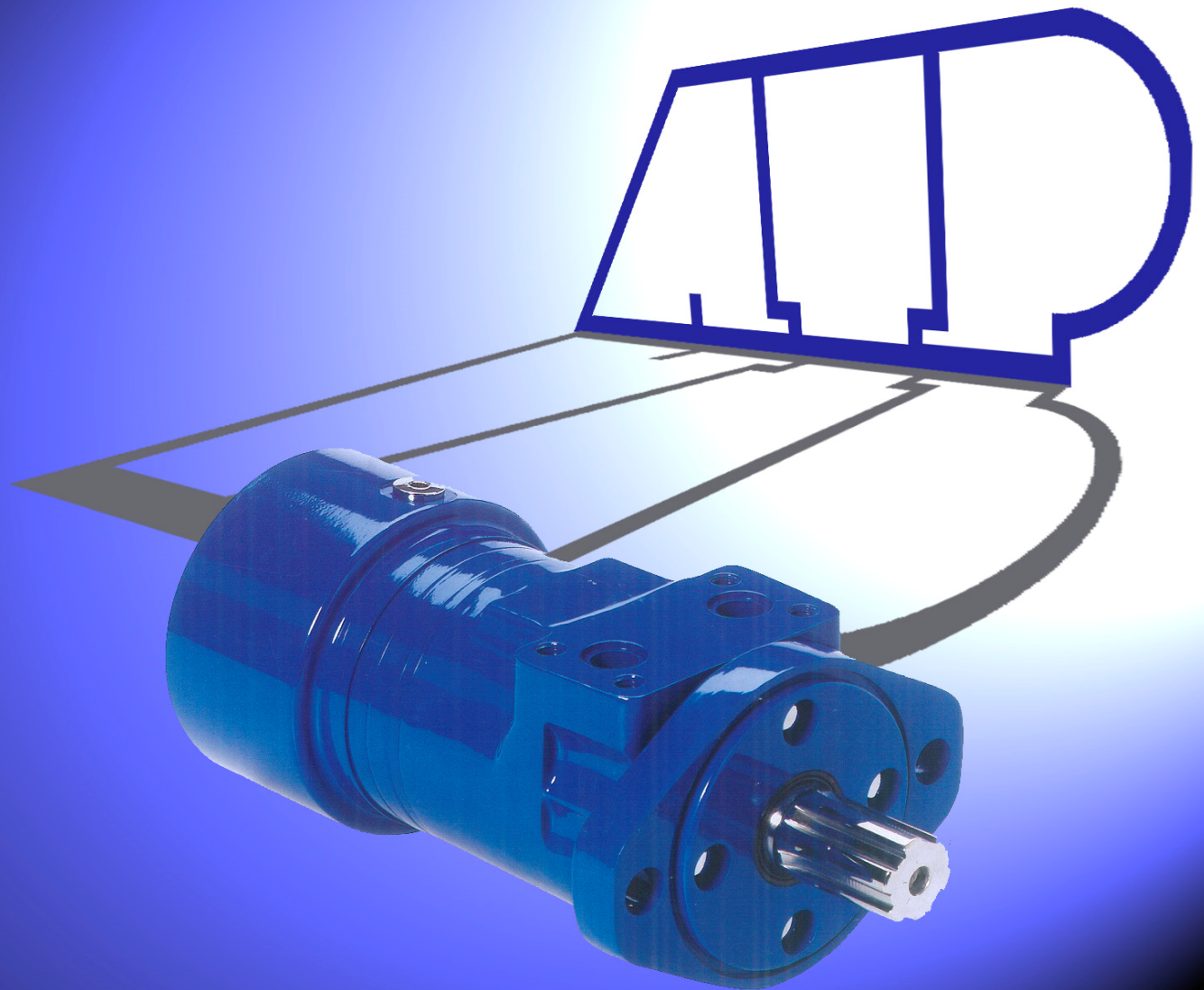


# Hydraulikmotor T-Brake Series





# T-Brake Serie

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## Features and Benefits

### Features

- Integrated, Compact, Patent-Pending Design
- Performance-matched system=> Load-holding Capacity Tailored to Match Motor Configuration
- Factory Preset Load-Holding Capacity
- Capability of Combining 4 inventory items into a single assembly (motor, brake, counter-balance valve, brake release line)
- Rear-mounted integrated brake with 6:1 torque advantage
- Spring-applied pressure release wet brake
- Access port for manual brake release (for overriding brake in the event of loss of release pressure.)

### Benefits

- Complete Packaged System Solution: One-Source - One-Contact - One-Call!
- Simplifies ordering and inventory requirements!
- Ensures correct holding capacity matches motor capability!
- Reduces assembly labor and eliminates need for special assembly operations!
- Design Flexibility!
- Cost Effective Packaged System Solution!
- Full-Capacity Load-Holding Capability in a compact package
- Wet brake is environmentally protected and provides long life

### Applications

Thousands of Char-Lynn, H, S and T series are used today in conjunction with conventional bolt-on brake packages supplied by a variety of manufacturers. These are often applied on winch, positioning, and boom rotate functions (also, commonly referred to a "swing drive")

Below is a list of some of the more common types of applications:

- Truck-Mounted Equipment - (boom rotate and winch)
- Conveyors – Positioners – Indexers
- Marine Cranes (boom rotate and winch)
- Fishing Winches
- Recycling and Refuse Equipment
- Vehicle Recovery Winches
- Mining Equipment
- Specialty Utility Vehicles / Machines
- Forestry Grapples
- Agricultural Equipment
- Railroad Equipment
- Airport Support Vehicles
- Lawn & Turf Equipment
- OR:

"Anywhere Load-Holding is Needed on a Low-Speed High-Torque Drive System"





## Application Information

### Principal of Operation

The wet brake is a spring-applied / pressure release design. Load-holding is applied by a mechanical spring and released by hydraulic pressure. The spring force holds the brake on when hydraulic pressure is absent. As a result, the brake is biased "on" when no pressure is present. This is a field-proven method of actuation that provides a fail-safe mode of operation.

### Release Pressure

Release pressure is defined as the amount of pressure required to fully release the brake. The brake pressure cavity is common (shared) with the motor case. As a result, maximum release pressure is constrained by the motor case-pressure capability. The T Brake Motor incorporates a shaft seal capable up to 1500 psi (see page 15). However, seal life is reduced at higher case pressure. For most applications, case pressures below 1500 psi, typically provide adequate life.

#### Note:

Special attention should be given to system back pressure. System back pressure directly affects brake release pressure and can cause the brake to release at undesired conditions.

### Residual Pressure

Residual back pressure is the pressure trapped in the system by restrictions or long return lines.

Residual back pressure will degrade the rated load holding torque of the brake. Increased pressure in the motor case/brake release cavity will reduce load hold-

ing capability, as well as, affect seal life. Because back pressure affects both motor case pressure and brake release pressure, special attention needs to be given when applying this product. Keep in mind that long return lines create higher pressure that will reduce brake holding torque. In applications with high system pressures, the use of a pressure reducing valve to limit case and release pressure is recommended.

### Holding Torque and Motor Output Torque

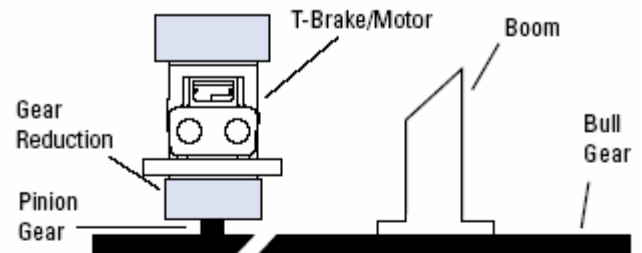
Holding torque is based on grade holding requirements for a vehicle or other load holding requirements in the application. System pressure and motor displacement are the factors in determining motor output torque. Motor displacement, measured in cubic centimeters or cubic inches, is the volume of fluid required to make one revolution. Motor output torque is the rotary force and is usually measured in inch pounds, newton meters or foot pounds. Maximum motor torque depends on pressure and motor displacement. Both output shaft size and shaft type can also affect motor torque. The T Brake Motor load holding capacity is factory set to match any limiting factor in each specific motor configuration (e.g. displacement, output shaft, etc).

#### Note

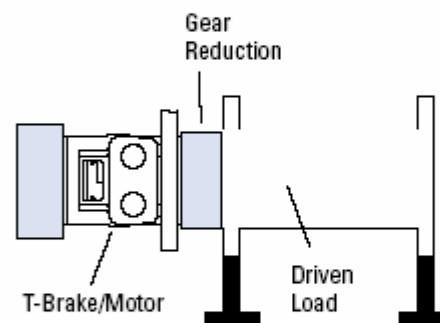
EATON Corporation does not approve any products for customer applications. It is the sole responsibility of the customer to qualify and verify the correct operation of products in their systems.

### Typical Applications

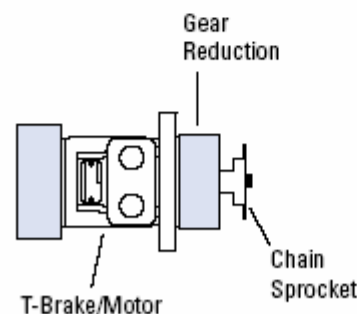
#### Swing Boom



#### Winch



#### Machine Drive







## General Information



Eaton's latest innovation in LSHT motor technology is the new T-Brake Motor. The patent-pending design incorporates an integrated brake capable of holding full motor torque. The brake is a spring-applied hydraulically-released wet disc design. The package-size is much more compact than conventional brake designs commonly used today. The T-Brake Series Motor utilizes the same proven Geroler®, and spool-valve principal found in standard CharLynn®, T Series motors. This design provides smooth, reliable and efficient performance, while the integrated performance-matched brake provides dependable, load-holding capability. The brake design is innovative and operates at the orbit speed of the Geroler, star. Orbit speed of the Geroler, star is 6 times (600%) faster than the output shaft speed. Consequently, the T-Brake operates with a 6:1 torque amplification advantage. This complete packaged solution is ideal for a variety of applications including aerial work platforms, truck-mounted booms/cranes, vehicle recovery winches, sweepers, marine winches, marine booms/cranes, and many others. It is the ideal choice for applications requiring load-holding capability and can be tailored to fit your application requirements using wide-variety of options as well as Vickers®, manifold valves and Aeroquip®, hose / tube / fitting assemblies.

