Dear partners!

We are pleased to draw your attention to the technical catalogue containing information about variable displacement axial piston hydraulic pumps 313 series, intended for usage in mobile and stationary assemblies.

“Pnevmostroimashina” JSC – leading Russian machine building company with century-old history, specialized in design, manufacture and sale on domestic and international markets of the following kinds of hydraulic equipment:

- fixed and variable displacement hydraulic motors and pumps;
- hydrostatic transmissions;
- pumping and motor units;
- hydraulic valve equipment;
- hydraulic drive elements.

Production activity of our enterprise is based on long-term engineering potential and constant introduction of new equipment and technologies.

All the products manufactured by our enterprise are 100% tested on the benches and at laboratories with modern measuring and testing equipment.

The quality management system of PSM-Hydraulics® products design and manufacture is certified by the international company Lloyds’ Register Quality Assurance to the conformity of the international standard BS EN ISO 9001:2008, certificate No. SPB0006283.

We tried to present the detailed information about variable displacement hydraulic pumps 313 series and will be glad if the catalogue will help you to apply and use our products in a proper way.

We have tried to present our product range in the most comprehensive and easily understandable way and we shall be glad if this catalogue will help you to apply and use our articles.

We shall appreciate your kind comments and suggestions on the present edition and on improvements of our products by tel.: +7 343 2646650, fax: +7 343 2299602 or by e-mail: trade@psmural.ru

Best regards,

Alexander An
General Director
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Hydraulic pumps 313 series – the product of global usage designed for world market according to international standards

Purpose

Pumps 313 series are intended to convey mechanical energy of input shaft rotation to the energy of working fluid flow with stepless regulation of flow. Pumps provide incontinuous change of working fluid flow from zero to max value.

Design

Pump design is based on bent axis axial piston circuit.

Size

Hydraulic pumps 313 series can have the following working displacements:

- 313...12 -11.6 cc/rev
- 313...28 -28 cc/rev
- 313...55 -55 cc/rev
- 313...56 -56 cc/rev
- 313...80 -80 cc/rev
- 313...107 -107 cc/rev
- 313...112 -112 cc/rev
- 313...160 -160 cc/rev
- 313...250 -250 cc/rev

Working pressure

max -40 MPa
peak -45 MPa

Connection

mounting flange - ISO 3019/2, 4 bolts

high pressure hoses connection flanges

- SAE 1” 3000psi
- SAE 1” 6000psi
- SAE 1 1/4” 6000psi

ports of drain lines

- as per GOST 26065 / ISO 6149-1
- as per ISO 9974-1 / DIN 3852-1

splined shafts

- as per GOST 6033-80
- as per ANSI B92.1a
- as per DIN 5480

keyed shaft

- as per DIN 6885

Regulation

mechanical hydraulic control
electric control
3. Description of hydraulic pumps 313 series

Hydraulic pump has cast iron housing which contains:
- main shaft mounted on two radial thrust roller conical bearings. Hydraulic pump is manufactured with splined and keyed shafts;
- rotary group containing cylinders block, spherical port plate, center pin and working pistons;
- screws for limitation of working displacement;
- gasket cap, installed from the side of mounting flange of hydraulic pump. The gasket cap contains gasket sealing providing reliable leakproofness of hydraulic pump housing chamber on main shaft.

Hydraulic pump can be equipped with rotation speed sensor.

Regulator block located at angle to hydraulic pump housing includes the following:
- spool and sleeve;
- regulator piston;
- regulator.

Hydraulic pumps are equipped with different versions of regulation mechanisms.

General view
### 4. Structural designation scheme of hydraulic pumps 313 series

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
<th>J</th>
<th>K</th>
<th>L</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>1</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**A – type (series)**

<table>
<thead>
<tr>
<th>code</th>
<th>designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>313</td>
<td>type (series) 313</td>
</tr>
</tbody>
</table>

**B-version**

<table>
<thead>
<tr>
<th>code</th>
<th>designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>roller bearings of shaft group, brass block of cylinders</td>
</tr>
<tr>
<td>3</td>
<td>conical bearings of shaft group, brass block of cylinders</td>
</tr>
<tr>
<td>4</td>
<td>conical bearings of shaft group, steel block of cylinders for 12, 28 cc/rev - roller bearings of shaft group</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>code</th>
<th>designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>398</td>
<td>= serial production</td>
</tr>
<tr>
<td>0</td>
<td>o = possible version</td>
</tr>
<tr>
<td>-</td>
<td>- = not available</td>
</tr>
</tbody>
</table>

**C - working displacement**

<table>
<thead>
<tr>
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<th>designation</th>
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</thead>
<tbody>
<tr>
<td>12</td>
<td>roller bearings of shaft group, brass block of cylinders</td>
</tr>
<tr>
<td>28</td>
<td>conical bearings of shaft group, brass block of cylinders</td>
</tr>
<tr>
<td>55</td>
<td>conical bearings of shaft group, steel block of cylinders for 12, 28 cc/rev - roller bearings of shaft group</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>code</th>
<th>designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 cc/rev</td>
<td>28 cc/rev</td>
</tr>
<tr>
<td>55 cc/rev</td>
<td>56 cc/rev</td>
</tr>
<tr>
<td>80</td>
<td>107</td>
</tr>
<tr>
<td>112</td>
<td>160</td>
</tr>
<tr>
<td>160</td>
<td>250</td>
</tr>
</tbody>
</table>

**D - regulation type**

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>0</td>
<td>proportional</td>
</tr>
<tr>
<td>1</td>
<td>negative discrete electric control</td>
</tr>
<tr>
<td>2</td>
<td>LS</td>
</tr>
<tr>
<td>3</td>
<td>constant pressure</td>
</tr>
<tr>
<td>4</td>
<td>constant power</td>
</tr>
<tr>
<td>5</td>
<td>positive discrete electric control</td>
</tr>
<tr>
<td>6</td>
<td>without control switch</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>code</th>
<th>designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 cc/rev</td>
<td>28 cc/rev</td>
</tr>
<tr>
<td>55 cc/rev</td>
<td>56 cc/rev</td>
</tr>
<tr>
<td>80</td>
<td>107</td>
</tr>
<tr>
<td>112</td>
<td>160</td>
</tr>
<tr>
<td>160</td>
<td>250</td>
</tr>
</tbody>
</table>

**E - limitation of working displacement**

<table>
<thead>
<tr>
<th>code</th>
<th>designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>without limitation</td>
</tr>
<tr>
<td>5</td>
<td>with limitation V_{min}</td>
</tr>
<tr>
<td>7</td>
<td>with limitation V_{max}</td>
</tr>
<tr>
<td>9</td>
<td>with limitation V_{min} and V_{max}</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>code</th>
<th>designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 cc/rev</td>
<td>28 cc/rev</td>
</tr>
<tr>
<td>55 cc/rev</td>
<td>56 cc/rev</td>
</tr>
<tr>
<td>80</td>
<td>107</td>
</tr>
<tr>
<td>112</td>
<td>160</td>
</tr>
<tr>
<td>160</td>
<td>250</td>
</tr>
</tbody>
</table>

**F - control type**

<table>
<thead>
<tr>
<th>code</th>
<th>designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>not available (for regulation types 2, 3, 5)</td>
</tr>
<tr>
<td>1</td>
<td>hydraulic positive</td>
</tr>
<tr>
<td>2</td>
<td>hydraulic negative</td>
</tr>
<tr>
<td>3</td>
<td>mechanical, shift with progressive motion</td>
</tr>
<tr>
<td>4</td>
<td>mechanical, shift with rotational motion</td>
</tr>
<tr>
<td>5</td>
<td>electro, discrete (24 V)</td>
</tr>
<tr>
<td>6</td>
<td>electro, discrete (12 V)</td>
</tr>
<tr>
<td>7</td>
<td>hydraulic positive with internal limitation</td>
</tr>
<tr>
<td>A</td>
<td>direct control, double-chamber multifold piston</td>
</tr>
<tr>
<td>B</td>
<td>direct control, single-chamber multifold piston</td>
</tr>
<tr>
<td>C</td>
<td>direct control, dual-chamber equilateral piston</td>
</tr>
<tr>
<td>D</td>
<td>electro, proportional 12 V</td>
</tr>
<tr>
<td>E</td>
<td>electro, proportional 24 V</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>code</th>
<th>designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 cc/rev</td>
<td>28 cc/rev</td>
</tr>
<tr>
<td>55 cc/rev</td>
<td>56 cc/rev</td>
</tr>
<tr>
<td>80</td>
<td>107</td>
</tr>
<tr>
<td>112</td>
<td>160</td>
</tr>
<tr>
<td>160</td>
<td>250</td>
</tr>
</tbody>
</table>

