



中国石油

F-1300/1600 Drilling pump

Operation Manual

AH13010200CZ

AH16010200CZ



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Preface

Thanks for using F series mud pumps produced by Baoji Oilfield Machinery Co., Ltd.

The outline dimension, frame, and fluid end of F-1300 and 1600 mud pump are the same, only the bearing and gear pair of power end are different. For convenience of customer, this manual introduces these two kinds mud pumps at the same time.

Instruction manual of F1300/1600 mud pump is a complete document for customers. This manual offers a plenty of accurate and concise data and operation procedure for reference of operator, maintenance personnel, and technologists.

It is not intended, nor would it be possible in such limited space, to cover every possible condition which may be encountered. Strictly operating according to specification and regulation can not only minimize down-time of mud pump but also prolong service life of equipments.

All specifications and data are in accordance with engineering designs specification and should be strictly abided during operation, maintenance and repair. For the matching equipments, user should operate and repair in reference to the documents supplied by original manufacturer.

If this manual has some defects, please present your suggestion and opinion.

1. Safety Regulations

The following safety regulations are general regulations for F-1300/1600 mud pump. The regulations don't appear in later chapters of Operation & Maintenance Manual. The operator should master and use these recommended preventive steps during rig operating and maintaining. The detailed preventive measures are included in the warnings of the manuals.

1.1 Qualified Persons

Only ones who are qualified can run or service the equipment.

1.2 Safety Devices

All operators and equipment servicing persons shall wear exposure suit, protective hat, protective shoes and other safety devices. Operators shall be equipped with anti-gas devices during drilling operation.

1.3 Safety Custom

Good safety custom should be followed in operation of installation, operation, disassembly, servicing etc. It is also the client's duty to establish good safety custom and train operators to obey such rules.

1.4 Equipment/Components Operation

Operators shall run equipment or its components only after they have read through every related manual and been familiar with controls and functions of these equipment / components.

1.5 Unauthorized Persons

Unauthorized persons shall be kept off equipment area when it is in operation or service.

1.6 Visibility

Operation of this system is not allowed under lower visibility. Including before sunrise and after sunset is not allowed to operate except for proper light source.

1.7 Pre-start

Any control element shall be in proper position ("On", "Off", or "Middle") before starting devices.

1.8 Working Area

Working area should be clean, with out obstacles, manual tools and other objects when this equipment running.

1.9 Firing Requirements

Firing during operation shall be kept far away from hazardous divisions and approved by related persons

2. Technical and performance parameters

2.1. Technical Specification

Model	F—1300	F—1600
Type	Triplex single acting piston pump	
Max. Liner size mm	180	180
Rated Power kW	960	1180
Rated stroke spm	120	120
Stroke length mm	305	305
Gear ratio	4.206	4.206
Valve pots	API 7 [#]	API 7 [#]
Weight kg	24572	24971

2.2 Performance data

Performance data of F-1300/1600 Mud Pump data sees table 1. When imperial system liner is adopted, the performance data sees table 2.

2.3 Overall Dimension

Overall dimension of F-1300/1600 Mud Pump sees Fig.1.

Table 1 Performance data of F-1300/1600 Mud Pump

Stroke/minute	Liner Diameter, mm & Rating pressure, MPa (Psi)													
			180		170		160		150		140		130	
	F-1300		18.7	2720	21.0	3050	23.7	3440	27.0	3915	31.0	4495	34.5	5000
	F-1600		23.1	3345	25.9	3750	29.2	4235	33.2	4820	34.5	5000	34.5	5000
	Rating power				Displacement L/S (GPM)									
F-1300		F-1600												
kW		HP		kW		HP								
130	1050	1408	1293	1733	50.42 (799)	44.97 (713)	39.83 (631)	35.01 (555)	30.50 (483)	26.30 (417)				
*120	969	1300	1193	1600	46.54 (737)	41.51 (658)	36.77 (583)	32.32 (512)	28.15 (446)	24.27 (385)				
110	889	1192	1094	1467	42.66 (676)	38.05 (603)	33.71 (534)	29.62 (469)	25.81 (409)	22.25 (352)				
100	808	1083	994	1333	38.78 (614)	34.59 (548)	30.64 (485)	26.93 (427)	23.46 (372)	20.23 (320)				
90	727	975	895	1200	34.90 (553)	31.13 (493)	27.58 (437)	24.24 (384)	21.11 (334)	18.21 (288)				
1					0.3878 (6.147)	0.3459 (5.483)	0.3064 (4.857)	0.2693 (4.269)	0.2346 (3.719)	0.2023 (3.206)				

