



**Jinan Highland Hydraulic Pump Co.,Ltd.**

**Series 20 Axial Piston Pumps/Motors**

**Technical Document**



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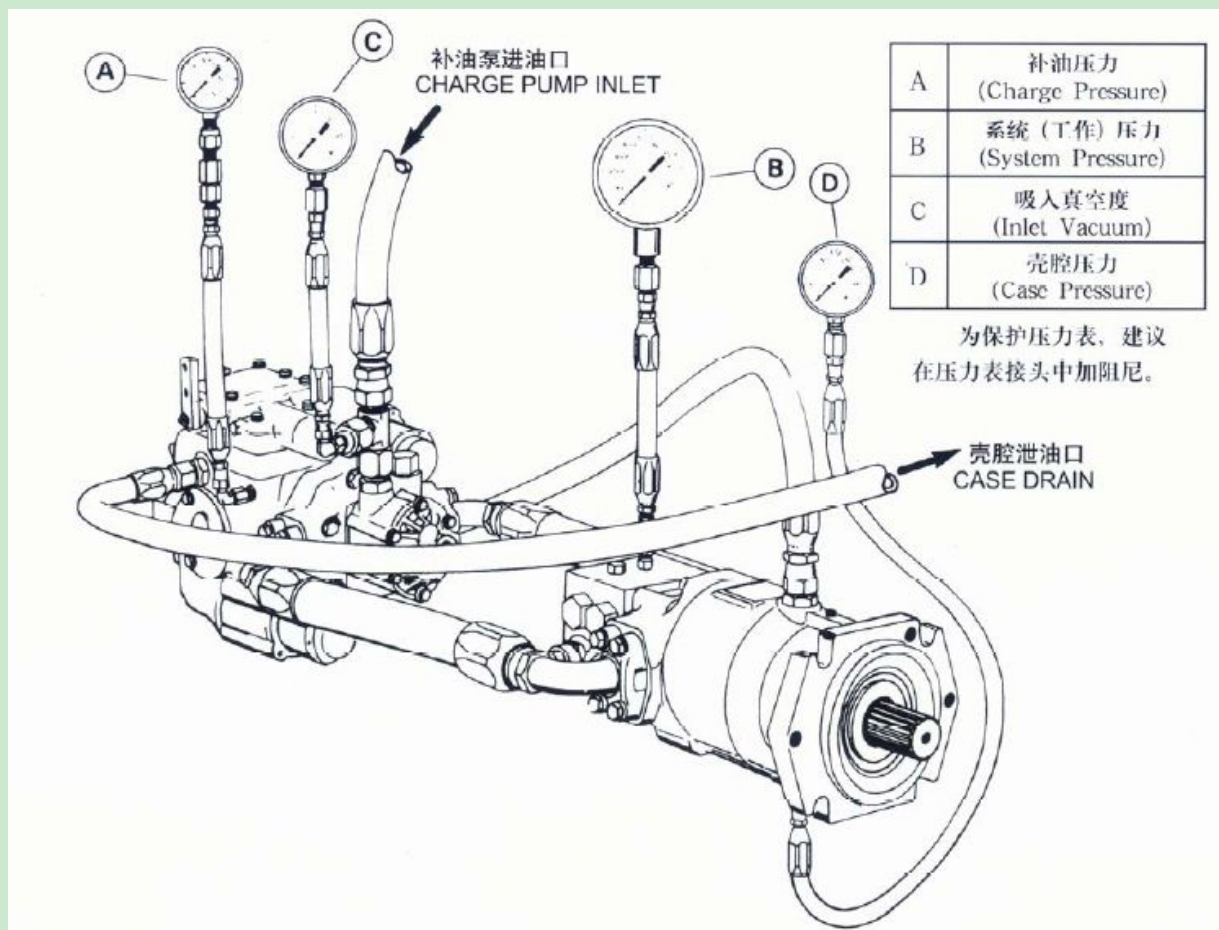
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# 敬告用户

It is the cleanliness of oil used that is the key of extending the useful life of the static hydraulic transmission.



## **Pump - Motor Static Hydraulic transmission diagram**

### **Series 21-23 static hydraulic transmission**

#### I. Introduction

By introducing Heavy Series21-23 static hydraulic transmission from SAUER-SUNDSTRAND of America, we can provide axial hydraulic pump and hydraulic motor assembly and hydraulic system with high quality, high-performance parameters. Pump is the variable one that is with Charge Pump, and the motor the quantitative, or variable one with valve assembly. The control way of variable displacement pump and motor can be manual or hydraulic operated, and can simply control speed, direction and power of the output shaft of hydraulic motor. It is widely used in agricultural machinery, engineering machinery, mining machinery, aviation and transport hydraulic engineering machinery and other equipment.

Our products are with careful processing, reliable quality, and prompt delivery. In the selection and use of the static hydraulic gearing, we will provide you good service.

#### II. Technical parameters

The continuous working pressure under the maximum speed 21-23 heavy-duty hydraulic pump and the sealed static hydraulic gear system made up of hydraulic motor series is 21MPa. The system's maximum operating pressure is 35Mpa and the system's minimum pressure is 0.9 Mpa higher than the shell whose maximum pressure is 0.28 Mpa.

Charging Pump's pressure is 1.31-1.45 Mpa higher than the shell, fill the motor oil pressure relief valve set point higher than the shell 1.10-1.24 Mpa, and the maximum oil temperature is 80 °C.

Table one-serial no. and performance data

Serial no.	Maximum discharge (ml/r)	Torque of every 10mpa (N.m)	Outputpower(whe n10Mpa,1500r/mi (kw)	ChargePumpdi scharge(ml/r)	Maximum rotational speed (r/min)
21	51.6	84.1	12.7	12.3 18.0	3000
22	69.8	114.2	17.2		
23	89.0	144.3	21.9		2800

Table two---component weight list

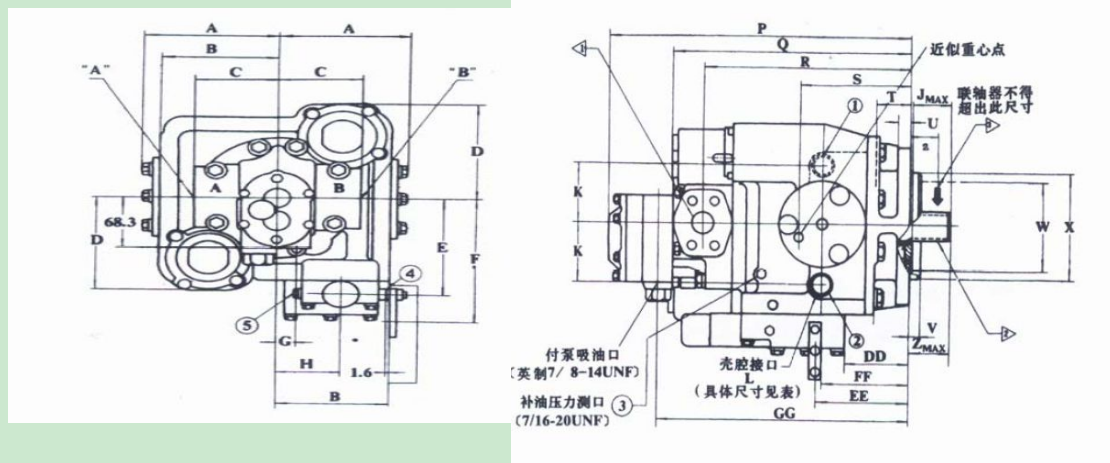
(kg)

Serial No. \ Type	Variable displacement pump	Variable displacement pump	Quantitative motor
21	53.52	58.51	34.47
22	61.24	66.23	39.92
23	78.47	83.46	47.17

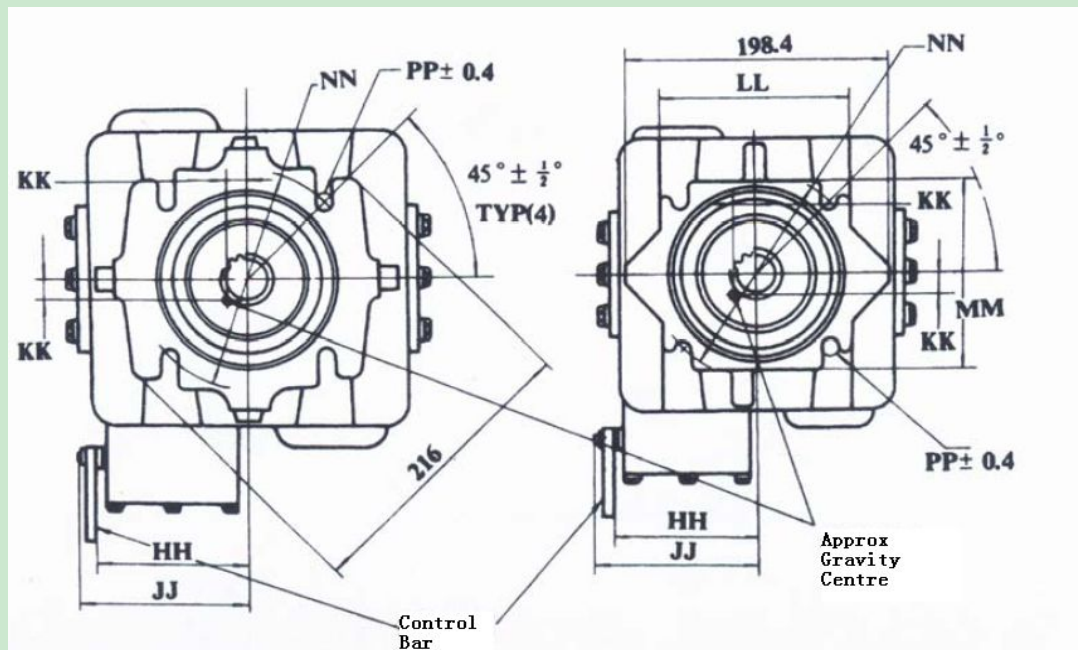
### III. Hydraulic pump and motor connection dimension

Note the dimension in this chapter is based on metric system. The dimension in “ ( ) ” is based on inch as reference for customer.