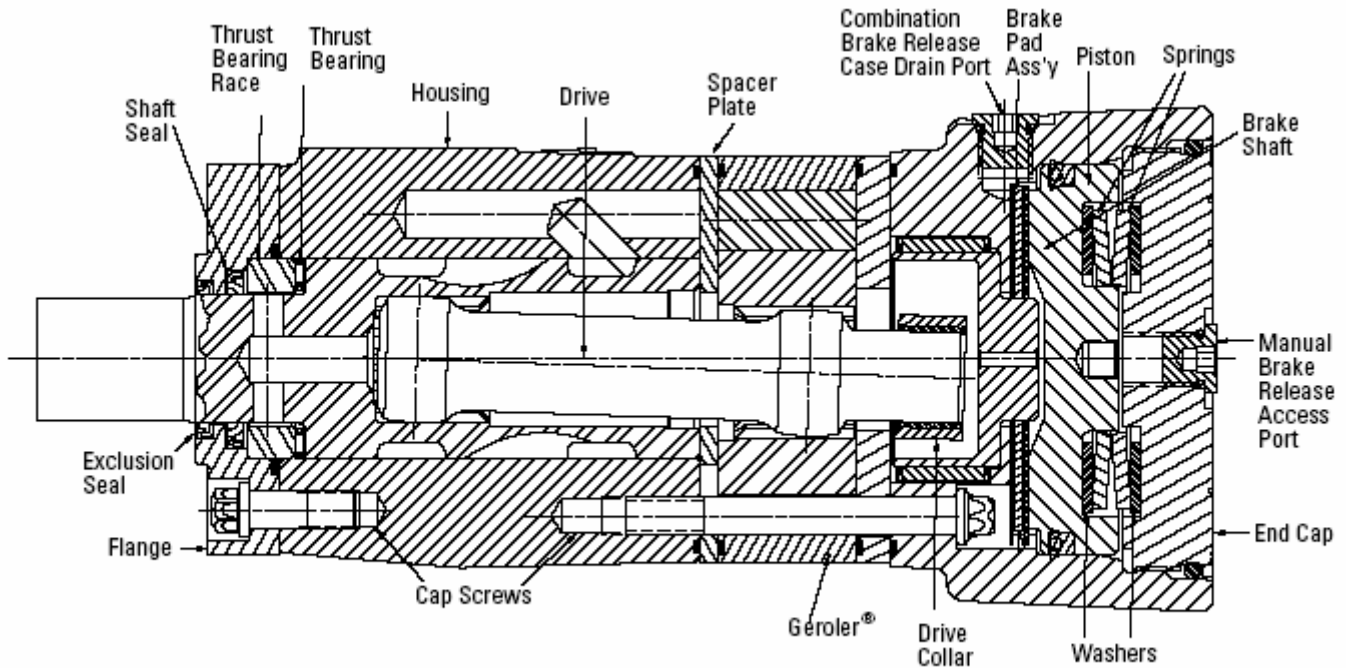
### T-Brake Series

Geroler® Element .....	11
Displacements	
Flow LPM [GPM] .....	55 [15]
	Continuous**
	75 [20]
	Intermittent*
Speed .....	Up to 1055 RPM
Pressure Bar [PSI] .....	155 [2250] Cont.
	190 [2750] Inter.
Torque Nm [lb-in] .....	440 [3905] Cont.
	510 [4515] Inter.
Minimum Release .....	17 [250]
Pressure Bar [PSI]	
Maximum Release .....	103 [1500]
Pressure Bar [PSI]	

\*\* Continuous— (Cont.) Continuous rating, motor may be run continuously at these ratings.

\* Intermittent— (Inter.) Intermittent operation, 10% of every minute.

## Specifications



### SPECIFICATION DATA – T-BRAKE SERIES

Displ. cm <sup>3</sup> /r [in <sup>3</sup> /r]		36 [2.2]	49 [3.0]	66 [4.0]	80 [4.9]	102 [6.2]	131 [8.0]	157 [9.6]	195 [11.9]	244 [14.9]	306 [18.7]	370 [22.6]
Max. Speed (RPM) @ Continuous Flow		1021	906	849	694	550	426	355	287	229	183	152
Flow LPM [GPM]	Continuous	38 [10]	45 [12]	57 [15]	57 [15]	57 [15]	57 [15]	57 [15]	57 [15]	57 [15]	57 [15]	57 [15]
	Intermittent	38 [10]	57 [15]	68 [18]	76 [20]	76 [20]	76 [20]	76 [20]	76 [20]	76 [20]	76 [20]	76 [20]
Torque Nm [lb-in]	Continuous	76 [672]	105 [928]	138 [1222]	174 [1541]	219 [1936]	251 [2226]	297 [2628]	359 [3178]	410 [3633]	441 [3905]	430 [3811]
	Intermittent **	93 [824]	118 [1131]	168 [1488]	212 [1872]	264 [2339]	307 [2718]	359 [3178]	437 [3864]	485 [4290]	483 [4275]	486 [4300]
Pressure Δ Bar [Δ PSI]	Continuous *	155 [2250]	155 [2250]	155 [2250]	155 [2250]	155 [2250]	138 [2000]	138 [2000]	138 [2000]	127 [1850]	110 [1600]	90 [1300]
	Intermittent ***	190 [2750]	190 [2750]	190 [2750]	190 [2750]	190 [2750]	172 [2500]	172 [2500]	172 [2500]	155 [2250]	124 [1800]	103 [1500]

### Maximum Case Pressure — 103 Bar [1500 PSI] see pages 14-15.

To assure best motor life, run motor for approximately one hour at 30% of rated pressure before application to full load. Be sure motor is filled with fluid prior to any load applications.

\* Maximum intermittent pressure at motor inlet port of 190 Bar [2750 PSI] without regard to D Bar [D PSI] and/or back pressure ratings or combination thereof.

\*\* A simultaneous maximum torque and maximum speed NOT recommended.

6B Splined or Tapered shafts are recommended whenever operating above 282 Nm [2500 lb-in] of torque, especially for those applications subject to frequent reversals (see page 10).

Δ Bar [Δ PSI]— True pressure difference between inlet port and outlet port.

Continuous Rating — Motor may be run continuously at these ratings.

Intermittent Operation — 10% of every minute.

Recommended Fluids — Premium quality, anti-wear type hydraulic oil with a viscosity of not less than 70 SUS at operating temperature (see page 00).

Recommended Maximum System Operating Temp. — Is 82° C [180° F]

Recommended Filtration — per ISO Cleanliness Code, level 18/13

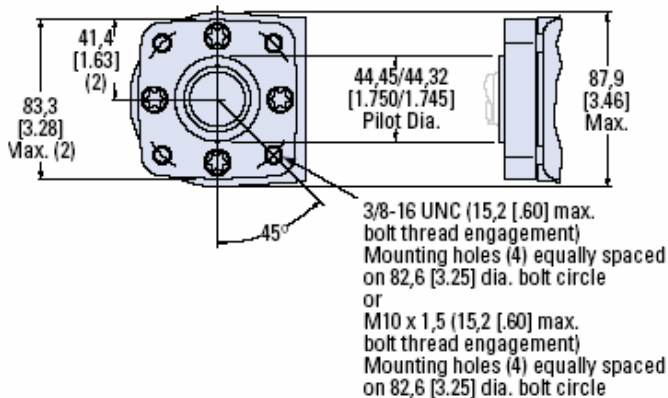
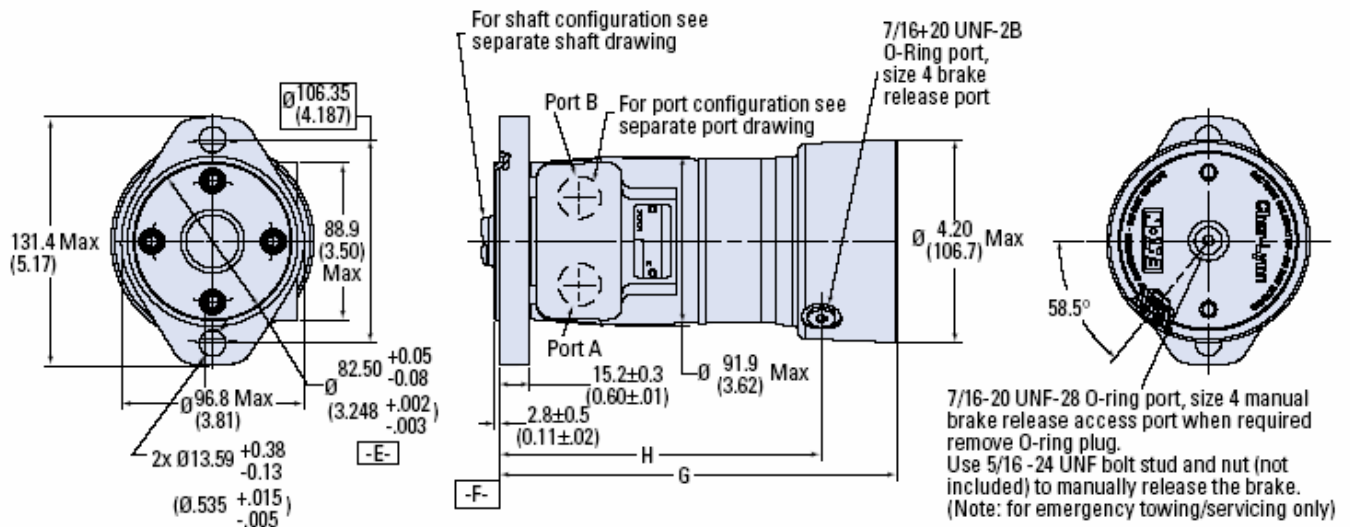