Note: 1. Based on 100% volumetric efficiency and 90% mechanical efficiency.



2. *Recommended strokes and input power for continuous service.

Table 1 Performance data of F-1300/1600 Mud Pump

Stroke /minut e	Liner Diameter, in & Rating pressure, MPa (Psi)															
			7		6 3/4		6 1/2		6 1/4		6		5 1/2		5	
	F-1300		19.2	278 5	20.7	299 5	22.3	323 0	24.1	349 5	26.2	379 5	31.1	451 5	34.5	5000
	F-1600		23.6	343 0	25.4	369 0	27.4	398 0	29.7	430 5	32.2	467 0	34.5	500 0	34.5	500 0
	Rating power				Displacement L/S (GPM)											
F-1300		F-1600														
kW	HP	kW	HP													
130	1050	1408	1293	1733	49.19 (779)	45.74 (725)	42.41 (672)	39.21 (621)	36.14 (573)	36.36 (481)	25.10 (398)					
*120	969	1300	1193	1600	45.40 (719)	42.22 (669)	39.15 (620)	36.20 (573)	33.36 (529)	28.03 (444)	23.16 (367)					
110	889	1192	1094	1467	41.62 (659)	38.70 (613)	35.89 (569)	33.18 (526)	30.58 (484)	25.69 (407)	21.23 (336)					
100	808	1083	994	1333	37.84 (599)	35.18 (557)	32.62 (517)	30.16 (478)	27.80 (440)	23.36 (370)	19.30 (306)					
90	727	975	895	1200	34.05 (540)	31.66 (502)	29.36 (465)	27.15 (430)	25.02 (396)	21.02 (333)	17.37 (275)					
1					0.3784 (5.997)	0.3518 (5.577)	0.3262 (5.171)	0.3016 (4.781)	0.2780 (4.406)	0.2336 (3.702)	0.1930 (3.060)					

Note:

1. Based on 100% volumetric efficiency and 90% mechanical efficiency.
2. *Recommended strokes and input power for continuous service.

