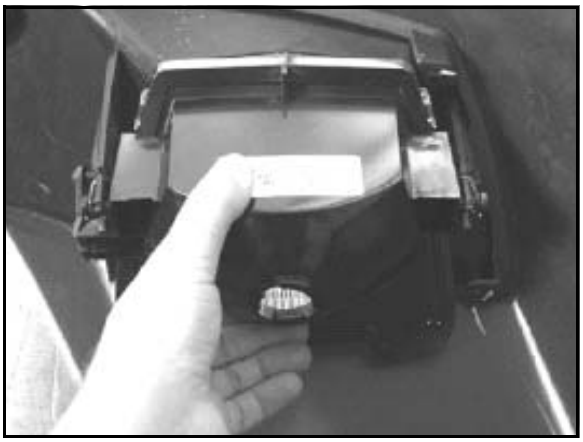
1. Open the hood.

2. Unplug the headlight from the wiring harness. Be sure to pull on the connector, not on the wiring.

3. Remove the O-ring (A) from the headlight brackets (both sides).

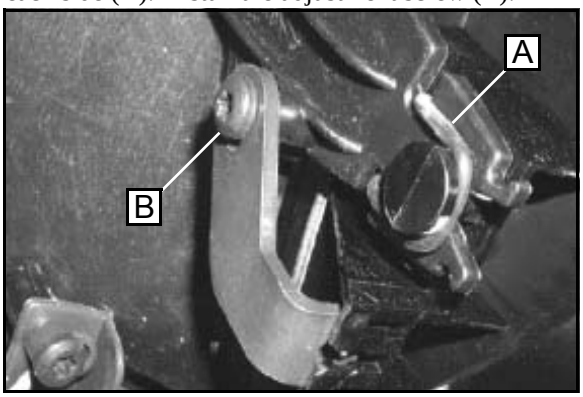


4. After the O-rings are removed from the headlight, remove the adjustment screw (B) and pull the headlight from the brackets.



Headlight Housing Installation

1. To install the headlight housing, press the headlight tabs back into the brackets.
2. Secure the headlight housing with the rubber O-rings on each side (A). Install the adjustment screw (B).



3. Reconnect wire harness or re-insert bulb if previously removed.
4. Adjust headlights using the "High Beam Headlight Adjustment" procedure on the previous page.

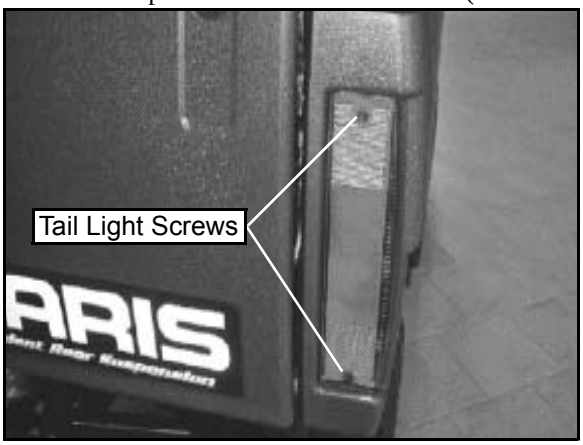
TAIL LIGHT / BRAKE LIGHT

Lamp Replacement

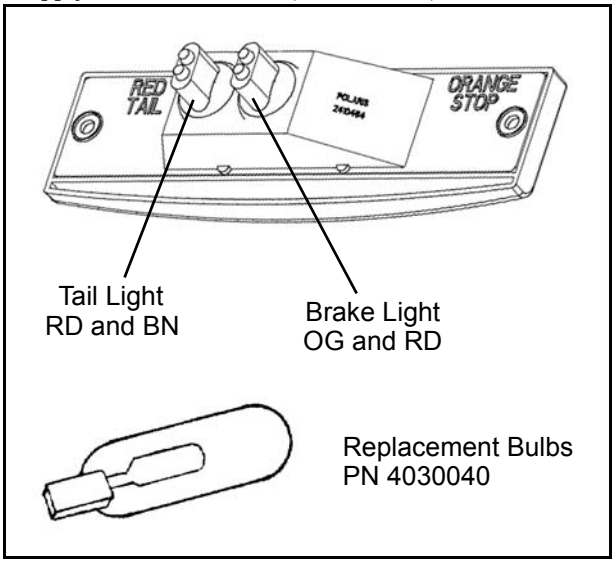
Before replacing the tail light, use a digital multi-meter to test the harness to ensure the lamp is receiving 12 volts and that a ground path is present.

If the tail light / brake light does not work the lamp assembly may need to be replaced.

1. From the rear of the tail light remove two screws holding lens cover in place and remove lens cover. (T-20 Torx)



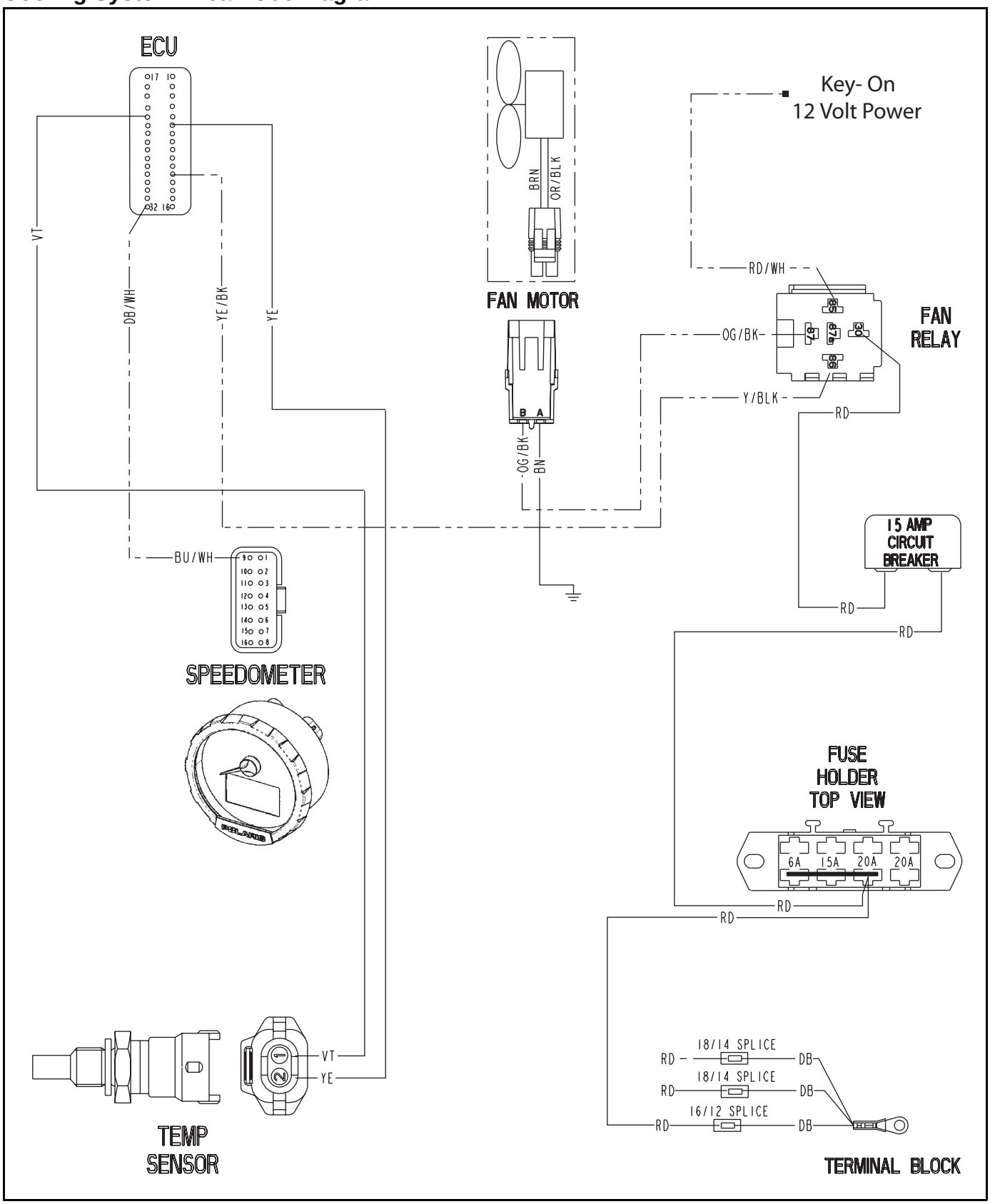
2. Remove lamp by turning the rubber base 1/4 turn and pulling the bulb out. Replace it with recommended lamp. Apply Dielectric Grease (PN 2871329).



3. Reinstall the lens cover removed in Step 1.
4. Test the tail light / brake light to see it is working.

COOLING SYSTEM

Cooling System Break-Out Diagram



Fan Control Circuit Operation

Power is supplied to the fan via the Orange/Black wire when the relay is ON. The ground path for the fan motor is through the Brown harness wire. Refer to "RELAYS" later in this chapter for more information on fan functions.

> ⚠ CAUTION
>
> Keep hands away from fan blades during operation. Serious personal injury could result.

NOTE: The fan may not function or operation may be delayed if coolant level is low or if air is trapped in the cooling system. Be sure cooling system is full and purged of air. Refer to Maintenance Chapter 2 for cooling system information.

Fan Control Circuit Bypass Test

1. Disconnect harness from coolant temperature sensor on engine.
2. With the parking brake applied, turn the ignition key (and engine stop switch) "ON". The fan should start running.
3. If the fan does not run or runs slowly, check the fan motor wiring, ground, motor condition and mechanical relay for proper operation. Repair or replace as necessary. If the fan runs with the sensor harness disconnected, but will not turn on when the engine is hot, check the coolant temperature sensor and connector terminals.

Coolant Temperature Sensor

The coolant temperature sensor can be tested using an ohmmeter or voltmeter.

1. With the engine and temperature sensor at room temperature (68°F = 20°C), disconnect the harness connector.
2. With the meter in the ohms mode, place the meter leads onto the sensor contacts.
3. Use the table Temperature / Resistance table to determine if the sensor needs to be replaced.

TEMPERATURE °F (°C)	RESISTANCE
68 °F (20 °C)	2.5 k Ω ± 6%
212 °F (100 °C)	186 Ω ± 2%

NOTE: If the coolant temperature sensor or circuit malfunctions the radiator fan will default to 'ON'.

EFI DIAGNOSTICS

EFI Component Testing

All EFI component information and diagnostic testing procedures are located in **Chapter 4**.

Refer to **Chapter 4** "Electronic Fuel Injection System (EFI)" when diagnosing an EFI System.

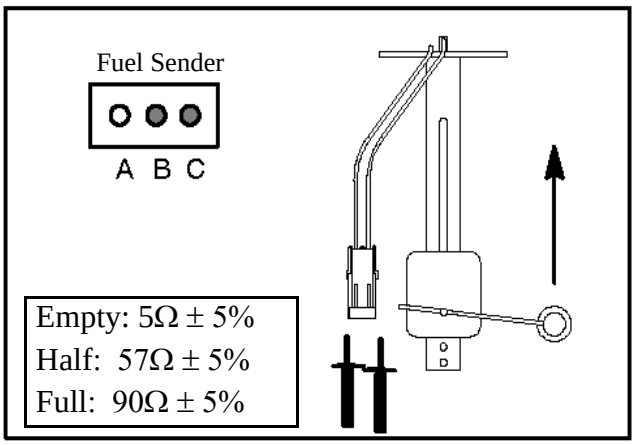
FUEL SENDER

Testing

1. Drain the fuel tank and remove it from the chassis.
2. Set the fuel tank on a flat surface.
3. Hook up an ohm meter to the fuel sender harness Violet/ White wire (B) and Brown wire (C).
4. With the sender float in the **empty position** and compare to specification.

Fuel Sender - Empty: 5 Ω ± 5%

5. Slowly tilt invert the tank so that gravity moves the sender float to the **full position** and compare to specification.



Fuel Sender - Full: 90 Ω ± 5%

6. If the readings are not to specification, or if the reading is erratic or LCD display "sticks", check the following before replacing the fuel pump assembly.
   - Loose float
   - Float contact with tank
   - Bent Float Rod

If none of the conditions exists, the sender assembly is faulty. Fuel pump/tank assembly replacement is required.

RELAYS

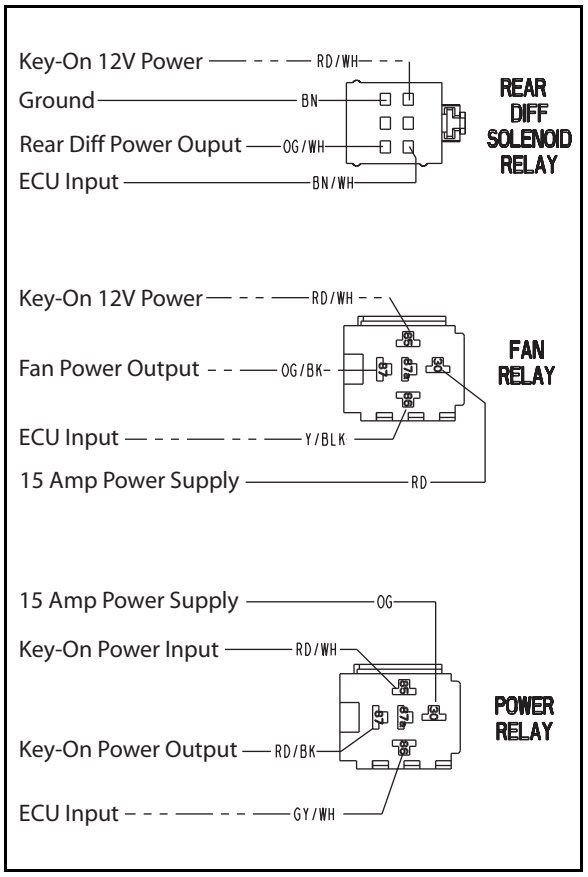
Operation

The relays, located under the hood, assist with component operation like the fan, fuel pump, and rear differential.

The differential relay, controlled by the AWD switch and ECU, operates the differential solenoid.

The fan relay, controlled by the ECU and Temp Sensor, operates the fan.

The power relay, controlled by the ECU, turns on power for components such as the fuel pump, injectors, etc.



REAR DIFF SOLENOID RELAY

COLOR	FUNCTION
Red / White	Key-On battery power supply, switched on by key switch, enables power to relay.
Brown	Ground path for relay.
Orange / White	Key-On power supply, switched by relay, provides power to Rear Diff Solenoid.
Brown / White	ECU ground input to connect relay Key-On power to Rear Diff Solenoid output.

FAN RELAY

COLOR	FUNCTION
Red / White	Key-On battery power supply, switched on by key switch, enables power to relay.
Orange / Black	Fused 15-Amp power, switched by relay, provides power to Fan Motor.
Yellow / Black	ECU input to connect relay Fused 15-Amp power to Fan Motor output.
Red	Fused 15-Amp, constant battery power IN supply for EFI component operation.