#### 1. Variable Displacement Pump



### PV21-23 Series



### 21-23 Series

### 21 Series

● Unit: mm Variable displacement pump outside dimension

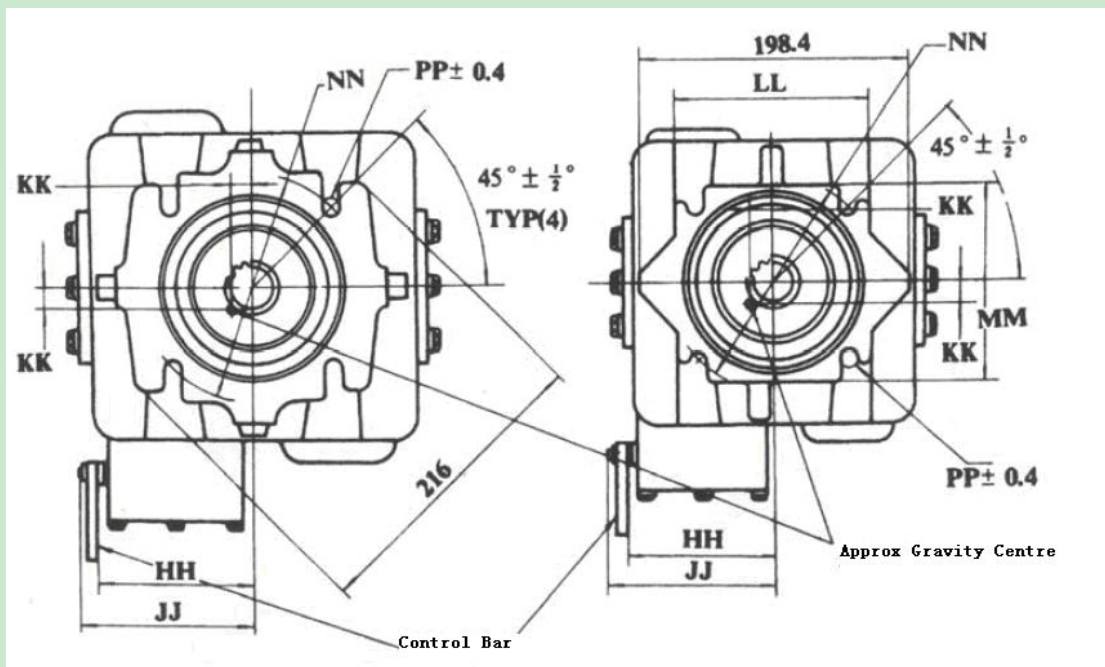
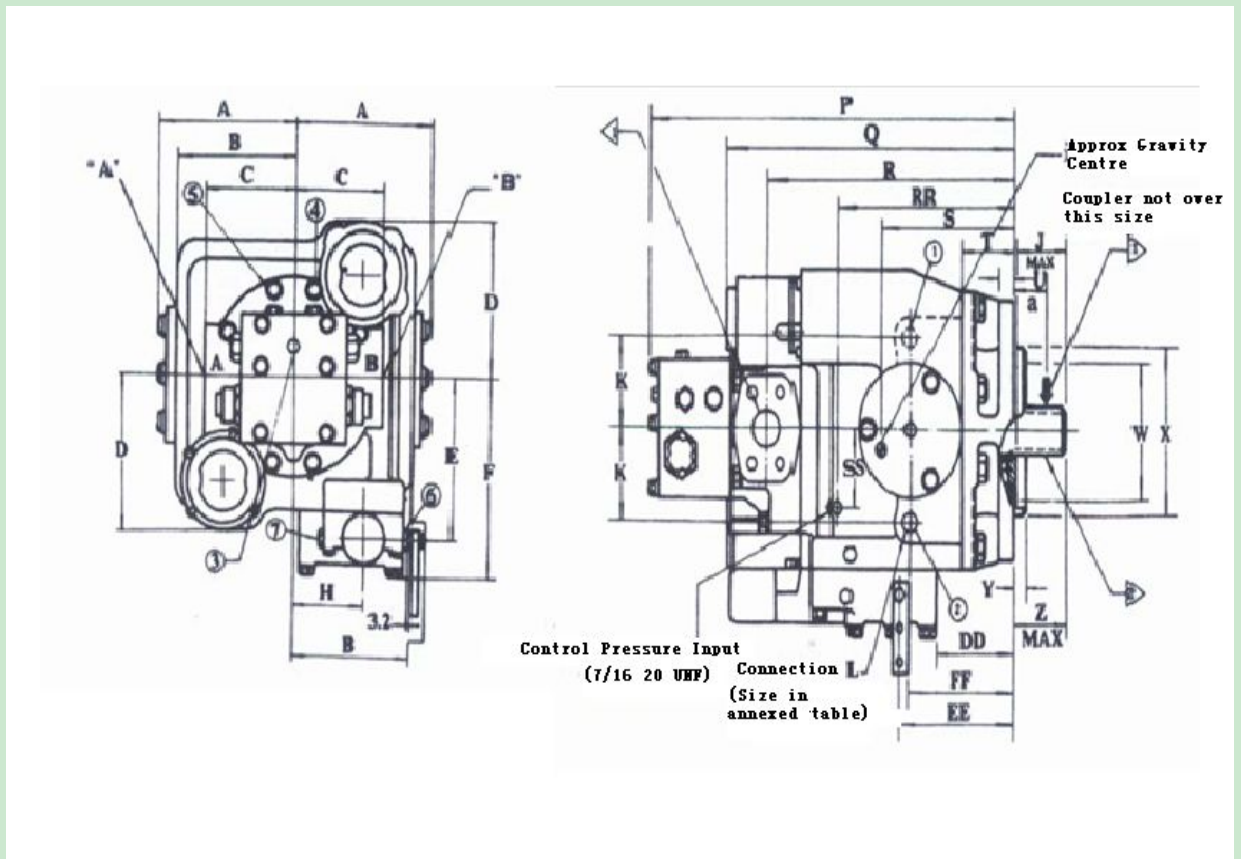
Grade	outside dimension		
	Series 21	Series 22	Series 23
A	127	133	151
B	111	114	130
C	87	87	97
D	121	127	138
E	129	129	140
F	165	165	176
G	19	19	19
H	65	68	78
J	48	48	48
K	68	71	78
P	365	378	391
Q	273	303	311
R	244	259	270
S	152	146	<u>140</u>
T	48	48	<u>49</u>
U	16	16	<u>17</u>
W	108	108	<u>108</u>
X	127 <sub>-0.05</sub> <sup>0</sup>	127 <sub>-0.05</sub> <sup>0</sup>	127 <sub>-0.05</sub> <sup>0</sup>
Y	12.5±0.2	12.5±0.2	12.5±0.2
Z	56	56	<u>56</u>
DD	65	78	<u>84</u>
EE	105	119	127
FF	106	111	117
GG	300	314	327
HH	110	113	124
JJ	133	135	146
KK	6	10	13
LL	154	-	-
MM	154	-	-
NN	162	162	162
PP	15±0.4	15±0.4	15±0.4
QQ	26°	26°	30°
RR	51.6	69.8	<u>89</u>
SS	6270	8480	5880
TT	3500	3200	2900
WW	12.3	12.3	12.3
XX	48.8	45.7	46.2
YY	53620	74955	99400

(F) (a+xx)=yy (kg.mm)

