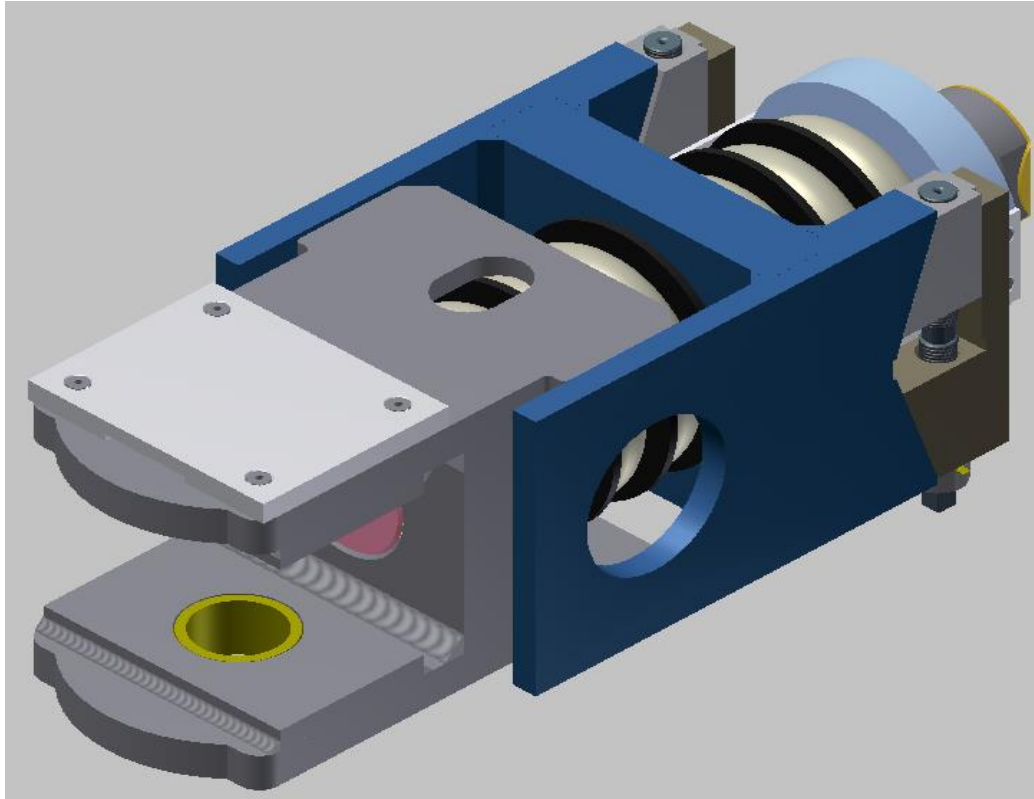
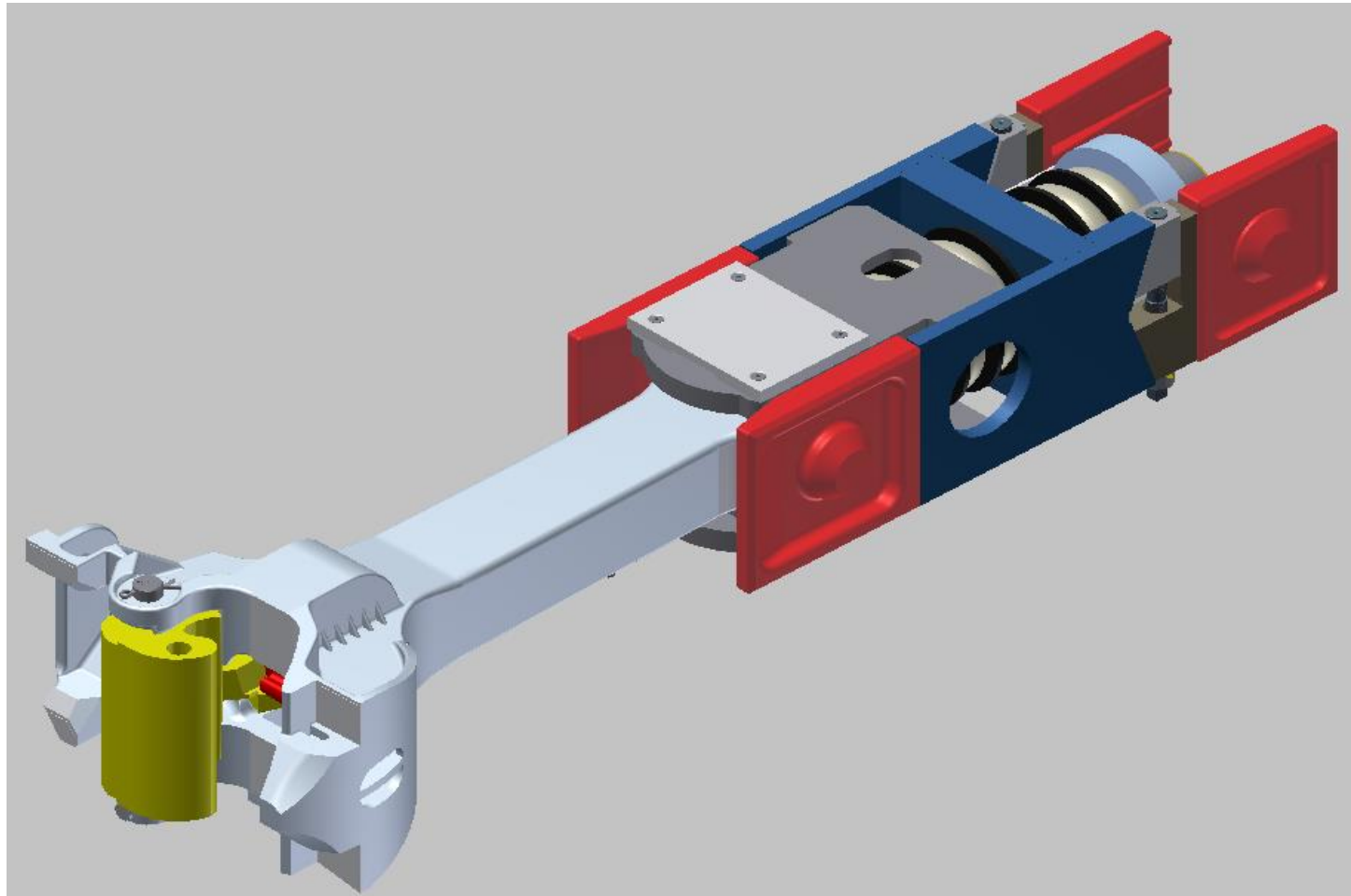


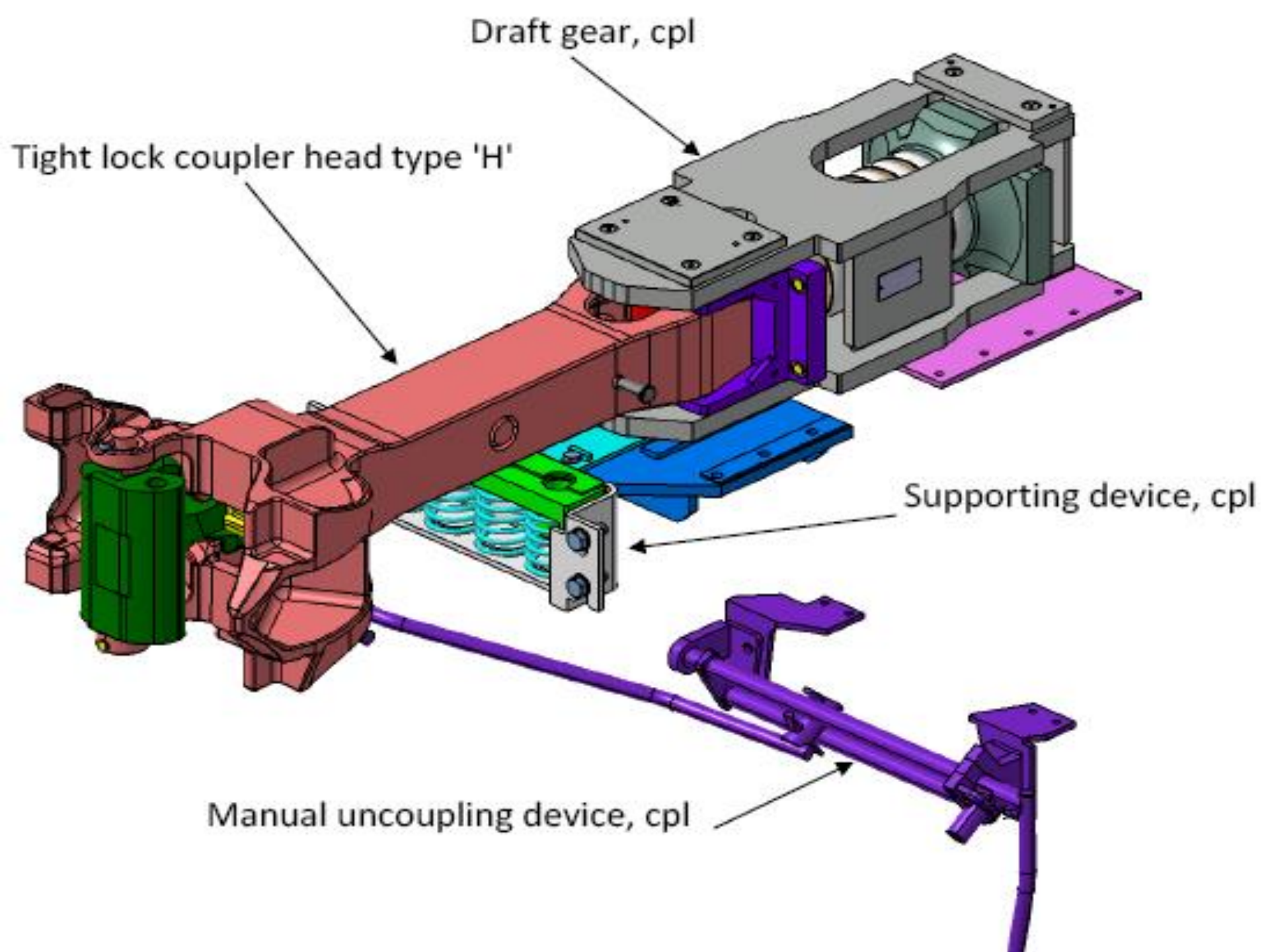
# BALANCED DRAFT GEAR

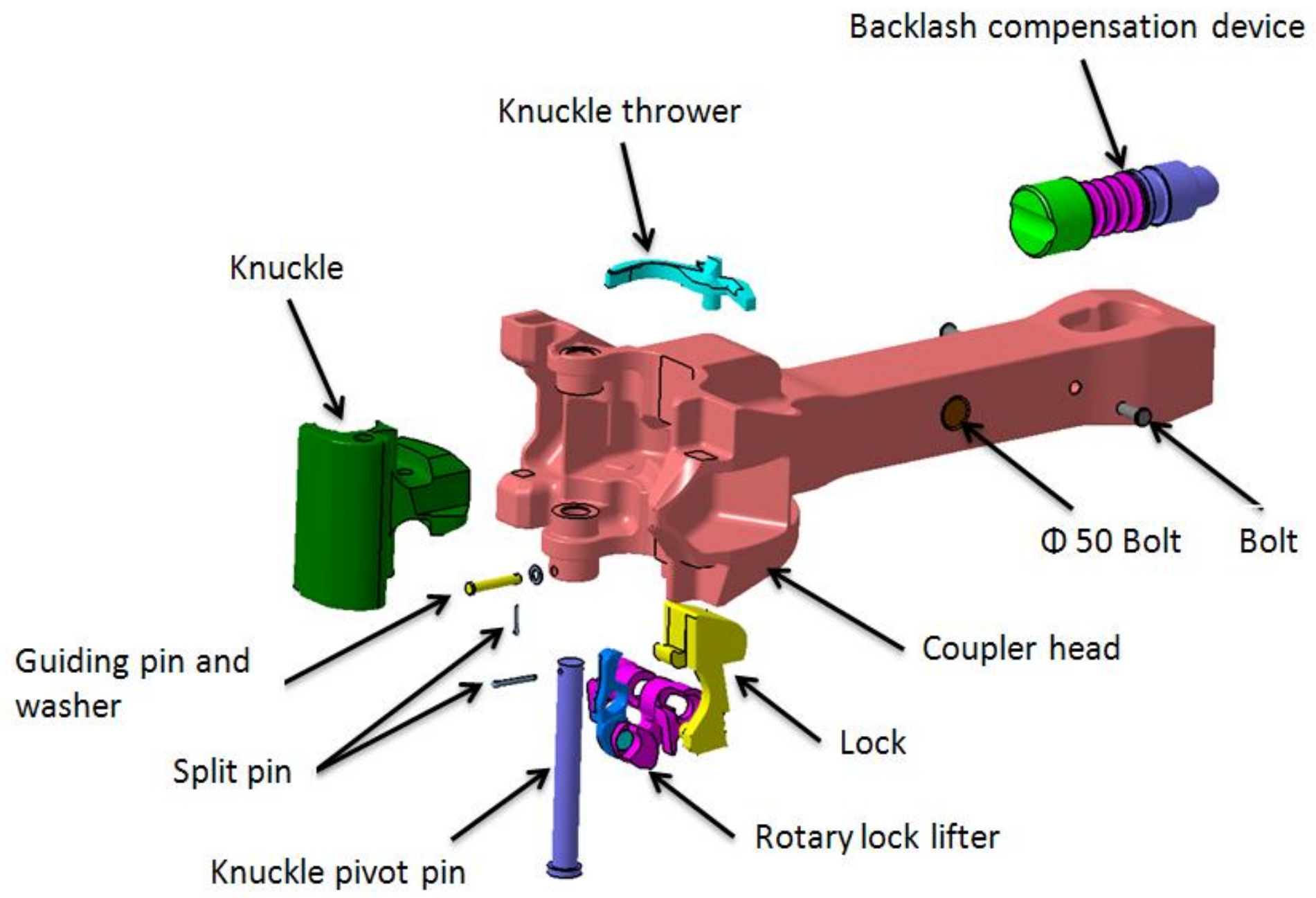


Rajendra Kushwaha  
Inst./C&W

# AAR H coupler with BDG

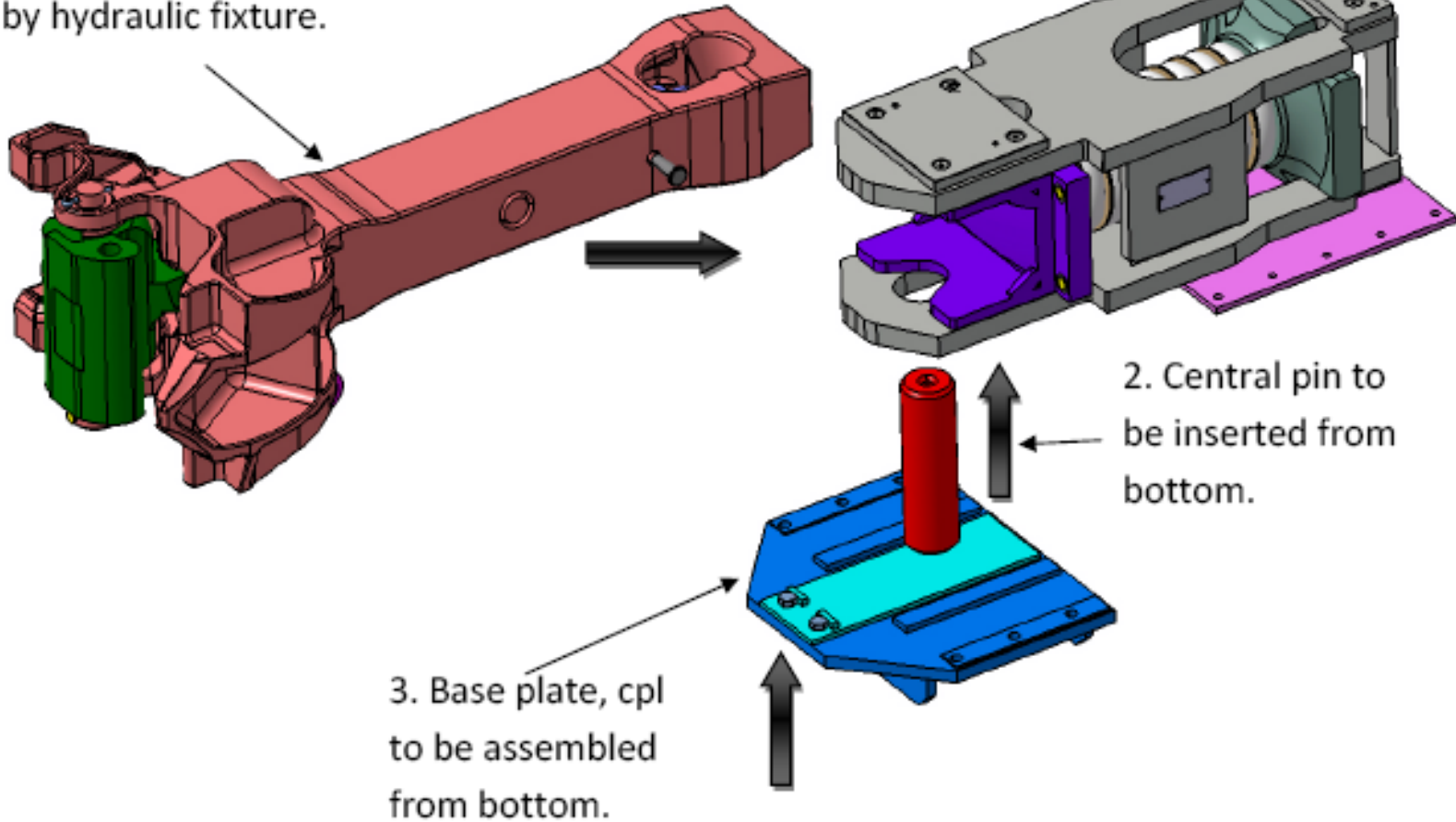








1. Support coupler head by hydraulic fixture.



## Mounting of the Coupler head

- **IR introduced High Tensile AAR ‘H’ type Tight Lock Centre Buffer Coupler on passenger coaches with the view to have longer train rakes, higher speed and safety features.**
- **AAR ‘H’ type Centre Buffer Coupler (CBC) was first time used in 24 imported Alstom /LHB coaches.**
- **The trains fitted with these couplers, when put in service, “Jerks” were observed.**
- **The AAR H coupler has been supplied by FTIL and Escorts which are fitted std Draft Gear, all were observed to have Jerks.**

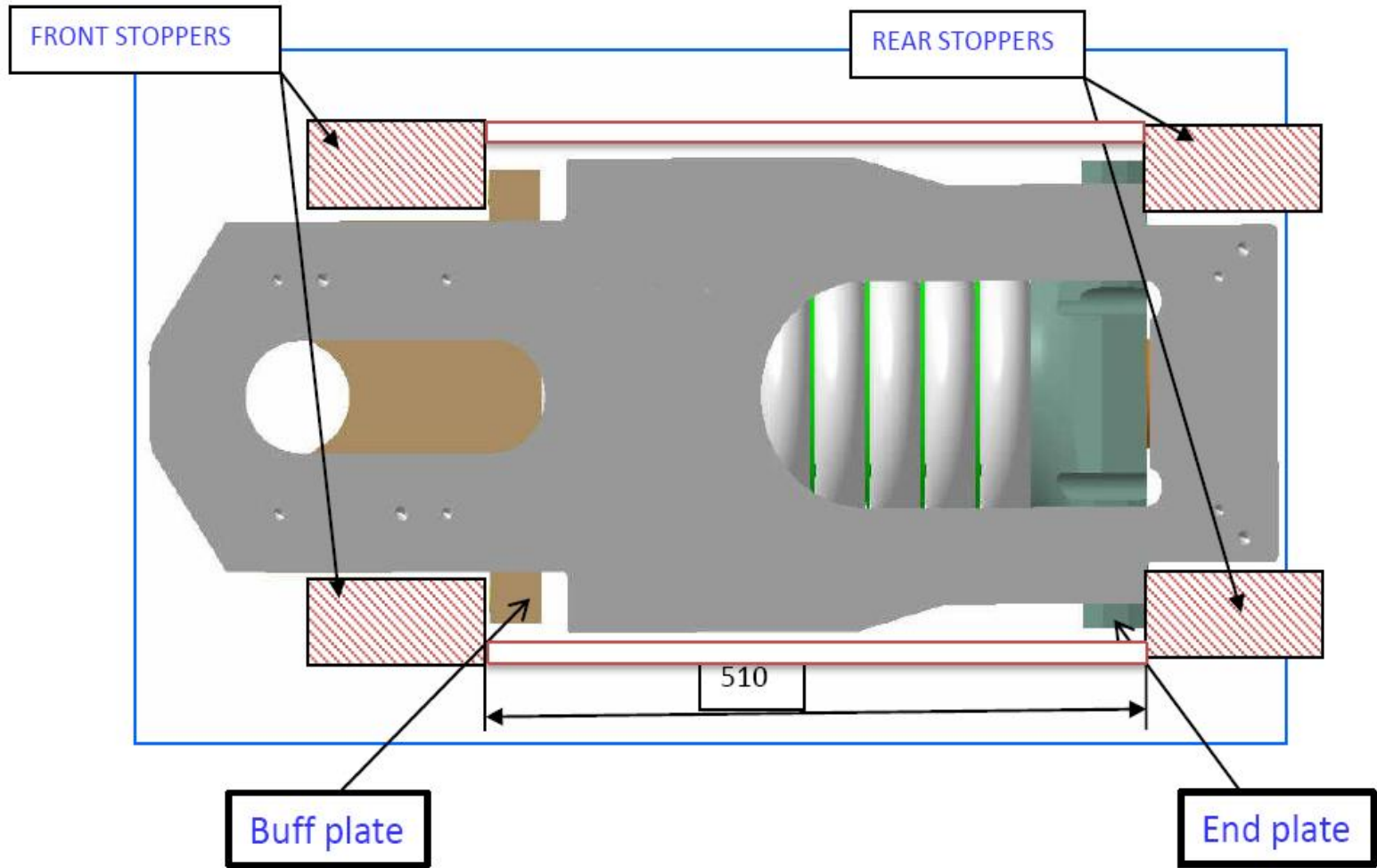
- Longitudinal jerks in mainline coaches equipped with CBC have been a major concern since introduction of CBC.
- Several measures were taken in the past to reduce the longitudinal jerks but they resulted in minor improvements only.