POWER RELAY

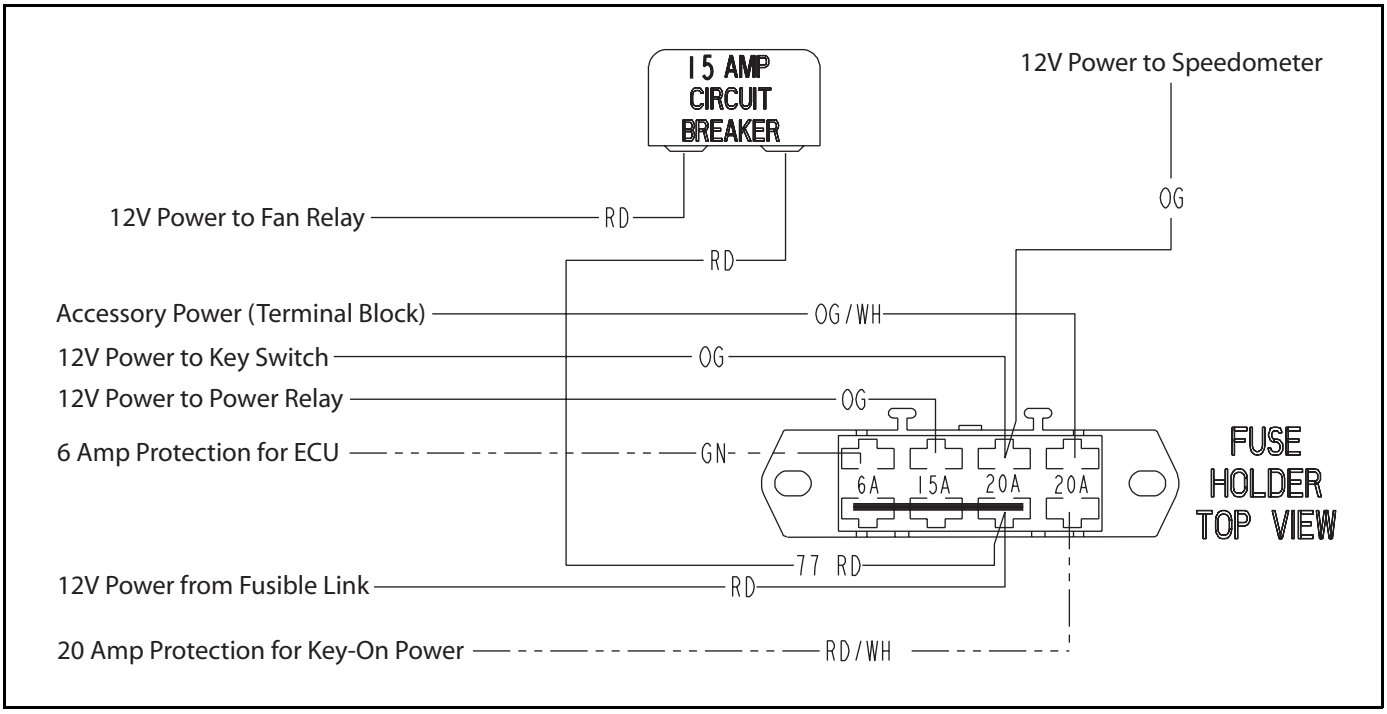
COLOR	FUNCTION
Orange	Fused 15-amp, constant battery power IN supply for EFI component operation.
Red / White	Key-On battery power supply, switched on by key switch, enables power to relay.
Red / Black	EFI power output. Switched by relay when ECU sends a signal on the GRY/W wire, closing the relay. Supplies 15-amp power for ECU-controlled operation of EFI components.
Gray / White	ECU input to enable relay. The ECU supplies a ground which closes the relay, supplying power to run the fuel pump, injectors, etc.

FUSES / CIRCUIT BREAKER

Operation

The fuse panel, located under the hood, provides component protection for components such as the Instrument Cluster, ECU, EFI system, Chassis Power and Accessories.

A 15-amp circuit breaker protects the fan motor circuit.

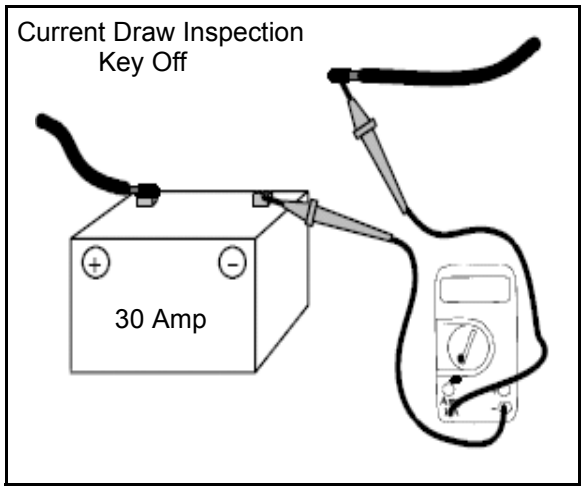


CHARGING SYSTEM

Current Draw - Key Off

> **⚠ CAUTION**
>
> Do not connect or disconnect the battery cable or ammeter with the engine running. Damage will occur to electrical components.

Connect an ammeter in series with the negative battery cable. Check for current draw with the key off. If the draw is excessive, loads should be disconnected from the system one by one until the draw is eliminated. Check component wiring as well as the component for partial shorts to ground to eliminate the draw.



Current Draw - Key Off:
Maximum of .01 DCA (10 mA)

Charging System "Break Even" Test

> **⚠ CAUTION**
>
> Do not allow the battery cables to become disconnected with the engine running. Follow the steps below as outlined to reduce the chance of damage to electrical components.

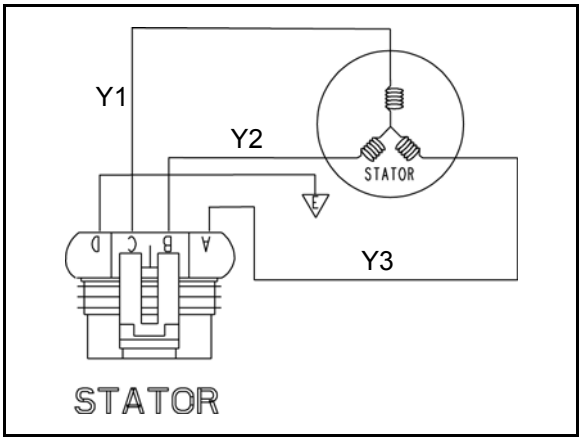
The "break even" point of the charging system is the point at which the alternator overcomes all system loads (lights, etc.) and begins to charge the battery. Depending on battery condition and system load, the break even point may vary slightly. The battery should be fully charged before performing this test.

> **⚠ WARNING**
>
> Never start the engine with an ammeter connected in series. Damage to the meter or meter fuse will result.
> Do not run test for extended period of time.
> Do not run test with high amperage accessories.

1. Using an inductive amperage metering device, (set to DC amps) connect to the negative battery cable
2. With engine off, and the key switch and lights in the ON position, the ammeter should read negative amps (battery discharge). Reverse meter lead if a positive reading is indicated.
3. Shift transmission into neutral with the parking brake applied and start the engine. With the engine running at idle, observe meter readings.
4. Increase engine RPM while observing ammeter and tachometer.
5. Note RPM at which the battery starts to charge (ammeter indication is positive).
6. With lights and other electrical loads off, the "break even" point should occur at approximately 1500 RPM or lower.
7. With the engine running, turn the lights on and engage parking brake to keep brake light on.
8. Repeat test, observing ammeter and tachometer. With lights on, charging should occur at or below 2000 RPM.

Charging System Alternator Tests

Three tests can be performed using a multi-meter to determine the condition of the stator (alternator).



TEST 1: Resistance Value of Each Stator Leg

1. Measure the resistance value of each of the three stator legs: Y1 to Y2, Y1 to Y3, and Y2 to Y3.
   Each test should measure: **0.19Ω ± 15%**

Test	Connect Meter Leads To:	Ohms Reading
Battery Charge Coil	Y1 to Y2	0.19Ω ± 15%
Battery Charge Coil	Y1 to Y3	0.19Ω ± 15%
Battery Charge Coil	Y2 to Y3	0.19Ω ± 15%

NOTE: If there are any significant variations in ohm readings between the three legs it is an indication that one of the three stator legs maybe weak or failed.

TEST 2: Resistance Value of Each Stator Leg to Ground

1. Measure the resistance value of each of the stator legs to ground: Y1 to Ground, Y2 to Ground, Y3 to Ground.
   Each test should measure: **Open Line (OL)**

Test	Connect Meter Leads To:	Ohms Reading
Battery Charge Coil	Y1, Y2, or Y3 to Ground	Open Line (Infinity)

NOTE: Any measurement other than Infinity (open) will indicate a failed or shorted stator leg.

TEST 3: Measure AC Voltage Output of Each Stator Leg at Charging RPM

1. Set the selector dial to measure AC Voltage.
2. Start the engine and let it idle.
3. While holding the engine at a specified RPM, separately measure the voltage across each 'leg' of the stator by connecting the meter leads to the wires leading from the alternator (Y1 to Y2, Y1 to Y3, Y2 to Y3).
4. Refer to the following table for approximate AC Voltage readings according to RPM. Test each leg at the specified RPM in the table.

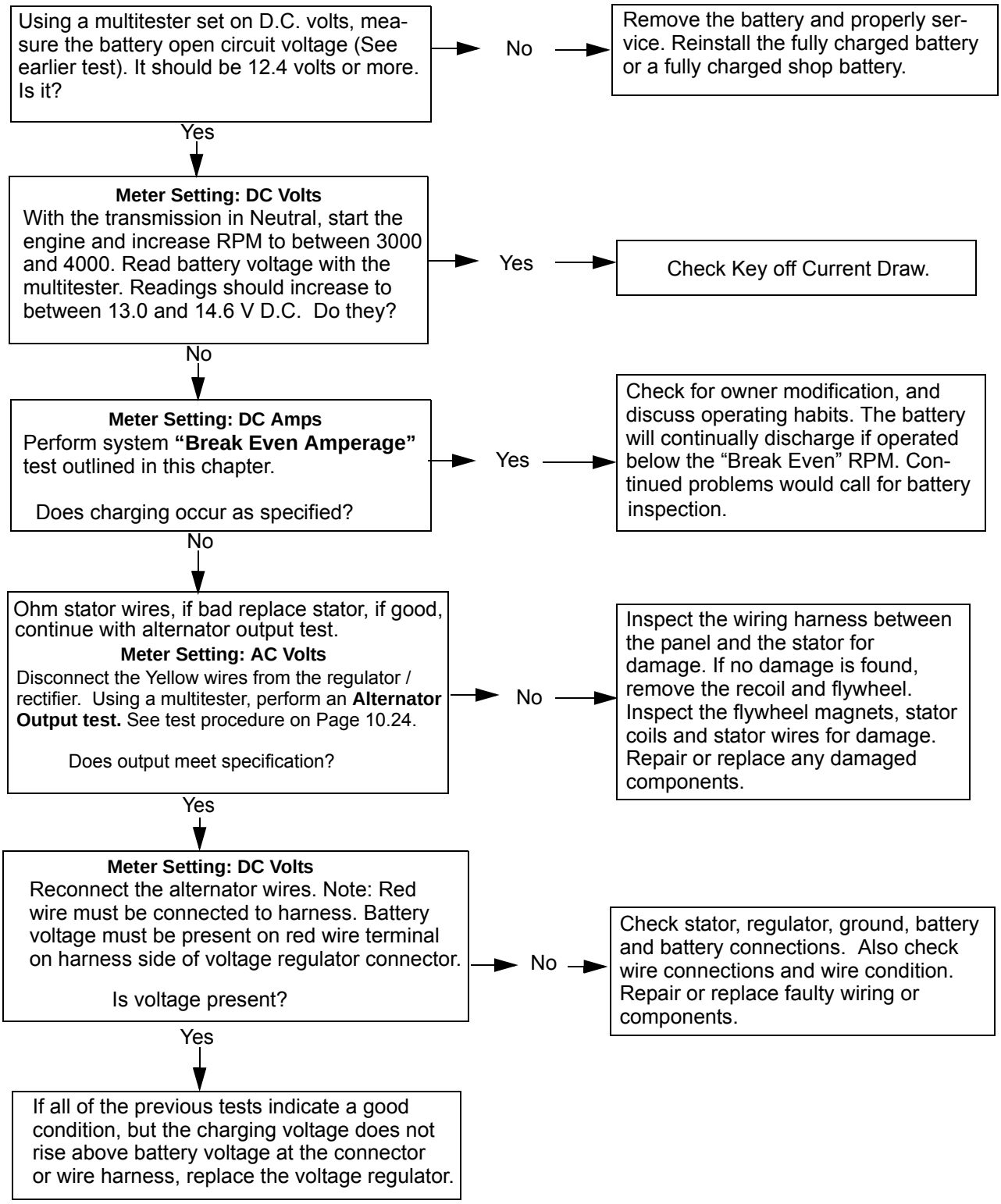
   Example: The alternator current output reading should be approximately **18 VAC at 1300 RPM between each 'leg'**.

NOTE: If one or more of the stator leg output AC voltage varies significantly from the specified value, the stator may need to be replaced.

RPM Reading	AC Voltage (VAC) Reading
1300	18 VAC ± 25 %
3000	42 VAC ± 25 %
5000	64 VAC ± 25 %

Charging System Testing Flow Chart

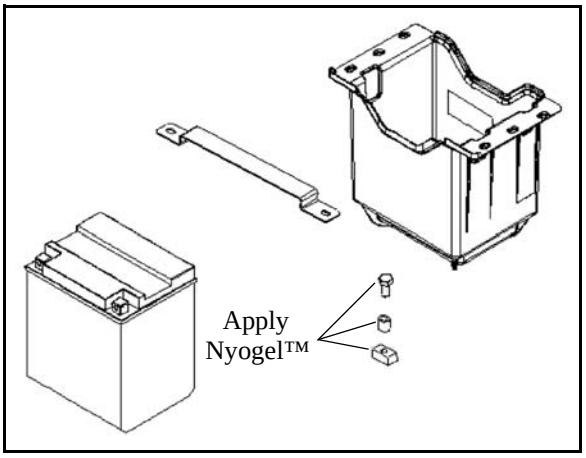
Whenever charging system problems are suspected, proceed with the following system check after verifying that all wires are in good condition, connected and not exposed or pinched.:



BATTERY SERVICE

Battery Terminals / Bolts

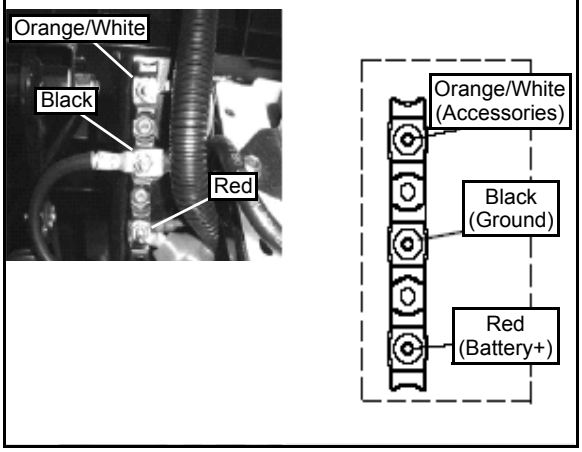
Use Polaris corrosion resistant Nyogel™ grease (PN 2871329) on battery terminal bolts.



Battery Terminal Block

The terminal block is located under the front hood next to the battery. The terminal block provides easy access to the main battery and starting cables. The terminal block also provides easy hookup for accessories.

TERMINAL BLOCK



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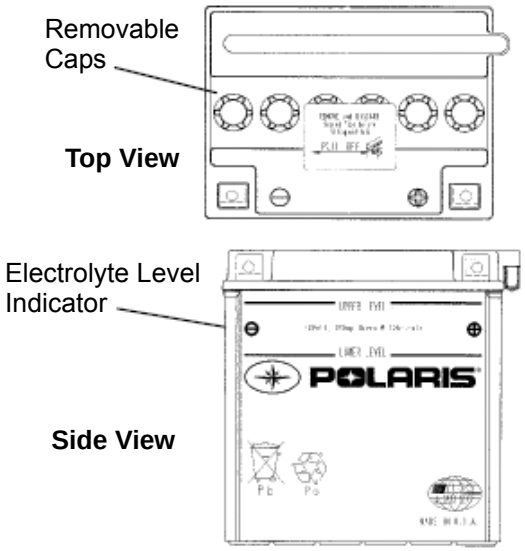
Terminal Block Nuts:
20-25 in. lbs. (2.3-2.8 Nm)

Battery Activation

CONVENTIONAL BATTERY



WARNING

Battery electrolyte is poisonous. It contains sulfuric acid. Serious burns can result from contact with skin, eyes or clothing. Antidote:

External: Flush with water.

Internal: Drink large quantities of water or milk. Follow with milk of magnesia, beaten egg, or vegetable oil. Call physician immediately.

Eyes: Flush with water for 15 minutes and get prompt medical attention.

Batteries produce explosive gases. Keep sparks, flame, cigarettes etc. away. Ventilate when charging or using in an enclosed space. Always shield eyes when working near batteries.
KEEP OUT OF REACH OF CHILDREN.

WARNING

The gases given off by a battery are explosive. Any spark or open flame near a battery can cause an explosion which will spray battery acid on anyone close to it. Should there be contact with battery acid, wash the affected area with large quantities of cool water and seek immediate medical attention.

To ensure maximum service life and performance from a new battery, perform the following steps. NOTE: Do not service the battery unless it will be put into regular service within 30 days. After initial service, add only distilled water to the battery. Never add electrolyte after a battery has been in service.

NOTE: New Battery: Battery must be fully charged before use or battery life will be significantly reduced 10-30% of the battery's full potential.

To activate a new battery:

1. Remove vent plug from vent fitting. Remove cell caps.
2. Fill battery with electrolyte to upper level marks on case.
3. Set battery aside to allow for acid absorption and stabilization for 30 minutes.
4. Add electrolyte to bring level back to upper level mark on case.

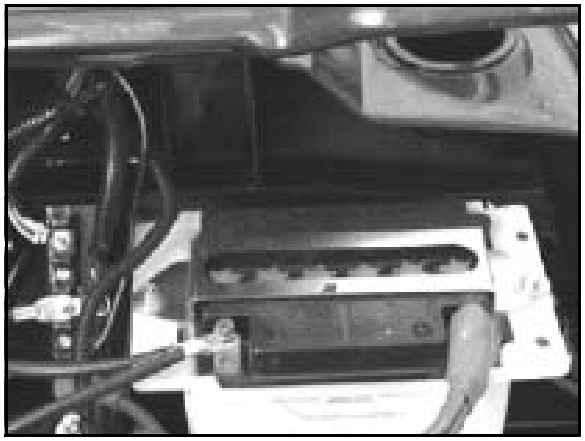
NOTE: This is the last time that electrolyte should be added. If the level becomes low after this point, add only distilled water.