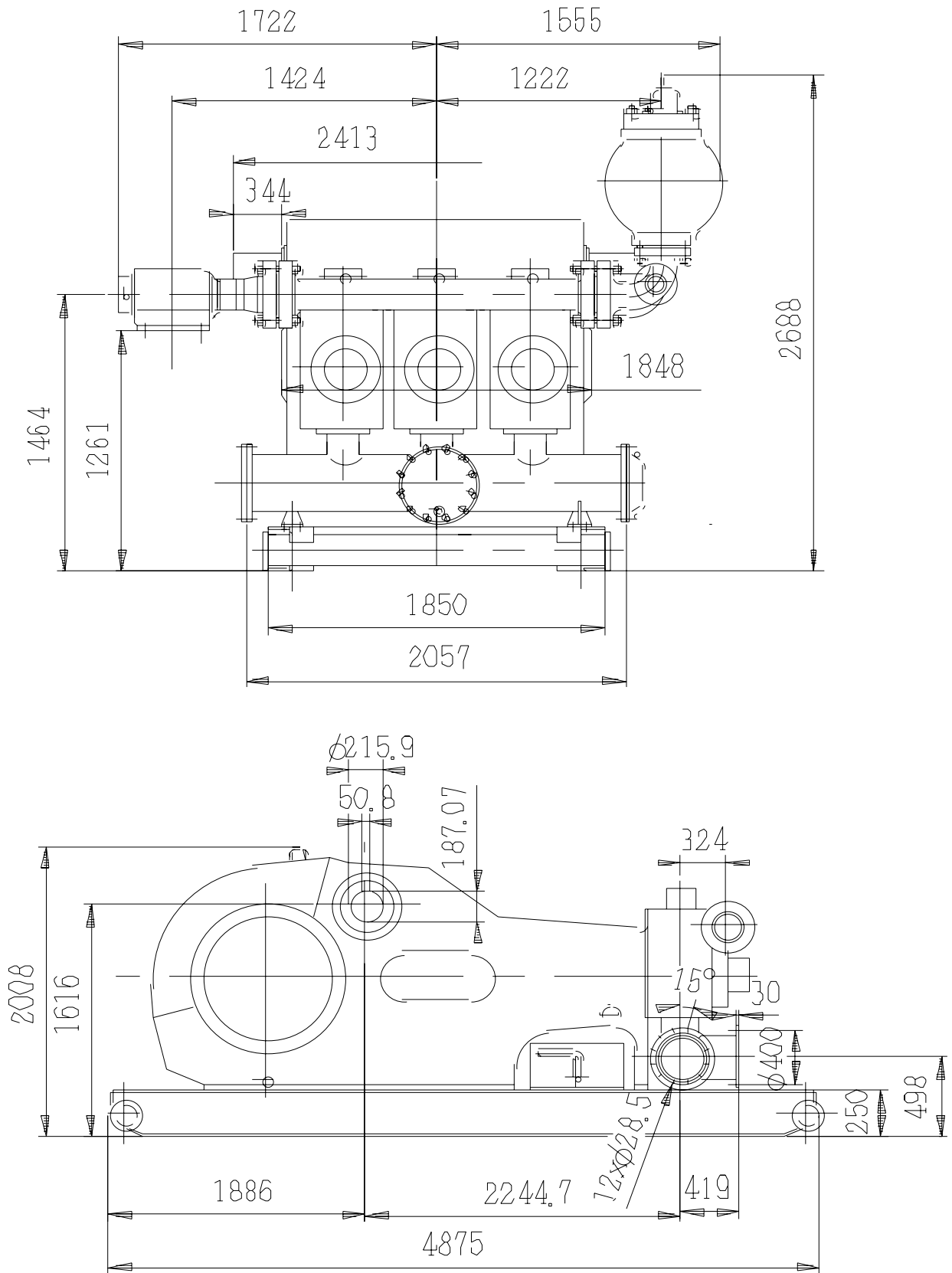


Fig.1 Overall dimension of 1300/1600 mud pump

2.4 Each assembly weight of F-1300/1600 mud pump

Unit \ Name		Pinion shaft assy.	Crank shaft assy.	Cross head	Cross head pin & baffle	Back cover	Suction manifold	Discharge manifold	1/3 fluid end connecting part
F-1300	lbs	2,356	14,564	431	201	379	704	740	2,724
F-1600		2,374	15,179						
F-1300	kg	1,069	6,606	196	91	172	319	336	1,236
F-1600		1,077	6,885						

Note: 1/3 fluid end connecting part means one hydraulic cylinder, Triplex cylinder pump has three hydraulic cylinders totally and every cylinder can be seen as one part.

3. Installation of New Pump

F-1300/1600 mud pump has been completely assembled and test operated under pressure before being shipped to the field. Unless otherwise instructed, the lubrication is drained from the power end. Before putting the pump into service, the precautions and operations must be performed or checked. In order to prevent personal injury during the performance of any maintenance or inspection procedures, this equipment **MUST BE SHUT DOWN AND NOT OPERATING**, and all safety devices on prime movers and drive devices **MUST BE IN THE SAFE POSITION**.

