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The Eaton Series 760 Variable Displacement Pump

Features
- 430 bar pressure rating
- Speeds to 3,200 rpm
- Electronic controls
- Tandem pump capability

Typical Applications
- Agricultural sprayers
- Directional drilling
- Dozers
- Large harvesting machines
- Marine thrusters
- Material handling
- Railway maintenance
- Sewer cleaning equipment
- Snow groomers
- Tub grinder

- The Series 760 Variable Displacement Pump, with a cradle swashplate design, combines the time-tested reliability you expect from Eaton with compact packaging, exceptional control and quiet operation. New pump mounted electronic controls range from the simple Electronic Proportional (EP) Displacement Control to the Solenoid control with electronic swashplate position feedback.

- The Series 760 Pump’s single piece pump housing provides exceptional strength and soundproofing. Eaton’s cast iron housing has only one major opening versus two openings for competitive pumps. This provides a stronger, more rigid pump housing and reduces the number of gasketed joints.

- A large diameter single servo piston permits pump operation at lower charge pressures, minimizing parasitic charge pump losses for increased overall pump efficiency. Large centering springs return the pump to neutral in the event of control pressure loss.

- Integral gerotor type charge pump combines excellent suction/speed capabilities in a compact design. Several displacement options are available to suit the needs of every application, including tandem pumps.

- The pump mounted electronic controls and sensors have been specially designed to meet the rigors of the mobile — off road environment, including resistance to electromagnetic interference or emissions.

- A variety of available drive shaft configurations — straight keyed, splined, or tapered—ensures the proper shaft for your application.

- The serviceable bi-metal bearing plate has steel for high pressure capability and a bronze bearing face for high speed capabilities.

- SAE auxiliary mounts: “A,” “B,” “B-B” and “C” are available with and without charge pump. SAE “D” mount is only available without charge pump. Excellent torque capability allows high horsepower to work circuits without multiple pump drives.

- The code 62 ports are located on the same side and are available with SAE and metric threads.
Specifications and Performance

Specifications

<table>
<thead>
<tr>
<th>Model Code Number</th>
<th>130 (7.93)</th>
<th>160 (9.76)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Displacement cc/rev (in³/rev)</td>
<td>130</td>
<td>160</td>
</tr>
<tr>
<td>Input Torque N x M @ 240 bar (lbf x in @ 3500 psi)</td>
<td>525 (4652)</td>
<td>647 (5725)</td>
</tr>
<tr>
<td>Temperature Rating °C</td>
<td>82°C</td>
<td>82°C</td>
</tr>
<tr>
<td>°F</td>
<td>180°F</td>
<td>180°F</td>
</tr>
</tbody>
</table>

* Nominal Pressure: max delta system pressure at which component fatigue does not occur (pump life estimated by bearing life).
* Peak Pressure: max operation pressure which is permissible for a short duration of time (t < 1 sec).

The following chart shows the expected bearing life with no external shaft side load and charge pressure of 21 bar (304 psi).

Performance

Input Torque vs. Speed

Output Flow vs. Speed

EATON Series 760 Variable Displacement Pump E-PUU7-TM007-E1 November 2009
The charge pump generates a low pressure flow of oil to perform the following functions:

1. Keeps the closed loop circuit full of oil.
2. Provides control pressure to the pump’s displacement control servo valve for easy control of the transmission’s output speed.
3. Provides cool, clean oil from the reservoir to keep the transmission pump and motor well lubricated and cooled.
4. Supplies a positive boost pressure to the pistons of the piston pump and piston motor.

<table>
<thead>
<tr>
<th>Charge Pump</th>
<th>cm³/r</th>
<th>21.0</th>
<th>27.9</th>
<th>34.7</th>
<th>42.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performance*</td>
<td>in³/r</td>
<td>1.28</td>
<td>1.70</td>
<td>2.12</td>
<td>2.56</td>
</tr>
<tr>
<td>Maximum Shaft Speed</td>
<td>rpm</td>
<td>3300</td>
<td>2700</td>
<td>2550</td>
<td>2400</td>
</tr>
<tr>
<td>Output Flow ** at Maximum Speed</td>
<td>l/min</td>
<td>69.2</td>
<td>75.2</td>
<td>88.6</td>
<td>100.7</td>
</tr>
<tr>
<td>Maximum Speed</td>
<td>gal/min</td>
<td>18.3</td>
<td>19.9</td>
<td>23.4</td>
<td>26.6</td>
</tr>
<tr>
<td>Input Horsepower** at Maximum Speed</td>
<td>kW</td>
<td>2.42</td>
<td>2.63</td>
<td>3.11</td>
<td>3.53</td>
</tr>
</tbody>
</table>

Series 760
Pump Displacement

* Used with Pump Displacement
** Theoretical output flow and input power at 21 bar (305 psi) and maximum input speed.
The following 32 digit coding system has been developed to identify preferred feature options for the 760 Series Variable Displacement Pump. Use this code to specify a pump with the desired features. All 32-digits of the code must be present to release a new product number for ordering. Please contact your local customer service representative for leadtime questions.

<table>
<thead>
<tr>
<th>Model Codes</th>
<th>ADZ – Hydrostatic - Heavy Duty Variable Pump</th>
</tr>
</thead>
<tbody>
<tr>
<td>Displacement</td>
<td>130 – 130.0 cm³/r (793 ln³/r) at 18°</td>
</tr>
<tr>
<td>160 – 160.0 cm³/r (9.76 ln³/r) at 18°</td>
<td></td>
</tr>
<tr>
<td>Input Shaft</td>
<td>01 – (1.750) diameter tapered with (4.4375) x (1.00) square key</td>
</tr>
<tr>
<td>02 – (1.750) diameter straight with (4.4375) x (1.00) square key</td>
<td></td>
</tr>
<tr>
<td>12 – 13 tooth 8/16 pitch spline with 5/8-11 unc thread in end</td>
<td></td>
</tr>
<tr>
<td>13 – 13 tooth 8/16 pitch spline</td>
<td></td>
</tr>
<tr>
<td>23 – 23 tooth 16/32 pitch spline (rear of tandem)</td>
<td></td>
</tr>
<tr>
<td>27 – 27 tooth 16/32 pitch spline</td>
<td></td>
</tr>
<tr>
<td>Input Rotation</td>
<td>L – Counterclockwise (lefthand)</td>
</tr>
<tr>
<td>R – Clockwise (righthand)</td>
<td></td>
</tr>
<tr>
<td>Valve Plate</td>
<td>0 – Standard</td>
</tr>
<tr>
<td>Main Ports (Includes Gage Ports)</td>
<td>A – 31.75 (1.25) - code 62 per SAE J518 same side location</td>
</tr>
<tr>
<td>B – 31.75 (1.25) - code 62 per SAE J518 same side location with M12 x 1.75 threaded holes</td>
<td></td>
</tr>
</tbody>
</table>

