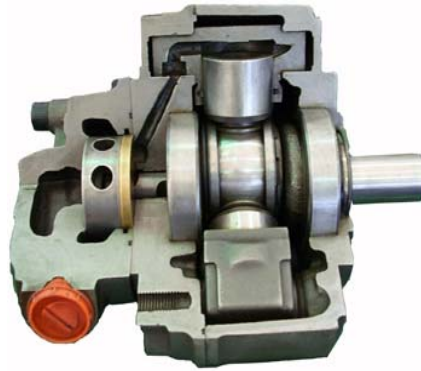




SAI GM Series Piston Hydraulic Motor

Crankshaft Design Radial Piston Motors

www.chinaWinches.cn

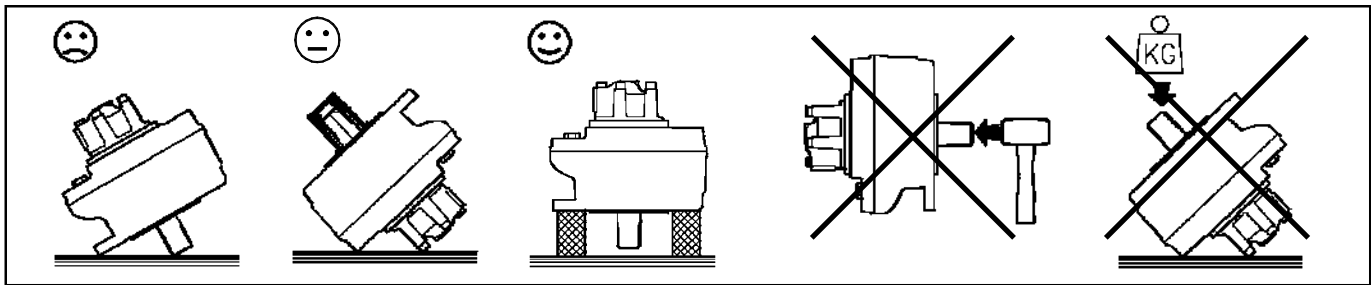


(Dimension: inch)

Brief Performance Table of Sai GM Series Piston Hydraulic Motor (Full range GM05- GM9 series)

	GM05 hydraulic motor	90	110	130	150	170		
	Displacement cc/rev.	86	115	129	151	166		
	Rated torque Nm	343	458	513	600	660		
	Max. speed rpm	1000	900	900	900	800		
	Max. power KW(HP)	20(27)	20(27)	20(27)	20(27)	20(27)		
	GM1 hydraulic motor	100	150	175	200	250	300	320
	Displacement cc/rev.	99	154	172	201	243	290	314
	Rated torque Nm	385	600	670	785	950	1130	1225
	Max. speed rpm	1000	1000	900	800	700	650	600
	Max. power KW(HP)	48(65)	48(65)	48(65)	48(65)	48(65)	48(65)	48(65)
	GM2 hydraulic motor	200	250	300	350	420	500	600
	Displacement cc/rev.	192	251	304	347	425	493	565
	Rated torque Nm	750	980	1188	1355	1658	1923	2208
	Max. speed rpm	800	800	750	750	750	700	700
	Max. power KW(HP)	59(79)	59(79)	59(79)	59(79)	59(79)	59(79)	59(79)
	GM3 hydraulic motor	500	600	700	800	900	1000	
	Displacement cc/rev.	486	595	690	792	873	987	
	Rated torque Nm	1895	2320	2700	3100	3400	3850	
	Max. speed rpm	600	575	500	500	400	350	
	Max. power KW(HP)	80(107)	80(107)	80(107)	80(107)	80(107)	80(107)	
	GM4 hydraulic motor	600	800	900	1000	1100	1300	
	Displacement cc/rev.	616	793	904	1022	1116	1316	
	Rated torque Nm	2403	3100	3525	4000	4350	5125	
	Max. speed rpm	550	550	450	400	400	350	
	Max. power KW(HP)	100(134)	100(134)	100(134)	100(134)	100(134)	100(134)	
	GM5 hydraulic motor	1000	1200	1300	1450	1600	1800	2000
	Displacement cc/rev.	1039	1185	1340	1462	1634	1816	2007
	Rated torque Nm	4050	4625	5225	5700	6350	7075	7825
	Max. speed rpm	450	400	400	350	300	300	250
	Max. power KW(HP)	120(160)	120(160)	120(160)	120(160)	120(160)	120(160)	120(160)
	GM6 hydraulic motor	1700	2100	2500	3000			
	Displacement cc/rev.	1690	2127	2513	3004			
	Rated torque Nm	6600	8300	9800	11875			
	Max. speed rpm	400	350	300	250			
	Max. power KW(HP)	170(228)	170(228)	170(228)	170(228)			

