Brine System Equipment & Install Specification

Vendor to provide all labor, equipment, transportation, and freight, necessary in order to provide and install (as required below) the equipment specified below. All equipment and materials, installed or otherwise shall be new. Vendor shall warrant all equipment and installations for 1 calendar year from time of acceptance, for both parts and labor. For Items 1 & 2 which are to be installed in three (3) SEPTA Trucks, the Vendor shall deliver fully-operational, cab-operated, Brine Delivery Systems.

1. Varitech AI1850 Direct Application Brine Sprayer (qty. 3), as follows:
   a. 1850 poly tank;
   b. galvanized frame;
   c. tank tamer baffle ball system;
   d. 3-lane closed loop hydraulic drive plumbing kit;
   e. 3-lane PVC spray bars;
   f. MT 403 in-cab controller with GPS speed sensor - will run flow meter and hydraulic control valve;
   g. electric solenoid diverter valve with switch in cab;
   h. hosing from pump to motor;
   i. hydraulic flow from existing pump/pto on SEPTA trucks. Existing pumps are Mannesmann-Rexroth variable displacement pumps model A10VO, Series 31, for Open-Circuits (see attached 45-page specification);
   j. unit supplied must be compatible to existing brine units in SEPTA’ fleet; &
   k. controller must have all functions as existing units in SEPTA’ fleet.

2. Free-Standing Galvanized Leg Kit Option (qty. 3).

3. Labor to Install items 1 & 2 above (qty. 3) on SEPTA Tri-Axle Dump Body Trucks as follows:
   a. 2013 - International, tri-axle 15-17 cu. yd. dump truck w/plow & salt spreader, vin-1htgrsjtxdj301124, septa id 1124;
   b. 2013 - International, tri-axle 15-17 cu. yd. dump truck w/plow & salt spreader, vin-1htgrsjtxdj301125, septa id 1125; &

4. Transfer Pump System, TS250 90 GPM (qty. 1), as follows:
   a. 230v/115v/1 phase;
   b. 90 gallon per minute;
   c. stainless steel pump head;
   d. totally enclosed fan cooled TEFC thermally protected motors;
   e. mechanical pump shaft seal; &
   f. foam insulation installed during molding.

5. Stainless Steel Submersible Pump, LDS 118 for SB600 Brine Maker, (qty. 1)
6. **Vertical Single-Wall 5,000 Gallon Storage Tank Kit (qty. 1), to include:****
   a. 25' of hosing;
   b. stainless steel fittings;
   c. integrated lifting lugs;
   d. extra-large 16" man way;
   e. high-density UV stabilized Polyethylene plastic;
   f. minimum 1.5 gravity shut-off valve; &
   g. recirculating line

7. **3-Lane Critical Spot Brine Sprayer, 200 Gallons or Authority approved equal: Varitech model AI200, (qty. 2), as follows:**
   a. galvanized frame;
   b. electric-start Honda engine;
   c. open loop;
   d. stainless steel spray bar;
   e. spring rewind hose reel with 50' of ½" hose and spray nozzle; &
   f. 3-lane witch pack

8. **Schedule, Pickup, Delivery, Freight, and Training**
   a. Vendor has 90 days from Notice to Proceed/Issuance of a Purchase Order to deliver and install (as required) all equipment included in this specification;
   b. Vendor shall have each of the three(3) trucks for no more than 1 week for the purposes of installing Items 1 & 2 of this specification;
   c. In order to minimize out-of-service time, the vendor should assume that only 1 truck shall be in their possession at any time for installation purposes.
   d. Vendor shall pick-up and deliver the trucks from and to SEPTA’s Courtland Utility Shop located at: 4301 Wissahickon Ave., Philadelphia Pa. 19129
   e. SEPTA reserves the right to reasonably inspect the equipment and installation work at Vendor’s facilities;
   f. Vendor shall provide 4-hours of on-site (SEPTA) training for the operation, maintenance, & repair of all equipment provided under this specification.
   g. Pick-up, Delivery, & Inspection activities and timing shall be discussed with the SEPTA Project Manager, Mr. John Rowan, 215-964-4700.
Variable displacement axial piston pump A10VO of swashplate design is designed for hydrostatic transmissions in open loop circuits. Flow is proportional to the drive speed and the displacement. By adjusting the position of the swashplate it is possible to smoothly vary the flow.

- Flange connections to SAE-UNC or SAE-metric
- 2 leakage ports
- High permissible speeds
- Good suction characteristics
- Low noise level
- Long service life
- Axial and radial loading of drive shaft possible
- High power/weight ratio
- Wide range of controls
- Short control times
- Through drive option for multi-circuit system
Variable displacement pump A10VO, Series 31

**Axial piston unit**

Swashplate design, variable

Nominal pressure 4000 psi (280 bar)

Peak pressure 5100 psi (350 bar)

**Mode of operation**

- Pump, open circuit

**Size**

<table>
<thead>
<tr>
<th>Displacement V_{gmax}</th>
<th>28</th>
<th>45</th>
<th>71</th>
<th>100</th>
<th>140</th>
</tr>
</thead>
<tbody>
<tr>
<td>in³/rev.</td>
<td>1.71</td>
<td>2.75</td>
<td>4.33</td>
<td>6.10</td>
<td>8.54</td>
</tr>
<tr>
<td>cm³/rev.</td>
<td>28</td>
<td>45</td>
<td>71</td>
<td>100</td>
<td>140</td>
</tr>
</tbody>
</table>

**Control devices**

- Two position control, direct operated
- Pressure control
- Remote control
- Adjustable pressure control
- Pressure and flow control
- X port closed

**Seals**

- Buna-N (NBR per DIN ISO 1629); shaft seal FPM (Fluorocarbon)
- FPM (fluorocarbon)

**Shaft end**

<table>
<thead>
<tr>
<th>SAE-splined shaft</th>
<th>7/8&quot;</th>
<th>1&quot;</th>
<th>1 1/4&quot;</th>
<th>1 1/2&quot;</th>
<th>1 3/4&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAE-splined shaft, reinforced (higher thru drive torques)</td>
<td>7/8&quot;</td>
<td>1&quot;</td>
<td>1 1/4&quot;</td>
<td>1 1/2&quot;</td>
<td>1 3/4&quot;</td>
</tr>
<tr>
<td>SAE-splined shaft, smaller size (not for pumps with thru drive)</td>
<td>7/8&quot;</td>
<td>1&quot;</td>
<td>1 1/4&quot;</td>
<td>1 1/2&quot;</td>
<td>U</td>
</tr>
</tbody>
</table>

**Mounting flange**

- SAE 2 hole
- SAE 4 hole

**Ordering code**

<table>
<thead>
<tr>
<th>Axial piston unit</th>
<th>Mode of operation</th>
<th>Size</th>
<th>Control devices</th>
<th>Series</th>
<th>Direction of rotation</th>
<th>Seals</th>
<th>Shaft end</th>
<th>Mounting flange</th>
</tr>
</thead>
<tbody>
<tr>
<td>A10V</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Service ports**

- Rear ports, SAE flange, standard series, UNC mounting screws (Code 61)
- Opposite side ports, SAE flange, standard series, UNC mounting screws (Code 61)
- Rear ports, SAE flange, standard series, metric mounting screws
- Opposite side ports, SAE flange, standard series, metric mounting screws
- Rear ports, SAE flange, standard series
- Opposite side ports, SAE flange, standard series
- B port size 1", UNC mounting screws (Code 61)
- B port size 1", metric mounting screws
- B port size 1", metric mounting screws
- B port size 1", metric mounting screws