The maximum load at any radial direction on the shaft



## 2. Variable motor dimension



21-23 Series

● **Varies motor outside dimension**

**TT(ml/rev)--maximum displacement (18°)      UU((ml/rev)--minimum displacement (7°)**

**VV (h)--在 21MPa,WWr/min Useful life of B10 without radial load at 21mpa**

**WW(r/min)-- Maximum rotation speed without load**

**“A” is for high pressure oil to inlet to make motor rotate clockwise.**

**“B” is for high pressure oil to inlet to make motor rotate counterclockwise**

Grade	Outside dimension		
	Series “21”	Series “22”	Series “23”
<b>A</b>	<b>127</b>	<b>134</b>	<b>151</b>
<b>B</b>	<b>111</b>	<b>114</b>	<b>130</b>
<b>C</b>	<b>87</b>	<b>87</b>	<b>87</b>
<b>D</b>	<b>121</b>	<b>127</b>	<b>138</b>
<b>E</b>	<b>129</b>	<b>129</b>	<b>140</b>
<b>F</b>	<b>165</b>	<b>165</b>	<b>176</b>
<b>H</b>	<b>65</b>	<b>68</b>	<b>78</b>
<b>J</b>	<b>48</b>	<b>48</b>	<b>48</b>
<b>K</b>	<b>68</b>	<b>71</b>	<b>78</b>
<b>P</b>	<b>373</b>	<b>386</b>	<b>400</b>
<b>Q</b>	<b>278</b>	<b>303</b>	<b>311</b>
<b>R</b>	<b>244</b>	<b>259</b>	<b>270</b>
<b>S</b>	<b>152</b>	<b>146</b>	<b>140</b>
<b>T</b>	<b>48</b>	<b>48</b>	<b>49</b>
<b>U</b>	<b>16</b>	<b>16</b>	<b>17</b>
<b>W</b>	<b>108</b>	<b>108</b>	<b>108</b>
<b>X</b>	<b>127-0.05<sup>0</sup></b>	<b>127-0.05<sup>0</sup></b>	<b>127-0.05<sup>0</sup></b>
<b>Y</b>	<b>12.5±0.2</b>	<b>12.5±0.2</b>	<b>12.5±0.2</b>
<b>Z</b>	<b>56</b>	<b>56</b>	<b>56</b>
<b>DD</b>	<b>65</b>	<b>78</b>	<b>84</b>
<b>EE</b>	<b>105</b>	<b>119</b>	<b>127</b>
<b>FF</b>	<b>106</b>	<b>111</b>	<b>117</b>
<b>HH</b>	<b>110</b>	<b>113</b>	<b>124</b>
<b>JJ</b>	<b>133</b>	<b>135</b>	<b>146</b>
<b>KK</b>	<b>6</b>	<b>10</b>	<b>13</b>
<b>LL</b>	<b>154</b>	<b>-</b>	<b>-</b>
<b>MM</b>	<b>154</b>	<b>-</b>	<b>-</b>
<b>NN</b>	<b>162</b>	<b>162</b>	<b>162</b>
<b>PP</b>	<b>15</b>	<b>15</b>	<b>15</b>
<b>QQ</b>	<b>14°</b>	<b>14°</b>	<b>17°</b>
<b>RR</b>	<b>175</b>	<b>187</b>	<b>270</b>
<b>SS</b>	<b>54</b>	<b>60</b>	<b>65</b>
<b>TT</b>	<b>51.6</b>	<b>69.8</b>	<b>89.0</b>
<b>UU</b>	<b>19.5</b>	<b>26.4</b>	<b>33.6</b>
<b>VV</b>	<b>6270</b>	<b>8480</b>	<b>5880</b>
<b>WW</b>	<b>3500</b>	<b>3200</b>	<b>2900</b>
<b>XX</b>	<b>48.8</b>	<b>45.7</b>	<b>46.2</b>
<b>YY</b>	<b>53620</b>	<b>74955</b>	<b>99400</b>



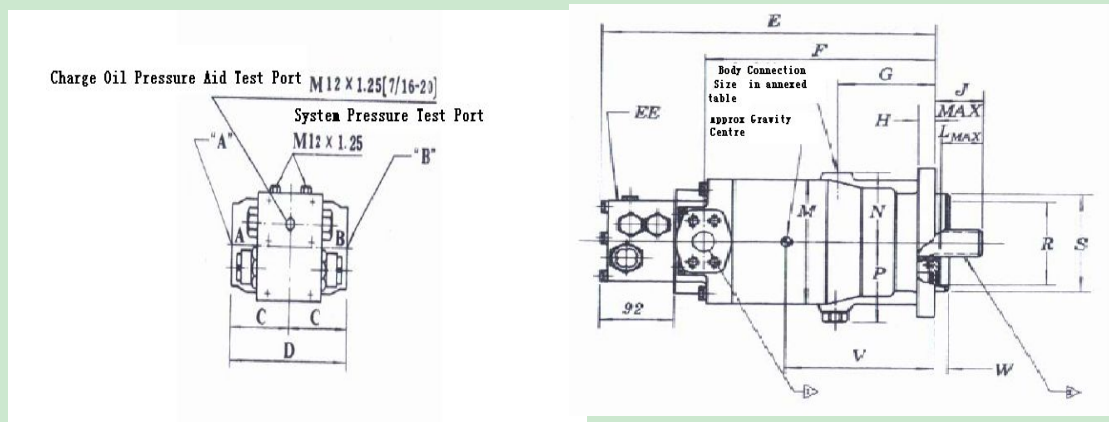
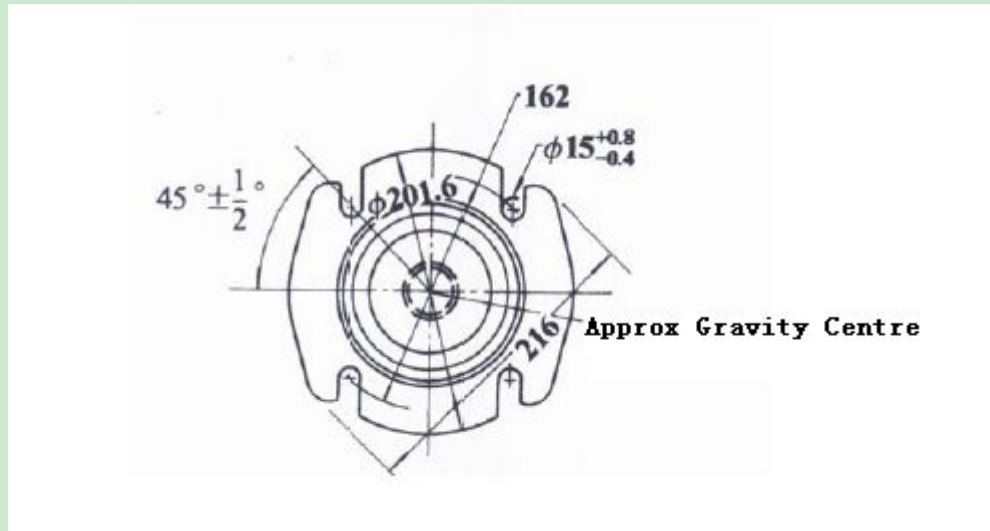
## 2、 Fixed-displacement motor outside dimension

BB ( $\Delta\text{Mpa}$ ) ----High-pressure relief valve setting value (standard)

CC (ml/rev)---- Displacement ( $18^\circ$ )

DD ( $\Delta\text{Mpa}$ ) ---- Oil-supply relief valve setting value

EE (l/min)-----Integrated valve flow

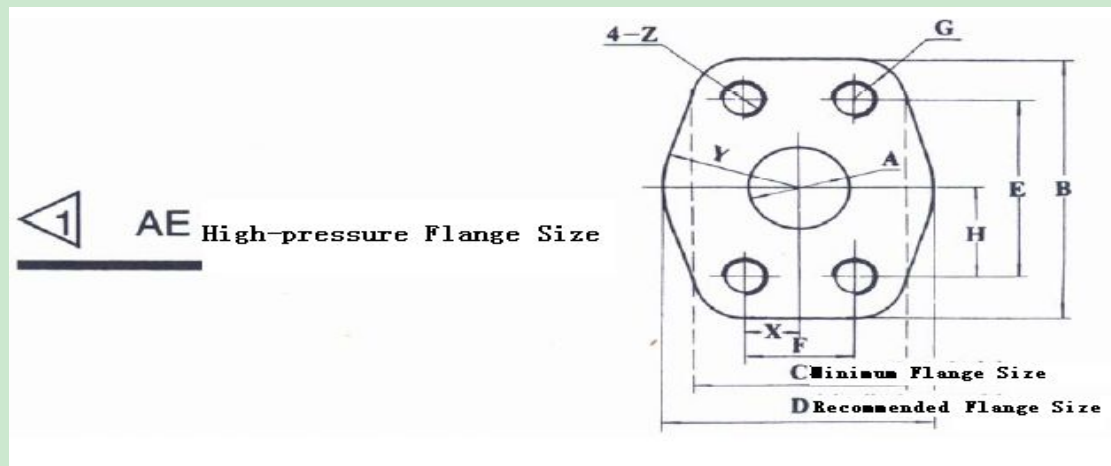


Put into high pressure through mouth "B" oil to make the motor rotate clockwise.

Put into high pressure through mouth "A" oil to make the motor rotate counterclockwise.

## ● Fixed-displacement motor outside dimension

标号 Grade	外形尺寸 Outside dimension		
	21 系列	22 系列	23 系列
C	87	87	97
D	175	175	194
E	364	383	400
F	235	256	270
G	97	108	117
H	16	16	17
J	56	56	56
L	48	48	48
M	162	170	189
N	84	95	103
P	94	105	113
R	108	108	108
S	127 <sup>-0.05</sup> <sub>0</sub>	127 <sup>-0.05</sup> <sub>0</sub>	127 <sup>-0.05</sup> <sub>0</sub>
V	160	165	170
W	12.5±0.2	12.5±0.2	12.5±0.2
BB	34.5	34.5	34.5
CC	51.6	69.8	89.0
DD	11.7±0.7	11.7±0.7	11.7±0.7
EE	40	40	40
FF			



Unit: mm

Nominal size	A	B	C(mi n)	D	E	F	G	H	X	Y	Z	
											Nominal size	inch size
Series 1-6000psi (21-23)	∅ 25.4	81	54	70	57.15 ±0.25	27.76±0.25	R1 2	2 8	1 4	R3 5	M12 depth 27	7/16- 14 depth27
Series 1-3000psi (21-23)	∅ 25.4	81	54	70	52.37 ±0.25	26.19±0.25	R1 2	2 6	1 3	R3 5		3/8-16 depth 22

- Connection dimension of case inside of variable displacement pump and motor and fixed-displacement motor  
( The highest position is as the connection of oil-return tank)



**Shaft Spline size**

Series no.		21	22	23
美 制 花 键 US- spline	Outside diameter	1.3585"	1.3585"	1.4835"
	Pitch diameter	1.3125"	1.3125"	1.4375"
	Tooth	21	21	23
	径节 Diametral pitch	16/32	16/32	16/32

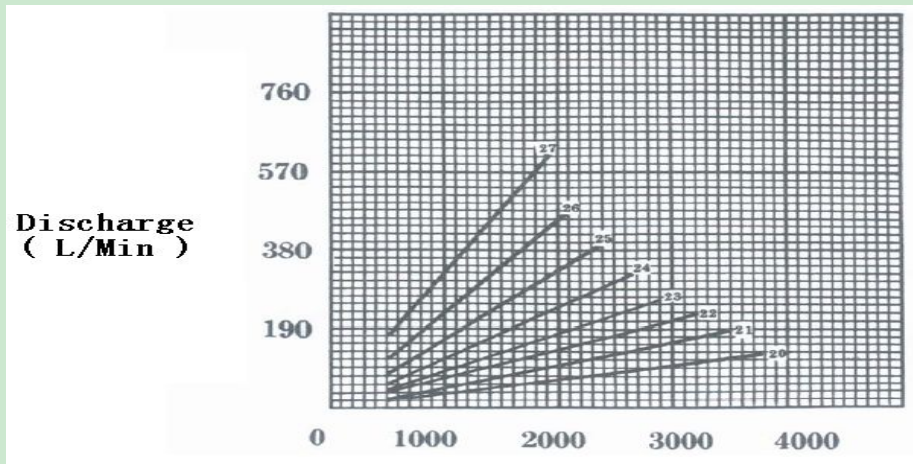
※ If no requirement, the delivery shall be US spline.