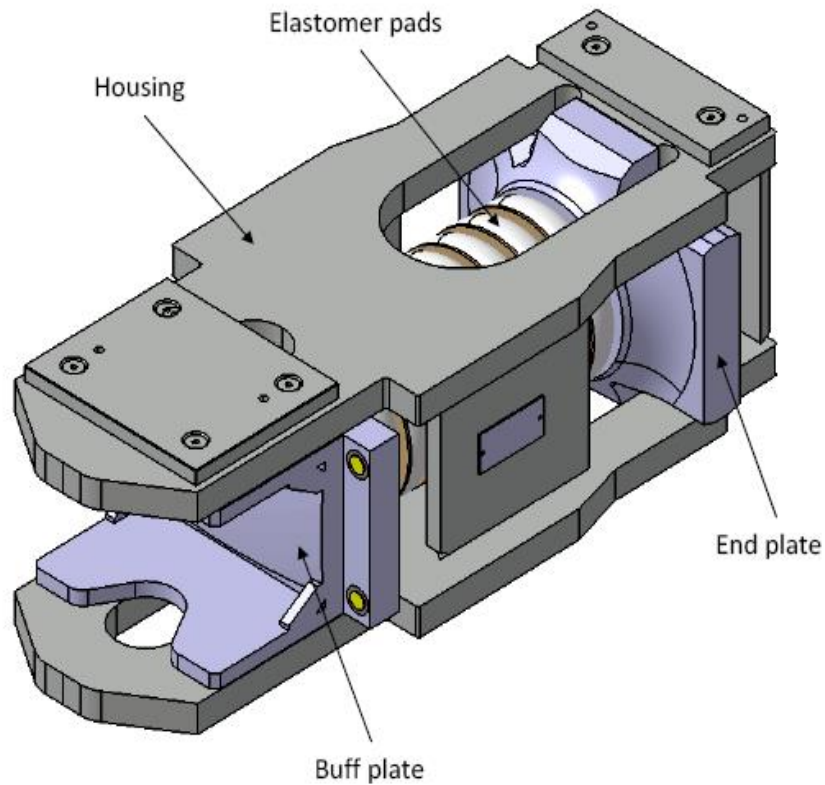
- The specification of CBC CK-009 (Rev.2) does not specify the type of draft gear. Suppliers are free to supply any type of draft gear such as single pack, twin pack, floating plate or any other design-
- On the basis of a systematic study of design of CBC, a new specification of CBC has been made. In the new specification, **balanced type draft gear** has been specified.

The couplers to this new specification have been mostly supplied to IR by M/s Faiveley, M/s ASF-Keystone and M/s Escorts.

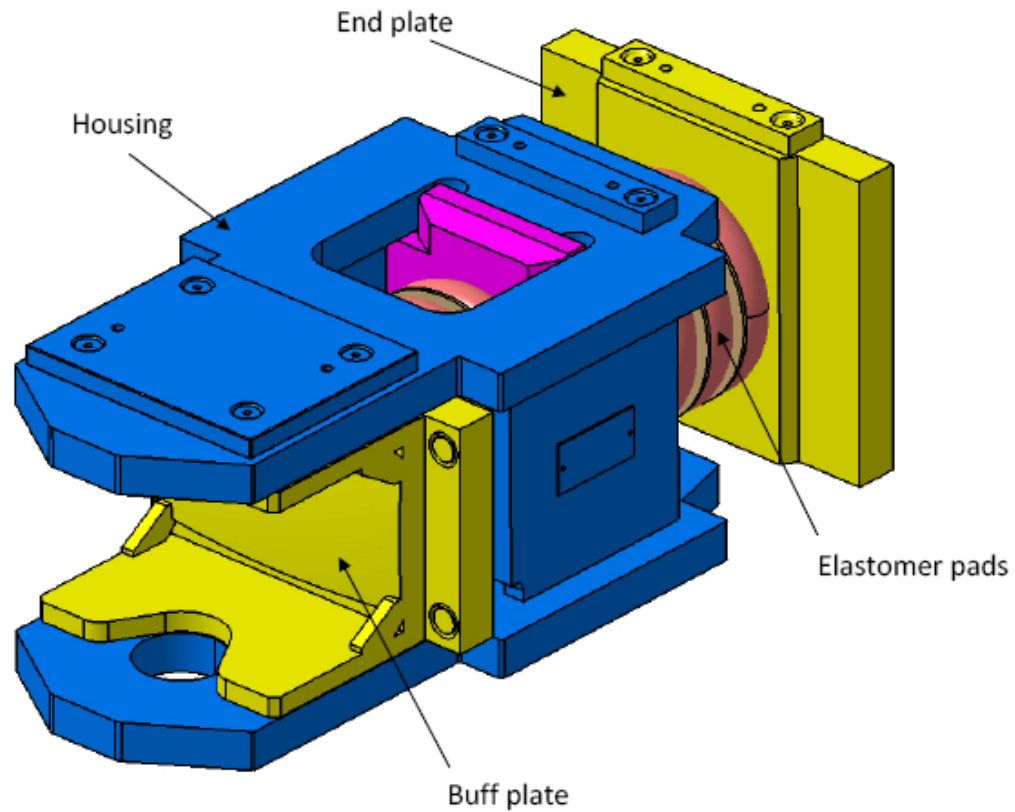
Type of draft gear	Population (Coach sets)	Service Since
Single pack	2560	Year 2001
Twin pack	325	Year 2004
Floating Plate	30	February 2010
Balanced type	22	February 2011







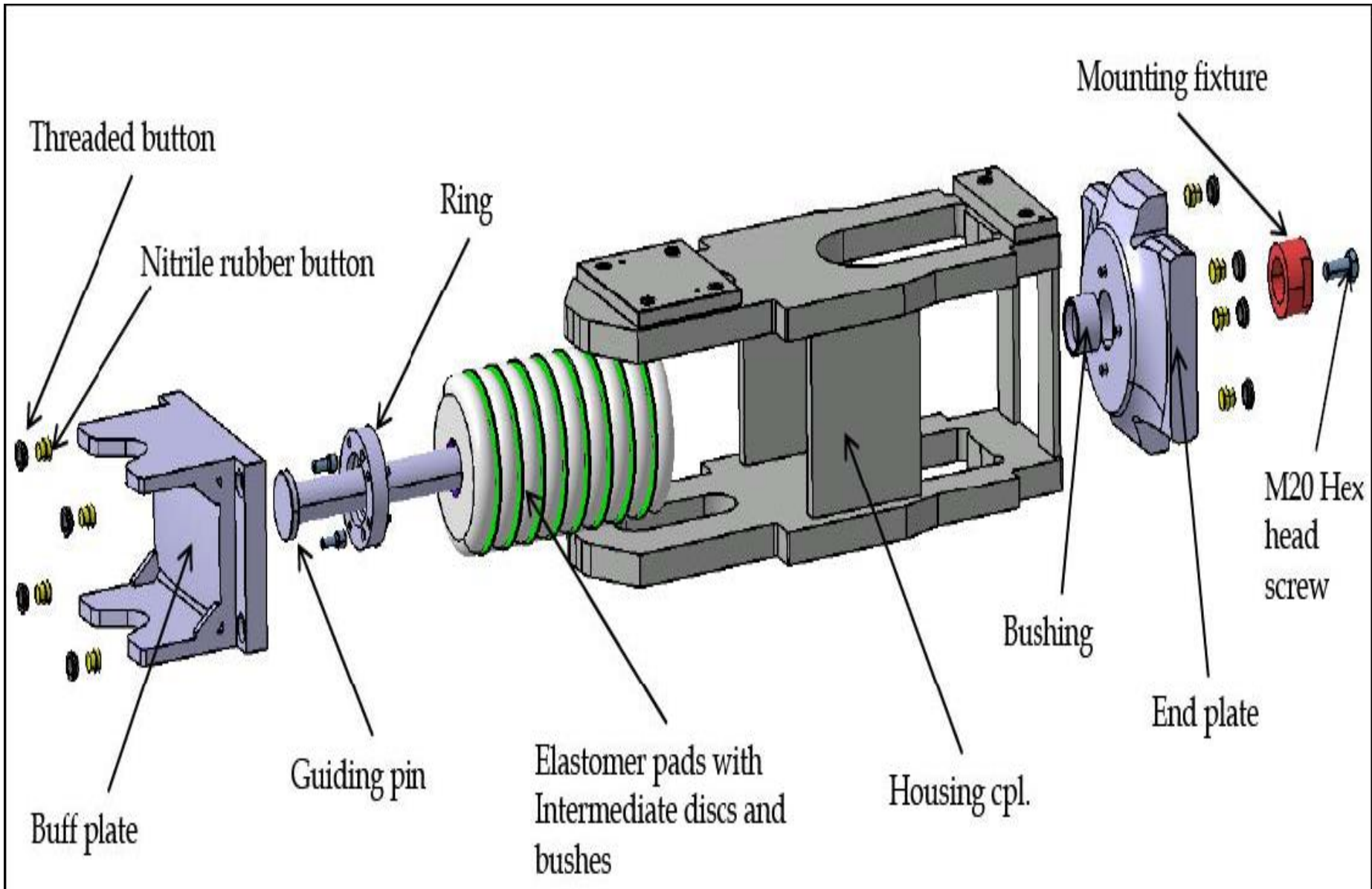
Draft gear, cpl



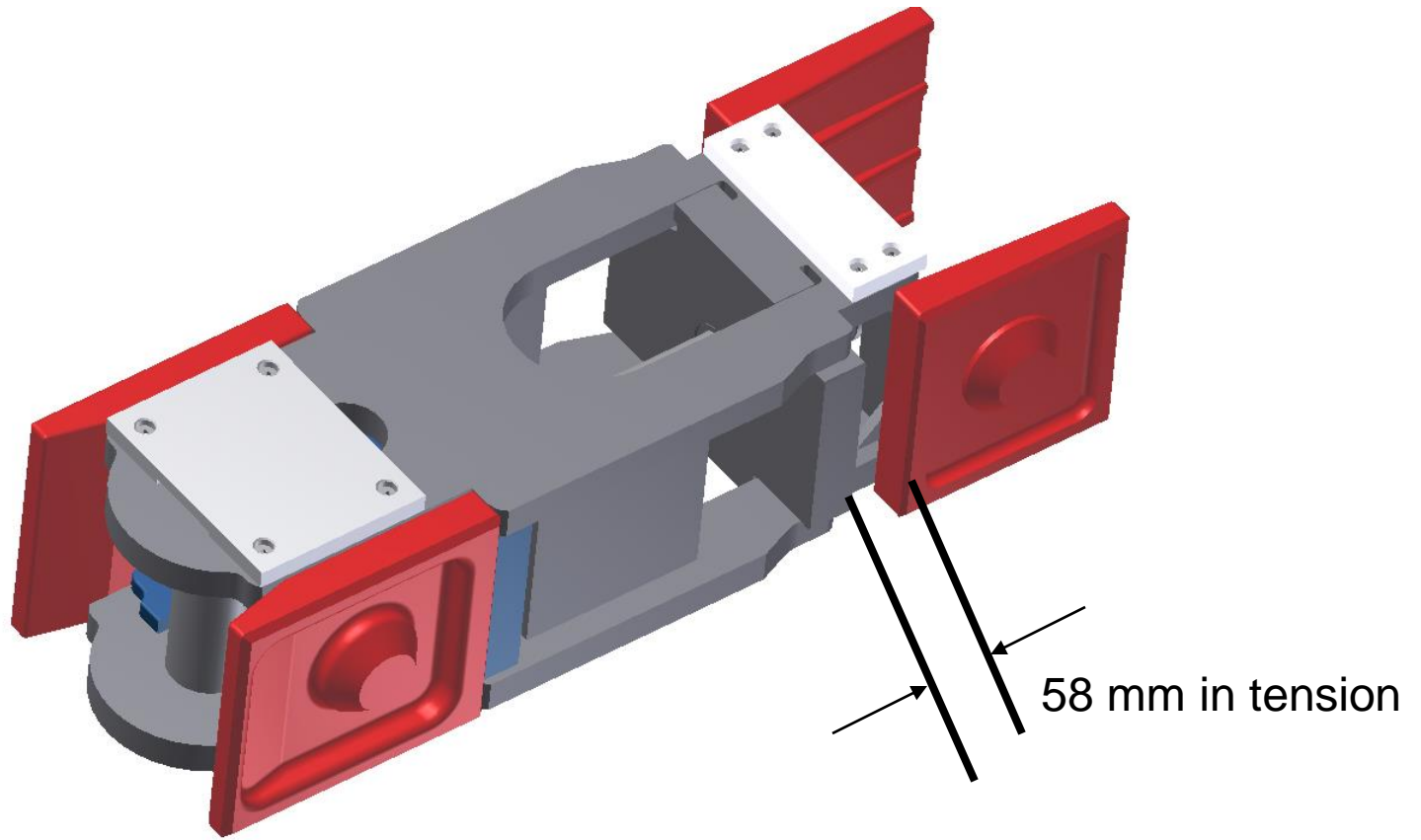
Draft Gear, cpl. with Floating plate, Type BC 80/45F

# • **Single Pack Draft Gear**

- In this type of draft gear, same set of draft pads is used in buff as well as in draw mode.
- In dynamic condition, the front follower leaves the front stopper during buff and the rear followers leaves the rear stopper during draw modes and hits them on load reversal.