5. Charge battery at 1/10 of its amp/hour rating. Examples: 1/10 of 9 amp battery = .9 amp; 1/10 of 14 amp battery = 1.4 amp; 1/10 of 18 amp battery = 1.8 amp (recommended charging rates).
6. Check specific gravity of each cell with a hydrometer to assure each has a reading of 1.270 or higher.

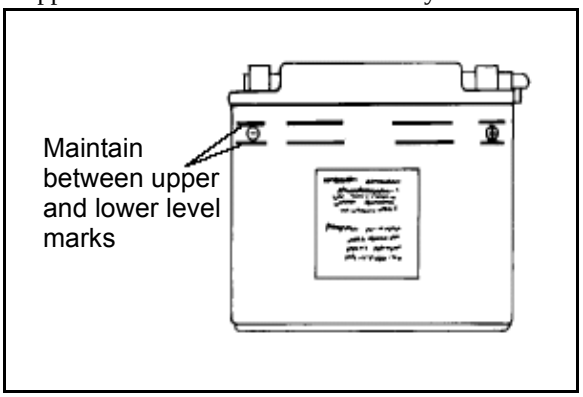
Battery Inspection

IMPORTANT: Proper servicing and upkeep of the battery is very important in maintaining long battery life.

The battery is located under the hood.



Inspect the battery fluid level. When the battery fluid nears the lower level, remove the battery and fill with distilled water only to the upper level line. To remove the battery:



Battery Removal / Installation

See Chapter 2 "Maintenance" for battery service procedures.

Battery Testing

Whenever a service complaint is related to either the starting or charging systems, the battery should be checked first.

Following are three tests which can easily be made on a battery to determine its condition: OCV Test, Specific Gravity Test and Load Test.

OCV - Open Circuit Voltage Test

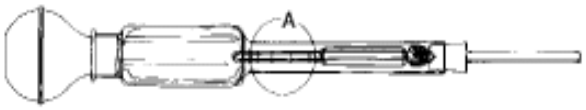
Battery voltage should be checked with a digital multitester. Readings of 12.6 volts or less require further battery testing and charging. See the following chart and Load Test.

NOTE: Lead-acid batteries should be kept at or near a full charge as possible. Electrolyte level should be kept between the low and full marks. If the battery is stored or used in a partially charged condition, or with low electrolyte levels, hard crystal sulfation will form on the plates, reducing the efficiency and service life of the battery.

OPEN CIRCUIT VOLTAGE		
State of Charge	**Conventional Lead-Acid**	**YuMicron™ Type**
100% Charged	12.60 V	12.70 V
75% Charged	12.40 V	12.50 V
50% Charged	12.10 V	12.20 V
25% Charged	11.90 V	12.0 V
0% Charged	less than 11.80 V	less than 11.9 V

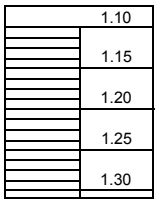
Specific Gravity Test

A tool such as a Battery Hydrometer (PN 2870836) can be used to measure electrolyte strength or specific gravity. As the battery goes through the charge/discharge cycle, the electrolyte goes from a heavy (more acidic) state at full charge to a light (more water) state when discharged. The hydrometer can measure state of charge and differences between cells in a multi-cell battery. Readings of 1.270 or greater should be observed in a fully charged battery. Differences of more than .025 between the lowest and highest cell readings indicate a need to replace the battery.



Battery Hydrometer **(PN 2870836)**

Detail A



SPECIFIC GRAVITY		
State of Charge*	**Conventional Lead-Acid**	**YuMicron™ Type**
100% Charged	1.265	1.275
75% Charged	1.210	1.225
50% Charged	1.160	1.175
25% Charged	1.120	1.135
0% Charged	less than 1.100	less than 1.115

* At 80° F
NOTE: Subtract .01 from the specific gravity reading at 40° F.

Load Test

CAUTION

To prevent shock or component damage, remove spark plug high tension leads and connect securely to engine ground before proceeding.

NOTE: This test can only be performed on machines with electric starters. This test cannot be performed with an engine or starting system that is not working properly.

A battery may indicate a full charge condition in the OCV test and the specific gravity test, but still may not have the storage capacity necessary to properly function in the electrical system. For this reason, a battery capacity or load test should be conducted whenever poor battery performance is encountered. To perform this test, hook a multitester to the battery in the same manner as was done in the OCV test. The reading should be 12.6 volts or greater. Engage the starter and observe the battery voltage while cranking the engine. Continue the test for 15 seconds. During cranking the observed voltage should not drop below 9.5 volts. If the beginning voltage is 12.6 volts or higher and the cranking voltage drops below 9.5 volts during the test, replace the battery.

Off Season Storage

See Chapter 2 “Maintenance” for battery service procedures.

Charging Procedure

1. Remove the battery to prevent damage from leaking or spilled acid during charging.
2. Charge the battery with a charging output no larger than 1/10 of the battery’s amp/hr rating. Charge as needed to raise the specific gravity to 1.270 or greater.
3. Install battery in vehicle with positive terminal toward the front. Coat threads of battery bolt with a corrosion resistant dielectric grease.

Dielectric Grease

(PN 2871329)

4. Connect battery cables.

WARNING

To avoid the possibility of explosion, connect positive (+) cable first and negative (-) cable last.

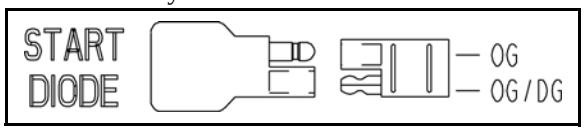
5. After connecting the battery cables, install the cover on the battery and attach the hold down strap.
6. Install clear battery vent tube from vehicle to battery vent. **WARNING:** Vent tube must be free from obstructions and kinks and securely installed. If not, battery gases could accumulate and cause an explosion. Vent should be routed away from frame and body to prevent contact with electrolyte. Avoid skin contact with electrolyte, as severe burns could result. If electrolyte contacts the vehicle frame, corrosion will occur.
7. Route cables so they are tucked away in front and behind battery.

STARTER SYSTEM

Troubleshooting

Starter Motor Does Not Run

- Battery discharged - Low specific gravity
- Loose or faulty battery cables or corroded connections (see Voltage Drop Tests)
- Related wiring loose, disconnected, or corroded
- Poor ground connections at battery cable, starter motor or starter solenoid (see Voltage Drop Tests)
- Faulty key switch
- Faulty Start Diode. Use a digital multi-meter to test diode operation. Unplug the diode from the harness and measure between the Orange and Orange/Green diode connections. Continuity should flow one direction only.



- Faulty starter solenoid or starter motor
- Engine problem - seized or binding (can engine be rotated easily)

Starter Motor Turns Over Slowly

- Battery discharged - low specific gravity
- Excessive circuit resistance - poor connections (see Voltage Drop Test)
- Engine problem - seized or binding (can engine be rotated easily)
- Faulty or worn brushes in starter motor

Starter Motor Turns - Engine Does Not Rotate

- Faulty starter drive
- Faulty starter drive gears or starter motor gear
- Faulty flywheel gear or loose flywheel

Voltage Drop Test

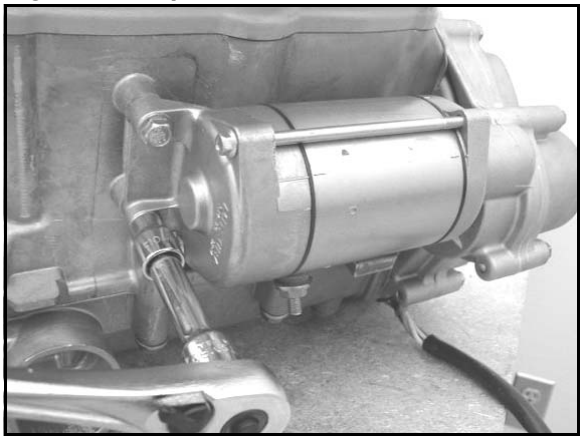
The Voltage Drop Test is used to test for bad connections. When performing the test, you are testing the amount of voltage drop through the connection. A poor or corroded connection will appear as a high voltage reading. Voltage shown on the meter when testing connections should not exceed .1 VDC per connection or component.

To perform the test, place the meter on DC volts and place the meter leads across the connection to be tested. Refer to the voltage drop tests on the starter system in this chapter.

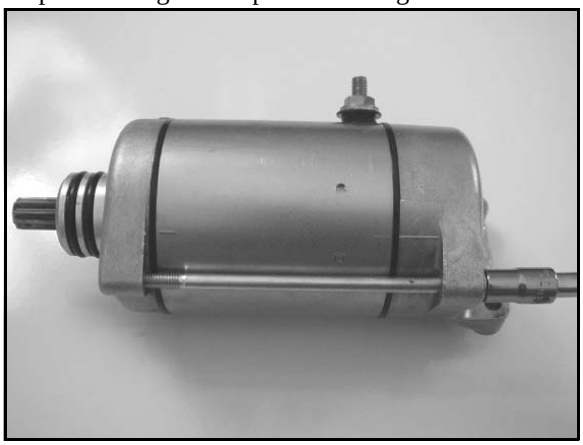
Voltage should not exceed .1 DC volts per connection

Starter Motor Removal / Disassembly

NOTE: Use electrical contact cleaner to clean starter motor parts. Some solvents may leave a residue or damage internal parts and insulation.

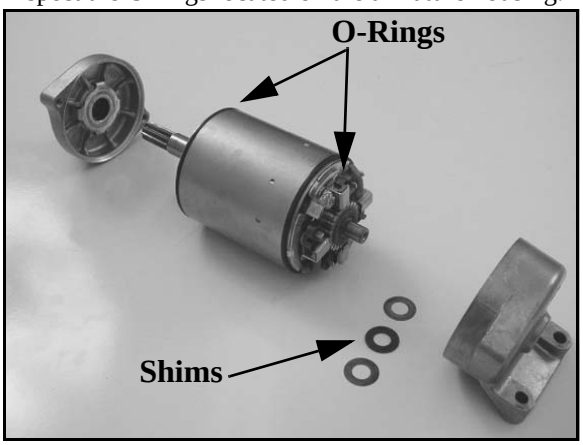


1. Remove the starter from the engine.
2. Remove the two bolts, washers, and sealing O-Rings. Inspect O-Rings and replace if damaged.



NOTE: Note the alignment marks on both ends of the starter motor casing. These marks must align during reassembly.

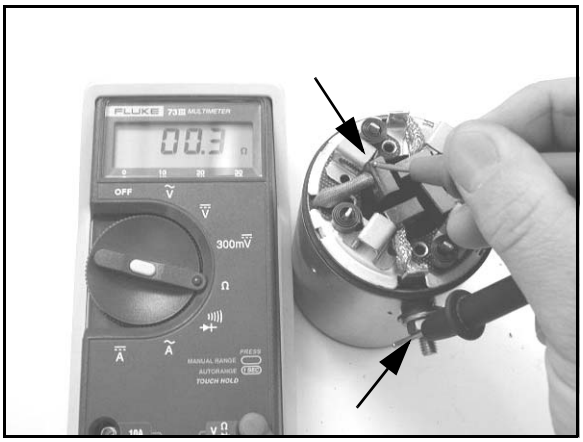
3. Remove the front bracket assembly and the rear bracket assembly. Remove the shims from the armature shaft and inspect the O-rings located on the armature housing.



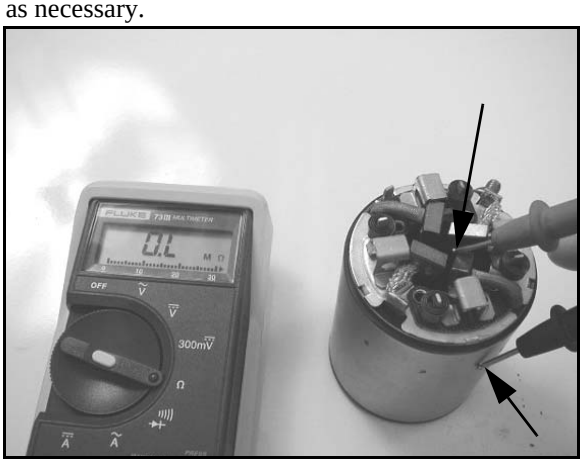
NOTE: The shims will be replaced during reassembly.

Brush Inspection / Replacement

1. Measure resistance between starter input terminal and insulated brushes. The reading should be .3 ohms or less. Remember to subtract meter lead resistance.



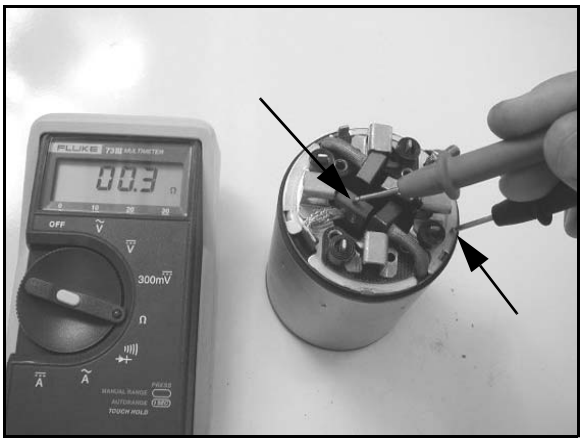
2. Measure resistance between insulated brush and starter housing. Reading should be infinite (OL). Inspect insulation on brush wires for damage and repair or replace as necessary.



3. Slide positive brush springs to the side, pull brushes out of their guides and remove brush plate. Slide brush end frame off end of starter.

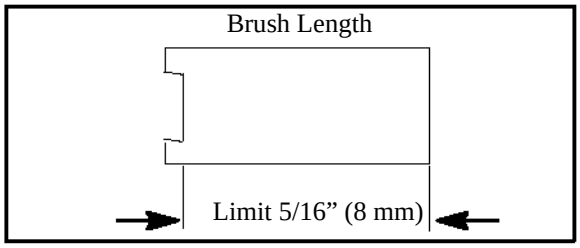
NOTE: The electrical input post must stay with the field coil housing.

4. Measure resistance between ground brush and brush plate. Resistance should be .3 ohms or less.



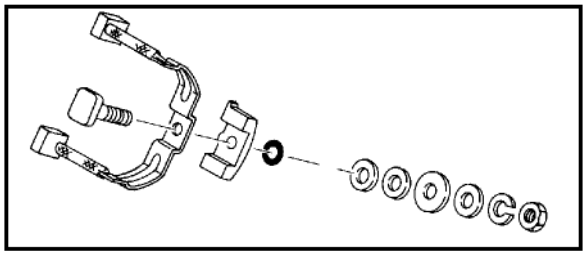
Brush Inspection

1. Measure length of each carbon brush. Replace brush assembly when worn to 5/16" (8 mm) or less. The brushes must slide freely in their holders.



Brush Replacement

1. Remove terminal nut with lock washer, flat washer, large phenolic washer, the small phenolic spacers, and sealing O-ring. Inspect O-ring and replace if damaged.

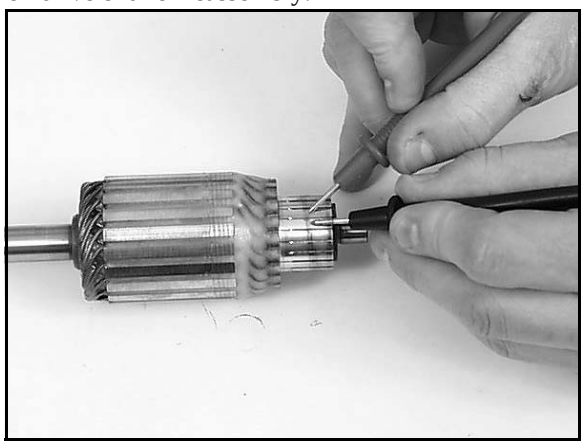


2. Slide positive brush springs to the side, pull brushes out of their guides and remove brush plate.

> **⚠ CAUTION**
>
> Some cleaning solvents may damage the insulation in the starter. Care should be exercised when selecting an appropriate solvent. If the commutator needs cleaning use only electrical contact cleaner.

