Whisper™ Pumps
VPV Vane Pumps
Introduction

This catalog provides details on the Rexroth VPV series variable vane pump, including performance, dimensional, and technical specifications. Please consult the factory if further details are required.

The pumps are designed to meet the requirements of the machine tool, general machinery, and other markets where low noise, high performance and competitive pricing are needed.

The design of the VPV series of vane pumps utilizes 30 years of field and manufacturing experience from the current Rexroth vane pump line. State-of-the-art technologies and materials were utilized while retaining the superior features of the existing designs. Additional goals were to create a pump with the international market in mind and to incorporate the extremely high quality standards the Rexroth name has come to exemplify.

Keeping in mind market expectations, Bosch Rexroth Corporation developed a pump with the following improvements and features:

- High reliability with fewer parts.
- Significant advances in noise reduction.
- High volumetric and overall efficiency.
- Excellent durability.
- Modern appearance.
- Improved ring and vane wear technology.
- Very good response and recovery times.
- Generally reduced envelope size.
- Redesigned controls with shock clipper.
- Conforms to the latest SAE, ISO, NFPA, and ANSI standards.
- Combination capability - full horsepower may be transferred to pump 2. Combinations of construction of multiple pumps may be required to be de-rated.

Benefits

- LOW COST - Competitively priced with other manufacturers of vane pumps and economy axial piston pumps.
- EXCEPTIONALLY QUIET - Helps machinery builders meet government and purchased sound level requirements.
- CONTINUOUS DUTY RATING - @ 3,000 PSI - High performance and long life design for 10,000 plus hours.
- HIGHLY EFFICIENT FAST RESPONSE & RECOVERY - Exceptional reaction time for critical system demands.
- PRESSURE COMPENSATED - Controls pump delivery to circuit demand thereby conserving energy.
- HIGH STRENGTH - Computer optimized casting design.
- HYDRODYNAMIC JOURNAL BEARINGS - Provides long life and quiet operation.
- NO PREFILL REQUIREMENTS - Pump case prefill not required for initial start-ups.
- REPAIRABLE - Repair kits and parts available from local distribution centers or the factory.
- CONTROL OPTIONS - Single stage; two-stage, remote control; solenoid multi-pressure, and load sensing.
- SHOCK CLIPPER - Reduces shock pressure by up to 50% increasing system component life and system stability. Must be plumbed on VPV 16, 25, & 32. The shock clipper is integrated into VPV 45, 63, 80, 100, 130, & 164 and drains to the case drain. See page 86.
### Specifications

<table>
<thead>
<tr>
<th>General</th>
<th>VPV 16</th>
<th>VPV 25</th>
<th>VPV 32</th>
</tr>
</thead>
<tbody>
<tr>
<td>Displacement (Nominal)</td>
<td>1 in³/rev (16 cm³/rev)</td>
<td>1.5 in³/rev (25 cm³/rev)</td>
<td>2 in³/rev (32 cm³/rev)</td>
</tr>
<tr>
<td>Displacement (Actual)</td>
<td>1.06 in³/rev (17.37 cm³/rev)</td>
<td>1.66 in³/rev (27.20 cm³/rev)</td>
<td>2.05 in³/rev (33.59 cm³/rev)</td>
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<tr>
<td>Flow at 1750 RPM</td>
<td>7.57 GPM (28.6 L/min)</td>
<td>11.36 GPM (43.0 L/min)</td>
<td>15.15 GPM (57.3 L/min)</td>
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<tr>
<td>Maximum continuous pressure</td>
<td>3000 psi (210 bar)</td>
<td></td>
<td></td>
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<tr>
<td>Pressure compensating range</td>
<td>Single stage</td>
<td>200-3000 psi (14-210 bar) Minimum pressure of 190 PSI</td>
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<tr>
<td></td>
<td>Two stage</td>
<td>300-3000 psi (20-210 bar) Minimum pressure of 290 PSI</td>
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<tr>
<td>Max. transient spike pressure</td>
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<td>3800 psi (260 bar)</td>
<td>4000 psi (280 bar)</td>
</tr>
<tr>
<td>Maximum case pressure</td>
<td></td>
<td>10 psi (0.7 bar)</td>
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</tr>
<tr>
<td>Speed range</td>
<td></td>
<td>900-1800 RPM</td>
<td></td>
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<tr>
<td>Direction of rotation (viewed from shaft end)</td>
<td></td>
<td>Right hand (clockwise)</td>
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<tr>
<td>Case drain flow while compensating @ 1800 RPM</td>
<td>1000 psi (70 bar)</td>
<td>0.6 GPM (2.3 L/min)</td>
<td>0.6 GPM (2.3 L/min)</td>
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<tr>
<td></td>
<td>2000 psi (140 bar)</td>
<td>0.9 GPM (3.4 L/min)</td>
<td>1.1 GPM (4.2 L/min)</td>
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<tr>
<td></td>
<td>3000 psi (210 bar)</td>
<td>1.26 GPM (4.8 L/min)</td>
<td>1.4 GPM (5.3 L/min)</td>
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<tr>
<td>Maximum inlet vacuum at sea level</td>
<td></td>
<td>6 in. HG (152 mm HG)</td>
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<tr>
<td>Mounting (9) – SAE 2-bolt flange (ISO 3019/1)</td>
<td>S.A.E. ‘A’ 2-bolt flange</td>
<td>S.A.E. ‘B’ 2-bolt flange</td>
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<tr>
<td>Mounting Position</td>
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<td>Unrestricted</td>
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<td>Port sizes</td>
<td>Inlet</td>
<td>#16 S.A.E.</td>
<td>#24 S.A.E.</td>
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<td>Outlet</td>
<td>#12 S.A.E.</td>
<td>#16 S.A.E.</td>
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<td>Case drain</td>
<td>#8 S.A.E.</td>
<td>#6 S.A.E.</td>
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<td></td>
<td>Clipper control drain (opt.)</td>
<td></td>
<td>#4 S.A.E.</td>
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<tr>
<td>Drive</td>
<td>Pump to be connected to prime mover by means of a flexible coupling that is aligned to a maximum of 0.006” (.152mm) total indicator reading. No overhung or side loads permitted. Alignments greater than 0.006” indicator reading could cause increased noise and vibration as well as premature shaft seal wear resulting in leakage.</td>
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<tr>
<td>Fluid recommendations</td>
<td>A premium quality hydraulic oil with anti-wear additives is recommended, but not required. Refer to publication 9 535 233 456 “Petroleum Hydraulic Fluids” for a list of fluids which meet or exceed the necessary lubrication requirements. Consult factory for use with water base fire resistant fluids.</td>
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<tr>
<td>Fluid viscosity at operating temperature</td>
<td>Minimum</td>
<td>100 SUS (21 cSt)</td>
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<td></td>
<td>Maximum</td>
<td>1000 SUS (216 cSt)</td>
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<td></td>
<td>Optimum</td>
<td>150-250 SUS (32-54 cSt)</td>
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<td></td>
<td>Max. start-up</td>
<td>4000 SUS (864 cSt)</td>
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<tr>
<td>Fluid temperature</td>
<td>Normal inlet fluid temperature should not exceed 140°F (60°C). Always select a fluid for optimum viscosity at operating temperature. Consult factory for applications assistance when inlet fluid temperatures over 140°F (60°C) are expected.</td>
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<td>Seals</td>
<td>Fluorocarbon Standard</td>
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<tr>
<td>Filtration</td>
<td>Fluid cleanliness per ISO 4406 Std. For pressures up to 2000 psi, 18/16/13 ISO code is required. For 2000 to 3000 psi operation, 17/15/12 ISO is required.</td>
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<tr>
<td>Response time (circuit dependent)</td>
<td>Full flow to min. flow</td>
<td>20-35 ms</td>
<td>20-35 ms</td>
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<tr>
<td>Recovery time (circuit dependent)</td>
<td>Min. flow to full flow</td>
<td>50-135 ms – single stage compensator</td>
<td>70-185 ms – single stage compensator</td>
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<tr>
<td>Weight</td>
<td>Single stage</td>
<td>34 lbs. (16.5 kg)</td>
<td>61 lbs. (28 kg)</td>
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<td></td>
<td>Two stage</td>
<td>38 lbs. (17.3 kg)</td>
<td>65 lbs. (28.5 kg)</td>
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</table>

1) Flows are actual. Volumetric efficiencies shown in technical data taken into account.
2) For new applications exceeding 2500 psi (172 bar) system pressure, please consult factory.
3) Metric 4-bolt flange available (ISO 3019/2) available. Please consult factory.
## Specifications

<table>
<thead>
<tr>
<th>General</th>
<th>VPV 45</th>
<th>VPV 63</th>
<th>VPV 80</th>
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<tbody>
<tr>
<td>Displacement (Nominal)</td>
<td>2.75 in³/rev (45 cm³/rev)</td>
<td>3.84 in³/rev (63 cm³/rev)</td>
<td>4.88 in³/rev (80 cm³/rev)</td>
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<tr>
<td>Displacement (Actual)</td>
<td>2.98 in³/rev (48.83 cm³/rev)</td>
<td>4.03 in³/rev (66.04 cm³/rev)</td>
<td>5.06 in³/rev (82.92 cm³/rev)</td>
</tr>
<tr>
<td>Flow at 1750 RPM</td>
<td>20.83 GPM (72.84 L/min)</td>
<td>29.10 GPM (110.1 L/min)</td>
<td>36.97 GPM (139.9 L/min)</td>
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<tr>
<td>Maximum continuous pressure</td>
<td>3000 psi (210 bar)</td>
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<tr>
<td>Pressure compensating range</td>
<td>Two stage</td>
<td>350-3000 psi (24-210 bar) Minimum pressure of 300 PSI</td>
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<tr>
<td>Max. transient spike pressure</td>
<td>4000 psi (280 bar)</td>
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<tr>
<td>Maximum case pressure</td>
<td>10 psi (0.7 bar)</td>
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<tr>
<td>Speed range</td>
<td>900-1800 RPM</td>
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<tr>
<td>Direction of rotation (viewed from shaft end)</td>
<td>Right hand (clockwise)</td>
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<tr>
<td>Case drain flow while compensating @ 1800 RPM</td>
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<tr>
<td>1000 psi (70 bar)</td>
<td>1.5 GPM (5.7 L/min)</td>
<td>1.4 GPM (5.3 L/min)</td>
<td>1.4 GPM (5.3 L/min)</td>
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<tr>
<td>2000 psi (140 bar)</td>
<td>1.9 GPM (7.2 L/min)</td>
<td>1.8 GPM (6.8 L/min)</td>
<td>1.8 GPM (6.8 L/min)</td>
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<tr>
<td>3000 psi (210 bar)</td>
<td>2.5 GPM (9.5 L/min)</td>
<td>2.4 GPM (9.1 L/min)</td>
<td>2.3 GPM (8.7 L/min)</td>
</tr>
<tr>
<td>Maximum inlet vacuum at sea level</td>
<td>6 in. HG (152 mm HG)</td>
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<tr>
<td>Mounting – SAE 2-bolt flange (ISO 3019/1)</td>
<td>S.A.E. 'C' 2-bolt flange</td>
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<tr>
<td>Mounting Position</td>
<td>Unrestricted</td>
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<tr>
<td>Port sizes</td>
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<tr>
<td>Inlet</td>
<td>2&quot; S.A.E.</td>
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<tr>
<td>Outlet</td>
<td>1 1/4&quot; S.A.E.</td>
<td>#8 S.A.E.</td>
<td>#4 S.A.E.</td>
</tr>
<tr>
<td>Remote control (opt.)</td>
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<tr>
<td>Drive</td>
<td>Pump to be connected to prime mover by means of a flexible coupling that is aligned to a maximum of 0.006&quot; (.152mm) total indicator reading. No overhung or side loads permitted. Alignments greater than 0.006&quot; indicator reading could cause increased noise and vibration as well as premature shaft seal wear resulting in leakage.</td>
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</tr>
<tr>
<td>Fluid viscosity at operating temperature</td>
<td>Minimum</td>
<td>150 SUS (32 cSt)</td>
<td></td>
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<tr>
<td>Maximum</td>
<td>1000 SUS (216 cSt)</td>
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<tr>
<td>Optimum</td>
<td>200-300 SUS (42-65 cSt)</td>
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<tr>
<td>Max. start-up</td>
<td>4000 SUS (864 cSt)</td>
<td></td>
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<tr>
<td>Fluid temperature</td>
<td>Normal inlet fluid temperature should not exceed 140°F (60° C). Always select a fluid for optimum viscosity at operating temperature. Consult factory for applications assistance when inlet fluid temperatures over 140° F (60° C) are expected.</td>
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<tr>
<td>Seals</td>
<td>Fluorocarbon Standard</td>
<td></td>
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</tr>
<tr>
<td>Filtration</td>
<td>Fluid cleanliness per ISO 4406 Std. For pressures up to 2000 psi, 18/16/13 ISO code is required. For 2000 to 3000 psi operation, 17/15/12 ISO is required.</td>
<td></td>
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<tr>
<td>Response time (circuit dependent)</td>
<td>Full flow to min. flow</td>
<td>20-40 ms</td>
<td></td>
</tr>
<tr>
<td>Recovery time (circuit dependent)</td>
<td>Min. flow to full flow</td>
<td>100-200 ms – two stage compensator</td>
<td></td>
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<tr>
<td>Weight</td>
<td>Single stage</td>
<td>120 lbs. (55 kg)</td>
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<tr>
<td></td>
<td>Two stage</td>
<td>128 lbs. (58 kg)</td>
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</table>