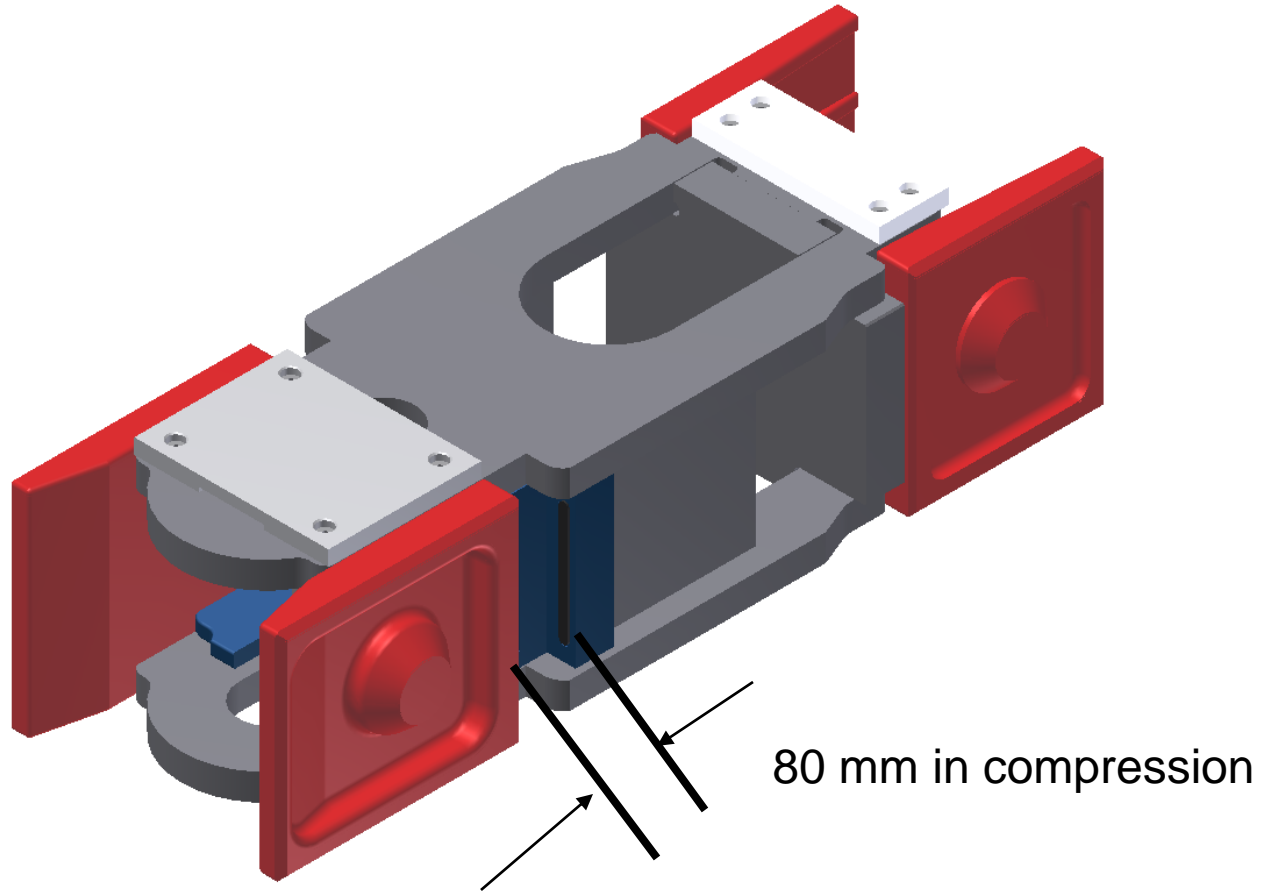


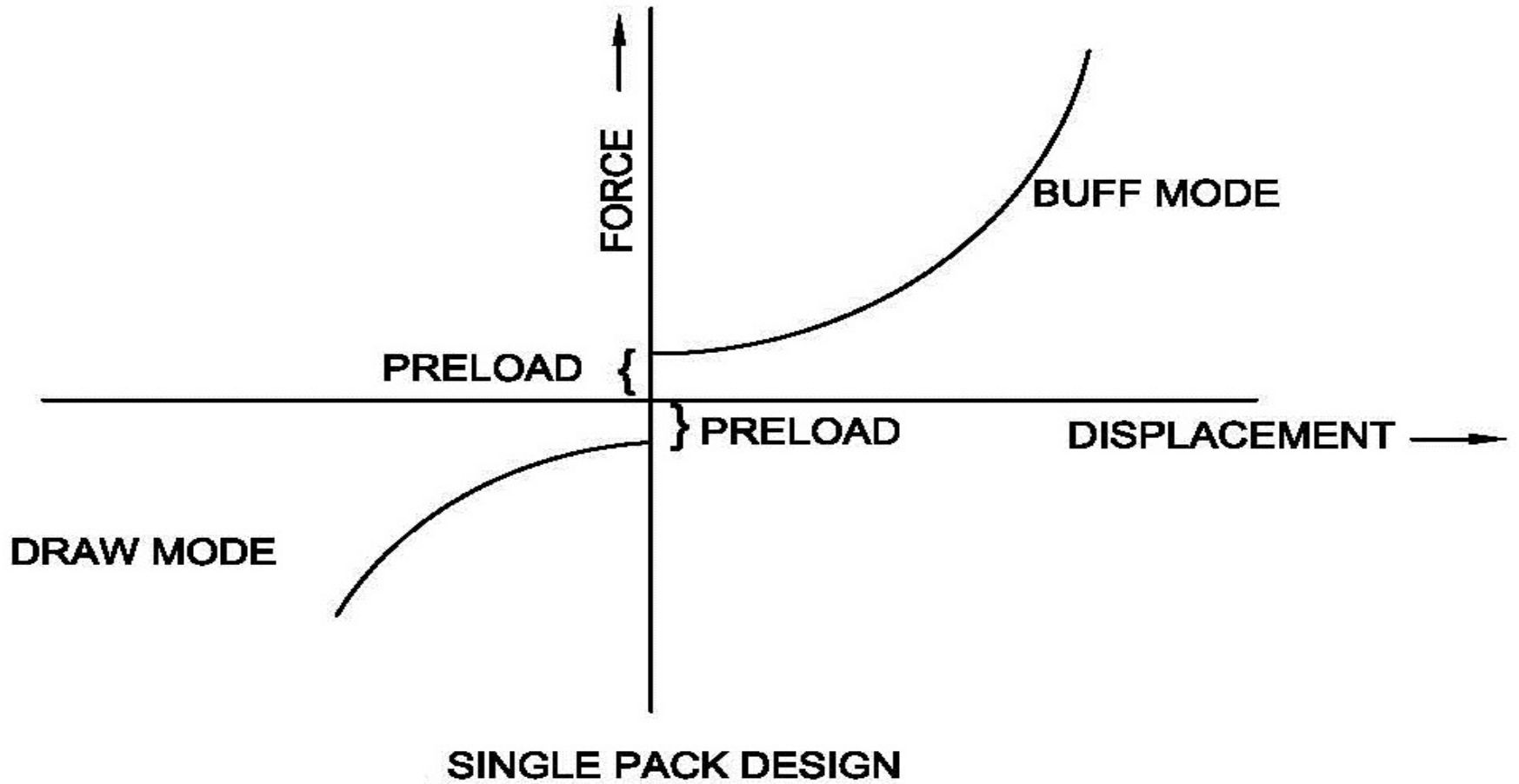
# STANDARD DRAFT GEAR IN TENSILE MODE





# STANDARD DRAFT GEAR IN COMPRESSION MODE





**Travel Characteristics of Single Pack Draft Gear**

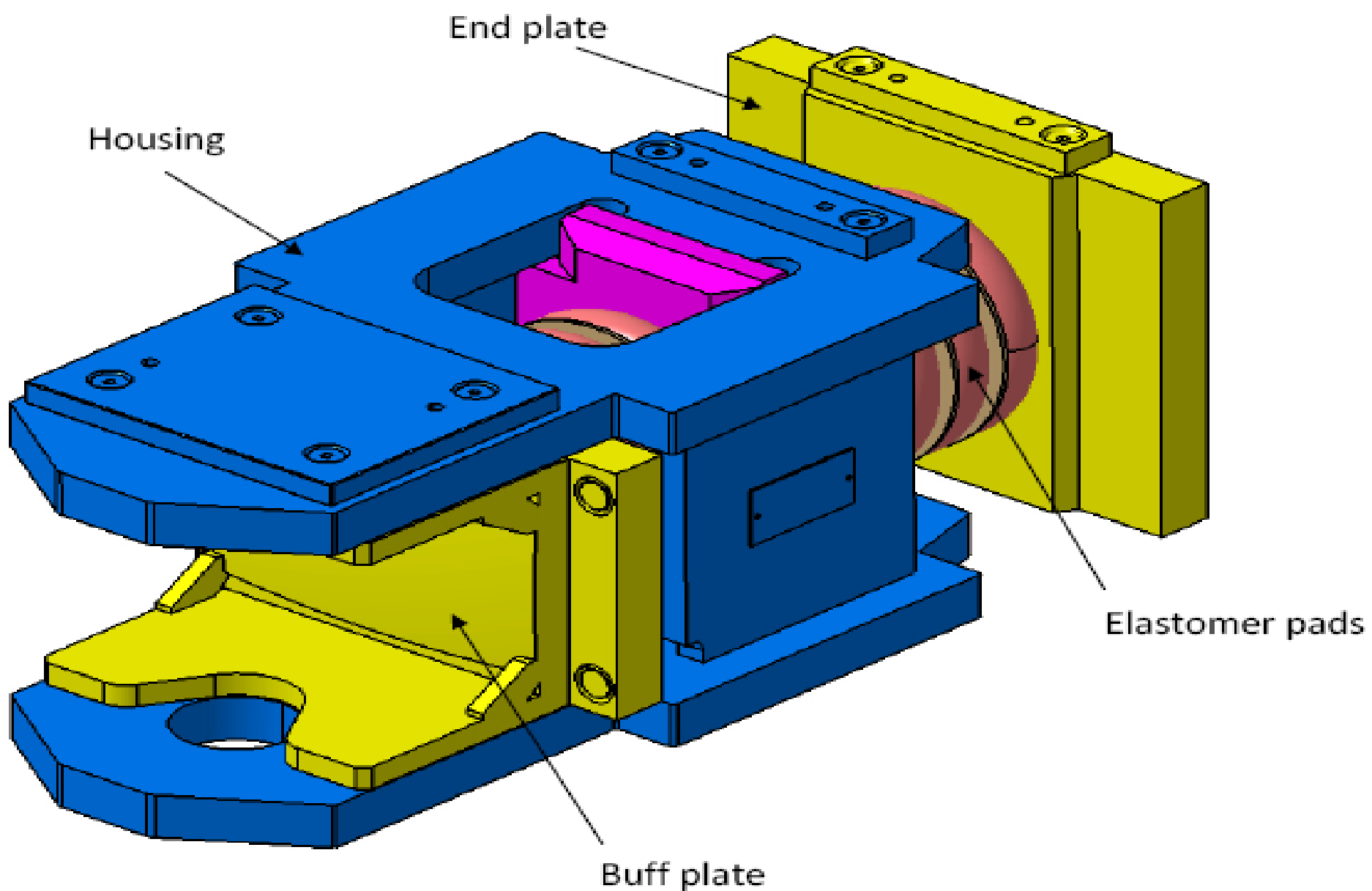
# Floating Plate or Twin Pack Draft Gear

Floating plate or twin pack draft gear has similar cushioning arrangement.

In floating plate or twin pack draft gear, the problem of rear follower plate striking the rear stopper has been addressed by dividing the draft pads into two parts by a floating plate and using this floating plate for the purpose of transmitting force in draw mode. In draw mode, only draft pads between floating plates and front follower is compressed whereas in buff mode, all the draft pads are used to take buff load. It has zero preload in draw mode.

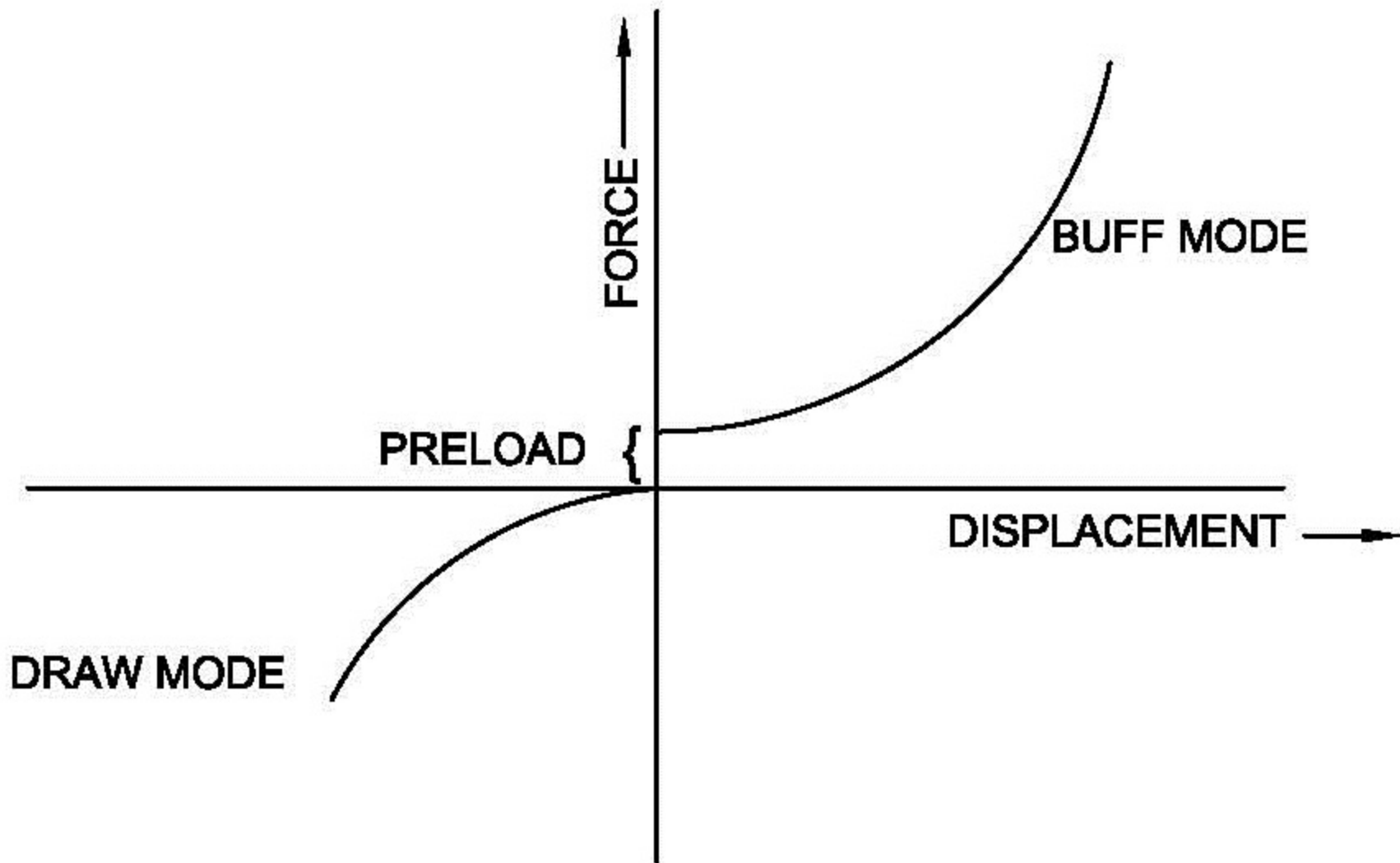
However, in buff mode, this type of draft gear behaves in a way similar to single pack draft gear.

In dynamic condition, the front follower leaves the front stopper and hits it on load reversal. Also, preload in the buff mode adversely affects the longitudinal dynamics of a train.



Draft Gear, cpl. with Floating plate, Type BC 80/45F





TWIN PACK AND FLOATING PLATE TYPE DESIGN

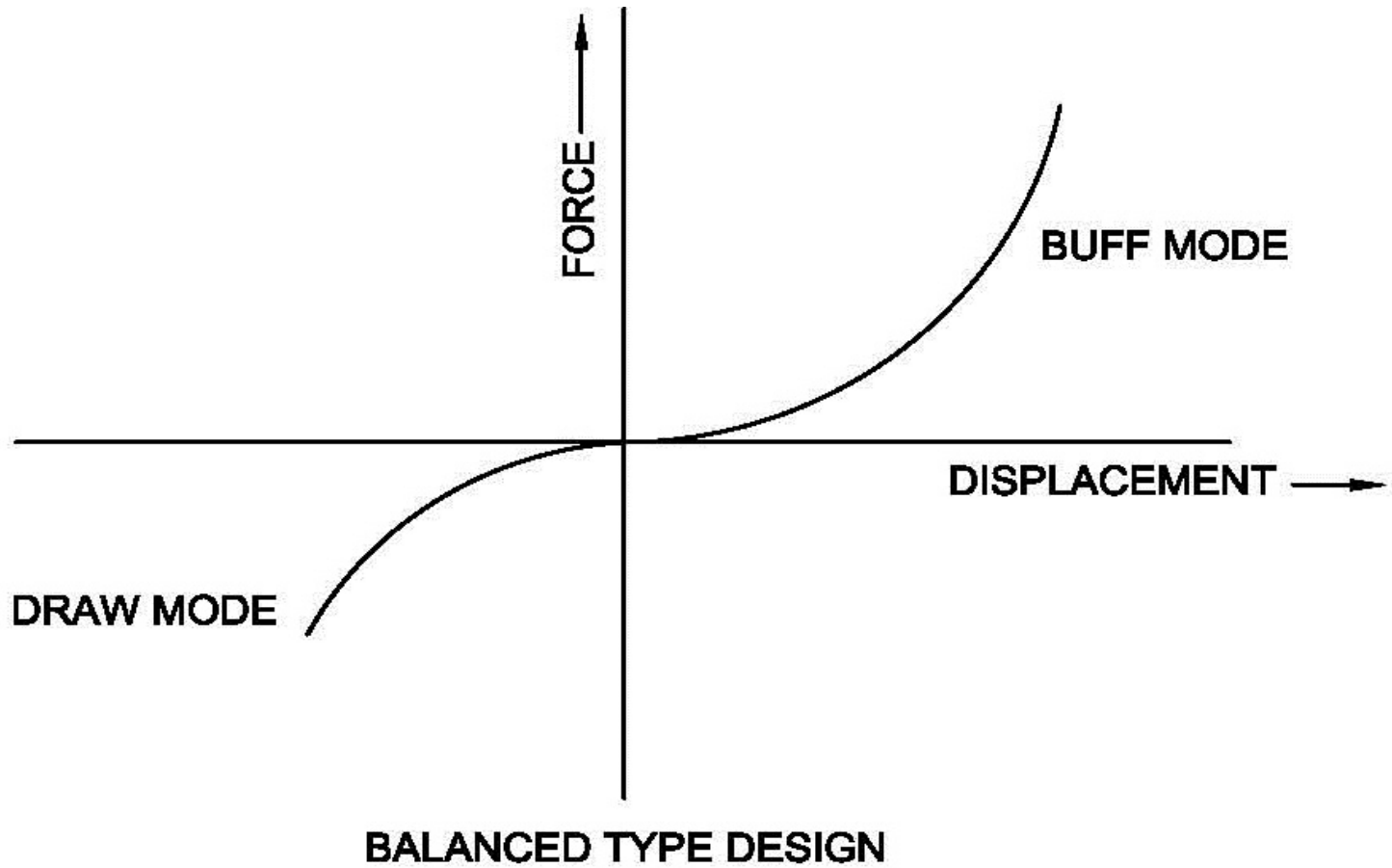
# Balanced Type Draft Gear

Balanced type draft gear overcomes all the problems mentioned in the above sections.

The draft gear is fixed between the front and rear stopper and no relative movement between the draft gear frames and these stoppers is possible.

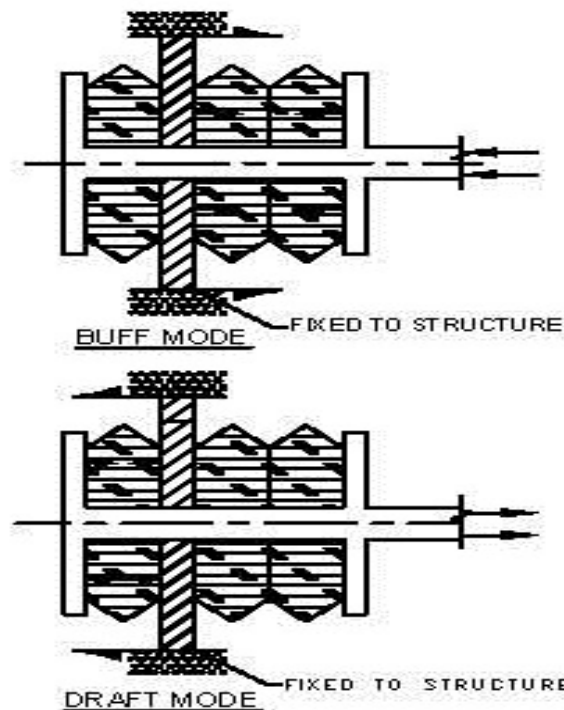
There is no situation of front follower leaving the front stopper and rear follower leaving the rear stopper and hitting them on load reversal.

- Apart from this, the following diagram of conceptual draft gear characteristics shows that there is no abrupt change in force on load reversal.
- Force travel curves are regular and they are not vertically separated at neutral position.
- It facilitates smooth load reversal.



**Travel Characteristics of Balanced Type Draft Gear**

FORCE FLOW DIAGRAM OF DOUBLE  
ACTING BALANCED DRAFT GEAR

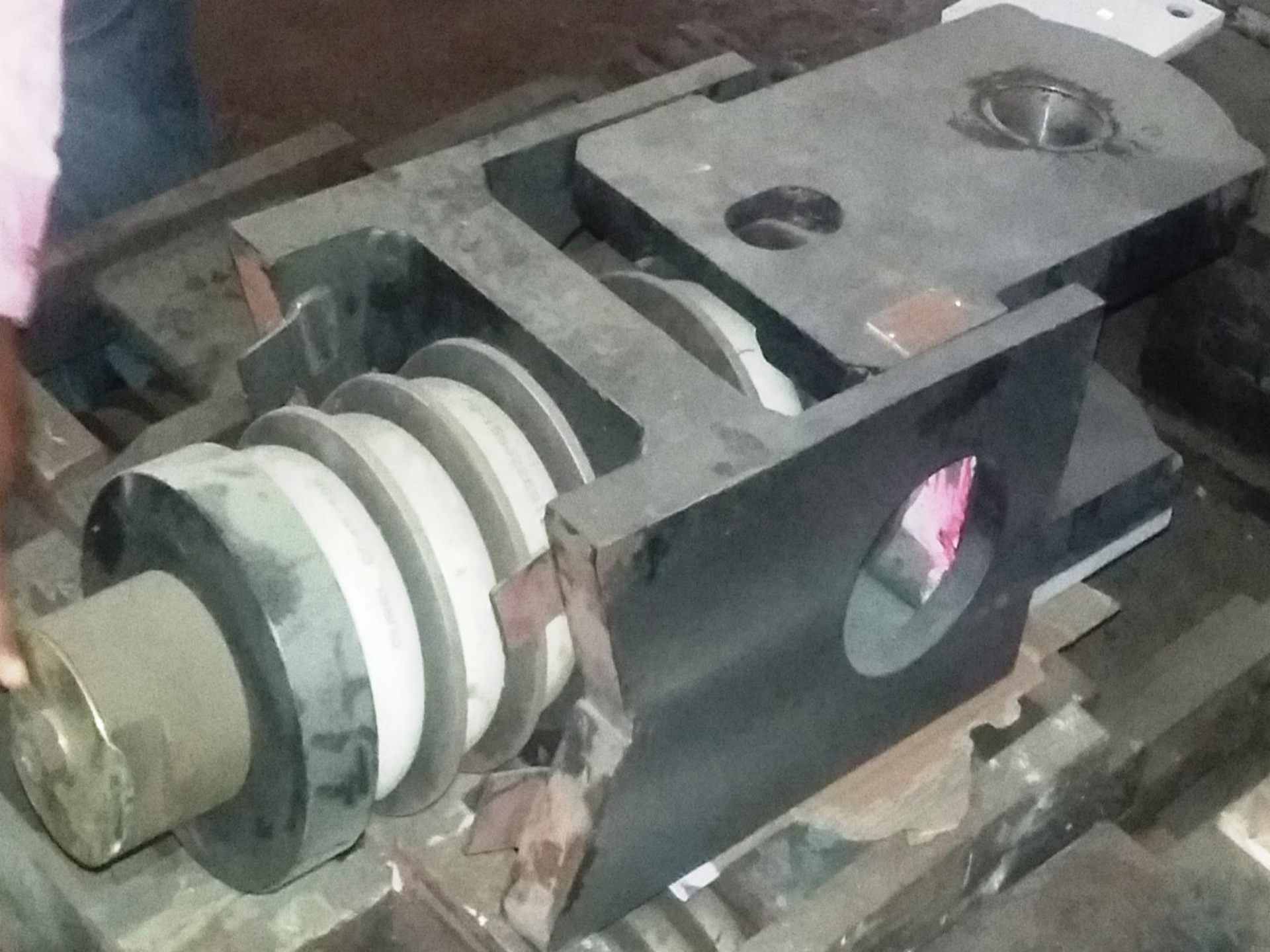


NOTE

1. NO.OF PAD SHOWN IN THE SKETCH IS SYMBOLIC ONLY.
2. DRAFT GEAR ARRANGEMENT SHALL HAVE EFFECTIVE ZERO PRELOAD IN BUFF AS WELL AS DRAFT MODE. IT MEANS THAT FORCE  $\nu$ S DISPLACEMENT CURVE OF DRAFT GEAR CHARACTERISTICS DRAWN FOR QUASISTATIC CONDITION SHALL PASS THROUGH ZERO FORCE AND SHALL HAVE REGULAR CURVE (NOT SEPARATED BY VERTICAL LINE) IN LOAD REVERSAL IN BOTH THE DIRECTIONS i.e.  
 (a) BUFF TO NEUTRAL TO DRAW AND  
 (b) DRAW TO NEUTRAL TO BUFF.