**T Series Brake Holding Torque Setting:**

Shaft Code	Output Shaft Description [ccn]	36	49	66	80	102	131	157	195	244	306	370
18	1" Tapered w/key and nut	225	225	225	405	405	405	565	565	565	565	565
02	1" SAE 6B Splined	225	225	225	405	405	405	565	565	565	565	565
24/39	25mm Straight w/key	225	225	225	405	405	405	405	405	405	405	405
01	1" Straight w/key	225	225	225	405	405	405	405	405	405	405	405
07	1" Straight w/.31 dia. crosshole	225	225	225	405	405	405	405	405	405	405	405
08	1" Straight w/.40 dia. crosshole	225	225	225	405	405	405	405	405	405	405	405
16	7/8" SAE B 13T Splined	225	225	225	225	225	225	225	225	225	225	225
17	7/8" SAE B Straight w/key	225	225	225	225	225	225	225	225	225	225	225

**Data In-Nm**



## Dimensions



DISPLACEMENT	G MAX	H
code	Width mm [in.]	Length mm [in.]
020	190.2 [7.49]	145.8±0.9 [5.74±0.3]
030	192.5 [7.58]	148.2±0.9 [5.84±0.3]
040	195.6 [7.70]	151.2±0.9 [5.95±0.3]
049	198.4 [7.81]	153.9±0.9 [6.06±0.3]
062	202.2 [7.96]	157.8±0.9 [6.21±0.3]
080	207.5 [8.17]	163.2±0.9 [6.42±0.3]
096	212.6 [8.37]	168.1±0.9 [6.62±0.3]
119	219.2 [8.63]	174.8±0.9 [6.88±0.3]
149	228.3 [8.99]	183.8±0.9 [7.24±0.3]
187	239.5 [9.43]	195.2±0.9 [7.69±0.3]
226	251.2 [9.89]	206.9±0.9 [8.14±0.3]

### Note

#### Standard Rotation

When facing shaft end of motor shaft to rotate clockwise when port "A" is pressurized, counter-clockwise when port "B" is pressurized

#### Reverse Rotation

When facing shaft end of motor shaft will rotate clockwise when port "B" is pressurized, counter-clockwise when port "A" is pressurized





## Product Numbers

### PRODUCT NUMBERS WITH STANDARD VALVING – T-BRAKE SERIES

Add three digit prefix —185—to four digit number from chart for complete product number—Example 185-1068.  
Orders will not be accepted without three digit prefix.

Mounting	Shaft	Ports	Part# Prefix	3.0	4.0	4.9	6.2	8.0	9.6	11.9	14.9	18.7	22.6	
				2-Bolt	1" Keyed	7/8-14 O-ring Manifold	185- 185-	2000 2010	2001 2011	2002 2012	2003 2013	2004 2014	2005 2015	2006 2016
2-Bolt	6B Splined	7/8-14 O-ring Manifold	185- 185-	2020 2030	2021 2031	2022 2032	2023 2033	2024 2034	2025 2035	2026 2036	2027 2037	2028 2038	2029 2039	
		13T Splined 16/32 pitch	7/8-14 O-ring Manifold	185- 185-	2040 2050	2041 2051	2042 2052	2043 2053	2044 2054	2045 2055	2046 2056	2047 2057	2048 2058	2049 2059
4-Bolt	1" Keyed	7/8-14 O-ring Manifold	185- 185-	2060 2070	2061 2071	2062 2072	2063 2073	2064 2074	2065 2075	2066 2076	2067 2077	2068 2078	2069 2079	
		6B Splined	7/8-14 O-ring Manifold	185- 185-	2080 2090	2081 2091	2082 2092	2083 2093	2084 2094	2085 2095	2086 2096	2087 2097	2088 2098	2089 2099
			13T Splined 16/32 pitch	7/8-14 O-ring Manifold	185- 185-	2100 2110	2101 2111	2102 2112	2103 2113	2104 2114	2105 2115	2106 2116	2107 2117	2108 2118
2-Bolt SAE B	1" Keyed	7/8-14 O-ring Manifold	185- 185-	2120 2130	2121 2131	2122 2132	2123 2133	2124 2134	2125 2135	2126 2136	2127 2137	2128 2138	2129 2139	
		6B Splined	7/8-14 O-ring Manifold	185- 185-	2140 2150	2141 2151	2142 2152	2143 2153	2144 2154	2145 2155	2146 2156	2147 2157	2148 2158	2149 2159
	13T Splined 16/32 pitch		7/8-14 O-ring Manifold	185- 185-	2160 2170	2161 2171	2162 2172	2163 2173	2164 2174	2165 2175	2166 2176	2167 2177	2168 2178	2169 2179

### PRODUCT NUMBERS WITH LOW SPEED VALVING – T-BRAKE SERIES

Mounting	Shaft	Ports	Part# Prefix	3.0	4.0	4.9	6.2	8.0	9.6	11.9	14.9	18.7	22.6
				2-Bolt	1" Keyed	7/8-14 O-ring Manifold	185- 185-	2180 2190	2181 2191	2182 2192	2183 2193	2184 2194	2185 2195
6B Splined	7/8-14 O-ring Manifold	185- 185-	2200 2210			2201 2211	2202 2212	2203 2213	2204 2214	2205 2215	2206 2216	2207 2217	2208 2218
	2-Bolt	13T Splined 16/32 pitch	7/8-14 O-ring Manifold	185- 185-	2220 2230	2221 2231	2222 2232	2223 2233	2224 2234	2225 2235	2226 2236	2227 2237	2228 2238
4-Bolt			1" Keyed	7/8-14 O-ring Manifold	185- 185-	2240 2250	2241 2251	2242 2252	2243 2253	2244 2254	2245 2255	2246 2256	2247 2257
	6B Splined	7/8-14 O-ring Manifold		185- 185-	2260 2270	2261 2271	2262 2272	2263 2273	2264 2274	2265 2275	2266 2276	2267 2277	2268 2278
4-Bolt		13T Splined 16/32 pitch	7/8-14 O-ring Manifold	185- 185-	2280 2290	2281 2291	2282 2292	2283 2293	2284 2294	2285 2295	2286 2296	2287 2297	2288 2298
	2-Bolt SAE B		1" Keyed	7/8-14 O-ring Manifold	185- 185-	2300 2310	2301 2311	2302 2312	2303 2313	2304 2314	2305 2315	2306 2316	2307 2317
6B Splined		7/8-14 O-ring Manifold		185- 185-	2320 2330	2321 2331	2322 2332	2323 2333	2324 2334	2325 2335	2326 2336	2327 2337	2328 2338
	2-Bolt SAE B	13T Splined 16/32 pitch	7/8-14 O-ring Manifold	185- 185-	2340 2350	2341 2351	2342 2352	2343 2353	2344 2354	2345 2355	2346 2356	2347 2357	2348 2358

\* Manifold product numbers shown are for motors with four 5/16-18 port face mounting threads. Manifold, manifold mounting o-rings and bolts are NOT included.

For T-Brake Series Motors with a configuration Not Shown in these charts: Use the model code number system on page 00 to specify the product in detail.

Special order displacements also available: 36cc [2.2], 38cc [2.4], 58cc [7.6]

These motors with the low speed valving option provide very low speed while maintaining high torque. **Designed to run continuously at up to 200 RPM at standard rated pressures and reduced flows,**

providing smooth operation at low speeds. Furthermore, they resist slippage and have more momentary load holding ability than the standard standard motors.

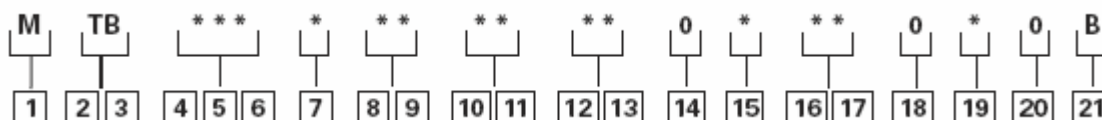
**Motors with this valving are not intended for low pressure applications (41 Bar [600 PSI] Minimum).** Shaft side / radial load ratings are not affected by this valving.