1) Flows are actual. Volumetric efficiencies shown in technical data taken into account.
2) For new applications exceeding 2500 psi (172 bar) system pressure, please consult factory.
3) Metric 4-bolt flange available (ISO 3019/2) available. Please consult factory.
### Specifications

<table>
<thead>
<tr>
<th>General</th>
<th>VPV 100</th>
<th>VPV 130</th>
<th>VPV 164</th>
</tr>
</thead>
<tbody>
<tr>
<td>Displacement (Nominal)</td>
<td>6.1 in³/rev (100 cm³/rev)</td>
<td>7.9 in³/rev (130 cm³/rev)</td>
<td>10.0 in³/rev (164 cm³/rev)</td>
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<tr>
<td>Displacement (Actual)</td>
<td>6.49 in³/rev (106.35 cm³/rev)</td>
<td>8.25 in³/rev (135.19 cm³/rev)</td>
<td>10.33 in³/rev (169.28 cm³/rev)</td>
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<tr>
<td>Flow at 1750 RPM¹</td>
<td>45.4 GPM (171.8 L/min)</td>
<td>59.85 GPM (226.5 L/min)</td>
<td>75.76 GPM (286.7 L/min)</td>
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<tr>
<td>Maximum continuous pressure²</td>
<td>3000 psi (210 bar)</td>
<td>350-3000 psi (24-210 bar)</td>
<td>4000 psi (280 bar)</td>
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<tr>
<td>Pressure compensating range</td>
<td>Two stage</td>
<td></td>
<td></td>
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<tr>
<td>Max. transient spike pressure</td>
<td>10 psi (0.7 bar)</td>
<td></td>
<td></td>
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<tr>
<td>Maximum case pressure</td>
<td>900-1800 RPM</td>
<td></td>
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<tr>
<td>Speed range</td>
<td>Right hand (clockwise)</td>
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<tr>
<td>Direction of rotation (viewed from shaft end)</td>
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<tr>
<td>Case drain flow while compensating @ 1800 RPM</td>
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<tr>
<td>1000 psi (70 bar)</td>
<td>1.5 GPM (5.7 L/min)</td>
<td>1.6 GPM (6.0 L/min)</td>
<td>1.7 GPM (6.4 L/min)</td>
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<tr>
<td>2000 psi (140 bar)</td>
<td>2.0 GPM (7.6 L/min)</td>
<td>2.2 GPM (8.3 L/min)</td>
<td>2.3 GPM (8.7 L/min)</td>
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<tr>
<td>3000 psi (210 bar)</td>
<td>2.5 GPM (9.5 L/min)</td>
<td>3.0 GPM (11.3 L/min)</td>
<td>3.1 GPM (11.7 L/min)</td>
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<tr>
<td>Maximum inlet vacuum at sea level</td>
<td>6 in. HG (152 mm HG)</td>
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<tr>
<td>Mounting³ – SAE 2-bolt flange (ISO 3019/1)</td>
<td>S.A.E. ‘D’ 2-bolt flange</td>
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<tr>
<td>Mounting Position</td>
<td>Unrestricted</td>
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<tr>
<td>Port sizes</td>
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<tr>
<td>Inlet</td>
<td>2 1/2” S.A.E.</td>
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<tr>
<td>Outlet</td>
<td>1 1/2” S.A.E.</td>
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<tr>
<td>Case drain</td>
<td>#8 S.A.E.</td>
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<tr>
<td>Remote control (opt.)</td>
<td>#4 S.A.E.</td>
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<tr>
<td>Drive</td>
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<tr>
<td>Fluid recommendations</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fluid viscosity at operating temperature</td>
<td>Minimum</td>
<td>150 SUS (32 cSt)</td>
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<tr>
<td></td>
<td>Maximum</td>
<td>1000 SUS (216 cSt)</td>
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<tr>
<td></td>
<td>Optimum</td>
<td>200-300 SUS (42-65 cSt)</td>
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<tr>
<td></td>
<td>Max. start-up</td>
<td>4000 SUS (864 cSt)</td>
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<tr>
<td>Fluid temperature</td>
<td>Normal inlet fluid temperature should not exceed 140°F (60°C). Always select a fluid for optimum viscosity at operating temperature. Consult factory for applications assistance when inlet fluid temperatures over 140°F (60°C) are expected.</td>
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<td>Seals</td>
<td>Fluorocarbon Standard</td>
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<tr>
<td>Filtration</td>
<td>Fluid cleanliness per ISO 4406 Std. For pressures up to 2000 psi, 18/16/13 ISO code is required. For 2000 to 3000 psi operation, 17/15/12 ISO is required.</td>
<td></td>
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<tr>
<td>Response time (circuit dependent)</td>
<td>Full flow to min. flow</td>
<td>20-50 ms</td>
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<tr>
<td>Recovery time (circuit dependent)</td>
<td>Min. flow to full flow</td>
<td>180-280 ms</td>
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<td>Weight</td>
<td>Single stage</td>
<td>240 lbs. (109 kg)</td>
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<tr>
<td></td>
<td>Two stage</td>
<td>248 lbs. (112.7 kg)</td>
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</tbody>
</table>

1) Flows are actual. Volumetric efficiencies shown in technical data taken into account.
2) For new applications exceeding 2500 psi (172 bar) system pressure, please consult factory.
3) Metric 4-bolt flange available (ISO 3019/2) available. Please consult factory.
## Ordering details

The alpha-numeric ordering code system enables any particular type of pump to be specified. Preferred type are also identified by a 10-digit part number for computerized ordering.

<table>
<thead>
<tr>
<th>Item No.</th>
<th>01</th>
<th>02</th>
<th>03</th>
<th>04</th>
<th>05</th>
<th>06</th>
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<th>12</th>
<th>13</th>
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<tbody>
<tr>
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<td>Pump 2†</td>
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<td>Pump 3 (Gear Pump)</td>
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### Ordering details

1. Vane Pump, stand alone version single pump or combination
   
2. Direction of rotation, clockwise, viewed from shaft end

#### Speed

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**VPV pumps can be operated over the entire speed range as defined in the specifications pages, independent of the calibrated speed.**

### Drive Shaft

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#### Bearing Arrangement / Mounting Flange

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### Displacement

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1. When trailing pump is another VPV pump, it can be coded by selecting items 6 through 15 for the alpha-numeric description. Consult factory for other models and descriptions of trailing pumps.

**Price and Part Numbers**


**Product Literature Disclaimer**

Specifications and/or dimensions are subject to change without prior notice. Please consult factory.
Ordering details (continued)

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<thead>
<tr>
<th>Item No.</th>
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<td>R</td>
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<tbody>
<tr>
<td>11 Water glycol <em>(this option is PHASED OUT)</em></td>
<td>C</td>
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<tr>
<td>Mineral oil and ester <em>(provides viton/FKM elastomer material)</em></td>
<td>M</td>
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### Operating Pressure

- **Maximum operating pressure:** e.g. 14 = 140 bar = 2000 psi
  - 14 = 210 bar = 3000 psi

### Control / Regulator

- **Pressure regulator - single stage**
  - 13
- **Pressure regulator - single stage - lockable 16/25/32cc only**
  - 13
- **Pressure regulator - two stage - with remote option**
  - 13
- **Combined pressure/flow compensator (load sense)**
  - 13
- **Torque limiter**
  - 13
- **Proportional P/Q (PHASED OUT 2002)**
  - 13
- **Solenoid Operated Two Press. Norm. (Normally open)/Normally Low Pressure/Energize to High**
  - 13
- **Solenoid Operated Two Press. Normally Closed (Normally High Pressure/Energize to Low)**
  - 13
- **Solenoid Operated Vent Two Press. Normally Open (Normally Vented/Energize to Pressure)**
  - 13

| 115V N.O. w/DIN 43650 & quick connect (compression fitting) w/sentinel light | F  |    |    |    |    |
| 220V N.O. w/DIN 43650 & quick connect (compression fitting) w/sentinel light | XA |    |    |    |    |
| 12V N.O. w/DIN 43650 & quick connect (compression fitting) w/sentinel light | XB |    |    |    |    |
| 24V N.O. w/DIN 43650 & quick connect (compression fitting) w/sentinel light | XC |    |    |    |    |
| 115V N.O. w/flying leads | XE |    |    |    |    |
| 220V N.O. w/flying leads | XF |    |    |    |    |
| 12V N.O. w/flying leads | XG |    |    |    |    |
| 24V N.O. w/flying leads | XH |    |    |    |    |
| 115V N.C. w/DIN 43650 & quick connect (compression fitting) w/sentinel light | YA |    |    |    |    |
| 220V N.C. w/DIN 43650 & quick connect (compression fitting) w/sentinel light | YB |    |    |    |    |
| 12V N.C. w/DIN 43650 & quick connect (compression fitting) w/sentinel light | YC |    |    |    |    |
| 24V N.C. w/DIN 43650 & quick connect (compression fitting) w/sentinel light | YD |    |    |    |    |
| 115V N.C. w/flying leads | YE |    |    |    |    |
| 220V N.C. w/flying leads | YF |    |    |    |    |
| 12V N.C. w/flying leads |YG |    |    |    |    |
| 24V N.C. w/flying leads | YH |    |    |    |    |
| 115V N.O. w/DIN 43650 & quick connect (compression fitting) w/sentinel light | ZA |    |    |    |    |
| 220V N.O. w/DIN 43650 & quick connect (compression fitting) w/sentinel light | ZB |    |    |    |    |
| 12V N.O. w/DIN 43650 & quick connect (compression fitting) w/sentinel light | ZC |    |    |    |    |
| 24V N.O. w/DIN 43650 & quick connect (compression fitting) w/sentinel light | ZD |    |    |    |    |
| 115V N.O. w/flying leads | ZE |    |    |    |    |
| 220V N.O. w/flying leads |ZF |    |    |    |    |
| 12V N.O. w/flying leads |ZG |    |    |    |    |
| 24V N.O. w/flying leads |ZH |    |    |    |    |
### Ordering details (continued)

| Item No. | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 10 | 11 | 12 | 13 | 14 | 15 |
|----------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Pump 1   | 0513 | R | V | P | V | S |   |   |   |   |   |   |   |   |   |
| Pump 2   |   | V | P | V | S |   |   |   |   |   |   |   |   |   |   |
| Pump 3 (Gear Pump) | AZ | P | F | R | R | 12 |   |   |   |   |   |   |   |   |   |

#### Control / Regulator (continued)

13 Solenoid Operated Vented Norm. High Normally closed (Normally at Pressure/Energize to Vent)

- 115V N.C. w/DIN 43650 & quick connect (compression fitting) w/sentinel light
- 220V N.C. w/DIN 43650 & quick connect (compression fitting) w/sentinel light
- 12V N.C. w/DIN 43650 & quick connect (compression fitting) w/sentinel light
- 24V N.C. w/DIN 43650 & quick connect (compression fitting) w/sentinel light
- 115V N.C. w/flying leads
- 220V N.C. w/flying leads
- 12V N.C. w/flying leads
- 24V N.C. w/flying leads

#### Accessories

- 14 Special (Consult Factory)
- Maximum delivery limiter
- No other accessories

#### Design Series

- 15 Pump 1 of a quick combination unit (adapter kit & coupling required to create a combination, see page 81)
### Gear Pump Guide