Armature Testing

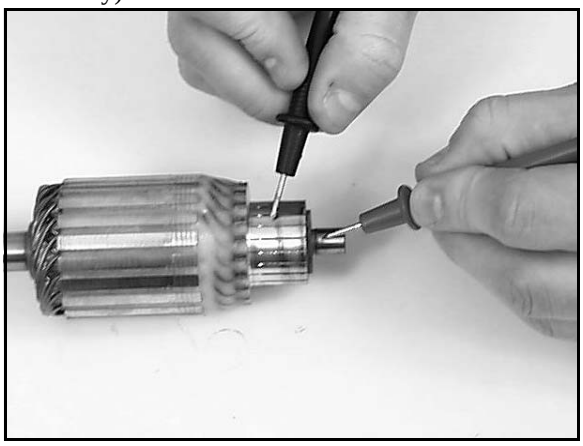
1. Remove armature from starter casing. Note order of shims on drive end for reassembly.



2. Inspect surface of commutator. Replace if excessively worn or damaged.

3. Using a digital multitester, measure the resistance between each of the commutator segments. The reading should be .3 ohms or less.

4. Measure the resistance between each commutator segment and the armature shaft. The reading should be infinite (no continuity).



5. Check commutator bars for discoloration. Bars discolored in pairs indicate shorted coils, requiring replacement of the starter motor.

6. Place armature in a growler. Turn growler on and position a hacksaw blade or feeler gauge lengthwise 1/8" (.3 cm) above armature coil laminates. Rotate armature 360°. If hacksaw blade is drawn to armature on any pole, the armature is shorted and must be replaced.

> **⚠ CAUTION**
>
> Use care when handling starter housing. Do not drop or strike the housing as magnet damage is possible. If magnets are damaged, starter must be replaced.

Starter Reassembly / Installation

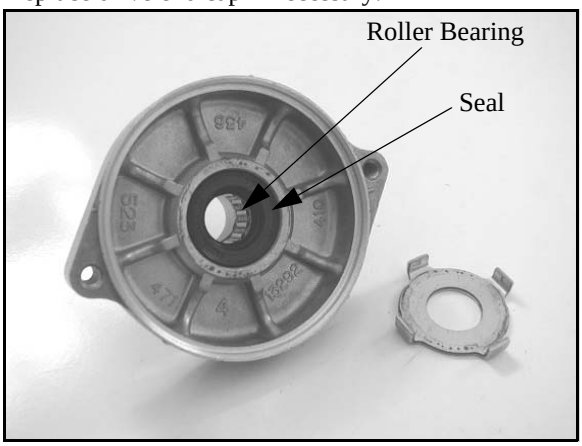
1. Install brush plate to field magnet housing aligning index tab.

2. Install O-ring, two small phenolic spacers, large phenolic washer, flat washer, lock washer, and terminal nut.

3. While holding brush springs away from brushes, push brushes back and hold in place.

4. Slide armature into field magnet housing. Release brushes.

5. Lightly grease the drive roller bearing and reinstall drive end frame on armature. Inspect seal for wear or damage. Replace drive end cap if necessary.

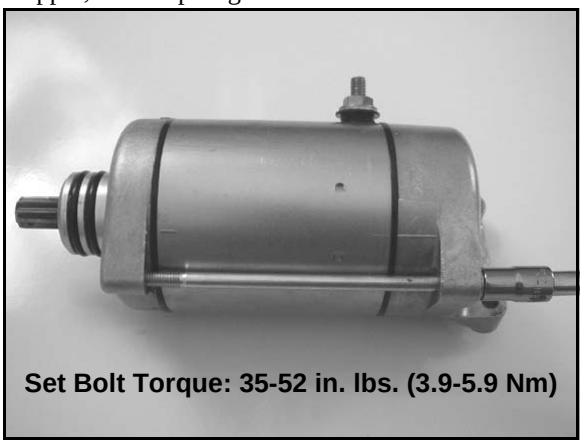


6. Be sure wire insulation is in place around positive brush wire and pushed completely into slot on phenolic plate.

7. Using Dielectric Grease (**PN 2871329**), lubricate brush end bushing and install shims.

8. Align brush plate and install cover and screws.

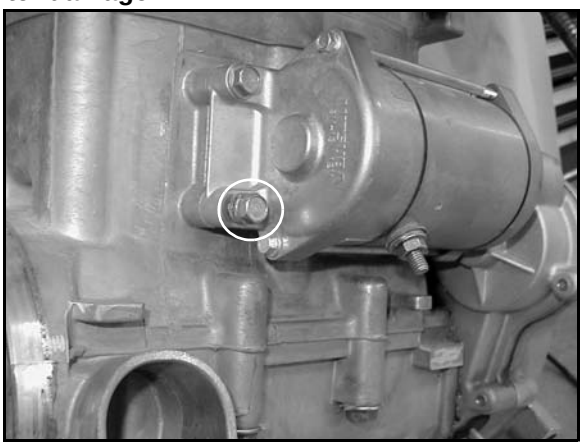
9. Lightly grease pinion shaft and install pinion, spring stopper, and snap ring.



10. Completely assemble starter motor and torque set bolts to **35 - 52 in. lbs. (3.9 - 5.9 Nm).**

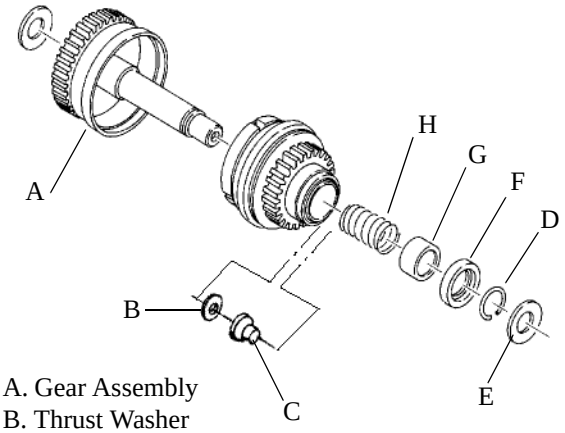
11. Install the starter onto the engine case. Hand tighten each of the starter bolts. **Torque the bottom bolt first to 9 ft.lbs. (12 Nm).** Then torque the top bolt to the same specification.

NOTE: It is important to tighten the bottom starter bolt first (circle), as the bottom hole acts as a pilot hole to properly align the starter drive (bendix) with the flywheel. This helps to prevent binding and starter damage.



Starter Drive

If the garter spring is damaged, the overrun clutch may fail to return properly. Use either of the following methods to remove and install a new garter spring:



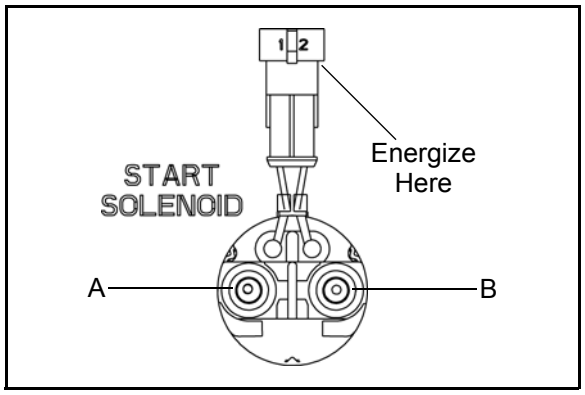
A. Gear Assembly
B. Thrust Washer
C. Busing
D. Retaining Ring
E. Thrust Washer
F. Stopper
G. Cover
H. Spring

1. Screw the overrun clutch out to the engaged position on the pinion shaft assembly. Use a small piece of wire with the end bent in a hook and pick the old spring out of its channel. Slide it off the end of the shaft. Slide the new spring over the overrun clutch and into the spring groove. Make sure that the spring is positioned between the shoe alignment pins and the back flange of the anti kick-out shoes.

2. Remove the retaining ring, thrust washer, spring retainers and clutch return spring. Screw the overrun clutch off the end of the pinion shaft. Remove the old spring and install a new one. Lightly grease the pinion shaft and reinstall the clutch, spring, retainers, end washer and lock ring in the reverse order. Make sure the end washer is positioned properly so that it will hold the lock ring in its groove.

Starter Solenoid Bench Test

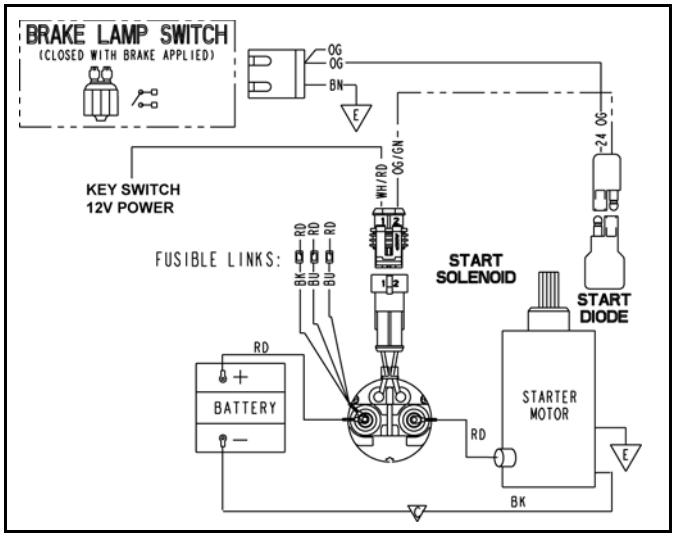
Test the start solenoid by powering the solenoid using battery voltage for a maximum of 5 seconds. With the solenoid energized, resistance should read about 0.5Ω ± 10% between terminal (A) and (B). If resistance measurement is out of specification, replace the starter solenoid.



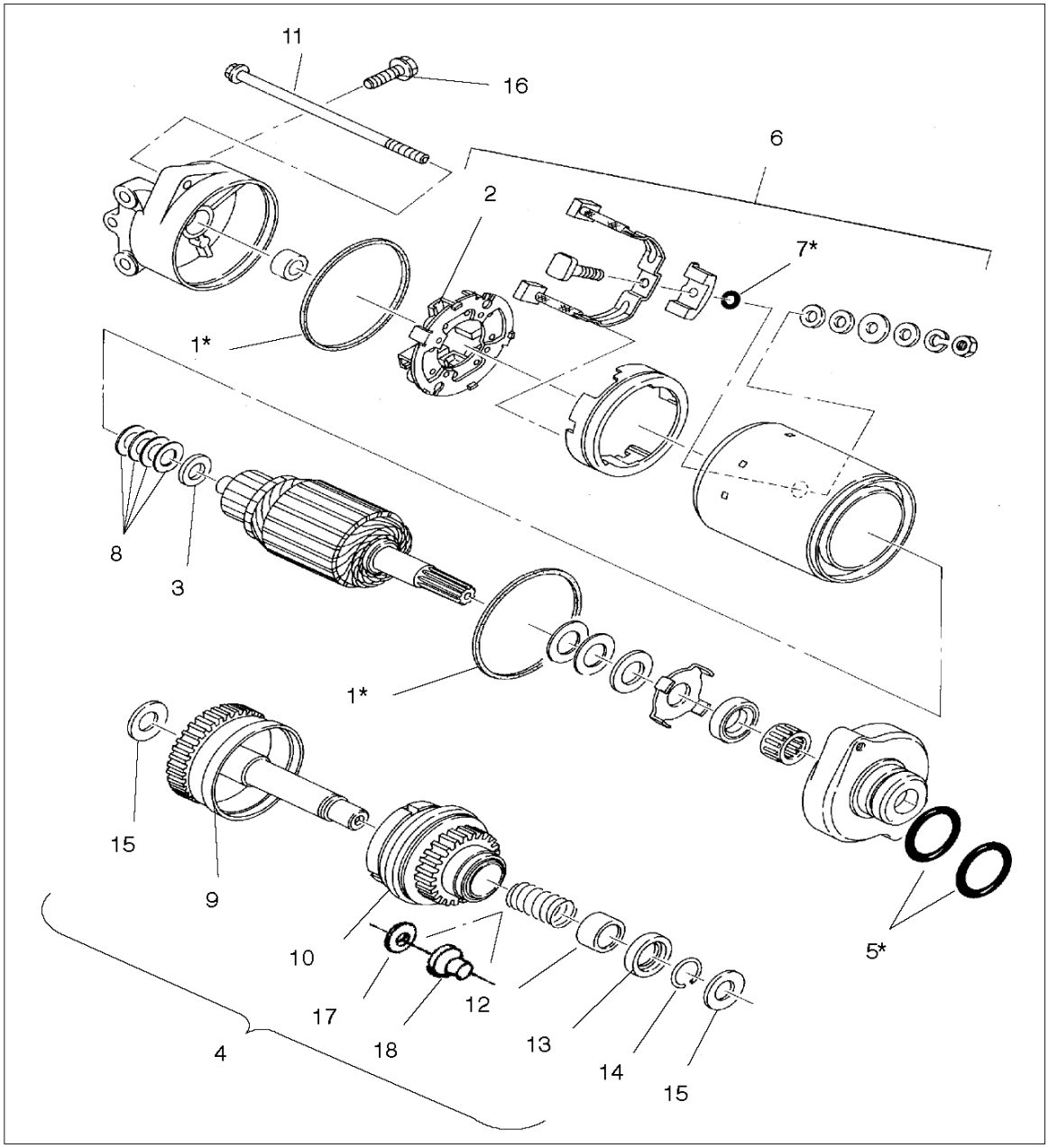
Starter Solenoid Operation

To energize the Starter Solenoid the following must occur:

- The brake must be applied to provide a ground path via the Orange / Green wire.
- The key switch must be turned to the “start” position to provide 12V power via the White / Red wire.
- Once the pull-in coil is energized, the solenoid provides a current path for 12V power to reach the starter motor.



Starter Exploded View



***** Indicates - Do not reuse. Replace with new parts.

1. Rubber Ring*	10. Gear Assembly
2. Brush Spring	11. Through Bolt
3. Thrust Washer	12. Cover
4. Gear Assembly	13. Stopper
5. O-Ring*	14. Snap Ring
6. Brush Complete	15. Washer
7. O-Ring*	16. Flange Bolt
8. Thrust Washer	17. Thrust Washer
9. Shaft Complete	18. Flange Bushing

STARTING SYSTEM TESTING FLOW CHART

Condition: Starter fails to turn over the engine.

With the tester on the VDC position, place the tester's black lead on the battery negative and the red lead on the battery positive. Reading should be 12.4 V D. C. or greater.

No → Remove battery and properly service. Install fully charged shop battery to continue test.

Yes

Disconnect 2-wire connector at the solenoid. Using a multi-meter, connect the black meter lead to the Orange/Green harness wire and the red meter lead to the White/Red harness wire. Apply the brake and turn ignition switch to the "start" position. Meter should read battery voltage.

No → Check for voltage at the chassis 20 Amp fuse and then check for voltage entering the ignition switch. Battery voltage should be present. If battery voltage is present at the ignition switch, but not the solenoid, replace the switch. **NOTE:** The brake MUST be applied when performing these tests.

Yes → Test the start solenoid by powering the solenoid via the 2-wire connection. With the solenoid energized, resistance should read about 0.5Ω ± 10% between the two terminals. If resistance measurement is out of specification, replace the starter solenoid (see "Starter Solenoid Bench Test")

Voltage Drop Testing

Reconnect the solenoid. Connect the tester black lead to the battery positive and the red lead to the solenoid end of the battery-to-solenoid wire. Turn the ignition key to the "start" position. Reading should be less than .1 V D.C.

No → Clean the battery-to-solenoid cable ends or replace the cable.

Yes

Connect the black tester lead to solenoid end of battery-to-solenoid cable. Connect red tester lead to solenoid end of solenoid-to-starter cable. Turn the ignition key to the "start" position. Reading should be less than .1 V D.C.

No → Replace the starter solenoid.

Yes

Connect the black tester lead to the solenoid end of the solenoid-to-starter cable. Connect the red tester lead to the starter end of the same cable. Turn the ignition key to the "start" position. The reading should be less than .1 V D.C.

No → Clean the solenoid-to-starter cable ends or replace the cable.

Yes

If all of these indicate a good condition, yet the starter still fails to turn, the starter must be removed for static testing and inspection.

ELECTRIC BOX LIFT ACTUATOR

DIAGNOSIS (if equipped)

1. Disconnect the wiring harness to the box lift actuator.

2. Connect a multimeter across the box lift actuator harness connection.

3. Actuate the box lift switch in both directions. Verify that there is 12 Volts reaching the box lift actuator. Follow the diagram below for diagnosis.

YES

YES - (12 Volts at actuator)

NO

(Not 12 Volts at actuator)
Lift the hood. Locate the box lift switch. Check for 12 Volts between the RED/BLACK wire terminal on the back of the switch and the BROWN wire terminal.

NO

(Not 12 Volts between wires)
On the main connector behind the dashboard, measure for 12 Volts between RED/BLACK wire terminal and ground.

NO

(Not 12 Volts between wires)
Test the accessory and wiring circuit breaker located under the seat. (Refer to Wiring Schematic)
Test the wiring between the main connector and the circuit breaker.