**G - direction of rotation and shaft version**

<table>
<thead>
<tr>
<th>code</th>
<th>designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>right, splined as per 6033-80</td>
</tr>
<tr>
<td>4</td>
<td>left, splined as per GOST 6033-80</td>
</tr>
<tr>
<td>5</td>
<td>right, keyed</td>
</tr>
<tr>
<td>6</td>
<td>left, keyed</td>
</tr>
<tr>
<td>7</td>
<td>right, splined as per DIN 5480</td>
</tr>
<tr>
<td>8</td>
<td>left, splined as per DIN 5480</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>code</th>
<th>designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 cc/rev</td>
<td>28 cc/rev</td>
</tr>
<tr>
<td>55 cc/rev</td>
<td>56 cc/rev</td>
</tr>
<tr>
<td>80</td>
<td>107</td>
</tr>
<tr>
<td>112</td>
<td>160</td>
</tr>
<tr>
<td>160</td>
<td>250</td>
</tr>
</tbody>
</table>
### H - secondary control

<table>
<thead>
<tr>
<th>code</th>
<th>designation</th>
<th>12</th>
<th>28</th>
<th>55</th>
<th>56</th>
<th>80</th>
<th>107</th>
<th>112</th>
<th>160</th>
<th>250</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>not available</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>2</td>
<td>pressure cut off valve</td>
<td>-</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>8</td>
<td>cut off valve in control line</td>
<td>-</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>9</td>
<td>LS block</td>
<td>-</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>A</td>
<td>regulator mechanical blocking for installation at V = 0 cc/rev.</td>
<td>-</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
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</table>

### I - mounted in hydraulic valve equipment

<table>
<thead>
<tr>
<th>code</th>
<th>designation</th>
<th>12</th>
<th>28</th>
<th>55</th>
<th>56</th>
<th>80</th>
<th>107</th>
<th>112</th>
<th>160</th>
<th>250</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 **</td>
<td>not available</td>
<td>-</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>1</td>
<td>relieve valve</td>
<td>-</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>3</td>
<td>valve «OR» for regulator connection to servo supply</td>
<td>-</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>4</td>
<td>valve «OR» for regulator connection to servo supply, output relieve valve</td>
<td>-</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
</tbody>
</table>

### J - type of hydraulic system

<table>
<thead>
<tr>
<th>code</th>
<th>designation</th>
<th>12</th>
<th>28</th>
<th>55</th>
<th>56</th>
<th>80</th>
<th>107</th>
<th>112</th>
<th>160</th>
<th>250</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 **</td>
<td>for open circuit</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
</tbody>
</table>

### K - location and type of working channels, mounting flange ISO 3019/2, 4 holes

<table>
<thead>
<tr>
<th>code</th>
<th>designation</th>
<th>12</th>
<th>28</th>
<th>55</th>
<th>56</th>
<th>80</th>
<th>107</th>
<th>112</th>
<th>160</th>
<th>250</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 **</td>
<td>1 flange on buttend, 1 flange sideways</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
</tbody>
</table>

### L - shaft sealing material

<table>
<thead>
<tr>
<th>code</th>
<th>designation</th>
<th>12</th>
<th>28</th>
<th>55</th>
<th>56</th>
<th>80</th>
<th>107</th>
<th>112</th>
<th>160</th>
<th>250</th>
</tr>
</thead>
<tbody>
<tr>
<td>B **</td>
<td>NBR</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>F</td>
<td>FKM</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
</tbody>
</table>

### M - climatic version

<table>
<thead>
<tr>
<th>code</th>
<th>designation</th>
<th>12</th>
<th>28</th>
<th>55</th>
<th>56</th>
<th>80</th>
<th>107</th>
<th>112</th>
<th>160</th>
<th>250</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y1 **</td>
<td>moderate climate, open air location</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>TB1</td>
<td>tropical humid climate, open air location</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
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<td>●</td>
<td>●</td>
</tr>
<tr>
<td>OM1</td>
<td>marine climate, open air location</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
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<td>●</td>
</tr>
</tbody>
</table>

* - not applied for new developments
** - allowed not to specify while ordering
5. Technical parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Values for variable pumps 313 series with the following working displacement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>12</td>
</tr>
<tr>
<td>Working displacement (V_o, cc/rev)</td>
<td>0</td>
</tr>
<tr>
<td>- min (V_{o,min})</td>
<td>11,6</td>
</tr>
<tr>
<td>- max (V_{o,max})</td>
<td>400</td>
</tr>
<tr>
<td>Rotation speed (n, rpm)</td>
<td>2400</td>
</tr>
<tr>
<td>- min (n_{min})</td>
<td>2000</td>
</tr>
<tr>
<td>- max (n_{max})</td>
<td>6000</td>
</tr>
<tr>
<td>Feed (Q, l/min)</td>
<td>4,64</td>
</tr>
<tr>
<td>- nominal (Q_{n})</td>
<td>27,84</td>
</tr>
<tr>
<td>- max (Q_{max})</td>
<td>46,40</td>
</tr>
<tr>
<td>- limit (Q_{lim})</td>
<td>69,60</td>
</tr>
<tr>
<td>Discharge pressure (change) (\Delta P, MPa)</td>
<td>20</td>
</tr>
<tr>
<td>- nominal (\Delta P_{n})</td>
<td>32</td>
</tr>
<tr>
<td>- max working (\Delta P_{max}) for 313.3 series</td>
<td>-</td>
</tr>
<tr>
<td>- max working (\Delta P_{max}) for 313.4 series</td>
<td>-</td>
</tr>
<tr>
<td>Input pressure, MPa</td>
<td>0,2</td>
</tr>
<tr>
<td>- min (absolute)</td>
<td>2750</td>
</tr>
<tr>
<td>- max</td>
<td>3750</td>
</tr>
<tr>
<td>Pressure of regulator stable operation, min, MPa</td>
<td>3</td>
</tr>
<tr>
<td>Consumed power (N, kW)</td>
<td>19,33</td>
</tr>
<tr>
<td>- nominal (N_{n}) (at (n_{max}, V_{o,max}, P_{nom}))</td>
<td>24,75</td>
</tr>
<tr>
<td>- max (N_{max}) (at (n_{max}, V_{o,max}, P_{nom})) for 313.3 series</td>
<td>46,15</td>
</tr>
<tr>
<td>- max (N_{max}) (at (n_{max}, V_{o,max}, P_{nom})) for 313.4 series</td>
<td>59,08</td>
</tr>
<tr>
<td>Driven torque (T, Nm)</td>
<td>0,95</td>
</tr>
<tr>
<td>- nominal (T_{n}) (at (n_{max}, V_{o,max}, P_{nom}))</td>
<td>0,95</td>
</tr>
<tr>
<td>- max (T_{max}) (at (n_{max}, V_{o,max}, P_{nom})) for 313.3 series</td>
<td>0,95</td>
</tr>
<tr>
<td>- max (T_{max}) (at (n_{max}, V_{o,max}, P_{nom})) for 313.4 series</td>
<td>0,95</td>
</tr>
<tr>
<td>Feed coefficient</td>
<td>0,90</td>
</tr>
<tr>
<td>Fulle coefficient</td>
<td>0,90</td>
</tr>
</tbody>
</table>

*values of torque \(T\) and power \(N\) are given without considering efficiency coefficient

Determination of nominal pump size:

\[ \text{Feed } Q = \frac{V_o \cdot n \cdot \eta_v}{1000} \text{ l/min} \]
\[ \text{Torque } T = \frac{1,5 \cdot V_o \cdot \Delta P}{\eta_m \cdot 100 \cdot \eta_v} \text{ N-m} \]
\[ \text{Power } N = \frac{Q \cdot \Delta P}{600 \cdot \eta_i} \text{ kW} \]

where:
- \(Q\) - pump feed, l/min
- \(T\) - torque consumed by pump, N-m
- \(N\) - power consumed by pump, kW
- \(V_o\) - pump working displacement, cc/rev
- \(n\) - shaft rotation speed, rpm
- \(\Delta P\) - pressure difference, kgf/cm²
- \(\eta_v\) - volumetric efficiency coefficient
- \(\eta_m\) - hydraulic mechanical efficiency coefficient
- \(\eta_i\) = \(\eta_v \cdot \eta_m\) - full efficiency coefficient
6. Maintenance restrictions

Requirements for hydraulic systems:
1. Hydraulic system of main unit which contains the pump shall have devices for controlling the oil temperature in the tank, the pressure in input and output lines of pump.
2. Relieve valve of hydraulic system shall be adjusted for pressure not higher than max output pressure given in the Table with technical parameters.
3. Avoid operation in the modes with frequent overloads. The operation time of the unit at 40 MPa within the recommended range of working fluid temperature shall not exceed 10-12 s. with the interval not less than 10 min.
4. At lower limit of maintenance temperature to -25°C it is recommended to use the material of shaft sealing (gasket) FKM, at lower limit to -40°C - NBR.