<table>
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<th>Item No.</th>
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<td>Pump 1</td>
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#### Ordering details (continued)

**Ordering details (continued)**

**Pump 1**
- Item No: 0513
- Shaft Type: 9T Spline shaft
- Mounting: SAE A pilot (3.25"")
- Seals: Buna, Viton
- End cover: Standard, side ports

**Pump 2**
- Item No: V P V S
- Shaft Type: 5/8" diameter keyed shaft
- Mounting: SAE thread (O-ring boss)
- Seals: Buna, Viton
- End cover: Optional rear ports

**Pump 3**
- Item No: AZ P F R R 12
- Shaft Type: 9T Spline shaft
- Mounting: SAE A pilot (3.25"")
- Seals: Buna, Viton
- End cover: Standard, side ports

**Size range**
- F Series: 4 cc to 28 cc
- G Series: 22 cc to 56 cc

**Displacement**
- 4 cc/rev = .24 cu in/rev
- 5.5 cc/rev = .34 cu in/rev
- 8 cc/rev = .49 cu in/rev
- 11 cc/rev = .67 cu in/rev
- 14 cc/rev = .85 cu in/rev
- 16 cc/rev = .98 cu in/rev
- 19 cc/rev = 1.16 cu in/rev
- 22.5 cc/rev = 1.37 cu in/rev
- 25 cc/rev = 1.53 cu in/rev
- 28 cc/rev = 1.71 cu in/rev
- 32 cc/rev = 1.95 cu in/rev
- 38 cc/rev = 2.32 cu in/rev
- 45 cc/rev = 2.75 cu in/rev
- 56 cc/rev = 3.42 cu in/rev

**Direction of rotation, right hand (clockwise)**
- 10 R

**Shaft type**
- 11 R
- 5/8" diameter keyed shaft

**Port type, SAE thread (O-ring boss)**
- 13 12
On the following pages are line graphs of the Performance Characteristics for each of the pumps in our series. Characteristics are shown at 1200 rpm, 1500 rpm and 1800 rpm. Since different geographical areas can utilize different drive frequencies, please refer to the appropriate graph.

Performance characteristics – VPV 16 to 3000 PSI (210 Bar)

Data plotted: with oil at 120°F (49°C)  Viscosity at 120° = 140 SUS (29.6 cSt)

Sound pressure levels measured in a hemi-anchoic chamber w/microphone placed 1 meter away at discrete locations. Sound pressure levels are spacially and time-weighted averaged.

Bosch Rexroth Corp., 9 535 233 724, Edition: 01-2014
Performance characteristics – VPV 16 to 3000 PSI (210 Bar) (continued)

Data plotted: with oil at 120°F (49°C)  Viscosity at 120° = 140 SUS (29.6 cSt)

Sound pressure levels measured in a hemi-anchoic chamber w/microphone placed 1 meter away at discrete locations.
Sound pressure levels are spacially and time-weighted averaged.
Performance characteristics – VPV 25 to 3000 PSI (210 Bar)

Data plotted: with oil at 120°F (49°C)  Viscosity at 120° = 140 SUS (29.6 cSt)

Sound pressure levels measured in a hemi-anchoic chamber w/microphone placed 1 meter away at discrete locations. Sound pressure levels are spacially and time-weighted averaged.
Performance characteristics – VPV 25 to 3000 PSI (210 Bar) (continued)

Data plotted: with oil at 120°F (49°C)  Viscosity at 120° = 140 SUS (29.6 cSt)

Sound pressure levels measured in a hemi-anchoic chamber w/microphone placed 1 meter away at discrete locations.
Sound pressure levels are spacially and time-weighted averaged.
Performance characteristics – VPV 32 to 3000 PSI (210 Bar)

Data plotted: with oil at 120°F (49°C)  Viscosity at 120° = 140 SUS (29.6 cSt)

Output Flow & Power @ 1200 rpm

Output Flow & Power @ 1500 rpm

Efficiency @ 1200 rpm

Efficiency @ 1500 rpm

Sound Pressure @ 1200 rpm

Sound Pressure @ 1500 rpm

Sound pressure levels measured in a hemi-anchoric chamber w/microphone placed 1 meter away at discrete locations.

Sound pressure levels are spacially and time-weighted averaged.
Performance characteristics – VPV 32 to 3000 PSI (210 Bar) (continued)

Data plotted: with oil at 120°F (49°C) Viscosity at 120° = 140 SUS (29.6 cSt)

Sound pressure levels measured in a hemi-anchoic chamber w/microphone placed 1 meter away at discrete locations.
Sound pressure levels are spacially and time-weighted averaged.
Performance characteristics – VPV 45 to 3000 PSI (210 Bar)

Data plotted: with oil at 120°F (49°C)  
Viscosity at 120° = 140 SUS (29.6 cSt)

Sound pressure levels measured in a hemi-anchoic chamber w/microphone placed 1 meter away at discrete locations.

Sound pressure levels are spacially and time-weighted averaged.
Performance characteristics – VPV 45 to 3000 PSI (210 Bar) (continued)

Data plotted: with oil at 120°F (49°C)  Viscosity at 120° = 140 SUS (29.6 cSt)

Sound pressure levels measured in a hemi-anchoc chamber w/microphone placed 1 meter away at discrete locations.
Sound pressure levels are spacially and time-weighted averaged.
Performance characteristics – VPV 63 to 3000 PSI (210 Bar)

Data plotted: with oil at 120°F (49°C)  Viscosity at 120° = 140 SUS (29.6 cSt)

Sound pressure levels measured in a hemi-anchocic chamber w/microphone placed 1 meter away at discrete locations.

Sound pressure levels are spacially and time-weighted averaged.

Bosch Rexroth Corp., 9 535 233 724, Edition: 01-2014
Performance characteristics – VPV 63 to 3000 PSI (210 Bar) (continued)

Data plotted: with oil at 120°F (49°C)  Viscosity at 120° = 140 SUS (29.6 cSt)

Sound pressure levels measured in a hemi-anchoic chamber w/microphone placed 1 meter away at discrete locations.
Sound pressure levels are spacially and time-weighted averaged.
Performance characteristics – VPV 80 to 3000 PSI (210 Bar)

Data plotted: with oil at 120°F (49°C)  Viscosity at 120° = 140 SUS (29.6 cSt)

Sound pressure levels measured in a hemi-anchioic chamber w/microphone placed 1 meter away at discrete locations.
Sound pressure levels are spatially and time-weighted averaged.
Sound pressure levels measured in a hemi-anchoic chamber with microphone placed 1 meter away at discrete locations. Sound pressure levels are spacially and time-weighted averaged.
Performance characteristics – VPV 100 to 3000 PSI (210 Bar)

Data plotted: with oil at 120°F (49°C)  Viscosity at 120° = 140 SUS (29.6 cSt)

Sound pressure levels measured in a hemi-anchoic chamber w/microphone placed 1 meter away at discrete locations.
Sound pressure levels are spacially and time-weighted averaged.
Performance characteristics – VPV 100 to 3000 PSI (210 Bar) (continued)

Data plotted: with oil at 120°F (49°C) Viscosity at 120° = 140 SUS (29.6 cSt)

Sound pressure levels measured in a hemi-anchoic chamber w/microphone placed 1 meter away at discrete locations. Sound pressure levels are spacially and time-weighted averaged.
Performance characteristics – VPV 130 to 3000 PSI (210 Bar)

Data plotted: with oil at 120°F (49°C)  Viscosity at 120° = 140 SUS (29.6 cSt)

Sound pressure levels measured in a hemi-anchoic chamber w/microphone placed 1 meter away at discrete locations.
Sound pressure levels are spacially and time-weighted averaged.
Performance characteristics – VPV 130 to 3000 PSI (210 Bar) (continued)

Data plotted: with oil at 120°F (49°C)  Viscosity at 120° = 140 SUS (29.6 cSt)

Sound pressure levels measured in a hemi-anchoic chamber w/microphone placed 1 meter away at discrete locations.
Sound pressure levels are spacially and time-weighted averaged.
Performance characteristics – VPV 164 to 3000 PSI (210 Bar)

Data plotted: with oil at 120°F (49°C)  Viscosity at 120° = 140 SUS (29.6 cSt)

Sound pressure levels measured in a hemi-anchoic chamber w/microphone placed 1 meter away at discrete locations.

Sound pressure levels are spacially and time-weighted averaged.

---

**Performance characteristics – VPV 164 to 3000 PSI (210 Bar)**

<table>
<thead>
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<th>Flow GPM (L/m)</th>
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**Sound Pressure @ 1200 rpm**

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**Sound Pressure @ 1500 rpm**

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Performance characteristics – VPV 164 to 3000 PSI (210 Bar) (continued)

Data plotted: with oil at 120°F (49°C)  Viscosity at 120° = 140 SUS (29.6 cSt)

Sound pressure levels measured in a hemi-anchoic chamber w/microphone placed 1 meter away at discrete locations.
Sound pressure levels are spacially and time-weighted averaged.
VPV 16, Single pump, S.A.E. ‘A’ flange, RH rotation

### 30° Involute Spline Data
- Flat root side fit: Class 5
- Pitch: 16/32
- Pressure angle: 30°
- Number of teeth: 9
- Base diameter: 0.487193 in. ref.
- Form diameter: 0.504 in. ref.
- Pitch diameter: 0.625-0.022 in. ref.
VPV 16, Single pump, metric flange, RH rotation

Inches (millimeters)

Optional combination capable pump with end cover

Optional volume control (CW rotation reduces flow)

Outlet port: 1/2 - 14 BSPP

Load sense port: 1/4 – 19 BSPP

Remote control port: 1/4 – 19 BSPP

Optional 2-stage compensator

Optional 2 pressure (vent) solenoid operated compensator

Optional 2-stage compensator with load compensator

Optional single-stage compensator with locking device

Optional 2-stage compensator

Pump control mounting datum "T"

Manual override pushpin

Inlet port: 1 - 11 BSPP

DIN 43650 connector w/ 1/2" NPT compression fitting and sentinel light (Optional)

Square key

Compensator adjusting knob

Load sense port

Centerline pump control

Remote control port

DIN 43650 connector

0.886 (22.5)

4.88 (123.9)

1.38 (35.0)

4.59 (116.7)

3.36 (85.0)

3.92 (99.7)

3.92 (99.7)

2.66 (67.5)

0.31 (8.0)

2.66 (67.5)

7.45 (189.2)

5.61 (142.5)

5.61 (142.5)

7.45 (189.2)

3.06 (77.9)

0.236 (6.0)

0.787 (20.0)

45

Mounting flange

4.055 (103.0)

3.150 (80.0)

Case drain port: 3/8 - 19 BSPP

Inlet port: 1 - 11 BSPP

#6 S.A.E. Shock Clipper port. Should be plumbed to tank to activate shock clipper function (See page 86).
VPV 25/32, Single pump, S.A.E. ‘B’ flange, RH rotation

Inches (millimeters)

30° Involute Spline Data
Flat root side fit .... Class 5
Pitch .................. 16/32
Pressure angle ...... 30°
Number of teeth ... 13
Base diameter...... 0.703645 in. ref.
Form diameter ...... 0.749 in. ref.
Major diameter ..... 0.875-0.022 in. ref.
VPV 25/32, Single pump, metric flange, RH rotation

Optional combination capable pump with end cover

Optional volume control (CW rotation reduces flow)

Optional 2 pressure (vent) solenoid operated compensator

Optional single-stage compensator with locking device

Optional 2-stage compensator

Centerline of pump control

2-stage compensator adjusting knob (CW rotation increases pressure setting)

Optional 2 stage load compensator

Remote control port 1/4 – 19 BSPP

Optional 2 pressure operated solenoid compensator

Manual override pushpin

Optional 2 pressure solenoid operated compensator

DIN 43650 connector w/ 1/2" NPT compression fitting and sentinel light (Optional)

Manual override pushpin

Optional combination capable pump with end cover

Pump centerline

Load sense port 1/4 – 19 BSPP

Optional 2-stage compensator

Pump control mounting datum "T"

Centerline of pump control

1/2" conduit connector

Optional 2-stage compensator

Pump centerline

Rotation arrows cast into body ø4.92 (ø125.0)

Mounting flange ø3.936 (ø99.97)

Inlet port 1-1/2 - 11 BSPP

Case drain port 3/8 - 19 BSPP

Manual override pushpin

Optional 2 pressure solenoid operated compensator

DIN 43650 connector w/ 1/2" NPT compression fitting and sentinel light (Optional)

Optional 2-stage compensator

Pump centerline

Optional volume control (CW rotation reduces flow)

Outlet port 1-11 BSPP

Optional 2 pressure (vent) solenoid operated compensator

Inlet port 1-1/2 - 11 BSPP

Optional 2-stage compensator

Pump centerline

Optional volume control (CW rotation reduces flow)

Remote control port 1/4 – 19 BSPP

Optional 2 pressure operated solenoid compensator

Manual override pushpin

Optional 2 pressure solenoid operated compensator

DIN 43650 connector w/ 1/2" NPT compression fitting and sentinel light (Optional)
VPV 45/63/80, Single pump, S.A.E. ‘C’ flange, RH rotation

Optional 2 pressure solenoid operated (and vent) compensator

Optional 2 stage with load compensator

Load sense port #4 S.A.E.