REFERENCE:-	<table border="1"> <tr> <td>①</td> <td>CB/18/11</td> <td>NOTE ADDED.</td> <td>08/11</td> </tr> <tr> <td>ALT.</td> <td>AUTHY</td> <td>DESCRIPTION</td> <td>DATE</td> </tr> </table>	①	CB/18/11	NOTE ADDED.	08/11	ALT.	AUTHY	DESCRIPTION	DATE	FORCE FLOW DIAGRAM OF DOUBLE ACTING BALANCED DRAFT GEAR	
	①	CB/18/11	NOTE ADDED.	08/11							
	ALT.	AUTHY	DESCRIPTION	DATE							
	<table border="1"> <tr> <td colspan="2">SUPERSEDED BY</td> </tr> <tr> <td>SUPERSEDES</td> <td>ALT. NIL</td> </tr> </table>	SUPERSEDED BY		SUPERSEDES	ALT. NIL						
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SUPERSEDES	ALT. NIL										
<table border="1"> <tr> <td>SCALE</td> <td>F</td> </tr> <tr> <td rowspan="4">HTS</td> <td>C</td> </tr> <tr> <td>D</td> <td>SPAwzlh.</td> </tr> <tr> <td>T</td> </tr> <tr> <td>JS</td> <td>CB/10/08</td> </tr> </table>	SCALE	F	HTS	C	D	SPAwzlh.	T	JS	CB/10/08		
SCALE	F										
HTS	C										
	D	SPAwzlh.									
	T										
	JS	CB/10/08									
FILE No.:-	<table border="1"> <tr> <td>BG</td> <td>RDSO (CARRIAGE)</td> <td></td> <td>CG- K8207</td> </tr> </table>	BG	RDSO (CARRIAGE)		CG- K8207						
BG	RDSO (CARRIAGE)		CG- K8207								

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  - (a) BUFF TO NEUTRAL TO DRAW &
  - (b) DRAW TO NEUTRAL TO BUFF.



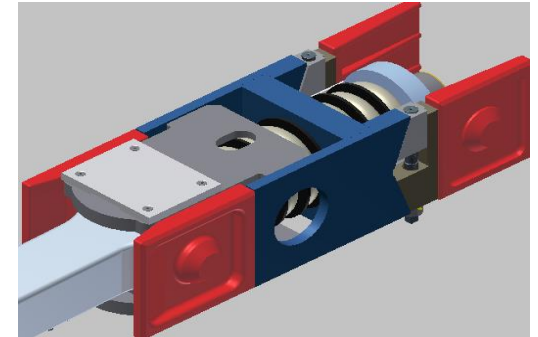






# BDG MAJOR COMPONENTS

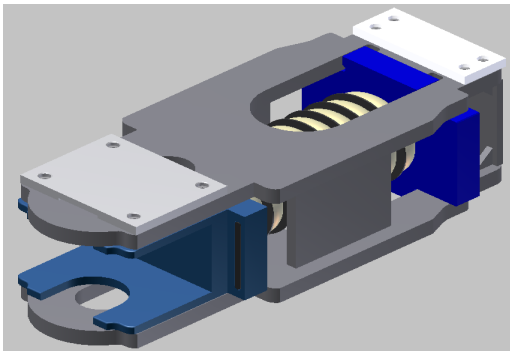
- **Stack of Heavy Duty Elastomeric Pads (Imported) - 04 in compression & 03 in tensile mode.**
- **PA-6 bushes for smooth sliding of intermediate plates & pads over Main bolt.**
- **Fabricated Front Fork & H - Housing.**
- **Main bolt - High toughness, forged.**
- **Adjustable wedges to tighten the BDG assembly with coach under frame.**
- **The fixed plate, a part of H Housing (blue color,) which is tight fitted with coach under frame (red color) between front & rear stoppers with the help of special design wedge key.**



# COMPARISON

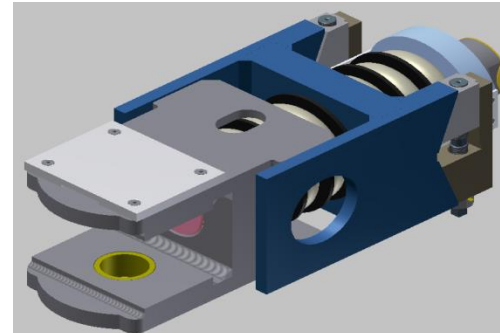
## CONVENTIONAL DRAFT GEAR

- Energy absorption 45 KJ in dynamic testing as per RDSO specification CK 009(Rev.02)
- Single pack of 10 Nos. Elastomeric pads used in buff & tensile loading.
- Life is average due to single pack takes load in both buff & tensile mode.
- Jerks experienced in longitudinal train dynamics.
  
- Escorts drawing No. DG-01-15(Rev.5) for Draft Gear.
- Draft Gear size ( length  $510+0/-5$  \* width 345 \* height 275 mm) is suitable to fit in coach under frame pocket



## BALANCED DRAFT GEAR

- Energy absorption 45 KJ in dynamic testing as per RDSO specification CK 009(Rev.02).
- Two separate packs of Elastomeric pads (4 pads in Buff & 3 pads in tension) have been used.
- Enhanced fatigue life due to separate packs used for buff & tensile loading.
- Jerks totally eliminated in longitudinal train dynamics by enhancing design.
  
- Escorts Drawing No. SK 1550(Rev.8) for Balanced Draft Gear.
- Draft Gear size ( length  $510+0/-5$  \* width 345 \* height 275 mm) is suitable to fit in coach under frame pocket

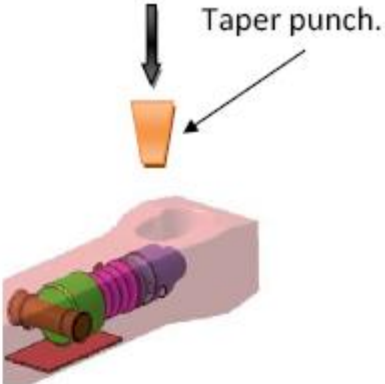
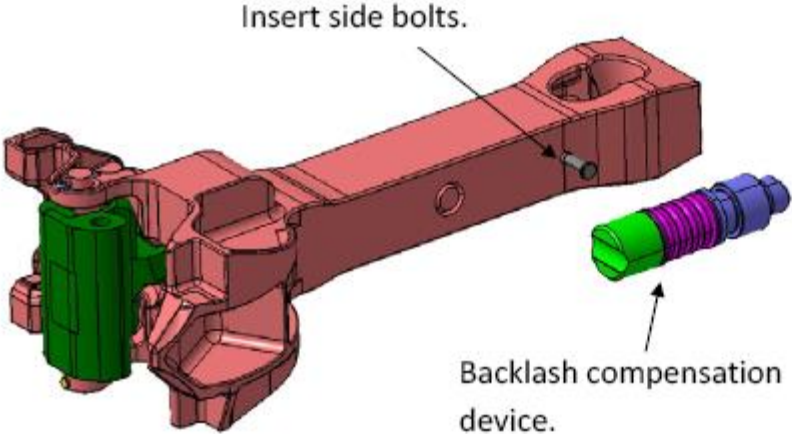


Following are the subjective assessment of relative performance of various types of draft gear

Performance Criteria#	Single Pack Draft Gear	Twin Pack Draft Gear	Balanced Draft Gear
Energy storage Capacity in Draw mode	*****	***	***
Energy storage Capacity in Buff Mode	*****	*****	***
Longitudinal Train Dynamics (Jerk Free)	*	**	*****

# - Higher number of \* means better attributes.

- Stabilizing link in case used with the balanced type of draft gear creates a reverse situation in which draft gear has effectively zero preload but stabilizing link has preload of 25 kN.
- The new specification specifies linking arrangement between coupler and draft gear to overcome this problem. Spherolastic bearing prescribed in the specification meets the functional requirement of articulation. Apart from its role of providing articulation to coupler head, it helps in blocking transmission of vibration and noise to coach body.





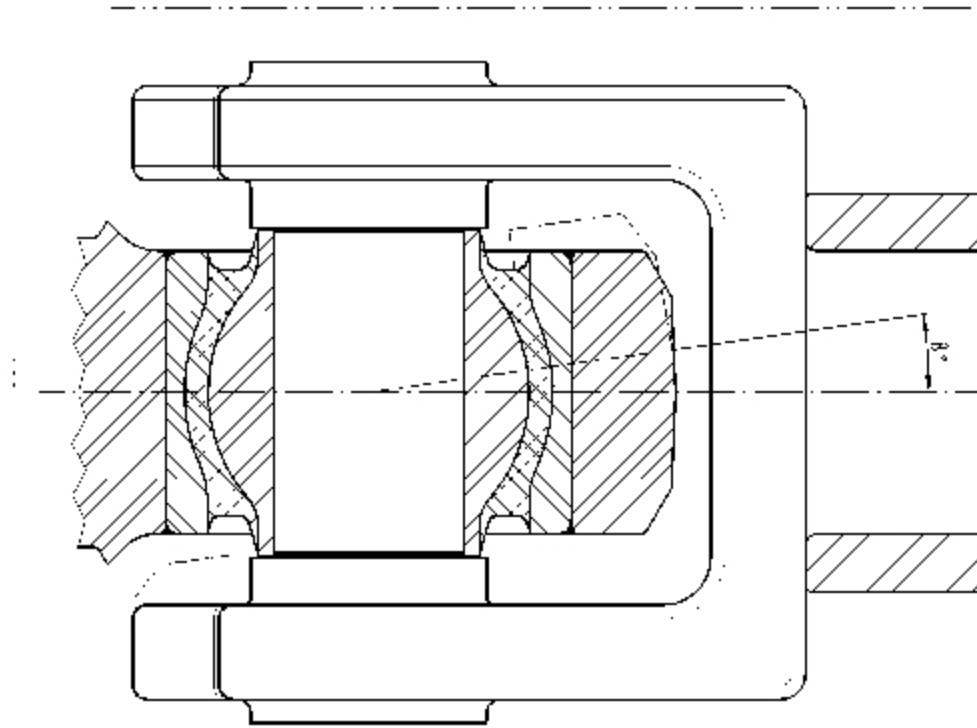










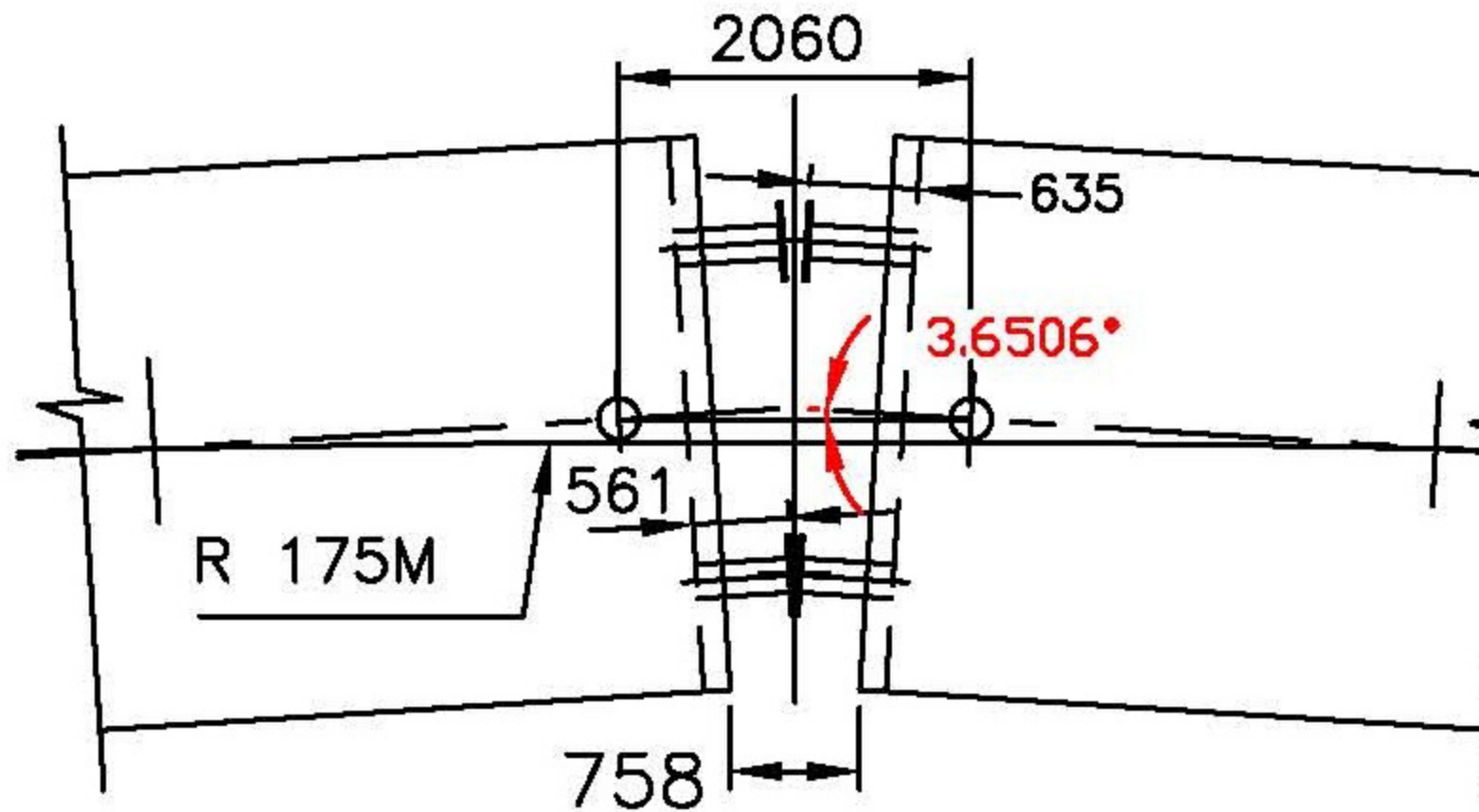


**Figure-5: Spherulastic Bearing**

Various doubts have been raised on using articulation inside draft gear.

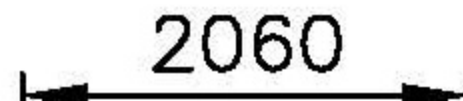
Analysis of LHB coach on 10 degree curve indicates that geometrical requirement of coupler head movement because of curvature of track is 3.9 degree horizontal swing.

The estimated bending force because of this horizontal swing is insignificant as compared to bending strength of the shank prescribed in the specification.

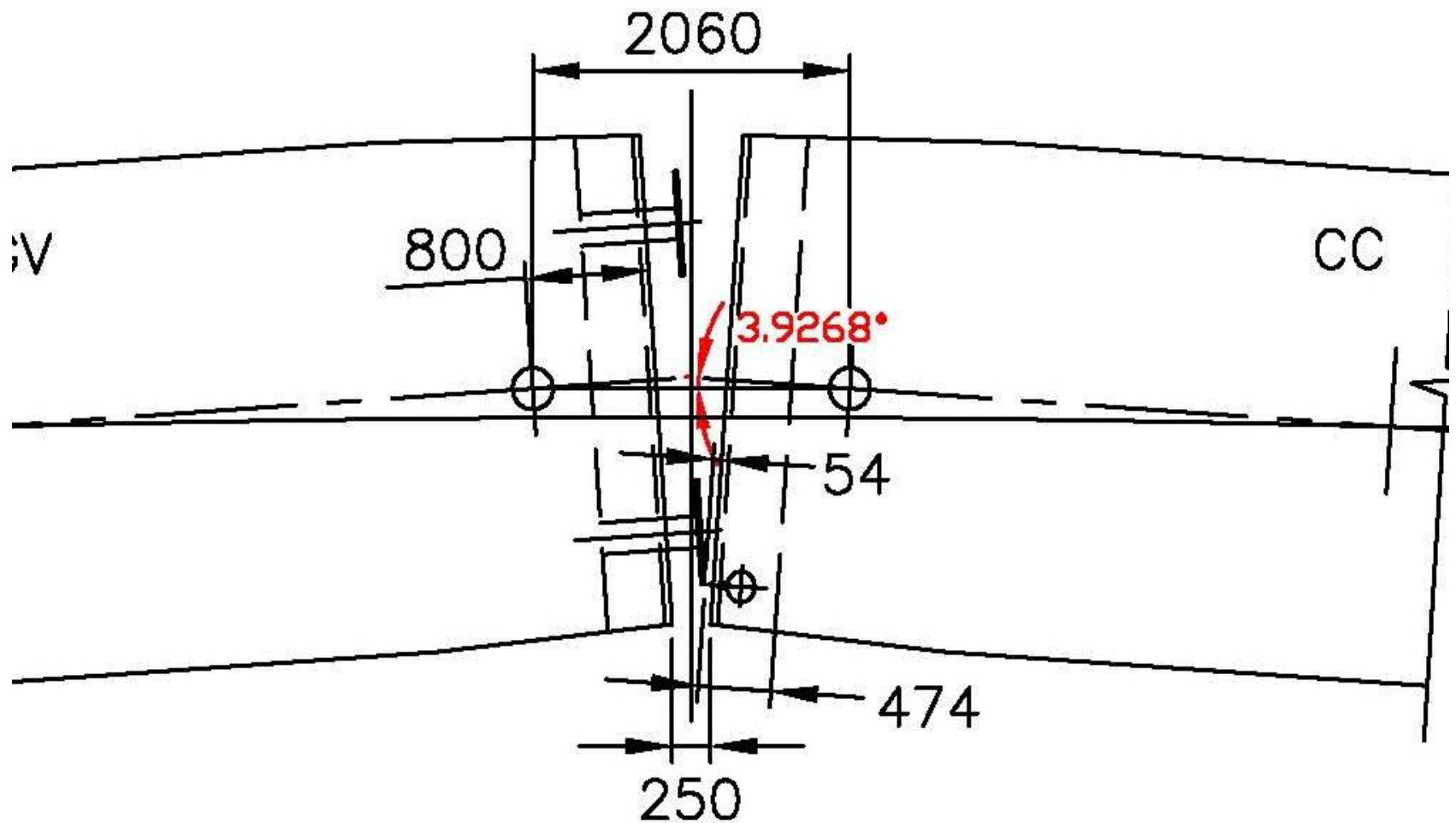


CONDITION:- NO COMPRESSION IN BOTH THE DRAFT GEARS

ICF COACH COUPLED WITH ANOTHER ICF COACH



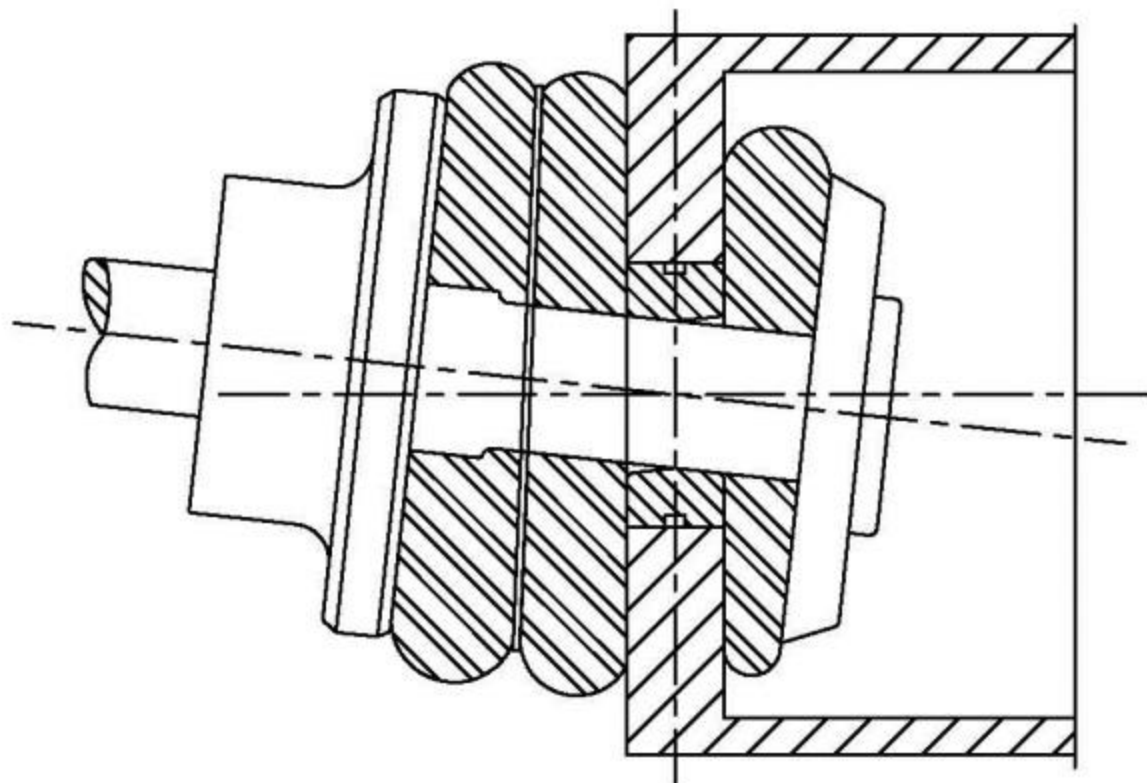




CONDITION:- NO COMPRESSION IN BOTH THE DRAFT GEARS

LHB COACH COUPLED WITH ANOTHER LHB COACH

In many coupling system design, some stiffness and damping in horizontal swing is desirable to prevent **yaw** of a coach during the taking of curve, transitions and switch points.