YES

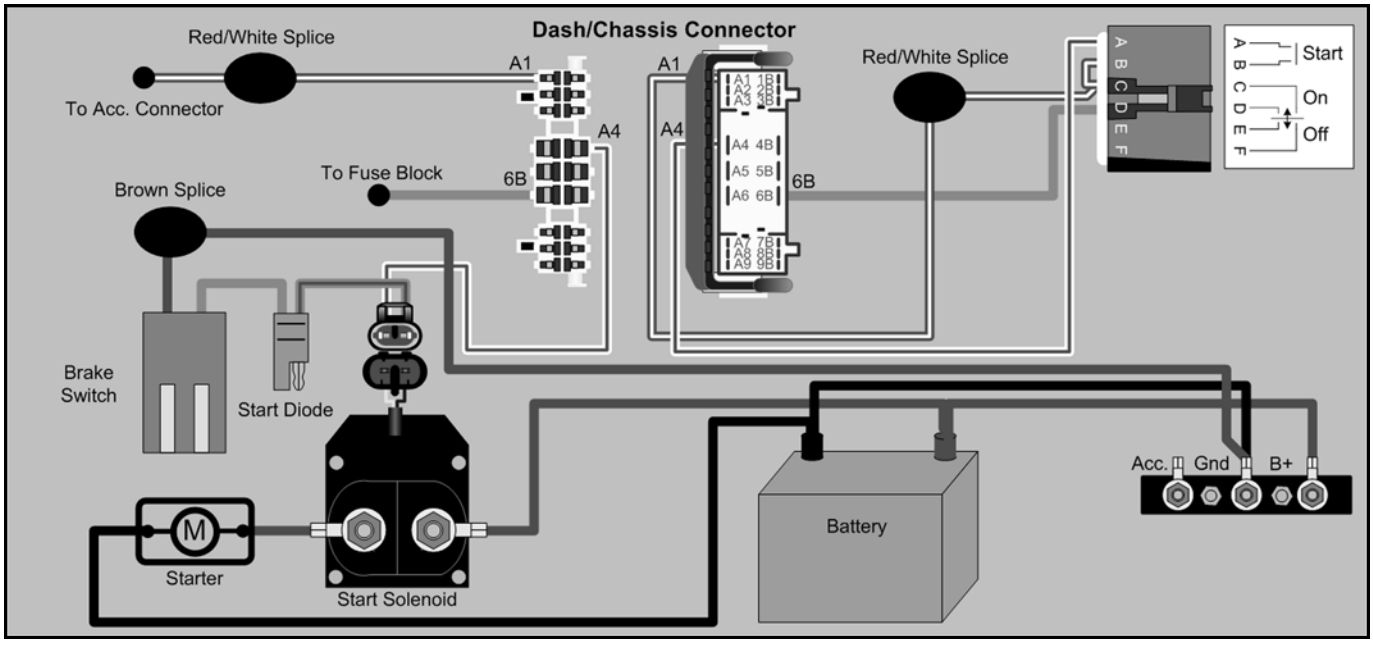
(12 Volts between wires)
Test wiring between the main connector and the circuit breaker.

YES

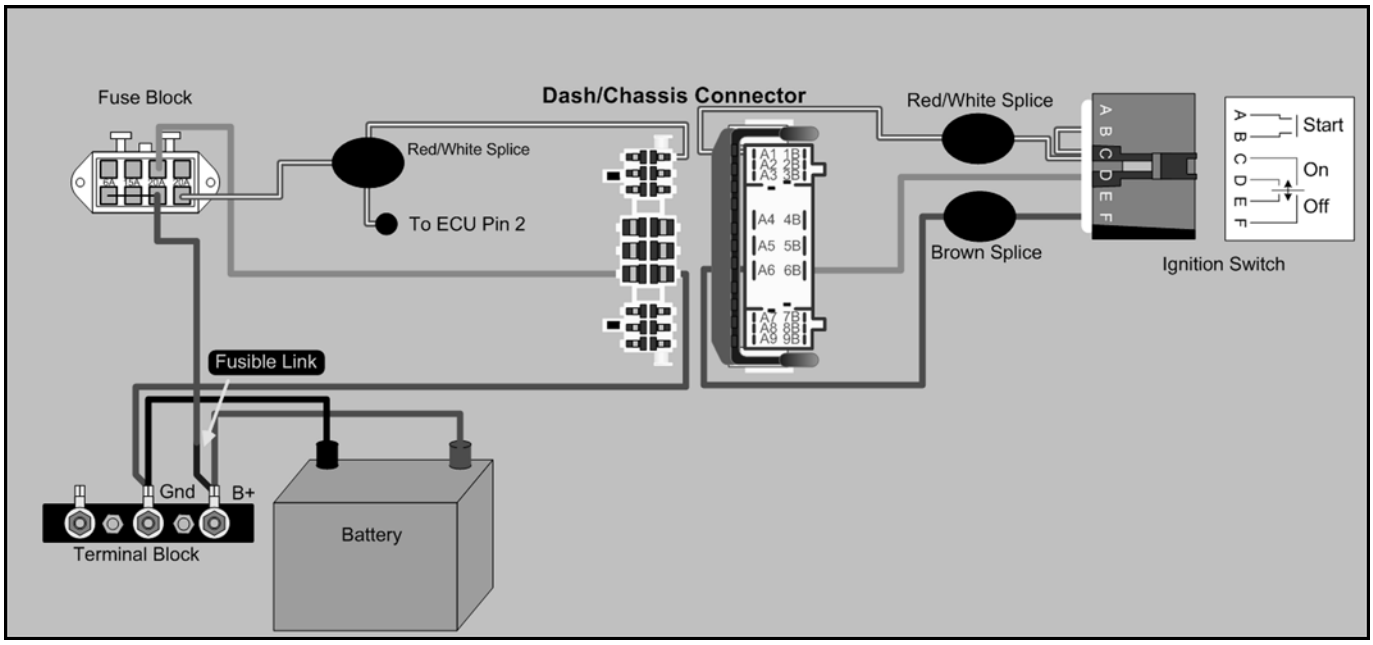
(12 Volts between wires)
Check the switch. Check the wires between the switch and the actuator motor.