Requirements for piping:
1. The section of pressure pipe is not recommended to be less than the area of the pump corresponding hole. Prohibited to accept the section of sucking pipe less than the section of pump sucking hole.
2. Each pressure pipe shall be checked for leak-proofness with static pressure of working fluid which is 1,6 P_{max} (50 MPa) during 5 min.
# 7. Requirements for working fluids

The working fluid shall conform to the following parameters:

<table>
<thead>
<tr>
<th>Cleanliness grade as per GOST 17216</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kinematic viscosity, mm²/s (cSt):</td>
</tr>
<tr>
<td>- optimal</td>
</tr>
<tr>
<td>- max launch</td>
</tr>
<tr>
<td>- min short term</td>
</tr>
<tr>
<td>Filtration fineness (nominal), mkm</td>
</tr>
<tr>
<td>Maintenance temperature, °C:</td>
</tr>
<tr>
<td>- max</td>
</tr>
<tr>
<td>- min</td>
</tr>
</tbody>
</table>

### Working fluids recommended for usage:

<table>
<thead>
<tr>
<th>Oil brand</th>
<th>Designation as per GOST 17479.3-85, 17479.4-87</th>
<th>Viscosity class as per ISO 3448</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>VG-15</td>
</tr>
<tr>
<td>БМГЗ ТУ 38.101479-86</td>
<td>МГ-15-В (c)</td>
<td>SHELL</td>
</tr>
<tr>
<td>МГЕ-10А ОТС 38.01281-82</td>
<td>МГ-15-В</td>
<td>Tellus S2 V15</td>
</tr>
<tr>
<td>Substituent AMF-10 GOST 6794-75*</td>
<td>МГ-15-В</td>
<td>MOBIL DTE 11M</td>
</tr>
<tr>
<td>АУП ТУ 38.1011258-89</td>
<td>МГ-22-В</td>
<td>CASTROL Hyspin AWH 15</td>
</tr>
<tr>
<td>СДМ-15 ТУ 0253-001-49319233-02 (&quot;SDM Zapchast-Service” Ltd.)</td>
<td>МГ-15-В</td>
<td>SHELL Tellus S3 M22</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MOBIL DTE 22</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CASTROL Hyspin AWS 22</td>
</tr>
<tr>
<td>МГЕ-46-В ТУ 38.001347-83</td>
<td>МГ-46-В</td>
<td>SHELL Tellus S2 V46</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MOBIL DTE 15</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CASTROL Hyspin AWH 46</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MOBIL DTE 25</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CASTROL Hyspin AWS 46</td>
</tr>
<tr>
<td>Substituent И-30А GOST 20799-88</td>
<td>И-Г-А-46</td>
<td>SHELL Tellus S2 M46</td>
</tr>
</tbody>
</table>

* - only for regions with severe climate

* - strictly prohibited to mix oils
8. Allowed radial and axial loads on shaft

Operation lifetime of hydraulic pump bearing group directly depends on the forces acting on output shaft of hydraulic pump from outside. To avoid early failure of hydraulic pump during project works observe the restrictions for external forces on output shaft of hydraulic pump.

Values of limit loads on shaft are given in the Table:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Values for pumps with the following working displacement:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>12</td>
</tr>
<tr>
<td>a, mm</td>
<td>20</td>
</tr>
<tr>
<td>F_{max}, N</td>
<td>2748</td>
</tr>
<tr>
<td>F/P, N/MPa</td>
<td>61</td>
</tr>
<tr>
<td>±F_{ax max}, N</td>
<td>200</td>
</tr>
<tr>
<td>±F_{ax max}/P, N/MPa</td>
<td>26</td>
</tr>
</tbody>
</table>

- **a** – distance of force F application from shaft collar;
- **F_{max}** – max radial load at optimal angle of gear installation;
- **F/P** – radial load acting at pressure P (additional load allowed at pressure P);
- **±F_{ax max}** – max allowed axial load at standstill;
- **±F_{ax max}/P** – max allowed axial load at operation with pressure P.

Direction of max allowed axial load shall be considered:

- **-F_{ax max}** – bearings lifetime is increased;
- **+F_{ax max}** – bearings lifetime is decreased (avoid if possible)

Values of limit loads on hydraulic pump shaft are given for optimal angles of gear (a) and V-belt (6) drives installation.

The choice of other angle of gear installation shall be negotiated with the Manufacturer.
9. Regulation

9.1 Pump with proportional positive hydraulic control (313 ... 007.3(4))

- Pump with proportional positive hydraulic control and valve «OR» for regulator connection to servo supply (313 ... 007.303(304))
- Pump with proportional positive hydraulic control and cut off valve in control line (313 ... 007.38(48))
- Pump with proportional positive hydraulic control with cut off valve in control line and valve «OR» for regulator connection to servo supply (313 ... 007.383(483))

Pump is intended for:
- changing feed Q in dependence of operator signal;
- providing automatic pump output for min displacement V\text{\tiny min} at adjusted cut-off pressure P\text{\tiny ortс} in hydraulic system.

Pump operation
In initial position, at absence of control pressure P\text{\tiny u}, the pump has min working displacement V\text{\tiny min}, feed Q\text{\tiny min} and min consumed power N\text{\tiny п}.

Regulation
At increase of control pressure P\text{\tiny u}, starting with the pressure of regulation beginning P\text{\tiny un}, working displacement V of pump is proportionally increasing, which leads increase of feed Q (consumed power N\text{\tiny п}), Having achieved the max working displacement V\text{\tiny max}, at control pressure equal to regulation end pressure P\text{\tiny u}= P\text{\tiny ук}, the pump will have max feed Q\text{\tiny max} (consumed power N\text{\tiny п}).

Cut-off valve (screw Z\text{\tiny 0}) controls working pressure P at pump output and provides automatic drop of control pressure P\text{\tiny u}, at pressure P, exceeding the pressure of cut-off valve adjustment P\text{\tiny ortс} which leads smooth output of pump to initial position.

Feed Q (consumed power N\text{\tiny п}), if necessary, can be restricted with one of the following ways:
- limitation of max working displacement V\text{\tiny max} of pump;
- limitation of control pressure P\text{\tiny u} with screw Z;
- limitation of working pressure P\text{\tiny max} of hydraulic system.

ATTENTION:
Cut-off valve is recommended to adjust for 2 MPa lower than adjustment pressure of relieve valve in hydraulic system.

The standard range P\text{\tiny un}=0,6...1 MPa, standard value at factory adjustment P\text{\tiny un}=0,6...0,8 MPa, at that the range of control pressure change \Delta P\text{\tiny u}=1,2...1,5 MPa, the range P\text{\tiny ук}=1,8...2,3 MPa. The range of pressure cut-off valve adjustment P\text{\tiny ortс}=5...40 MPa.

While ordering hydraulic pumps specify the value of regulation beginning pressure P\text{\tiny un}, of min and max working displacement V\text{\tiny min}, V\text{\tiny max}, of cut off valve adjustment pressure P\text{\tiny ortс}.

Hydraulic pump regulator operates based on working pressure in hydraulic system, the min value of working pressure for normal operation of regulator: -3 MPa. If the pressure is lower, it is necessary to order the pump with valve «OR» for regulator connection to servo supply (313...007.303(403) or 313...007.383(483)).

Diagrams of dependance between the change of feed Q and working displacement V from pressure change P

![Diagram](https://example.com/diagram.png)
Hydraulic circuits of pumps

Designation on hydraulic circuit:
A - pressure line
S - suction line
R - hole for deaeration (plugged in)
Y - input line for servo supply of regulator, not less than 3 MPa, socket M16x1,5-7H
X - control pressure line, $P_{\text{max}}=3.5$ MPa, M12x1,5-7H GOST 25065-90
Z_0 - pressure cut off valve $P_{\text{off}}$ adjusting screw
Z, Z_1 - adjusting screw of regulation beginning pressure $P_{\text{in}}$
9.2 Pump with constant pressure difference valve and pressure cut off valve (313 … 200.32)

Pump is intended for:
- providing constant pressure change at edge of LS control valve by regulation of feed Q (analogous to automatic regulator of flow);
- limitation of pressure P in hydraulic system by regulation of feed Q of the pump in the modes with higher pressure P and lower feed Q (e.g. operation of working body at short range).