BALANCED TYPE DRAFT GEAR WHILE NEGOTIATING CURVE

# **ADVANTAGES**

- **Design aims at eliminating Jerk.**
- **In new design Draft Gear (BDG), Jerk & hammer noise problem has been eliminated completely by modifying the design.**
- **On the other hand End force has been balanced in tensile as well as in compressive mode.**
- **Enhanced life of equipment by using Durel GmbH heavy duty Elastomeric pads.**
- **Balanced Draft Gear flexible connection with coupler shank is a proven one and eases the horizontal & vertical movement of coupler head.**
- **Poly Acetel bushes used to avoid wear of Main bolt from metallic separator plates.**
- **In BDG separate packs of heavy duty Elastomeric pads have been used for tension and compression which will enhance the life of equipment up to double of conventional Draft Gear.**
  - BDG 04 pads stack is equal to 10 pads stack of conventional Draft Gear in Energy absorption and damping. BDG have bigger size imported (Durel Germany) pads than conventional Draft Gear pads.**



# VkbV ykd difyax fQVsM dksp dh igpku

- IkbM iSuy ds vUr esa ihyh iV~Vh
- dksp ua0 ds vUr esa ysVj 'C' dk Á;ksx





प्रवेशा  
ENTRY

बिजनेस/सोफ्ट स्लीपर  
1-8  
TO SEAT / SLEEP

1-8

10214/C

9-16



LIFT HERE

भारत

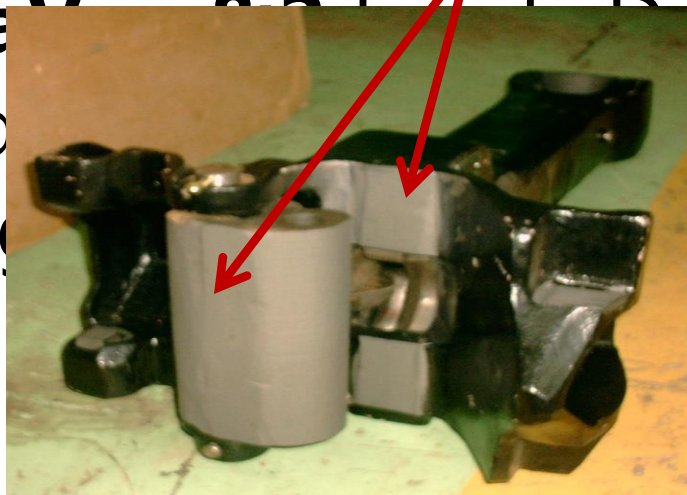
# difyax ls igys dh psd

**psd IokbaV ua&1** diyj ds lrg ij xzhl vFkok  
rsy dk

iz;ksx u djsa vU;Fkk vudiy gksus dh  
laHkkouk c<+

tkrh gSA

**psd IokbaV** 0 2 t h Dykst gks rks  
udy vkSj o 1 Qsl **lekukUrj**  
gksuk pkf



# difyax dk rjhdk $\frac{1}{4}$ dksp ls dksp $\frac{1}{2}$

- dksp dks 2&3 fdeh0@?ka0 dh LihM ls ,d nwljs ds utnhd ykdj 1&2 eh0 dh nwjh ij jksd nsrs gSaA
- ,ykbUesUV ns[ksaA bls xSnfjax jsUt esa jguk pkfg,A
- vko';drkuqlkj diyj dks [khapdj xSnfjax jsUt esa yk;saA
- eSuqvy vudifyax vkijsfVax jkM gSfUMy [kqys jgus pkfg;sA nksuksa dksp dk udy [kqyk gksuk pkfg;sA /khjs&/khjs /kDdk nsaA
- vkxs dk 5 dksp esa czsd yxk gksA
- Vsy&Vsy dh iksth'ku psd djsaA Vsy&Vsy LykV

# difyax dk rjhdk $\frac{1}{4}$ dksp ls yksdks $\frac{1}{2}$

- **yksdks lkbM ls ikip dksp esa czsd yxk gksA**
- **yksdks dks igys dksp ls 20 eh0 igys jksd nsa vkSj /khjs&/khjs vkxs c<+saA tc 3 eh0 rd dh nwjh jg tk; rks yksdks dks jksd nsaA**
- **,ykbUesUV ns[ksaA bls xSnfjax jsUt esa jguk pkfg,A vko';drkuqlkj diyj dks [khapdj xSnfjax jsUt esa yk;saA**
- **,l,yvkj lhchlh dks ukeZyh Dykst iksth'ku esa vkSi vkdks lhchlh udv dks vksiu**

# difyax dk rjhdk $\frac{1}{4}$ dksp ls yksdks $\frac{1}{2}$

- yksdks ik;yV dks 2 ukWp ij jsd dks vkxs [khapuk pkfg;sA
- tc yksdks [khaps gq, daMh'ku esa gks rks nksuksa lhchlh ds chp xSi dks i;kZIr eksVkbZ ds fle  $\frac{1}{4}$ fjfLV<sup>a</sup>DVj $\frac{1}{2}$  }kjk dS0,.MoS0 LVkQ }kjk Hkj fn;k tkuk pkfg,A
- yksdks ik;yV vkSj xkMZ }kjk chih vkSj ,Qih ikbi dk Ás'kj lqfuf'pr fd;k tkuk pkfg,A
- ÁFke ik;p dksp ds czsd dks ihvht di nsuk

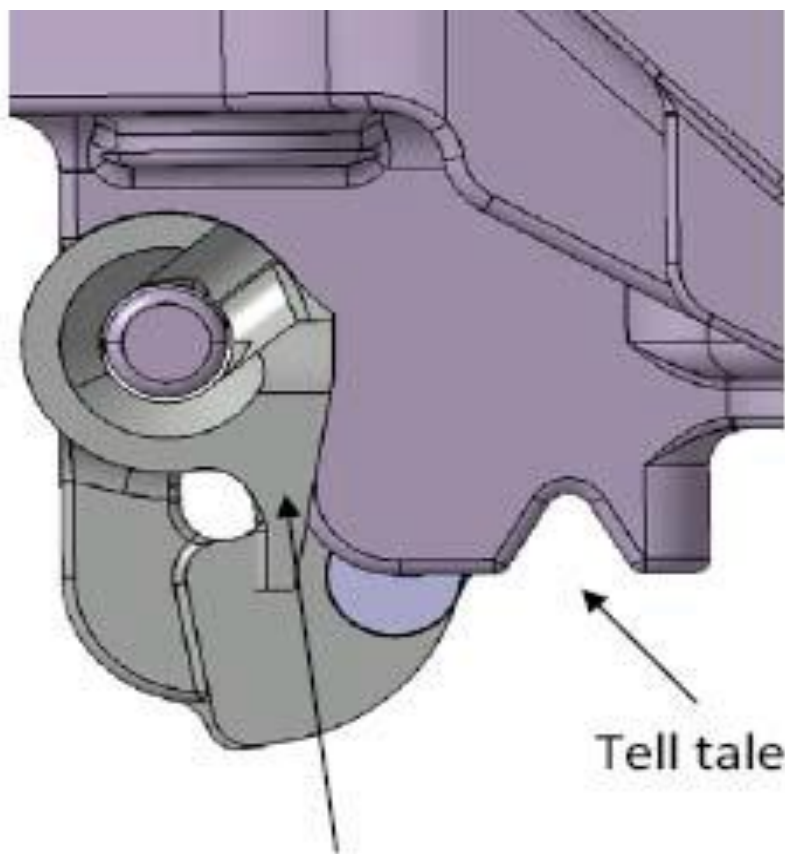
# Igh difyax gsrq psd IokbUV~I

psd IokbUV 1- Vsy&Vsy LykV  
fcYdqy fDy;j gksA

2- jksVjh ykd fyπVj fjc  
ofVZdy gksA

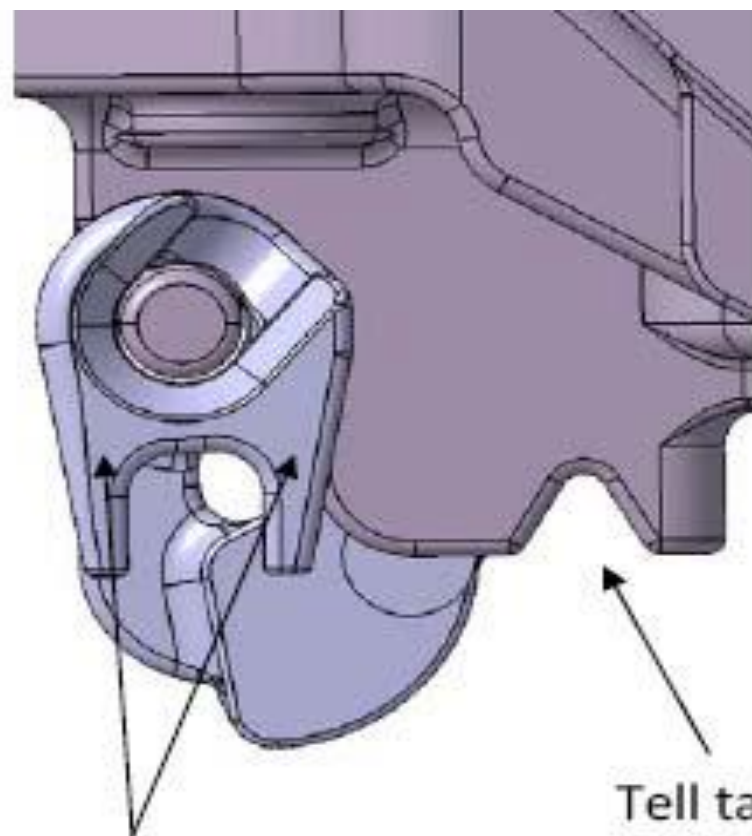
3- eSuqvy ykfdax fMokbl  
iw.kZ :i Is ykd iksth'ku





Tell tale

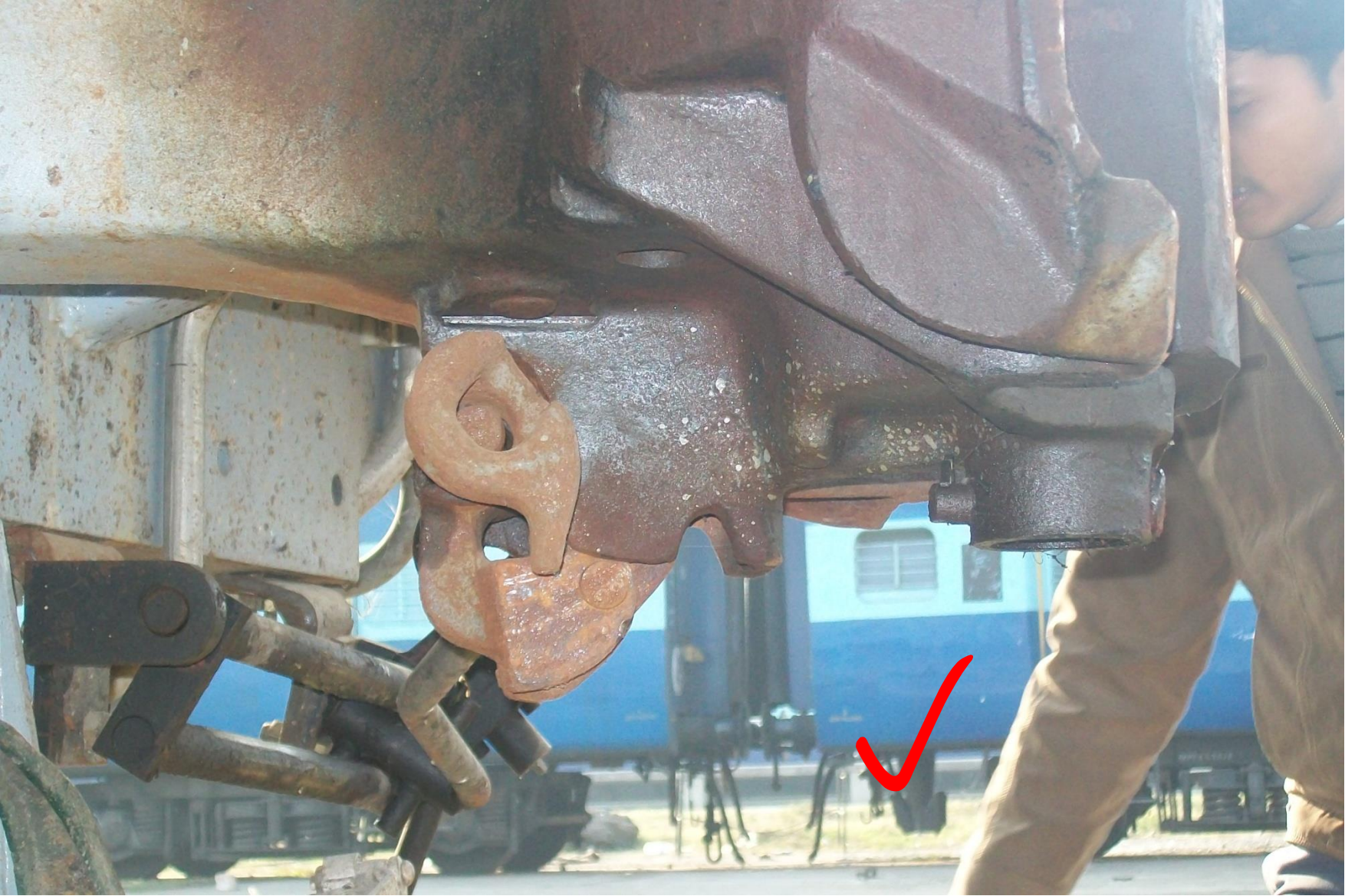
Rotary lock lifter  
with single rib.



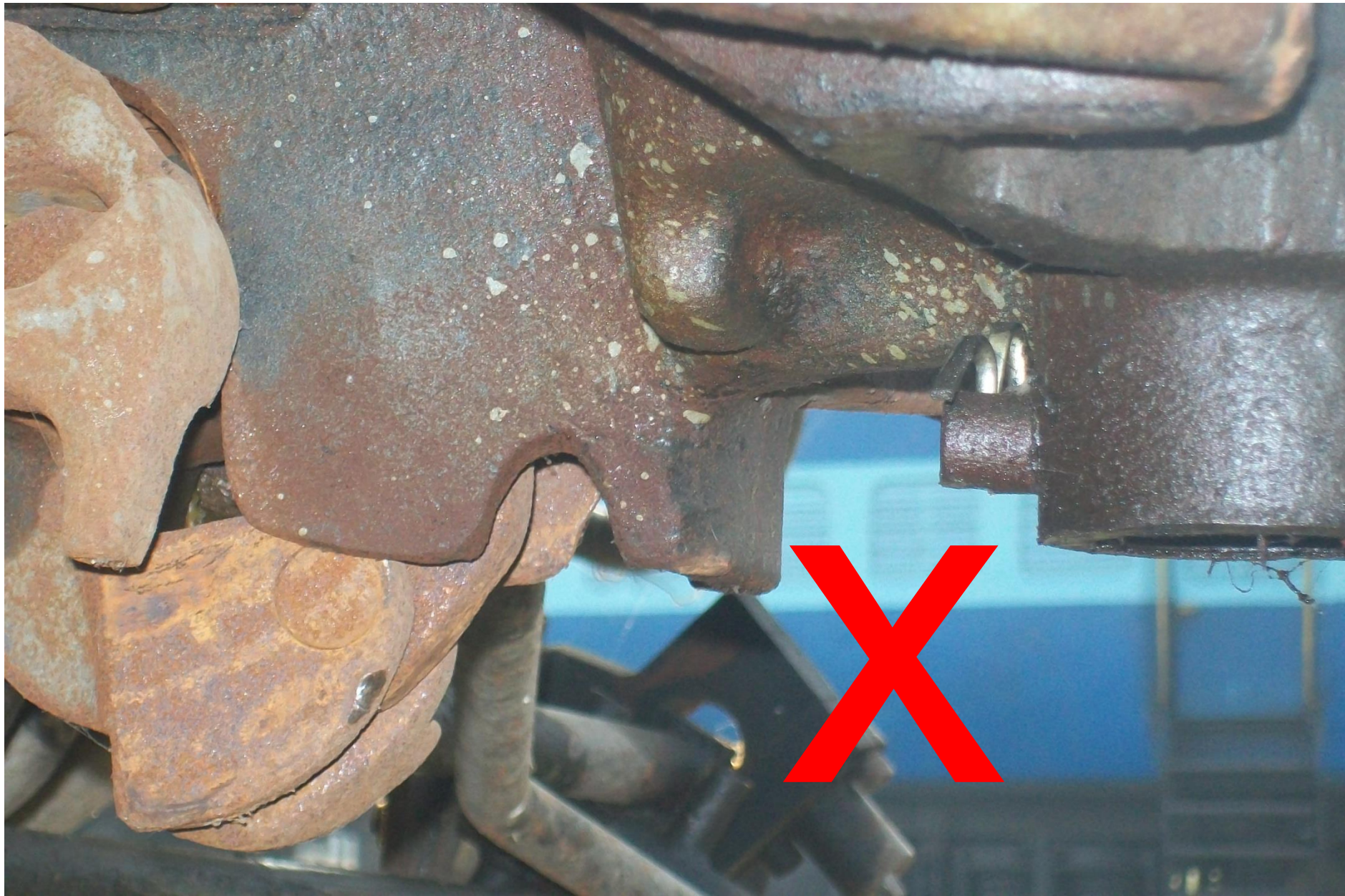
Tell tale

Rotary lock lifter  
with double rib.