ELECTRICAL BREAK-OUT DIAGRAMS

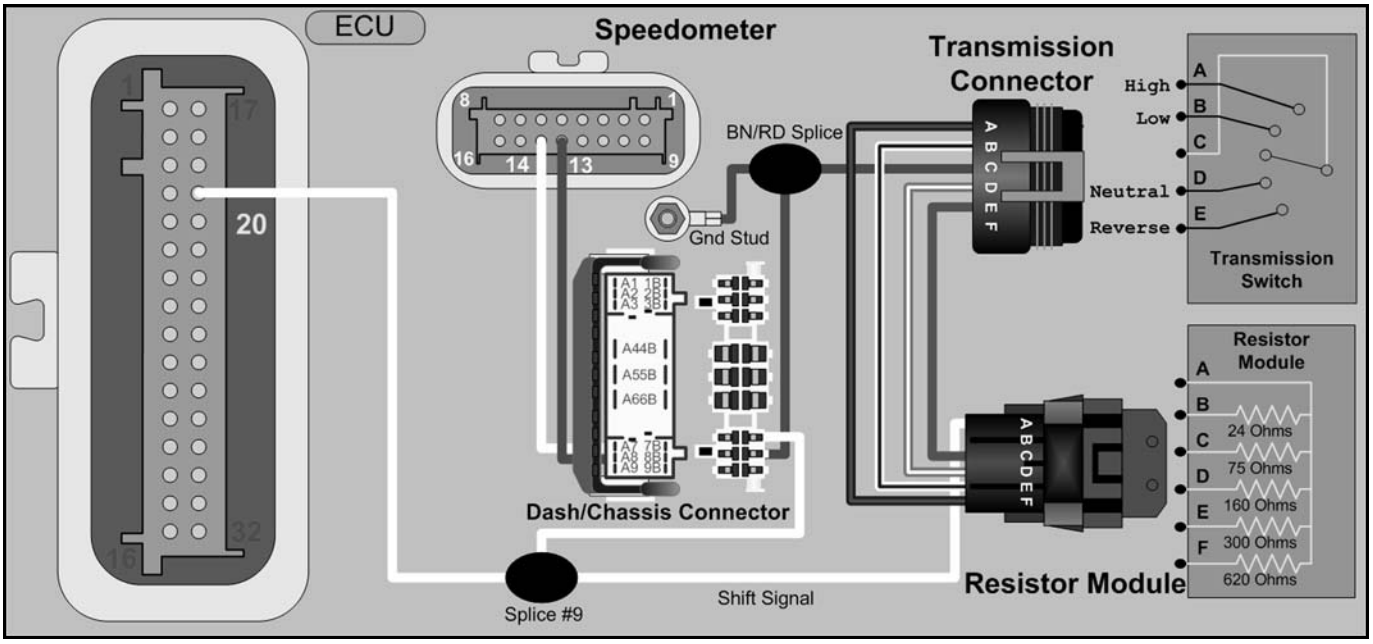
Starting Circuit



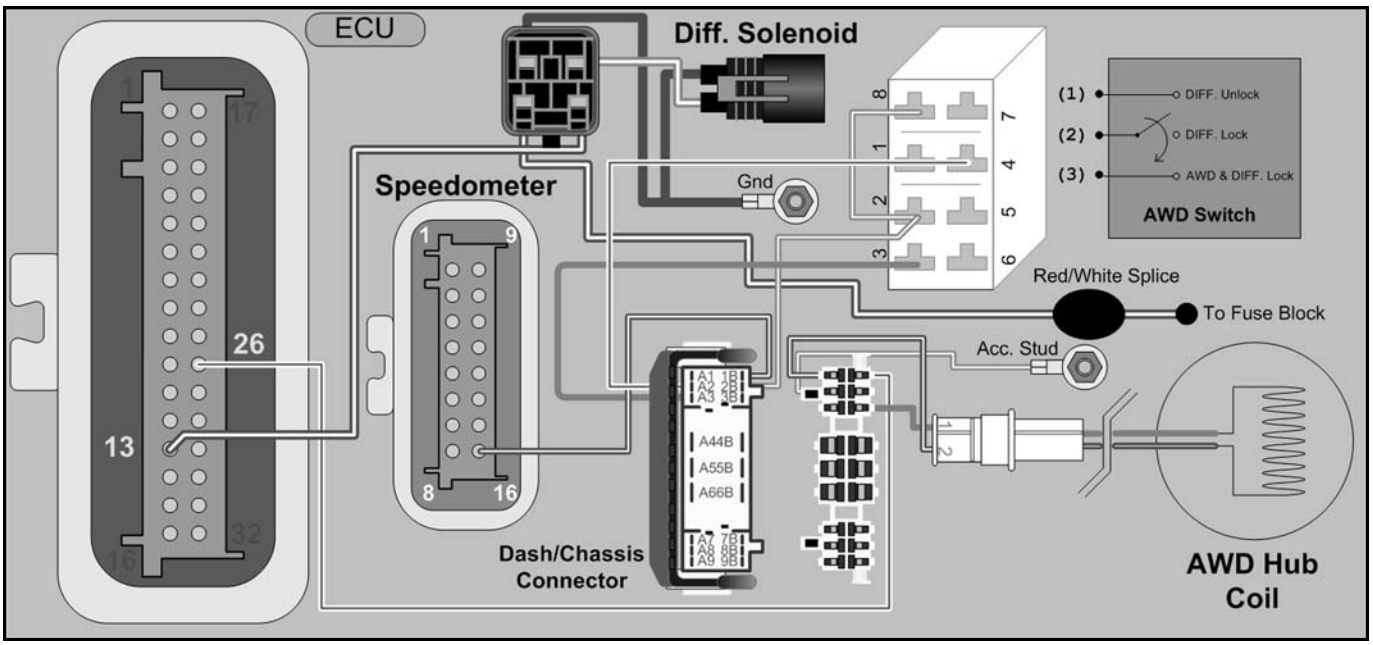
Key-On Power Circuit



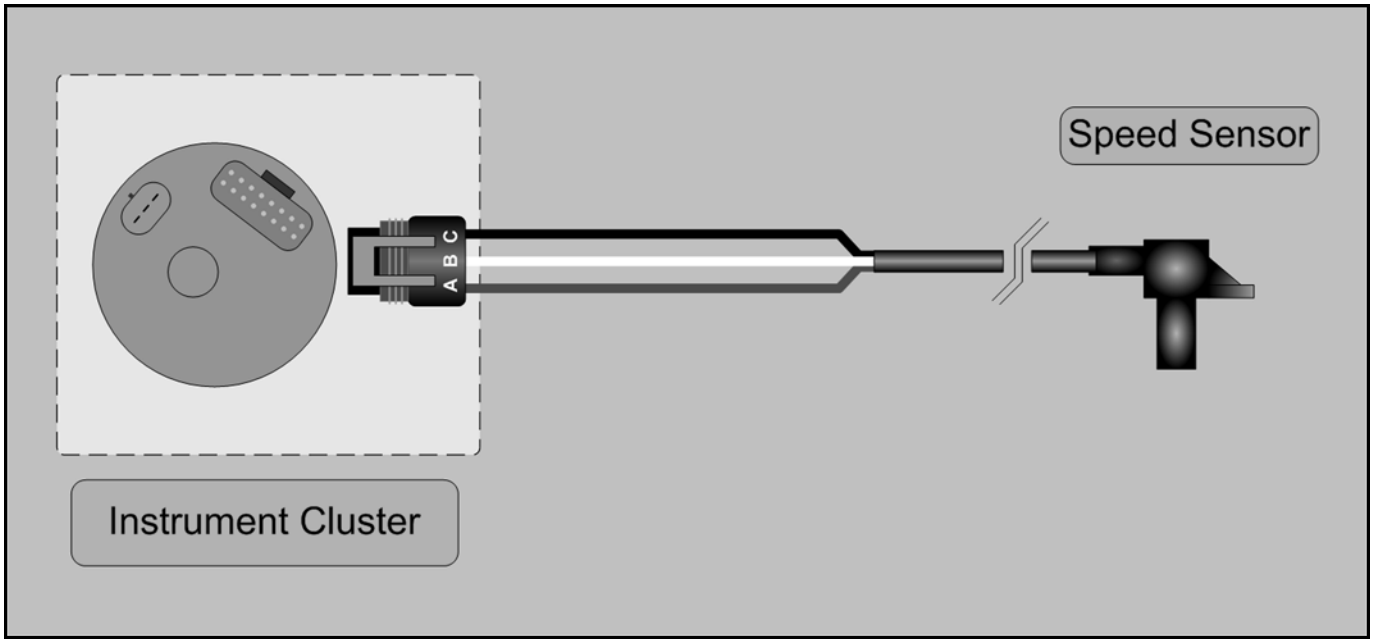
Transmission Switch Circuit



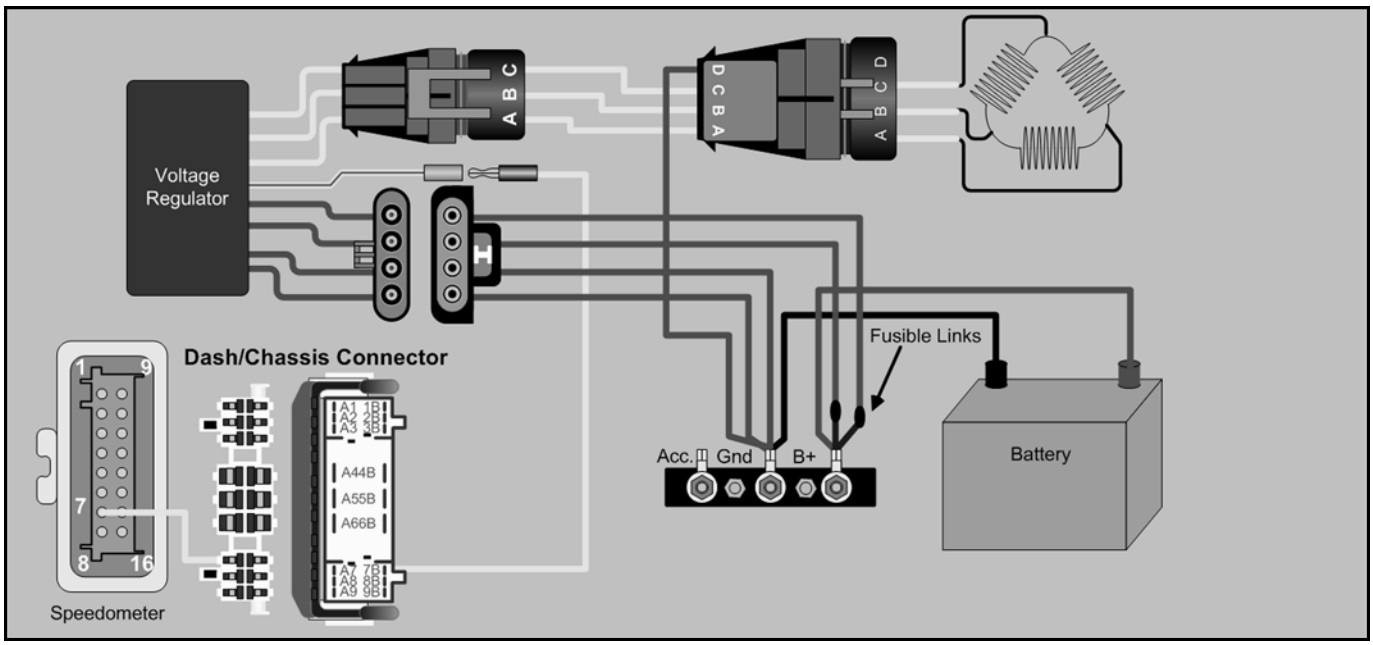
AWD Circuit



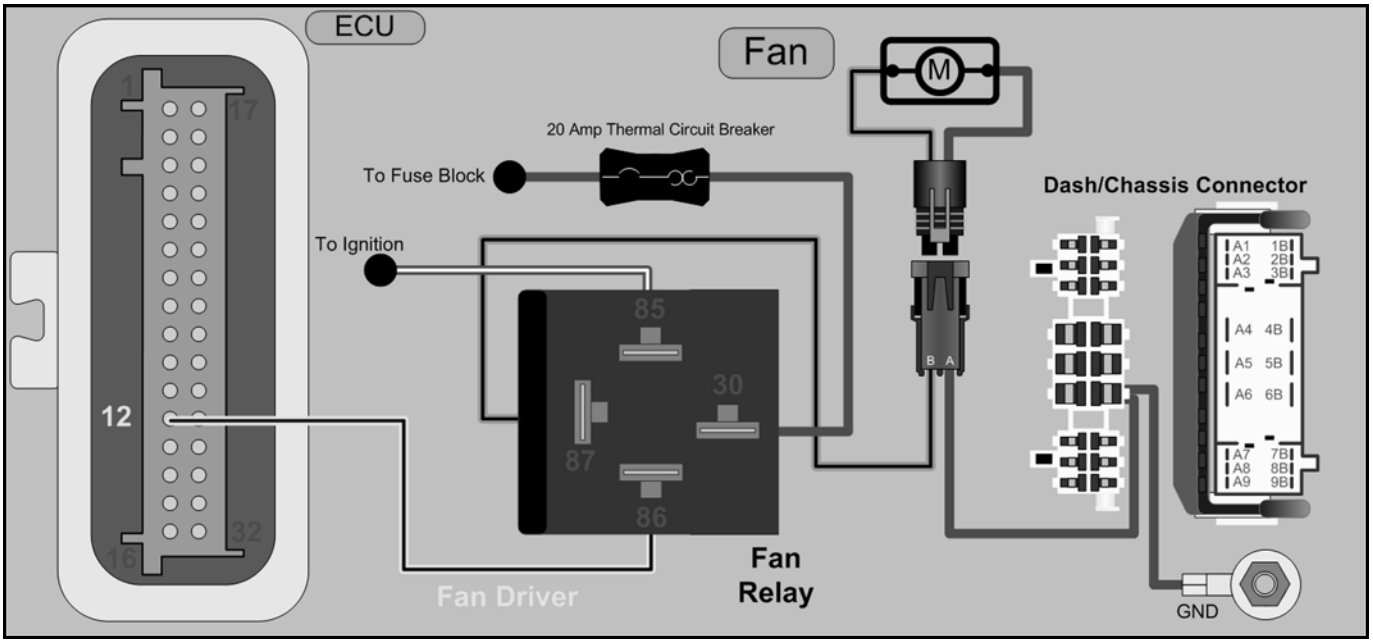
Speed Sensor Circuit



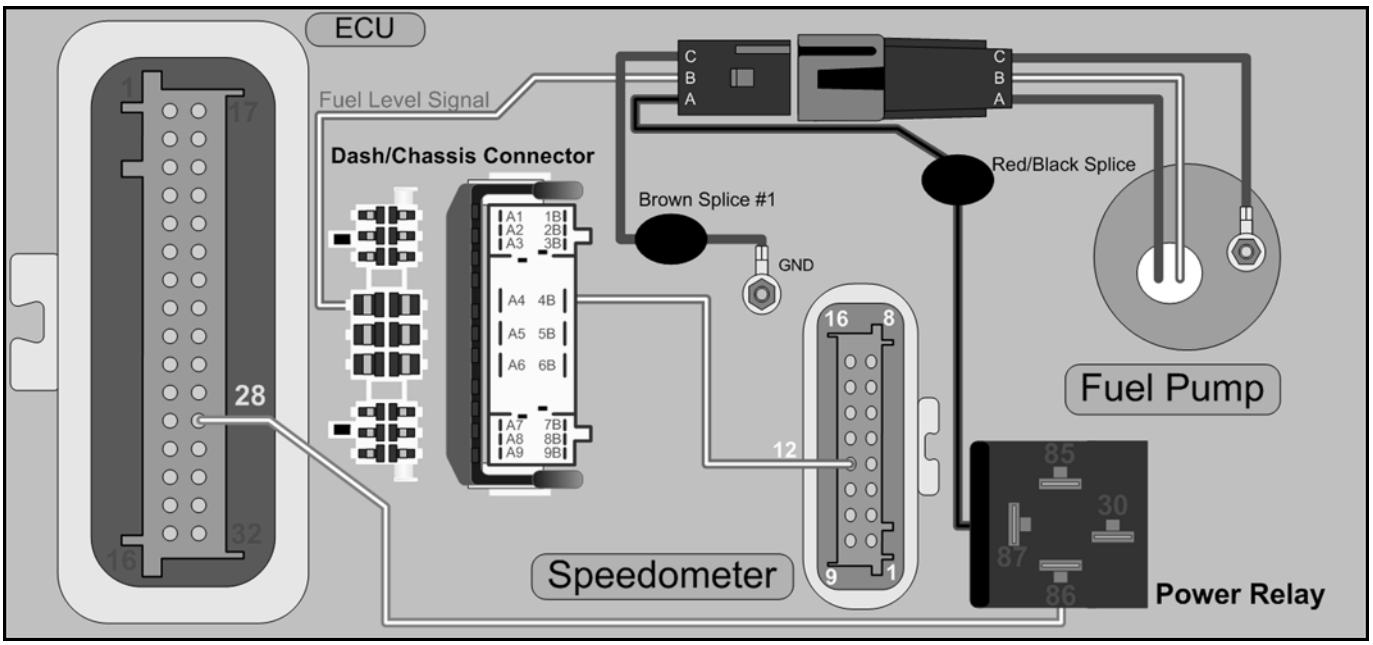
Charging System Circuit



Cooling Fan Circuit



Fuel Display / Fuel Pump Circuit



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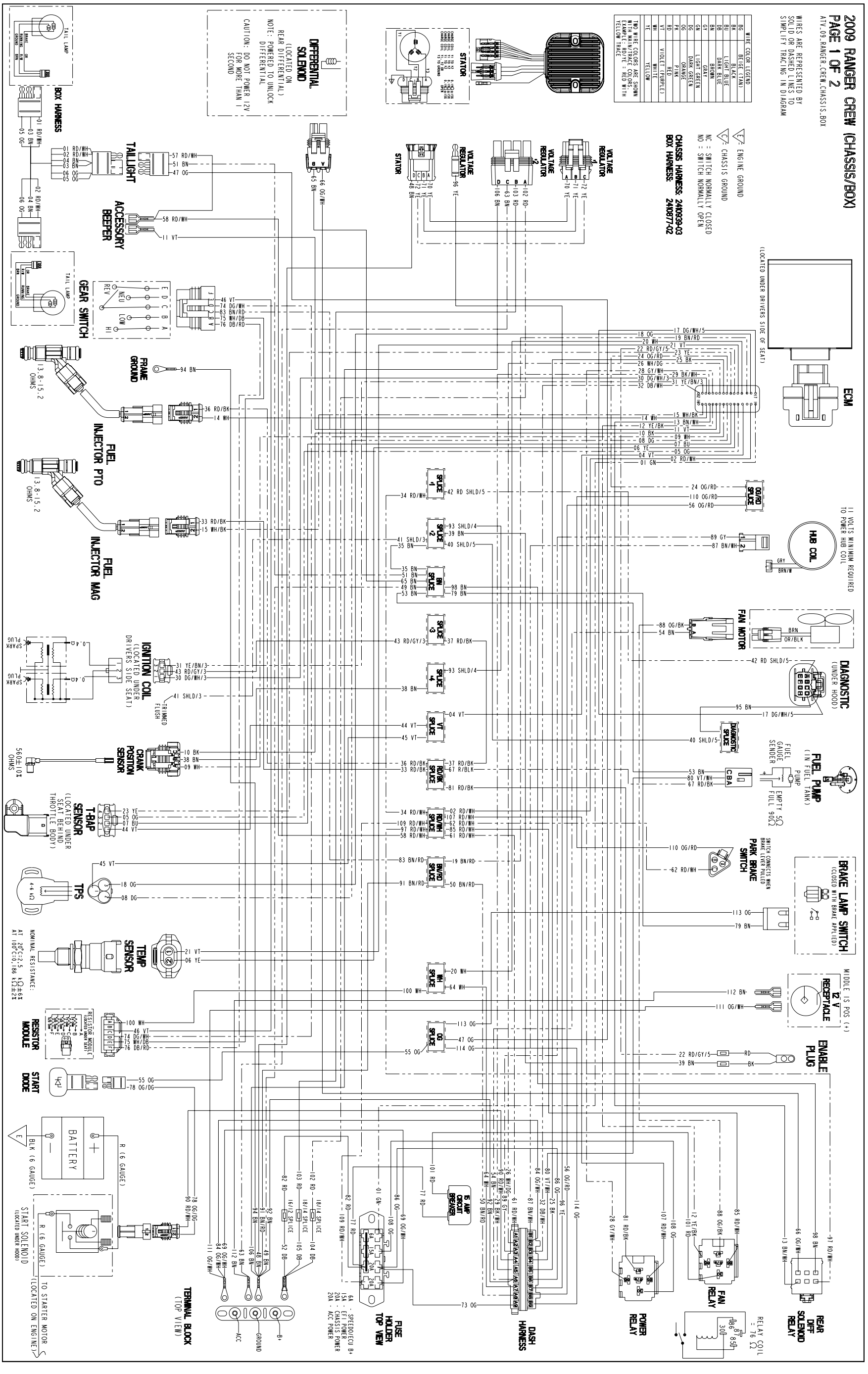

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ATV_09_RANGER_CREW_CHASSIS_BOX

WIRES ARE REPRESENTED BY
SOLID OR DASHED LINES TO
SIMPLIFY TRACING IN DIAGRAM

E = ENGINE GROUND

C = CHASSIS GROUND

NC = SWITCH NORMALLY CLOSED
NO = SWITCH NORMALLY OPEN

WIRE TERMINATION TABLE

CCT #	COLOR	GAUGE	FROM CONNECTOR	CAVITY	TO CONNECTOR	CAVITY
01	LT GREEN	20	ECM	1	FUSE HOLDER (6 AMP)	-
02	RED/WHITE	20	ECM	2	RED/WHITE SPLICE	-
03	-	-	-	-	-	-
04	VIOLET	20	ECM	4	VIOLET SPLICE	-
05	ORANGE	20	ECM	5	T-MAP SENSOR	3
06	YELLOW	20	ECM	6	TEMP SENSOR	2
07	LT BLUE	20	ECM	7	T-MAP SENSOR	2
08	GREEN	20	ECM	8	TPS	2
09	WHITE	FCAB202-030 (4)	ECM	9	CPS	A
10	BLACK	FCAB202-030 (4)	ECM	10	CPS	C
11	VIOLET	18	ECM	11	ACCESSORY BEEPER	.250F
12	YELLOW/BLACK	20	ECM	12	FAN RELAY	86
13	BROWN/WHITE	18	ECM	13	REAR DIFF SOLENOID RELAY	86
14	WHITE	18	ECM	14	PTO FUEL INJECTOR	2
15	WHITE/BLACK	18	ECM	15	MAG FUEL INJECTOR	2
17	GREEN/WHITE/5	FCAB204-035 (5)	ECM	17	DIAGNOSTIC	C
18	ORANGE	20	ECM	18	TPS	3
19	BROWN/RED	20	ECM	19	BROWN/RED SPLICE	-
20	WHITE	20	ECM	20	WHITE SPLICE	-
21	VIOLET	20	ECM	21	TEMP SENSOR	1
22	RED/GRAY/5	FCAB204-035 (5)	ECM	22	ENABLE PLUG	-
23	YELLOW	20	ECM	23	T-MAP SENSOR	4
24	ORANGE/RED	20	ECM	24	ORANGE/RED SPLICE	-
25	BLACK	20	ECM	25	DASH HARNESS	B5
26	WHITE/GREEN	18	ECM	26	DASH HARNESS	A2
28	GRAY/WHITE	20	ECM	28	POWER RELAY	86
29	BLACK/WHITE	20	ECM	29	DASH HARNESS	A5
30	GREEN/WHITE/3	FCAB204-035 (3)	ECM	30	IGNITION COIL	1
31	YELLOW/BROWN/3	FCAB204-035 (3)	ECM	31	IGNITION COIL	3
32	BLUE/WHITE	20	ECM	32	DASH HARNESS	B3
33	RED/BLACK	18	MAG FUEL INJECTOR	1	RED/BLACK SPLICE	-
34	RED/WHITE	20	SPLICE #1	-	RED/WHITE SPLICE	-
35	BROWN	20	SPLICE #2	-	BROWN SPLICE	-
36	RED/BLACK	18	PTO FUEL INJECTOR	1	RED/BLACK SPLICE	-
37	RED/BLACK	18	SPLICE #3	-	RED/BLACK SPLICE	-
38	BROWN	20	SPLICE #4	-	CPS	B
39	BROWN	20	ENABLE PLUG	-	SPLICE #2	1
40	SHIELD/5	FCAB204-035 (5)	SPLICE #2	-	DIAGNOSTIC SPLICE	-
41	SHIELD/3	FCAB204-035 (3)	SPLICE #2	-	IGNITION COIL (TRIM)	-
42	RED/5	FCAB204-035 (5)	SPLICE #1	-	DIAGNOSTIC	A
43	RED/GRAY/3	FCAB204-035 (3)	SPLICE #3	-	IGNITION COIL	2
44	VIOLET	20	VIOLET SPLICE	-	T-MAP SENSOR	1
45	VIOLET	20	VIOLET SPLICE	-	TPS	1
46	VIOLET	18	GEAR SWITCH	E	RESISTOR MODULE	C
47	ORANGE	18	ORANGE SPLICE	-	TAILLIGHT	.180M
48	BROWN	14	STATOR	D	GROUND STUD	#10R
49	BROWN	16	GROUND STUD	#10R	BROWN SPLICE	-
50	BROWN/RED	18	BROWN/RED SPLICE	-	DASH HARNESS	A8
51	BROWN	18	TAILLIGHT	.180M	BROWN SPLICE	-
52	BLUE	1.0	16/12 SPLICE	-	B+ STUD	#10R
53	BROWN	18	FUEL PUMP	C	BROWN SPLICE	-
54	BROWN	16	DASH HARNESS	A6	FAN MOTOR	A
55	ORANGE	18	STARTER DIODE	.180F	ORANGE SPLICE	-
56	ORANGE/RED	18	DASH HARNESS	B8	ORANGE/RED SPLICE	-
57	RED/WHITE	18	TAILLIGHT	.180F	ACCESSORY BEEPER	.250F
58	RED/WHITE	18	ACCESSORY BEEPER	.250F	RED/WHITE SPLICE	-
61	RED/WHITE	16	DASH HARNESS	A1	RED/WHITE SPLICE	-
62	RED/WHITE	18	RED/WHITE SPLICE	-	PARK BRAKE SWITCH	C
63	BROWN	14	VOLTAGE REGULATOR #2	C	GROUND STUD	#10R
64	WHITE	18	DASH HARNESS	A7	WHITE SPLICE	-
65	BROWN	18	BROWN SPLICE	-	DIFF SOLENOID	B
66	ORANGE/WHITE	18	REAR DIFF SOLENOID RELAY	87	DIFF SOLENOID	A
67	RED/BLACK	18	FUEL PUMP	A	RED/BLACK SPLICE	-
69	ORANGE/WHITE	16	FUSE HOLDER (20 AMP)	-	ACC STUD	#10R
70	YELLOW	14	VOLTAGE REGULATOR #1	A	STATOR	A
71	YELLOW	14	VOLTAGE REGULATOR #1	B	STATOR	B
72	YELLOW	14	VOLTAGE REGULATOR #1	C	STATOR	C
73	ORANGE	16	FUSE HOLDER (20 AMP)	-	DASH HARNESS	A9
74	GREEN/WHITE	18	RESISTOR MODULE	D	GEAR SWITCH	D
75	WHITE/DK BLUE	18	RESISTOR MODULE	E	GEAR SWITCH	B
76	DK BLUE/RED	18	RESISTOR MODULE	F	GEAR SWITCH	A
77	RED	16	FUSE HOLDER (20 AMP)	-	20 AMP CIRCUIT BREAKER	-
78	ORANGE/GREEN	18	STARTER DIODE	.180M	START SOLENOID	2
79	BROWN	18	BRAKE PRESSURE SWITCH	-	BROWN SPLICE	-
80	VIOLET/WHITE	18	DASH HARNESS	B4	FUEL PUMP	B
81	RED/BLACK	16	POWER RELAY	87	RED/BLACK SPLICE	-
82	RED	12	FUSE HOLDER (20 AMP)	-	FUSIBLE LINK (SPLICE)	-
83	BROWN/RED	18	GEAR SWITCH	C	BROWN/RED SPLICE	-
84	ORANGE/WHITE	16	DASH HARNESS	B2	ACC STUD	#10R
85	RED/WHITE	18	FAN RELAY	85	RED/WHITE SPLICE	-
86	ORANGE	16	FUSE HOLDER (20 AMP)	-	DASH HARNESS	B6
87	BROWN/WHITE	18	DASH HARNESS	B1	HUB COIL	2
88	ORANGE/BLACK	16	FAN MOTOR	B	FAN RELAY	87
89	GRAY	18	HUB COIL	1	DASH HARNESS	A3
90	WHITE/RED	18	DASH HARNESS	A4	START SOLENOID	1
91	BROWN/RED	16	GROUND STUD	#10R	BROWN/RED SPLICE	-
92	BROWN	16	DASH HARNESS	A6	GROUND STUD	#10R
93	SHIELD/4	FCAB202-030 (4)	SPLICE #2	-	SPLICE #4	-
94	BROWN	14	FRAME GROUND	1/4R	GROUND STUD	#10R
95	BROWN	20	DIAGNOSTIC	D	DIAGNOSTIC SPLICE	-
96	YELLOW	18	VOLTAGE REGULATOR	.180M	DASH HARNESS	B7
97	RED/WHITE	18	REAR DIFF SOLENOID RELAY	30	RED/WHITE SPLICE	-
98	BROWN	18	REAR DIFF SOLENOID RELAY	85	BROWN SPLICE	-
100	WHITE	18	WHITE SPLICE	-	RESISTOR MODULE	A
101	RED	16	20 AMP CIRCUIT BREAKER	-	FAN RELAY	30
102	RED	14	VOLTAGE REGULATOR #2	A	18/14 SPLICE	-
103	RED	14	VOLTAGE REGULATOR #2	B	18/14 SPLICE	-
104	BLUE	0.8	18/14 SPLICE	-	B+ STUD	#10R
105	BLUE	0.8	18/14 SPLICE	-	B+ STUD	#10R
106	BROWN	14	VOLTAGE REGULATOR #2	D	GROUND STUD	#10R
107	RED/WHITE	18	RED/WHITE SPLICE	-	POWER RELAY	85
108	ORANGE	16	FUSE HOLDER (15 AMP)	-	POWER RELAY	30
109	RED/WHITE	16	FUSE HOLDER (20 AMP)	-	RED/WHITE SPLICE	-
110	ORANGE/RED	18	PARK BRAKE SWITCH	A	ORANGE/RED SPLICE	-
111	ORANGE/WHITE	16	12V RECEPTACLE	.188F	ACC STUD	#10R
112	BROWN	16	12V RECEPTACLE	.250F	GROUND STUD	#10R
113	ORANGE	18	BRAKE PRESSURE SWITCH	-	ORANGE SPLICE	-
114	ORANGE	20	DASH HARNESS	B9	ORANGE SPLICE	-