Pump operation
While LS control valve is closed, the pump is at min working displacement \( V_{\text{min}} \), provides min feed \( Q_{\text{min}} \), enough for keeping the pressure in hydraulic system \( \Delta P_{\text{LS}} = 1.5...3 \) MPa.

Regulation
While opening LS control valve LS signal readjusts the pump for feed Q, which provides the adjusted difference \( \Delta P_{\text{LS}} = 1.5...3 \) MPa on the edge of LS control valve.

Decrease of flow section leads decrease of feed Q and of consumed power \( N_{p} \) of pump, while increase of control valve flow section leads increase of feed Q and of consumed power \( N_{p} \).

At complete opening of LS control valve, the pump achieves max feed \( Q_{\text{max}} \).

Pressure cut-off valve:
following LS signal of control valve is made at pressure not exceeding pressure valve adjustment (see vertical line RD on the Fig.). At the pressure of valve regulation beginning \( P_{n} \) the pressure valve starts operating which restricts pressure growth P by decrease of feed Q to zero value not depending on LS signal.

External regulation and restriction:
- constant pressure P in hydraulic system is provided by pump only within the regulation zone, that is why it is NOT RECOMMENDED to limit the min working displacement \( V_{\text{min}} \) of pump;
- supported difference \( \Delta P_{\text{LS}} \) can be changed with regulation of screw \( r \);
- if necessary, the supported pressure P and max consumed power \( N_{\text{max}} \) can be changed by regulation of screw \( Z \).

ATTENTION:
The cut-off valve is recommended to adjust 2 MPa lower than adjustment pressure of relieve valve in hydraulic system.
The range of pressure regulation beginning of cut-off valve \( P_{n} = 5...40 \) MPa, the difference range LS \( \Delta P_{\text{LS}} = 1.5...3.0 \) MPa.
When ordering hydraulic pumps specify the values of adjustment pressure for cut-off valve \( P_{n} \), of min and max working displacement \( V_{\text{min}}, V_{\text{max}} \), pressure of supported difference \( \Delta P_{\text{LS}} \).
9.3 Pump with constant pressure regulator (313 … 300.3)

Pump is intended for providing constant pressure in hydraulic system by means of feed regulation.

Pump operation
While pressure in hydraulic system does not exceed the pressure of regulation beginning $P_n$, the pump is at max working displacement $V_{max}$ and provides max feed $Q_{max}$ (point 1).

Regulation
At increase of working pressure $P$, starting with pressure of regulation beginning $P_n$ (point 1), working displacement $V$ of pump starts to decrease smoothly and automatically. Having achieved the min working displacement $V_{min}$ at final pressure $P_k \approx P + 1$ MPa, the pump feeds min flow necessary for compensation of leakages and providing the min consumed power $N_{pmin}$ (point 2).

External regulation and restriction:
- max and min feed of pump can be adjusted by changing the working displacement of pump with limiting adjusting screws;
- supported pressure and max consumed power if necessary can be adjusted with screw $Z$;
- constant pressure in hydraulic system is provided with pump only within the regulation zone. That is why it is not recommended to restrict the min working displacement $V_{min}$ of pump;
- during the long maintenance of pump at zero feed $Q_{min} \rightarrow 0$ (more than 50 % of working cycle) at pressure $P > 15$ MPa, for cooling the rotary group parts it is necessary to charge the working fluid with flow $Q = 8…10 \% Q_{max}$ through hole $R$ of pump.

ATTENTION:
Pressure range of regulation beginning $P_n = 5…35$ MPa.
While ordering hydraulic pumps specify the values for regulation beginning pressure $P_n$, for min and max working displacement $V_{min}, V_{max}$.

Dependence diagrams of torque $M$, consumed power $N$, and feed $Q$ from pressure difference $P$

Hydraulic circuit of pumps

Designation on hydraulic circuit:
A - charge line
S - suction line
R - hole for deaeration (plugged in)
L - regulator drain line (connect with hydraulic tank),
M12x1,5 GOST 25065-90
Z - adjusting screw for regulation beginning pressure $P_n$
9.4 Pump with constant power regulator (313 ... 500.3)

Pump is intended for providing constant consumed torque \( M_p \) by means of angle regulation of rotary group.

Pump operation
While pressure in hydraulic system does not exceed the pressure of regulation beginning \( P_n \), the pump is at max working displacement \( V_{\text{max}} \) and provides max feed \( Q_{\text{max}} \).

Regulation
At increase of working pressure \( P \), starting with pressure of regulation beginning \( P_n \), the working displacement of pump \( V \) starts to decrease automatically, providing the constant consumed torque \( M_p \) and consumed power \( N_p \).

Constant consumed torque \( M_p \) and power \( N_p \) are provided within the regulation zone of pump. Having achieved the min working displacement \( V_{\text{min}} \) (when mechanical restriction is available) at pressure \( P = P_{\text{k}} \approx P_n \), the pump will have min feed \( Q_{\text{min}} \); and at further pressure increase \( P > P_k \), consumed torque \( M_p \) and power \( N_p \) will increase.

External regulation and restriction:
- max feed of pump can be changed by regulation of adjusting screw for max working displacement \( V_{\text{max}} \) of pump;
- consumed power \( N_p \), if necessary, can be changed by adjustment of screw \( Z \).

ATTENTION:
The range of pressure regulation beginning \( P_n = 5...25 \) MPa.
While ordering hydraulic pumps specify the values of power \( N_p \) and rotation speed \( n = n_{\text{дв}} \) of drive engine or pressure of regulation beginning \( P_n \).

Hydraulic circuit
Dependence diagrams of consumed torque \( M_p \), consumed power \( N_p \) and feed \( Q \) from pressure difference \( P \)

Designation on hydraulic circuit
A - charge line
S - suction line
R - hole for deaeration (plugged in)
Z - adjusting screw of regulation beginning pressure \( P_n \)
9.5 Pump with constant power regulator and cut-off valve in high pressure line (313 … 500.32)

The pump is intended for providing constant consumed torque $M_p$ by regulation of rotary group inclination angle.

**Pump operation**
While pressure in hydraulic system does not exceed $P_n$ the pump is at max working displacement $V_{max}$ and provides max feed $Q_{max}$.

**Regulation**
At increase of working pressure $P$, starting with regulation beginnign pressure $P_n$, working displacement $V$ of pump starts to decrease smoothly and automatically, providing the costant torque $M_p$ and consumed power $N_p$. Constant consumed torque $M_p$ and power $N_p$ are provided within the regulation zone of pump.

Having achieved the min working displacement $V_{min}$ at pressure $P_k \approx P \cdot V_{max}/V_{min}$, the pump will have min feed $Q_{min}$, and at further increase of pressure $P>P_k$ the consumed torque $M_p$ and power $N_p$ will increase.

The cut-off valve operates at pressure $P$ at pump output, exceeding adjustment pressure of cut-off valve $P_{отс}$. The pump enters the mode of min feed and power, dropping the feed and preventing the overheating and the drain of working fluid through relieve valve.

**External regulation and restriction:**
- max feed of pump can be changed with regulation of screw for restriction of max working displacement $V_{max}$ of pump;
- consumed power $N_p$, if necessary, can be changed with regulation of screw $Z$;
- pressure adjustment of cut-off valve $P_{отс}$, if necessary, can be changed with regulation of screw $Z_0$;

**ATTENTION:**
Cut-off valve is recommended to be adjusted for 2 MPa which is lower than pressure adjustment of relieve valve in hydraulic system.

The range of pressure regulation beginning $P_n=5…25$ MPa. The range of pressure adjustment of cut-off valve $P_{отс}=5…40$ MPa.

While ordering hydraulic pumps specify the values of power $N_p$ and rotation speed $n$ of drive engine or pressure of regulation beginning $P_n$, pressure of cut-off valve adjustment $P_{отс}$.

**Dependence diagrams of torque $M_p$, consumed power $N_p$ and feed $Q$ from pressure difference $P$**

**Hydraulic circuit**

- $A$ - charge line
- $S$ - suction line
- $R$ - hole for deaeration (plugged-in)
- $Z$ - screw for adjustment of regulation beginning pressure $P_n$
- $Z_0$ - pressure adjusting screw $P_{отс}$ of cut-off valve
9.6 Pump with constant power regulator and with mechanical block of regulator for installation at V=0 cc (313 ...55. 500.4A)

The pump is intended for providing the constant consumed torque $M_p$ by regulation of rotary group inclination angle.