### High Press Relief Valve Setting Port A
- A – 138 bar (2000 lbf/in²)
- B – 172 bar (2500 lbf/in²)
- C – 207 bar (3000 lbf/in²)
- D – 241 bar (3500 lbf/in²)
- E – 276 bar (4000 lbf/in²)
- F – 310 bar (4500 lbf/in²)
- G – 345 bar (5000 lbf/in²)
- H – 379 bar (5500 lbf/in²)
- J – 414 bar (6000 lbf/in²)
- K – 431 bar (6250 lbf/in²)
- L – 448 bar (6500 lbf/in²)
- M – 466 bar (6750 lbf/in²)
- N – 483 bar (7000 lbf/in²)

### High Press Relief Valve Setting Port B
- A – 138 bar (2000 lbf/in²)
- B – 172 bar (2500 lbf/in²)
- C – 207 bar (3000 lbf/in²)
- D – 241 bar (3500 lbf/in²)
- E – 276 bar (4000 lbf/in²)
- F – 310 bar (4500 lbf/in²)
- G – 345 bar (5000 lbf/in²)
- H – 379 bar (5500 lbf/in²)
- J – 414 bar (6000 lbf/in²)
- K – 431 bar (6250 lbf/in²)
- L – 448 bar (6500 lbf/in²)
- M – 466 bar (6750 lbf/in²)
- N – 483 bar (7000 lbf/in²)

### Press Override Setting Port A
- A – 103 bar (1500 lbf/in²)
- B – 138 bar (2000 lbf/in²)
- C – 172 bar (2500 lbf/in²)
- D – 207 bar (3000 lbf/in²)
- E – 241 bar (3500 lbf/in²)
- F – 276 bar (4000 lbf/in²)
- G – 310 bar (4500 lbf/in²)
- H – 345 bar (5000 lbf/in²)
- J – 379 bar (5500 lbf/in²)
- K – 395 bar (5750 lbf/in²)
- L – 414 bar (6000 lbf/in²)
- M – 431 bar (6250 lbf/in²)
- N – 448 bar (6500 lbf/in²)

### Press Override Setting Port B
- A – 103 bar (1500 lbf/in²)
- B – 138 bar (2000 lbf/in²)
- C – 172 bar (2500 lbf/in²)
- D – 207 bar (3000 lbf/in²)
- E – 241 bar (3500 lbf/in²)
- F – 276 bar (4000 lbf/in²)
- G – 310 bar (4500 lbf/in²)
- H – 345 bar (5000 lbf/in²)
- J – 379 bar (5500 lbf/in²)
- K – 395 bar (5750 lbf/in²)
- L – 414 bar (6000 lbf/in²)
- M – 431 bar (6250 lbf/in²)
- N – 448 bar (6500 lbf/in²)

### Control Options
- EA – Electronic proportional control 12 volt DC with non contact feedback sensor
- EB – Electronic proportional control 24 volt DC with non contact feedback sensor
- EC – Electronic proportional control 12 volt DC
- ED – Electronic proportional control 24 volt DC
- HA – Hydraulic remote 5-15 bar (73-218 lbf/in²)
- HB – Hydraulic remote 2-14 bar (29-203 lbf/in²)
- MA – Manual displacement control
- MB – Manual displacement control with (NC) neutral lockout switch (wide band neutral)
- MC – Manual displacement control with neutral detent (wide band neutral)
- MD – Manual displacement control with (no) neutral lockout switch (wide band neutral)
- ME – Manual displacement control (wide band neutral)
- SA – Solenoid control 24 volt with non-contact feedback sensor with electrical connectors per DIN 43650
- SB – Solenoid control 12 volt with non-contact feedback sensor with electrical connectors per DIN 43650
### Model Codes

<table>
<thead>
<tr>
<th>ADZ XXX</th>
<th>XX</th>
<th>X</th>
<th>0</th>
<th>X</th>
<th>X</th>
<th>X</th>
<th>X</th>
<th>X</th>
<th>X</th>
<th>X</th>
<th>X</th>
<th>X</th>
<th>X</th>
<th>XX</th>
<th>A</th>
<th>0</th>
<th>A</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,2,3</td>
<td>4,5,6</td>
<td>7, 8</td>
<td>9</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>14</td>
<td>15</td>
<td>16,17</td>
<td>18</td>
<td>19</td>
<td>20</td>
<td>21</td>
<td>22</td>
<td>23</td>
<td>24</td>
</tr>
</tbody>
</table>

#### Control Orifice Supply (P)
- **0** – None
- **A** – 0,53 (.21) diameter
- **B** – 0,71 (.28) diameter
- **C** – 0,91 (.36) diameter
- **D** – 1,12 (.44) diameter
- **E** – 1,22 (.48) diameter
- **F** – 1,32 (.52) diameter
- **G** – 1,45 (.57) diameter
- **H** – 1,65 (.65) diameter
- **J** – 1,85 (.73) diameter
- **K** – 2,06 (.81) diameter
- **L** – 2,39 (.94) diameter
- **M** – 2,59 (.102) diameter

#### Control Orifice Servo (S1)
- **0** – None
- **A** – 0,53 (.21) diameter
- **B** – 0,71 (.28) diameter
- **C** – 0,91 (.36) diameter
- **D** – 1,12 (.44) diameter
- **E** – 1,22 (.48) diameter
- **F** – 1,32 (.52) diameter
- **G** – 1,45 (.57) diameter
- **H** – 1,65 (.65) diameter
- **J** – 1,85 (.73) diameter
- **K** – 2,06 (.81) diameter
- **L** – 2,39 (.94) diameter
- **M** – 2,59 (.102) diameter

#### Control Orifice Servo (S2)
- **0** – None
- **A** – 0,53 (.21) diameter
- **B** – 0,71 (.28) diameter
- **C** – 0,91 (.36) diameter
- **D** – 1,12 (.44) diameter
- **E** – 1,22 (.48) diameter

#### Control Special Features
- **F** – 1,32 (.52) diameter
- **G** – 1,45 (.57) diameter
- **H** – 1,65 (.65) diameter
- **J** – 1,85 (.73) diameter
- **K** – 2,06 (.81) diameter
- **L** – 2,39 (.94) diameter
- **M** – 2,59 (.102) diameter

#### Charge Pump Options
0 – No control special features
A – Destroke valve 12 VDC (NO) with 2 PIN weather pack connector
B – Destroke valve 24 VDC (NO) with 2 PIN weather pack connector
C – Destroke valve 12 VDC (NC) with 2 PIN weather pack connector
D – Destroke valve 24 VDC (NC) with 2 PIN weather pack connector
E – Destroke valve 12 VDC (NO) with 2 PIN weather pack connector