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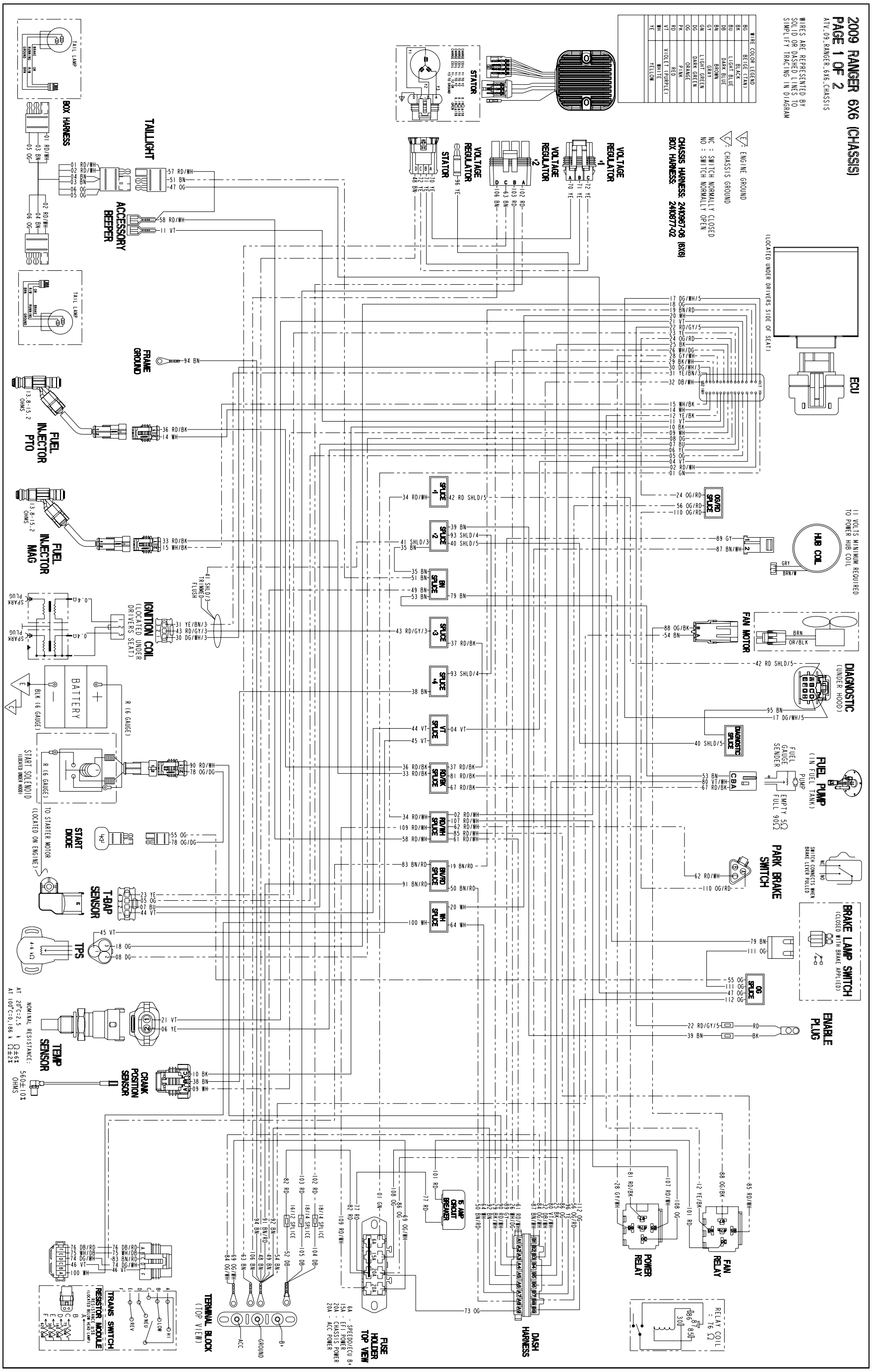

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WIRE TERMINATION TABLE

CCT #	COLOR	GAUGE	FROM CONNECTOR	CAVITY	TO CONNECTOR	CAVITY
01	LT GREEN	20	ECU	1	FUSE HOLDER 16 AMP)	-
02	RED/WHITE	20	ECU	2	WHITE/RED SPLICE	-
03	-	-	-	-	-	-
04	VIOLET	20	ECU	4	VIOLET SPLICE	-
05	ORANGE	20	ECU	5	T-BAP SENSOR	3
06	YELLOW	20	ECU	6	TEMP SENSOR	2
07	LT BLUE	20	ECU	7	T-BAP SENSOR	2
08	DK GREEN	20	ECU	8	TPS	A
09	WHITE	FCAB202-030 (4)	ECU	9	CPS	A
10	BLACK	FCAB202-030 (4)	ECU	10	ACCESSORY	4
11	YELLOW/BLACK	18	ECU	11	ACCESSORY BEEPER	.250F
12	-	20	ECU	12	FAN RELAY	86
13	-	-	-	-	-	-
14	WHITE	18	ECU	14	PTO FUEL INJECTOR	2
15	WHITE/BLACK	18	ECU	15	MAG FUEL INJECTOR	2
17	GREEN/WHITE/5	FCAB204-035 (5)	ECU	17	DIAGNOSTIC	C
18	ORANGE	20	ECU	18	TPS	3
19	BROWN/RED	20	ECU	19	BROWN/RED SPLICE	-
20	VIOLET	20	ECU	20	WHITE SPLICE	-
21	VIOLET	20	ECU	21	KNARR PLUG	-
22	RED/GRAY/5	FCAB204-035 (5)	ECU	22	KNARL PLUG	-
23	YELLOW	20	ECU	23	T-BAP SENSOR	4
24	ORANGE/RED	20	ECU	24	ORANGE/RED SPLICE	-
25	BLACK	20	ECU	25	DASH HARNESS	B
26	WHITE/DK GREEN	18	ECU	26	DASH HARNESS	A
28	GRAY/WHITE	20	ECU	28	POWER RELAY	87
29	BLACK/WHITE	20	ECU	29	DASH HARNESS	A
30	YELLOW/BROWN/3	FCAB204-035 (3)	ECU	30	IGNITION COIL	-
31	GREEN/BROWN/3	FCAB204-035 (3)	ECU	31	IGNITION COIL	-
32	DK BLUE/WHITE	FCAB204-035 (3)	ECU	32	DASH HARNESS	B
33	RED/BLACK	18	MAG FUEL INJECTOR	1	RED/BLACK SPLICE	-
34	RED/WHITE	20	SPLICE #1	-	WHITE/RED SPLICE	-
35	BROWN	20	SPLICE #2	-	BROWN SPLICE	-
36	RED/BLACK	18	PTO FUEL INJECTOR	1	RED/BLACK SPLICE	-
37	RED/BLACK	18	SPLICE #3	-	RED/BLACK SPLICE	-
38	BROWN	20	SPLICE #4	-	SPLICE #2	B
39	BROWN	20	KNARL PLUG	-	SPLICE #2	I
40	SHIELD/5	FCAB204-035 (5)	SPLICE #2	-	DIAGNOSTIC SPLICE	-
41	SHIELD/3	FCAB204-035 (3)	SPLICE #2	-	IGNITION COIL (TRIM)	-
42	RED/5	FCAB204-035 (5)	SPLICE #1	-	DIAGNOSTIC	A
43	RED/GRAY/3	FCAB204-035 (3)	SPLICE #3	-	IGNITION COIL	2
44	VIOLET	20	VIOLET SPLICE	-	T-BAP SENSOR	I
45	VIOLET	20	VIOLET SPLICE	-	TPS	I
46	VIOLET	18	GEAR SWITCH	E	RESISTOR MODULE	C
47	ORANGE	18	ORANGE SPLICE	D	TAILLIGHT	.180M
48	BROWN	16	GROUND STUD	#10R	GROUND STUD	#10R
49	BROWN	18	BROWN/RED SPLICE	-	BROWN SPLICE	A
50	BROWN/RED	18	TAILLIGHT	.180M	DASH HARNESS	A
51	BROWN	18	16/12 SPLICE	-	BROWN SPLICE	-
52	BLUE	1.0	FUEL PUMP	-	B+ STUD	#10R
53	BROWN	18	GROUND STUD	#10R	FAN MOTOR	A
54	BROWN	16	STARTER DIODE	.180F	ORANGE SPLICE	-
55	ORANGE/RED	18	DASH HARNESS	.180F	ORANGE/RED SPLICE	-
56	ORANGE/RED	18	TAILLIGHT	.180F	ORANGE/RED SPLICE	.250F
57	YELLOW	14	VOLTAGE REGULATOR #1	C	STATOR	C
58	RED/WHITE	18	ACCESSORY BEEPER	.250F	WHITE/RED SPLICE	-
61	RED/WHITE	16	DASH HARNESS	A1	WHITE/RED SPLICE	-
62	RED/WHITE	18	RED/WHITE SPLICE	-	PARK BRAKE SWITCH	C
63	BROWN	14	VOLTAGE REGULATOR #2	C	GROUND STUD	#10R
64	WHITE	18	DASH HARNESS	A7	WHITE SPLICE	-
65	-	-	-	-	-	-
66	-	-	-	-	-	-
67	RED/BLACK	18	FUEL PUMP	A	RED/BLACK SPLICE	-
69	ORANGE/WHITE	18	FUSE HOLDER (20 AMP)	A	ACCESSORY	#10R
70	YELLOW	14	VOLTAGE REGULATOR #1	B	STATOR	A
71	YELLOW	14	VOLTAGE REGULATOR #1	B	STATOR	B
72	YELLOW	14	VOLTAGE REGULATOR #1	C	STATOR	C
73	ORANGE	16	FUSE HOLDER (20 AMP)	-	DASH HARNESS	A
74	DK GREEN/WHITE	18	RESISTOR MODULE	D	GEAR SWITCH	D
75	WHITE/DK BLUE	18	RESISTOR MODULE	F	GEAR SWITCH	B
76	DK BLUE/RED	18	RESISTOR MODULE	E	GEAR SWITCH	A
77	-	-	FUSE HOLDER (20 AMP)	-	20 AMP CIRCUIT BREAKER	-
78	ORANGE/DK GREEN	18	FUSE HOLDER (20 AMP)	.180M	START SOLENOID	2
79	BROWN	18	BRAKE PRESSURE SWITCH	-	BROWN SPLICE	-
80	VIOLET/WHITE	18	DASH HARNESS	B4	FUEL PUMP	B
81	RED/BLACK	16	POWER RELAY	87	RED/BLACK SPLICE	-
82	RED	12	FUSE HOLDER (20 AMP)	-	FUSTBLE LINK (SPLICE)	-
83	BROWN/RED	18	GEAR SWITCH	C	BROWN/RED SPLICE	-
84	ORANGE/WHITE	16	DASH HARNESS	B2	ACCESSORY	#10R
85	RED/WHITE	18	FAN RELAY	85	WHITE/RED SPLICE	-
86	ORANGE	18	FUSE HOLDER (20 AMP)	B1	DASH HARNESS	2
87	BROWN/WHITE	18	DASH HARNESS	B1	HUB COIL	2
88	ORANGE/BLACK	16	FAN MOTOR	B	FAN RELAY	87
89	GRAY	18	HUB COIL	I	DASH HARNESS	A
90	WHITE/RED	18	DASH HARNESS	A4	START SOLENOID	I
91	BROWN/RED	16	GROUND STUD	#10R	BROWN/RED SPLICE	-
92	BROWN	16	DASH HARNESS	A6	GROUND STUD	#10R
93	SHIELD/4	FCAB202-030 (4)	SPLICE #4	-	SPLICE #4	#10R
94	BROWN	14	FLAMEOUT	I/4R	DIAGNOSTIC STUD	#10R
95	BROWN	18	DIAGNOSTIC	D	DIAGNOSTIC SPLICE	-
96	YELLOW	18	VOLTAGE REGULATOR	.180M	DASH HARNESS	B
97	-	-	-	-	-	-
98	-	-	-	-	-	-
100	WHITE	18	WHITE SPLICE	-	RESISTOR MODULE	A
101	RED	16	20 AMP CIRCUIT BREAKER	-	FAN RELAY	30
102	RED	14	VOLTAGE REGULATOR #2	A	18/14 SPLICE	-
103	RED	14	VOLTAGE REGULATOR #2	B	18/14 SPLICE	-
104	BLUE	0.8	18/14 SPLICE	-	B+ STUD	#10R
105	BLUE	0.8	18/14 SPLICE	-	B+ STUD	#10R
106	BROWN	14	VOLTAGE REGULATOR #2	D	GROUND STUD	#10R
107	RED/WHITE	18	WHITE/RED SPLICE	-	POWER RELAY	85
108	ORANGE	16	FUSE HOLDER (15 AMP)	-	POWER RELAY	30
109	RED/WHITE	16	FUSE HOLDER (20 AMP)	-	WHITE/RED SPLICE	-
110	ORANGE/RED	18	PARK BRAKE SWITCH	A	ORANGE/RED SPLICE	-
111	ORANGE	18	BRAKE PRESSURE SWITCH	B9	ORANGE SPLICE	-
112	ORANGE	20	DASH HARNESS	-	ORANGE SPLICE	-