PACKING, HANDLING, TRANSPORTING AND STORING MOTORS

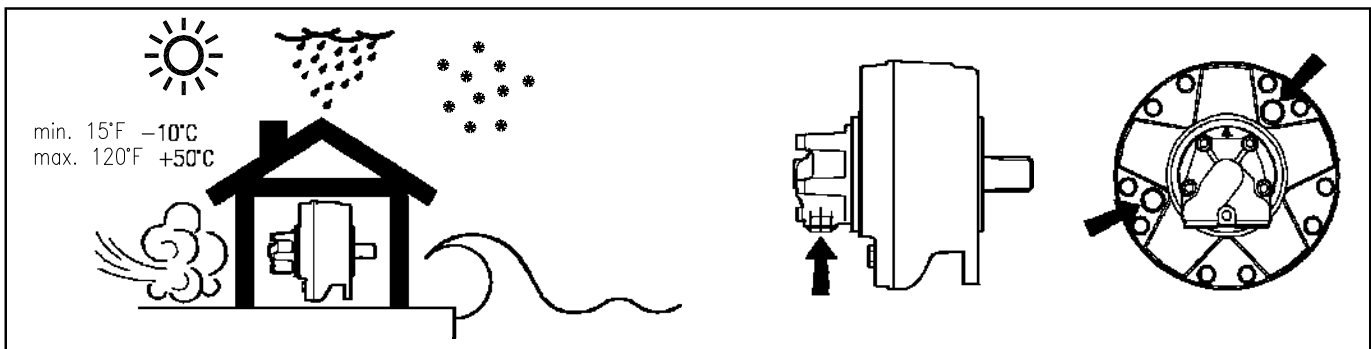


Make sure that the shaft of the motor is not loaded in any way and is protected from knocks.

Axial loads or shocks may easily damage the bearings inside the motor.

Knocks or contact with hard surfaces may damage the shaft or otherwise damage the motor.

- Cover the shaft with a protective layer or element (e.g. cover the shaft with tape, or use a tubular element or cover made of plastic or metal).
- Do not pack or store the motors with the shaft pointing downwards so that the weight of the motor is on the shaft.
- Pack the motors in closed crates or boxes so that they are immobilized inside the crate; do not wedge the shaft against any other surface.



Make sure that all the oil supply, discharge, drainage or other motor ports are closed.

If the ports are not tightly sealed, dirt, water or other materials may penetrate inside the motor and possibly damage the working surfaces of the motor.

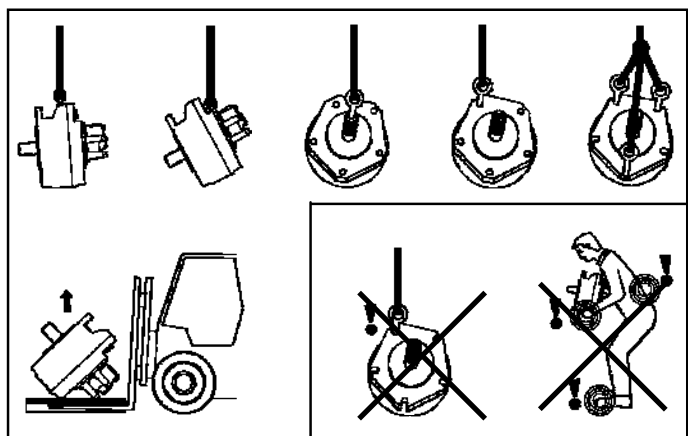
Rusting of the internal surfaces of the motor make the motor unusable; rust ruins the working surfaces and rust particles dislodged enter into the hydraulic circuit, contaminating the oil.

- Tightly close all ports using suitable plastic plugs or other system suitable for this purpose.
- Store the motors in a dry environment, protected from extreme temperatures and corrosive substances (e.g. salt).
- If the motor has to be stored for long periods or is exposed to unfavorable conditions during transport, completely fill the motor with hydraulic oil (fill motor casing as well as the cylinders and oil supply channels).

Observe safety precautions during handling.

The round shape of the motors means they roll if placed on sloping surfaces and their weight is such that they may cause serious injury to persons or damage to things during handling.