**Thru-drive**

- With thru-drive, pump with side port only

**Mounting flange**

- Shaft/coupling

**For the mounting of:**

- 82-2 (SAE A) 16-4 (SAE A) G2, GC2/GC3-1X
- 82-2 (SAE A) 19-4 (SAE A-B) A10VSO 18 (shaft end S)
- 101-2 (SAE B) 22-4 (SAE B) A10VO 28 (shaft end S), G3
- 101-2 (SAE B) 25-4 (SAE B-B) A10VO 45 (shaft end S), GC4-1X
- 101-2 (SAE B) 32-4 (SAE C) GC5-1X
- 127-2 (SAE C) 32-4 (SAE C) A10VO 71 (shaft end S)
- 127-2 (SAE C) 38-4 (SAE C-C) A10VO 100 (shaft end S), GC6-1X
- 152-4 (SAE D) 44-4 (SAE D) A10VO 140 (shaft end S)
- 82-2 (SAE A) 19-4 (SAE A-B mod.) A10VSO 18 (shaft end R)
- 101-2 (SAE B) 22-4 (SAE B mod.) A10VO 28 (shaft end R), PVV 4 and 2 (w/j shaft)
- 101-2 (SAE B) 25-4 (SAE B-B mod.) A10VO 45 (shaft end R)
- 127-2 (SAE C) 32-4 (SAE C-C mod.) A10VO 71 (shaft end R), PVV 4 and 5 (w/j shaft)

**Seals**

- Shaft end
- Mounting flange

**Ordering code**

- Fluid/Version
- Petrol Oil (no code)

- Axial piston unit
  - A10V

- Control devices
  - Series
  - Direction of rotation
  - Seals
  - Shaft end
  - Mounting flange

**Series**

- 31
**Hydraulic fluid**

Prior to project design, please see our data sheets RA 90220 (petroleum oil), RA 90221 (ecologically acceptable fluids) for detailed information on the fluids and application conditions. When using ecologically acceptable fluids attention must be paid to possible limitations of the technical data and if necessary, please consult us.

**Operating viscosity range**

In order to obtain optimum efficiency and service life, we recommend that the operating viscosity (at operating temperature) be selected from within the range

\[
\nu_{\text{opt}} \quad 80...170 \text{ SUS (16...36 mm}^2/\text{s)}
\]

referred to tank temperature (open loop circuit).

**Limits of viscosity range**

The following values are valid for extreme operating conditions:

\[
\begin{align*}
\nu_{\text{min}} &= 60 \text{ SUS (10 mm}^2/\text{s)} \\
& \quad \text{for short periods at max. leakage oil temperature of} \\
& \quad 195^\circ \text{F (90}^\circ \text{C)} \\
\nu_{\text{max}} &= 4600 \text{ SUS (1000 mm}^2/\text{s)} \\
& \quad \text{for short periods upon cold start.}
\end{align*}
\]

**Temperature range** (see selection diagram)

\[
\begin{align*}
t_{\text{min}} &= -13^\circ \text{F (} -25^\circ \text{C)} \\
t_{\text{max}} &= +195^\circ \text{F (+90}^\circ \text{C)}
\end{align*}
\]

**Notes on hydraulic fluid selection**

In order to select the correct fluid, it is necessary to know the operating temperature in the tank (open loop circuit) in relation to the ambient temperature.

The hydraulic fluid should be selected so that within the operating temperature range, the operating viscosity is within the optimum range \(\nu_{\text{opt}}\) (see shaded area of the selection diagram). We recommend that the higher viscosity grade is selected in each case.

Example: At an ambient temperature of \(X^\circ \text{F (} ^\circ \text{C})\), the operating temperature in the tank is \(140^\circ \text{F (60}^\circ \text{C)}\). Within the operating viscosity range \(\nu_{\text{opt}}\); shaded area), this corresponds to viscosity grades VG 46 or VG 68. VG 68 should be selected.

Important: The leakage oil temperature is influenced by pressure and speed and is always higher than the tank temperature. However, at no point in the system may the temperature exceed \(195^\circ \text{F (90}^\circ \text{C)}\).

If it is not possible to comply with the above conditions because of extreme operating parameters or high ambient temperature, please consult us.

**Filtration of fluid**

In order to ensure correct functioning of the unit, a minimum level of cleanliness

\[
\begin{align*}
& \text{to NAS 1638 class 9,} \\
& \text{to SAE class 6 or} \\
& \text{to ISO/DIS 4406 class 18/15 is required.}
\end{align*}
\]

This may be achieved, for example, with filter elements type ...D 020... (see RA 31278).

Hence the following degree of separation is produced

\[
\beta_{10} \geq 100.
\]
Variable displacement pump A10VO, Series 31

Technical data

Input operating pressure range
Absolute pressure at port S (A)

\[ p_{\text{abs min}} = 12 \text{ psi} (0.8 \text{ bar}) \]
\[ p_{\text{abs max}} = 435 \text{ psi} (30 \text{ bar}) \]

Output operating pressure range
Pressure at port B
Nominal pressure \( p_n \) 4000 psi (280 bar)
Peak pressure \( p_{\text{max}} \) 5100 psi (350 bar)

(Pressure data to DIN 24312)
Intermittend operating pressures up to 4600 psi (315 bar) are possible at 10 % duty cycle.

Case drain pressure
Maximum pressure of leakage fluid (at ports L, L1):
Maximum 7 psi (0.5 bar) higher than input pressure at port S, but not higher than 30 psi (2 bar) absolute.

Direction of flow
S to B

Table of values (theoretical values, without considering \( \eta_{\text{mh}} \) and \( \eta_v \); values rounded)

<table>
<thead>
<tr>
<th>Size</th>
<th>28</th>
<th>45/H*</th>
<th>71/H*</th>
<th>100/H*</th>
<th>140/H*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Displacement ( V_{g \text{ max}} ) in(^3) (cm(^3))</td>
<td>1.71 (28)</td>
<td>2.75 (45)</td>
<td>4.33 (71)</td>
<td>6.10 (100)</td>
<td>8.54 (140)</td>
</tr>
<tr>
<td>Max. speed (^1) at ( V_{g \text{ max}} ) ( n_{\text{max}} ) rpm</td>
<td>3000</td>
<td>2800/3000</td>
<td>2200/2550</td>
<td>2000/2300</td>
<td>1800/2050</td>
</tr>
<tr>
<td>Max. flow (^2) at ( n_{\text{max}} ) ( Q_{\text{max}} ) gpm (L/min)</td>
<td>21.5 (81)</td>
<td>30/34.5 (113)/131</td>
<td>40/46 (152)/173</td>
<td>51/59 (194)/223</td>
<td>64/73.5 (244)/278</td>
</tr>
<tr>
<td>Max. power ( \Delta p = 4000 \text{ psi} (\Delta p = 280 \text{ bar}) ) at ( n_{\text{max}} ) ( P_{\text{max}} ) HP (kW)</td>
<td>52 (39)</td>
<td>72 (55)</td>
<td>96 (73)</td>
<td>123 (93)</td>
<td>155 (118)</td>
</tr>
<tr>
<td>Max. torque ( \Delta p = 4000 \text{ psi} (\Delta p = 280 \text{ bar}) ) at ( V_{g \text{ max}} ) ( T_{\text{max}} ) lb-ft (Nm)</td>
<td>91 (125)</td>
<td>146 (200)</td>
<td>230 (316)</td>
<td>324 (445)</td>
<td>453 (623)</td>
</tr>
<tr>
<td>Torque ( \Delta p = 1450 \text{ psi} (\Delta p = 100 \text{ bar}) ) at ( V_{g \text{ max}} ) ( T_{\text{max}} ) lb-ft (Nm)</td>
<td>33 (45)</td>
<td>53 (72)</td>
<td>83 (113)</td>
<td>117 (159)</td>
<td>164 (223)</td>
</tr>
<tr>
<td>Moment of inertia about drive axis ( J ) lb-ft(^2) (kgm(^2))</td>
<td>0.040 (0.0017)</td>
<td>0.078 (0.0033)</td>
<td>0.197 (0.0083)</td>
<td>0.396 (0.0167)</td>
<td>0.574 (0.0242)</td>
</tr>
<tr>
<td>Filling volume (case) gal (L)</td>
<td>0.2 (0.7)</td>
<td>0.25 (1.0)</td>
<td>0.4 (1.6)</td>
<td>0.6 (2.2)</td>
<td>0.8 (3.0)</td>
</tr>
<tr>
<td>Weight (without fluid) m lbs (kg)</td>
<td>33 (15)</td>
<td>46 (21)</td>
<td>73 (33)</td>
<td>99 (45)</td>
<td>132 (60)</td>
</tr>
<tr>
<td>Permissible loading on drive shaft max. axial load ( F_{ak \text{ max}} ) lbf (N)</td>
<td>225 (1000)</td>
<td>340 (1500)</td>
<td>540 (2400)</td>
<td>900 (4000)</td>
<td>1080 (4800)</td>
</tr>
<tr>
<td>max. radial load ( F_{q \text{ max}} ) lbf (N)</td>
<td>540 (2400)</td>
<td>810 (3600)</td>
<td>1350 (6000)</td>
<td>2250 (10000)</td>
<td>2700 (12000)</td>
</tr>
</tbody>
</table>

\(^1\) Values shown are valid with an absolute pressure of 14.5 psi (1 bar) at suction port "S". If the flow is reduced or if the input pressure is increased the speed may be increased according to the diagram.