#### Charge Pump Displacement
0 – None
1 – 21,0 cm³/r (1,28 in³/r) – standard 130
2 – 27,9 cm³/r (1,70 in³/r) – standard 160
3 – 34,7 cm³/r (2,12 in³/r)
4 – 42,0 cm³/r (2,56 in³/r)

#### Charge Pressure Relief Valve Setting
0 – None
A – 21,0 bar (304 lbf/in²) – standard 130
B – 22,0 bar (320 lbf/in²)
C – 22,5 bar (326 lbf/in²)
D – 23,0 bar (340 lbf/in²)

#### Auxiliary Mounting
0 – None
A – A-PAD, dual 2 bolt mount, 9 tooth 16/32 pitch spline
B – A-PAD, dual 2 bolt mount, 11 tooth 16/32 pitch spline

#### Servo Stop Options
0 – None
1 – Externally adjustable servo stop on both sides
2 – Externally adjustable servo stop S1 side
3 – Externally adjustable servo stop S2 side

#### Special Pump Features
00 – No special features
01 – Rear of tandem (no shaft seal)
02 – Gauge ports with diagnostic fittings in system a and b ports
03 – Cooler bypass

#### Paint And Packaging
A – Painted primer blue (standard)

#### Identification on Unit
0 – Standard

#### Design Code
A – A
Optional speed sensor mating connector
packard electric 2 way
P/N 1216 2192 connector body
P/N 1204 0750 connector seal
P/N 1204 0751 cable seal
P/N 1212 4075 socket

Charge Pump
Displacement Dim A
cc/rev (in³/rev) mm (in)
20.9 (1.28) 388.3 (15.29)
27.9 (1.70) 395.2 (15.56)
34.7 (2.12) 402.0 (15.83)
42.0 (2.56) 409.2 (16.11)
Do not remove plugs can not be used as a case drain port

Port P
gauge port for B side system pressure 9/16-18 UNF-2B SAE O-ring port

Port N
gauge port for A side system pressure 9/16-18 UNF-2B SAE O-ring port

Port H
charge pump inlet port 1 5/8-12 UN-2B SAE O-ring port
Dimensional Drawing

Case drain port
1 5/16-12 UN-2B
SAE O-ring port

Port E
SAE O-ring port

Port K
Gauge port for servo 2
7/16-20 UNF-2B
SAE O-ring port

PORT A
PORT B

See port options

Port A
Gauge port for servo 2
7/16-20 UNF-2B
SAE O-ring port

Port F
1 5/16-12 UN-2B
SAE O-ring port

Port J
Gauge port for servo 1
7/8-14 UN-2B
SAE O-ring port

Port D
Gauge port for Charge pressure
7/8-14 UN-2B
SAE O-ring port

Case drain port
1 5/16-12 UN-2B
SAE O-ring port

82.6 [3.25]

Port J
Gauge port for servo 1
7/16-20 UNF-2B
SAE O-ring port
## Input Shaft Options

**Model Code Position 7, 8**

### Code 01

(1.75) Diameter Tapered with (0.4375) X (1.00) Square Key

- Ø 69.9 ±0.5 [2.75 ±0.02]
- Ø 63.5 ±0.02 [2.500 ±0.001]

1.250-18 UNEF-2B grade 5 slotted hex locknut per SAE J-501 [except 47.7 [1.88] across flat] recommended torque to 542 n.M [400 lb.Ft] plus torque required to align slotted nut to shaft cross hole not to exceed 813 n.M [600 lb.Ft]. Lubricate nut face and shaft threads

**Note:** 1 Tapered shaft compatible with ISO 3019/1 [SAE-J744] specification

### Code 02

(1.75) Diameter Straight with (0.4375) X (1.00) Square Key

- Ø 44.45 ±0.08 [1.752 ±0.003]
- Ø 3.96 [1.56]

11,125 ±0.025 [0.4380 ±0.005] Square key X long

25,40 ±0.60 [1.000 ±0.025]

87.4 [3.44]

1,125 ±0.025 [0.4380 ±0.005] Square key X long

25,40 ±0.60 [1.000 ±0.025]

49.31 ±0.12 [1.942 ±0.005]
**Input Shaft Options**
Model Code Position 7, 8

**Code 12**
13 Tooth 8/16 Pitch Spline with 5/8-11 UNC
Thread in End
Torque 1921 Nm
17,000 lbf-in

**Code 13**
13 Tooth 8/16 Pitch Spline
Torque 1921 Nm
17,000 lbf-in
**Input Shaft Options**

**Model Code Position 7, 8**

**Code 23**
23 Tooth 16/32 Pitch Spline (Rear of Tandem)
Torque 1469 Nm
13,000 lbf-in

**Code 27**
27 Tooth 16/32 Pitch Spline
Torque 734 Nm
6,500 lbf-in
High Pressure Relief Valve
Setting Port A & B
Model Code Position 12 & 13

Integrated Valve System (IVS)
The Integrated Valve System (IVS) contains the High Pressure Relief Valve, Pressure Override, System Check Valves, and Bypass Valve. The IVS reduces the pump size and weight, simplifies service and diagnostics troubleshooting.

High Pressure Relief Valves
The High Pressure Relief Valves for ports A and B activate whenever system pressure equals the relief valve setting. The valves are direct acting and help protect system components from excessive pressure spikes.
Pressure Override Control
Setting Port A & B
Model Code Position 14 & 15

**Pressure Override Control (POR)**
The Pressure Override Control (POR) is used in combination with the high pressure relief valves, to protect the transmission when operated for extended periods at overload pressures. If the system pressure reaches a preset limit, the pump destrokes and adjusts its displacement to the load. The POR is available in a number of pressure settings.

**System Check Valves**
The System Check Valves open charge flow to the low side of the loop to supplement system internal leakage.

**Bypass Valve**
The Bypass Valve unseats the System Check Valves and short circuits the A and B ports. This allows flow to bypass through the pump end cover in either direction.
Control Options -
Electronic Proportional Displacement Control
Model Code Position 16 & 17

The Electronic Proportional (EP) displacement control is ideal for applications requiring electronic pump displacement control. The EP displacement control has been designed to withstand the rigors of off-highway equipment environmental conditions.