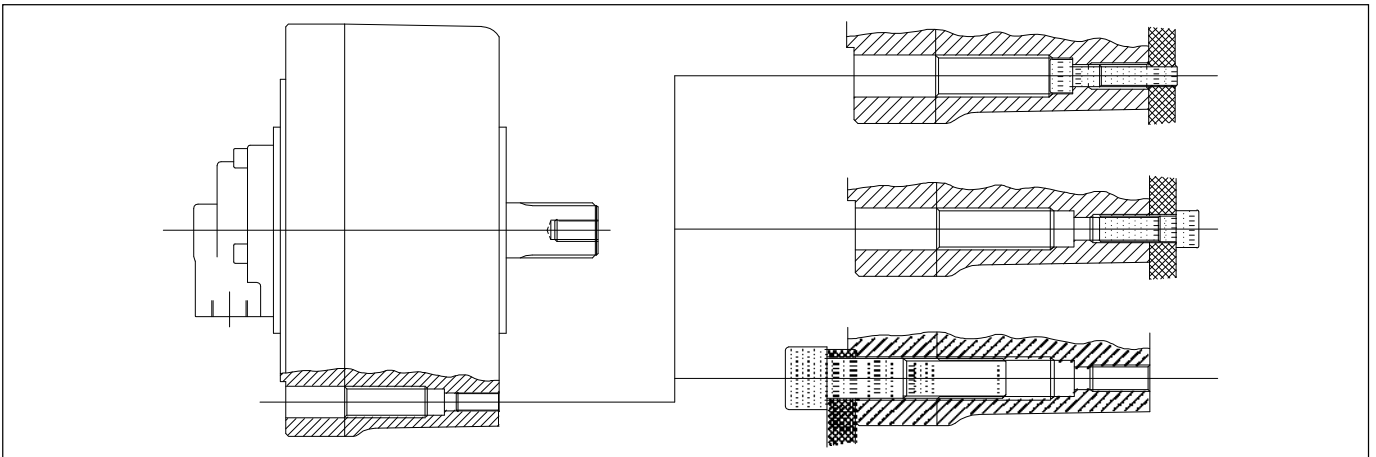
- Lift and move the motors using appropriate lifting and handling equipment, making sure the motors are not free to move unrestrained.
- Use eyebolts screwed into available holes in the motor flange, the motor cover, or eyebolt holes provided on the side of the motor.
- Do not handle the motors manually.



SAI GM series Hydraulic Motor**INSTALLATION**

Before installing any motor ensure that it has not been damaged during transport. The design of the GM-Series Motors enables a number of methods to be used to fix the motor to the chassis. NOTE: the thru bolt holes are not required for closing the motor body and cover. The diagram shows three possible methods for fixing the motor to a chassis.

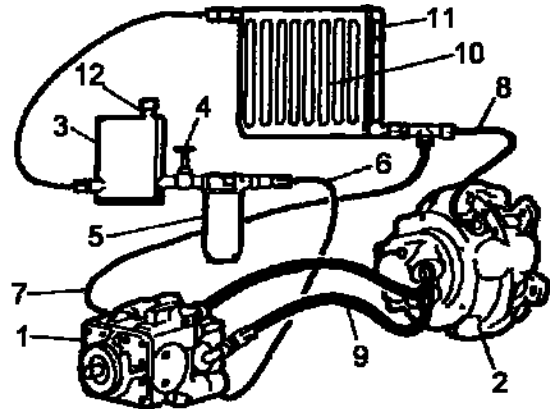
- 1.) Bolt passing through motor from the distributor side screwed into a flange on the shaft side of the motor.
- 2.) Bolt passing through flange on the shaft side of the motor and screwed into the shaft side fillet of the motor.
- 3.) Bolt passing through flange on the distributor side of the motor and screwed into the distributor side fillet of the motor.



NOTE: Installation type 1.) P05 and GM05 Series, with thru bolt M10, use washer size 10.5x18x2.

TYPICAL INSTALLATION OF A VARIABLE

- 1 Pump
- 2 Motor
- 3 Tank
- 4 Shut-off valve
- 5 Filter
- 6 Pump inlet
- 7 Pump drain
- 8 Motor drain
- 9 High pressure lines
- 10 Heat exchanger
- 11 By-pass
- 12 Tank filler cap

**PIPING AND PIPE CONNECTIONS**

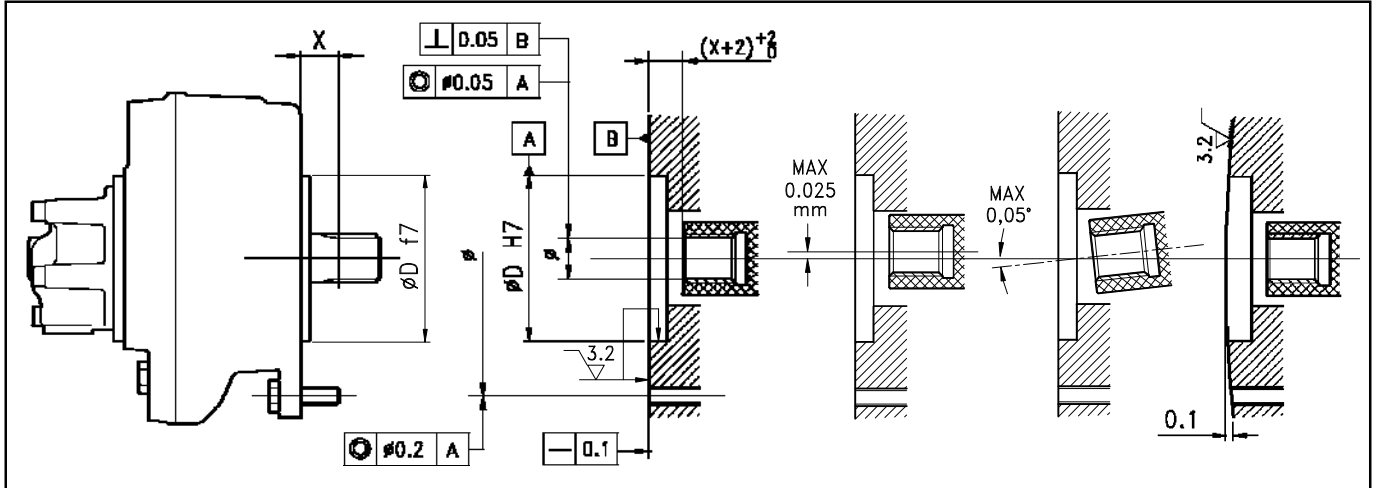
SAI recommends the use of high quality pipes and pipe connections for high pressure hydraulic applications. Use only BSPP/GAS parallel thread connections; do not use tapered thread connections or water piping on all motor drain-lines. Follow manufacturer's recommendations for pipe sizing; do not use pipe sizes that are smaller than the port connections; to reduce the effects of oil compressibility use pipes with minimum length, minimum diameter and maximum rigidity; to reduce effects of pressure loss, avoid sharp corners, restrictions and high flow velocity.