Pump operation
While pressure in hydraulic system does not exceed the pressure of regulation beginning $P_n$, the pump is at max working displacement $V_{max}$ and provides max feed $Q_{max}$.

Regulation
At increase of working pressure $P$, starting with regulation beginning pressure $P_n$, the working displacement $V$ of pump starts to decrease smoothly and automatically, providing the constant consumed torque $M_p$ and consumed power $N_p$. The constant consumed torque $M_p$ and power $N_p$ are provided within the pump regulation zone.

Having achieved the min working displacement $V_{min}$, at pressure $P_k \approx P_n \cdot V_{max}/V_{min}$, the pump will have min feed $Q_{min}$ and at further further increase of pressure $P>P_k$ consumed torque $M_p$ and power $N_p$ will increase.

External regulation and restriction
- max feed of the pump can be changed with regulation of screw for restriction of max working displacement $V_{max}$ of pump;
- consumed power $N_p$ if necessary, can be changed with regulation of screw $Z$;
- regulator for installation at zero working displacement is blocked with tightening screw $v$ to the rest. After diesel launch turn off screw $v$ to the rest.

ATTENTION:
The range of pressure regulation beginning $P_n=5...25$ MPa.
While ordering hydraulic pumps specify the values of power $N_{max}$ and rotation speed $n_{max}$ of driving engine or regulation beginning pressure $P_n$.

Dependence diagrams of consumed torque $M_p$, consumed power $N_p$ and feed $Q$ from pressure change $P$

Designation on hydraulic diagram
A - pressure line
S - suction line
R - hole for deaeration (plugged)
Z - screw for adjustment of regulation beginning pressure $P_n$
$v$ - screw for pump installation at zero working displacement

Hydraulic diagram
9.7 Pump with constant power regulator, hydraulic positive control (313 … 501.303)

Pump is intended for:
- providing constant consumed torque \( M_n \) by regulation of rotary group inclination angle;
- regulation of pump consumed power \( N_p \) in dependence of control pressure \( P_y \).

Pump operation
At absence of control pressure \( P_y = 0 \) the pump is at min working displacement \( V_{min} \), providing min feed \( Q_{min} \) and consumed power \( N_{p,min} \).
After feed of control pressure \( P_y \) while pressure in hydraulic system does not exceed the pressure of regulation beginning \( P_n \), the pump is at max working displacement \( V_{max} \) and provides max feed \( Q_{max} \).

Regulation
At increase of working pressure \( P \), starting with pressure of regulation beginning \( P_n \), the working displacement \( V \) of pump starts smooth decreasing, providing (supporting) constant drive \( M_n \) and constant power \( N_p \). By means of decreasing the working displacement \( V \) the feed \( Q \) decreases to min values \( V_{min} \) and \( Q_{min} \).

The pressure of regulation beginning \( P_n \), drive torque \( M_n \), and consumed power \( N_p \) are determined (adjusted) with control pressure \( P_y \).
At any moment pump feed depends on control pressure \( P_y \) and working pressure \( P \).
Constant torque \( M_n \) and consumed power \( N_p \) are provided within the zone of pump regulation.
Having achieved the min working displacement \( V_{min} \) at pressure \( P \approx P_n \cdot V_{max}/V_{min} \) the pump will have min feed \( Q_{min} \), and at further pressure increase \( P > P_n \) the consumed torque \( M_n \) and consumed power \( N_p \) will increase.

External regulation and restriction:
- max feed of pump can be changed with regulation of screw for max working displacement \( V_{max} \) of pump;
- consumed power \( N_p \), if necessary, can be changed with regulation of screw \( Z \).

ATTENTION:
The range of regulation beginning pressure \( P_n = 5 \ldots 25 \) MPa.
While ordering hydraulic pumps specify the values of power \( N_{aw} \) and rotation speed \( n_{aw} \) of drive engine or regulation beginning pressure \( P_n \), min and max working displacement \( V_{min}, V_{max} \).
Do not apply for new developments.

Dependence diagrams of consumed torque \( M_n \), consumed power \( N_p \) and feed \( Q \) from pressure difference \( P \)

Designation on hydraulic circuit:
A - charge line
S - suction line
R - hole for deaeration (plugged in)
Y - input line for external feed of regulator, not less than 3 MPa, socket M16x1,5-7H
X - control pressure line, \( P_y = 3.5 \) MPa, M12x1,5-7H GOST 25065-90
Z - screw for adjustment of regulation beginning pressure \( P_n \)
9.8 Pump with constant power regulator and negative control
(313 … 502.3)

Pump is intended for:
- automatic support of consumed power \( N_p \) at pressure change \( P \) in hydraulic system by regulation of rotary group inclination angle;
- pump output to the mode of min consumed power \( N_{p \min} \) (feed \( Q \)) with hydraulic signal from operator.

**Pump operation**
While pressure in hydraulic system does not exceed the pressure of regulation beginning \( P_n \), the pump is at max working displacement \( V_{\max} \) and gives max feed \( Q_{\max} \).

**Regulation**
At increase of working pressure \( P \), starting with regulation beginning pressure \( P_n \), working displacement \( V \) of pump starts to decrease automatically, providing the constant consumed power \( N_p \) of pump, at that the consumed torque \( M_p \) is constant, and pump feed \( Q \) decreases.

Having achieved the min working displacement \( V_{\min} \) at pressure \( P_{n \approx} = R \cdot V_{\max}/V_{\min} \), the pump will have min feed \( Q_{\min} \).

**Operator interference**
At smooth feed of control signal \( P_y \) (negative control) to line \( X \) the pump can get readjusted for less pressure of regulation beginning \( P_n \) and already at \( P_y = 2,5...3 \) MPa the working displacement \( V \) of pump is min if hydraulic system working pressure \( P > 4 \) MPa.

**External regulation and restriction:**
- max rotation speed of pump shall not exceed max allowed;
- working displacement \( V_{\min} \) and \( V_{\max} \) of pump can be restricted with regulating screws;
- pressure of regulation beginning \( P_n \) of pump can be changed with regulation of screw \( Z \).

**ATTENTION:**
The range of regulation beginning pressure \( P_{n} = 5...25 \) MPa.
While ordering a hydraulic pump specify the values of power \( N_{p \min} \) and rotation speed \( n_{p \min} \) of drive engine or regulation beginning pressure \( P_n \).

Diagrams of dependence between consumed torque \( M_p \), consumed power \( N_p \) and feed \( Q \) from pressure change \( P \)

[Diagrams of dependence between consumed torque \( M_p \), consumed power \( N_p \) and feed \( Q \) from pressure change \( P \)]

Designation on hydraulic circuit
- \( A \) - pressure line
- \( S \) - suction line
- \( R \) - hole for deaeration (plugged)
- \( X \) - control pressure line, M12x1,5 GOST 25065-90
- \( Z \) - adjustment screw for pressure adjustment
9.9 Pump with constant power regulator, positive control and restriction of upper level of response (313 … 507.303)

The pump is intended for:
- regulation of consumed power \( N_p \) of pump in dependence of control pressure \( P_y \);
- restriction of max consumed power \( N_{p,max} \) of pump by means of internal mechanical restrictor \( Z \) in the block of pump regulator.

**Pump operation**

At absence of control pressure \( P_y = 0 \) and presence of pressure in regulator \( P > 3 \text{ MPa} \) the pump is at min working displacement \( V_{min} \), providing min feed \( Q_{min} \) and consumed power \( N_{min} \).

After feeding control pressure \( P_y > 0,6\cdots0,8 \text{ MPa} \), while pressure \( P \) in hydraulic system does not exceed the pressure of regulation beginning \( P_n \), the pump is at max working displacement \( V_{max} \) and provides max feed \( Q_{max} \).

**Regulation**

At increase of working pressure \( P \), starting with pressure \( P_n \), the working displacement \( V \) of pump smoothly automatically decreases, providing the constant drive torque \( M_p \) and consumed power \( N_p \) by means of decreasing the working displacement \( V \) and feed \( Q \), till min value \( V_{min} \) (\( Q_{min} \)).

The pressure of regulation beginning \( P_n \), drive torque \( M_p \) and consumed power \( N_p \) are determined (adjusted) with control pressure \( P_y \).

Feed \( Q \) of pump at any time depends on control pressure \( P_y \) and working pressure \( P \).