## Model Code

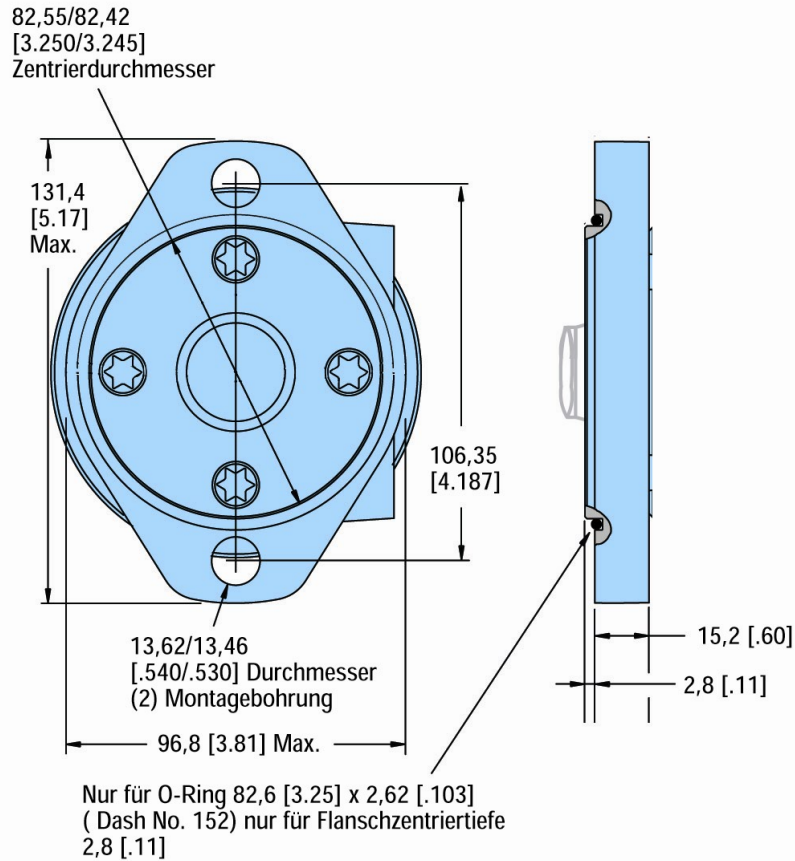
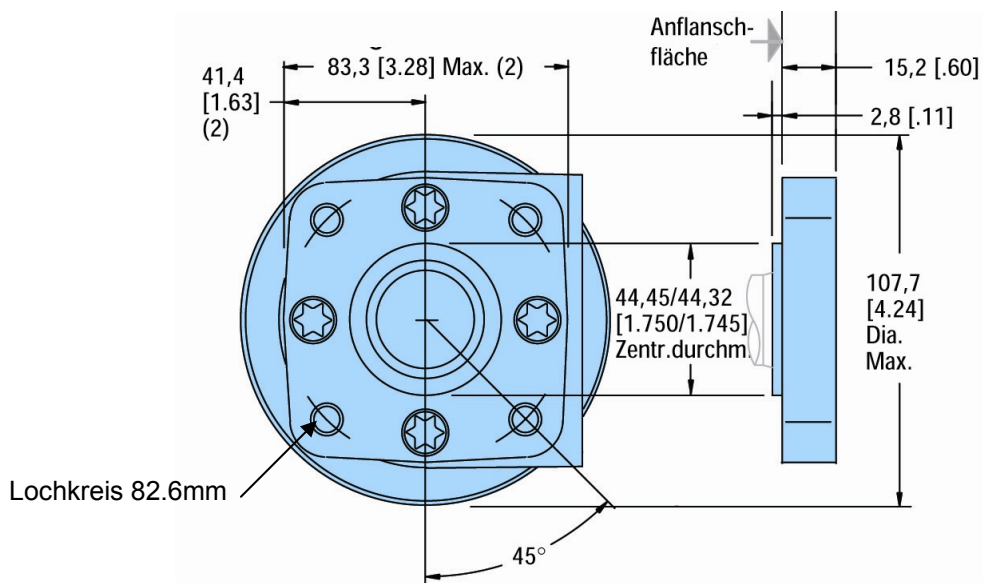
### T Series with Parking Brake

The following 21-digit coding system has been developed to identify all of the configuration options for the T Series Motor with Parking Brake. Use this model code to specify a motor with the desired features. All 21-digits of the code must be present when ordering. You may want to photocopy the matrix below to ensure that each number is entered in the correct box.

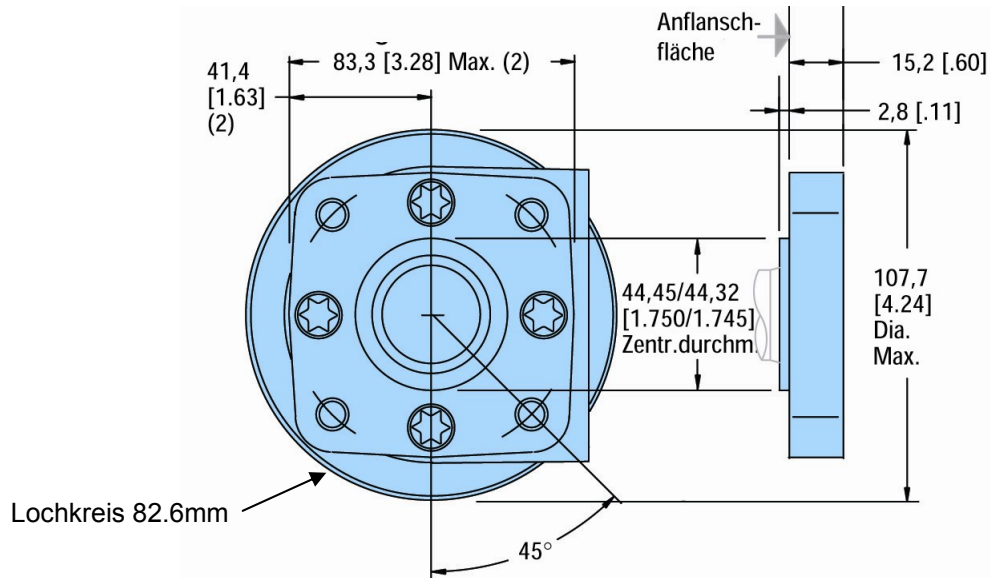


<p><b>1</b> <b>Product</b> M Motor</p> <p><b>2</b>, <b>3</b> <b>Series</b> TB T-Series Motor with Parking Brake</p> <p><b>4</b>, <b>5</b>, <b>6</b> <b>Displacement cm<sup>3</sup>/r [in<sup>3</sup>/r]</b> 022 – 36 [2.2] 030 – 49 [3.0] 040 – 66 [4.0] 049 – 80 [4.9] 062 – 102 [6.2] 080 – 131 [8.0] 096 – 157 [9.6] 119 – 195 [11.9] 149 – 244 [14.9] 187 – 306 [18.7] 226 – 370 [22.6]</p> <p><b>7</b> <b>Gerotor/Geroler Options</b> A Standard B Free Running</p>	<p><b>8</b>, <b>9</b> <b>Mounting Type</b> AA 2 Bolt (Standard) 82,6 [3.25] Pilot Dia. and 13,59 [.535] Dia. Mounting Holes on 106,4 [4.19] Dia. B.C. BA 4 Bolt (Standard) 44,4 [1.75] Pilot Dia. and 3/8-16 Mounting Holes on 82,6 [3.25] Dia. B.C. DA 2 Bolt (Standard) 101,6 [4.00] Pilot Dia. and 14,35 [.565] Dia. Mounting Holes on 146,0 [5.75] Dia. B.C. (SAE B) EA 4 Bolt Magneto 82,6 [3.25] Pilot Dia. and 13,59 [.535] Dia. Mounting Holes 106,4 [4.19] Dia. B.C. FA 4 Bolt (Standard) 44,4 [1.75] Pilot Dia. and M10 x 1,5-6H Mounting Holes on 82,6 [3.25] Dia. B.C. MA 2 Bolt (Standard) 82,50 [3.25] Pilot Dia x 8.13 [0.32] Pilot, 13.59 [0.535] Dia.</p>	<p><b>10</b>, <b>11</b> <b>Output Shaft</b> 01 25.4 [1.00] Dia. Straight with Woodruff Key and 1/4-20 Threaded Hole 02 25.4 [1.00] Dia. SAE 6B Spline with 1/4-20 Threaded Hole 16 21,74 [.856] Dia. SAE B 13 T Spline 18 25.4 [1.00] Dia. Tapered with Woodruff Key and Nut 24 25 [.98] Dia. Straight with 8mm Key and 8mm x 1.2 Threaded Hole 27 25.4 [1.00] Dia. Straight with Woodruff Key and 1/4-20 Threaded Hole (Plated for Corrosion Pr 39 25mm (k6) Dia. Straight with 8mm key, M8x1.25-6H hole in shaft</p> <p><b>12</b>, <b>13</b> <b>Port Type</b> AA 7/8 – 14 O-ring AC Manifold (5/16-18 Mounting Threads) AE G ½ (BSP) Straight Thread</p>	<p><b>14</b> <b>Case Flow Options</b> 0 None</p> <p><b>15</b> <b>Seal Options</b> 0 Standard 7 High Pressure Shaft Seal</p> <p><b>16</b>, <b>17</b> <b>Special Features (Hardware)</b> 00 None Specified AB Low Speed Value</p> <p><b>18</b> <b>Special Features (Assembly)</b> 0 None Specified</p> <p><b>19</b> <b>Paint/Packaging Options</b> 0 No Paint A Painted Low Gloss Black</p> <p><b>20</b> <b>Eaton Assigned Code When Applicable</b> 0 Assigned Code</p> <p><b>21</b> <b>Design Code</b> B Two (2)</p>
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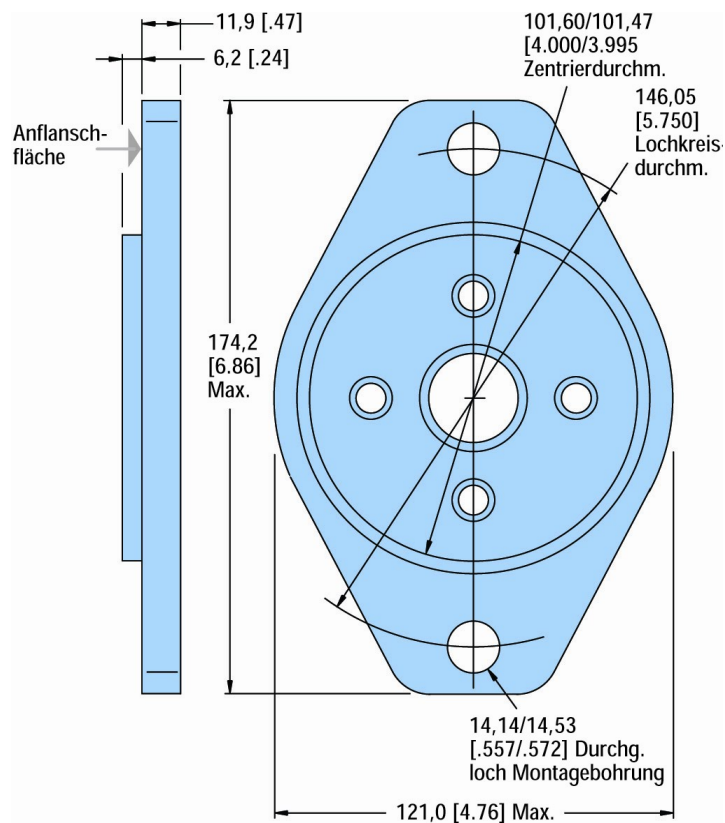
### Mounting Type (Model Code Pos. 8 and 9)