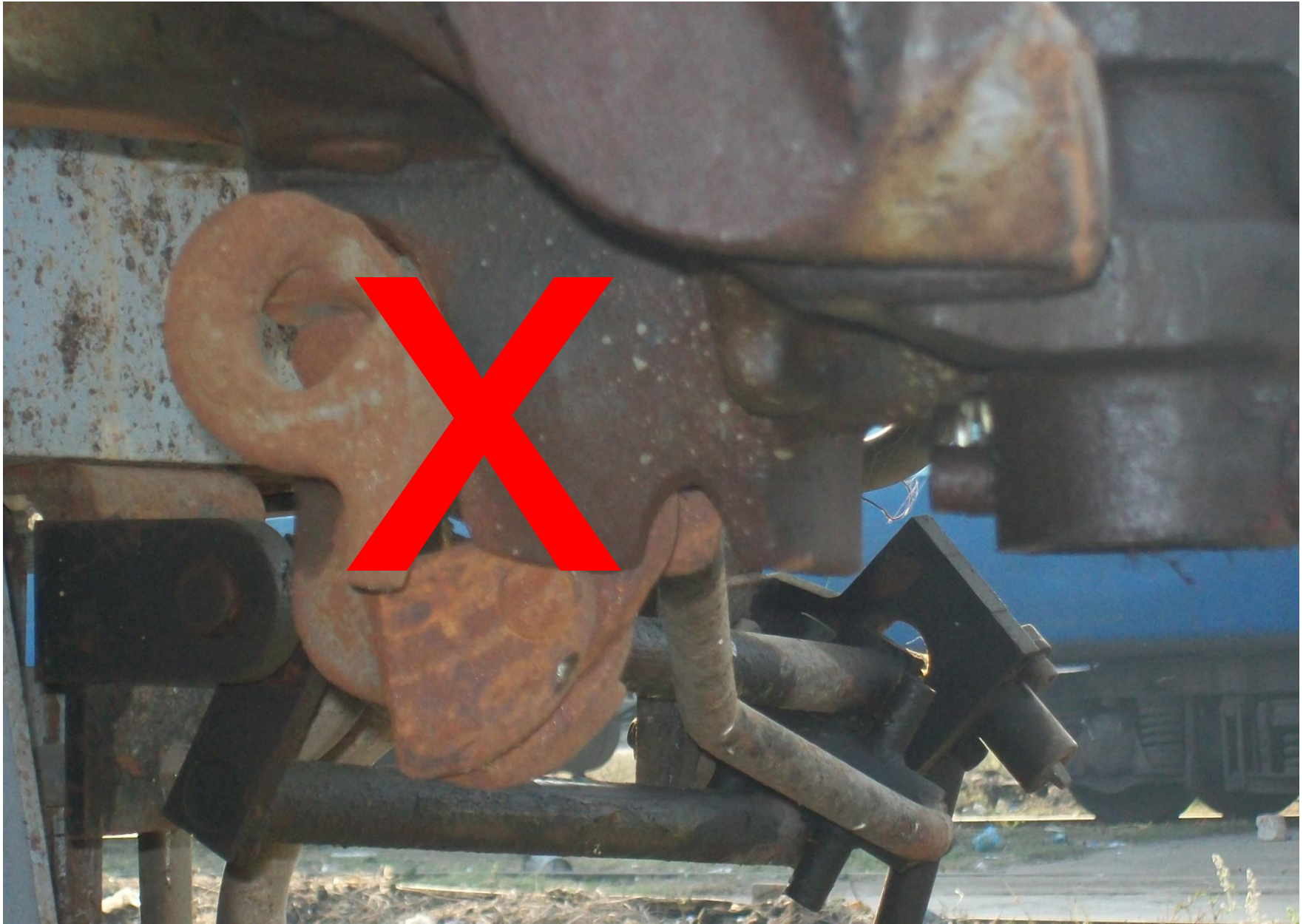






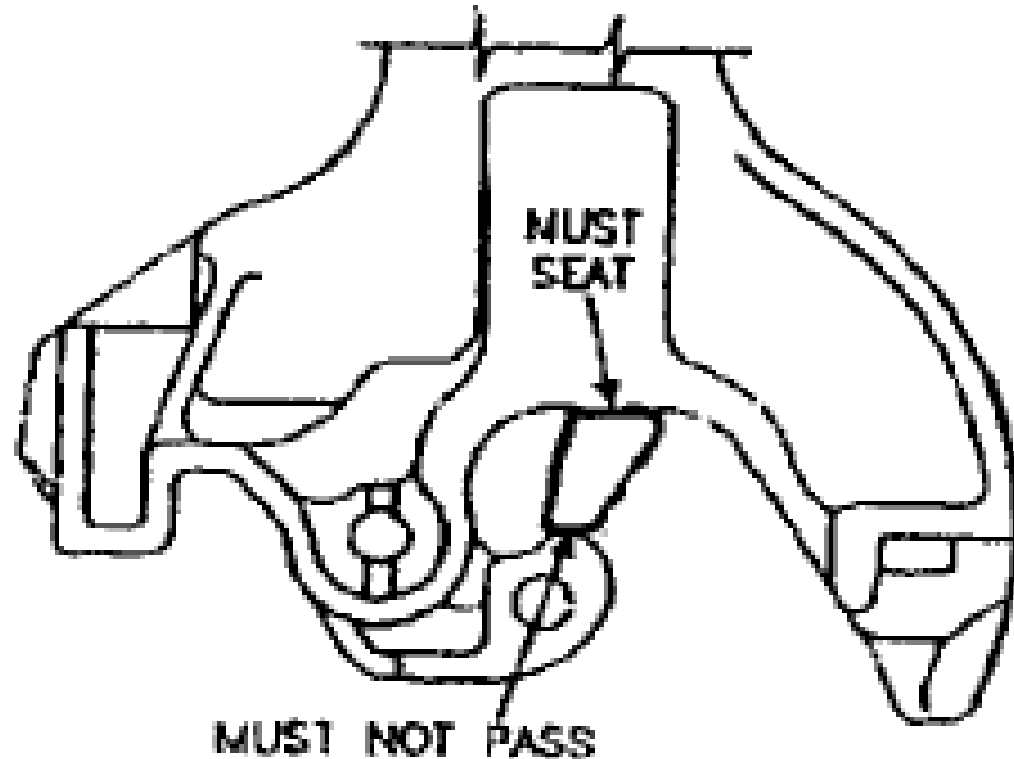






## Jaw gap test :

We check the contour of the coupler head assembly using “**Condemning limit gauge**”



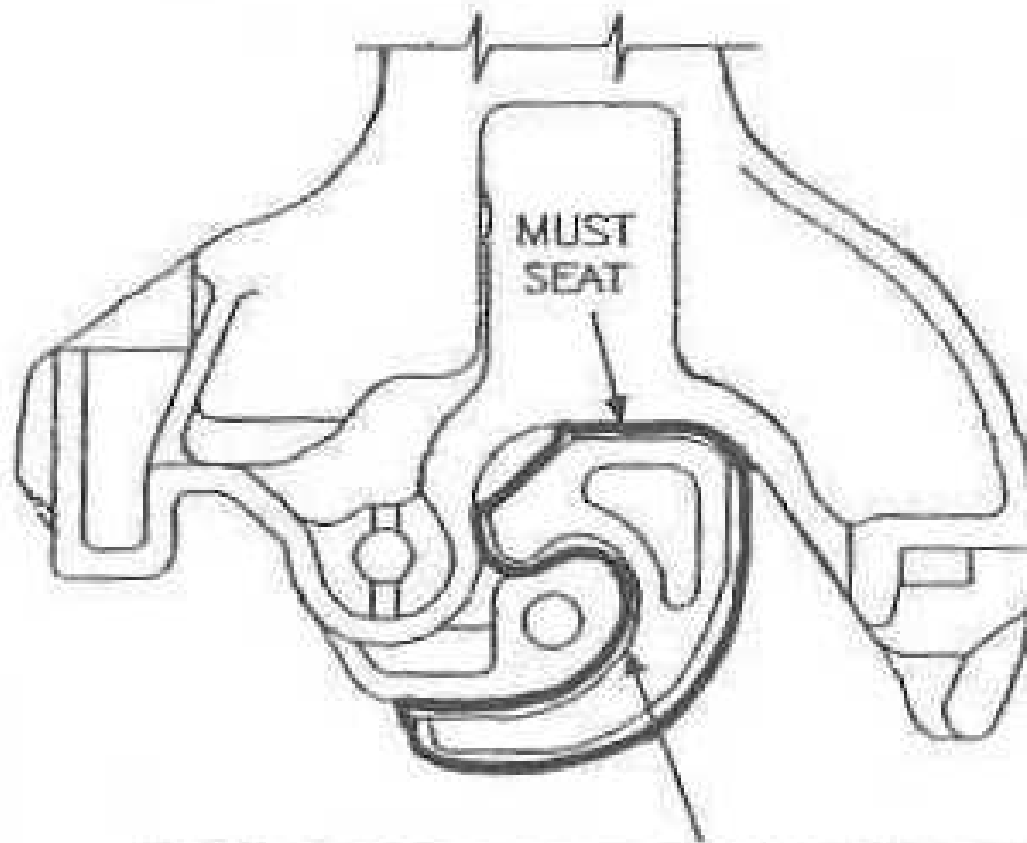
## **Knuckle contour (profile) check :**

Check the contour of the knuckle using the “ **Contour maintenance Gauge** .

Shake the knuckle while passing the gauge.

This is to ensure that slack in the assembly is included in the profile.

If gauge does not pass, Knuckle and coupler head must be checked and replace it or lock to be modified per APTA standards.(American Public Transportation Association)



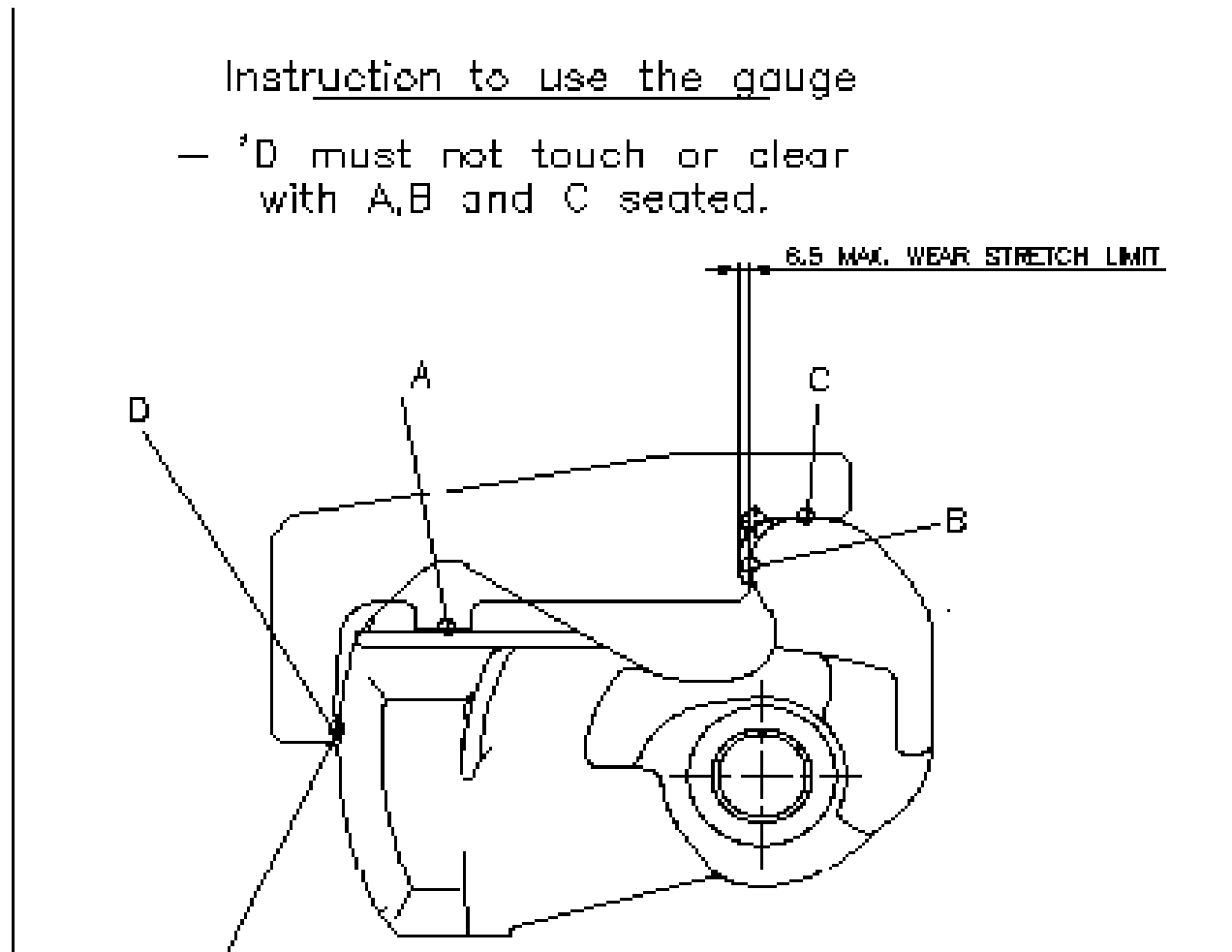
GAGE MUST PASS THROUGH CONTOUR  
WITH KNUCKLE FULLY CLOSED AND  
LOCKED.

**ÁksQkby xst**

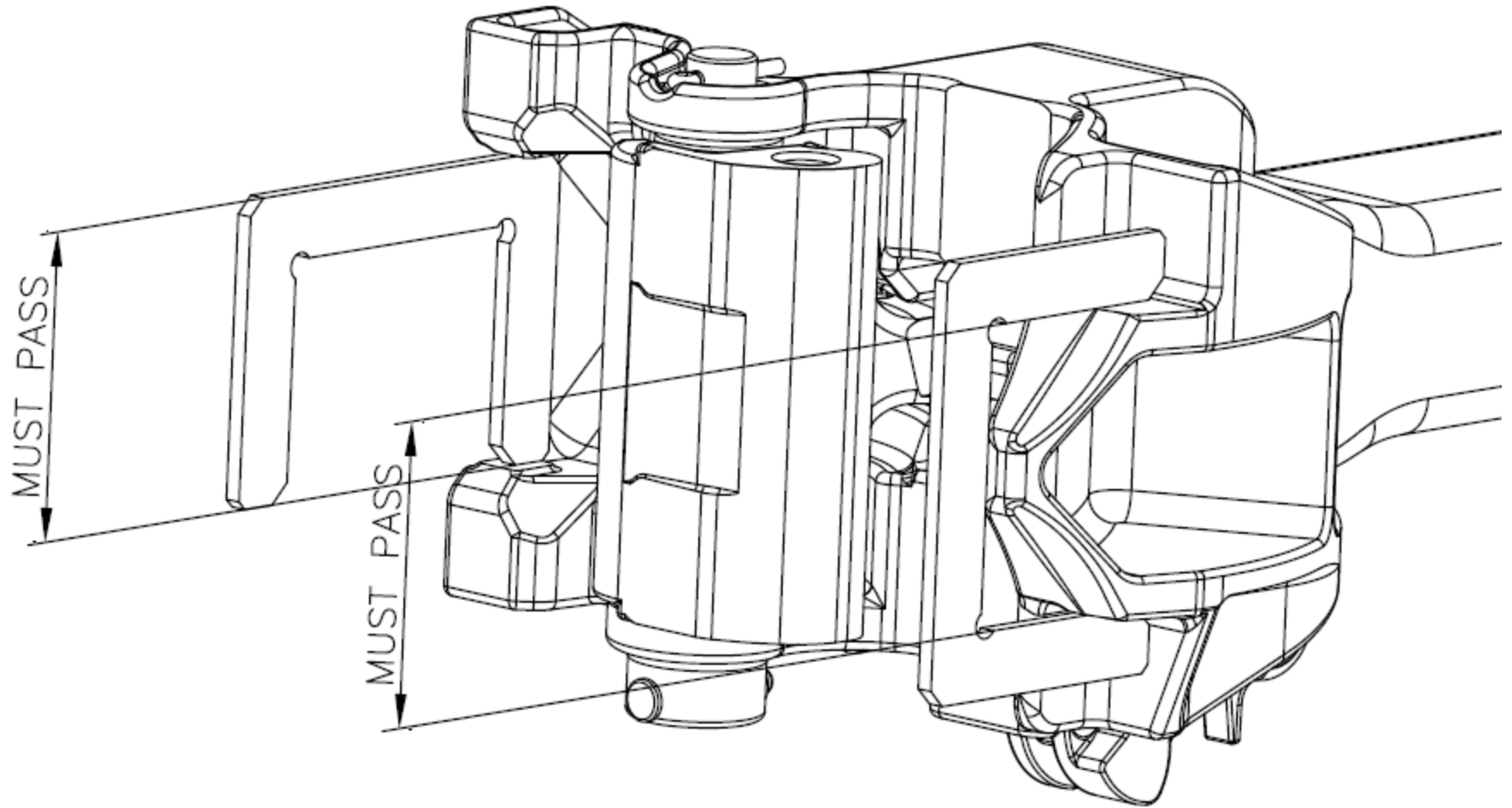


# Knuckle nose wear and stretch limit gauge

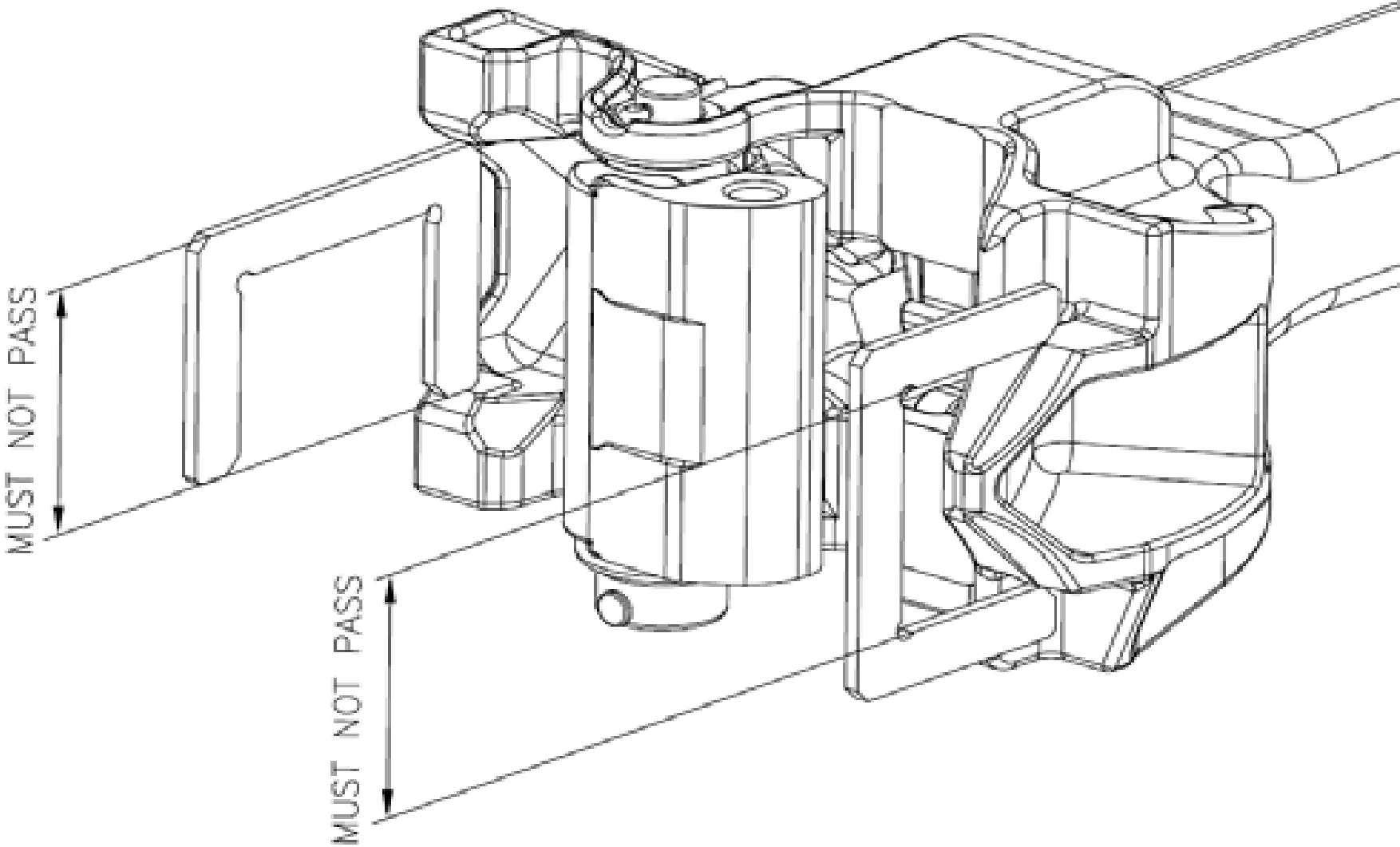
The permitted wear at the nose side is 6.5 mm.