The highest position is as the connector for oil return tank.

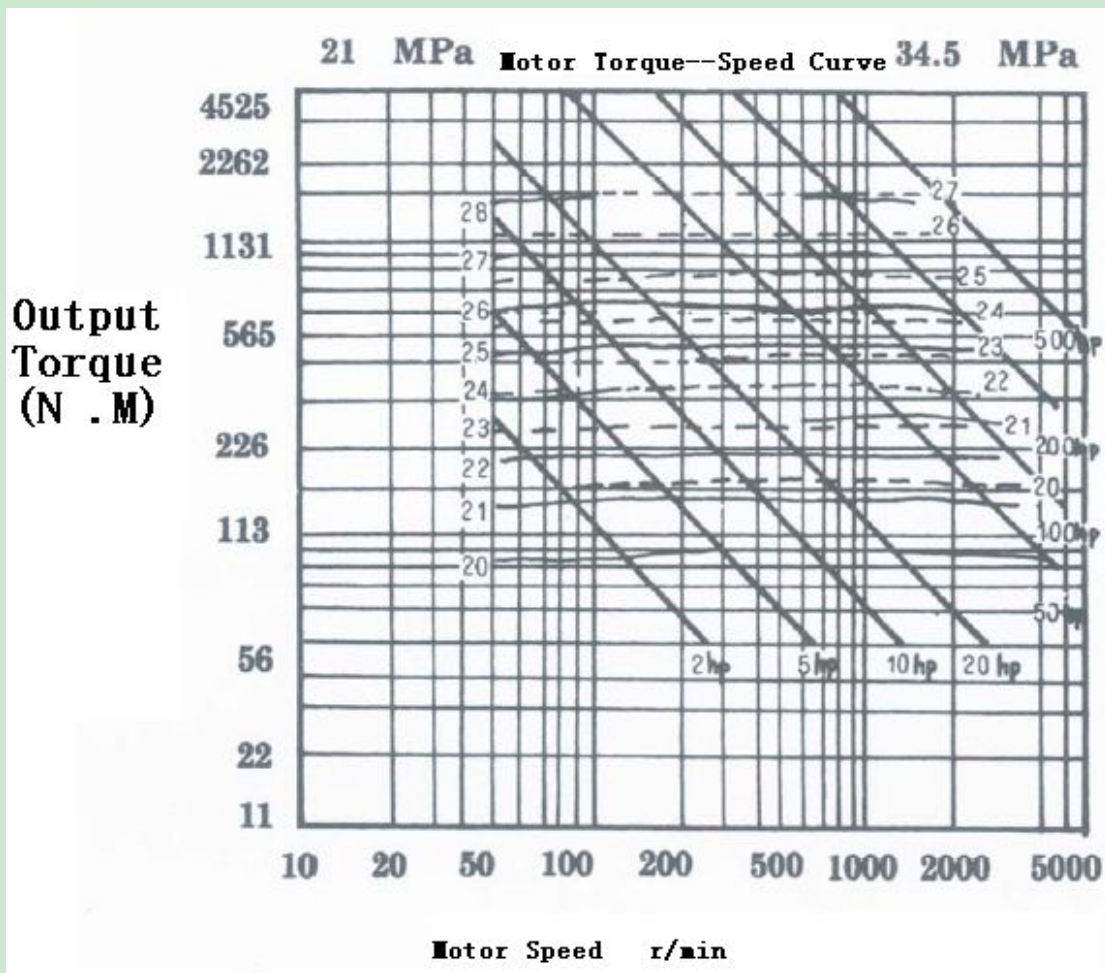
Series no.	21	22	23
Dimension			
Made in America	7/8-14UNF	7/8-14UNF	7/8-14UNF