2009 RANGER 6X6 (CHASSIS)
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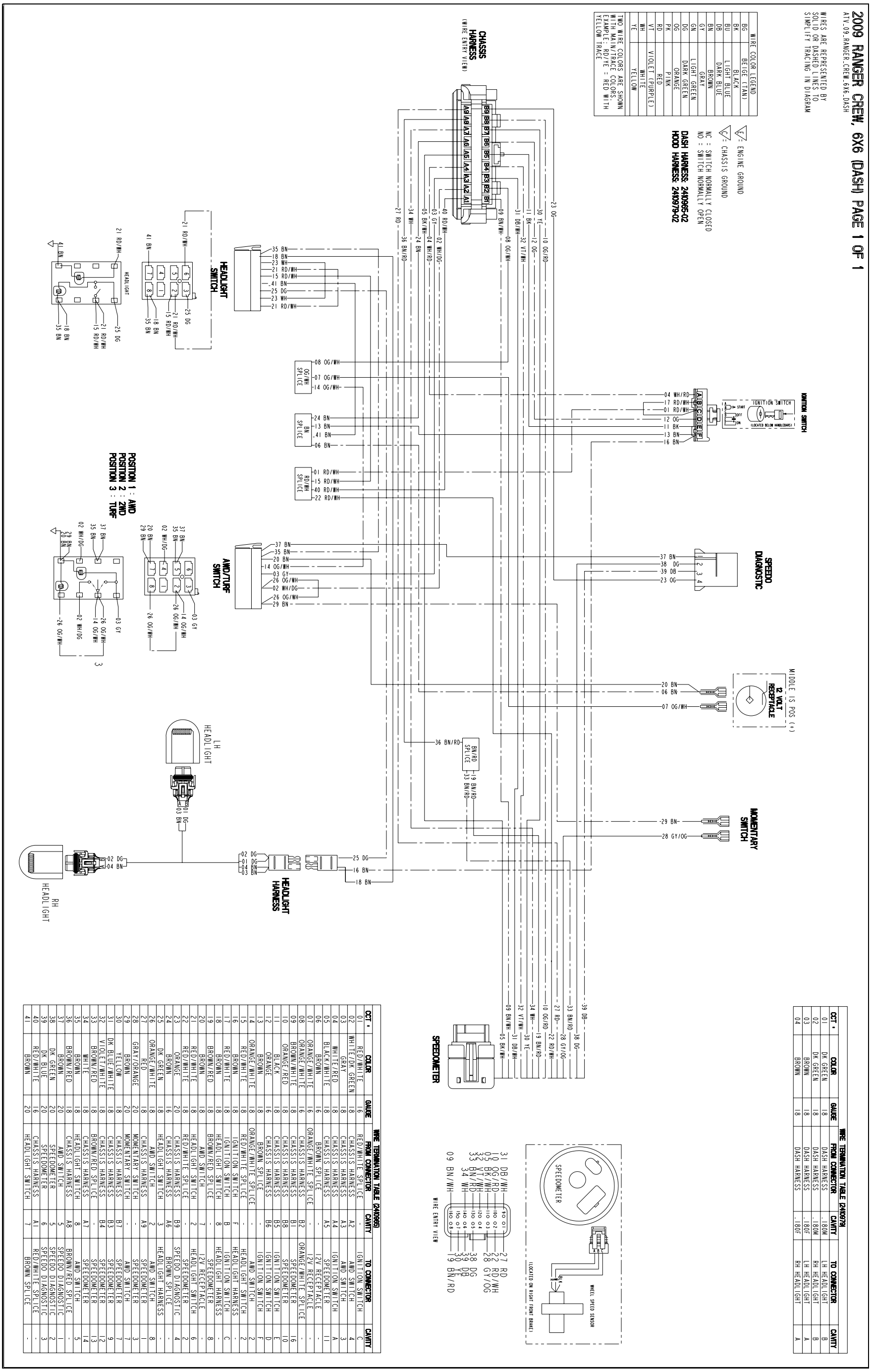
ATV_09_RANGER_6X6_CHASSIS

2009 *RANGER* 700 4X4 CREW / 6X6 (DASH)



WIRE TERMINATION TABLE (2410979)

CCT #	COLOR	GAUGE	FROM CONNECTOR	CAVITY	TO CONNECTOR	CAVITY
01	DK GREEN	18	DASH HARNESS	.180M	LH HEADLIGHT	B
02	DK GREEN	18	DASH HARNESS	.180M	RH HEADLIGHT	B
03	BROWN	18	DASH HARNESS	.180F	LH HEADLIGHT	A
04	BROWN	18	DASH HARNESS	.180F	RH HEADLIGHT	A

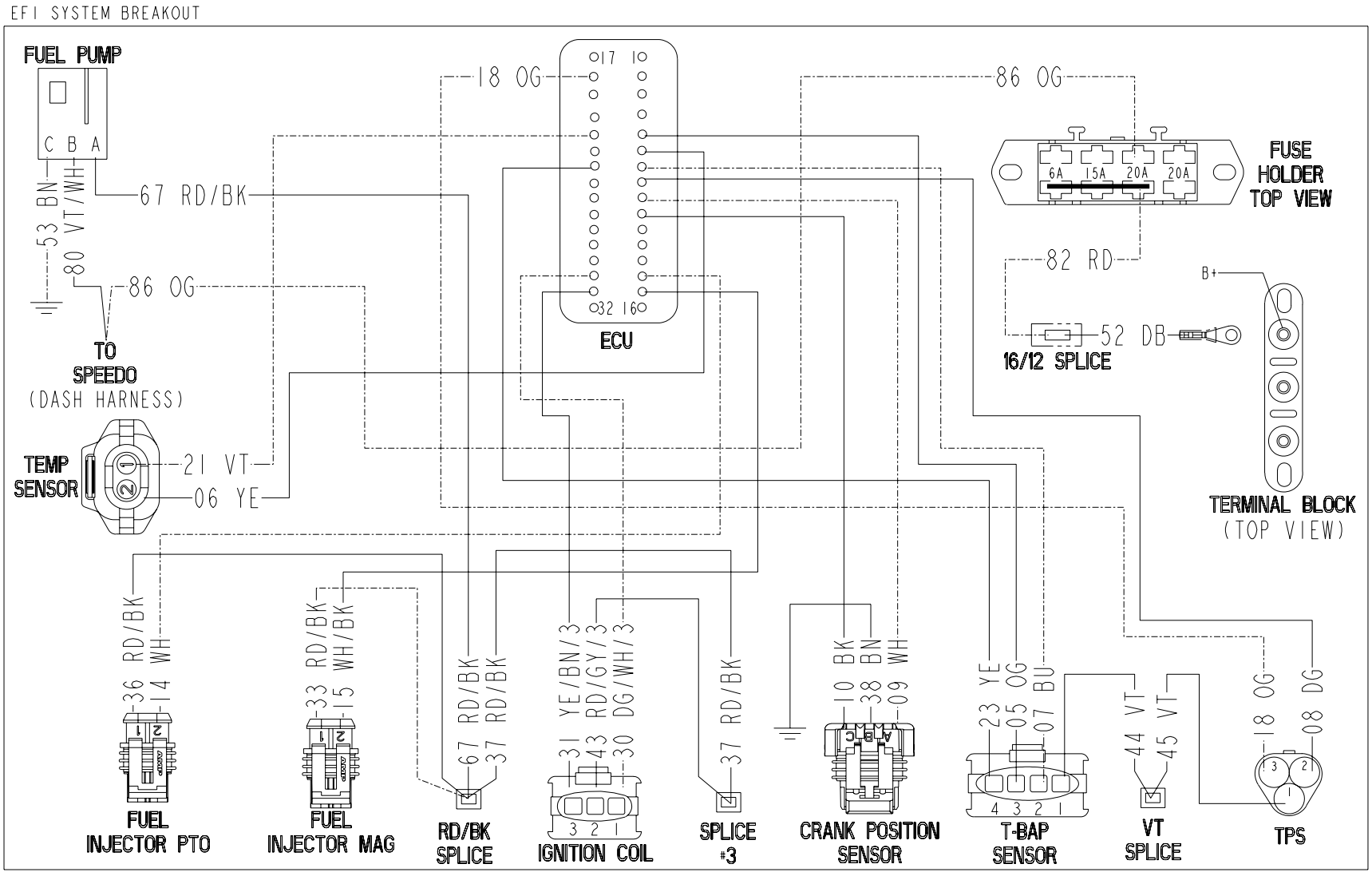
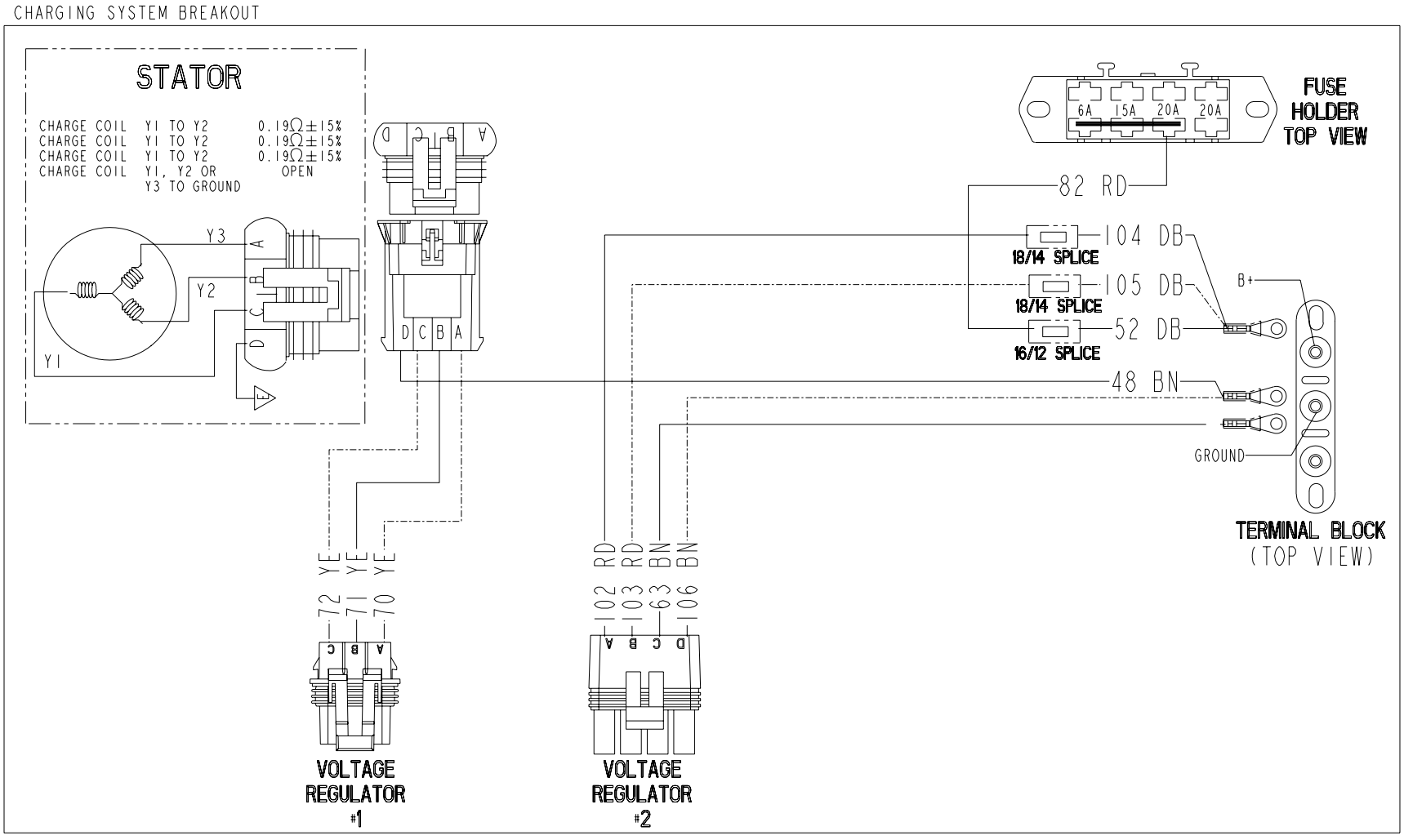
WIRE TERMINATION TABLE (2410965)

CCT #	COLOR	GAUGE	FROM CONNECTOR	CAVITY	TO CONNECTOR	CAVITY
01	RED/WHITE	16	RED/WHITE SPLICE	-	IGNITION SWITCH	C
02	WHITE/DK GREEN	18	CHASSIS HARNESS	A2	AWD SWITCH	4
03	GRAY	18	CHASSIS HARNESS	A3	AWD SWITCH	3
04	WHITE/RED	18	CHASSIS HARNESS	A4	IGNITION SWITCH	A
05	BLACK/WHITE	18	CHASSIS HARNESS	A5	SPEEDOMETER	11
06	BROWN	16	BROWN SPLICE	-	12V RECEPTACLE	-
07	ORANGE/WHITE	16	ORANGE/WHITE SPLICE	-	12V RECEPTACLE	-
08	ORANGE/WHITE	16	CHASSIS HARNESS	B2	ORANGE/WHITE SPLICE	-
09	BROWN/WHITE	18	CHASSIS HARNESS	B1	SPEEDOMETER	16
10	ORANGE/RED	18	CHASSIS HARNESS	B8	SPEEDOMETER	10
11	BLACK	18	CHASSIS HARNESS	B5	IGNITION SWITCH	E
12	ORANGE	16	CHASSIS HARNESS	B6	IGNITION SWITCH	D
13	BROWN	18	BROWN SPLICE	-	IGNITION SWITCH	F
14	ORANGE/WHITE	18	ORANGE/WHITE SPLICE	-	AWD SWITCH	2
15	RED/WHITE	18	RED/WHITE SPLICE	-	HEADLIGHT SWITCH	2
16	BROWN	18	IGNITION SWITCH	F	HEADLIGHT HARNESS	-
17	RED/WHITE	18	IGNITION SWITCH	B	IGNITION SWITCH	C
18	BROWN	18	HEADLIGHT SWITCH	8	HEADLIGHT HARNESS	-
19	BROWN/RED	18	BROWN/RED SPLICE	-	SPEEDOMETER	8
20	BROWN	18	AWD SWITCH	7	12V RECEPTACLE	-
21	RED/WHITE	18	HEADLIGHT SWITCH	2	HEADLIGHT SWITCH	6
22	RED/WHITE	18	RED/WHITE SPLICE	-	SPEEDOMETER	2
23	ORANGE	20	CHASSIS HARNESS	B9	SPEEDO DIAGNOSTIC	4
24	BROWN	16	CHASSIS HARNESS	A6	BROWN SPLICE	-
25	DK GREEN	18	HEADLIGHT SWITCH	3	HEADLIGHT HARNESS	-
26	ORANGE/WHITE	18	AWD SWITCH	2	AWD SWITCH	8
27	RED	18	CHASSIS HARNESS	A9	SPEEDOMETER	1
28	GRAY/ORANGE	20	MOMENTARY SWITCH	-	SPEEDOMETER	3
29	BROWN	20	MOMENTARY SWITCH	-	AWD SWITCH	7
30	YELLOW	18	CHASSIS HARNESS	B7	SPEEDOMETER	7
31	DK BLUE/WHITE	18	CHASSIS HARNESS	B3	SPEEDOMETER	9
32	VIOLET/WHITE	18	CHASSIS HARNESS	B4	SPEEDOMETER	12
33	BROWN/RED	18	BROWN/RED SPLICE	-	SPEEDOMETER	13
34	WHITE	18	CHASSIS HARNESS	A7	SPEEDOMETER	14
35	BROWN	18	HEADLIGHT SWITCH	8	AWD SWITCH	5
36	BROWN/RED	18	CHASSIS HARNESS	A8	BROWN/RED SPLICE	-
37	BROWN	20	AWD SWITCH	5	SPEEDO DIAGNOSTIC	1
38	DK GREEN	20	SPEEDOMETER	5	SPEEDO DIAGNOSTIC	2
39	DK BLUE	20	SPEEDOMETER	6	SPEEDO DIAGNOSTIC	3
40	RED/WHITE	16	CHASSIS HARNESS	A1	RED/WHITE SPLICE	-
41	BROWN	20	HEADLIGHT SWITCH	7	BROWN SPLICE	-

2009 *RANGER* 700 4X4 CREW / 6X6 (BREAKOUTS)

2009 RANGER 4X4 CREW / 6X6 BREAKOUTS

EFI SYSTEM BREAKOUT



CHARGING SYSTEM BREAKOUT