**AA**

**BA**


FA

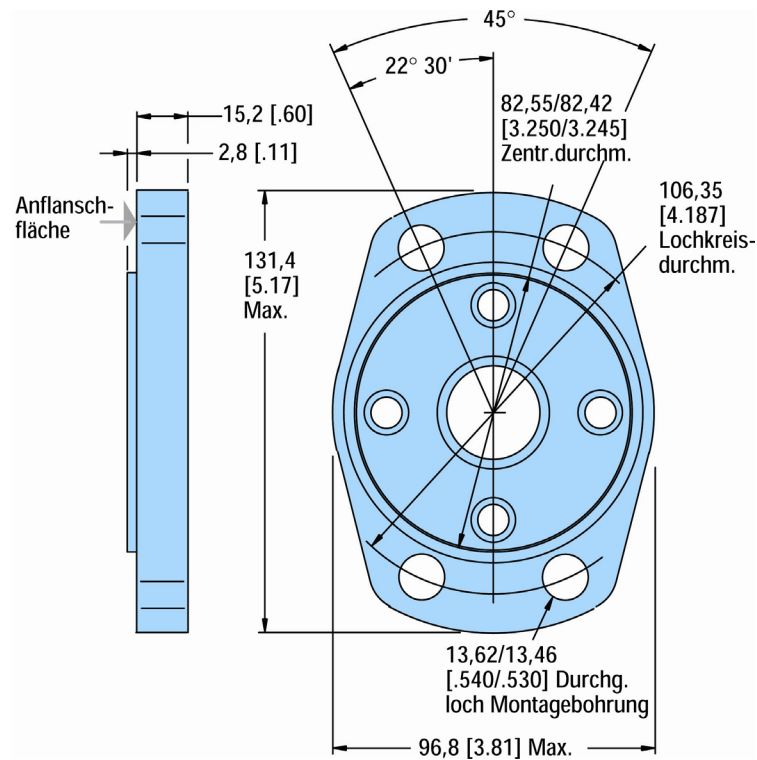


DA

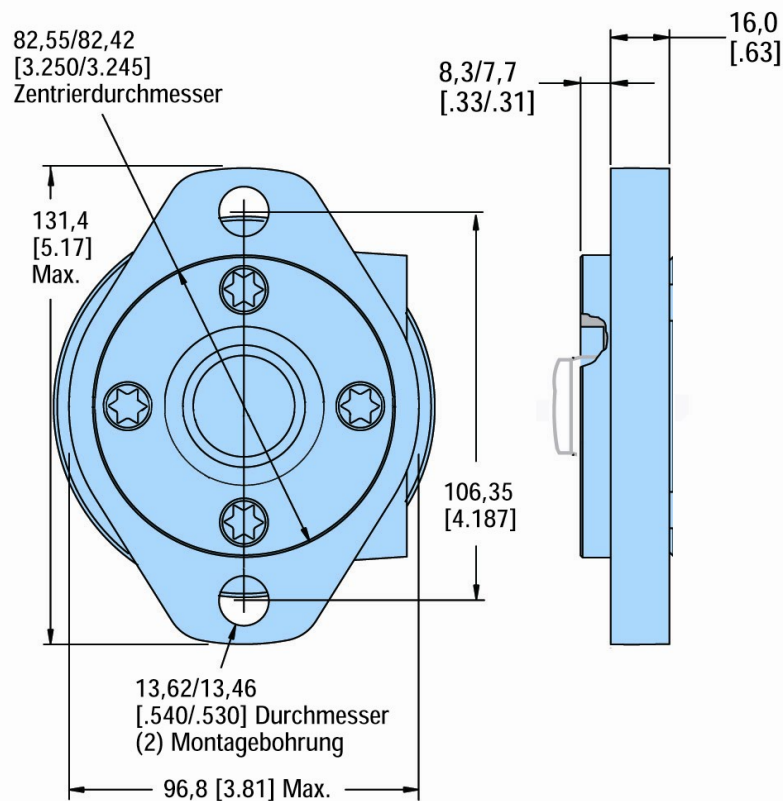




EA



MA





## Shaft Side Load Capacity

The hydrodynamic journal bearings have infinite life when shaft load ratings are not exceeded. As a result, the shaft side load capacity is more than adequate to handle most application requirements provided the motor is applied within its torque rating.

Side load curves (below) are based on the side/radial loads being applied to the shaft at locations A, B, and C. To determine the shaft side load capacity at locations other than those shown use the formula below: For more information about shaft side loads on Char-Lynn motors contact your Eaton representative.

### Note

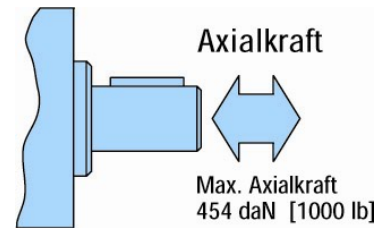
When the speed sensor option is used, the side load ratings are reduced 25%.

Zul. Radialkraft P in N

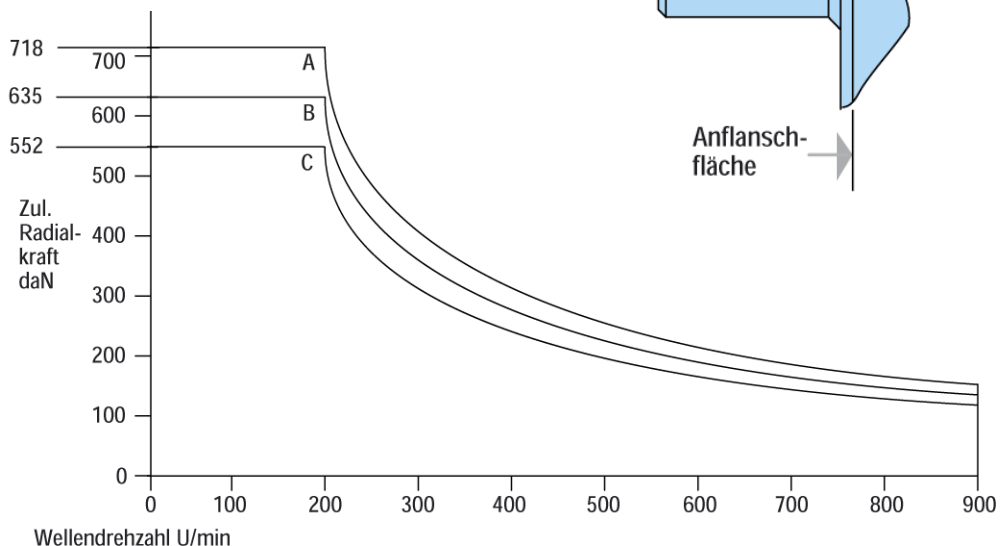
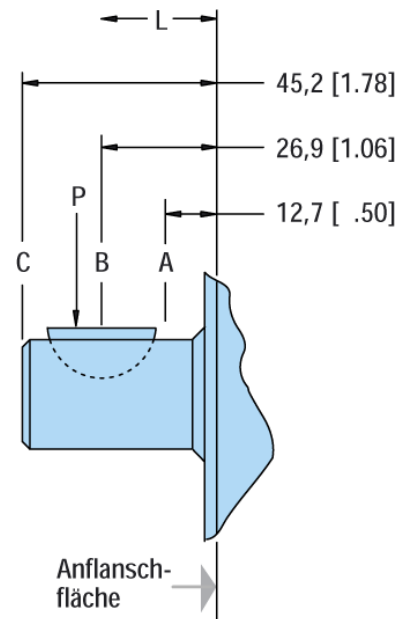
$$P = \frac{9000}{n} \times \left( \frac{16800}{L + 96.3} \right)$$

n = Wellendrehzahl in 1/min

L = Abstand von der Anflanschfläche in mm [in]



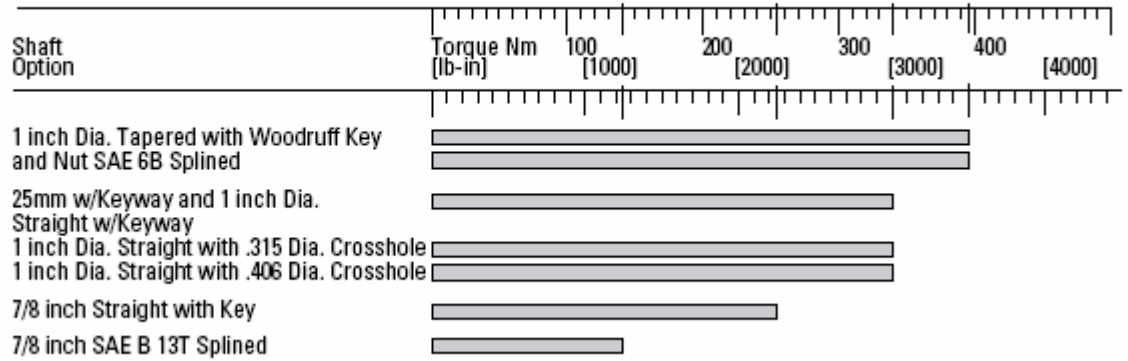
1/min	Zul. Radialkraft daN [lb]		
	A	B	C
900	154 [ 339]	136 [ 300]	118 [ 261]
625	205 [ 452]	181 [ 400]	158 [ 348]
500	256 [ 565]	227 [ 500]	197 [ 435]
400	307 [ 678]	272 [ 600]	237 [ 522]
300	410 [ 904]	363 [ 800]	316 [ 696]
200	718 [1582]	635 [1400]	552 [1216]