※ If no special requirement, the delivery shall be US screw thread

#### IV. Feature curve

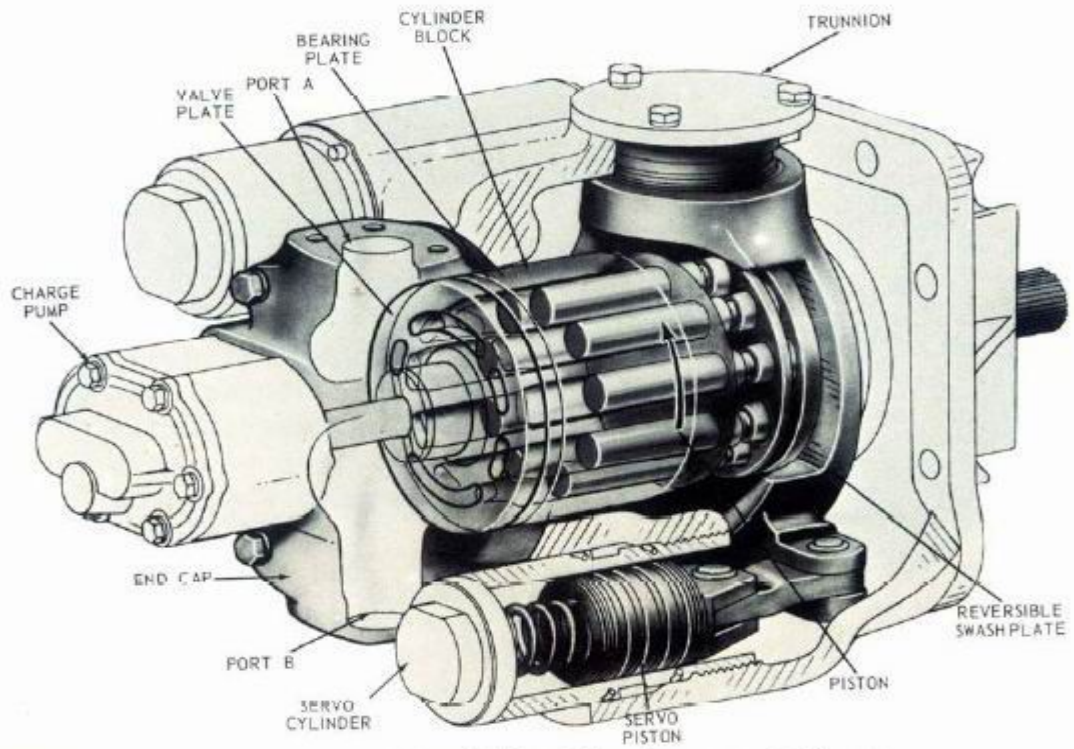


Rotational Speed                      r/min

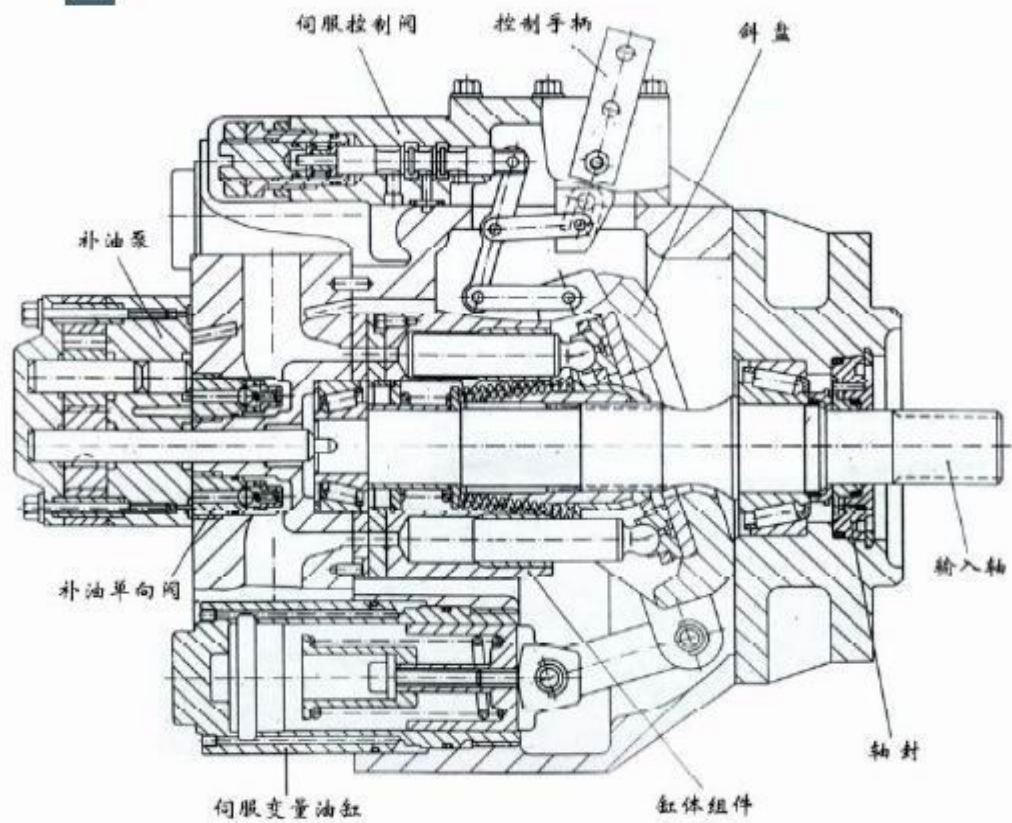


Motor Speed                      r/min



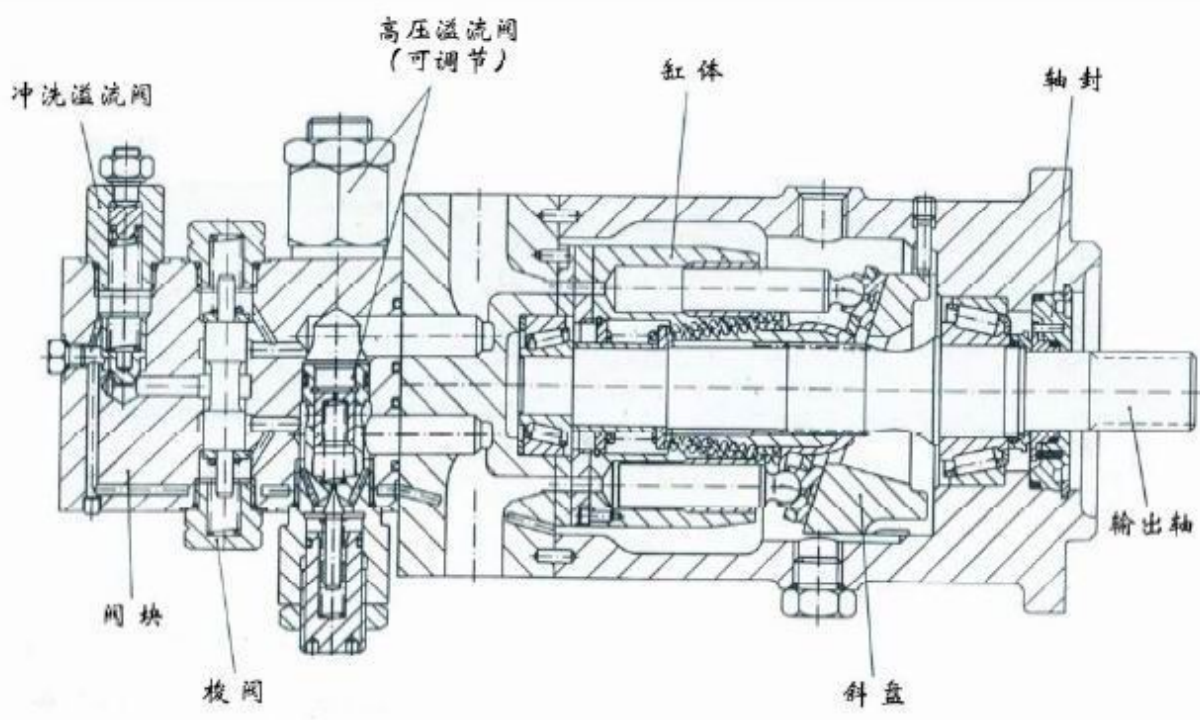
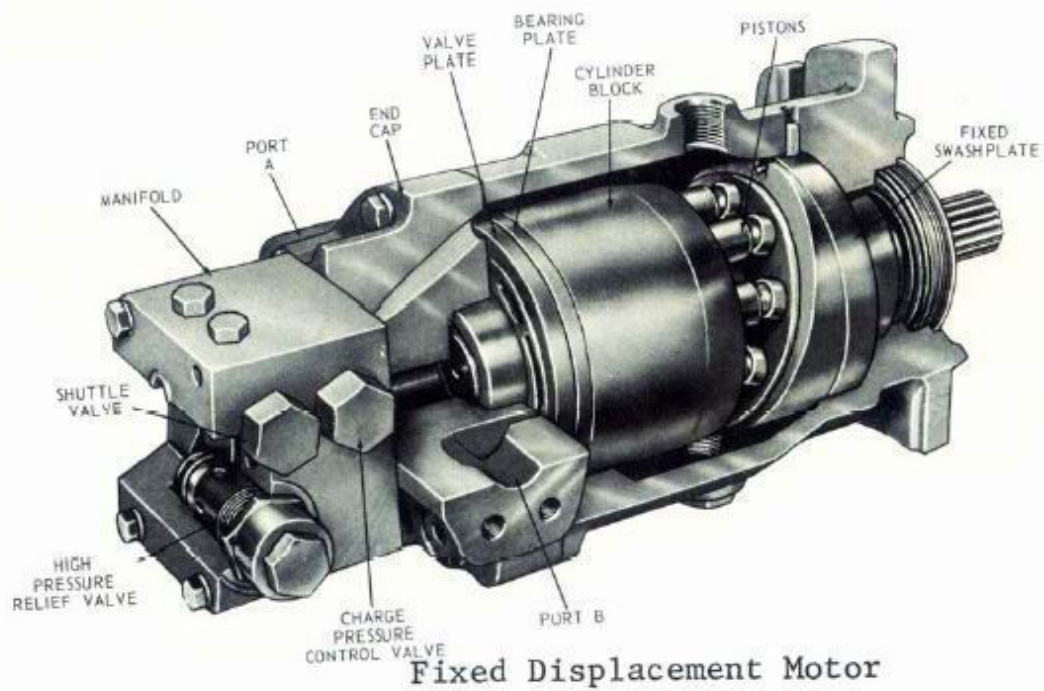