**EP Control Features**

- Ease of installation
- Automotive style environmentally sealed Metri-Pack connectors
- Operates from 12 or 24 VDC power supply
- External fuse (customer supplied) 3A for 12 VDC system, 1A for 24 VDC system
- Operating temperature range -40°C to +85°C
- Closed loop current control compensates for resistance change of the proportional solenoids due to temperature variations
- Return to neutral for loss of power, or loss of command input signal
- Mechanical feedback of swashplate position for closed loop control
- External neutral adjustment
- Manual override capability

**Ambient Operating Temperature Range**

-65°F to +140°F, 28 Watts Max

**12 VDC Coil**

- 5.19 Ohms ± 10% Resistance at 25°C
- 1.5 Amps to Obtain Full Pump Displacement
- .4 Amps to Obtain Neutral
- 17.5 mH Nominal Inductance
- 1.5 Amps Max. Cont. Current

**24 VDC Coil**

- 20.80 Ohms ± 10% Resistance at 25°C
- .75 Amps to Obtain Full Pump Displacement
- .2 Amps to Obtain Neutral
- 158 mH Nominal Inductance
- .75 Amps Max. Cont. Current

**Matting 4 Way Connector**

- P/N 1218 6568 Connector (1)
- P/N 1204 8074 PIN Terminal (4)
- P/N 1204 8086 Cable Seal (4)
- P/N 1204 7948 TPA (1)

**Note:**

- Coils have no Internal Diodes. A-B Polarity and C-D Polarity Does Not Affect Operation
- Modulation Frequency Range for Optimal Performance is 75-200 Hz
Control Options -
Electronic Proportional Displacement Control
Model Code Position 16 & 17

Code EA, EB

EA  Electronic Proportional Control 12 Volt DC with Non Contact Feedback Sensor
EB  Electronic Proportional Control 24 Volt DC with Non Contact Feedback Sensor

Neutral adjustment

Pin C   Pin B   Pin A

Neutral adjustment

2x Manual override; push to activate manual override

Control valve mounting surface

Front face of pump

3.24

4.272

5.616

Control Options
Electronic Proportional Displacement Control
Model Code Position 16 & 17

Feedback Sensor

Electrical Characteristics:
Supply Voltage: 5.00±0.50 VDC
Supply Current: Shall not Draw in Excess of 10mA
Sensor Gain: 10°/V, CW Shaft Rotation Increases Output Voltage

Angle Sweep: -20° at 0.5V and +20° at 4.5V with 0° (Pump Neutral) at 2.5V
Maximum Output Error Band: ±3% of F.S. Voltage at 0.5V and 4.5V: ±1.5% of F.S. Voltage at 2.5V (Error Includes Thermal Linearity, and Sensitivity Drift)

Input Shaft Rotation

<table>
<thead>
<tr>
<th>CCW</th>
<th>CW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solenoid Energized</td>
<td>1</td>
</tr>
<tr>
<td>Port A Flow</td>
<td>Out</td>
</tr>
<tr>
<td>Port B Flow</td>
<td>In</td>
</tr>
</tbody>
</table>
Control Options -
Electronic Proportional
Displacement Control
Model Code Position 16 & 17

**Code EC, ED**

**EC**  Electronic Proportional
Control 12 Volt DC

**ED**  Electronic Proportional
Control 24 Volt DC

---

<table>
<thead>
<tr>
<th>Input Shaft Rotation</th>
<th>CCW</th>
<th>CW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solenoid Energized</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Port A Flow</td>
<td>Out</td>
<td>In</td>
</tr>
<tr>
<td>Port B Flow</td>
<td>In</td>
<td>Out</td>
</tr>
</tbody>
</table>
Control Options - Hydraulic Remote Control
Model Code Position 16 & 17

The hydraulic remote pump control makes it possible to control pump flow by changing pump displacement via a remote pilot pressure signal. The angle of the swashplate, that determines pump displacement, is proportional to the pilot pressure. Typical pressure requirements are 5-15 bar (72.5 - 217.5 psi) with a swashplate angle from 0° to 18°.

The direction of flow, and therefore the direction of the vehicle, is reversed by applying the control pressure to the opposite inlet port of the hydraulic remote pump control.

The hydraulic remote pump control is readily adaptable in the following applications:
- Where remote transmission control is needed
- Where control cables or linkages are not feasible
- Where electronic controls cannot be used.

The Eaton hydraulic remote pump control is compatible with:
- Other Eaton control options such as the destroke control, and pressure override
- Most commercially available hydraulic command stations

The hydraulic remote pump control is a three position, four-way closed center (spring centered) hydraulically activated servo control.

This control, like the manual displacement control uses the feedback linkage connected directly to the swashplate.

The control spool is activated to position the swashplate by regulating the remote pilot pressure to the control piston. There are various manufacturers of command stations that can be used to supply this remote pilot pressure.

**Code HA, HB**

**HA**  Hydraulic Remote 5-15 Bar
(73-218 Lbf/in²)

**HB**  Hydraulic Remote 2-14 bar
(29-203 Lbf/in²)

### Input Shaft Rotation

<table>
<thead>
<tr>
<th>Input Shaft Rotation</th>
<th>CCW</th>
<th>CW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actuator Energized</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Port A Flow</td>
<td>Out</td>
<td>In</td>
</tr>
<tr>
<td>Port B Flow</td>
<td>In</td>
<td>Out</td>
</tr>
</tbody>
</table>

**Note:**
Secure actuator to prevent turning when installing fittings or hoses.
Control Options - Manual Displacement Controls
Model Code Positions 16 & 17

The wide variety of available controls on the Eaton Series 760 Variable Displacement Pump offers vehicle designers the control necessary for optimal vehicle performance. Many of these controls are combined as single control options; please refer to the model code for the specific option configuration.

**Standard Manual Displacement Control (MA)**
The standard manual displacement control, the most common control option, typically connects directly with mechanical linkages or cables.

**Manual Displacement Control with Wide Band Neutral Detent (ME)**
This control is the same as the above with an increased neutral band.

**Code MA, ME**

- **MA** Manual Displacement Control
- **ME** Manual Displacement Control (Wide Band Neutral)

---

**Input Shaft Rotation**

<table>
<thead>
<tr>
<th>CCW</th>
<th>CW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Handle Rotation</td>
<td>“A” (CCW)</td>
</tr>
<tr>
<td>Port A Flow</td>
<td>Out</td>
</tr>
<tr>
<td>Port B Flow</td>
<td>In</td>
</tr>
</tbody>
</table>

---

Note:
Radial Position of Control Handle to Shaft is Optional at 7° 30’ Increments. 7° 30’ Increments are Achieved by Alternately Turning Control Handle over. 0.45 N/m (4 Lbf/in) Torque is Required For Full Control Handle Travel. Total Applied Torque Not To Exceed 16.9 N/m (150 Lbf/in).
Control Options -
Manual Displacement Controls
Model Code Positions 16 & 17

**Code MB, MD**

**MB** Manual Displacement Control with (NC) Neutral Lockout Switch (Wide Band Neutral)

**MD** Manual Displacement Control with (NO) Neutral Lockout Switch (Wide Band Neutral)

**Manual Control with Neutral Lockout (MB & MD)**

The neutral lock-out feature is an electrical switch that is closed (MB) or open (MD) when the transmission is in neutral. This switch can be used to prevent the activation of certain functions that require the pump to be in neutral. The lock-out feature is commonly used to prevent starting the prime mover or activating auxiliary functions. The electrical switch is available as normally open or normally closed.