\(^2\) 3 % flow losses included

H* High Speed Version For higher speeds than listed, consult factory for application limitatons.

Calculation of size

Flow \( Q = \frac{V_s \cdot n \cdot \eta_v}{231} \text{ gpm} \)
Torque \( T = \frac{V_s \cdot \Delta p}{24 \cdot \pi \cdot \eta_{\text{in}}} \text{ lb-ft} \)
Power \( P = \frac{Q \cdot \Delta p}{1714 \cdot \eta_t} \text{ HP} \)

\( V_s \) = Displacement in\(^3\) (cm\(^3\)) per revolution
\( \Delta p \) = Pressure differential psi (bar)
\( n \) = Speed rpm (rpm)
\( \eta_v \) = Volumetric efficiency
\( \eta_{\text{in}} \) = Mechanical-hydraulic efficiency
\( \eta_t \) = Total efficiency (\( \eta_t = \eta_v \cdot \eta_{\text{in}} \))
**Installation notes**

Installation position is optional. The pump housing must be filled with fluid both when commissioning and in operation. In order to achieve low noise levels, all connecting lines (suction, pressure and drain lines) are to be isolated from the tank by flexible members.

A non-return line in the drain lines should be avoided. In individual cases, this may be possible, please enquire.

1. **Vertical installation** (shaft end upwards)

   The following installation conditions should be noted:

   1.1. **Installation within a tank**

      Before installation, fill pump housing with it horizontal.
      a) If the minimum fluid level is equal to or above the pump mounting surface, open ports “L,” “L,” and “S” (see fig. 1).
      b) If the minimum fluid level is below the pump mounting surface, pipe port “L,” and perhaps port “S” with respect to fig. 2. Close port “L” with respect to the conditions in 1.2.1.

   1.2. **Installation outside a tank**

      Before installation, fill pump housing with it horizontal. For mounting above tank see fig. 2.

      Limiting condition:

      1.2.1. Minimum pump input pressure $p_{in \, min} = 12 \, \text{psi} \ (0.8 \, \text{bar})$ under static and dynamic loading.

      Note: Avoid mounting above a tank whenever possible in order to attain a low noise level.

      The permissible suction height $h$ is a result of the overall pressure loss, by may not be greater than $h_{max} = 32 \, \text{inch} \ (800 \, \text{mm})$ [immersion depth $h_{min} = 8 \, \text{inch} \ (200 \, \text{mm})$].

2. **Horizontal installation**

   The pump must be installed so that either "L" or "L," is at the top.

   2.1. **Installation within a tank**

      a) If the minimum fluid level is above the top of the pump, leave ports "L", "L," and "S" open (see fig. 3).
      b) If the minimum fluid level is equal to or below the top of the pump pipe ports "L", "L," and perhaps "S" according to fig. 4. Conditions according to 1.2.1.

   2.2. **Installation outside a tank**

      Fill pump housing before commissioning.
      Pipe port "S" and the higher one of the two ports "L" or "L,"
      a) Mounting above tank according to fig. 4.
      Conditions according to 1.2.1.

      b) Position below tank
      Pipe ports "L" and "S" according to fig. 5.

---

**Total pressure loss** $\Delta p_{tot} = \Delta p_1 + \Delta p_2 + \Delta p_3 \leq 0.2 \, \text{bar}$

- **$\Delta p_1$:** Pressure loss in pipe due to accelerating column of fluid
  
  $\Delta p_1 = \frac{\rho \cdot l \cdot \frac{dv}{dt}}{dt} \cdot 10^{-5} \, \text{bar}$

  - $\rho = \text{density (kg/m}^3\text{)}$
  - $l = \text{pipe length (m)}$
  - $\frac{dv}{dt} = \text{change in rate of suction (m/s}^2\text{)}$

- **$\Delta p_2$:** Pressure loss due to static head
  
  $\Delta p_2 = h \cdot \rho \cdot g \cdot 10^{-5} \, \text{bar}$

  - $h = \text{height (m)}$
  - $\rho = \text{density (kg/m}^3\text{)}$
  - $g = \text{gravity = 9.81 m/s}^2$

- **$\Delta p_3$:** Line pressure loss (elbows etc.)
Operating curves for pump with pressure control DR

Noise characteristic
Measured in an anechoic chamber
Distance from microphone to pump = 3.3 ft (1 m)
Measurement tolerance: ± 2 dB (A)
Fluid: hydraulic oil to ISO VG 46 DIN 51519, t = 122 °F (50 °C)

Size 28

Size 100

Size 45

Size 140

Size 71
Variable displacement pump A10VO, Series 31

Drive power and flow
Fluid: hydraulic oil to ISO VG 46 DIN 51519, t = 122° F (50° C)

Size 28
- - - - n = 1800 rpm
- - - - n = 3000 rpm

Size 45
- - - - n = 1800 rpm
- - - - n = 2600 rpm

Size 71
- - - - n = 1800 rpm
- - - - n = 2200 rpm
Variable displacement pump A10VO, Series 31

**Size 100**
- \( n = 1800 \text{ rpm} \)
- \( n = 2000 \text{ rpm} \)

**Size 140**
- \( n = 1800 \text{ rpm} \)

**Total efficiency:**

\[
\eta_t = \frac{Q \cdot p}{P_{Q_{\text{max}}} \cdot 1714}
\]

**Volumetric efficiency:**

\[
\eta_v = \frac{Q}{Q_{\text{theor}}}
\]

\( Q \) = gpm (L/min)
\( p \) = psi (bar)
\( P_{Q_{\text{max}}} \) = HP (kW)
Unit dimensions, size 28
Service ports at rear, no through drive; model 61 N00
without considering control

Drive shaft S
22-4; (SAE B)
SAE J744 OCT 83

Drive shaft R
22-4; (SAE B) Modified
SAE J744 OCT 83

Port connections
B  Pressure port  3/4" SAE  (standard pressure series, Code 61)
S  Suction port  1 1/4" SAE  (standard pressure series, Code 61)
L  Case drain port  3/4-16 UNF-2B
L  Case drain port  3/4-16 UNF-2B  (sealed in factory)
Unit dimensions, size 28
Service ports on sides, no through drive; model 62 N00

Service ports at rear, no through drive; model 11 N00 (metric threads)

Service ports on sides, no through drive; model 12 N00 (metric threads)
Unit dimensions, size 45
Service ports at rear, no through drive; model 61 N00
without considering control

Flange 101-2
(SAE B; 2 hole)
SAE J744 OCT 83

Before finalising your design, please request a certified drawing.
Dimensions in inches and millimeters ( ).

Dimensions in inches and millimeters ( ).

Drive shaft S
25-4; (SAE B-B)
SAE J744 OCT 83

Drive shaft R
25-4; (SAE B-B) Modified
SAE J744 OCT 83

Drive shaft U
22-4; (SAE B)
SAE J744 OCT 83

Drive shaft W
22-4; (SAE B) Modified
SAE J744 OCT 83

Port connections
B  Pressure port 1" SAE
   (standard pressure series, Code 61)
S  Suction port 1 1/2" SAE
   (standard pressure series, Code 61)
L  Case drain port 7/8-14 UNF-2B
   (sealed in factory)
L1 Case drain port 7/8-14 UNF-2B
   (sealed in factory)
Variable displacement pump A10VO, Series 31

**Unit dimensions, size 45**

*Service ports on sides, no through drive; model 62 N00*

![Diagram of service ports on sides, no through drive; model 62 N00](image)

- L = Case drain port M22x1.5

*Service ports at rear, no through drive; model 11 N00 (metric threads)*

![Diagram of service ports at rear, no through drive; model 11 N00](image)

- L = Case drain port M22x1.5

*Service ports on sides, no through drive; model 12 N00 (metric threads)*

![Diagram of service ports on sides, no through drive; model 12 N00](image)

- L = Case drain port M22x1.5

Before finalising your design, please request a certified drawing. Dimensions in inches and millimeters ( ).
Unit dimensions, size 71
Service ports at rear, no through drive; model 91 N00
without considering control

Drive shaft S
32-4; (SAE C)
SAE J744 OCT 83

Drive shaft R
32-4; (SAE C) Modified
SAE J744 OCT 83

CAUTION!!
Pressure port B with one port size option!
1.) Port size 1" SAE, standard pressure series (Code 61) 5000 psi,
for pressures higher 3600 psi (250 bar)

For both, operating pressures higher 3600 psi (250 bar) and new
applications 1" SAE pressure flange must be used!