Compensator adjusting knob (CW rotation increases pressure setting)

Remote control port 7/16 – 20 UNF, 0.45 deep

SAE “C” mounting flange

Optional eye bolt

Centerline pump control

Rotation arrows cast into body

Optional 2 pressure solenoid operated vent compensator

DIN 43650 connector w/ 1/2” NPT compression fitting and sentinel light (Optional)

Manual override pushpin

1/2” conduit connector

2 stage compensator

Case drain port #8 SAE

Optional 2 pressure solenoid operated (and vent) compensator

Std. SAE 2” pad suction 2.00” dia.

SCALE: 2X
VPV 45/63/80, Single pump, S.A.E. ‘C’ flange, RH rotation (continued)

Optional combination capable pump with end cover (P1 Version)

Optional volume control (CW rotation reduces flow)

Support (Lift) point
M10 X 1.5-6H X 11.25 deep TH'D

Pump control mounting Datum "T"

Std. SAE 1 1/4" pad pressure 1.25 (31.8) dia.

7/16 - 14 UNC - 2B TH'D 4 holes
VPV 45/63/80, Single pump, metric flange, RH rotation

SCALE: 2X

SINGLE STAGE CONTROL
NOT AVAILABLE ON VPV 45-164

Optional 2 stage with load compensator
1/4 - 19 BSPP

Optional 2 stage compensator
Remote control port
1/4 - 19 BSPP, 0.48 deep

Mounting flange

Optional 2 pressure solenoid operated vent compensator

Compensator adjusting knob
(CW rotation increases pressure setting)

Manual override pushpin

(Optional) DIN 43650 connector w/ 1/2" NPT compression fitting and sentinel light

2 stage compensator
VPV 45/63/80, Single pump, metric flange, RH rotation (continued)
VPV 100/130/164, Single pump, S.A.E. ‘D’ flange, RH rotation

SINGLE STAGE CONTROL
NOT AVAILABLE ON VPV 45-164

Centerline of pump control

Rotation arrows cast into body

Optional 2 pressure solenoid operated compensator

Compensator adjusting knob (CW rotation increases pressure setting)

Manual override pushpin

Remote control port 7/16 – 20 UNF, 0.45 deep

2 stage compensator

SAE “D” mounting flange

Optional 2 stage with load compensator

Load sense port #4 S.A.E.

Optional 2 pressure solenoid operated vent compensator

Case drain port #8 SAE

IN

OUT

1/2” -13 UNC, 28 deep, 4 holes

1/2" conduit connector

Optional 1/2” conduit connector w/ 1/2" NPT compression fitting and sentinel light

SCALE: 2X

Inches (millimeters)

Centerline of pump control

Rotation arrows cast into body

Optional 2 pressure solenoid operated compensator

Compensator adjusting knob (CW rotation increases pressure setting)

Manual override pushpin

Remote control port 7/16 – 20 UNF, 0.45 deep

2 stage compensator

SAE “D” mounting flange

Optional 2 stage with load compensator

Load sense port #4 S.A.E.

Optional 2 pressure solenoid operated vent compensator

Case drain port #8 SAE

IN

OUT

1/2” -13 UNC, 28 deep, 4 holes

1/2" conduit connector

Optional 1/2” conduit connector w/ 1/2" NPT compression fitting and sentinel light

SCALE: 2X

Inches (millimeters)
VPV 100/130/164, Single pump, S.A.E. ‘D’ flange, RH rotation (continued)

Optional combination capable pump with end cover (P1 Version)

Inches (millimeters)

Optional volume control (CW rotation reduces flow)

Pump centerline

Std S.A.E. 1-1/2" pad pressure 1.48 (37.1) dia.

Lift point

M10 x 1.5 - 6H x 11.0 deep th’d
VPV 100/130/164, Single pump, metric flange, RH rotation

SINGLE STAGE CONTROL
NOT AVAILABLE ON VPV 45-164

Centerline of pump control

Rotation arrows cast into body

Case drain port
3/8-19 BSPP

M12 x 1.75, 28 deep
4 holes

Optional 2 stage with load compensator
1/4 - 19 BSPP

Remote control port
1/4 - 19 BSPP, 0.48 deep
2 stage compensator

Optional 2 pressure solenoid operated vent compensator

Optional 2 stage with load compensator

Compensator adjusting knob
(CW rotation increases pressure setting)

Manual override pushpin

Optional 2 pressure solenoid operated compensator

1/2" conduit connector

DIN 43650 connector w/ 1/2" NPT compression fitting and sentinel light

Mounting flange

Case drain port
3/8-19 BSPP

Std SAE 2-1/2" pad suction
2.47 (62.7) DIA

SCALE: 2X
VPV 100/130/164, Single pump, metric flange, RH rotation (continued)
VPV 16, Combination pump, S.A.E. ‘A’ flange, RH rotation

Optional volume control (CW rotation reduces flow)

Optional vertical supports for combination pumps when rotated 90°

Support (Lift) point 3/8”-16 UNC-2B X 22.0mm deep

Inlet port, #16 S.A.E.
Case drain port, #8 S.A.E.

Remote control #4 S.A.E.

Compensator adjusting knob (CW rotation increases pressure setting)

2-stage compensator adjusting knob (CW rotation increases pressure setting)

Standard single stage compensator

Optional 2-stage compensator (now in modular design)

#6 S.A.E. Shock clipper port. Should be plumbed to tank to activate shock clipper function (See page 97).

Support (Lift) point 3/8”-16 UNC-2B X 22.0mm deep
VPV 25/32, Combination pump, S.A.E. ‘B’ flange, RH rotation

VIEW A-A

Optional vertical supports for combination pumps when rotated 90°

Optional volume control (CW rotation reduces flow)

Support (Lift) point 3/8" = 16UNC-2B X 22.0mm deep

Outlet port, #16 S.A.E.

Inlet port, #24 S.A.E.

Case drain port, #8 S.A.E.

Remote control #4 S.A.E.

Compensator adjusting knob (CW rotation increases pressure setting)

Standard single stage compensator

Support (Lift) point 3/8" = 16UNC-2B X 22.0mm deep

Outlet port, #16 S.A.E.

Inlet port, #24 S.A.E.

Case drain port, #8 S.A.E.

Optional 2-stage compensator (now in modular design)

Optional 2-stage compensator (now in modular design)

Case drain port, #8 S.A.E.

Support (Lift) point 3/8" = 16UNC-2B X 22.0mm deep

Outlet port, #16 S.A.E.

Inlet port, #24 S.A.E.

Case drain port, #8 S.A.E.

Optional 2-stage compensator (now in modular design)

Case drain port, #8 S.A.E.

Support (Lift) point 3/8" = 16UNC-2B X 22.0mm deep

Outlet port, #16 S.A.E.

Inlet port, #24 S.A.E.

Case drain port, #8 S.A.E.

Optional volume control (CW rotation reduces flow)

Support (Lift) point 3/8" = 16UNC-2B X 22.0mm deep

Outlet port, #16 S.A.E.

Inlet port, #24 S.A.E.

Case drain port, #8 S.A.E.

Optional 2-stage compensator (now in modular design)

Optional 2-stage compensator (now in modular design)

Optional 2-stage compensator (now in modular design)

Optional 2-stage compensator (now in modular design)
VPV 32/16, Combination pump, S.A.E. ‘B’ flange, RH rotation

VIEW B-B

Standard single stage compensator

Compensator adjusting knob (CW rotation increases pressure rating)

Optional volume control (CW rotation reduces flow)

Optional vertical supports for combination pumps when rotated 90°

VIEW A-A

Support (Lift) point 3/8"-16UNC-2B X 22.0mm deep

Outlet port, #12 S.A.E.

Key & Shaft Detail

S.A.E. “B” 2-bolt mounting flange

Remote control port, #4 S.A.E.

Inlet port, #24 S.A.E.

Case drain port, #8 S.A.E.

Inlet port, #16 S.A.E.

Case drain port, #8 S.A.E.
VPV 32/25, Combination pump, S.A.E. to 'F' gear, RH rotation

**Inches (millimeters)**

<table>
<thead>
<tr>
<th>Gear Pump Theoretical Displacement</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>Total Weight (Vane Pump + Gear Pump)</th>
</tr>
</thead>
<tbody>
<tr>
<td>in³/rev (cc/rev)</td>
<td>in (mm)</td>
<td>in (mm)</td>
<td>in (mm)</td>
<td>in (mm)</td>
<td>lbs. (Kg)</td>
</tr>
<tr>
<td>0.2 (4)</td>
<td>1.571 (39.9)</td>
<td>3.346 (85.0)</td>
<td>10.46 (265.7)</td>
<td>12.24 (311.0)</td>
<td>70.0 (31.7)</td>
</tr>
<tr>
<td>0.3 (5.5)</td>
<td>1.618 (41.1)</td>
<td>3.445 (87.5)</td>
<td>10.51 (267.0)</td>
<td>12.34 (313.5)</td>
<td>70.2 (31.8)</td>
</tr>
<tr>
<td>0.49 (6)</td>
<td>1.697 (43.2)</td>
<td>3.606 (91.6)</td>
<td>10.59 (269.0)</td>
<td>12.50 (317.5)</td>
<td>70.4 (31.9)</td>
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<tr>
<td>0.67 (11)</td>
<td>1.850 (47.0)</td>
<td>3.803 (96.6)</td>
<td>10.74 (272.8)</td>
<td>12.70 (322.5)</td>
<td>70.6 (32.0)</td>
</tr>
<tr>
<td>0.85 (14)</td>
<td>1.870 (47.5)</td>
<td>4.0 (101.6)</td>
<td>10.76 (273.3)</td>
<td>12.90 (327.7)</td>
<td>70.8 (32.1)</td>
</tr>
<tr>
<td>0.98 (16)</td>
<td>1.870 (47.5)</td>
<td>4.134 (105.0)</td>
<td>10.76 (273.3)</td>
<td>13.03 (331.0)</td>
<td>70.9 (32.2)</td>
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<tr>
<td>1.16 (19)</td>
<td>1.870 (47.5)</td>
<td>4.330 (110.0)</td>
<td>10.76 (273.3)</td>
<td>13.23 (336.0)</td>
<td>71.1 (32.3)</td>
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<tr>
<td>1.37 (22.5)</td>
<td>2.189 (55.1)</td>
<td>4.543 (115.4)</td>
<td>11.06 (281.0)</td>
<td>13.44 (341.4)</td>
<td>71.4 (32.4)</td>
</tr>
</tbody>
</table>

**Key & Shaft Detail**

- Optional volume control (CW rotation reduces flow)
- Gear Pump
- Standard single stage compensator
- S.A.E. "F" gear pump
- S.A.E. "F" mounting flange
- 25 (6.35) square key
- 0.87 (22.2) shaft dia.
- Compensator adjusting knob (CW rotation increases pressure setting)
- Optional 2-stage compensator (now in modular design)
- Optional vertical supports for combination pumps when rotated 90°
- Centerline pump control
- Outlet port—opposite side
- Remote control port, #4 S.A.E.
- Inlet port—#24 S.A.E.
- Case drain port, #8 S.A.E.
- Shock clipper port. Should be plumbed to tank to activate shock clipper function (See page 97).
VPV 45/63/80 to VPV 16, S.A.E. & metric combination