## Vertical height aligning wing pocket and guard arm gauge (GO)



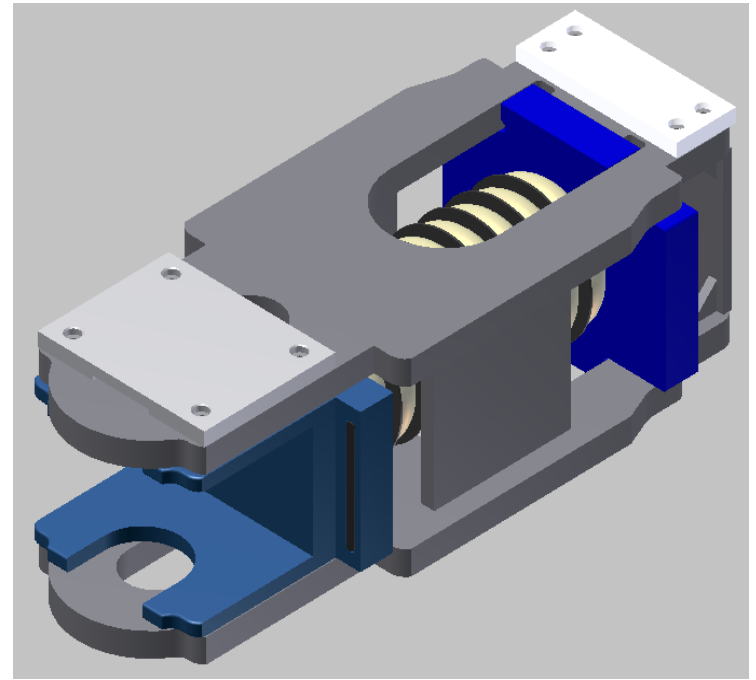
**Vertical height condemning limit aligning wing pocket and guard arm gauge (NO GO)**



**/kU;okn**

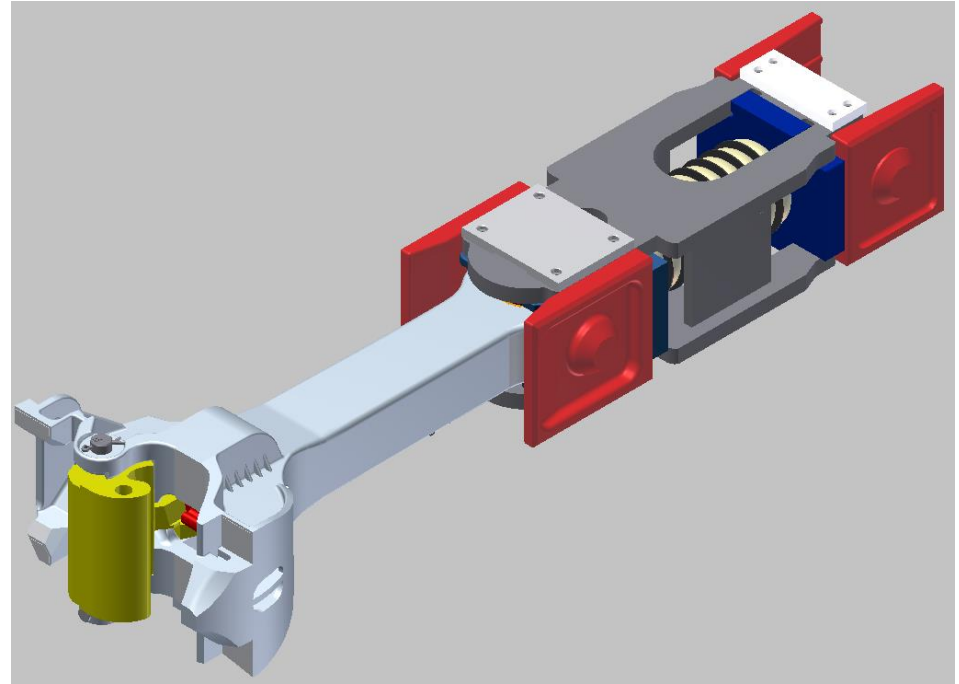
## CONVENTIONAL DRAFT GEAR

- **Standard Draft Gear consists of a single pack of 10 nos. Elastomeric pads which work in compression as well as in tensile loading.**
- **On the other hand BDG consists of separate packs for compression (4 pads) and for tension (3 pads).**
- **Elastomeric pads used for compression in BDG (pack of 4 pads) have equal energy absorbing capacity as compared to 10 pad pack used in conventional draft gear.**



## CONVENTIONAL DRAFT GEAR

- **Standard Draft Gear has Front Fork plate and Rear Stopper plate (in blue color).**
- **These two plates hit the coach under frame Stoppers (in red color) during force reversal after buffing (compression) and in tension mode respectively in deceleration and acceleration.**





# Draw and Buffing Gear System *for* LHB Coaches

Chief Instructor

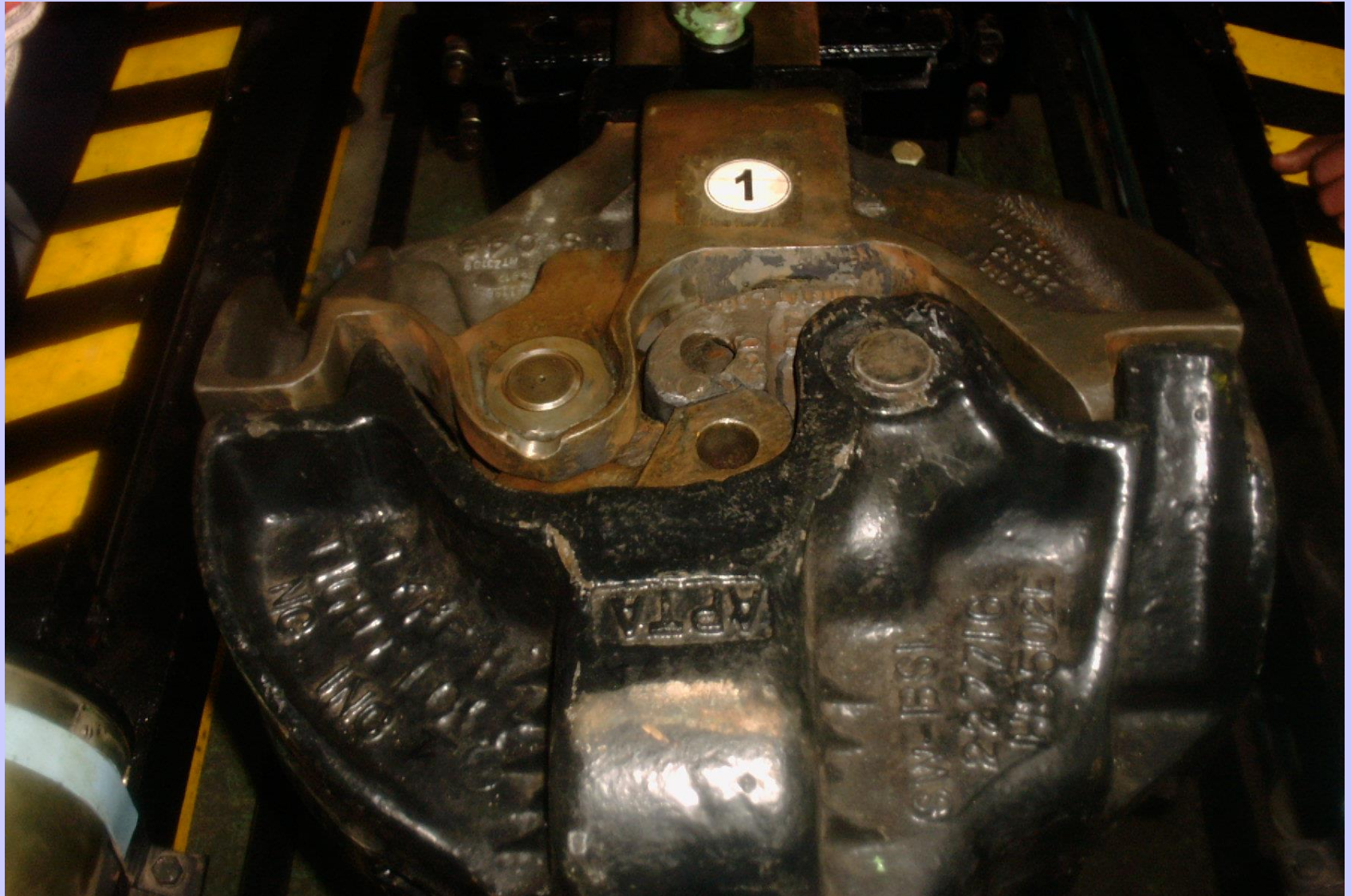
# Two Types Of System

- **Screw Coupling with side buffer**
  - Separate elements for draft and buff action
- **Centre buffer coupler**
  - Same element to take the draw and buff load

# ***Benefits of CBC***

- **Higher strength-Haulage of longer trains possible.**
- **Anti-climbing Feature.**
- **Lesser Intercoach Distance Possible.**
- **Lesser Maintenance.**
- **Less No. of Components ,Reduced inventories.**
- **Shunting Time Reduced.**
- **Shunting at Higher Speeds Possible.**
- **Automatic Coupling.**
- **Quick detachment possible in the event of fire.**

# AAR TYPE H Coupler in Coupled Condition





# PERFORMANCE TEST - INTERCHANGEABILITY OF PARTS - COUPLING OF SAB WABCO COUPLER WITH MERIDIAN RAIL COUPLER (.....CONTD)



# Types of Centre Buffer Coupler

- **Open Claw Type**

Janney-AAR D Type, AAR E type, Atlas, Alliance; Willision

- **Claw Type(Knuckle Type Tight lock)**

**AAR F Type, AAR H Type, AP -  
Tightlock, Controlled Slack, JNR**

- Rigid Type

Shacku, Compact, Wedglock, Westinghouse, George Fischer



# Limitations of Screw Coupling

- Limited Strength due to weight restriction.
  - Haulage of longer trains not possible.
  - Train can not stop automatically on ACP.
- Over-riding of coaches in collisions and derailment
- Anti-climbing Arrangement Not Possible.
- Shunting Staff at Risk.
- Longer Inter-coach Distance.
- More Number of Components and Assemblies.
- Higher maintenance requirement.
- Less energy absorption.

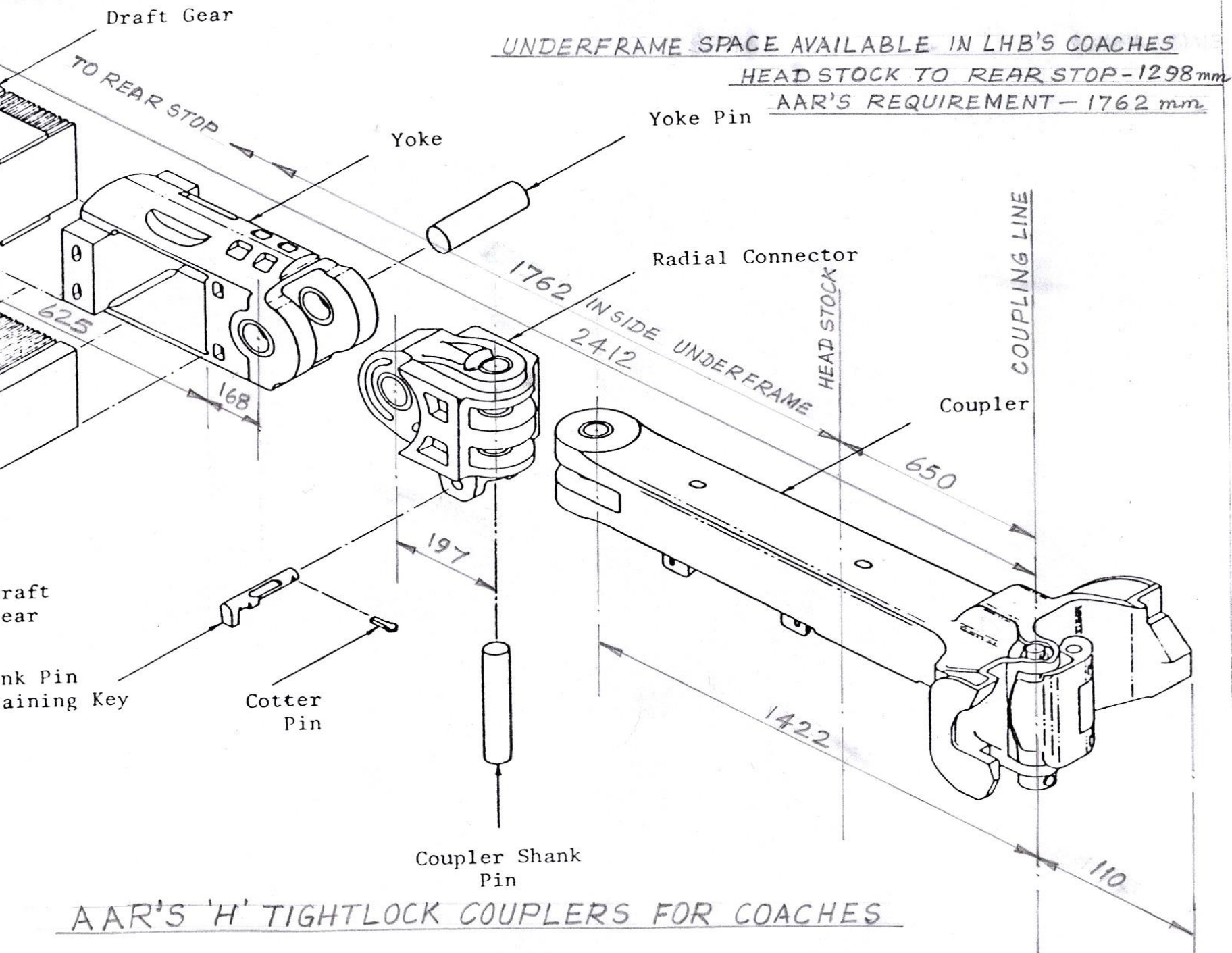
# IR Adopted AAR Type 'H' Coupler

## Main Reasons:-

- Couplability with Type-E Coupler fitted on IR Locomotives.
- **Anti-climbing Feature in-built.**
- Strength Suitable for Operation of 26-coach Train.
- **Low Cost.**

# **IR Efforts on adoption of AAR H type Coupler**

- Effort started in late Seventies.
- Specification was issued in 1985.
- ICF issued Global Tender.
- Purchase did not materialise due to very high price.



AAR'S 'H' TIGHTLOCK COUPLERS FOR COACHES

# LHB Coach Specification

- Tight lock centre buffer coupler
- The draft gear will adequate capacity for operation of 16 coach at 160 kmph and 26 coaches at 110 kmph.
- Train has to stop on ACP