Port connections
B  Pressure port  1" SAE (standard pressure series)
S  Suction port  2" SAE (standard pressure series)
L  Case drain port 7/8-14 UNF-2B
L1  Case drain port 7/8-14 UNF-2B (sealed in factory)
Unit dimensions, size 71
Service ports on sides, no through drive; model 92 N00

Service ports at rear, no through drive; model 41 N00 (metric threads)

Service ports on sides, no through drive; model 42 N00 (metric threads)

L = Case drain port M22x1.5
Variable displacement pump A10VO, Series 31

Before finalising your design, please request a certified drawing.
Dimensions in inches and millimeters (   ).

Unit dimensions, size 100
Service ports at rear, no through drive; model 61 N00
without considering control

Flange 127-2
(SAE C; 2 hole)
SAE J744 OCT 83

Port connections
B Pressure port  1 1/4" SAE (high pressure series, Code 62)
S Suction port  2 1/2" SAE (standard pressure series, Code 61)
L Case drain port  1 1/16-12 UNF-2B (plugged at factory)
L Case drain port  1 1/16-12 UNF-2B
Unit dimensions, size 100
Service ports on sides, no through drive; model 62 N00

Service ports at rear, no through drive; model 11 N00 (metric threads)

Service ports on sides, no through drive; model 12 N00 (metric threads)

L = Case drain port M27x2
Variable displacement pump A10VO, Series 31

Unit dimensions, size 140
Service ports at rear, no through drive; model 61 N00
without considering control

Drive shaft S
44-4; (SAE D)
SAE J744 OCT 83

Port connections
B  Pressure port  1 1/4" SAE  (high pressure series, Code 62)
S  Suction port   2 1/2" SAE  (standard pressure series, Code 61)
L  Case drain port 1 1/16-12 UNF-2B  (plugged at factory)
L1 Case drain port 1 1/16-12 UNF-2B  (plugged at factory)
Unit dimensions, size 140

Service ports on sides, no through drive; model 62 N00

Service ports at rear, no through drive; model 11 N00 (metric threads)

Service ports on sides, no through drive; model 12 N00 (metric threads)

L = Case drain port M27x2
**DG Two-position control, direct operated**

The variable displacement pump is set to a minimum swivel angle by applying an external remote pilot pressure at port X. This directly supplies the control piston with pilot oil with a minimum pilot pressure requirement of \( p_{st} \geq 435 \) psi (30 bar).

The variable displacement pump is adjustable between \( V_g \text{ max} \) or \( V_g \text{ min} \) only.

### Static operating curve

![Static operating curve diagram](image)

Switching pressure in X = 0 psi (bar) = \( V_g \text{ max} \)

Switching pressure in X \( \geq \) 435 psi (30 bar) = \( V_g \text{ min} \)

### Control data

- min. switching pressure = 435 psi (30 bar)
- max. perm. switching pressure = 4000 psi (280 bar)

### Unit dimensions DG

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<th>( A_3 )</th>
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**Port connections**

- B Pressure port
- S Suction port
- L, L1 Case drain ports (L1 plugged)
- X Pilot pressure port (plugged)
Unit dimensions DG
Service ports at rear, models 61 N00 and 11 NOO
Sizes 28...100

Service ports on sides, models 62 and 12
Sizes 28...100

Before finalising your design, please request a certified drawing. Dimensions in inches and millimeters (   ).
**DR Pressure control**

The pressure control serves to maintain a constant pressure in the hydraulic system, within the control range of the pump. The pump therefore supplies only the amount of hydraulic fluid required by the actuators. Pressure may be smoothly set at the pilot valve.

**Static operating curve**

at $n_1 = 1500$ rpm; $t_{ol} = 122\,^\circ F (50\,^\circ C)$

Dynamic operating curves

The curves show average measured values under test conditions, with the unit within the tank.

Conditions: $n = 1500$ rpm

$t_{ol} = 122\,^\circ F (50\,^\circ C)$

Pressure cut-off at 5100 psi (350 bar)

Stepped loading by suddenly opening or closing the pressure line using a pressure relief valve set at 3.3 ft (1 m) from the axial piston unit.

**Control data**

Hysteresis and repetition accuracy $\Delta p$ max. 45 psi (3 bar)

Max. pressure increase

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<td>60</td>
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<td>145</td>
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<tr>
<td>bar</td>
<td>4</td>
<td>6</td>
<td>8</td>
<td>10</td>
<td>12</td>
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Pilot oil consumption max. approx. 0.8 gpm (3 L/min)

Volumetric flow losses at $Q_{\text{max}}$ see pages 8 and 9

<table>
<thead>
<tr>
<th>Size</th>
<th>$t_{sa}$ (ms) against 725 psi (50 bar)</th>
<th>$t_{sa}$ (ms) against 3200 psi (220 bar)</th>
<th>$t_{se}$ (ms) zero stroke 4000 psi (280 bar)</th>
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Variable displacement pump A10VO, Series 31

Unit dimensions DR
Service ports at rear, models 61 N00 and 11 NOO

Sizes 28...100

<table>
<thead>
<tr>
<th>Size</th>
<th>A₁</th>
<th>A₂</th>
<th>A₃</th>
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<td>6.65(169)</td>
<td>5.00(127)</td>
</tr>
</tbody>
</table>

In sizes 28 to 100 the DFR valve is used, whereby the flow control is sealed in the factory and not tested.
DRG  Pressure control, remotely controlled

Function and design as for DR.

A pressure relief valve may be externally piped to port X here for the purpose of remote control. However, it is not included in the DRG control supply.

The differential pressure at the pilot valve is set as standard to 290 psi (20 bar) and this results in a pilot flow of 0.4 gpm (1.5 L/min).

If another setting is required [range: 145 - 320 psi (10 – 22 bar)], please state this in clear text.

We recommend that one of the following is used as the separate pressure relief valve:

DBDH6 (hydraulic) to RA 25 402
DBEC-3X (electrical) to RA 29 142 or
DBETR-SO381 with orifice 0.03 in Dia (0.8 mm ø) in P (electrical) to RA 29 166

The max. length of line should be no longer than 6.5 ft (2 m).

Static operating curve
at n₁ = 1500 rpm; t oil = 122 °F (50 °C)

Control data
Hysteresis and repetition accuracy Δp max. 45 psi (3 bar)
Max. pressure increase

<table>
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<tr>
<th>Size</th>
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<th>100</th>
<th>140</th>
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<td>60</td>
<td>90</td>
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<td>Δp bar</td>
<td>4</td>
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<td>8</td>
<td>10</td>
<td>12</td>
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</table>

Pilot oil consumption approx. 1.2 gpm (4.5 L/min)
Volumetric flow losses at Q_max see pages 8 and 9

Port connections
B  Pressure port
S  Suction port
L, L₁  Case drain ports (L, plugged)
X  Pilot pressure port

<table>
<thead>
<tr>
<th>Model</th>
<th>Sizes 28...100</th>
<th>Size 140</th>
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<tr>
<td>61 and 62</td>
<td>without adapter</td>
<td>with adapter</td>
</tr>
<tr>
<td>11 and 12</td>
<td>with adapter</td>
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### Unit dimensions DRG

**Service ports at rear, models 61 N00 and 11 NOO**

#### Sizes 28...100

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<th>(A_{10})</th>
<th>(A_{11})</th>
<th>(A_{12})</th>
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<th>Port X models 11 + 12</th>
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<td>1.57</td>
<td>4.68</td>
<td>5.51</td>
<td>4.68</td>
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<td>7/16-20 UNF-2B; 10 deep</td>
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<td>(140)</td>
<td>(119)</td>
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**Service ports on sides, models 62 and 12**

#### Sizes 28...100

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<td>(M14x1.5; 12 deep)</td>
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</table>
DRT1/2 Pressure control adjustable by remote pilot pressure

The DRT1/2 is a pressure compensator with adjustable control pressure. Without control pressure the pump is in standby at approximately 365 psi (25 bar). By means of control pressure the pump pressure is increased according to the ratio of the DRT1 and/or DRT2 (see static curve).