Variable Displacement Pump



轴向柱塞变量泵

Axial piston variable pump

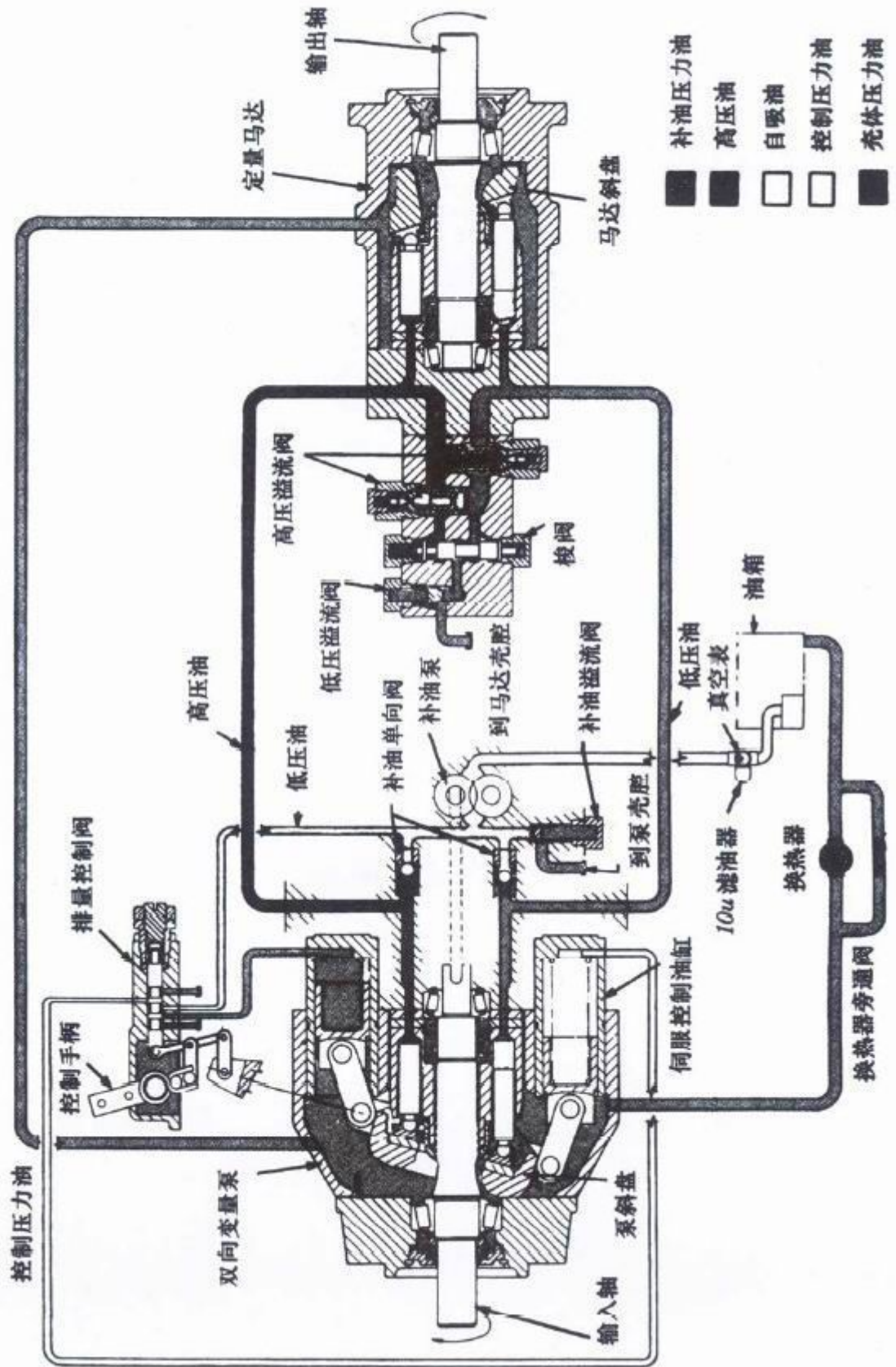


**轴向柱塞定量马达**



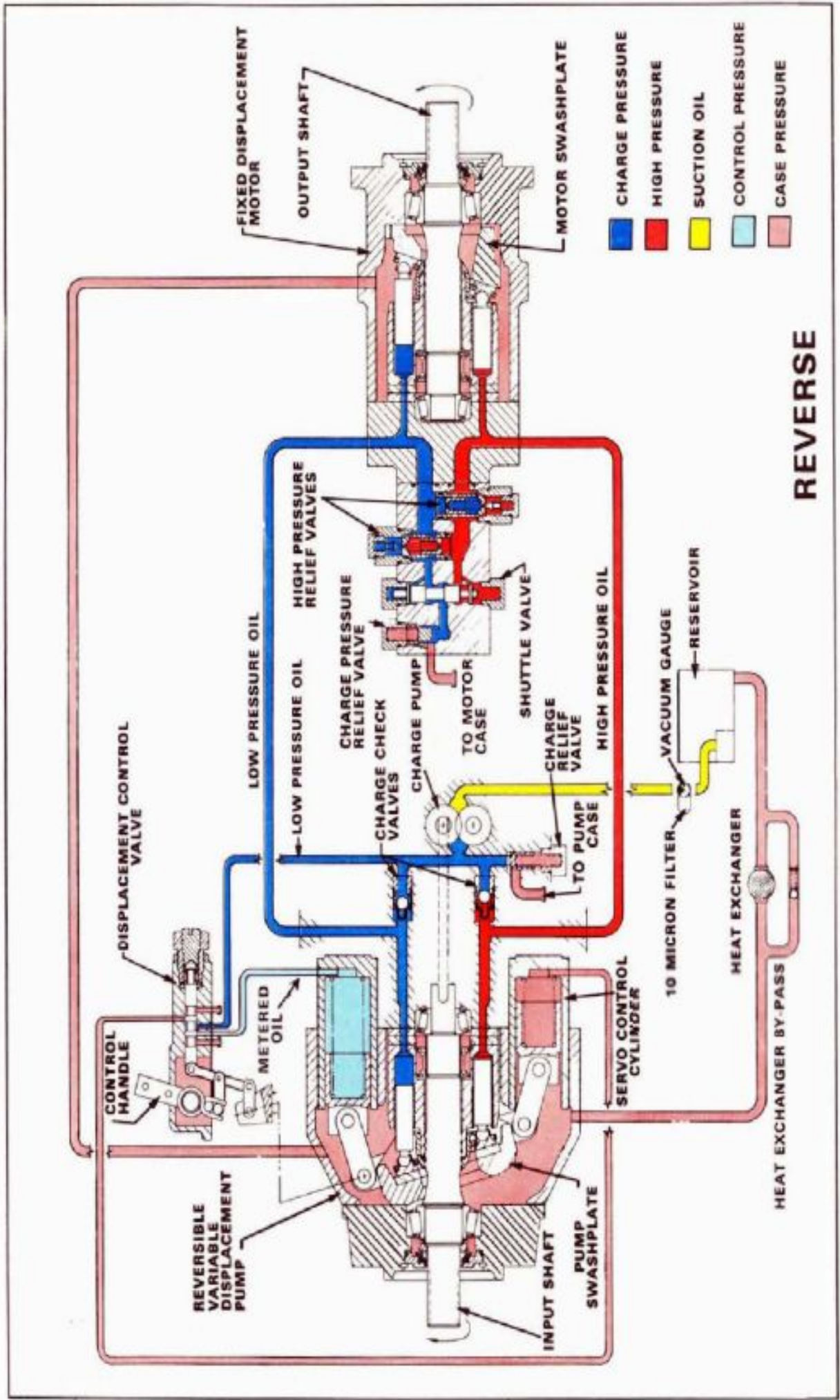
## 五、典型闭式回路液压系统图

### ● PV-MF 变量泵一定量马达

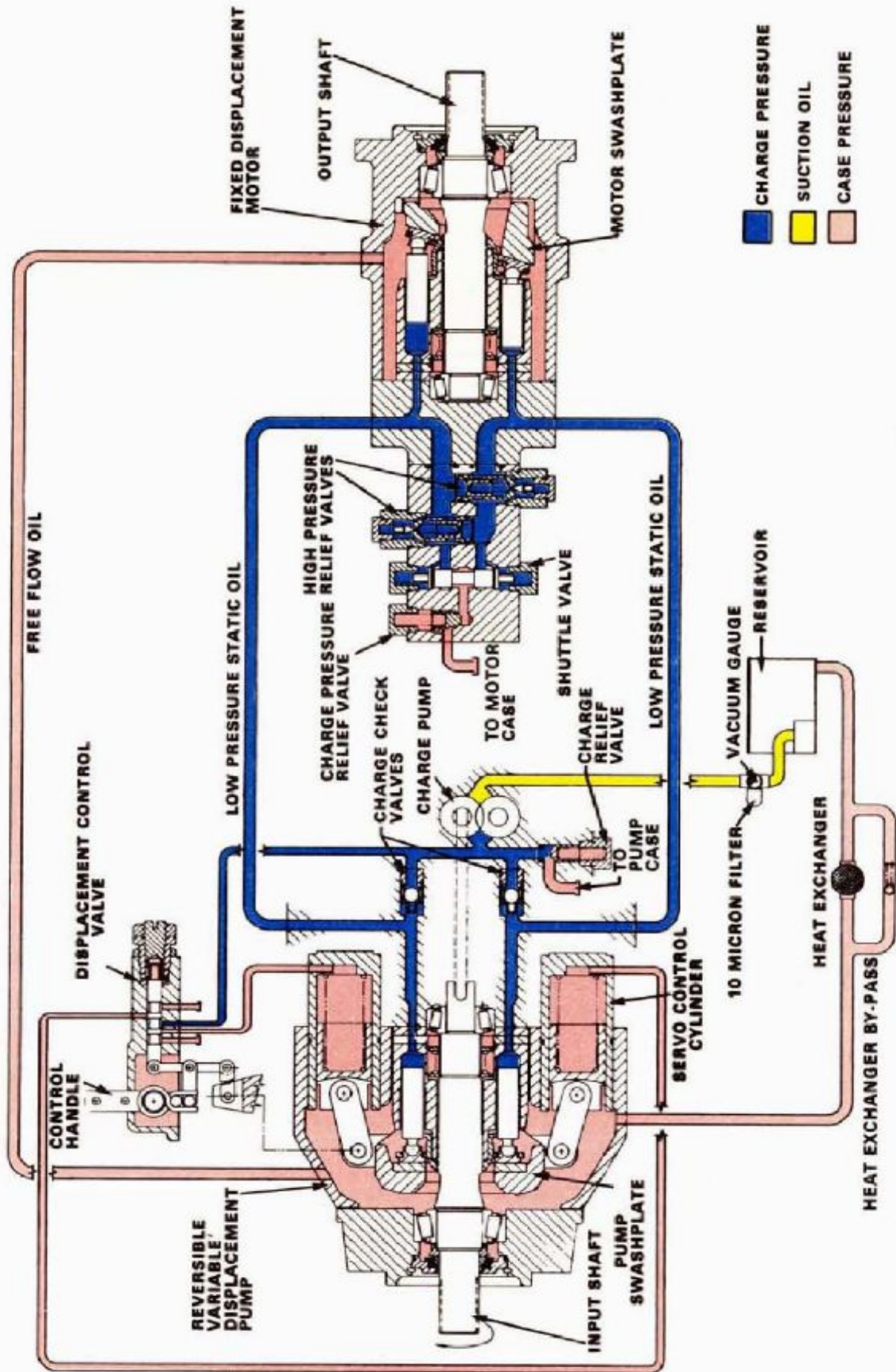




TYPICAL HEAVY DUTY VARIABLE PUMP—FIXED MOTOR TRANSMISSION SCHEMATIC



正偏角通轴泵与马达系统图

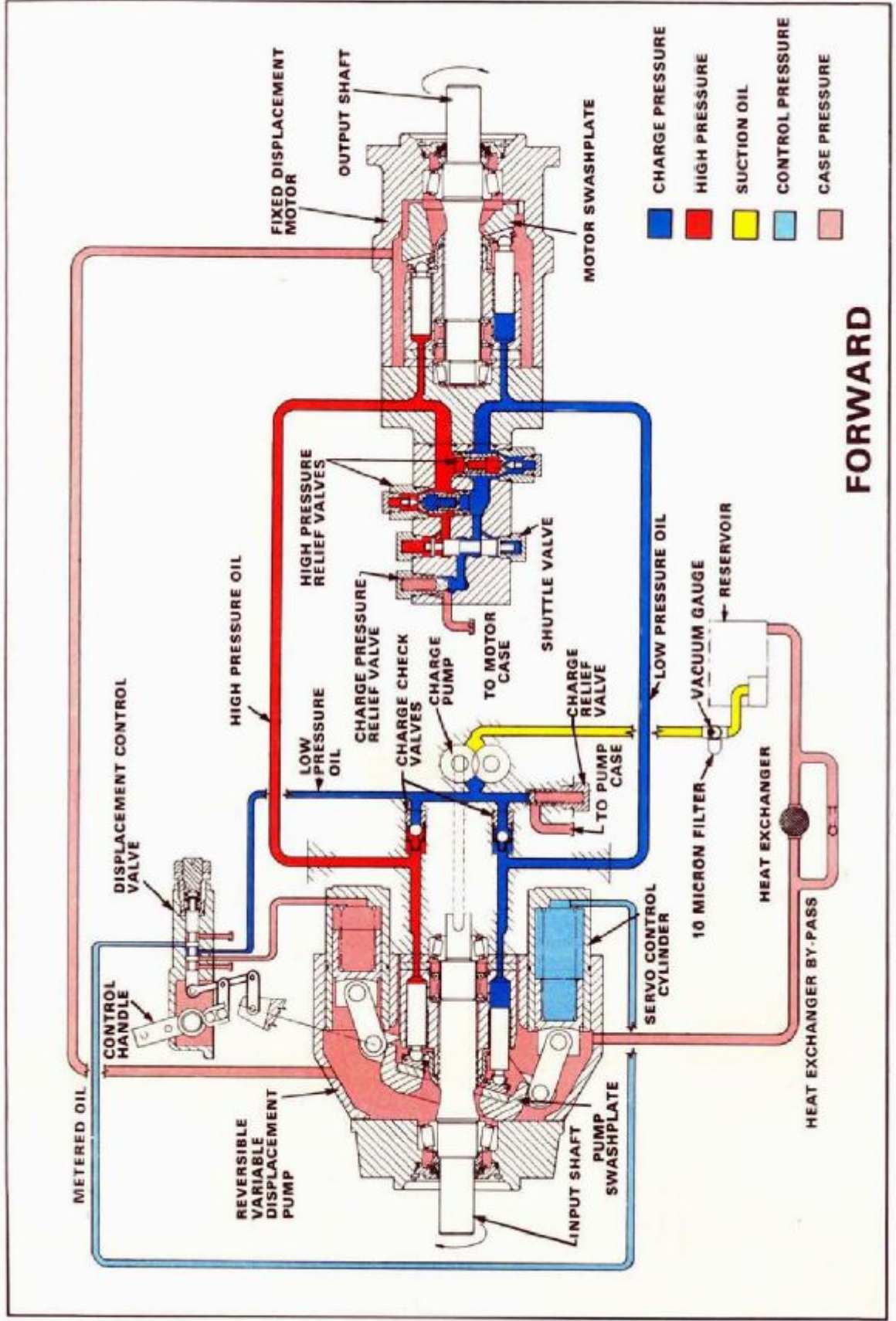


- CHARGE PRESSURE
- SUCTION OIL
- CASE PRESSURE

**NEUTRAL**

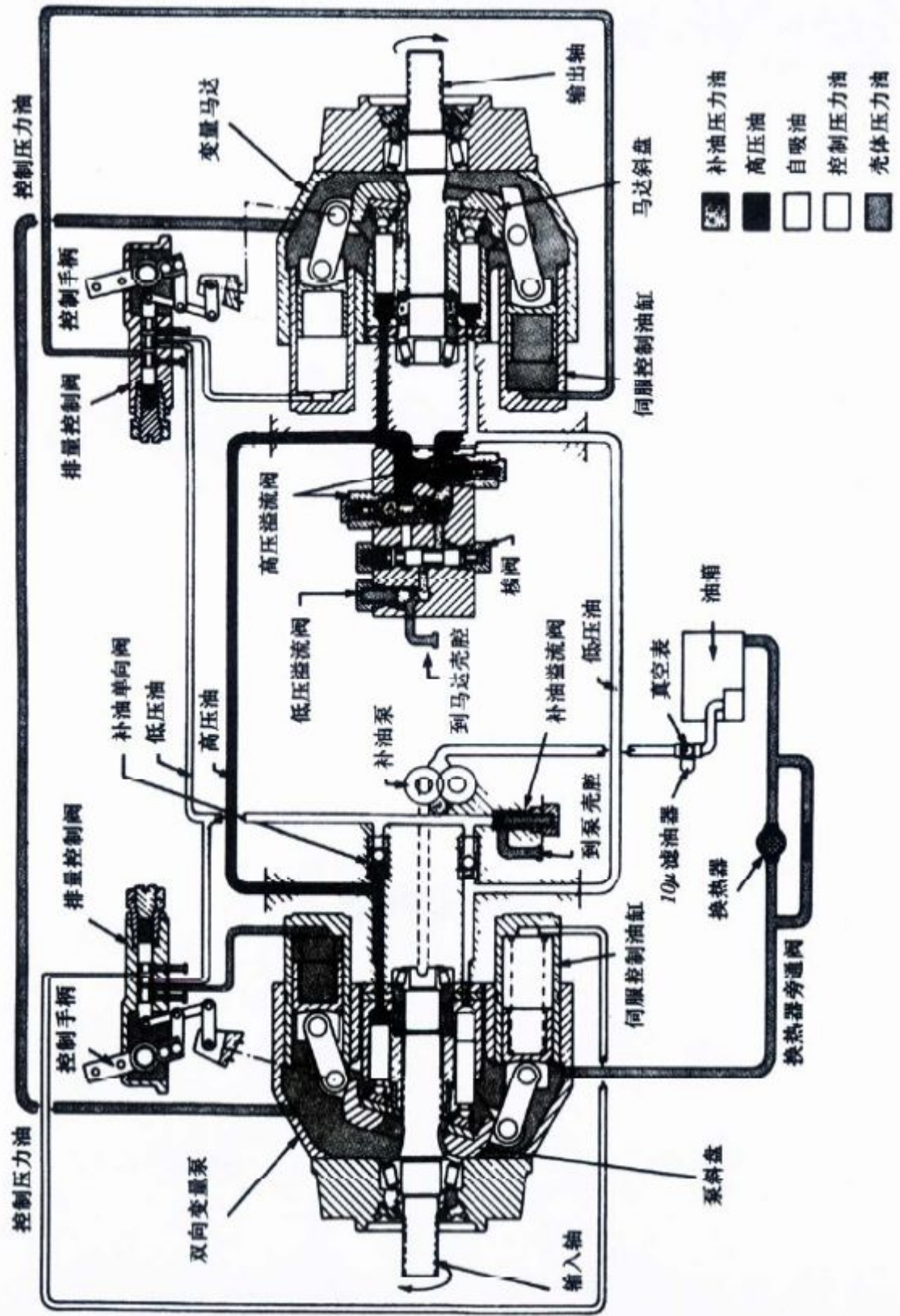


TYPICAL HEAVY DUTY VARIABLE PUMP-FIXED MOTOR TRANSMISSION SCHEMATIC