---

**Input Shaft Rotation**

<table>
<thead>
<tr>
<th>CCW</th>
<th>CW</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Handle Rotation</strong></td>
<td>“A” (CCW)</td>
</tr>
<tr>
<td>Port A Flow</td>
<td>Out</td>
</tr>
<tr>
<td>Port B Flow</td>
<td>In</td>
</tr>
</tbody>
</table>

**Note:**
Radial Position of Control Handle to Shaft is Optional at 7° 30’ Increments. 7° 30’ Increments are Achieved by Alternately Turning Control Handle. 0,45 N/m (4 Lbf/in) Torque is Required For Full Control Handle Travel. Total Applied Torque Not To Exceed 16,9 N/m (150 Lbf/in).
Control Options -
Manual Displacement Controls
Model Code Position 16 & 17

Manual Control with Neutral Detent (MC)
The neutral detent feature provides a more positive feel when finding neutral. This option is ideal for transmissions with long control linkages or cables, or in other situations where there is a great deal of space between the operator station and the pump.

Code MC

**MC**
Manual Displacement Control with Neutral Detent (Wide Band Neutral)

<table>
<thead>
<tr>
<th>Input Shaft Rotation</th>
<th>CCW</th>
<th>CW</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Handle Rotation</strong></td>
<td>“A” (CCW)</td>
<td>“B” (CW)</td>
</tr>
<tr>
<td>Port A Flow</td>
<td>Out</td>
<td>In</td>
</tr>
<tr>
<td>Port B Flow</td>
<td>In</td>
<td>Out</td>
</tr>
</tbody>
</table>
Control Options-
Solenoid Control with Swashplate Feedback Sensor
Model Code Position 16 & 17

The solenoid control for the Eaton Series 760 Variable Displacement Pump accurately controls the displacement of the pump using electronic swash plate angle feedback.

Solenoid Control Features:
- Consists of two proportional flow control valves and a non-contacting swash plate angle sensor
- Valves provide flow to the control piston to change the displacement of the pump
- Fast response, precise, and repeatable performance with less hysteresis while maintaining pump efficiency
- Operates from 12 or 24 V power supply

Code SA, SB

SA Solenoid Control 24 Volt with Non-contact Feedback Sensor with Electrical Connectors Per DIN 43650
SB Solenoid Control 12 Volt with Non-contact Feedback Sensor with Electrical Connectors Per DIN 43650

The solenoid control for the Eaton Series 760 Variable Displacement Pump accurately controls the displacement of the pump using electronic swash plate angle feedback.

Solenoid Control Features:
- Consists of two proportional flow control valves and a non-contacting swash plate angle sensor
- Valves provide flow to the control piston to change the displacement of the pump
- Fast response, precise, and repeatable performance with less hysteresis while maintaining pump efficiency
- Operates from 12 or 24 V power supply

Code SA, SB

SA Solenoid Control 24 Volt with Non-contact Feedback Sensor with Electrical Connectors Per DIN 43650
SB Solenoid Control 12 Volt with Non-contact Feedback Sensor with Electrical Connectors Per DIN 43650

The solenoid control for the Eaton Series 760 Variable Displacement Pump accurately controls the displacement of the pump using electronic swash plate angle feedback.

Solenoid Control Features:
- Consists of two proportional flow control valves and a non-contacting swash plate angle sensor
- Valves provide flow to the control piston to change the displacement of the pump
- Fast response, precise, and repeatable performance with less hysteresis while maintaining pump efficiency
- Operates from 12 or 24 V power supply

Coil Specifications

<table>
<thead>
<tr>
<th>Voltage</th>
<th>12 VDC</th>
<th>24 VDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Watts (Nominal)</td>
<td>36</td>
<td>36</td>
</tr>
<tr>
<td>Ohms ±10%</td>
<td>4.0</td>
<td>16.0</td>
</tr>
<tr>
<td>Amps (Nominal)</td>
<td>1.75</td>
<td>.875</td>
</tr>
<tr>
<td>Push Force ±10%</td>
<td>10.25 lbs</td>
<td>10.25 lbs</td>
</tr>
<tr>
<td>Pull Force ±10%</td>
<td>10.25 lbs</td>
<td>10.25 lbs</td>
</tr>
</tbody>
</table>

Mating Connector for SA Valve Per DIN 43650, Form A:
Mechanical Characteristics for Feedback Sensor:
- Angle Rotation: 50° Max, 40° Functional
- Mating Connector: Delphi-packard 3 Pin Weatherpack
- PN 12015793 (Tower)
- PIN Terminal PN 12089188
- Qty 3

Cable Seal PN 12015323 Qty 3
Operating Temperature: -40°C to 125°C
Ambient Operating Temperature Range: -65° to 220°F
Control Special Features - Destroke Valve
Model Code Position 21

On all Series 760 controls there is a pad machined to attach a destroke valve. The destroke solenoid valve, when activated, causes the pump to destroke and go to zero displacement. Typically, the valve is activated by a seat switch detecting operator presence or by a remote emergency stop switch on the operator’s console. It is available in 12 or 24 VDC and either normally open or normally closed configurations.

Control Special Features - Destroke Valve
Model Code Position 21

<table>
<thead>
<tr>
<th>Control S/A</th>
<th>Dim A</th>
<th>Dim B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manual</td>
<td>77.65 (3.06)</td>
<td>98.91 (3.89)</td>
</tr>
<tr>
<td>Solenoid</td>
<td>99.24 (3.91)</td>
<td>120.50 (4.74)</td>
</tr>
<tr>
<td>EP Control</td>
<td>96.70 (3.81)</td>
<td>117.96 (4.64)</td>
</tr>
</tbody>
</table>
Remote pressure filter ports allow you to mount a pressure side filter in a more easily accessible location. The filter ports accept 7/8-14 UNF-2B SAE O-ring fittings. The filter and lines must be able to withstand pressures up to 70 bar (1000 psi).

The Series 760 Hydrostatic Pump contains an integral charge pump that may be provided with various filtration options. A standard charge pump will use suction filtration where practical.

**Code A**
Remote pressure filter ports allow you to mount a pressure side filter in a more easily accessible location. The filter ports accept 7/8-14 UNF-2B SAE O-ring fittings. The filter and lines must be able to withstand pressures up to 70 bar (1000 psi).