This control is designed specifically for the pressure demand control.

The pressure demand control is a control for mobile equipment.

In this system the main control spool of the directional valve is operated hydraulically with the remote control valve and at the same time preselecting pump pressure.

As a separate 4/3 directional control valve we recommend, for example: M1-16 as per RA 64263.

Available ratios:

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<tr>
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<th>i = 18.2</th>
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<tbody>
<tr>
<td>DRT2</td>
<td>i = 12.4</td>
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Static operating curve

Port connections

- B Pressure port
- S Suction port
- L, L Case drain ports (L, plugged)
- X Pilot pressure port
- T Case drain port (with tank piped separately)

Control data

Pilot oil consumption approx. 1.2 gpm (4.5 L/min)

Volumetric flow losses at Q_{max} see pages 8 and 9
Variable displacement pump A10VO, Series 31

Before finalising your design, please request a certified drawing. Dimensions in inches and millimeters.

Unit dimensions DRT1/2
Service ports at rear, model 61 N00

Size 45

Model 11 N00 (metric threads) on demand.

Service ports on sides, model 62

Size 45

Model 12 (metric threads) on demand.

<table>
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<tr>
<th>Size</th>
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<th>( A_{14} )</th>
<th>( A_{15} )</th>
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<td>7/16-20 UNF-2B; 0.39 deep</td>
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<td>(155)</td>
<td>(134)</td>
<td>(7/16-20 UNF-2B; 10 deep)</td>
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</table>
Variable displacement pump A10VO, Series 31

### DFR/DFR1 Pressure/flow control

In addition to the pressure control function, the pump flow may be varied by means of a differential pressure at the actuator (e.g. an orifice).

In model DFR1 the X orifice is plugged.

Function and design as for DR, pages 22 and 23.

### Static operating curve

at \( n_1 = 1500 \) rpm; \( t_{\text{oil}} = 122^\circ \text{F} \) (50°C)

<table>
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<tr>
<th>Size</th>
<th>( t_{\text{peak}} ) (ms)</th>
<th>( t_{\text{down}} ) (ms)</th>
<th>( t_{\text{se}} ) (ms)</th>
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### Port connections

B Pressure port
S Suction port
L, L1 Case drain ports (L1 plugged)
X Pilot pressure port

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<tr>
<th>Model</th>
<th>Sizes 28...100</th>
<th>Size 140</th>
</tr>
</thead>
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<tr>
<td>61 and 62</td>
<td>without adapter</td>
<td>with adapter</td>
</tr>
<tr>
<td>11 and 12</td>
<td>with adapter</td>
<td>without adapter</td>
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### Control data

Pressure control data see page 22

### Max. flow deviation (Hysteresis and increase)

measured at drive speed \( n = 1500 \) rpm

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<th>140</th>
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<td>1.0</td>
<td>1.6</td>
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<tr>
<td>L/min</td>
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<td>1.8</td>
<td>2.8</td>
<td>4.0</td>
<td>6.0</td>
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</table>

Pilot oil consumption DFR max. approx. 0.8 ... 1.2 gpm (3 ... 4.5 L/min)

Pilot oil consumption DFR 1 max. approx. 0.8 gpm (3 L/min)

Volumetric flow losses at \( Q_{\text{max}} \) see pages 8 and 9

### Flow control - differential pressure \( \Delta p \):

Variable between 145 and 320 psi (10 and 22 bar)

higher values please request

Standard setting 200 psi (14 bar)

If a different setting is required, please state it in clear text.

When port X is unloaded to tank, a zero stroke pressure of \( p = 260 \pm 30 \) psi (18 ± 2 bar) results ("stand by").

### Optional valves at port B

(not included in supply)

Mobile valve blocks SP 12 (RE 64145)
Mobile valve blocks SP 18 (RE 64148)
Mobile valve blocks MP 18 (RE 64594)
Mobile valve blocks MP 22 (RE 64598)
Proportional directional valves 4WRE (RA 29060)
Unit dimensions DFR
Service ports at rear, models 61 N00 and 11 NO0

Sizes 28...100

Service ports on sides, models 62 and 12
Sizes 28...100

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<th>A_9</th>
<th>A_10</th>
<th>A_11</th>
<th>A_12</th>
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<td>M14x1.5; 0.47 deep</td>
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</table>
Variable displacement pump A10VO, Series 31

**DFLR  Pressure/flow/power control**

In order to achieve a constant drive torque with a varying operating pressure, the swivel angle and with it the output flow from the axial piston unit is varied so that the product of flow and pressure remains constant. Constant flow control is possible below the power curve.

**Static operating curve**

State required power characteristic in clear text when ordering, e.g. 27 HP (20 kW) at 1500 rpm.

**DFLR-SO160  Pressure/power control**

The flow control function is eliminated, and X-port plugged. An internal 0.8 mm orifice is provided to supply the LR. valve (see DRG valve for schematic). X-port may be used for remote pressure control.

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Control data

Pressure control data see page 22
Flow control data see page 28
Control start__________from 1160 psi (80 bar)
Pilot oil consumption________max. approx. 1.45 gpm(5.5 L/min)
Volumetric flow losses at Q_{max}________see pages 8 and 9

* 7/16-20 UNF-2B; 0.39 (10) deep model 61
9/16-18 UNF-2B; 0.51 (13) deep model 62
Unit dimensions DFLR
Service ports at rear, models 61 N00 and 11 NOO
Sizes 28...100

Service ports on sides, models 62 and 12
Sizes 28...100

Before finalising your design, please request a certified drawing. Dimensions in inches and millimeters ( ).
**DFSR Pressure, flow and summation HP control**

The attained summation hp of the A10 pump and a second pump is limited together. There are two transmission ratios: 70 : 30 and 50 : 50 – the first indicating the A10 and the second indicating the second pump.

For example: A10VO 45 DFSR * G2 19 results in an aspect ratio of 45 : 19 = 70 : 30

Please check with the appropriate project engineer when you design your system.

Flow control is possible below the power characteristic curve.

### Static curve transmission ratio 50 : 50
with an even pressure \( p_1 = p_2 \)
\( p_1 \) pressure control start 1st pump; \( p_2 \) pressure control start 2nd pump

### Static curve transmission ratio 70 : 30
with an even pressure \( p_1 = p_2 \)
\( p_1 \) pressure control start 1st pump; \( p_2 \) pressure control start 2nd pump

Performance characteristics are preset at the plant. Please indicate total power requirements and transmission ratio in your order text, e.g. size 71; 27 HP (20kW) at 1500 rpm; 70 : 30

**Port connections**
- B Pressure port
- S Suction port
- \( L, L_1 \) Case drain ports (\( L_1 \) plugged)
- \( P_2 \) Pressure port of pump 2
- \( X \) Pilot pressure port

**Control data**
- Pressure control data see page 22
- Flow control data see page 28
- Pilot oil consumption max. approx. 1.45 gpm (5.5 L/min)
- Volumetric flow losses at \( Q_{\text{max}} \) see pages 8 and 9

Port plates "61 N00" and "11 N00" were deleted, since the second pump is normally mounted on the through drive.
Variable displacement pump A10VO, Series 31

Unit dimensions DFSR
Service ports on sides, models 62 and 12
Sizes 28...100

Before finalising your design, please request a certified drawing.
Dimensions in inches and millimeters ( ).

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<th>A₇</th>
<th>A₈</th>
<th>A₉</th>
<th>A₁₀</th>
<th>A₁₁</th>
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<th>Port X model 62</th>
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<td></td>
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</table>
**FHD Flow control, dependent on pilot pressure with pressure control**

The angle of swivel of the pump, and hence the flow is dependent on the pilot pressure \( P_{St} \) present in port \( X \).