SINGLE STAGE CONTROL
NOT AVAILABLE ON VPV 45-164

SAE/„METRIC

S A E/S A E

SAE/„METRIC

SAE/S A E

METRIC-„METRIC

METRIC/METRIC

Support point
“SAE” 3/8"-16UNC-2B THD
“METRIC” M10 X 1.5-6H THD
2.81 (71.3)
6.19 (156.8)
2.47 (62.7)
1.81 (46.0)
1.47 (37.3)
0.94 (23.9)
0.76 (19.3)
0.94 (23.9)
1.20 (30.5)
1.39 (35.3)
0.39 (10.0)
0.31 (7.9)
0.31 (7.9)
1.39 (35.3)
0.94 (23.9)
0.94 (23.9)
2.08 (52.8)
2.08 (52.8)
2.08 (52.8)
2.08 (52.8)
1.45 (36.9)
1.45 (36.9)
1.45 (36.9)
1.45 (36.9)
1.45 (36.9)
1.45 (36.9)
1.45 (36.9)
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1.45 (36.9)
1.45 (36.9)
VPV 45/63/80 to VPV 16, S.A.E. & metric combination (continued)

Optional VPV25/32 single stage compensator with locking device

VIEW A-A
(SH 1 @ H-4)

Optional volume control (CW rotation reduces flow)

VIEW B-B
(SH 1 @ H-2)

Outlet port
Std. SAE 1-1/4" pad
ø1.25 (ø31.8)
See detail "SAE1/METRIC1"

Suport point
"SAE" 7/16-14 UNC-2B TH'D X 1.14 (29.0) deep typ
4 holes

"METRIC" M12 X 1.75-6H TH'D

Outlet port
"SAE" #12 S.A.E.
"METRIC" 1-14 BSPP

Suport point
"SAE" 3/8" - 16 UNC - 2B TH'D X .59 (15.0) deep
"METRIC" M10 X 1.5-6H TH'D X .44 (11.2) deep

Suport (Lift) point
"SAE & METRIC" M10 X 1.5 - 6H TH'D X .49 (12.45)

Inches (millimeters)
VPV 45/63/80 to VPV 16, S.A.E. & metric combination (continued)

Optional 2-stage compensator

VIEW A – A

Centerline pump control

2-stage compensator adjusting knob (CW rotation increases pressure setting)

#6 S.A.E. Shock Clipper port. Should be plumbed to tank to activate shock clipper function (See page 97).

Remote control

2-stage compensator

Inlet

Inches (millimeters)
VPV 45/63/80 to VPV 25/32, S.A.E. & metric combination

Inches (millimeters)

**SAE/METRIC**

Compensator adjusting knob (CW rotation increases pressure setting)

Support point
- "SAE" 3/8"-16 UNC-2B TH'D
- "METRIC" M10 X 1.5-6H TH'D

Case drain port
- "SAE" #6 S.A.E.
- "METRIC" 3/8-19 BSPP

Inlet port
- "SAE" #94 S.A.E.
- "METRIC" 1 1/2/11 BSPP

Inlet port std. SAE 2" pad
- ø2.00 (ø50.8)

**METRIC-METRIC**

SINGLE STAGE CONTROL

NOT AVAILABLE ON VPV 45-164

Optional eye bolt

METRIC 4-bolt mounting flange per ISO 3019/2

DETAIL SAE-SAE

DETAIL METRIC-METRIC

SAE "C" 2-bolt mounting flange per ISO 3019/1

9.13
(181.0)

7.13
(181.0)

5.91
(150.0)

5.91
(150.0)

5.96
(151.4)

5.96
(151.4)

6.61
(168.0)

6.61
(168.0)

9.31
(236.5)

9.31
(236.5)

45 typ

45 typ

0.55
(14.0)

0.55
(14.0)

1.37
(34.9)

1.37
(34.9)

14.41
(366.1)

14.41
(366.1)

3.06
(77.0)

3.06
(77.0)

1.02
(25.7)

1.02
(25.7)

7.13
(181.0)

7.13
(181.0)

19.40
(492.0)

19.40
(492.0)

17.43
(442.6)

17.43
(442.6)

4.47
(112.0)

4.47
(112.0)

4.34
(105.4)

4.34
(105.4)

10.12
(257.0)

10.12
(257.0)

4.37
(111.0)

4.37
(111.0)

4.37
(111.0)

4.37
(111.0)

3.53
(89.7)

3.53
(89.7)

4.19
(106.4)

4.19
(106.4)

Support point thru support hole
- .87 deep
- "SAE" 3/8"-16 UNC-2B TH'D
- "METRIC" M10 X 1.5-6H TH'D

Inlet port
- "SAE" #6 S.A.E.
- "METRIC" 3/8-19 BSPP

Case drain port
- "SAE" #6 S.A.E.
- "METRIC" 3/8-19 BSPP

Support point thru support hole
- .87 deep
- "SAE" 3/8"-16 UNC-2B TH'D
- "METRIC" M10 X 1.5-6H TH'D

Inlet port std. SAE 2" pad
- ø2.00 (ø50.8)

Inlet port std. SAE 2" pad
- ø2.00 (ø50.8)
VPV 45/63/80 to VPV 25/32, S.A.E. & metric combination (continued)
VPV 45/63/80 to VPV 25/32, S.A.E. & metric combination (continued)

Inches (millimeters)

VIEW A – A

Centerline pump control

2-stage compensator adjusting knob
(CW rotation increases pressure setting)

#6 S.A.E. Shock Clipper port. Should be plumbed to tank to activate shock clipper function (See page 97).

Inlet

Optional 2-stage compensator

Remote control

2-stage compensator

Inlet

18.07 (459.0)

16.60 (421.6)

4.94 (125.5)

7.30 (185.5)

8.00 (203.1)
VPV 45/63/80 to an ‘F’ gear pump, S.A.E. & metric combination

Compensator adjusting knob (CW rotation increases pressure setting)

Optional 2 stage compensator

Support point
"SAE" 3/8"-16UNC-2B THD x .59 deep
"METRIC" M10 X 1.5 THD (15.0)

Case drain port
"METRIC" 3/8-19 BSPP
"SAE" #8 S.A.E.

Remote control port
SAE 1/2"-13UNC-2B TH'D x 1.14 deep typ
"METRIC" M12 X 1.75-6H TH'D (29.0)
4 holes

Remote control port
1/4 – 19 BSPP, 0.48/(12.2) deep

Optional eye bolt

Detail SAE-SAE

Detail METRIC-METRIC

SAE "C" 2-bolt mounting flange per ISO 3019/1

METRIC 4-bolt mounting flange per ISO 3019/2

IN

OUT

ø160.0 (6.30)

9.31 (45.23)

ø146.2 (3.89)

ø125.4 (4.94)

ø124.0 (4.88)

ø119.4 (4.70)

ø118.4 (4.65)

ø115.9 (4.57)

ø114.4 (4.50)

ø112.7 (4.45)

ø111.0 (4.37)

ø108.0 (4.25)

ø106.4 (4.17)

ø104.8 (4.12)

ø103.2 (4.06)

ø101.6 (4.00)

ø99.2 (3.89)

ø97.6 (3.84)

ø96.0 (3.75)

ø94.4 (3.71)

ø92.8 (3.65)

ø91.2 (3.60)

ø89.6 (3.50)

ø88.0 (3.45)

ø86.4 (3.37)

ø84.8 (3.30)

ø83.2 (3.25)

ø81.6 (3.20)

ø80.0 (3.15)

ø78.4 (3.05)

 ø76.8 (3.00)

ø75.2 (2.95)

ø73.6 (2.90)

ø72.0 (2.85)

ø70.4 (2.80)

ø68.8 (2.75)

ø67.2 (2.70)

ø65.6 (2.65)

ø64.0 (2.60)

ø62.4 (2.55)

ø60.8 (2.50)

ø59.2 (2.45)

ø57.6 (2.40)

ø56.0 (2.35)

ø54.4 (2.30)

ø52.8 (2.25)

ø51.2 (2.20)

ø49.6 (2.15)

ø48.0 (2.10)

ø46.4 (2.05)

ø44.8 (2.00)

ø43.2 (1.95)

ø41.6 (1.90)

ø40.0 (1.85)

ø38.4 (1.80)

ø36.8 (1.75)

ø35.2 (1.70)

ø33.6 (1.65)

ø32.0 (1.60)

ø30.4 (1.55)

ø28.8 (1.50)

ø27.2 (1.45)

ø25.6 (1.40)

ø24.0 (1.35)

ø22.4 (1.30)

ø20.8 (1.25)

ø19.2 (1.20)

ø17.6 (1.15)

ø16.0 (1.10)

ø14.4 (1.05)

ø12.8 (1.00)

ø11.2 (0.95)

ø9.6 (0.90)

ø8.0 (0.85)

ø6.4 (0.80)

ø4.8 (0.75)

ø3.2 (0.70)

ø1.6 (0.65)

ø0.0 (0.60)

0.31 (7.98) square key

0.31 (8.00) thru support hole

 ø2.00 (50.8) std. S.A.E. 2" pad

 ø1.26 (32.0) X 0.39 X 0.31 rectangular key (10.0 X 8.0)

 ø1.25 (31.74) (SH.2 D-6)

 ø1.11 (28.17) (SH.2 K-6)

 ø0.47 (12.0) (SH.2 A-6)

 ø0.55 (14.0) (SH.2 B-6)

 ø0.47 (12.0) (SH.2 C-6)

 ø0.47 (12.0) (SH.2 D-6)

 ø0.47 (12.0) (SH.2 F-6)

 ø0.47 (12.0) (SH.2 H-6)
VPV 45/63/80 to an ‘F’ gear pump, S.A.E. & metric combination (continued)

Support point
“SAE” 3/8”-18UNC-2B THD x 0.59 deep
“METRIC” M10 x 1.5 THD (15.0)

Support (Lift) point
“SAE & METRIC” M10 x 1.5-6H TH'D x 0.44 (11.2) deep
4 holes

Optional volume control
(CW rotation reduces flow)

See detail "SAE1/METRIC1"

Inches (millimeters)

<table>
<thead>
<tr>
<th>Gear Pump Theoretical Displacement</th>
<th>Dimension</th>
<th>Total Weight (Vane Pump + Gear Pump)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.24 (4)</td>
<td>1.571</td>
<td>3.348</td>
</tr>
<tr>
<td>0.34 (5.5)</td>
<td>1.618</td>
<td>3.445</td>
</tr>
<tr>
<td>0.49 (8)</td>
<td>1.697</td>
<td>3.606</td>
</tr>
<tr>
<td>0.67 (11)</td>
<td>1.850</td>
<td>3.803</td>
</tr>
<tr>
<td>0.85 (14)</td>
<td>1.870</td>
<td>4.0</td>
</tr>
<tr>
<td>0.98 (16)</td>
<td>1.870</td>
<td>4.134</td>
</tr>
<tr>
<td>1.16 (19)</td>
<td>1.870</td>
<td>4.330</td>
</tr>
<tr>
<td>1.37 (22.5)</td>
<td>2.169</td>
<td>4.543</td>
</tr>
</tbody>
</table>

SAE "F" gear pump

Pressure outlet port
std. S.A.E. 1-1/4” pad
ø1.25 (ø31.8)

max.

3.73 (94.7)

Pump centerline
VPV 45/63/80 to an ‘F’ gear pump, S.A.E. & metric combination (continued)
VPV 45/63/80 to a ‘G’ gear pump, S.A.E. & metric combination

Inches (millimeters)

SAE/METRIC

Remote control port
7/16 – 20 UNF, 0.45/(11.4) deep

SAE "C" 2-bolt mounting flange per ISO 3019/1

DETAIL SAE-SAE

SAE/METRIC

Inlet: 1.031 (26.2)
Outlet: 0.875 (22.2)

SAE "C" 2-bolt mounting flange per ISO 3019/1

DETAIL SAE-SAE

Optional 2 stage compensator
Case drain port
"METRIC" 3/8-19 BSPP
"S.A.E" #8 S.A.E.

SAE/METRIC

Suction inlet port
std. SAE 2" pad
ø2.00 (ø50.8)
3.06 (77.78)
0.84 (21.44)
2.04 (51.7)

13.03 (330.8)
13.03 (330.8)

SAE/METRIC

Suction inlet port
std. SAE 2" pad
ø2.00 (ø50.8)
3.06 (77.78)
0.84 (21.44)
2.04 (51.7)

13.03 (330.8)
13.03 (330.8)

Optional 2 stage compensator
Case drain port
"METRIC" 3/8-19 BSPP
"S.A.E" #8 S.A.E.