**Code B**
Pressure Side Filter Mounted on the "A" Port Side
Charge Pump Options
Model Code Position 24

**Code C**
Pressure Side Filter
Mounted on the “B” Port Side

**Code D**
Pressure Side Filter
Mounted Toward the Mounting Flange

**Code E**
Pressure Side Filter
Mounted Toward the Charge Pump
**Sensor Options**

Model Code Position 25

---

**Code 1**

Magnetic Speed Sensor

---

### Parameter

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Condition</th>
<th>Unit</th>
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</thead>
<tbody>
<tr>
<td>Operating Temp Limit</td>
<td>-40°C - 150°C</td>
<td>-40°F - 302°F</td>
</tr>
<tr>
<td>Sensor Resistance</td>
<td>25°C (77°F)</td>
<td>1.5 k to 3.5k Ohms</td>
</tr>
<tr>
<td>Sensor Inductance</td>
<td>25°C (77°F)</td>
<td>0.6 to 3.7 VPP min</td>
</tr>
<tr>
<td>Output Voltage</td>
<td>25°C (77°F)</td>
<td>9.3 Hz at 2.29 (.090) GAP 400 mVpp min</td>
</tr>
<tr>
<td></td>
<td></td>
<td>300 Hz at 0.25 (.010) GAP 80 Vpp max</td>
</tr>
<tr>
<td>Air Gaps</td>
<td></td>
<td>0.26 - 2.28 (.010 - .090)</td>
</tr>
<tr>
<td>Vibration Voltage</td>
<td>15G Random</td>
<td>0.4V P-P Max</td>
</tr>
<tr>
<td></td>
<td>Vibration</td>
<td></td>
</tr>
</tbody>
</table>

---

### Mating Connectors Pinouts

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Sensor 1+</td>
</tr>
<tr>
<td>B</td>
<td>Sensor 1-</td>
</tr>
</tbody>
</table>

---

**Mating Packard Connector**

- Connector Body - 1216 2192
- Connector Seal - 1204 0750
- Cable Seal - 1204 0751
- Socket - 1212 4075

Optional Mating Connector:

- Connector Assembly (Body, Cable Seal, Seal) - 1216 2193
- Socket (16-18 Awg) - 1212 4075
- Socket (20-22 Awg) - 1212 4076
Auxiliary Mounting Options
Model Code Position 26

Code A
A-PAD, Dual 2 Bolt Mount, 9 Tooth 16/32 Pitch Spline

Spline to mate with internal involute fillet root side fit 9 tooth 16/32 pitch 30° pressure angle per ansi b92.1-1970 maximum allowable auxiliary pump torque 113 n-m [1000 lbf-in]

4x Auxiliary mounting holes 3/8-16 UNC-2B, depth 19.0 [.75]

Code B
A-PAD, Dual 2 Bolt Mount, 11 Tooth 16/32 Pitch Spline

Spline to mate with internal involute flat root side fit 11 tooth 16/32 pitch 30° pressure angle per ansi b92.1-1970 maximum allowable auxiliary pump torque 189,4 n-m [1500 lbf]

4x Auxiliary mounting holes 3/8-16 UNC-2B, depth 19.0 [.75]
**Auxiliary Mounting Options**

Model Code Position 26

**Code C**
B-PAD, Dual 2 Bolt Mount, 13 Tooth 16/32 Pitch Spline

Maximum allowable shaft protrusion

D O-ring supplied as loose item to be installed prior to assembly of auxiliary unit

ISO 3019/1 SAE-J744 B-pad mounting flange specification

Spline to mate with internal involute fillet root side fit 13 tooth 16/32 pitch 30° pressure angle per ANSI b92.1-1970 maximum allowable auxiliary pump torque 282.4 N•m [2500 lbf/in]

**Section C-C**

4x Auxiliary mounting holes 1/2-13 UNC-2B, depth 23.4 [.92]

C C

2X 146.05 [5.750]

2X 73.02 [2.875]

**Code D**
B-B-PAD, Dual 2 Bolt Mount, 15 Tooth 16/32 Pitch Spline

Maximum allowable shaft protrusion

D O-ring supplied as loose item to be installed prior to assembly of auxiliary unit

ISO 3019/1 SAE-J744 B-pad mounting flange specification

Spline to mate with internal involute fillet root side fit 15 tooth 16/32 pitch 30° pressure angle per ANSI b92.1-1970 maximum allowable auxiliary pump torque 406.7 N•m [3600 lbf/in]

**Section D-D**

4x Auxiliary mounting holes 1/2-13 UNC-2B, depth 23.4 [.92]

D D

2X 146.05 [5.750]

2X 73.02 [2.875]
Auxiliary Mounting Options
Model Code Position 26

**Code E**
C-PAD, 4 Bolt Mount, 14 Tooth 12/24 Pitch Spline

- Spline to mate with internal involute fillet root side fit 14 tooth 12/24 pitch
- 30° pressure angle per ANSI B92.1-1970
- Maximum allowable auxiliary pump torque 700 N•m [6200 lbf/in]

**Code F**
D-PAD, 4 Bolt Mount, 23 Tooth 16/32 Pitch Spline

- Spline to mate with internal involute fillet root side fit 23 tooth 16/32 pitch
- 30° pressure angle per ANSI B92.1-1970
- Maximum allowable auxiliary pump torque 1469 N•m [13,000 lbf/in]
Special Pump Features

Model Code
Position 28 & 29

**Code 01**
Rear of Tandem
(No Shaft Seal)

**Code 02**
Gauge Ports with Diagnostic Fittings in System A and B Ports

**Code 03**
Cooler Bypass
Operational Diagram

Typical Series 760 Variable Displacement Pump/Fixed Displacement Motor Schematic

Note: For ease of viewing, the Servo Control Cylinder, Swashplate, and Control Valve are shown removed from the pump.
Component Descriptions

The Operational Diagram on page 32 shows a typical heavy duty hydrostatic transmission. The axial piston pump and axial piston motor are the main components. The filter, reservoir, heat exchanger, and oil lines make up the rest of the system. The function of each of these components is described below:

A separate energy source, such as an electric motor or internal combustion engine, turns the input shaft of the pump.

Variable Displacement Axial Piston Pump

The variable displacement pump provides a flow of high pressure oil. Pump output flow can be varied to obtain the desired motor output speed. For example, when the pump’s displacement is zero, no oil is pumped and the transmission’s motor output shaft is stopped. Conversely, maximum pump displacement produces maximum motor shaft speed. The direction of high pressure flow can also be reversed; doing so reverses the direction the motor output shaft rotates.

A charge pump is integrated into the piston pump and driven by the shaft of the piston pump. The drawing illustrates a suction filtration circuit. Eaton recommends a suction filter without a bypass valve. The charge pump has a Low Pressure Relief Valve that regulates the output pressure.