The constant consumed power \( N_p \) is provided with pump only within regulation zone.

Having achieved the min working displacement \( V_{min} \) at pressure \( P \approx P_n \cdot V_{max}/V_{min} \), the pump feeds min flow \( Q_{min} \), providing the adjusted consumed power \( N_{min} \). At further increase of pressure \( P > P_n \) (in case of mechanical restriction of \( V_{min} \)) the drive torque \( M_p \) and consumed power \( N_p \), will increase.

Recomendations and external regulation:
- max feed \( Q_{max} \) of pump can be changed with regulation of screw for max working displacement \( V_{max} \) of pump;
- max supported consumed power \( N_{max} \), if necessary, can be changed with regulation of screw \( Z \);

**ATTENTION:**

Pressure range of regulation beginning \( P_n = 5\cdots25 \text{ MPa} \).

While ordering hydraulic pumps specify values of power \( N_{max} \) and rotation speed \( n_{max} \) of drive engine or regulation beginning pressure \( P_n \).

For providing the operation of pump regulator at low pressure at pump output \( P < 3 \text{ MPa} \), it is necessary to use nipple \( Y \) for input of external pressure (servo power) \( P > 3 \text{ MPa} \).

![Dependence diagrams of consumed torque \( M_p \), consumed power \( N_p \) and feed \( Q \) from pressure change \( P \)](image_url)

**Designation on hydraulic circuit**

- \( A \) - pressure line
- \( S \) - suction line
- \( R \) - hole for deaerating (plugged)
- \( Y \) - input line for external supply of regulator, not less than 3 MPa, socket M16x1,5-7H
- \( X \) - control pressure line, \( P_{y,max} = 3,5 \text{ MPa} \), M12x1,5-7H ГОСТ25065-90
- \( Z, Z_1 \) - screw for adjustment of regulation beginning pressure \( P_n \)
9.10 Pump with constant power regulator, positive control, restriction of upper level of response and cut off valve in servo line (313 ... 507.383)

Pump is intended for:
- regulation of consumed power \( N_p \) of pump in dependence of control pressure \( P_u \);
- restriction of max consumed power \( N_m \) of pump, by means of internal mechanical restrictor Z in pump regulator block;
- cut-off of pump feed at pressure \( P \) at pump output, exceeding the adjustment pressure of cut-off valve \( P_{otc} \).

Pump operation
At absence of control pressure \( P_u = 0 \) and presence of pressure in regulator \( P_r > 3 \) MPa, the pump is at min working displacement \( V_{min} \), providing min feed \( Q_{min} \) and consumed power \( N_{min} \).
After feed of control pressure \( P_u > 0,6 \ldots 0,8 \) MPa, while pressure \( P \) in hydraulic system does not exceed the pressure of regulation beginning \( P_n \), the pump is at max working displacement \( V_{max} \) and provides max feed \( Q_{max} \).

Regulation
At increase of working pressure \( P \), starting with pressure of regulation beginning \( P_n \), the working displacement \( V \) of pump smoothly automatically decreases, providing (supporting) the constant drive torque \( M_p \) and consumed power \( N_p \) by decreasing the working displacement \( V \) and feed \( Q \) till min value \( V_{min} \) \( (Q_{min}) \).
The pressure of regulation beginning \( P_n \), drive torque \( M_p \) and consumed power \( N_p \) are determined (set) with control pressure \( P_u \). Feed \( Q \) of pump depends on control pressure \( P_u \) and working pressure \( P \).
The constant consumed power \( N_p \) is provided by pump only within the regulation zone. Having achieved the min working displacement \( V_{min} \) at pressure \( P \approx P_{n} V_{max}/V_{min} \), the pump feeds min flow \( Q_{min} \), providing the adjusted consumed power \( N_{n} \).
At further pressure increase \( P > P_{n} \) the drive torque \( M_p \) and consumed power \( N_p \) will increase again.

Operation of cut-off valve
Cut-off valve operates at pressure \( P \) at pump output, exceeding the adjustment pressure of cut-off valve \( P_{otc} \), regulating till zero value the control pressure \( P_u \) in adjustment cap. The pump starts operating in the mode of min feed and power, releasing the feed and preventing the draining of working fluid through relief valve and external overheating.

Recommendations and external overheating:
- max feed \( Q_{max} \) of pump can be changed with regulation of screw for max working displacement \( V_{max} \) of pump;
- max supported consumed power \( N_{max} \), if necessary, can be changed with regulation of screw Z;
- adjustment of pressure cut-off valve \( P_{otc} \), if necessary, can be changed with regulation of screw Z0;

ATTENTION:
Cut-off valve is recommended to adjust 2 MPa lower than adjustment of relieve valve in hydraulic system.
For providing the operation of pump regulator at low pressure at pump output \( P < 3 \) MPa, it is necessary to use socket Y for input of external pressure (servo supply) \( P > 3 \) MPa.
The range of regulation beginning pressure \( P_n = 5 \ldots 25 \) MPa. The range of pressure regulation beginning of cut-off valve \( P_{otc} = 5 \ldots 40 \) MPa.
While ordering hydraulic pumps specify the values of power \( N_m \) and rotation speed \( n_{max} \) of drive engine or regulation beginning pressure \( P_n \), the adjustment pressure of cut-off valve \( P_{otc} \).
Dependence diagrams of consumed torque $M$, consumed power $N$, and feed $Q$ from pressure change $P$.

Hydraulic circuit

Designation on hydraulic circuit:
- A - pressure line
- S - suction line
- R - hole for deaeration (plugged)
- Y - input line for external supply of regulator, not less than 3 MPa, socket M16x1,5-7H
- X - control pressure line, $P_{\text{max}}=3,5$ MPa, M12x1,5-7H GOST 25065-90
- $Z_0$ - screw for pressure adjustment of cut-off valve $P_{\text{off}}$
- $Z, Z_1$ - screw for adjustment of regulation beginning pressure $P_{\text{r}}$. 

![Hydraulic circuit diagram](image-url)
9.11 Pump with constant power regulator, with hydraulic positive control and LS in servo line (313 … 507.39).

Pump with constant power regulator, with hydraulic positive control, with LS in servo line and valve «OR» for regulator connection to servo supply (313 … 507.393)

The pump is intended for:
- providing automatic support of consumed power \( N_p \) (consumed torque \( M_p \)), during pressure \( P \) change in hydraulic system by regulation of rotary group inclination angle;
- providing constant pressure difference on edge of LS control valve by regulation of feed \( Q \) at power not exceeding the adjustment of power regulator.

Pump operation
While LS control valve is closed, the pump is at min working displacement \( V_{min} \), providing min feed \( Q_{min} \), cient for supporting the pressure in hydraulic system \( P = 2 \) MPa.

Regulation
At opening of LS control valve LS the signal readjusts the pump for feed \( Q \), providing the adjusted difference \( \Delta P_{LS} = 1.5...2.5 \) MPa on edge of LS control valve.

Decrease of passage section of control valve leads decrease of feed \( Q \) and consumed power \( N_p \) of pump, while increase of control valve passage section leads increase of feed \( Q \) and consumed power \( N_p \), to the value of power regulator adjustment value. At full opening of LS control valve, the pump achieves max feed \( Q_{max} \).

Sharp tracking of LS signal is performed with pump at power not exceeding the adjustment of power regulator. As soon as the pressure of regulation beginning \( P_{n} \) exceeds at feed \( Q \), the power regulator starts operating which decreases the feed \( Q \) at further increase of pressure \( P \) in hydraulic system.

External regulation and restriction:
- max rotation speed of pump shall not exceed the max allowed;
- pump working displacement \( V_{min} \) and \( V_{max} \), if necessary, can be limited with regulating screw;
- max consumed power \( N_p \) of pump can be changed with regulation of screw \( Z \), supported difference \( \Delta P \) can be changed with regulation of screw \( r \).

ATTENTION:
The range of regulation beginning pressure \( P_{n} = 5...25 \) MPa. Max control pressure \( P_{y_{max}} = 3.5 \) MPa.

While ordering a hydraulic pump specify the values of power \( N_{p max} \) and rotation speed \( n_{p max} \) of drive engine or pressure of regulation beginning \( P_{n} \), \( V_{min}, V_{max} \),

Diagrams of dependence between consumed torque \( M_p \), consumed power \( N_p \) and feed \( Q \) from pressure change \( P \)
Hydraulic circuit of pumps

Designation on hydraulic circuit
A - pressure line
S - suction line
R - hole for deaeration (plugged)
Y - input line of external supply for regulator, not less than 3 MPa, socket М16х1,5-7Н
X - control pressure line, $P_{y \text{ max}}=3,5$ MPa, М12х1,5-7Н ГОСТ25065-90
r - screw for regulation of supported difference $\Delta P_{LS}$
$Z, Z_1$ - screw for adjustment of regulation beginning pressure $P_\ast$. 