The skid under the F-1300/1600 mud pumps is suitable for any type of installation. However, the support under the pump must be level and adequate to support the self-weight and operating forces exerted by the pump.

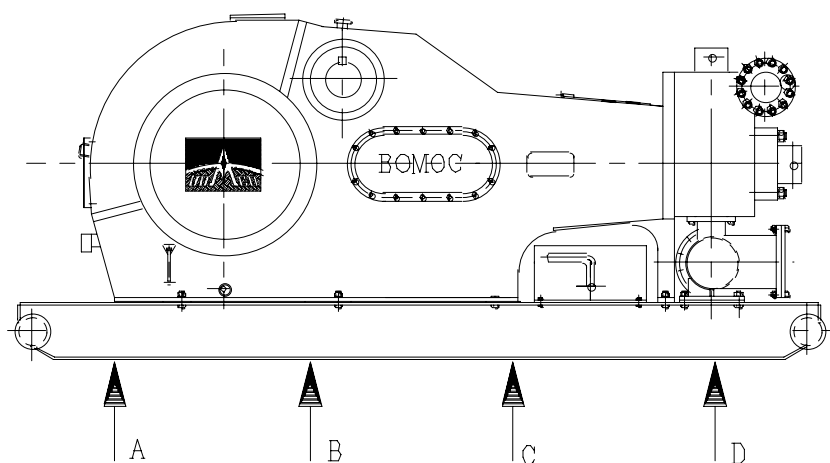


Fig. 2 Support of drilling pump

3.1. Ground Installation

When ground installation is going on, 8 pieces of 76mm×305mm boards is cushioned in the direction of pump skid, as indicated in Fig.2. The base of boards should be 300mm wider than that of pump skid beam. In the wet or moist circumstance, need solid base.

3.2. Permanent Installation

When installing mud pump on the structural base or concrete slab of drilling barge and platform, fix pump skid with bolts, it is essential that the skid should be properly shimmed to prevent possibility of twisting or distorting the power frame. The pump skids must sit solid on all shim points with bolts loose.

On barge installations, the pump skids are generally bolted down to T-beams. Install shims at points shown in Fig, 2 and 3 and observe caution of proper shimming to prevent twist or distortion. The shims on all installations should extend the full width of the skid beam flanges and have a minimum length of 12" (305mm).

When prime mover, drive device are installed integrally with the pump skids, the preferred installation would be to set the pump package on the T-beam skids and provide retention blocks rather than bolts to hold it in place. This will allow the pump to "float" and minimize the transfer of barge deck or platform distortion into the frame.

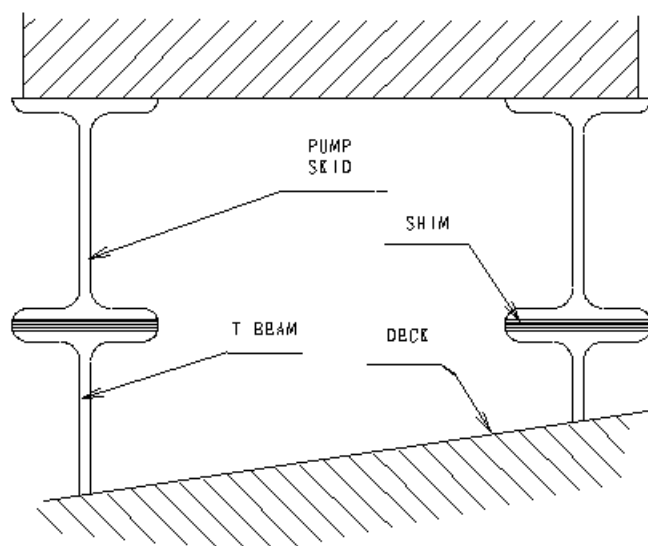


Fig. 3 Installation of drilling pump

3.3. Installations of Driving Device

The drive between the mud pumps and prime mover should be adopted V-belts or multi-row chains drive, which is installed with precision to assure longest service life and minimum possibility of unexpected or undesirable shutdowns due to drive failures.