Eaton’s Series 760 Pump offers High Pressure Relief Valves and Pressure Override Control for system high pressure protection. These valves are integrated into one cartridge valve called the Integrated Valve System or IVS. (see page 14-15 for a description of these features).

Fixed Displacement Axial Piston Motor

The motor uses the high pressure oil flow from the pump to produce transmission output. The high pressure oil comes to the motor through one of the high pressure lines. It enters the motor, turns the output shaft, then returns to the pump. Eaton piston motors integrate a hot oil shuttle and low pressure relief valve into the end cover. The shuttle valve and low pressure relief valve direct excess charge pump flow into the motor case. The shuttle valve is activated by high pressure and directs excess charge pump flow over the low pressure relief valve. This flushing action allows the charge pump to provide clean, cool oil to the closed loop circuit.

Reservoir

The reservoir is an important part of the hydrostatic transmission system. It should provide adequate oil storage and allow easy oil maintenance.

The reservoir must hold enough oil to provide a continuous oil supply to the charge pump inlet. It must also have enough room for the hydraulic oil to expand as the system warms up.

Consider charge pump flow when sizing the reservoir:

One half (.5) minute times (X) the maximum charge pump flow should be the minimum oil volume in the reservoir. Maintaining this oil volume will give the oil a minimum of thirty (30) seconds in the reservoir. This will allow any entrained air to escape and contamination to settle out of the oil.

To allow for oil expansion, the reservoir’s total volume should be at least six tenths (.6) minute times (X) the maximum charge pump flow.

The reservoir’s internal structure should cut down turbulence and prevent oil aeration.

The line returning flow to the reservoir should be fitted with a diffuser to slow the incoming oil to 1 to 1.2 meters (3-4 feet) per second to help reduce turbulence. The return flow line should also be positioned so that returning oil enters the reservoir below the liquid surface. This will help reduce aeration and foaming of the oil.

The reservoir should have baffles between the return line and suction line. Baffles prevent return flow from immediately reentering the pump.

A sixty mesh screen placed across the suction chamber of the reservoir will act as a bubble separator. The screen should be placed at a thirty degree angle to the horizon.

The entrance to the suction line should be located well below the fluid surface so there is no chance of air being sucked into the charge pump inlet. However, the suction line entrance should not be located on the bottom of the reservoir where there may be a buildup of sediment. The suction line entrance should be flared and covered with a screen.

The reservoir should be easily accessible. The fill port should be designed to minimize the possibility of contamination during filling and to help prevent overflow filling. There should be a drain plug at the lowest point of the reservoir and it should also have a clean-out and inspection cover so the reservoir can be thoroughly cleaned after prolonged use. A vented reservoir should have a breather cap with a micronic filter.

Sealed reservoirs must be used at altitudes above 2500 feet. These reservoirs should be fitted with a two way micronic filter pressure cap to allow for fluid expansion and contraction.

In both cases the caps must be designed to prevent water from entering the reservoir during bad weather or machine washing. A hydrostatic transmission with a well designed reservoir will run quieter, stay cleaner and last longer.
Application Information

Filter
A filter must be used to keep the hydraulic fluid clean. Either a suction filter or a pressure side filter may be used. The filter must be a no-bypass type. A suction filter is shown in the operational diagram on page 32. System oil particulate levels should not exceed ISO 18/13. Refer to Eaton Hydraulic Fluid Recommendations on page 36.

Recommended beta ratios for each filter type are listed below:

- Suction Filter $\beta_{10} = 1.5$ to $2.0$
- Pressure Side Filter $\beta_{10} = 10$ to $20$

When a suction filter is used, its flow capacity must be large enough to prevent an excessive pressure drop between the reservoir and charge pump inlet. The pressure at the charge pump inlet port must not be less than 0.8 bar (11.6 psi) absolute at normal continuous operating temperatures.

Charge Pump Inlet Line
The inlet line to the charge pump should be large enough to keep the pressure drop between the reservoir and charge pump inlet within the limits described in the filter section. Fittings will increase the pressure drop, so their number should be kept to a minimum. It is best to keep fluid velocities below 1.25 meters (4 feet) per second.

Fluid and temperature compatibility must be considered when selecting the inlet line.

High Pressure Lines
The high pressure lines that connect the pump and motor must be able to withstand the pressures generated in the high pressure loop.

Heat Exchanger
Use of a heat exchanger is dependent on the transmission's duty cycle and machine layout. The normal continuous operating fluid temperature measured in the pump and motor cases should not exceed 80°C (180°F) for most hydraulic fluids. The maximum fluid temperature should not exceed 105°C (220°F).

The heat exchanger should be sized to dissipate 25% of the maximum input power available to the transmission. It must also be sized to prevent the case pressures in the pump and motor from getting too high. Case pressure up to 2.8 bar (40 psi), at normal operating temperatures, are acceptable.

Heat Exchanger Bypass Valve
The heat exchanger bypass valve is a pressure and/or temperature valve in parallel with the heat exchanger. Its purpose is to prevent case pressures from getting too high. The heat exchanger bypass valve opens when the oil is thick, especially during cold starts.

Reservoir Return Line
The same general requirements that apply to case drain lines apply to the reservoir return line.
Shaft Couplings and Mounting Brackets

Shaft couplings must be able to withstand the torque that will be transmitted to the pump or motor. If the pump or motor is to be directly coupled to the drive, the misalignment should not exceed 0.050 mm (0.002 in.) total indicator run-out for the combination of perpendicularity and concentricity measurements.

The hardness of the couplings connected to Eaton pump or motor shafts should be 35 Rc for tapered or straight keyed shafts and 50-55 Rc for splined shafts.

Open Loop Circuits

Eaton heavy duty pumps and heavy duty motors may be used in open loop circuits under certain operating conditions. Consult your Eaton representative for details.

Orientation

The mounting orientation of Eaton heavy duty pumps and motors is unrestricted. The case drain line that carries the flow leaving the pump or motor should be connected to the highest drain port on each of the units. This assures that the pump and motor cases remain full.