PRESSURE LINES

SAI recommends the use of high quality flexible or rigid pressure pipelines. Follow pipe manufacturer's recommendations on appropriate sizes for different flow velocities, pressures and resistances. To minimize the effects of oil compressibility, pipelines should be kept to a minimum length, minimum diameter and maximum rigidity.

MOUNTING THE MOTOR

The motor must be mounted onto a rigid structure capable of withstanding the weight of the motor, the torque reaction forces and the vibrations during operation. The diagram below indicates the recommended tolerances of the mounting flange to which the motor is fixed.



DRAIN-LINE POSITIONING

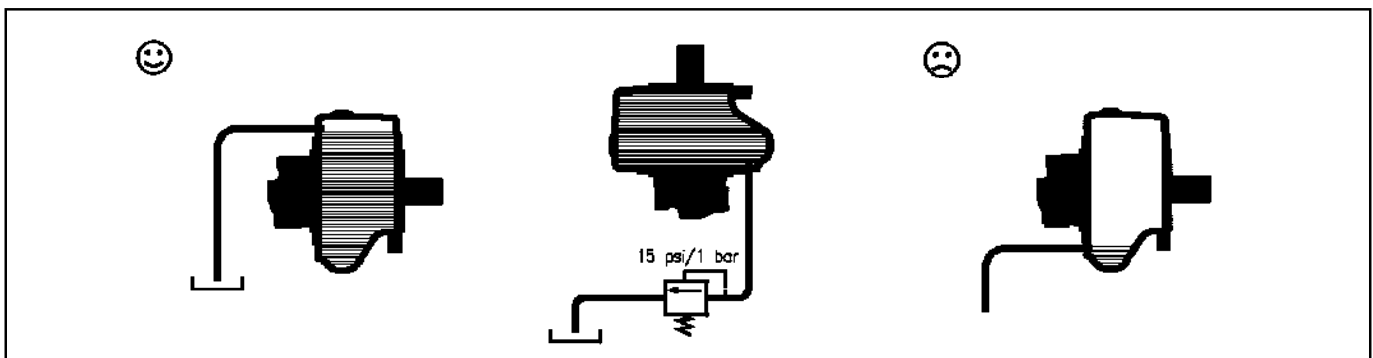
The drain-line must be positioned in such a way that there is always sufficient oil in the casing for the lubrication of the dynamic components in the motor.

If the motor is installed with the shaft in a horizontal position, the drain-line should be connected to the uppermost drain-line port.

If the motor is installed with the shaft pointing downwards, the drain-line can be connected to either of the two drain-line ports.

If the motor is installed with the shaft pointing upwards, the motor casing has to be entirely filled with oil before being installed and the drain-line connected in such a way that no air can enter into the motor casing so causing the front bearing to run dry. This is especially important if the motor operates at very low speeds or remains inactive for long periods. For alternative systems, contact your SAI representative.

The drain-line should be of a diameter corresponding to the size of the drain line port and flow must not be obstructed by sharp corners, restrictions, etc.

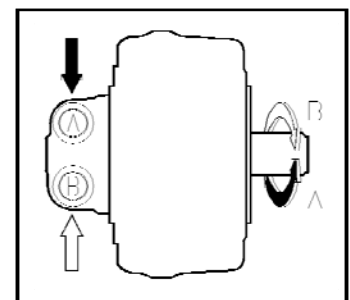


DIRECTION OF SHAFT ROTATION

All motors are bidirectional.

The direction of shaft rotation is determined by the direction of oil flow.