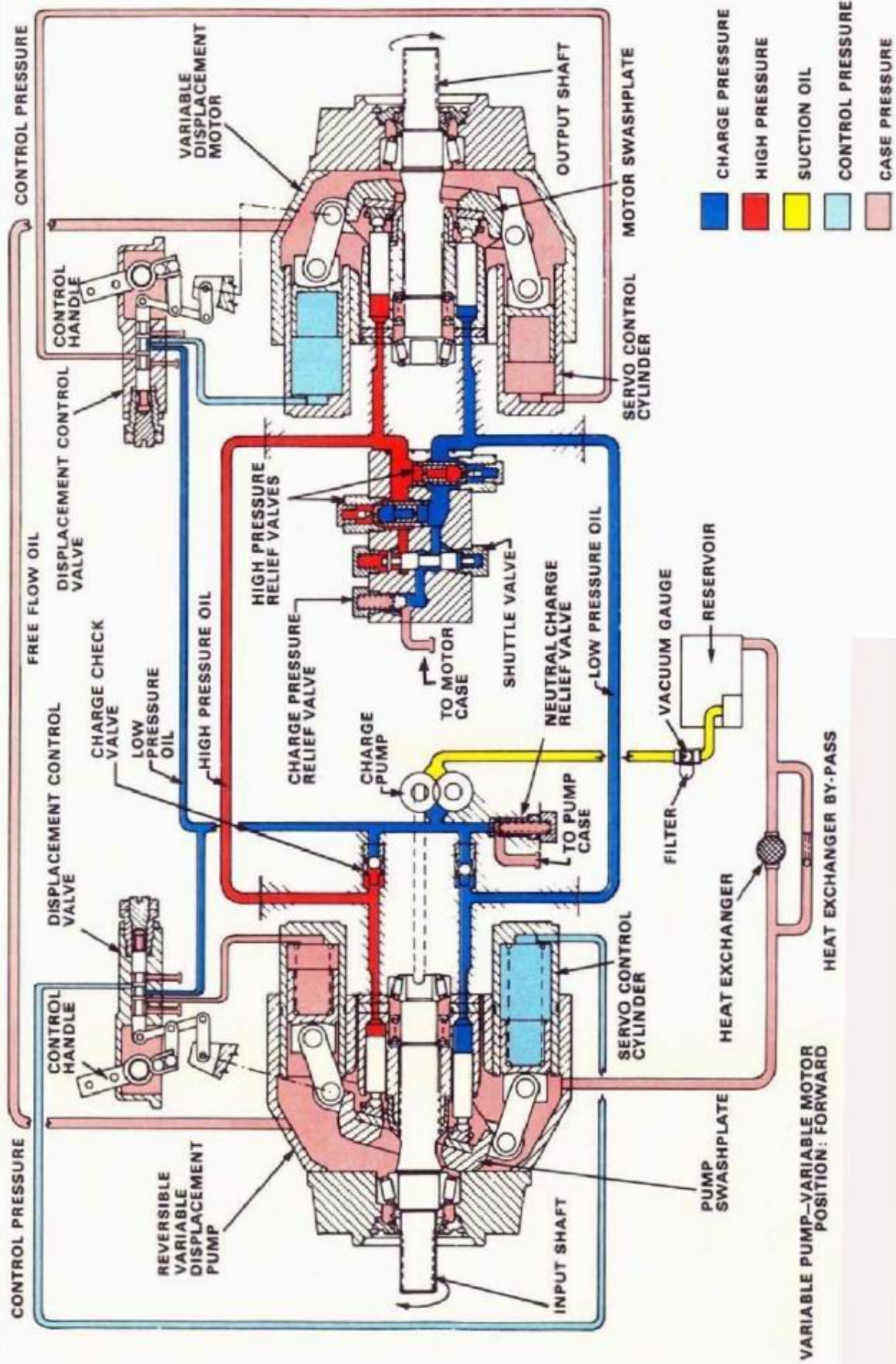


反偏角通轴泵与马达系统图

# ● PV-MV 变量泵—变量马达







- **Six** System equipment and operational requirements

operational system of pump and the motor. The following instructions set out below are based on our experience and will ensure correct use and extend components' useful life. The following also describes the requirements of the necessary auxiliary devices for the whole hydraulic system. If untraditional methods are used, the user must take appropriate steps to ensure no dangerous condition arises.