Throttling "LS" control valve
9.12 Pump with positive discrete electric control (313…605.303, 313…606.303)

Pump is intended for change of hydraulic pump feed $Q$ at input and relieve of voltage $U_m$ on electromagnet.

Pump operation
In initial position when there is no voltage $U_m$ on electromagnet, the pump has min working displacement $V_{\text{min}}$, feed $Q_{\text{min}}$ and min consumed power $N_{\text{min}}$.

Regulation
During the feed of voltage $U_m$ on electromagnet the pump working displacement $V_g$ steplessly decreases leading the increase of feed $Q$ (consumed power $N$). Having achieved the max working displacement $V_{\text{max}}$, the pump will have max feed $Q_{\text{max}}$ and consumed power $N_{\text{max}}$.

External regulation and restriction:
Feed $Q$ (consumed power $N$), if necessary, can be restricted with one of the following ways:
- restriction of max or min working displacement $V_{\text{max}}$ or $V_{\text{min}}$ of pump;
- restriction of working pressure $P_{\text{max}}$ in hydraulic system.

**ATTENTION:**
While ordering hydraulic pumps specify the values of min and max working displacement $V_{\text{min}}, V_{\text{max}}$.

Hydraulic circuit of pumps with positive discrete electric control

Electric circuit of connection

Designation on hydraulic circuit
A - pressure line
S - suction line
R - hole for deaeration (plugged)
Y - input line for external supply of regulator, not less than 3 MPa, socket M16x1.5-7H
$U_m$ - supply voltage for electromagnet, socket as per DIN 43650A or male connector 2PMГ14Б4Ш1Е2 ГЕО.364.14ОТУ
9.13 Pump with direct shift (manual regulation) of working displacement (313…803.3, 804.3)

Pump is intended for feed regulation with direct shift of working displacement with external force.

Dependence diagram of feed Q and pressure difference P

Hydraulic circuit of pump with direct shift (manual regulation) of working displacement

313…803.3(4) 313…804.3(4)

Designation on hydraulic circuit
A - pressure line
S - suction line
R - hole for deaeration (plugged)
9.14 Pumps with direct control (313… 8…A(B,C).3)

Pumps are intended for change of working displacement with feed and regulation of pressure at connections X and X1.

Hydraulic circuits of pumps with pistons for regulation
9.15 Pump with constant pressure regulator with remote hydraulic pilot (313…80В.300П + 313.084.7020)

The pump is intended for providing the constant pressure in hydraulic system by regulation of feed $Q$.

**Pump operation**
While pressure in hydraulic system does not exceed the pressure of regulation beginning $P_n$, the pump is at max working displacement $V_{max}$ and provides max feed $Q_{max}$.

**Regulation**
At increase of working pressure $P$, starting with the pressure of regulation beginning $P_n$ (point 1 on the Fig.), the working displacement $V$ starts to decrease smoothly and automatically. Having achieved the min working displacement $V_{min}$ at final pressure $P_k \approx P_n + 1$ (MPa), the pump feeds min flow necessary for leakage compensation $Q_{ut}$, providing the min consumed power $N_{min}$ (point 2).

**External regulation and restriction:**
- max $Q_{max}$ and min pump feed $Q_{min}$ can be changed with regulation of screws for restriction of pump working displacement;
- supported pressure $P_p$ is changed with regulation of screw $Z$;
- constant pressure in hydraulic system is provided by pump only within the regulation zone, that is why it is NOT RECOMMENDED to restrict the min working displacement $V_{min}$ of pump;

**ATTENTION:**
The range of regulation beginning pressure $P_n=5…35$ MPa.
While ordering hydraulic pumps specify the values of regulation beginning pressure $P_n$ of min and max working displacement $V_{min}, V_{max}$.

Dependence diagrams of torque $M_n$, consumed power $N_n$ and feed $Q$ from pressure difference $P$.

Hydraulic circuit of pumps

Designation on hydraulic circuit
- $A$ - pressure line
- $S$ - suction line
- $L$ - regulator drain line (connect with hydraulic tank), M12x1,5 GOST 25065-90
- $R$ - hole for deaeration (plugged)
- $P$ - working pressure line
- $X$ - line for interchangeable control pressure
- $Z$ - screw for regulation of supported pressure $P_p$
Connection circuit of pumps with constant pressure regulator and remote hydraulic pilot

Min level of oil in tank

Hydraulic pilot

Plug M6

M12x1.5 GOST 25065

M22x1.5 GOST 25065

M18x1.5 GOST 25065
10 Overall-mounting dimensions

10.1 Size range 12 cc

Shaft versions

Splined as per GOST 6033-80 20x7x1.5x9g
Option G: 3, 4

Keyed. Keyed as per DIN 6885 6x6x32 (corresponds to GOST 23360-78)
Option G: 5, 6

Location of working channels
1 flange on buttend, 1 flange sideways
Option K: 0

Connections:
A - pressure line
S - suction line
R - hole for deaeration,
   M12x1,5 GOST 25065-90 (plugged)
Z - adjusting screw P,
L - drain line of regulator (connect with hydraulic tank),
   M12x1,5 GOST 25065-90
10.2 Size range 28 cc

Shaft versions
Splined as per GOST 6033-80 25xf7x1.5x9g
Option G: 3, 4

Location of working channels
1 flange on buttend, 1 flange sideways

Connections:
A - pressure line
S - suction line
X - control pressure (one hole plugged) - M12x1,5 GOST 25065-90
Z1, Z2 and Z3 - adjusting screws Pwm, Ph и Pinst, plugged in for delivery,
if it is necessary to change Pwm and Ph, make a request.
R - hole for deaeration (plugged), M18x1,5 GOST 25065-90
L - regulator drain line (connect with hydraulic tank), M12x1,5 GOST 25065-90
U - supply voltage of electromagnet, socket as per DIN 43650A or male plug
2PM Г164Ш11Е2 ТЕО.364.140ТУХ1 - LS signal line, M12x1,5 GOST 25065-90
(for hydraulic pumps with LS regulation)
Y - input line for external supply of regulator, not less than 3 MPa, socket M16x1,5-7H

Keyed. Key as per DIN 6885 8x7x40
(corresponds to GOST 23360-78)
Option G: 5, 6

Splined as per GOST 6033-80 25xf7x1.5x9g
Option G: 3, 4
Size range 55 cc

313.3.55.500.3

Shaft versions

Splined as per GOST 6033-80 35x7x2x9g
Option G: 3, 4

Location of working channels
1 flange on buttend, 1 flange sideways

Keyed. Key as per DIN 6885 8x7x50 (corresponds to GOST 23360-78)
Option G: 5, 6

Splined as per DIN 5480 (GOST 23360-78)
W 30x2x30x14x9g
Option G: 7, 8

Connections:
A - pressure line
S - suction line
X - control pressure (one hole plugged), M12x1,5 GOST 25065-90
Z₀, Z₁ and Z₂ - adjusting screws Pᵣₑᵣ, Pₑₑ and Pₑₑₑ are plugged in for delivery, make a request if it is required to change Pᵣₑₑ and Pₑₑₑ
R - hole for deaeration (plugged), M18x1,5 GOST 25065-90
L - regulator drain line (connect with hydraulic tank), M12x1,5 GOST 25065-90
Uₑₑ - supply voltage for electromagnet, socket as per DIN 43650A or male plug 2PMF164WJ12 F0.364.140TY
Xₑₑ - line for LS signal - M12x1,5 GOST 25065-90 (for hydraulic pumps with LS regulation)
Y - input line for external supply of regulator, not less than 3 MPa, socket M16x1,5-7H
10.4 Size range 56 cc