Standard motors are supplied so that flow entering in port A causes the shaft to rotate clockwise (as seen from the shaft side of the motor). Flow entering port B causes anticlockwise rotation. To invert the direction of rotation of the shaft, invert the direction of the flow, or invert port A and port B tube connections, or invert the phase of the distributor (see motor order codes, see the maintenance manual or contact SAI).



*SAI GM series Hydraulic Motor***HYDRAULIC FLUIDS**

For the choice of hydraulic fluid SAI recommends the use of high quality mineral-based hydraulic oil, containing anti-wear, anti-foaming, anti-oxidation and extreme pressure additives.

Allowable oil temperature range: 0°F to 175°F (-20°C to 80°C)

Operating viscosity range: optimal 40 cSt to 60 cSt
allowable 20 cSt to 150 cSt

Choice of hydraulic oil should be made so that the viscosity is within the given range at its normal operating temperature.

Recommended hydraulic oils:

Temperature	TEXACO	B.P.	ESSO	SHELL	MOBIL	ISO rating
70 - 100°F	RANDO	HLP 32	NUTO H32	TELLUS 37	DTE 24	32
100 - 120°F	RANDO HD46	HLP 46	NUTO H46	TELLUS 46	DTE 25	46
120 - 140°F	RANDO HD68	HLP 68	NUTO H68	TELLUS 68	DTE 26	68
140 - 160°F	RANDO HD100	HLP 100	NUTO H100	TELLUS 100	DTE 26	100

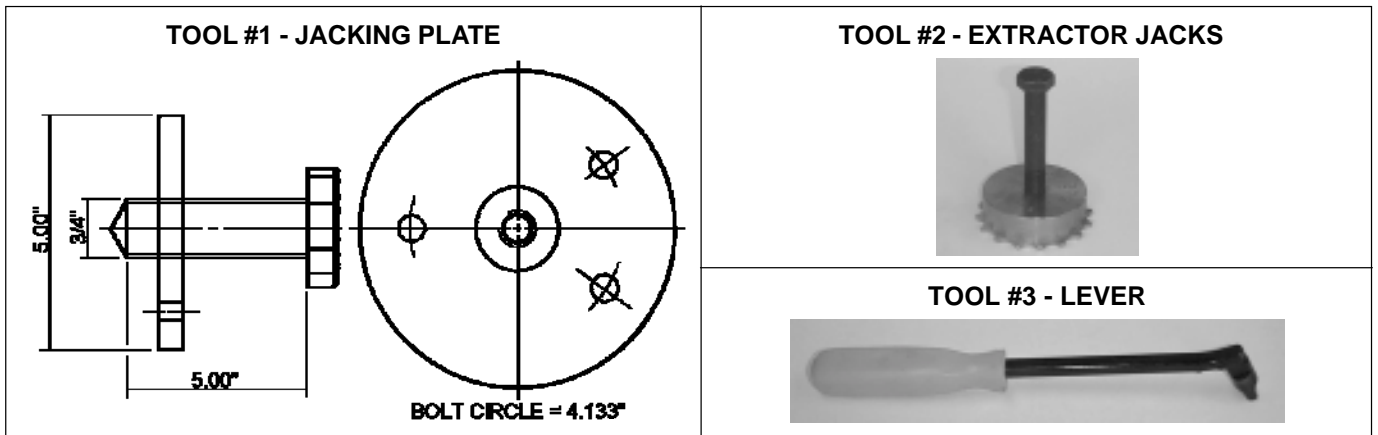
FILTRATION

SAI recommends max. 25 µm filters, preferably of 10 µm. Clean oil and therefore efficient filters are essential for the correct functioning of all the components in the hydraulic system. The efficiency of the filters is impaired by the gradual accumulation of particles intercepted and filters should therefore be regularly inspected. Special attention is required when the hydraulic system is first put into operation or when any of the components are replaced or have become worn through use. The relative efficiency of a filter may be measured, for example, by taking regular readings of the pressure drop across the filter. Follow filter manufacturer's recommendations for filter element lifetimes and cleaning or substitution cycles.

START UP

Before connecting any tubes ensure that they are thoroughly clean, any excess material that could work loose should be removed and there should not be any oxidation of surfaces that come into contact with the oil. Make sure the motor casing is filled with oil. Before starting work, the hydraulic circuit should be purged of air. This can be achieved by running the motor without load for 10-20 minutes, during which time checks should be made for leakages from connections. During the first few hours of working under load checks should be made for leakages from connections and ensure that all components remain firmly fixed to their supports. The motors are factory tested and do not require to be run in.

MOTOR STRIP-DOWN & ASSEMBLY TOOLS



MOTOR STRIP-DOWN PROCEDURE

NOTE: On assembly at the factory one of the distributor closing bolts is lead sealed. The number on the seal is a factory reference number and should not be removed. The guarantee, where applicable, on motors returned for repairs is only valid if this seal is intact.