When installing the drive sheave or sprocket, make sure all grease or rust preventative is removed clearly from the shaft end and the matched bore. Remove all burrs or rough spots from the shaft, key, and keyway. Fit key to the keyways in both the shaft and drive and install key into shaft keyway.

Coat pinion shaft with light grease or anti-adhesive compound or light oil and install the drive sheave or sprocket hub. Tighten hub bolts as indicated below:

Use of wrench or lengthening bar to tighten bolt may lead to increase of torque, so it is necessary and important to tighten bolt according to the following torque values, because in mounting the hub, the tightening force on the bolts is multiplied many times by the wedging action of the tapered surface. This action compresses the hub for a snug fit on the shaft. If the bolt-tightening forces are extreme, bursting pressure is created in the hub of the mounted pulley; this pressure may cause the hub to crack. The hub bolts should always be tightened alternately, progressively and gradually.

Wrench Torque N.m	Wrench Length mm	Wrench pull N
810	900	900

Note: N=0.1kgf

3.3.1. V-Belt Drives

1. Check sheaves groove condition

Before installing the v-belts, check if sheave grooves is worn or rounded for wearing, worn grooves will destroy V-belts rapidly. The sidewalls must be straight. In sheave grooves there is no dirt, rust or other extrusions, which could damage the V-belts.

2. Check alignment of belt pulley

3. Adjust V-belt for previous tension

Adjust the belt tension by moving the belt pulley center distance until all of the sag has just been eliminated from the tight side of the belt and some of the belts on the slack side. Then increase the given center distance. For example: on 2540mm(100") Center distance, after adjust center distance then increase additional 13mm(1/2"). On 3180mm (150") center distance, after adjust center distance then increase additional 19.5mm (3/4").

Do not obtain belt tension by picking up end of pump and allowing belts to tighten under weight of pump as end is being lowered to the ground.

3.3.2 Chain Drive

Proper installation and maintenance of the sprocket and chain drives are essential if good service life is to be obtained. Since many factors, such as chain width, center distances, speeds, and loads must be considered when determining the allowable tolerance for sprocket alignment; no good "rule of thumb" can be applied. The chain alignment must simply be held as nearly perfect as possible. A more precise alignment can be made by stretching two steel wires (piano wire) along one face of the two sprockets, one above and the other below the centerline, and moving one of the sprockets until the wires touch at four points. This will determine that the centerlines of the drives are parallel and the faces of the sprockets are square.

3.4. Installation of pump components

3.4.1 The Preparation of Power End

F-series mud pump has been completely assembled and test operated before being shipped to the field. Unless otherwise instructed, the lubrication is drained from the power end. Before operating the pump, the following must be performed or checked.

3.4.1.1 Power End Lubrication

Before injecting lubricant, open inspection door of cover, check if oil in power end reservoir goes bad, remove the pipe plugs (No. 2 in Fig.7) on each side of the pump, drain all the remaining lubrication oil and flush. Add the proper type and quantity of lubrication in the power end (Refer to nameplate on pump frame for type and quantity required).

Recheck oil level after pump has operated for 15 minutes. Shut pump down and allow approximately five minutes for the oil level to equalize, Check oil level gauge, (No. 1 in Fig. 7). It is usually necessary to refill about 10L (3 gallons) oil since a certain amount is retained in the crosshead area and frame cavities.