A constant pressure of \( P_y = 500 \text{ psi} \) (35 bar) must be fed to port Y.

Pressure control is integrated and may be smoothly varied at the pilot valve.

(Please state setting values in clear text).

**Control data**

Hysteresis \( \pm 2 \% \) of \( V_{g_{max}} \)

External pilot oil consumption in \( Y \) max. approx. 0.8 ... 1.2 gpm

\[ \text{(3 ... 4.5 L/min)} \]

Volumetric flow losses at \( Q_{max} \) see pages 8 and 9

**Port connections**

- **B** Pressure port
- **S** Suction port
- **L, L_1** Case drain ports (L_1 plugged)
- **M** Measuring port
- **X, Y** Pilot pressure ports

**Static operating curve**

at \( n_1 = 1500 \text{ rpm; } t_{oil} = 122^\circ \text{ F (50^\circ \text{ C)}} \)

---

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<td>8.23</td>
<td>1.06</td>
<td>7.20</td>
<td>8.74</td>
<td>9.61</td>
<td>5.51</td>
<td>1.89</td>
<td>2.01</td>
<td>4.68</td>
<td>3.90</td>
<td>5.91</td>
</tr>
<tr>
<td></td>
<td>(127)</td>
<td>(208)</td>
<td>(27)</td>
<td>(183)</td>
<td>(222)</td>
<td>(244)</td>
<td>(140)</td>
<td>(48)</td>
<td>(51)</td>
<td>(119)</td>
<td>(98)</td>
<td>(150)</td>
</tr>
</tbody>
</table>
Unit dimensions FHD
Service ports at rear, models 61 N00 and 11 NOO

On demand

Service ports on sides, models 62 and 12
Sizes 28...100

Size 140
**FE1 Electronic flow control**

The FE1 control serves as an electro-hydraulic swivel angle control, and thus the displacement of the A10VO variable displacement pump.

The FE1 pump control is operated with the VT 5041 analog amplifier card. The amplifier card has to be ordered separately.

For additional information see RE 30022.

**Control data**
- Hysteresis < 1 % of \( V_{\text{g max}} \)
- Repetition accuracy < 1 %

**Components**
1. A10VO with hydraulic setting device
1.1 Proportional valve STW 0063
1.2 Inductive positional transducer IW9-03-01

Control electronics (please order separately, see RE 30022)

**Port connections**
- B Pressure port
- S Suction port
- L, L1 Case drain ports (L1 plugged)

**DFE1 Electronic pressure and flow control**

The pump flow is controlled via the swivel angle. Any changes in speed, e.g. with diesel engines will not be compensated for. Pump system pressure via a pressure transducer and pump position (swivel angle) via a LVDT are fed back to the amplifier card controlling the proportional valve.

The DFE1 pump design is suitable for controlling processes with the VT 5041 analog amplifier card.

The amplifier card and the pressure transducer are to be ordered separately.

For safety reasons an additional pressure relief valve has to be installed along with the pump pressure control. This is to insure that the max. permissible operating pressure is not exceeded.

For additional information and applications see RE 30022 and RE 98090.

**Static operating curve**

[Diagram showing static operating curve]

**Control data**
- Hysteresis < 1 % of \( V_{\text{g max}} \)
- Repetition accuracy < 1 %

**Components**
1. A10VO with hydraulic setting device
1.1 Proportional valve STW 0063
1.2 Inductive positional transducer IW9-03-01

Pressure sensor and Control electronics VT 5041-2X are free components (please order separately, see RE 30022)
Unit dimensions FE1 and DFE1
Service ports on sides, models 61 and 11

On demand

Service ports on sides, models 62 and 12
Sizes 28...140

Before finalising your design, please request a certified drawing.
Dimensions in inches and millimeters ( ).
Through drive
Axial piston unit A10VO may be supplied with a through drive, as shown in the ordering code on page 3.
The type of through drive is determined by codes (K01–K...).
If no additional pumps are to be factory installed, the simple model code is sufficient. In that case, the following is included in the order:
coupler, mounting screws, seal, and, if necessary, an adaptor flange.

Combination pumps:
Independent circuits can be made available by mounting additional pumps.
1. If the combination pump consists of 2 A10VO and if they are to be supplied mounted together, both model codes have to be connected with a "+" symbol.
Order example:
A10VO 71 DR/31 R–PSC62K02 +
A10VO 28 DR/31 R–PSC62N00
2. If a gear pump or radial piston pump is to be mounted at the plant, please note RD 90139 (in preparation). It lists the possible pump combinations with model codes of the first pump.

No through drives are available for pumps with drive shafts “U” and “W”. The input torque limitations are:

<table>
<thead>
<tr>
<th>Size</th>
<th>28</th>
<th>45</th>
<th>71</th>
<th>100</th>
<th>140</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. perm. input torque on drive shaft &quot;U&quot;</td>
<td>lb-ft</td>
<td>132</td>
<td>369</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nm</td>
<td>180</td>
<td>500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum operating pressure</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>psi</td>
<td>3650</td>
<td>4060</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>bar</td>
<td>252</td>
<td>280</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Size</th>
<th>45</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. perm. input torque on drive shaft &quot;W&quot;</td>
<td>lb-ft</td>
<td>164</td>
</tr>
<tr>
<td></td>
<td>Nm</td>
<td>223</td>
</tr>
</tbody>
</table>

Permissible bending moment

\[ T_m = \left( m_1 \cdot l_1 + m_2 \cdot l_2 + m_3 \cdot l_3 \right) \cdot \frac{1}{12} \text{ lb-ft} \]
\[ T_m = \left( m_1 \cdot l_1 + m_2 \cdot l_2 + m_3 \cdot l_3 \right) \cdot \frac{1}{102} \text{ (Nm)} \]

<table>
<thead>
<tr>
<th>Size</th>
<th>28</th>
<th>45</th>
<th>71</th>
<th>100</th>
<th>140</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permissible bending moment</td>
<td>T_m</td>
<td>lb-ft</td>
<td>65</td>
<td>101</td>
<td>159</td>
</tr>
<tr>
<td>Weight</td>
<td>m_1</td>
<td>lbs</td>
<td>33</td>
<td>46</td>
<td>73</td>
</tr>
<tr>
<td></td>
<td>kg</td>
<td>15</td>
<td>21</td>
<td>33</td>
<td>45</td>
</tr>
<tr>
<td>Distance to center of gravity</td>
<td>l_1</td>
<td>in</td>
<td>4.33</td>
<td>5.11</td>
<td>5.91</td>
</tr>
<tr>
<td></td>
<td>mm</td>
<td>110</td>
<td>130</td>
<td>150</td>
<td>160</td>
</tr>
</tbody>
</table>

Permissible torque on through drive

1 T_{tot,\text{max}}

<table>
<thead>
<tr>
<th>Size</th>
<th>28</th>
<th>45</th>
<th>71</th>
<th>100</th>
<th>140</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. perm. torque on through drive, drive shaft &quot;W&quot;, pump 1 (pump 1 + pump 2)</td>
<td>T_{tot,\text{max}}</td>
<td>lb-ft</td>
<td>132</td>
<td>221</td>
<td>369</td>
</tr>
<tr>
<td></td>
<td>Nm</td>
<td>180</td>
<td>300</td>
<td>500</td>
<td>890</td>
</tr>
<tr>
<td>1 Perm. torque on through drive</td>
<td>T_{D1,\text{max}}</td>
<td>lb-ft</td>
<td>92</td>
<td>147</td>
<td>233</td>
</tr>
<tr>
<td></td>
<td>Nm</td>
<td>125</td>
<td>200</td>
<td>316</td>
<td>445</td>
</tr>
<tr>
<td>2 Perm. torque on through drive</td>
<td>T_{D1,\text{max}}</td>
<td>lb-ft</td>
<td>41</td>
<td>74</td>
<td>136</td>
</tr>
<tr>
<td></td>
<td>Nm</td>
<td>55</td>
<td>100</td>
<td>184</td>
<td>445</td>
</tr>
</tbody>
</table>