1. PRELIMINARY STEPS

Drain the motor casing of oil. In order to be able to re-assemble the distributor in the same position it is advisable to mark the alignment of the distributor ports with respect to the drain-line holes. To help with fault diagnosis it is advisable to mark also the position of the motor cover with respect to the motor body and, after step 3, the position of each of the cylinders with respect to the motor body.

2. REMOVING THE DISTRIBUTOR

Remove the 5 closing bolts of the distributor. Lift off the distributor cover and the distributor rotary [1]. Take out the distributor drive pin and the distributor centering bush [2]. If the distributor is of the type with the bronze bearing disc, remove also the two locating pins.

1



2



3



See Tool #1

>> The working surfaces of distributor rotary, distributor disc & motor cover must not be scratched or damaged in any way.

3. REMOVING THE MOTOR COVER

Remove motor cover closing bolts. With an appropriate jacking plate, using the distributor bolt holes and levering on the shaft through the distributor drive pin hole, lift off the motor cover [3]. Remove the motor cover/body seals and locating pins.

4. REMOVING THE REAR RETAINING RINGS

Using appropriate snap ring pliers, remove the retaining clip [4]. Take off the spring and the retaining ring.

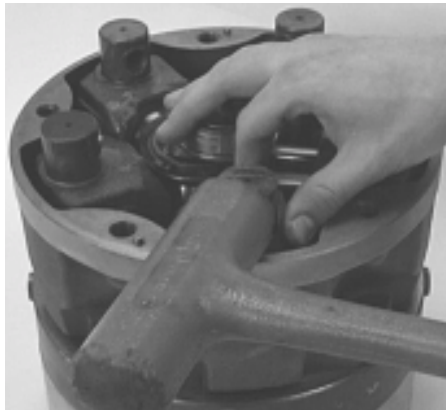
5. REMOVING THE CYLINDERS

Rotate the shaft so that the piston of the cylinder to be removed is fully extended. By hooking a finger under the piston lift up the piston, tapping the cylinder turn-on with a rubber hammer to loosen the piston from the shaft. Lift out the cylinder and piston [5]. The piston may be extracted for inspection of seals and working surfaces.

4



5



6. REMOVING THE SHAFT

It is advisable to place a protective covering over the spline of the shaft (e.g., tape) before extraction to avoid damaging the shaft seal.

Motors with roller bearings: lift out the shaft.

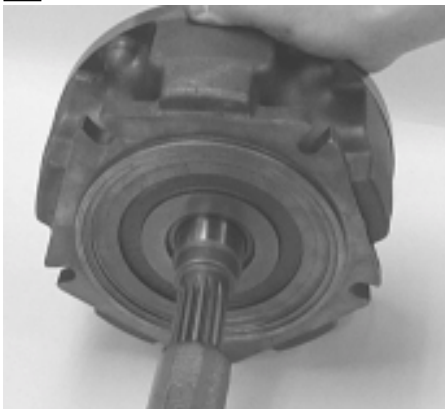
Motors with ball bearings: remove the shaft by tapping on the end of the shaft with a rubber hammer [6].

7. REMOVING THE SHAFT BEARINGS

If it is necessary to replace the shaft bearings, the bearing races can be removed from the shaft or from the motor cover or body using appropriate extractor jacks [7].

>> If the bearings do not need to be replaced it is recommended that the bearing races are not removed from the motor cover or body.

6



7



See Tool #2

MOTOR ASSEMBLY PROCEDURE

With GM-series motors the shaft and cylinder sub-assemblies are mounted on the motor cover and not in the motor body as with M-series motors. Before proceeding with the reassembly of the motor:

- Ensure that the lubrication channels in the cylinder turn-on seats of both motor body and cover are clean;
- Check that the distribution plane on top of the motor cover is perfectly flat and smooth.

1. SHAFT SEAL

Ensure that the shaft seal in the motor body has not been damaged. Replace if necessary [8].

2. BEARING ASSEMBLY

To avoid the possibility of damage to the bearing seat in the motor cover or the motor body caused by edges on the external diameter of the bearing race the motor body or cover should be heated to a temperature of 80°C before inserting the bearing. Alternatively smooth down any edges, even slight ones and especially in the area of the corner fillets, that may have remained after the machining processes. Roller bearings: to avoid the possibility of axial shocks the outer bearing race should be placed in the motor cover or body and the inner race should be assembled to the shaft [9]. Ball bearings: these should be inserted in the motor body or cover (and not assembled to the shaft).

8



9



10



3. SHAFT ASSEMBLY

Replace the piston retaining ring, spring and C-clip to the rear-side of the piston support ring [10]. Dislodge the C-clip from the front-side of the piston support ring [11].

Insert the shaft in the bearing seat in the motor cover, in the case of ball bearings using a rubber hammer to tap it home [12]. (Keep shaft shoulder 0.250 away from bearing race.)