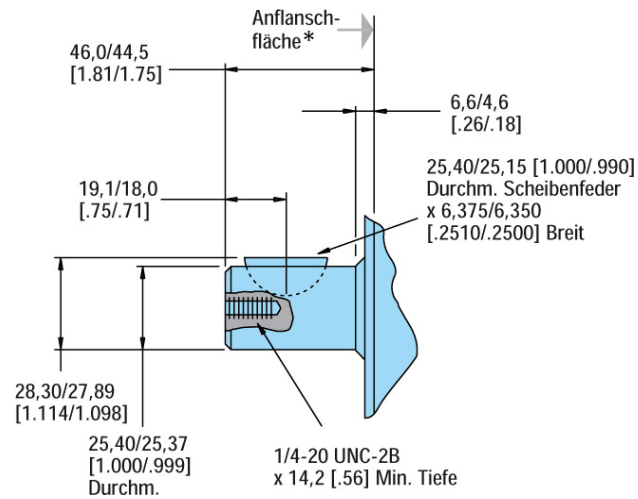
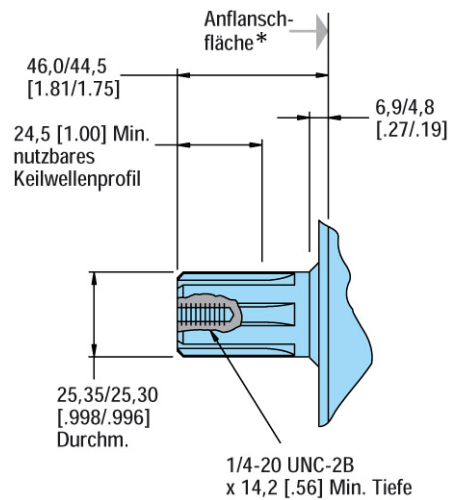


## Shaft Dimension

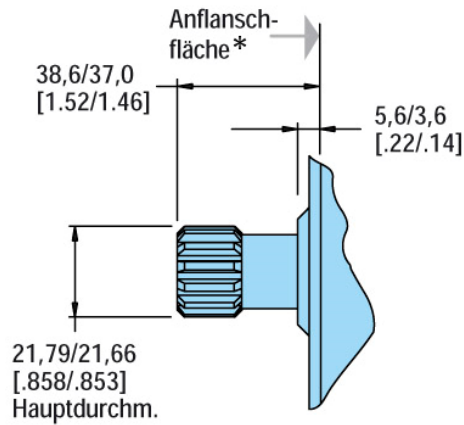
### Shaft Size/Motor Torque Combination Limit Guide