3.4.1.2. Installation of Intermediate Rod and Stuffing Box Seals

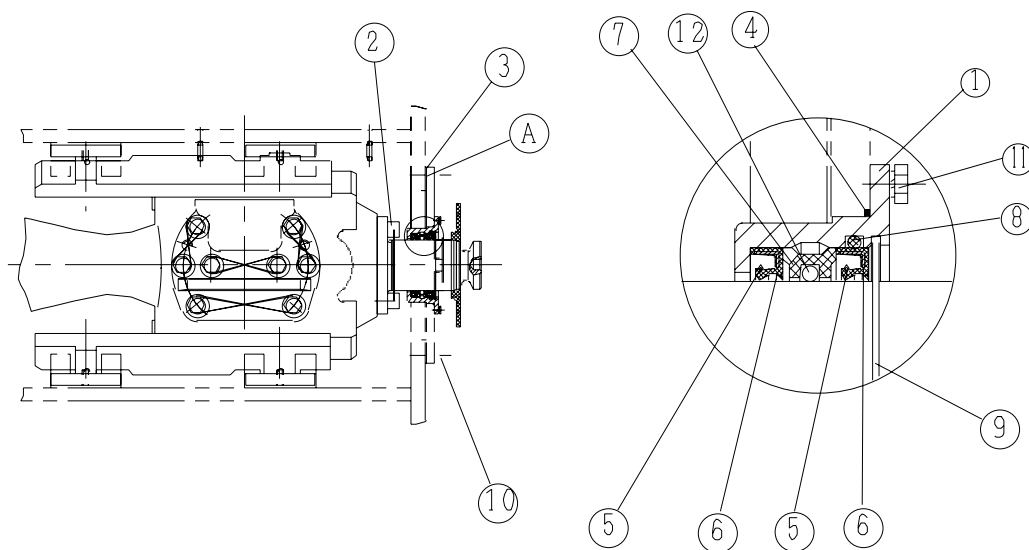


Fig. 4 Intermediate Rod and Crosshead Assembly

(1)stuffing box (2) Bolt (3) Shim (4) O ring (5) spring (6) two-lip oil seal (7) Sealing ring (8) O ring (9) Locking spring (10) Bolt (11) Bolt (12) O-ring

Refer to Figure 4, remove the stuffing box¹ and mud apron so that crosshead is at the front of the stroke; thoroughly clean the front of the crosshead and the face of the crosshead extension rod. Mount position boss of extension rod to the crosshead and tighten the retainer bolts², the torque is 475~500N.m (350~370ft.lbs), at last tighten with iron wire. Thoroughly clean mud apron and the face of frame, on the "A" place in Fig. 4 mount washer ³ and bolt ¹⁰, tighten it and the torque is 120~160N.m (90~120ft.lbs).

Thoroughly clean the hole and the end face, and meanwhile clean exterior surface of stuffing box and surface of flange stuffing box plate. Coat the exterior surface of stuffing box with light oil and install O-ring ⁴. Install stuffing box on the mud guard packing then tighten bolts as the following torque: 16~24N.m (12~18 ft .lbs).

The stuffing box packing assembly consists of two lip oil seal⁶, oil seal ring⁷, O-ring¹², O-ring⁸ and lock spring⁹. Install the assembly as follows:

Method A:

Remove spring⁵ from two lip oil seal⁶ and mount it on the exterior of the crosshead extension rod with lip toward power end. Then install spring ⁵ on the oil seal lip, and slide them into the stuffing box. See the following notes.

Put the O-ring¹² into Oil Seal ring⁷. Install O-ring¹² and oil seal ring⁷ on the extension rod and then put it into stuffing box bore.

Install the O-ring⁸ in groove of stuffing box.

Installation left/right double lip seal ⁶ in the Fig.4 as a).

Note: The double lip seal near power end can be replaced by single lip oil seal, but DO NOT use the single lip seal in the outer position (fluid end).

Install the locking spring⁹

Method B:

Take down the stuffing box Φ from pump frame. Assemble two lip oil seal, oil seal ring $\textcircled{7}$, O-ring $\textcircled{12}$, O-ring $\textcircled{8}$ and lock spring $\textcircled{9}$ in the stuffing box as per Fig. 4 of partial enlargement, and then hook O-ring $\textcircled{4}$ over the cylindrical outside surface of the stuffing box Φ .