4. CYLINDER ASSEMBLY

Insert O-ring and plastic slipper seal in the cylinders [13]. Insert O-ring, plastic ring seal, steel ring and shaped insert into the cylinder turn-on. Insert the pistons in the cylinders.

11



12



13



4. CYLINDER ASSEMBLY (Continued)

Place the longer cylinder turn-on containing the seal into the turn-on seat in the motor cover. Slide the piston out onto the piston support ring and place the lip of the piston foot between the piston retaining ring and the piston support ring [14]. Using an appropriate lever ensure that the piston foot comes into full contact with the piston support ring. It may be necessary to lift the cylinder and shaft out of their seats a little to facilitate the operation. Repeat for all five cylinders. Position the front retaining ring and spring over the piston feet and insert C-clip [15]. By tapping lightly with a rubber hammer on the cylinder turn-on and shaft-end ensure that cylinders and shaft are properly seated.

14



15



5. MOTOR BODY AND COVER ASSEMBLY

Grease all the motor cover and body O-ring seats, position O-rings [16], and insert the locating pins. Position the motor body aligning the turn-on seats with the cylinder turn-on and gently lower the motor body into place, taking care not to damage the shaft seal [17]. For motors with the O-rings between the cover and body, it is advisable to insert the bolts in the cover to ensure that the O-rings are correctly positioned when closing the motor. Turn the motor over so that the shaft points downwards, insert and tighten the motor cover closing bolts

IMPORTANT: Do not hammer the distribution surface in the center of the motor cover. Using an appropriate lever inserted in the distributor drive-pin slot ensure the shaft rotates through 360° without excessive or variable resistance [18].

16



17



18



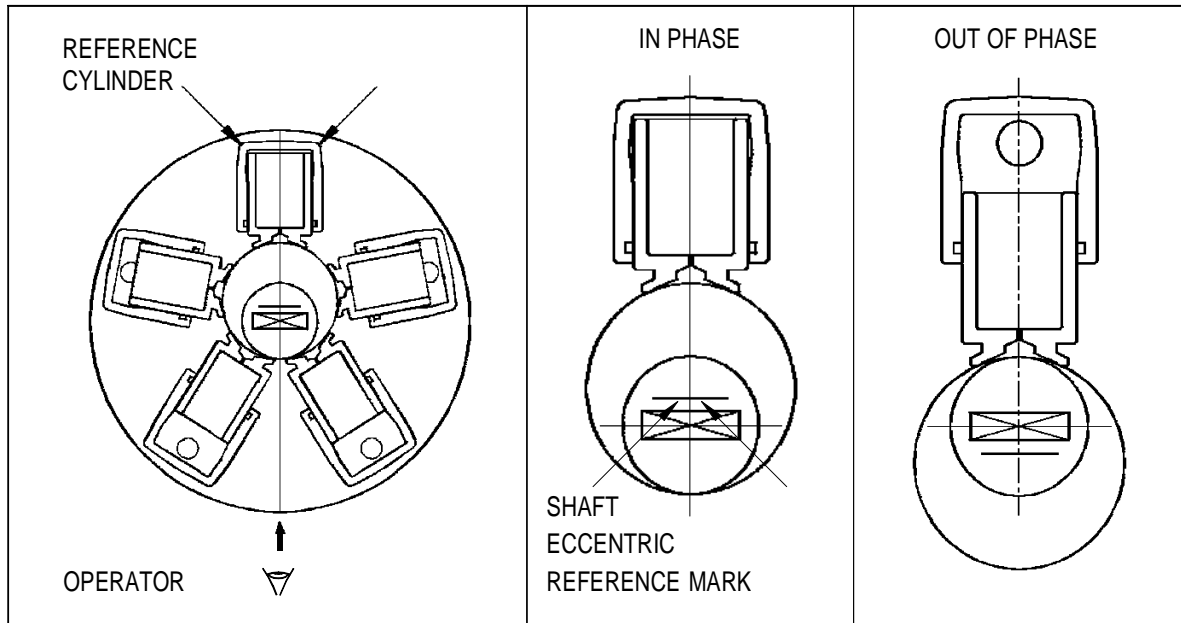
See Tool #3

6. SETTING THE DIRECTION OF MOTOR SHAFT ROTATION

For the motor shaft to rotate as described in the section "Direction of Shaft Rotation", the motor has to be put "in phase" before the distributor is assembled.

To set the motor "in phase": Choose any one of the cylinders of the motor (termed the "reference cylinder"). Rotate the motor so that in relation to the center of the motor and the viewpoint of the operator, the reference cylinder is on the opposite side of the motor and in line with the operator. With an appropriate lever inserted in the distributor drive pin slot in the end of the shaft, rotate the shaft until the reference mark to one side of the slot is positioned on the same side as the reference cylinder. Keeping note of the reference cylinder proceed with the assembly of the distributor.