## Output Shaft (Model Code Pos. 10 and 11)

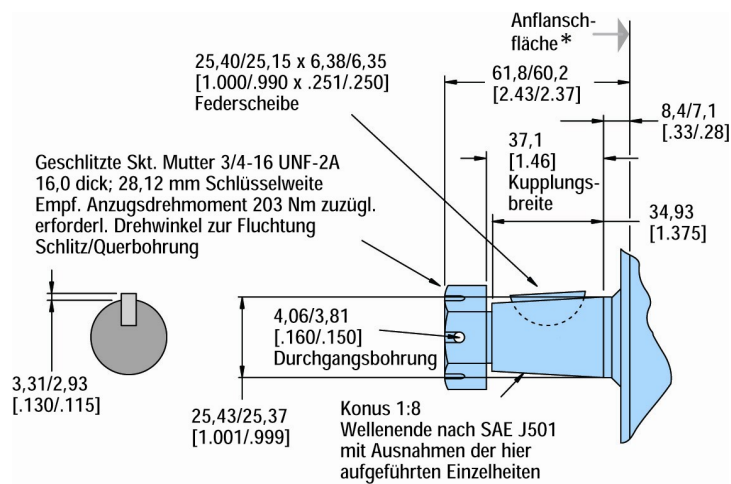
**01**

**02**


16



Max. Drehmoment 150Nm

18

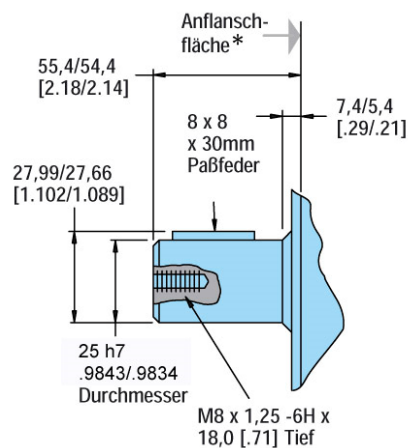


Max. Drehmoment 350Nm

Max. Drehmoment 350Nm

Max. Drehmoment 400Nm

24

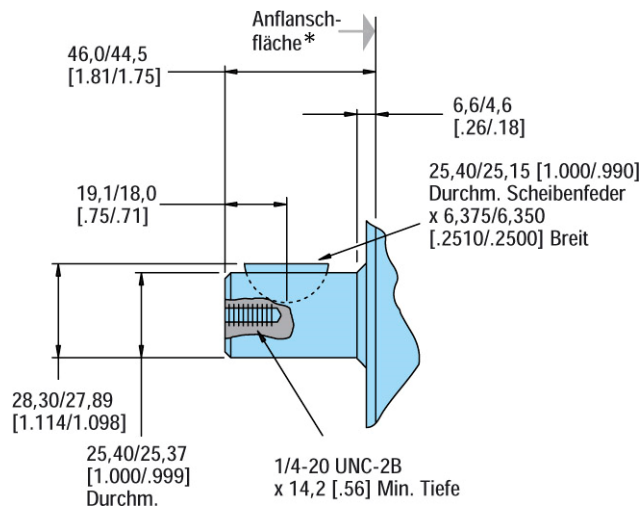


Max. Drehmoment 350Nm

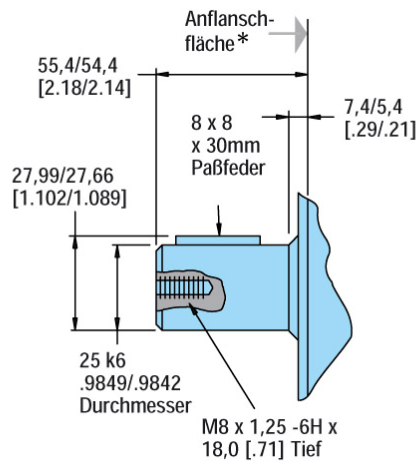
Max. Drehmoment 350Nm



27

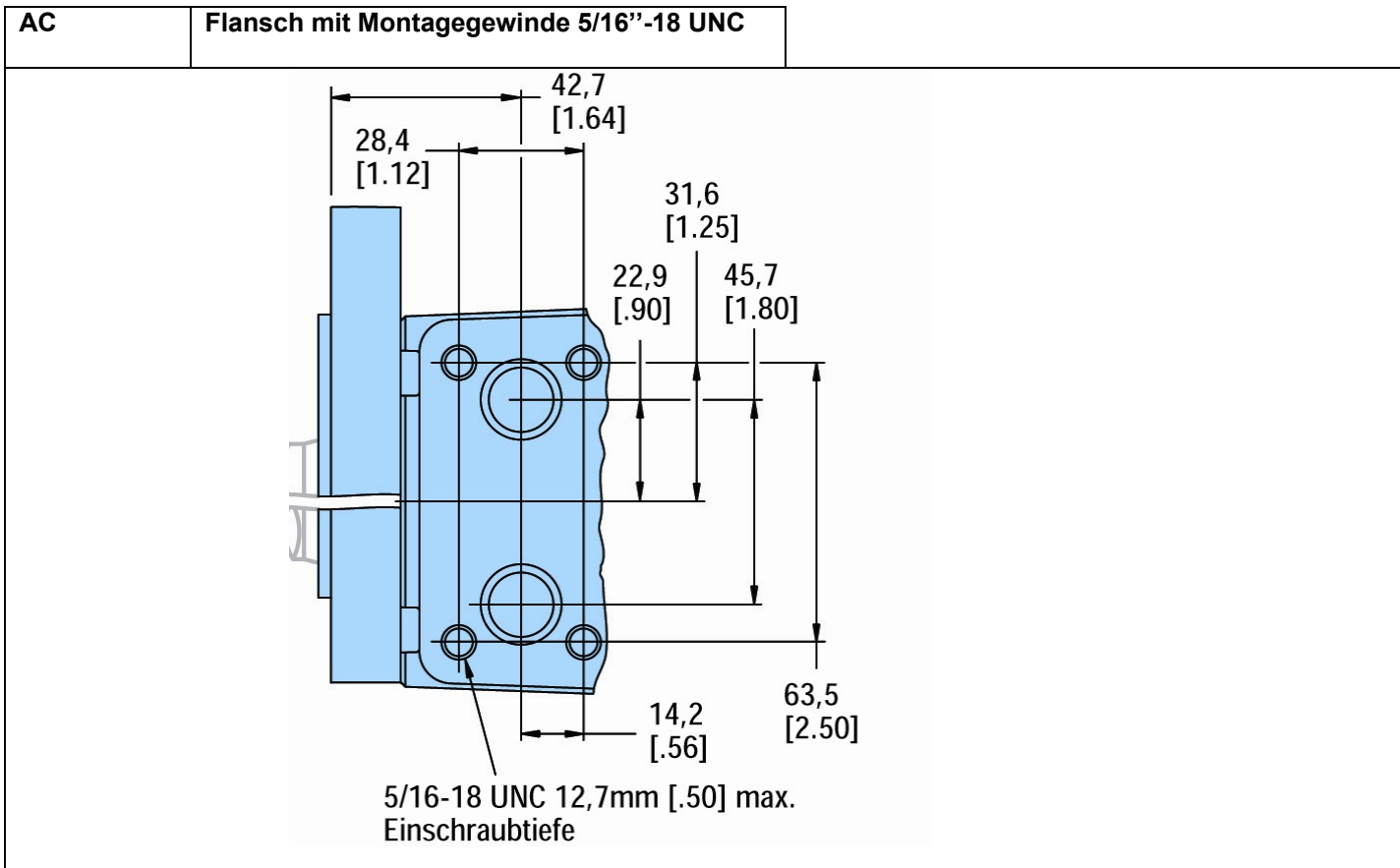
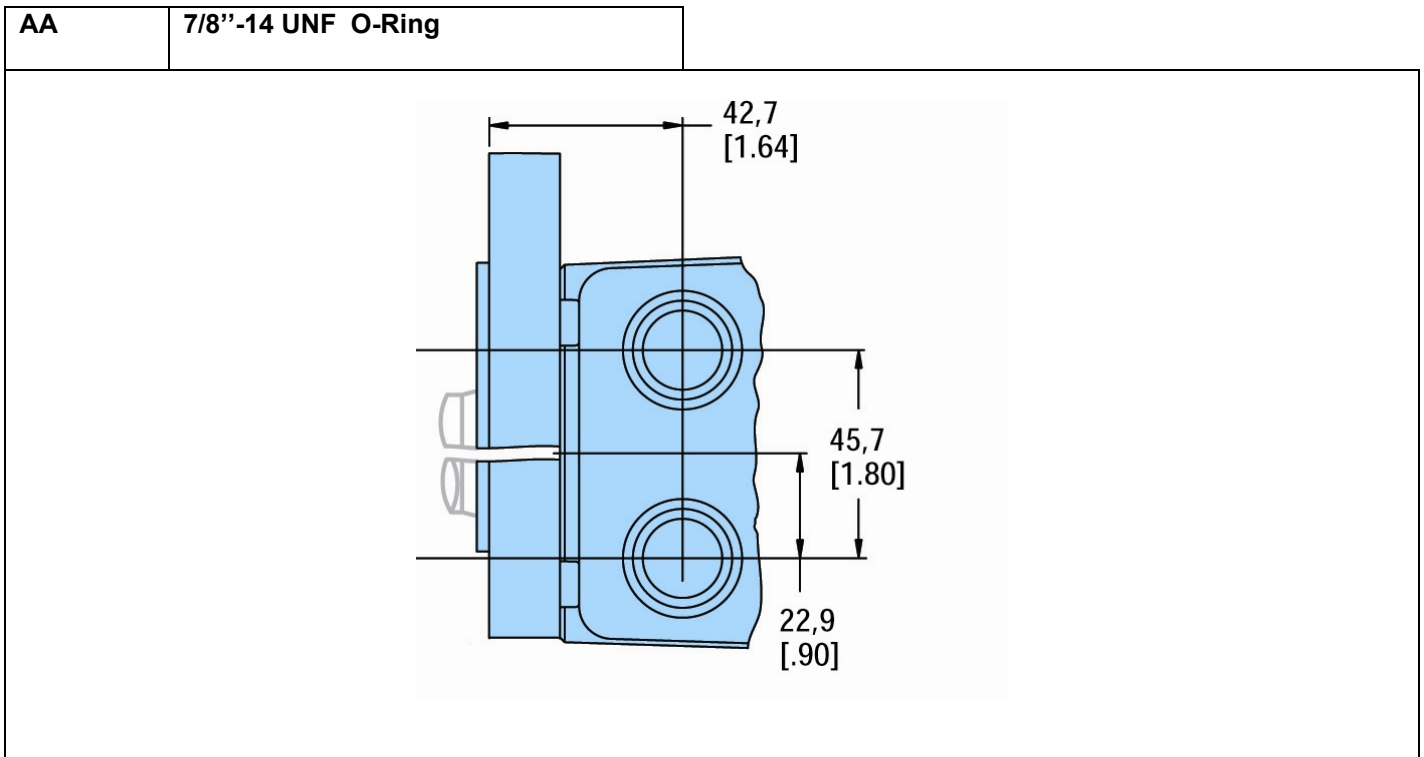


39



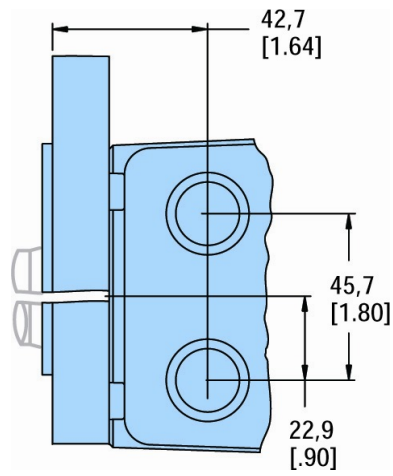


## Port Type (Model Code Pos. 12 and 13)





AE	G 1/2" BSP
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## Case Pressure, Release Pressure and Case Drain

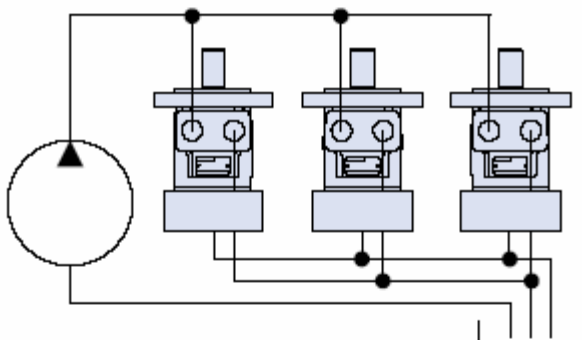
### Series or Parallel Connection

Hydraulic lines bringing pressurized fluid from the pump to the motor and return flow from the motor back to tank can be flexible or rigid. One pump can be sized to supply a single motor or many motors. Furthermore, one pump and multiple motors can be connected in series or in parallel (see each type of connection shown below). When connecting the pump to the motors in series excess internal case pressure is created in the motor, this excess pressure must be ported back to

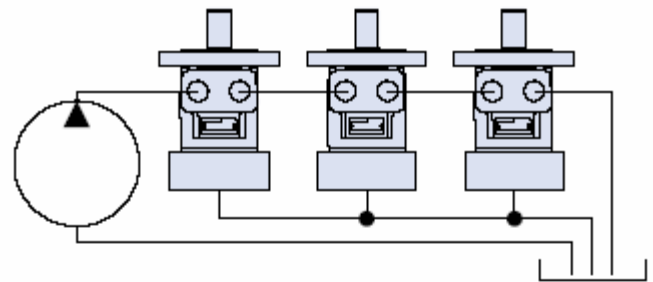
tank. However, when making a parallel connection from the pump to the motors no excess case pressure will be added. The T brake motor must maintain a minimum case pressure of 250 psi to fully release the brake. Case pressure must be zero for full holding capacity.

**...Case Drain Advantage —** In addition to providing lower case pressures for motors connected in series, there are advantages for adding an external case drain line to motors with normal case pressures as well. These advantages are:  
**Contamination Control —** flushing the motor case.  
**Cooler System —** exiting oil draws motor heat away.  
**Extend Motor Seal Life —** maintain low case pressure with a preset restriction installed in the case drain line.

### Case Drain Optional

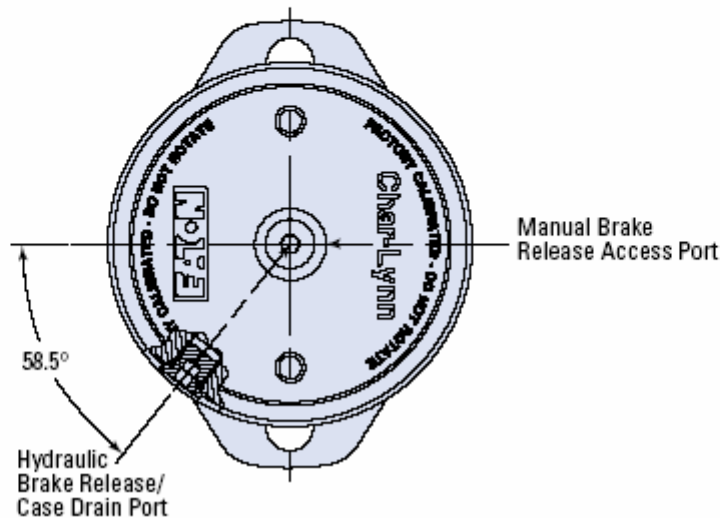


Parallel Connection



Series Connection

### Manual Brake Release Access Port

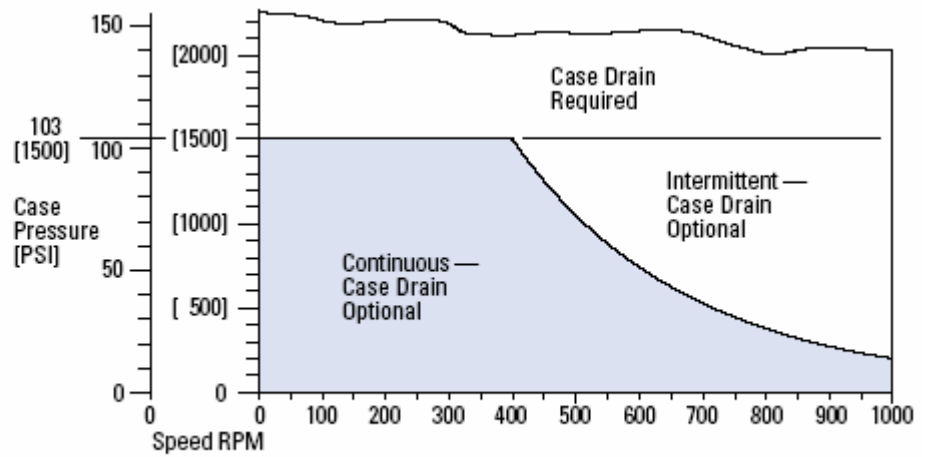
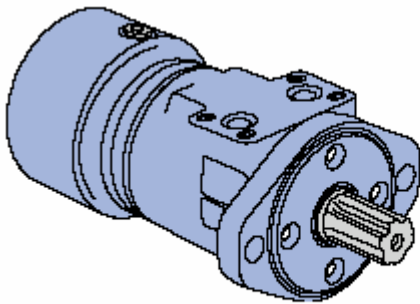