- Operating permissions of pump and motor

Speed limit: the maximum rotation speed of series 21-23 pumps and motors listed in Table 1. To ensure the correct static hydraulic gear functions, two ways of power and brake to estimate the maximum rotation speed of pump and motor.

- Pressure limit

a) Sealed circuit: maximum pressure of sealed circuit should be controlled by **overflow valve** within 31.5MPa. Due to additional fill oil pressure of low voltage circuit, the obtained value is 1.04MPa higher than the preset value of relief valve. The lowest pressure in Sealed Circuit should be over 0.9MPa higher than the case pressure.

a) Preset value of fill oil pressure, lowest fill oil pressure should be over 1.1MPa higher than the case pressure, which is the control requirement to provide adequate pressure and sealed circuit pressure. The adding-oil pressure of hydraulic pump with Charge Pump provided has been adjusted well by our company.

- b) Case pressure: in any case, the case pressure of the driving device must not exceed 0.28MPa, the case leak system (hydraulic piping, heat exchangers, etc.) should be designed to not exceed this limit. In general, leakage loss of leakage pipe between the pump and motor housing should not exceed 0.07MPa.
- c) Charge Pump suction pressure: Under normal circumstances, the maximum vacuum of the suction mouth of the adding-oil pumps shall not exceed 0.03MPa.

When cold started, it is allowed that the vacuum of inhalation exceed 0.03MPa.

The general requirement is that the vacuum of new oil filtering devices in general use should be between 0.01MPa-0.02MPa. When the filter is blocked to make the vacuum of the entrance of the adding-oil pump exceed 0.05MPa, it is necessary to replace the filter.

Temperature limit: The maximum continuous movement temperature is 70°C. It is allowed that the temperature within 5 minutes up to 72°C. Although the maximum temperature generally arises in the sealed circuit, it is possible to measure the maximum temperature at the leakage mouth of the pump or motor when the cooling requirement is determined.

Flow of Charge Pump: the flow of slippage should the requirement of maintain minimum circuit pressure and maximum temperature.



Filter: It is necessary for the flow providing to the traditional Charge Pump to go through a non-nominal 10 $\mu$ m filter without bypass valve. This form of filtration system provides the highest level of reliability of making the system free from contamination. A congested filter makes the pressure input into the pump decreased until more than the specified value, and ultimately reduce the static hydraulic transmission control pressure to slowdown or stagnate the static hydraulic transmission speed and. This phenomenon occurs before the static hydraulic transmission is damaged.

This requires oil filter to give filter that needs to be replaced a good signal. If you use an outside slippage pump, filter can be installed at outlet of circuit. It is required that the filter should be with indicator the situation of the filter element. Regardless of the location the filter, all cartridge filter should be of sufficient strength to prevent from being broken at the worst operating condition.

Hydraulic Oil: It depends on the quality of liquid operating in the system whether the hydraulic actuator to maintain satisfactory performance and achieve its useful life. The liquid quality can be measured in three general areas: lubrication capacity, impurities and temperature. Field experience has shown that most of the breakdown of hydraulic actuator results from the place damaged for the bad quality of liquid. This is mainly because of solid particles and impurities and overheating, and secondly of oil in the water and air. There are

different brand of qualified hydraulic oil compatible with this equipment on the market, but it is beyond our ability to test all of them one by one, for which users should take appropriate measures, including tests, to ensure adaptability of oil used and hydraulic components. For the best useful life and efficiency, the best viscosity of petroleum base hydraulic oil should be  $15 \times 10^{-6} \text{m}^2 / \text{s}$  (70 °C under oil temperature).

Fuel tank: It is recommended the minimum tank capacity (l) is 1.1 times of the total fill oil flow (l / min), which will allow the oil stay at least for 30 seconds to remove the air entering into the system to expand the volume to suit most ensealed tank most equipments allow to use.(no ventilation device).

Outlet of fuel tank leading to the entrance of the pump should be higher than the tank bottom to take advantage of gravity for separation and prevent any large sediment particles into the outlet pipeline. It is proposed to use filter with 100 meshes to further assist separation of large particles before the hydraulic oil leave the tank. Fuel level should be higher than the slippage pump suction. If this can not be achieved, a cut-off valve is needful to prevent the oil sucked by the suction pipe of Charge Pump from flowing backward.

The inlet pipeline of fuel tank (back oil of system) should be located generally below the oil level and direct access to the internal of fuel tank in order to make the oil stay in the tank the longest time and most effectively remove the air in the oil.

It is recommended to install an oil **outlet** through which it is no need to unload hydraulic connection to replace hydraulic oil and this connection also allow the system parts to be washed when heavily contaminated.

An oil inlet should be set on the tank and this inlet make possible contamination entering into the system the least quantity during maintenance or operation. Sealed tank is recommended to reduce contamination. The Pressure of the inlet of the Charge Pump and the case should not exceed the specified value.

Heat exchanger: It depends on special system load recycle and design whether a heat exchanger is needed that ensures the temperature of the back oil of the pump or motor does not exceed the set limit. The flow resistance caused by the back oil pipe and the exchanger should not exceed 0.28MPa, which possibly need a bypass to be connected at the ends of the exchanger.

- **Start steps of static hydraulic driving device**

1. After complete installation of the driving device ( The space between the pump and the shaft of the prime mover  $\leq 0.1$

The drive shaft coupling should have axial limit so as not to damage the seal ring and further cause the leakage of the case.). Remove the screw from the side of the main pump and then here equip a 4MPa of pressure meter with a short hose to measure the pressure of charging oil. In the same way, equip a vacuum meter at the inlet of Charge Pump to measure vacuum degree

2. Check every pipe connection to ensure them screwed tight.
3. Charge oil into pump and motor trough the drain mouth on the case with oil recommended. Any oil recommended should flow through a filter of 10 $\mu$ . Equip back pipe again and screw it tight.
4. At the inlet leading Charge Pump, loosen the suction pipe of filter/oil tank.
5. Add oil into the oil tank. If oil arises at the loose place of Charge Pump, here screw the connection and continue adding oil. Loosen oil tank head to make the air out.
6. It is suggested that before start of pump do not connect control bar with control valve so as to make pump maintain neutral position.
7. If prime mover is:  
Engine(of diesel, gasoline or gas)—start engine in            until oil pressure up to 0.21MPa or more.

8. Start prime mover. If possible, keep pump shaft's rotation speed at 750r/min for 5 minutes to make system full. Meanwhile, it is normal if ripple is shown on pressure meter(4mpa),

9. Increase pump rotation speed to 1000r/min. Here the oil-charging pressure value shown on the pressure meter(4MPa) should be (1.31-1.45) MPa

**Attention:** For those pumps with Charge Pump(65.5ml/rev), the pressure of the Charge Pump should be higher than the case.

(1.45-1.66) MPa ----The pump steering 1000 r/min, neutral position

(2.07-2.66) MPa ---The pump running 1500-1800r/min, neutral position

(1.59-1.73) MPa ----The pump running 1500-1800r/min, variable displacement

(1.45-1.66) MPa -----The pump steering 1000 r/min, neutral position

(2.07-2.66) MPa ----The pump running 1500-1800r/min, neutral

(1.59-1.73) MPa -----The pump running 1500-1800r/min, variable displacement

10. Stop, connect link with discharge-control bar.

Attention: If motor shaft is connected with driver directly, it is necessary to consider safety measure.

Torque acting on control handle shaft should not be greater than 17Nm.

11. Check oil tank's level, and refuel when necessary.

12. Move the control handle forward and then backward. The controlled pressure will fall to 1.10-1.24 Mpa above the pressure on the motor housing.
13. If refuel pressure fall to 0.69 MPa, stop starting until the breakdown is removed.
14. When the pump is at median, make the prime mover run at the highest speed. In general, the vacuum should not exceed 0.003 Mpa.
15. Remove all measuring devices, and put the entire plug or pipe. check the fuel tank level, and tighten the fuel injection cover. Now, the machine is ready to use.

## 七、 Maintenance of system

### Hydraulic oil:

Generally speaking, the replacement time of hydraulic oil of sealed oil tank system is 2000hours. If the hydraulic oil is contaminated or other outside material bears abnormal running condition, the hydraulic oil should be changed often. Hydraulic oil in the open oil tank system should be changed every 500hours. For different vehicle, the measures should be determined by specific design and operational experience.

### Filter:

As a general recommendation, in a sealed tank systems, 10 $\mu$  of inlet oil filter should be replaced every spring or every 1500 hours (no matter whatever situation first appear). For the

open oil tank system with air filter head, the oil filter should be replaced every 500 hours

Tank:

Daily inspections of the tank liquid level and oil in the water there. If the tank needs adding oil, hydraulic oil that has been filtered is necessary. Water in the oil should be removed if needful.

Heat exchanger:

keep the chip and heat-sink of the exchanger clean to obtain the best cooling result and system efficiency. Everyday check if there is any jam outside the heat exchanger. If any jam found, remove.

## VIII. System Maintenance

Customers should determine the following requirements before

Ordering:

1. Pump and motor displacements.
2. Pump turn.
3. Charge Pump displacement.
4. Control form.
5. High-pressure relief valve settings.
6. Other requirements (such as pressure limiting, valves, rotary bypass valve, etc.).