Shaft versions

Splined as per GOST 6033-80
35x7x2x9g

Keyed. Key as per DIN 6885 8x7x50
(corresponds to GOST 23360-78)
Option G: 5, 6

Splined: as per DIN 5480 (GOST 23360-78)
W30x2x30x14x9g
Option G: 7, 8

Location of working channels
1 flange on buttend, 1 flange sideways

Connections:
A - pressure line
S - suction line
X - control pressure (one hole plugged), M12x1,5 GOST 25065-90
Z₁, Z and Z₂ - adjusting screws of Pₚₜ, Pᵣ and Pᵣ₃, are plugged for delivery,
make a request to change Pₚₜ and Pᵣ
R - hole for deaeration (plugged), M18x1,5 GOST 25065-90
L - regulator drain lines (connect with hydraulic tank), M12x1,5 GOST 25065-90
Uᵣ - voltage supply of electromagnet, socket as per DIN 43650A or male plug
2PMГ146ИШ1Е2 ГЕО.364.14ОТУ
X₁ - LS signal line - M12x1,5 GOST 25065-90 (for hydraulic pumps with LS regulation)
Y - input line for external supply of regulator, not less than 3 MPa,
socket M16x1,5-7H

Option G: 5, 6
Splined: as per GOST 6033-80
35x7x2x9g

Option G: 7, 8
Splined: as per GOST 5480 (GOST 23360-78)
W30x2x30x14x9g

Right rotation

Left rotation
10.5 Size range 80 cc

Shaft versions

- Splined as per GOST 6033-80 40xh8x2x9g
  Option G: 3, 4

- Keyed. Key as per DIN 6885 10x8x56 (corresponds to GOST 23360-78)
  Option G: 5, 6

- Splined as per DIN 5480 (GOST 23360-78)
  W35x2x30x16x9g
  Option G: 7, 8

Location of working channels
1 flange on buttend, 1 flange sideways

Connections:
- A - pressure line
- S - suction line
- X - control pressure (one hole plugged), M12x1,5 GOST 25065-90
- Zn, Z and Z1 - adjusting screws of Pw, Ph and Pw, are plugged for delivery, make a request to change Pw and Ph
- R - hole for deaeration (plugged), M18x1,5 GOST 25065-90
- L - regulator drain lines (connect with hydraulic tank), M12x1,5 GOST 25065-90
- Um - voltage supply of electromagnet, socket as per DIN 43650A or male plug 2PMГ14Б4Ш1Е2 ГЕО.364.14ОТУ
- X1 - LS signal line - M12x1,5 GOST 25065-90 (for hydraulic pumps with LS regulation)
- Y - input line for external supply of regulator, not less than 3 MPa, socket M16x1,5-7H
10.6 Size range 107 cc

Shaft versions
Splined as per GOST 6033-80 45xh8x2x9g
Option G: 3,4

Keyed. Key as per DIN 6885 12x8x63
(corresponds to GOST 23360-78)
Option G: 5, 6

Splined: as per DIN 5480 (GOST 23360-78)
W40x2x30x18x9g
Option G: 7, 8

Connections:
A - pressure line
S - suction line
X - control pressure (one hole plugged), M12x1,5 GOST 25065-90
Zn, Z and Z1 - adjusting screws of Pw, Ph and Pw, are plugged for delivery,
make a request to change Pw and Pw.
R - hole for deaeration (plugged), M18x1,5 GOST 25065-90
L - regulator drain lines (connect with hydraulic tank), M12x1,5 GOST 25065-90
Um - voltage supply of electromagnet, socket as per DIN 43660A or male plug
2PMGI464W1E2 E0.364.14OTY
X1 - LS signal line - M12x1,5 GOST 25065-90 (for hydraulic pumps with LS regulation)
Y - input line for external supply of regulator, not less than 3 MPa,
socket M16x1,5-7H

Location of working channels
1 flange on buttend, 1 flange sideways
Option K: 0
10.7 Size range 112 cc

Shaft versions

Splined as per GOST 6033-80 45х8х2х9g
Option G: 3, 4

Keyed. Key as per DIN 6885 12х8х63 (corresponds to GOST 23360-78)
Option G: 5, 6

Splined: as per DIN 5480 (GOST 23360-78) W40х2х30х18x9g
Option G: 7, 8

Location of working channels
1 flange on buttend, 1 flange sideways
Option K: 0

Connections:
A - pressure line
S - suction line
X - control pressure (one hole plugged), M12x1.5 GOST 25065-90
Z, Z and Z: adjusting screws of Pw, Pн and Pнu are plugged for delivery, make a request to change Pw and Pн.
R - hole for deaeration (plugged), M18x1.5 GOST 25065-90
L - regulator drain lines (connect with hydraulic tank), M12x1.5 GOST 25065-90
U - voltage supply of electromagnet, socket as per DIN 43650A or male plug 2PM1464W1E2 ГЕО.364.14OTV
X - LS signal line - M12x1.5 GOST 25065-90 (for hydraulic pumps with LS regulation)
Y - input line for external supply of regulator, not less than 3 MPa, socket M16x1.5-7H
10.8 Size range 160 cc

Shaft versions

Splined as per GOST 6033-80 45xh8x2x9g
Option G: 3, 4

Keyed. Key as per DIN 6885 12x8x63 (corresponds to GOST 23360-78)
Option G: 5, 6

Splined: as per DIN 5480 (GOST 23360-78) W40x2x30x18x9g
Option G: 7, 8

Location of working channels
1 flange on buttend, 1 flange sideways

Connections:
A - pressure line
S - suction line
X - control pressure (one hole plugged), M12x1,5 GOST 25065-90
Zn, Z and Z: - adjusting screws of Pн, Pн and Pнт. are plugged for delivery,
makes a request to change Pн and Pн
R - hole for deaeration (plugged), M18x1,5 GOST 25065-90
L - regulator drain lines (connect with hydraulic tank), M12x1,5 GOST 25065-90
Uн - voltage supply of electromagnet, socket as per DIN 43650A or male plug
2PMТ14В4Ш12ГЕО.364.14ОТУ
X - LS signal line - M12x1,5 GOST 25065-90 (for hydraulic pumps with LS regulation)
Y - input line for external supply of regulator, not less than 3 MPa,
socket M16x1,5-7H
10.9 Size range 250 cc

Shaft versions

Splined as per GOST 6033-80 45xh8x2x9g
Option G: 3,4

Keyed. Key as per DIN 6885 12x8x63 (corresponds to GOST 23360-78)
Option G: 5, 6

Splined: as per DIN 5480 (GOST 23360-78)
W40x2x30x18x9g
Option G: 7, 8

Location of working channels
1 flange on buttend, 1 flange sideways
Option K: 0

Connections:
A - pressure line
S - suction line
X - control pressure (one hole plugged), M12x1,5 GOST 25065-90
Zr, Z and Z - adjusting screws of Pω, Pη and Pω, are plugged for delivery, make a request to change Pω and Pη
R - hole for deaeration (plugged), M18x1,5 GOST 25065-90
L - regulator drain lines (connect with hydraulic tank), M12x1,5 GOST 25065-90
Uω - voltage supply of electromagnet, socket as per DIN 43650A or male plug 2PMГ 1464 И1Е2 ГО.364.14OTU
Xr - LS signal line - M12x1,5 GOST 25065-90 (for hydraulic pumps with LS regulation)
Y - input line for external supply of regulator, not less than 3 MPa,
11. Recommendations for installation

For proper operation of hydraulic pumps 313 series it is necessary to observe the requirements of the present Section.

Connection of hydraulic pump shaft with shaft of driven device shall be performed through flexible coupling. The coupling (gear or pulley) shall be set only with the help of bolt or threaded hole in drive shaft. It is prohibited to screw the coupling with impacts. After axial tightening and bolt locking observe the dimensions given on the Fig.

Usage of other types device conveying the torque is allowed after negotiations with the manufacturer.

During the mounting of hydraulic pump observe the following requirements:
– shifting of axes connecting the shafts – 0,1 mm, not more;
– non flatness of mounting surfaces – 0,03 mm, not more;
– roughness of mounting surface – \(Ra \leq 2,5 \mu m\);
– observe ultimate axial and radial loads on shaft (see Section 8), the choice of optimal angle for installation of gear drive according to Section 8.

At open mounting of shaft the additional protection of gasket sealing is required against any contamination.

The pump can be mounted in any position but shall be lower than the lowest level of oil in the tank according to versions given on the Fig.

PROHIBITED to connect the drain pipe during the pump operation in open circuit hydraulic systems.

Allowed to mount hydraulic pump directly to the tank with working fluid. At such installation it is necessary to specify the required version of hydraulic pump with index «П» (submersible) at the end of designation. Hydraulic pump must be installed according to the Fig. During the mounting deaerate through hole \(R(M6)\), after that install the plug on its place. If max level of oil in the tank is on the same level with min level of oil in the tank, it is allowed not to install plug M6 in order to prevent the air lock.

Before the launch check reliability of pump mount on the main unit, tighten the mounting bolts.
Notes
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