2 T_{tot,\text{max}}

<table>
<thead>
<tr>
<th>Size</th>
<th>28</th>
<th>45</th>
<th>71</th>
<th>100</th>
<th>140</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. perm. torque on through drive, drive shaft &quot;U&quot;, pump 1 (pump 1 + pump 2)</td>
<td>T_{tot,\text{max}}</td>
<td>lb-ft</td>
<td>164</td>
<td>294</td>
<td>466</td>
</tr>
<tr>
<td></td>
<td>Nm</td>
<td>233</td>
<td>400</td>
<td>632</td>
<td>--</td>
</tr>
<tr>
<td>1 Perm. torque on through drive</td>
<td>T_{D1,\text{max}}</td>
<td>lb-ft</td>
<td>92</td>
<td>147</td>
<td>233</td>
</tr>
<tr>
<td></td>
<td>Nm</td>
<td>125</td>
<td>200</td>
<td>316</td>
<td>--</td>
</tr>
<tr>
<td>2 Perm. torque on through drive</td>
<td>T_{D1,\text{max}}</td>
<td>lb-ft</td>
<td>72</td>
<td>147</td>
<td>233</td>
</tr>
<tr>
<td></td>
<td>Nm</td>
<td>98</td>
<td>200</td>
<td>316</td>
<td>--</td>
</tr>
</tbody>
</table>
# Unit dimensions of combination pumps

## A10VO + A10VO

![Diagram of A10VO + A10VO combination pumps](image.png)

<table>
<thead>
<tr>
<th>2nd. pump</th>
<th>A10VO 28</th>
<th>A10VO 45</th>
<th>A10VO 71</th>
<th>A10VO 100</th>
<th>A10VO 140</th>
</tr>
</thead>
<tbody>
<tr>
<td>A10VSO 18</td>
<td>6.50 (165)</td>
<td>8.03 (204)</td>
<td>13.74 (349)</td>
<td>15.71 (399)</td>
<td>7.24 (194)</td>
</tr>
<tr>
<td>A10VO 28</td>
<td>6.50 (165)</td>
<td>8.03 (204)</td>
<td>14.53 (369)</td>
<td>15.67 (398)</td>
<td>7.24 (184)</td>
</tr>
<tr>
<td>A10VO 45</td>
<td>6.50 (165)</td>
<td>8.03 (204)</td>
<td>16.30 (398)</td>
<td>17.64 (448)</td>
<td>7.24 (184)</td>
</tr>
<tr>
<td>A10VO 71</td>
<td>6.50 (165)</td>
<td>8.03 (204)</td>
<td>16.65 (423)</td>
<td>17.64 (448)</td>
<td>7.24 (184)</td>
</tr>
<tr>
<td>A10VO 100</td>
<td>6.50 (165)</td>
<td>8.03 (204)</td>
<td>16.65 (423)</td>
<td>17.64 (448)</td>
<td>7.24 (184)</td>
</tr>
<tr>
<td>A10VO 140</td>
<td>6.50 (165)</td>
<td>8.03 (204)</td>
<td>16.65 (423)</td>
<td>17.64 (448)</td>
<td>7.24 (184)</td>
</tr>
</tbody>
</table>

Before finalising your design, please request a certified drawing. Dimensions in inches and millimeters ( ).
Variable displacement pump A10VO, Series 31

Dimensions of through drives

**Flange SAE 82-2** (SAE A, 2-hole) for mounting of gear pump G2 (see RA 10 030) or for mounting of internal gear pump 1 PF2GC2/3-1X/XXXR07MU2 (see RA 10 215)

Ordering code: **K01**

**Flange SAE 82-2** (SAE A, 2-hole) for mounting of axial piston pump A10VSO 18 - drive shaft "S" (see RA 92 712)

Ordering code: **K52**

### Dimensions in inches and millimeters

<table>
<thead>
<tr>
<th>Size</th>
<th>( A_1 )</th>
<th>( A_2 )</th>
<th>( A_3 ) (metric thread)</th>
</tr>
</thead>
<tbody>
<tr>
<td>28</td>
<td>8.03(204)</td>
<td>1.85(47)</td>
<td>M 10; 0.63(16) deep</td>
</tr>
<tr>
<td>45</td>
<td>9.02(229)</td>
<td>2.09(53)</td>
<td>M 10; 0.63(16) deep</td>
</tr>
<tr>
<td>71</td>
<td>10.51(267)</td>
<td>2.40(61)</td>
<td>M 10; 0.79(20) deep</td>
</tr>
<tr>
<td>100</td>
<td>13.31(338)</td>
<td>2.56(65)</td>
<td>M 10; 0.79(20) deep</td>
</tr>
<tr>
<td>140</td>
<td>13.78(350)</td>
<td>3.03(77)</td>
<td>M 10; 0.79(20) deep</td>
</tr>
</tbody>
</table>

### Flange SAE 101-2

(SAE B, 2-hole) for mounting of gear pump G3 (see RA 10 039) or for mounting of axial piston pump A10VO 28 - drive shaft "S"

Ordering code: **K02**

<table>
<thead>
<tr>
<th>Size</th>
<th>( A_1 )</th>
<th>( A_2 )</th>
<th>( A_3 ) (metric thread)</th>
</tr>
</thead>
<tbody>
<tr>
<td>28</td>
<td>8.03(204)</td>
<td>1.85(47)</td>
<td>M 12; 0.59(15) deep</td>
</tr>
<tr>
<td>45</td>
<td>9.02(229)</td>
<td>2.09(53)</td>
<td>M 12; 0.71(18) deep</td>
</tr>
<tr>
<td>71</td>
<td>10.51(267)</td>
<td>2.40(61)</td>
<td>M 12; 0.79(20) deep</td>
</tr>
<tr>
<td>100</td>
<td>13.31(338)</td>
<td>2.56(65)</td>
<td>M 12; 0.79(20) deep</td>
</tr>
<tr>
<td>140</td>
<td>13.78(350)</td>
<td>3.03(77)</td>
<td>M 12; 0.79(20) deep</td>
</tr>
</tbody>
</table>

At size 28, the gear pump G3 only mounted 45° turned.
Variable displacement pump A10VO, Series 31

Before finalising your design, please request a certified drawing. Dimensions in inches and millimeters.

**Flange SAE 101-2** (SAE B, 2-hole) for mounting of gear pump G4 (see RA 10 042)
Ordering code: K68

At size 28, the gear pump G4 only mounted 45° turned

<table>
<thead>
<tr>
<th>Size</th>
<th>A₁</th>
<th>A₂</th>
<th>A₃ (metric thread)</th>
</tr>
</thead>
<tbody>
<tr>
<td>28</td>
<td>8.03(204)</td>
<td>1.85(47)</td>
<td>M 12; 0.59(15) deep</td>
</tr>
<tr>
<td>45</td>
<td>9.02(229)</td>
<td>2.09(53)</td>
<td>M 12; 0.71(18) deep</td>
</tr>
<tr>
<td>71</td>
<td>10.51(267)</td>
<td>2.40(61)</td>
<td>M 12; 0.79(20) deep</td>
</tr>
<tr>
<td>100</td>
<td>13.31(338)</td>
<td>2.56(65)</td>
<td>M 12; 0.79(20) deep</td>
</tr>
<tr>
<td>140</td>
<td>13.78(350)</td>
<td>3.03(77)</td>
<td>M 12; 0.79(20) deep</td>
</tr>
</tbody>
</table>

**Flange SAE 101-2** (SAE B, 2-hole) for mounting of axial piston pump A10VO 45 - drive shaft "S" or for mounting of internal gear pump 1PF2GC4-1X/0XXXR07MU2 (see RA 10 215)
Ordering code: K04

<table>
<thead>
<tr>
<th>Size</th>
<th>A₁</th>
<th>A₂</th>
<th>A₃</th>
<th>A₄</th>
<th>A₅ (metric thread)</th>
</tr>
</thead>
<tbody>
<tr>
<td>45</td>
<td>9.02(229)</td>
<td>0.35(9)</td>
<td>2.09(53)</td>
<td>0.39(10)</td>
<td>M 12; 0.71(18) deep</td>
</tr>
<tr>
<td>71</td>
<td>10.51(267)</td>
<td>0.31(8)</td>
<td>2.40(61)</td>
<td>0.39(10)</td>
<td>M 12; 0.79(20) deep</td>
</tr>
<tr>
<td>100</td>
<td>13.31(338)</td>
<td>0.39(10)</td>
<td>2.56(65)</td>
<td>0.39(10)</td>
<td>M 12; 0.79(20) deep</td>
</tr>
</tbody>
</table>
Variable displacement pump A10VO, Series 31

Before finalising your design, please request a certified drawing.
Dimensions in inches and millimeters ( ).