SAE/METRIC

Suction inlet port
std. SAE 2" pad
ø2.00 (ø50.8)
3.06 (77.78)
0.84 (21.44)
2.04 (51.7)

13.03 (330.8)
13.03 (330.8)
VPV 45/63/80 to a ‘G’ gear pump, S.A.E. & metric combination (continued)

<table>
<thead>
<tr>
<th>Gear Pump Theoretical Displacement</th>
<th>Dimension</th>
<th>Total Weight (Vane Pump + Gear Pump)</th>
</tr>
</thead>
<tbody>
<tr>
<td>in3/rev</td>
<td>in (mm)</td>
<td>in (mm)</td>
</tr>
<tr>
<td>1.37 (22.5)</td>
<td>2.40 (61.0)</td>
<td>5.07 (128.5)</td>
</tr>
<tr>
<td>1.71 (26)</td>
<td>2.48 (63.0)</td>
<td>5.26 (137.2)</td>
</tr>
<tr>
<td>1.95 (32)</td>
<td>2.54 (64.5)</td>
<td>5.40 (137.2)</td>
</tr>
<tr>
<td>2.32 (38)</td>
<td>2.62 (66.5)</td>
<td>5.62 (142.6)</td>
</tr>
<tr>
<td>2.75 (45)</td>
<td>2.74 (69.5)</td>
<td>5.87 (149.2)</td>
</tr>
<tr>
<td>3.42 (56)</td>
<td>2.95 (75.2)</td>
<td>6.31 (160.2)</td>
</tr>
</tbody>
</table>

**SAE "G" gear pump**

Pressure outlet port
std. S.A.E. 1-1/4" pad ø1.25 (ø31.8)

Optional volume control (CW rotation reduces flow)

Support (Lift) point
"SAE & METRIC" M10 X 1.5-6H TH'D × 0.44 (11.2) deep

**"SAE" 7/16-14UNC-2B TH'D × 1.14 deep typ**

**"METRIC" M12 X 1.75-6H TH'D × (29.0) 4 holes**

**VIEW B-B**

(SH.1 @ N-2)

**VIEW A-A**

(SH.1 @ N-4)

**SAE "G" gear pump**

Support (Lift) point
"SAE & METRIC" M10 X 1.5-6H TH'D × 0.44 (11.2) deep

**Inches (millimeters)**

See detail "SAE1/METRIC1"
VPV 45/63/80 to VPV 45/63/80, S.A.E. & metric combination

**Diagram:**
- **Case drain port:**
  - "METRIC" 3/8-19 BSPP type
  - "SAE" #8 S.A.E. type

- **Inlet port:**
  - SAE 2" pad
  - ø2.00 typ (ø50.8)
  - "SAE" 1/2"-13UNC-2B TH'D X 1.14 deep typ
  - METRIC M12 x 1.75-6H TH'D (29.0)

- **Remote control port:**
  - 7/16 – 20 UNF, 0.45/ (11.4) deep

- **Compensator adjusting knob:**
  - (CW rotation increases pressure setting)

- **Optional eye bolt:**

- **Support (Lift) point:**
  - "SAE" 5/8"-11UNC-2B TH'D X 1.30 deep
  - METRIC M16 x 2-6H TH'D (33.0)

- **Optional 2 stage compensator:**

**Dimensions:**
- **SAE / METRIC**
  - Standard 2 stage compensator:
    - 1.91 (48.6)

- **SAE / METRIC**
  - Remote control port:
    - 7/16 – 20 UNF, 0.45/ (11.4) deep

- **SAE / METRIC**
  - 0.39 X 0.31 rectangular key:
    - (10.0 X 8.0)

- **METRIC**
  - 2 bolt mounting flange per ISO 3019/1:
    - 2.08 (52.8)

- **METRIC**
  - 4 bolt mounting flange per ISO 3019/2:
    - 5.91 (150.0)

**Details:**
- **SAE-SAE**
  - Compensator adjusting knob:
    - (CW rotation increases pressure setting)

- **METRIC-METRIC**
  - Optional eye bolt:
VPV 45/63/80 to VPV 45/63/80, S.A.E. & metric combination (continued)

**Detail SAE1**

- "SAE" 7/16"-14 UNC-2B TH'D
- "METRIC" M12 x 1.75-6H TH'D
- 4 holes

**Detail METRIC1**

- ø4.92
- ø124.97

**Outlet port**

- Std. S.A.E. 1-1/4" pad
- ø1.25

**Optional volume control**

- (CW rotation reduces flow)

**Support (Lift) point**

- "SAE & METRIC"
- M10 x 1.5-6H TH'D
- .44

**Support point**

- "SAE" 5/8"-11 UNC-2b TH'D
- "METRIC" M16 x 2-6H TH'D
- 1.30

**Inches (millimeters)**
VPV 45/63/80 to VPV 45/63/80, S.A.E. & metric combination (continued)
VPV 45/63/80 to VPV 45/63/80, S.A.E. & metric combination (continued)

Inches (millimeters)
VPV 100/130/164 to VPV 100/130/164, S.A.E. & metric combination

Optional 2 stage with load sense compensator

Load sense port
- "S.A.E." #4 SAE
- "Metric" 1/4-19 BSPP

Optional 2 pressure solenoid operated compensator

Optional 2 pressure solenoid operated vent compensator

Compensator adjusting knob
- (CW rotation increases pressure setting)

2 stage compensator

Remote control port
- 7/16 – 20 UNF, 0.45/ (11.4) deep

Detal METRIC-METRIC

Detal SAE-SAE

Compensator adjusting knob
- (CW rotation increases pressure setting)

2 stage compensator

Remote control port
- 1/19-20 BSPP, 0.48/ (12.2) deep

Detailed View of the Pump

Inches (millimeters)
### VPV 100/130/164 to VPV 16, S.A.E. & metric combination

#### Installation Drawings

<table>
<thead>
<tr>
<th>S.A.E.</th>
<th>METRIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.70</td>
<td>ø18.0</td>
</tr>
<tr>
<td>1.69</td>
<td>42.9</td>
</tr>
<tr>
<td>2.08</td>
<td>52.9</td>
</tr>
<tr>
<td>2.61</td>
<td>67.5</td>
</tr>
<tr>
<td>7.44</td>
<td>189.0</td>
</tr>
<tr>
<td>7.26</td>
<td>184.5</td>
</tr>
<tr>
<td>6.06</td>
<td>153.8</td>
</tr>
<tr>
<td>5.77</td>
<td>148.6</td>
</tr>
<tr>
<td>5.76</td>
<td>146.2</td>
</tr>
<tr>
<td>12.11</td>
<td>307.6</td>
</tr>
<tr>
<td>0.47 × 0.31</td>
<td>12.0 × 8.0</td>
</tr>
<tr>
<td>ø1.57 (ø40.0)</td>
<td></td>
</tr>
<tr>
<td>ø1.75 (ø44.5)</td>
<td></td>
</tr>
</tbody>
</table>

#### Inlet Port

- **S.A.E.**: #16 S.A.E.
- **METRIC**: M12 X 1.75-6H TH'D

#### Case Drain

- **S.A.E.**: #8 S.A.E.
- **METRIC**: 3/8-19 BSPP

#### S.A.E. 1/2-13UNC-2B TH'D X 1.10 deep

#### METRIC M10 X 1.5 TH'D X 15.0 deep

#### Case Drain Support Point

- **S.A.E.**: 3/8"-16 UNC-2B TH'D
- **METRIC**: M10 X 1.5 TH'D

#### Compensator Adjustment Knob

- **S.A.E.**: 3/8"-16 UNC-2B TH'D
- **METRIC**: M10 X 1.5 TH'D

#### METRIC 4-bolt mounting flange per ISO 3019/2

- **S.A.E.**: *D* 2-bolt mounting flange per ISO 3019/1

---

**Note:** All dimensions are given in inches (millimeters).
VPV 100/130/164 to VPV 16, S.A.E. & metric combination (continued)
VPV 100/130/164 to VPV 16, S.A.E. & metric combination (continued)

Inches (millimeters)

2 stage compensator adjusting knob (CW rotation increases pressure setting)

Centerline pump control

Optional 2-stage compensator

Remote control

Inlet port

VPV 100/130/164 to VPV 16, S.A.E. & metric combination (continued)
VPV 100/130/164 to VPV 25/32, S.A.E. & metric combination

Inches (millimeters)

SAE/METRIC

SAE/METRIC

SINGLE STAGE CONTROL

NOT AVAILABLE ON VPV 45-164

DETIAL METRIC-METRIC

DETIAL SAE-SAE
VPV 100/130/164 to VPV 25/32, S.A.E. & metric combination (continued)

Optional volume control (CW rotation reduces flow)

Outlet port
  "SAE" #16 SAE
  "METRIC" 1-11 BSPP

Support point
  "SAE" 3/8"-16 UNC-2B TH'D X (22.0) deep
  "METRIC" M10 x 1.5-6H TH'D X (22.0) deep

Support (Lift) point
  "SAE & METRIC"
  M10 x 1.5-6H TH'D X (11.0) deep

Support point
  "SAE" 3/8"-16 UNC-2B TH'D X (22.0) deep
  "METRIC" M10 x 1.5-6H TH'D X (22.0) deep

Outlet port
  Std. S.A.E. 1-1/2" pad
  ø1.48 (ø37.1)

Outlet port
  Std. S.A.E. 1-1/2" pad
  ø1.48 (ø37.1)

Outlet port
  Std. S.A.E. 1-1/2" pad
  ø1.48 (ø37.1)

Outlet port
  Std. S.A.E. 1-1/2" pad
  ø1.48 (ø37.1)

Support (Lift) point
  "SAE & METRIC"
  M10 x 1.5-6H TH'D X (11.0) deep

Optional VPV25/32 single stage compensator with locking device

Control drain
  "SAE" #6 S.A.E.
  "METRIC" 3/8-19 BSPP

Optional VPV25/32 single stage compensator with locking device

Control drain
  "SAE" #6 S.A.E.
  "METRIC" 3/8-19 BSPP
VPV 100/130/164 to VPV 25/32, S.A.E. & metric combination (continued)
VPV 100/130/164 to VPV 45/63/80, S.A.E. & metric combination
VPV 100/130/164 to VPV 45/63/80, S.A.E. & metric combination (continued)

Optional volume control (CW rotation reduces flow)

Support (Lift) point
"SAE & METRIC" M10 X 1.5-6H TH'D X .43 deep

Outlet port
Std. "SAE" 1 1/4" pad
ø1.25 (ø31.8)

"SAE" 7/16"-14 UNC-2B TH'D typ
"METRIC" M12 x 1.75-6H TH'D typ

Support point
"SAE" 5/8"-11 UNC-2B TH'D 1.30 deep
"METRIC" M16 x 2-6H TH'D 1.30 deep

Support (Lift) point
"SAE & METRIC" M10 X 1.5-6H TH'D X .43 deep

Outlet port
Std. S.A.E. 1-1/2" pad
ø1.46 (ø37.1)

"SAE" 1/2"-13 UNC-2B TH'D X 1.10 deep
"METRIC" M12 X 1.75-6H TH'D X .43 deep

View A-A
(GH1 @ P-1)

View B-B
(GH1 @ B-1)

Inches (millimeters)
VPV 100/130/164 to VPV 45/63/80, S.A.E. & metric combination (continued)
VPV 100/130/164 to an ‘F’ gear pump, S.A.E. & metric combination

<table>
<thead>
<tr>
<th>Installation drawings</th>
<th>Inches (millimeters)</th>
<th>METRIC</th>
<th>SAE</th>
<th>METRIC</th>
<th>SAE</th>
<th>METRIC</th>
<th>SAE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case drain</td>
<td>&quot;SAE&quot; #8 S.A.E.</td>
<td>ø2.47</td>
<td>ø2.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&quot;METRIC&quot; 3/8-19 BSPP</td>
<td></td>
<td>0.96</td>
<td>24.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inlet port</td>
<td>Std. S.A.E. 2 1/2&quot; pad</td>
<td>1.65</td>
<td>41.91</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&quot;SAE&quot; 1/2-13UNC-2B TH'D</td>
<td></td>
<td>1.75</td>
<td>44.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&quot;METRIC&quot; M12 X 1.75-6H TH'D</td>
<td></td>
<td>1.00</td>
<td>25.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optional 2 stage compensator</td>
<td></td>
<td>0.59</td>
<td>15.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Support point</td>
<td>&quot;SAE&quot; 3/8&quot;-16UNC-2B TH'D</td>
<td>0.47</td>
<td>12.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&quot;METRIC&quot; M10 X 1.5-6H TH'D</td>
<td></td>
<td>1.10</td>
<td>28.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Remote control port
1/4 – 19 BSPP TH'D 0.48/(12.2) deep
7/16-20 UNF TH'D 0.45/(11.4) deep