Multiple Pump or Motor Circuits

Multiple pumps or motors can be combined in the same circuit. When two pumps are used in a parallel circuit, their swashplate controls can be operated in phase or in sequence. The following precautions should be observed whenever multiple pumps and/or motors are connected in the same circuit:

1. Charge pump flow must be greater than the sum of the charge pump flow requirements of the individual units.
2. The possibility of motor overspeeding increases in multiple motor circuits. The parallel motor circuit will act as a frictionless differential. Should one of the motors stall the other could overspeed. The motors used in parallel circuits should, therefore, be sized to prevent overspeeding. Valves that will limit the flow to each of the motors may be used to prevent overspeeding. This will allow the use of smaller motors, however the flow limiting valves will create heat.
3. When using one pump with multiple motors, the case drain lines should be connected in series. The case flow should be routed from the most distant motor, through the remaining motors, to the pump, and finally back to the reservoir. The most distant motor should have the valve block or integral shuttle valve while the additional motors do not need a valve block or integral shuttle valve. A remote valve block is also available for multiple motor circuits. A series-parallel drain line circuit may be needed for the high case flow created in multiple pump circuits. In either case, each pump and motor should be checked for proper cooling when testing the prototype circuit.
4. Series circuits present a unique problem for axial piston motors. Pressure applied to the input port and discharge port are additive as regards to the load and life of the drive shaft and the drive shaft bearings. Please consult with your Eaton representative regarding series circuits.
Hydraulic Fluid Recommendations

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

Selecting a hydraulic fluid
The hydraulic fluids in hydraulic systems are bound to perform in different dimensions. They serve as the power transmission medium, lubricate the moving components and carry away the heat produced within the system. Therefore the fluids must have adequate properties to give the assurance of adequate wear protection, effective power transmission and excellent chemical stability under the most adverse operating conditions. The multi dimensional performance establishes that the hydraulic fluid is a vital factor in a hydraulic system; proper selection of oil assures satisfactory life and operation of the system components / lubricants.

Viscosity
The most important characteristics to consider when choosing a fluid to be used in a hydraulic system are viscosity. 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 for Eaton’s Heavy Duty Hydrostatic product line are specified later in this document.

Viscosity and Temperature
Temperature and viscosity are related inversely. As the fluid warms it gets thinner and its viscosity decreases. When fluid cools the fluid viscosity increases. It is important to consider the entire operating temperature window for selecting the right viscosity for a hydraulic system. Calculate the viscosity of the fluid temperatures at start up, normal operating conditions and maximum possible point, and compare the same with the recommendation of the hydraulic system.

Generally, the fluid is thick when the hydraulic system is started. With movement, the fluid warms to a point where the cooling system begins to operate. From then on, the fluid is maintained at the temperature for which the hydrostatic system was designed. In actual applications this sequence varies; hydrostatic 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 hydrostatic components in their products should anticipate temperature in their designs and make the appropriate fluid recommendations to their customers.

In general, a lower ISO viscosity grade fluid is recommended for operation in cold to moderate climates. Higher ISO viscosity grade fluid is recommended for operation in moderate to hot climates.

Cleanliness
Cleanliness of the fluid in a hydrostatic system is extremely important. Eaton recommends that the fluid used in its hydrostatic 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 µm and a maximum of 80 particles per milliliter greater than 15 µm. When components with different cleanliness requirements are used in the same system, the cleanest standard should be applied. OEM’s and distributors who use Eaton hydrostatic components in their products should provide for these requirements in their designs. A reputable filter supplier can supply filter information.
Hydraulic Fluid Recommendations

Viscosity and Cleanliness Guidelines

<table>
<thead>
<tr>
<th>Product Line</th>
<th>Minimum</th>
<th>Optimum Range</th>
<th>Maximum</th>
<th>ISO Cleanliness Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heavy Duty Piston</td>
<td>10cSt</td>
<td>16 - 39 cSt</td>
<td>2158 cSt</td>
<td>18/13</td>
</tr>
<tr>
<td>Pumps and Motors</td>
<td>(60 SUS)</td>
<td>(80 - 180 SUS)</td>
<td>(10,000 SUS)</td>
<td></td>
</tr>
</tbody>
</table>

Note:

- 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. Thick oil can cause high case pressures which in turn cause shaft seal problems.
- If the natural color of the fluid has become black it is possible that an overheating problem exists.
- If the fluid becomes milky, water contamination may be a problem.
- Take fluid level reading when the system is cold.
- Viscosity modified fluid may lose viscosity due to shearing of viscosity improvers.
- Contact your Eaton representative if you have specific questions about the fluid requirements of Eaton hydrostatic components.
Hydraulic Fluid Recommendations

Fluid Maintenance

Maintaining correct fluid viscosity and cleanliness level is essential for all hydrostatic systems. Since Eaton hydrostatic 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 hydrostatic 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

AW Hydraulic Oil

Premium grade petroleum based AW hydraulic fluids will provide the best performance in Eaton hydrostatic components. These fluids typically contain additives that are beneficial to hydrostatic 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.

Pump performance and reliability are directly affected by the anti-wear additive formulation contained in the oil. Oils providing a high level of anti-wear protection are recommended for optimum performance and long life. Eaton has its own method to estimate Mineral / Petroleum based AW hydraulic oils for their anti-wear property. The fluid must pass Eaton Vickers® 35VQ25 pump test or meet the performance specification Eaton Vickers M 2950 S.

Engine Oils / Motor Oils

Engine oils using hydraulic applications, must meet API SF / SG / SH or higher performance specifications. Appropriate SAE Grade to be selected based on the operating temperatures.
Hydraulic Fluid Recommendations

Biodegradable Oil (Vegetable) Guidelines

<table>
<thead>
<tr>
<th>Product Line</th>
<th>Rating With Biodegradable Oil</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heavy Duty Piston</td>
<td>80% of normal pressure rating</td>
<td>82° C (180° F) max fluid temp (unit)</td>
</tr>
<tr>
<td>Pumps and Motors</td>
<td>listed for mineral oils</td>
<td>71° C (160° F) max fluid temp (reservoir)</td>
</tr>
</tbody>
</table>

Additional Notes:

- Viscosity and ISO cleanliness requirements must be maintained as outlined on previous page.
- For any system where the fluid is non-petroleum oil, set the target one Range Code cleaner for each particle size, than that of petroleum fluids.
  If the cleanest code required was 19/17/15 and HETG is the system fluid, the target becomes 18/16/14.
- Based on limited product testing to date, no reduction in unit life is expected when operating at the pressure ratings indicated above.
- Vegetable oil is miscible with mineral oil. However, only the vegetable oil content is biodegradable. Systems being converted from mineral oil to vegetable oil should be repeatedly flushed with vegetable oil to ensure 100% biodegradability.
- Specific vegetable oil products may provide normal unit life when operating at pressure ratings higher than those indicated above.
- Vegetable oils oxidize more quickly than petroleum based hydraulic fluid. Care must be taken to maintain fluid temperature within specified limits and to establish more frequent fluid change intervals.
- All seals must be Fluorocarbon (FKM) / Viton / HNBR.
- Specific gravity of the fluid is 0.92. Design circuit with reservoir oil level sufficiently above the pump inlet to assure a minimum of 1 bar absolute pressure at pump.
- Water contamination may degrade the fluid - 0.07% wt maximum. Precaution to be taken to avoid water contamination.
- Foaming and aeration can be greater with this fluid than petroleum base oils. Reservoir may be designed to give maximum retention time for effective air release.
- TAN - 2.0 mg KOH/gm Max increase in total acid number from the start up value.