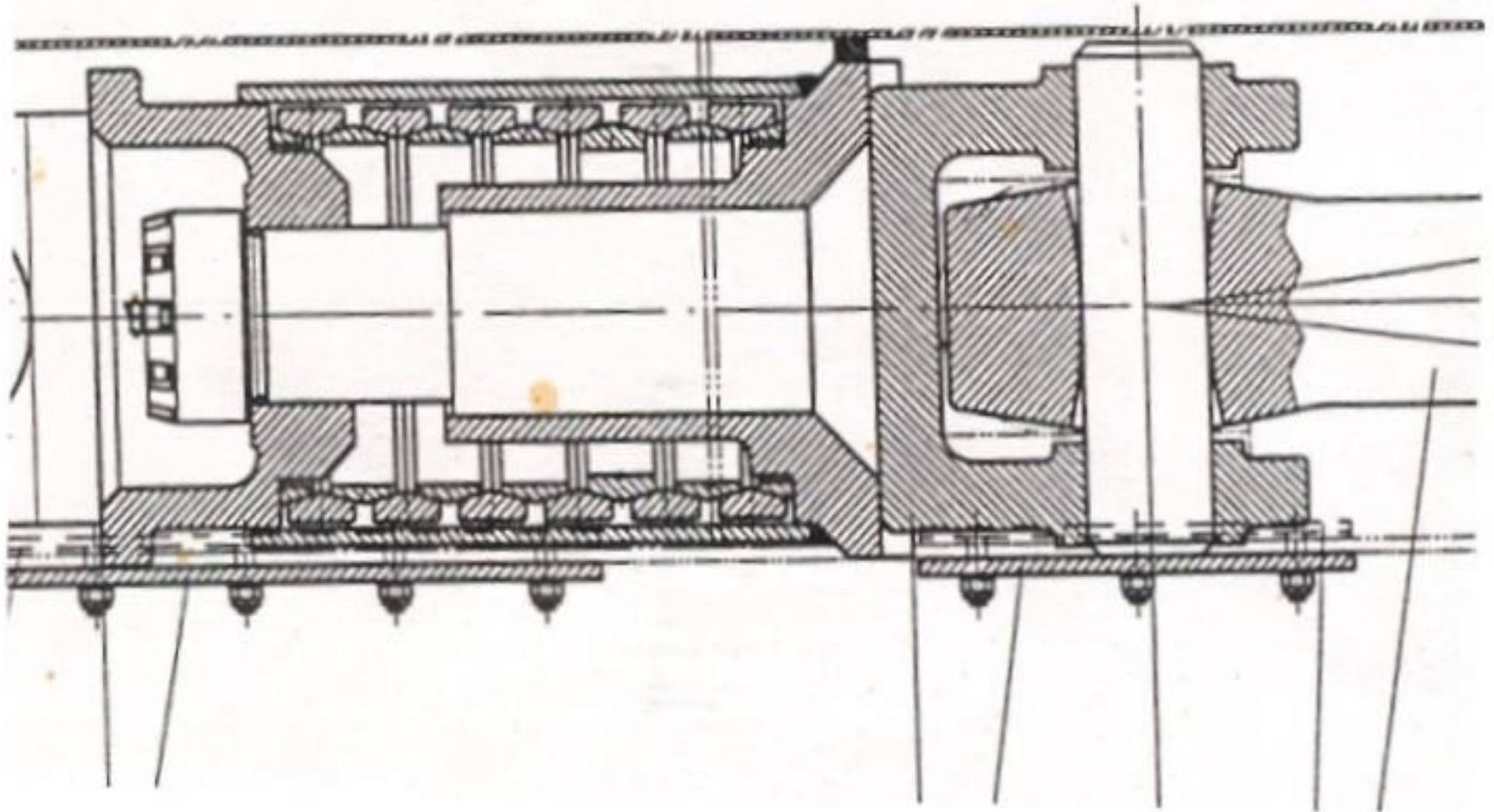


# CENTER BUFFER COUPLER OF IMPORTED LHB COACHES

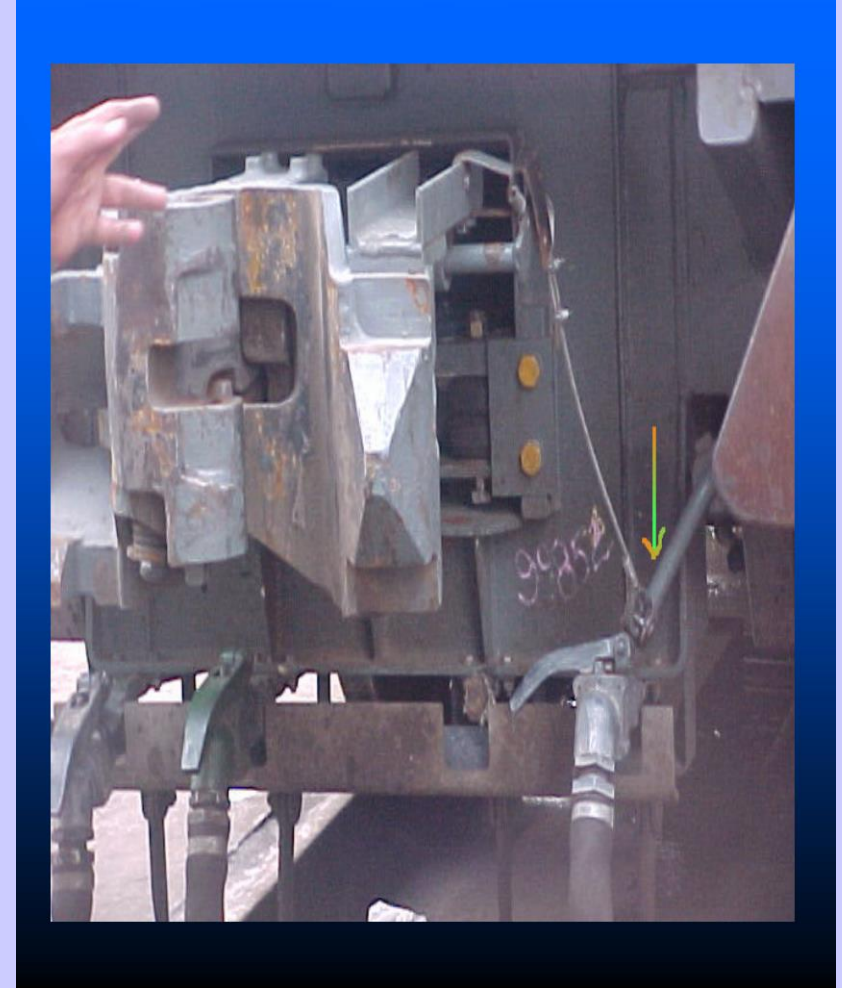
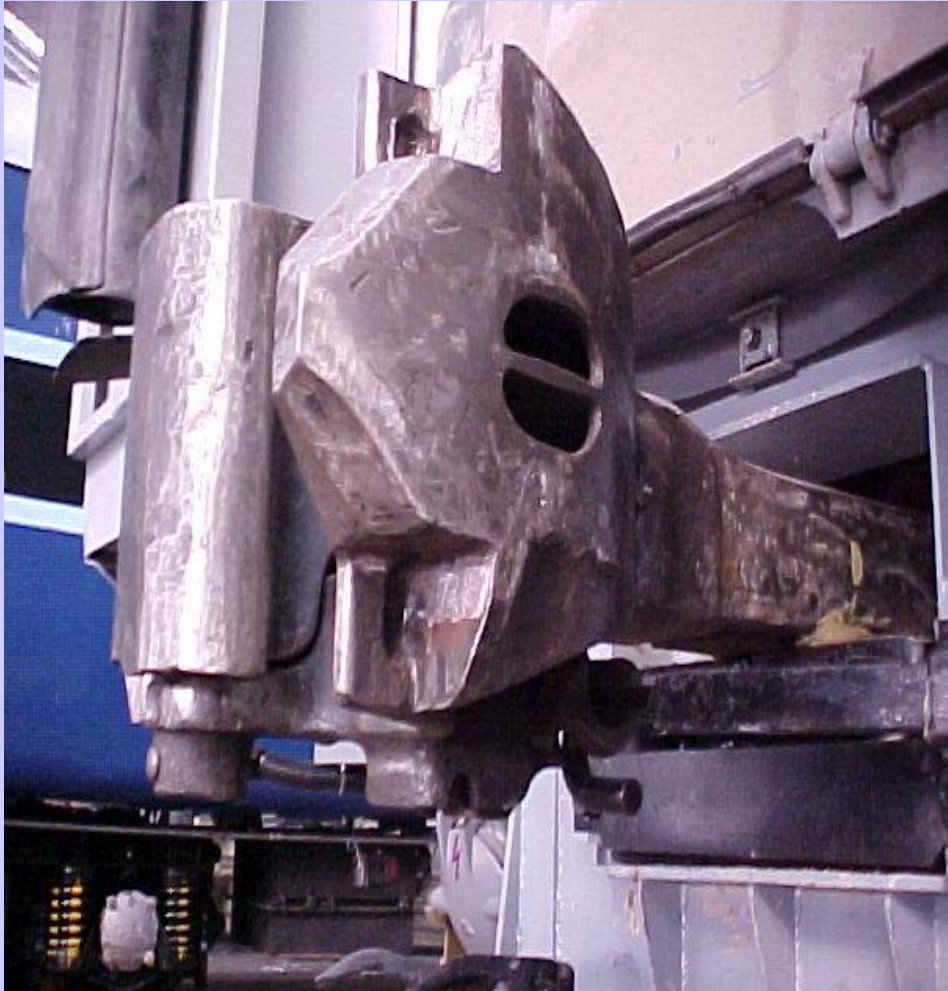




# Ring-feder Draft Gear



# Comparison of two coupler heads





# ANTI-CREEP TESTING



# Problems Encountered

- **Train Partings**
  - **3 Partings in Train service**
  - **3 Parings during trials**
- **Longitudinal Jerks in Train Operation**
  - **Increased with service**
- **Rapid Wear at Coupler and Draft Gear Connection**
- **Coupler damaged in shunting.**
  - **Strength of Shank not suitable for Indian Condition**

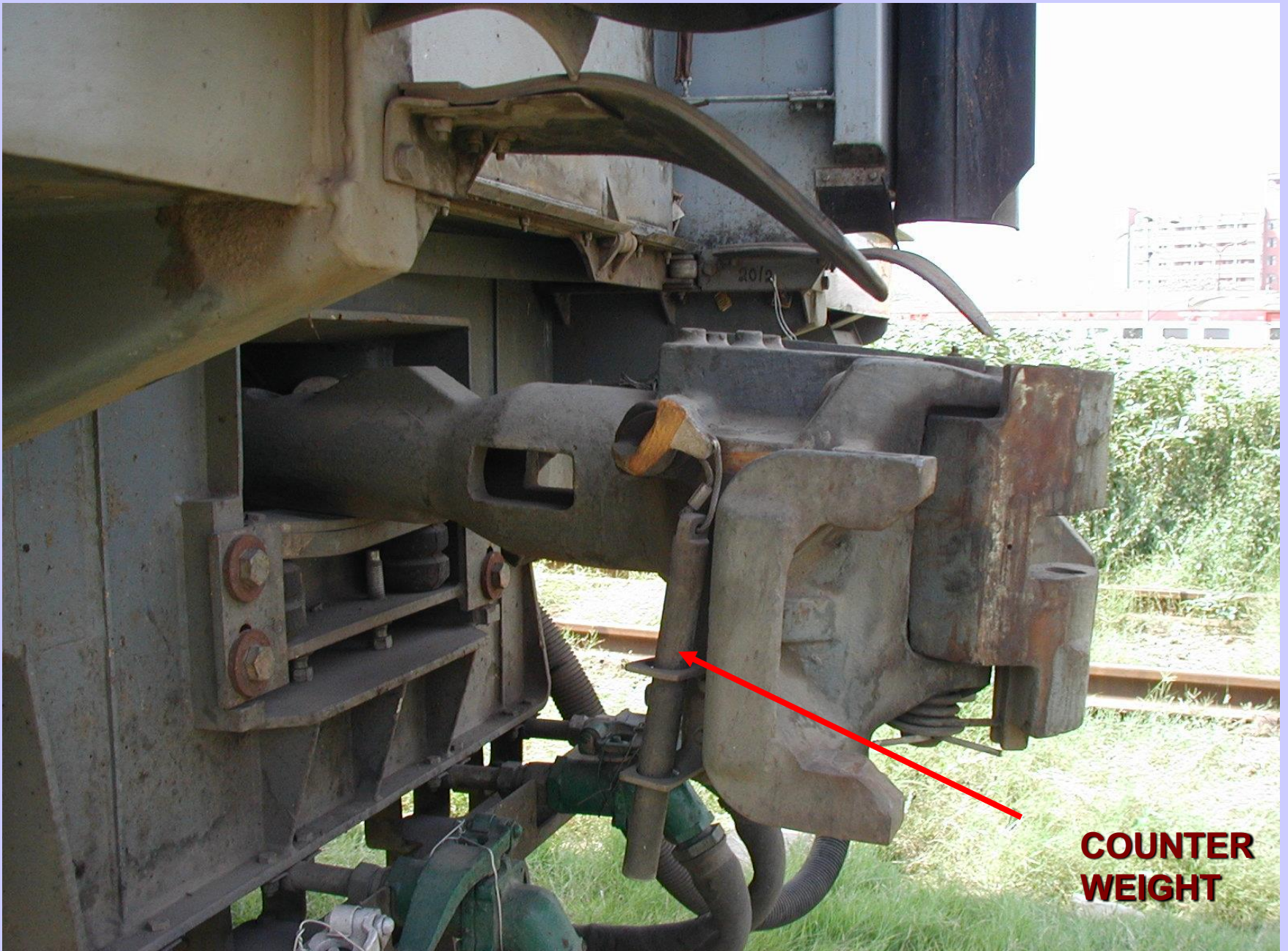
# Reasons for Uncoupling

- **Coach To Coach**
  - **Weak return spring.**
  - **Ambiguous tell-tale.**
  - **Anti-creep Design not fool proof.**
- **Between Loco and Gen. Van**
  - **Low height of couplers.**
  - **Vertical interlocking between loco coupler and coach coupler not available.**

# Measures Adopted

- **Return spring replaced with dead weight**
- **Locking of the rotor lever through a pin**
- **Painting of new tell-tale marks on the coupler body and the rotor**
- **Buffer height adjustment of the coaches**
- **Provision of a restrictor between loco and coach knuckle**





**COUNTER  
WEIGHT**



**Restrictor was provided on Power Car CBC  
knuckle to prevent the vertical separation of  
knuckles between Power Car & Engine**



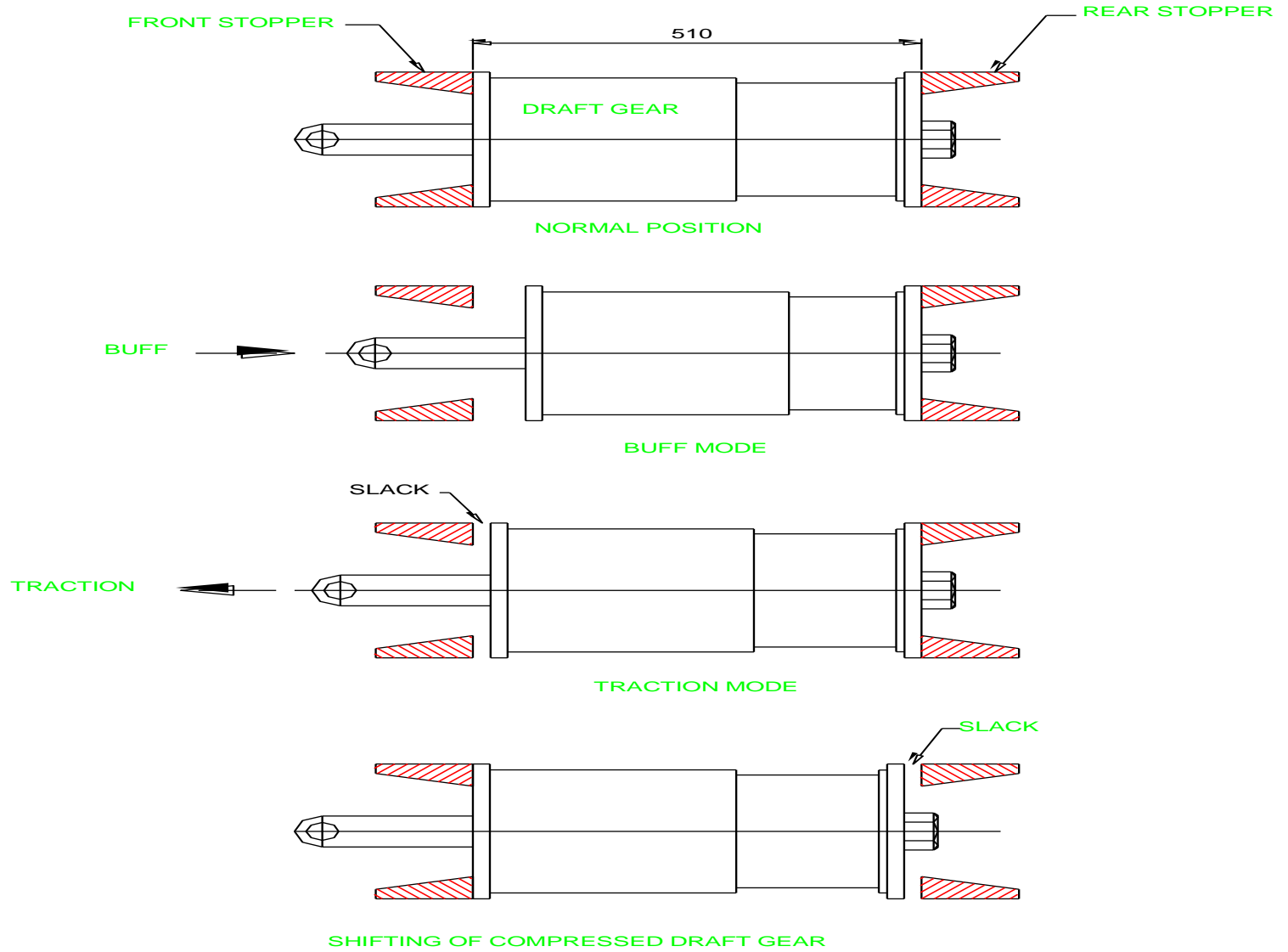
# **Reasons for the jerks in train service**

- **Slack in coupler heads**
- **Slack in the coupler and draft gear connection due to wear**
- **High response time of the draft gear due to slip-stick-slip phenomenon**
- **Slack generation due to draft gear action**
- **Loss of preload due to wear of friction springs**

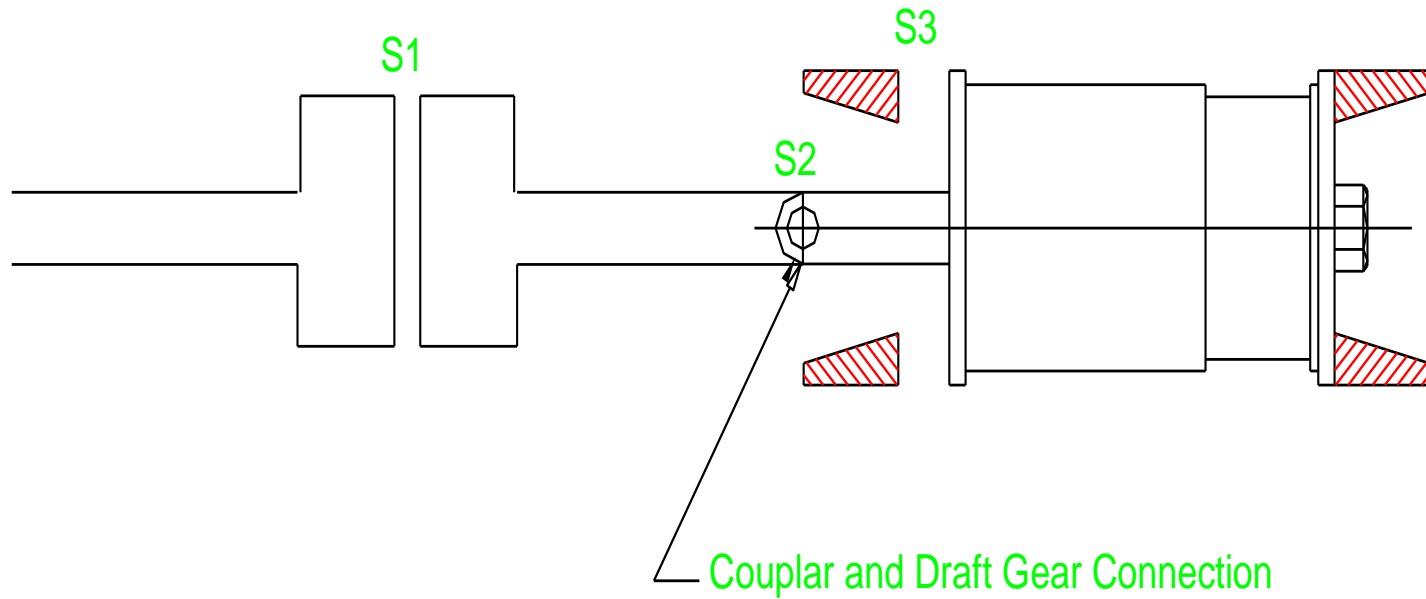
# SHANK EYE HOLE DIA INCREASED



# SLACK DUE TO DRAFT GEAR ACTION



# SLACK DUE TO DRAFT GEAR ACTION





# **New designs of coupler**

- **RDSO developed specification CK-009**
- **Board issued a Global Developmental Tender**
- **Two Designs were selected**
  - **M/s SAB WABCO India Ltd**
  - **M/s ASF-Keystone USA**

# INTERCHANGEABILITY OF PARTS

**SAB WABCO COUPLER HEAD WITH MERIDIAN RAIL KNUCKLE**



# FEATURES OF SAB-WABCO COUPLERS

- AAR 'H' TYPE COUPLERS WITH SQUARE SHANK
- DRAFT GEAR HAVING MTPACK SPRINGS

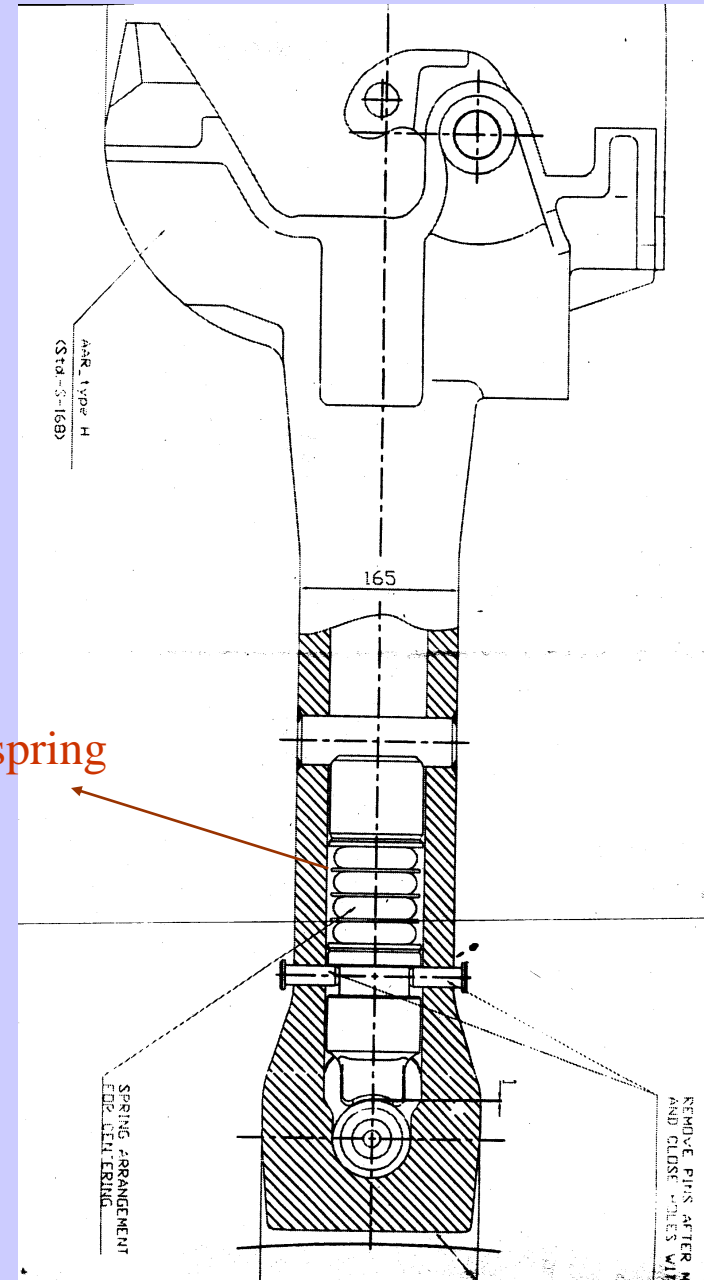




# SAB-WABCO



Centering spring



# Coupler on the LHB Coach



# Salient Features

- **Slack in new condition specified 3.5 mm.**
- **End Force –1600KN Max.**
- **Damping factor specified 0.6.**
- **Travel of draft gear increased to 90 mm.**
- **Pre-load specified as 50+/- 10 KN.**
- **Emphasis on indigenization for more sources.**
- **Test procedure regarding Mech. Properties defined.**



*Thank*

*You*