Flange SAE 101-2 (SAE B, 2-hole) for mounting of internal gear pump
1PF2GC5-1X/0XXXR07MU2 (see RA 10 215)
Ordering code: K06

<table>
<thead>
<tr>
<th>Size</th>
<th>A₁</th>
<th>A₂</th>
<th>A₃ (metric thread)</th>
</tr>
</thead>
<tbody>
<tr>
<td>45</td>
<td>9.61(244)</td>
<td>2.09(53)</td>
<td>M 12;</td>
</tr>
<tr>
<td>71</td>
<td>10.51(267)</td>
<td>2.40(61)</td>
<td>M 12; 0.79(20) deep or through</td>
</tr>
<tr>
<td>100</td>
<td>13.31(338)</td>
<td>2.56(65)</td>
<td>M 12; 0.79(20) deep</td>
</tr>
</tbody>
</table>

Section A – B

Flange SAE 127-2 (SAE C, 2-hole) for mounting of axial piston pump A10VO 71 - drive shaft “S”
Ordering code: K07

<table>
<thead>
<tr>
<th>Size</th>
<th>A₁</th>
<th>A₂</th>
<th>A₃</th>
<th>A₅ (metric thread)</th>
</tr>
</thead>
<tbody>
<tr>
<td>71</td>
<td>10.51(267)</td>
<td>0.39(10)</td>
<td>2.40(61)</td>
<td>M 16; 0.71(18) deep</td>
</tr>
<tr>
<td>100</td>
<td>13.31(338)</td>
<td>0.31(8)</td>
<td>2.56(65)</td>
<td>M 16; 0.98(25) deep</td>
</tr>
<tr>
<td>140</td>
<td>13.78(350)</td>
<td>0.35(9)</td>
<td>3.03(77)</td>
<td>M 16; 1.26(32) deep</td>
</tr>
</tbody>
</table>

Section A – B
Variable displacement pump A10VO, Series 31

Before finalising your design, please request a certified drawing. Dimensions in inches and millimeters ( )

**Flange SAE 127-2** (SAE C, 2-hole) for mounting of axial piston pump A10VO 100 - drive shaft "S"
or for mounting of internal gear pump 1PF2GC6-1X/XXXXR07MU2 (see RA 10 215)
Ordering code: **K24**

![Diagram of Flange SAE 127-2](image)

<table>
<thead>
<tr>
<th>Size</th>
<th>(A_1)</th>
<th>(A_2)</th>
<th>(A_4)</th>
<th>(A_5) (metric thread)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>13.31(338)</td>
<td>0.31(8)</td>
<td>2.56(65)</td>
<td>M 16; 0.98(25) deep</td>
</tr>
<tr>
<td>140</td>
<td>13.78(350)</td>
<td>0.39(10)</td>
<td>3.03(77)</td>
<td>M 16; 0.98(25) deep</td>
</tr>
</tbody>
</table>

**Flange SAE 152-4** (SAE D, 4-hole) for mounting of axial piston pump A10VO 140 - drive shaft "S"
Ordering code: **K17**

![Diagram of Flange SAE 152-4](image)

<table>
<thead>
<tr>
<th>Size</th>
<th>(A_4)</th>
<th>(A_5)</th>
<th>(A_6) (metric thread)</th>
</tr>
</thead>
<tbody>
<tr>
<td>140</td>
<td>6.36(161.6)</td>
<td>3.03(77)</td>
<td>M1.6 (metric thread)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.41(10.5)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.51(13)</td>
<td>to pump mounting face 13.78(350)</td>
</tr>
</tbody>
</table>

Splined sleeve 1 3/4"; 8/16 DP; 13T

M 16 (metric thread)
**Variable displacement pump A10VO, Series 31**

Before finalising your design, please request a certified drawing. Dimensions in inches and millimeters.

### Flange SAE 82-2 (SAE A, 2-hole) for mounting of axial piston pump A10VSO 18 - drive shaft "R" (see RA 92 712)

Ordering code: **KA1**

<table>
<thead>
<tr>
<th>Size</th>
<th>( A_1 ) (inch)</th>
<th>( A_2 ) (inch)</th>
<th>( A_3 ) (metric thread)</th>
</tr>
</thead>
<tbody>
<tr>
<td>28</td>
<td>8.03(204)</td>
<td>1.85(47)</td>
<td>M 10; 0.63(16) deep</td>
</tr>
<tr>
<td>45</td>
<td>9.02(229)</td>
<td>2.09(53)</td>
<td>M 10; 0.63(16) deep</td>
</tr>
<tr>
<td>71</td>
<td>10.51(267)</td>
<td>2.40(61)</td>
<td>M 10; 0.79(20) deep</td>
</tr>
<tr>
<td>100</td>
<td>13.31(338)</td>
<td>2.56(65)</td>
<td>M 10; 0.79(20) deep</td>
</tr>
<tr>
<td>140</td>
<td>13.78(350)</td>
<td>3.03(77)</td>
<td>M 10; 0.79(20) deep</td>
</tr>
</tbody>
</table>

For size 28, only the fixed vane pump PVV is mounted 45° turned.

### Flange SAE 101-2 (SAE B, 2-hole) for mounting of fixed vane pump PVV1 or 2 with drive shaft "J" (see RA 10 335) or for mounting of axial piston pump A10VO 28 - drive shaft "R"

Ordering code: **KA3**

<table>
<thead>
<tr>
<th>Size</th>
<th>( A_1 ) (inch)</th>
<th>( A_2 ) (inch)</th>
<th>( A_3 ) (metric thread)</th>
</tr>
</thead>
<tbody>
<tr>
<td>28</td>
<td>8.03(204)</td>
<td>1.85(47)</td>
<td>M 12; 0.59(15) deep</td>
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<tr>
<td>45</td>
<td>9.02(229)</td>
<td>2.09(53)</td>
<td>M 12; 0.71(18) deep</td>
</tr>
<tr>
<td>71</td>
<td>10.51(267)</td>
<td>2.40(61)</td>
<td>M 12; 0.79(20) deep</td>
</tr>
<tr>
<td>100</td>
<td>13.31(338)</td>
<td>2.56(65)</td>
<td>M 12; 0.79(20) deep</td>
</tr>
<tr>
<td>140</td>
<td>13.78(350)</td>
<td>3.03(77)</td>
<td>M 12; 0.79(20) deep</td>
</tr>
</tbody>
</table>
**Variable displacement pump A10VO, Series 31**

Before finalising your design, please request a certified drawing.
Dimensions in inches and millimeters ( ).

**Flange SAE 101-2 (SAE B, 2-hole) for mounting of axial piston pump A10VO 45 - drive shaft 'R'**
or PVV4 or 5 with drive shaft "J" (see RA 10 335) *)

Ordering code: **KA4**

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<th>Size</th>
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<th>A₃</th>
<th>A₄</th>
<th>A₅ (metric thread)</th>
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<tbody>
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<td>9.02(229)</td>
<td>0.63(16)</td>
<td>2.09(53)</td>
<td>M 12; 0.71(18) deep</td>
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<td>10.51(267)</td>
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<td>2.40(61)</td>
<td>M 12; 0.79(20) deep</td>
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<td>2.56(65)</td>
<td>M 12; 0.79(20) deep</td>
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</tbody>
</table>

*) **CAUTION!** A 1.5 mm (1/16") spacer plate is required between vane pump mounting face for size A10VO71.

**Flange SAE 127-2 (SAE C, 2-hole) for mounting of axial piston pump A10VO 71 - drive shaft "R"**

Ordering code: **KA5**

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<th>A₅ (metric thread)</th>
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<tr>
<td>71</td>
<td>10.51(267)</td>
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<td>2.40(61)</td>
<td>M 16; 0.71(18) deep</td>
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<td>2.56(65)</td>
<td>M 16; 0.98(25) deep</td>
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<td>0.63(16)</td>
<td>3.03(77)</td>
<td>M 16; 1.26(32) deep</td>
<td></td>
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</tbody>
</table>
Variable displacement pump A10VO, Series 31