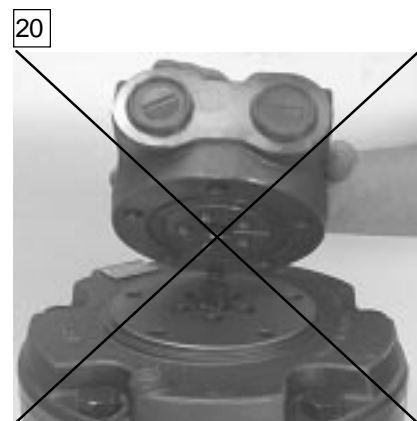
To set the motor “out of phase”: Position the reference cylinder as described above. Rotating the shaft so that the reference mark is on the opposite side and in line with the reference cylinder (rotated 180° from the in phase position) the motor will be out of phase and the shaft will rotate in the opposite direction from that indicated above.



If there are no reference marks on the shaft: Position the reference cylinder as described before. Rotate the shaft so that the distributor drive pin slot is perpendicular to the line between the center of the motor and the reference cylinder. Closing one of the cylinder feed channels to the left of the reference cylinder, rotate the shaft a quarter turn anti-clockwise. The motor is in phase if suction of the cylinder is felt with a finger. The motor is out of phase if the cylinder compression is felt with a finger. Return the lever to the starting position. If the motor was out of phase, rotate the shaft 180° to put it in phase, or vice-versa [19].



See Tool #3



7. DISTRIBUTOR ASSEMBLY

IMPORTANT: To avoid seriously damaging the motor, do not attempt to place a distributor cover pre-assembled with rotary valve and disc directly onto the motor cover [20]. The internal components of the distributor must be assembled separately from the distributor cover.

IMPORTANT: Ensure that no objects (e.g., locating pins) fall into cylinder feed holes in the motor cover. If this happens it will be necessary to dismantle the motor to remove the object.

7. DISTRIBUTOR ASSEMBLY (Continued)

ROTARY VALVE SUB-ASSEMBLY: Insert the O-ring [21] and plastic slipper [22] with the concave side on the O-ring side in the seat in the top side of the distributor rotary. The plastic seal should be assembled by first placing the positioning lug in its seat [23]. For versions with the steel ring; first place the O-ring, then the plastic seal (without lug) and then the steel ring.

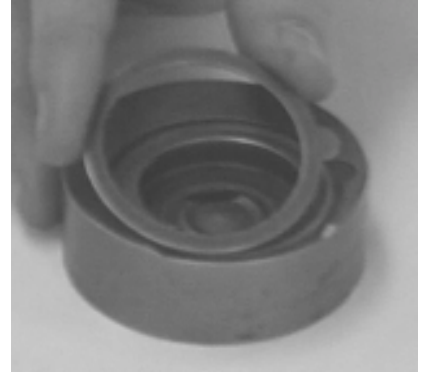
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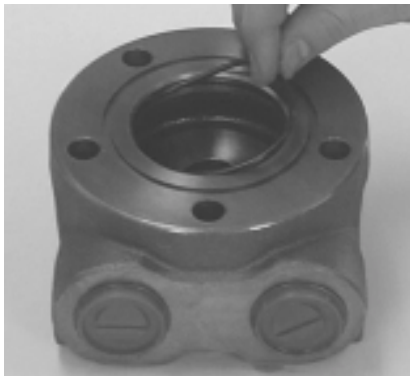


DISTRIBUTOR COVER SUB-ASSEMBLY: Insert the distributor/motor cover O-ring in the seat in the bottom of the distributor cover [24]. For distributors with the bronze disc; insert the O-ring [25] and the plastic slipper [26] with the chamfer on the side of the bottom of the distributor.

24



25



26



ROTARY GROUP ASSEMBLY: Insert distributor drive pin in shaft through the central hole in motor cover [27].

NOTE: Ensure that no objects fall into cover. If this happens it will be necessary to dismantle the motor to remove the objects. Insert the locating pins in their holes in the motor cover [28].

27



28



7. DISTRIBUTOR ASSEMBLY (Continued)

Place the disc on cover, positioning it with the locating pins [29]. Motors without the disc do not have locating pins.

Note: Motors produced before 7/87 used .236 inch pins. Motors produced after 7/87 use .196 inch pins. A certain number of discs produced have holes for both types of pin and it is important when placing the disc that it is positioned using the correct holes. The disc must sit flush with the motor cover. It does not need to be pressed on and the five oil feed holes must line up with the holes in the motor cover. Once positioned it must not be able to rotate or to move laterally. Insert the centering bush in the disc [30]. Position the distributor rotary on the disc with the side containing the seals on top and with the three radial holes to the left of the reference cylinder and the three axial holes to the right [31].

29



30



31



DISTRIBUTOR COVER ASSEMBLY: Place the distributor cover over the rotary, aligning the bolt holes in the distributor cover and the motor cover [32]. The distributor can be placed in any one of the five positions. Screw in and tighten the five bolts [33].

32



33