Compensator adjusting knob (CW rotation increases pressure setting)
1.91 (48.8)

METRIC 4-bolt mounting flange per ISO 3019/2
ø1.97  (ø40.0)
ø7.87  (ø200.0)
ø7.65  (ø194.2)
ø12.80 (ø325.0)
ø16.08 (ø408.5)
ø16.08 (ø408.5)
ø7.27 (184.7)
ø7.27 (184.7)
ø7.65 (194.2)
ø7.65 (194.2)
ø9.00 (229.0)
ø8.1  (20.7)
ø8.1  (20.7)
ø4.4   (11.1)
ø4.4   (11.1)
ø4.7   (12.0)
ø4.7   (12.0)
ø4.7   (12.0)
ø4.7   (12.0)
ø0.70  (ø18.0)
ø7.27  (184.7)
ø16.08 (ø408.5)
ø16.08 (ø408.5)
ø45   typ
ø45   typ
ø12.80 (ø325.0)
ø12.80 (ø325.0)
ø2.08 typ
ø2.08 typ
ø1.69  (ø42.9)
VPV 100/130/164 to an ‘F’ gear pump, S.A.E. & metric combination (continued)

<table>
<thead>
<tr>
<th>Gear Pump Theoretical Displacement (in3/rev)</th>
<th>Dimension A (in)</th>
<th>Dimension B (mm)</th>
<th>Dimension C (in)</th>
<th>Dimension D (mm)</th>
<th>Total Weight (lbs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.24 (4)</td>
<td>1.571 (39.9)</td>
<td>3.346 (85.0)</td>
<td>15.66 (397.8)</td>
<td>17.44 (443.2)</td>
<td>252 (114.3)</td>
</tr>
<tr>
<td>0.34 (5.5)</td>
<td>1.618 (41.1)</td>
<td>3.445 (87.5)</td>
<td>15.71 (399.0)</td>
<td>17.55 (445.8)</td>
<td>252.2 (114.4)</td>
</tr>
<tr>
<td>0.49 (8)</td>
<td>1.697 (43.2)</td>
<td>3.606 (91.6)</td>
<td>15.79 (401.0)</td>
<td>17.70 (449.6)</td>
<td>252.4 (114.5)</td>
</tr>
<tr>
<td>0.67 (11)</td>
<td>1.850 (47.0)</td>
<td>3.803 (96.6)</td>
<td>15.94 (404.9)</td>
<td>17.86 (453.3)</td>
<td>252.6 (114.6)</td>
</tr>
<tr>
<td>0.85 (14)</td>
<td>1.870 (47.5)</td>
<td>4.0 (101.6)</td>
<td>15.96 (405.4)</td>
<td>18.05 (458.5)</td>
<td>252.8 (114.7)</td>
</tr>
<tr>
<td>0.98 (16)</td>
<td>1.870 (47.5)</td>
<td>4.134 (105.0)</td>
<td>15.96 (404.8)</td>
<td>18.22 (463.0)</td>
<td>252.9 (114.7)</td>
</tr>
<tr>
<td>1.16 (19)</td>
<td>1.870 (47.5)</td>
<td>4.330 (110.0)</td>
<td>15.96 (404.5)</td>
<td>18.42 (468.0)</td>
<td>253.1 (114.8)</td>
</tr>
<tr>
<td>1.37 (22.5)</td>
<td>2.169 (55.1)</td>
<td>4.543 (115.4)</td>
<td>16.26 (413.1)</td>
<td>18.63 (473.4)</td>
<td>253.4 (114.9)</td>
</tr>
</tbody>
</table>
VPV 100/130/164 to an ‘F’ gear pump, S.A.E. & metric combination (continued)
VPV 100/130/164 to an ‘F’ gear pump, S.A.E. & metric combination (continued)

View B-B

Optional volume control
(CW rotation reduces flow)

"SAE" 1/2"-13UNC-2B TH'D X 1.10
"METRIC" M12 X 1.75-6H TH'D X 1.43 deep

Support (Lift) point
"SAE & METRIC"
M10 X 1.5-6H TH'D X .43 deep (11.0)

Support point
"SAE" 3/8"-16 UNC-2B TH'D X .87 deep (22.0)
"METRIC" M10 x 1.5-6H TH'D X .87 deep (22.0)

View A-A

Outlet port
Std. S.A.E. 1-1/2" pad
ø1.46 (ø37.1)

Optional volume control
(CW rotation reduces flow)

"SAE" 1/2"-13UNC-2B TH'D X 1.10 (28.0) deep

"SAE" G" gear pump

---

### Gear Pump Theoretical Displacement

<table>
<thead>
<tr>
<th>Gear Pump Theoretical Displacement</th>
<th>Dimension</th>
<th>Total Weight (Vane Pump + Gear Pump)</th>
</tr>
</thead>
<tbody>
<tr>
<td>in³/rev</td>
<td>in (mm)</td>
<td>in (mm)</td>
</tr>
<tr>
<td>------------------------------------</td>
<td>-----------</td>
<td>---------</td>
</tr>
<tr>
<td>1.37 (22.5)</td>
<td>2.40 (61.0)</td>
<td>5.07 (128.5)</td>
</tr>
<tr>
<td>1.71 (28)</td>
<td>2.48 (63.0)</td>
<td>5.26 (133.7)</td>
</tr>
<tr>
<td>1.95 (32)</td>
<td>2.54 (64.5)</td>
<td>5.40 (137.2)</td>
</tr>
<tr>
<td>2.32 (38)</td>
<td>2.62 (66.5)</td>
<td>5.62 (142.6)</td>
</tr>
<tr>
<td>2.75 (45)</td>
<td>2.74 (69.5)</td>
<td>5.87 (149.2)</td>
</tr>
<tr>
<td>3.42 (56)</td>
<td>2.95 (75.2)</td>
<td>6.31 (150.2)</td>
</tr>
</tbody>
</table>

---
VPV Controls
Schematics shown illustrate VPV 45–164 controls with shock clipper integrated and no exterior plumbing required.

The case drain shows an integrated check valve not present in VPV 16, 25 and 32. All controls leave the factory pre-set at 500 PSI.

**Single Stage Compensator**
The single stage control for normal pressure compensation is a good choice where speed is important and remote capability is not required. This control available on VPV 16, 25 and 32.

**Two Stage Compensator**
The two stage pressure compensators are the platform for most VPV controls. A remote port is standard and may, or may not be enabled according to the circuit design. This is the smoothest of the standard pressure controls, and is the standard pressure compensator for VPV 45–164.

**Load Sense Compensator**
Load sense allows the user to maintain constant flow regardless of changes in load or in pump shaft rotational speed. The Whisper™ Pump load sense accomplishes this by using an external orifice and continually senses a pressure drop of 100 PSI across this orifice. The minimum ΔP is 100 PSI, however the pressure drop can be adjusted to meet circuit requirements. Consult factory.
VPV Controls (continued)

Two Pressure Compensator
Solenoid two-pressure compensators are available in normally open (normally low, energize to high) and normally closed (normally high, energize to low) versions. These two-pressure controls can greatly reduce horsepower demand and heat generation during periods of idle cycle time, or when the machine operating cycle does not require maximum pressure.

Solenoid Vent Compensator
Solenoid vented compensators are similar to the two-pressure controls, except that there is no adjustment possible. By venting the compensator the pump will go to minimum deadhead.
## Comparison of sound levels

<table>
<thead>
<tr>
<th>Source of Sound</th>
<th>Intensity (dB)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Threshold</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Rustling leaves</td>
<td>10</td>
<td>Barely audible</td>
</tr>
<tr>
<td>Broadcast studio</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Typical bedroom at night</td>
<td>30</td>
<td>Very quiet</td>
</tr>
<tr>
<td>Typical living room</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>Office, classroom</td>
<td>50</td>
<td>VPV16 @ 1200 rpm &amp; 500 psi, deadhead (49 dB)</td>
</tr>
<tr>
<td>Normal conversation</td>
<td>60</td>
<td>Moderate</td>
</tr>
<tr>
<td>Automobile interior</td>
<td>70</td>
<td>VPV130 @ 1800 rpm &amp; 3000 psi, full flow (76 dB)</td>
</tr>
<tr>
<td>Urban street</td>
<td>80</td>
<td>Noisy</td>
</tr>
<tr>
<td>Heavy truck (15 m)</td>
<td>90</td>
<td>Very noisy</td>
</tr>
<tr>
<td>Shout (1.5 m)</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Construction site</td>
<td>110</td>
<td></td>
</tr>
<tr>
<td>Loud rock music</td>
<td>120</td>
<td>Threshold of pain</td>
</tr>
<tr>
<td>Jet airplane</td>
<td>150</td>
<td>Intolerable</td>
</tr>
<tr>
<td>Rocket engine</td>
<td>180</td>
<td></td>
</tr>
</tbody>
</table>
## Troubleshooting for VPV Whisper Pumps™

Some of the most common difficulties that could be experienced in the field are listed here with potential causes and their remedies.

<table>
<thead>
<tr>
<th>Troubleshooting</th>
<th>Potential Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Excessive pump noise</strong></td>
<td>1) Coupling misalignment.</td>
<td>1) Align the pump and motor shaft to within .006 of an inch total indicator reading. The tighter the alignment, the quieter the pump will be.</td>
</tr>
<tr>
<td></td>
<td>2) The continuous pressure is significantly below 200 psi for 140 bar pumps, or 300 psi for 210 bar pumps.</td>
<td>2) The pumps have been sound tuned at rated pressure. Consult factory or raise minimum pressure 200 psi for single stage compensators in 2000 psi rated pumps, or 300 psi for 3000 psi rated pumps.</td>
</tr>
<tr>
<td></td>
<td>3) Fluid in the reservoir is low and the pump is sucking air.</td>
<td>3) Fill the reservoir so that the fluid level is well above the end of the suction line during all of the working cycle.</td>
</tr>
<tr>
<td></td>
<td>4) Restricted inlet.</td>
<td>4) If a suction strainer is used, check it for obstructions or dirt. We do not recommend the use of strainers as they tend to be a leading cause of cavitation which manifests as excessive noise. Check also for shop rags left in the reservoir.</td>
</tr>
<tr>
<td></td>
<td>5) Air leak in the suction line.</td>
<td>5) Tighten all fittings. If it still leaks, smear grease over the joints to locate the leak.</td>
</tr>
<tr>
<td></td>
<td>6) Suction line has too many elbows, or is too long.</td>
<td>6) The suction line should be as short and as straight as possible to reduce the resistance to flow.</td>
</tr>
<tr>
<td></td>
<td>7) Air in the fluid.</td>
<td>7) The return line should terminate below the fluid level to prevent splashing.</td>
</tr>
<tr>
<td></td>
<td>8) Suction line is too small.</td>
<td>8) Suction line should always be equal in size to the suction port. Never reduce it.</td>
</tr>
<tr>
<td></td>
<td>9) Vane does not move freely.</td>
<td>9) Contamination in the fluid or a burr in the vane slot can cause a vane to bind up. Proper filtration and/or deburring of the vane slots is required.</td>
</tr>
<tr>
<td></td>
<td>10) Vane is installed incorrectly.</td>
<td>10) VPV pumps with B0x design utilize vanes with offset tip geometry. Vane orientation is extremely important and if installed improperly, can cause premature wear and reduced operating life. The leading edge is identified as the low side of the vane taper. Please refer to catalog page 85 for further illustration.</td>
</tr>
<tr>
<td></td>
<td>11) A vane is missing.</td>
<td>11) Make sure all vane slots have a vane in them.</td>
</tr>
<tr>
<td></td>
<td>12) Port plates installed incorrectly.</td>
<td>12) Port plates must be installed properly or excessive noise or reduced performance may occur. Plates must be installed with the directional arrows on the plates matching the intended rotation indicated on the pump housing. VPV pumps are RH (CW) only as viewed from the drive shaft end of the pump.</td>
</tr>
<tr>
<td><strong>Pump will not prime</strong></td>
<td>1) Shaft rotation in the wrong direction.</td>
<td>1) When installing a pump, always jog the electric motor to check for proper shaft rotation. Rotation should only be clockwise (right hand) for VPV pumps.</td>
</tr>
<tr>
<td></td>
<td>2) Air leak in the suction line.</td>
<td>2) Make sure all fittings are tight.</td>
</tr>
</tbody>
</table>