## Case Pressure

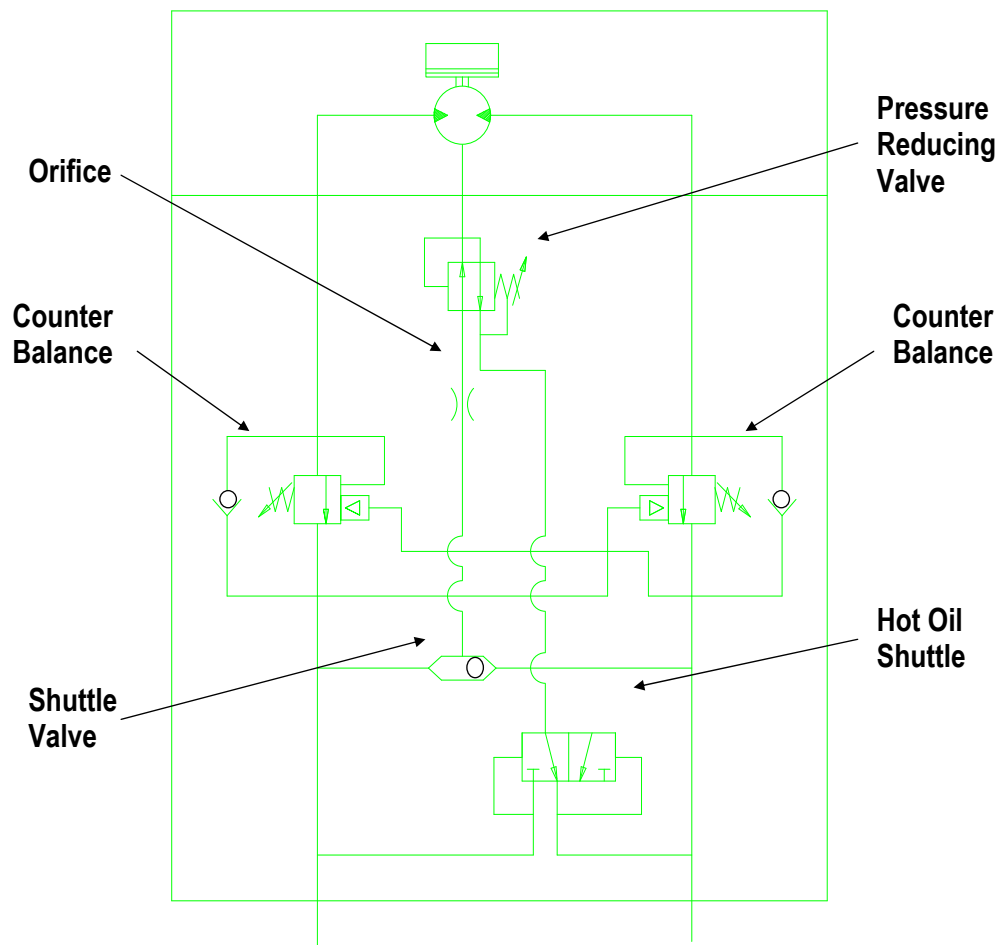
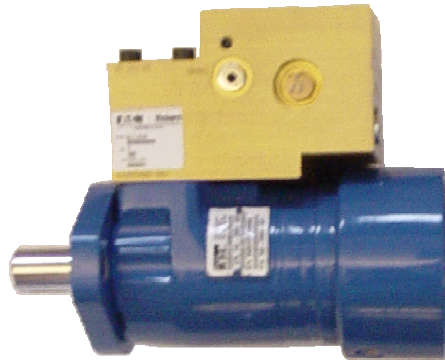
Char-Lynn T-Brake Series motors are durable and have long life as long as the recommended case pressure is not exceeded. Allowable case pressure is highest at low shaft speeds. Consequently, motor life will be shortened if case pressure exceeds these ratings (acceptability may vary with application). Reference the case pressure seal limitation chart

below — chart based on case pressure and shaft speed. A pressure restriction should be added to the case drain/brake release line, during which a motor case pressure of 17 Bar [250 PSI] is maintained.



## Brake Circuit with Dual Counter-Balance

New manifold mounted cartridge valve assembly immediately releases the brake with a small shuttle valve when pressure is applied to either work port. This shuttle feeds through a pressure reducing valve so as not to damage the integrity of the shaft seal. This valve also comes with a counter balance option.







## Fluid Recommendations

### Introduction

The ability of Eaton hydraulic components to provide the desired performance and life expectancy depends largely on the fluid used. The purpose of this section is to provide readers with the knowledge required to select the appropriate fluids for use in systems that employ Eaton hydraulic components.

One of the most important characteristics to consider when choosing a fluid to be used in a hydraulic system is viscosity. Viscosity choice is always a compromise; the fluid must be thin enough to flow easily but thick enough to seal and maintain a lubricating film between bearing and sealing surfaces. Viscosity requirements, see chart below.

### Viscosity and Temperature

Fluid temperature affects viscosity. In general, as the fluid warms it gets thinner and its viscosity decreases. The opposite is true when fluid cools. When choosing a fluid, it is important to consider the start-up and operating temperatures of the hydraulic system.

Generally, the fluid is thick when the hydraulic system is started. With movement, the fluid warms to a point where a cooling system begins to operate.

From then on, the fluid is maintained at the temperature for which the hydraulic system was designed. In actual applications this sequence varies; hydraulic systems are used in many environments from very cold to very hot. Cooling systems also vary from very

elaborate to very simple, so ambient temperature may affect operating temperature. Equipment manufacturers who use Eaton hydraulic components in their products should anticipate temperature in their designs and make the appropriate fluid recommendations to their customers.

### Cleanliness

Cleanliness of the fluid in a hydraulic system is extremely important. Eaton recommends that the fluid used in its hydraulic components be maintained at ISO Cleanliness Code 18/13 per SAE J1165. This code allows a maximum of 2500 particles per milliliter greater than 5 mm and a maximum of 80 particles per milliliter greater than 15 mm. Cleanliness requirements for specific products are given in the table below.

OEM's and distributors who use Eaton hydraulic components in their products should provide for these requirements in their designs. A reputable filter supplier can supply filter information.

### Fluid Maintenance

Maintaining correct fluid viscosity and cleanliness level is essential for all hydraulic systems. Since Eaton hydraulic components are used in a wide variety of applications it is impossible for Eaton to publish a fluid maintenance schedule that would cover every situation. Field testing and monitoring are the only ways to get accurate measurements of system cleanliness. OEM's and distributors who use Eaton hydraulic components should test and establish

fluid maintenance schedules for their products. These maintenance schedules should be designed to meet the viscosity and cleanliness requirements laid out in this document.

### Fluid Selection

Premium grade petroleum based hydraulic fluids will provide the best performance in Eaton hydraulic components. These fluids typically contain additives that are beneficial to hydraulic systems. **Eaton recommends fluids that contain anti-wear agents, rust inhibitors, anti-foaming agents, and oxidation inhibitors.** Premium grade petroleum based hydraulic fluids carry an ISO VG rating.

SAE grade crankcase oils may be used in systems that employ Eaton hydraulic components, but it should be noted that these oils may not contain all of the recommended additives. This means using crankcase oils may increase fluid maintenance requirements.

Hydraulic fluids that contain V.I. (viscosity index) improvers, sometimes called multi-viscosity oils, may be used in systems that employ Eaton hydraulic components. These V.I. improved fluids are known to "shear-down" with use. This means that their actual viscosity drops below the rated value. Fluid maintenance must be increased if V.I. improved fluids are used. Automotive

automatic transmission fluids contain V.I. improvers.

Synthetic fluids may be used in Eaton hydraulic components. A reputable fluid supplier can provide information on synthetic fluids. Review applications that require the use of synthetic fluids with your Eaton representative.

### Additional Notes:

- Fluids too thick to flow in cold weather start-ups will cause pump cavitation and possible damage. **Motor cavitation is not a problem during cold start-ups.**
- When choosing a hydraulic fluid, all the components in the system must be considered and the best viscosity range adjusted accordingly. For example, when a medium duty piston pump is combined with a Geroler motor the best viscosity range becomes 100 - 150 SUS [20 - 32 cSt] and viscosity should never fall below 70 SUS [13 cSt].
- If the natural color of the fluid has become black it is possible that an overheating problem exists.
- If the fluid becomes milky a water contamination problem may exist.
- Take fluid level reading when the system is cold.
- Contact your Eaton representative if you have specific questions about the fluid requirements of Eaton

Product Line	Viscosity Minimum	Viscosity Best Range	ISO Cleanliness Requirements
T Series	13 SUS	20-43 cSt	18/13