*continued on next page*
## Troubleshooting for VPV Whisper Pumps™ (continued)

<table>
<thead>
<tr>
<th>Trouble</th>
<th>Potential Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pump will not prime (cont.)</strong></td>
<td>3) Pump is air bound.</td>
<td>3) Use an air bleed valve to void the pump and suction line of air.</td>
</tr>
<tr>
<td></td>
<td>4) Fluid level in the reservoir is too low.</td>
<td>4) Fill the reservoir so that the fluid level is well above the end of the suction line.</td>
</tr>
<tr>
<td></td>
<td>5) Stroke limiter is turned in too far.</td>
<td>5) Flow should not be reduced more than 50% of maximum. Turn CW to restrict flow, (see page 83).</td>
</tr>
<tr>
<td></td>
<td>6) Suction port dust plug left in place.</td>
<td>6) Remove plug.</td>
</tr>
<tr>
<td><strong>Pump is unstable</strong></td>
<td>1) Contamination in the compensator.</td>
<td>1) Thoroughly clean the control orifices and check filtration.</td>
</tr>
<tr>
<td></td>
<td>2) Pressure ring is not moving properly.</td>
<td>2) Control piston should be checked for freedom of movement.</td>
</tr>
<tr>
<td><strong>Pump is too hot</strong></td>
<td>1) Case drain line is installed too close to the pump inlet line.</td>
<td>1) The case drain and pump inlet should be separated by a baffle in the reservoir.</td>
</tr>
<tr>
<td></td>
<td>2) Reservoir is undersized. Rule of thumb is a minimum of 3 to 5 times max. pump output flow.</td>
<td>2) Add a cooler.</td>
</tr>
</tbody>
</table>
## Adapter kits for VPV combinations using ‘P1’ pumps

### List Number Description

<table>
<thead>
<tr>
<th>Ref.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>32</td>
<td>Coupling half, spline</td>
</tr>
<tr>
<td>33</td>
<td>Coupling disc</td>
</tr>
<tr>
<td>34</td>
<td>Retaining ring</td>
</tr>
<tr>
<td>35</td>
<td>Coupling half, combo</td>
</tr>
<tr>
<td>36</td>
<td>Set screw</td>
</tr>
<tr>
<td>37</td>
<td>Roll pin</td>
</tr>
<tr>
<td>38</td>
<td>Adapter</td>
</tr>
<tr>
<td>39</td>
<td>Washer</td>
</tr>
<tr>
<td>40</td>
<td>Hex head cap screw</td>
</tr>
<tr>
<td>41</td>
<td>Jam nut</td>
</tr>
</tbody>
</table>

### ADAPTER KITS – Consult factory for other possible pump combinations

<table>
<thead>
<tr>
<th>List Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>9 511 230 520</td>
<td>VPV 16 to VPV 16 Metric</td>
</tr>
<tr>
<td>9 511 230 518</td>
<td>VPV 16 to VPV 16 SAE</td>
</tr>
<tr>
<td>R978711779</td>
<td>VPV 16 to “F” Gear SAE Key</td>
</tr>
<tr>
<td>9 511 230 673</td>
<td>VPV 16 to “F” Gear SAE Spline</td>
</tr>
<tr>
<td>9 511 230 522</td>
<td>VPV 25/32 to VPV 25/32 Metric</td>
</tr>
<tr>
<td>9 511 230 523</td>
<td>VPV 25/32 to VPV 25/32 SAE</td>
</tr>
<tr>
<td>9 511 230 524</td>
<td>VPV 25/32 to VPV 16 Metric</td>
</tr>
<tr>
<td>9 511 230 525</td>
<td>VPV 25/32 to VPV 16 SAE</td>
</tr>
<tr>
<td>R978711780</td>
<td>VPV 25/32 to “F” Gear SAE Key</td>
</tr>
<tr>
<td>9 511 230 674</td>
<td>VPV 25/32 to “F” Gear SAE Spline</td>
</tr>
<tr>
<td>R978711792</td>
<td>VPV 25/32 to “G” Gear SAE Key</td>
</tr>
<tr>
<td>9 511 230 531</td>
<td>VPV 45/63/80 to VPV 16 Metric</td>
</tr>
<tr>
<td>9 511 230 532</td>
<td>VPV 45/63/80 to VPV 16 SAE</td>
</tr>
<tr>
<td>9 511 230 529</td>
<td>VPV 45/63/80 to VPV 25/32 Metric</td>
</tr>
<tr>
<td>9 511 230 530</td>
<td>VPV 45/63/80 to VPV 25/32 SAE</td>
</tr>
<tr>
<td>9 511 230 527</td>
<td>VPV 45/63/80 to VPV 45/63/80 Metric</td>
</tr>
<tr>
<td>9 511 230 528</td>
<td>VPV 45/63/80 to VPV 45/63/80 SAE</td>
</tr>
<tr>
<td>R978711781</td>
<td>VPV 45/63/80 to “F” Gear SAE Key</td>
</tr>
<tr>
<td>9 511 230 675</td>
<td>VPV 45/63/80 to “F” Gear SAE Spline</td>
</tr>
<tr>
<td>R978711782</td>
<td>VPV 45/63/80 to “G” Gear SAE Key</td>
</tr>
<tr>
<td>R978711833</td>
<td>VPV 45/63/80 to SAE “B” Spline</td>
</tr>
<tr>
<td>9 511 230 541</td>
<td>VPV 100/130/164 to VPV 16 Metric</td>
</tr>
<tr>
<td>9 511 230 542</td>
<td>VPV 100/130/164 to VPV 16 SAE</td>
</tr>
<tr>
<td>9 511 230 539</td>
<td>VPV 100/130/164 to VPV 25/32 Metric</td>
</tr>
</tbody>
</table>

### Torque Notes

**Torque Note #1**
- Torque to 2000 lb/in (225 Nm) “VPV 100/130/164”
- Torque to 1800 lb/in (204 Nm) “VPV 45/63/80”
- Torque to 1050 lb/in (119 Nm) “VPV 25/32”
- Torque to 780 lb/in (88 Nm) “VPV 16” & Type ‘G’ gear pump
- Torque to 550 lb/in (62 Nm) Type ‘F’ gear pump

**Torque Note #2**
- Torque to 2300 lb/in (260 Nm) “VPV 100/130/164”
- Torque to 850 lb/in (96 Nm) “VPV 45/63/80”
- Torque to 550 lb/in (62 Nm) “VPV 25/32” & Type ‘G’ gear pump
- Torque to 400 lb/in (46 Nm) “VPV 16” & Type ‘F’ gear pump

**Torque Note #3**
- Torque to 800 lb/in (90 Nm) “VPV 100/130/164”
- Torque to 330 lb/in (37 Nm) “VPV 45/63/80”
- Torque to 280 lb/in (31.5 Nm) “VPV 25/32” & Type ‘G’ gear pump
- Torque to 200 lb/in (22.5 Nm) Type ‘F’ gear pump
Through drive horsepower limitations

The VPV pumps can be coupled with other VPV pumps, Bosch Rexroth gear pumps or other pumps with standard SAE or metric mounting patterns. (VPV pumps can be coupled without losing use of stroke limiter.) VPV combination pumps are rated to carry the load of an additional pump(s) equal to the maximum load the lead VPV pump can generate (see chart).

<table>
<thead>
<tr>
<th>Pump</th>
<th>Flow @ 1750 RPM (gpm)</th>
<th>Maximum pressure (psig)</th>
<th>Pump #1 input horsepower (hp)</th>
<th>Maximum input power for other pumps (hp)</th>
</tr>
</thead>
<tbody>
<tr>
<td>VPV 16</td>
<td>8.03</td>
<td>3000</td>
<td>17.6</td>
<td>17.6</td>
</tr>
<tr>
<td>VPV 25</td>
<td>12.6</td>
<td>3000</td>
<td>25.3</td>
<td>25.3</td>
</tr>
<tr>
<td>VPV 32</td>
<td>15.4</td>
<td>3000</td>
<td>30.7</td>
<td>30.7</td>
</tr>
<tr>
<td>VPV 45</td>
<td>21.8</td>
<td>3000</td>
<td>43.3</td>
<td>43.3</td>
</tr>
<tr>
<td>VPV 63</td>
<td>29.6</td>
<td>3000</td>
<td>58.5</td>
<td>58.5</td>
</tr>
<tr>
<td>VPV 80</td>
<td>37.2</td>
<td>3000</td>
<td>74.6</td>
<td>74.6</td>
</tr>
<tr>
<td>VPV 100</td>
<td>46.2</td>
<td>3000</td>
<td>88.8</td>
<td>88.8</td>
</tr>
<tr>
<td>VPV 130</td>
<td>60.0</td>
<td>3000</td>
<td>117.6</td>
<td>117.6</td>
</tr>
<tr>
<td>VPV 164</td>
<td>75.8</td>
<td>3000</td>
<td>156.5</td>
<td>156.5</td>
</tr>
</tbody>
</table>

Examples:

VPV 100 @ 3045 psig + VPV 63 @ 3045 psig + VPV 25 @ 3045 psig
88.8 hp ≥ 58.5 hp + 23.3 hp

VPV 116 @ 3045 psig + VPV 16 @ 1500 psig + VPV 16 @ 1500 psig
17.6 hp ≥ 8.7 hp + 8.7 hp
VPV stroke limiter adjustment

- During initial start-up, volume should be at least 50% of maximum flow.
- Only make adjustments to volume control with pump running at full flow and low pressure while observing output flow.

<table>
<thead>
<tr>
<th>Pump model</th>
<th>Nominal stroke</th>
<th>Decrease in flow per turn</th>
<th>Minimum flow attainable</th>
</tr>
</thead>
<tbody>
<tr>
<td>VPV 16</td>
<td>1.9 mm (0.075&quot;)</td>
<td>53%</td>
<td>&lt;0%</td>
</tr>
<tr>
<td>VPV 25</td>
<td>2.0 mm (0.080&quot;)</td>
<td>50%</td>
<td>0%</td>
</tr>
<tr>
<td>VPV 32</td>
<td>2.5 mm (0.099&quot;)</td>
<td>40%</td>
<td>20%</td>
</tr>
<tr>
<td>VPV 45</td>
<td>1.9 mm (0.077&quot;)</td>
<td>80%</td>
<td>&lt;0%</td>
</tr>
<tr>
<td>VPV 63</td>
<td>2.7 mm (0.106&quot;)</td>
<td>56%</td>
<td>8%</td>
</tr>
<tr>
<td>VPV 80</td>
<td>3.4 mm (0.132&quot;)</td>
<td>44%</td>
<td>26%</td>
</tr>
<tr>
<td>VPV 100</td>
<td>3.0 mm (0.117&quot;)</td>
<td>50%</td>
<td>17%</td>
</tr>
<tr>
<td>VPV 130</td>
<td>3.8 mm (0.150&quot;)</td>
<td>40%</td>
<td>34%</td>
</tr>
<tr>
<td>VPV 164</td>
<td>4.7 mm (0.186&quot;)</td>
<td>32%</td>
<td>47%</td>
</tr>
</tbody>
</table>
3000 PSI cutaway – VPV 45–164

**TYPE “P1” VANE PUMP COMBO CAPABLE**

- Torque to 350 lb/in (Torque to 39.5 Nm)

**VPV 45/63/80 Torque to 1800 lb/in (Torque to 204 Nm)**

- VPV 45/63/80 Torque to 1800 lb/in (Torque to 204 Nm)
- VPV 100/130/164 Torque to 4970 lb/in (Torque to 562 Nm)

- Torque to 850 lb/in (Torque to 96 Nm)
- Torque to 850 lb/in (Torque to 96 Nm)
- Torque to 12 lb/in (Torque to 1.4 Nm)
Vane tip orientation

Orient vanes as shown when servicing VPV Whisper™ Pumps.

Orientation of vane tips are critical

Rotation

Looking into pump body from cover side
Reaction characteristics and shock clipper function

VPV 16, Single stage compensator, plot with shock clipper inactive.
(Response overshoot of 950 PSI, response undershoot of 700 PSI)

VPV 16, Single stage compensator, plot with shock clipper active.
(Response overshoot of 500 PSI, response undershoot of 450 PSI)