Install the guide sleeve on the front end of Crosshead tension rod as per Fig.4, and coat light lubricant on the outside surfaces of Crosshead tension rod and the guide sleeve.

Mount the stuffing box assembly on Crosshead tension rod through the guide sleeve, pull it into position by hand, and then fix the stuffing box Φ on the mud guard packing with spring washer and bolt (11).

Note: must ensure the pressure spring (5) does not slip out of the groove in the oil seal lip, as severe scoring of the crosshead extension rod can occur. Coat light lubricant on extension rod for easy installation of the stuffing box assembly.

3.4.2. Spray Pump Assembly

Spray pump assembly consists of spray pump, water tank and spray nozzle etc. It functions flushing and cooling piston and liner during pump operated.

Proper attention must be paid at all times to assure adequate cooling fluid is being applied to the piston and liner assembly. Stoppage of the cooling fluid will result in almost instant failure of the piston rubbers and possibly extensive damage to the liner.

Stationary spray pipes have been used on F-series pumps Ref. Fig 5. It consists of a fixture frame (1), steel pipe (2) and spray nozzle (3), it makes cooling fluid spray to piston and liner. Adjust cooling water supply to the manifold and inspect spray nozzle operation very often to make sure the nozzle is pointed directly at the piston.

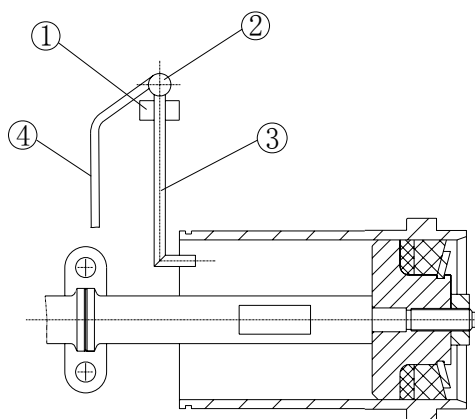


Fig. 5 Stationary spray pipes

(1) Fixing frame (2) Steel pipe (3) Spray Nozzle (4) Soft pipe

Cooling fluid is transfused from spray pump (No.3 in Fig .7) through Water tank (No.5. in Fig. 7) to the manifold on left/right wall plate of the frame. Adjust regulating valve (No.4 in Fig .7) to supply as much water as possible to the liners without splashing back on the crosshead extension rods. Avoid some water will work back into the power end to contaminate the lubrication oil.

The cooling fluid returns to the setting chamber from the crosshead extension rod compartment, and as the fluid overflows through the filter screen between the two sections of the tank, the solids are allowed to settle out. The filter screen will catch much of the foreign material in the fluid. Refer to Fig .6.

Check cleanliness of the cooling fluid at frequent intervals and CLEAN and FLUSH reservoir and replace the cooling fluid as required. Increasing sand grain in contaminated fluid will cause premature

abrasion of liner and piston or stoppage of the spray nozzle or spray tube.

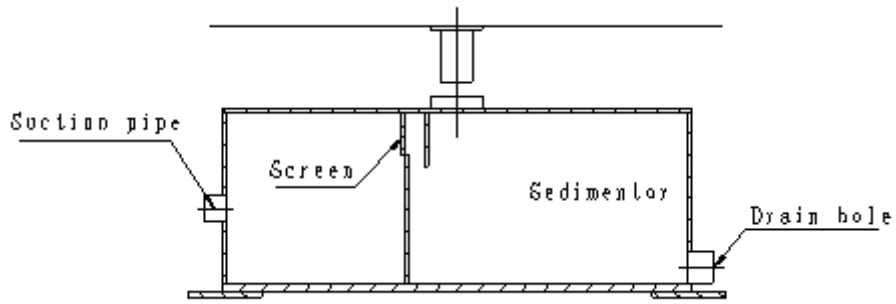


Fig. 6 Cooling fluid box

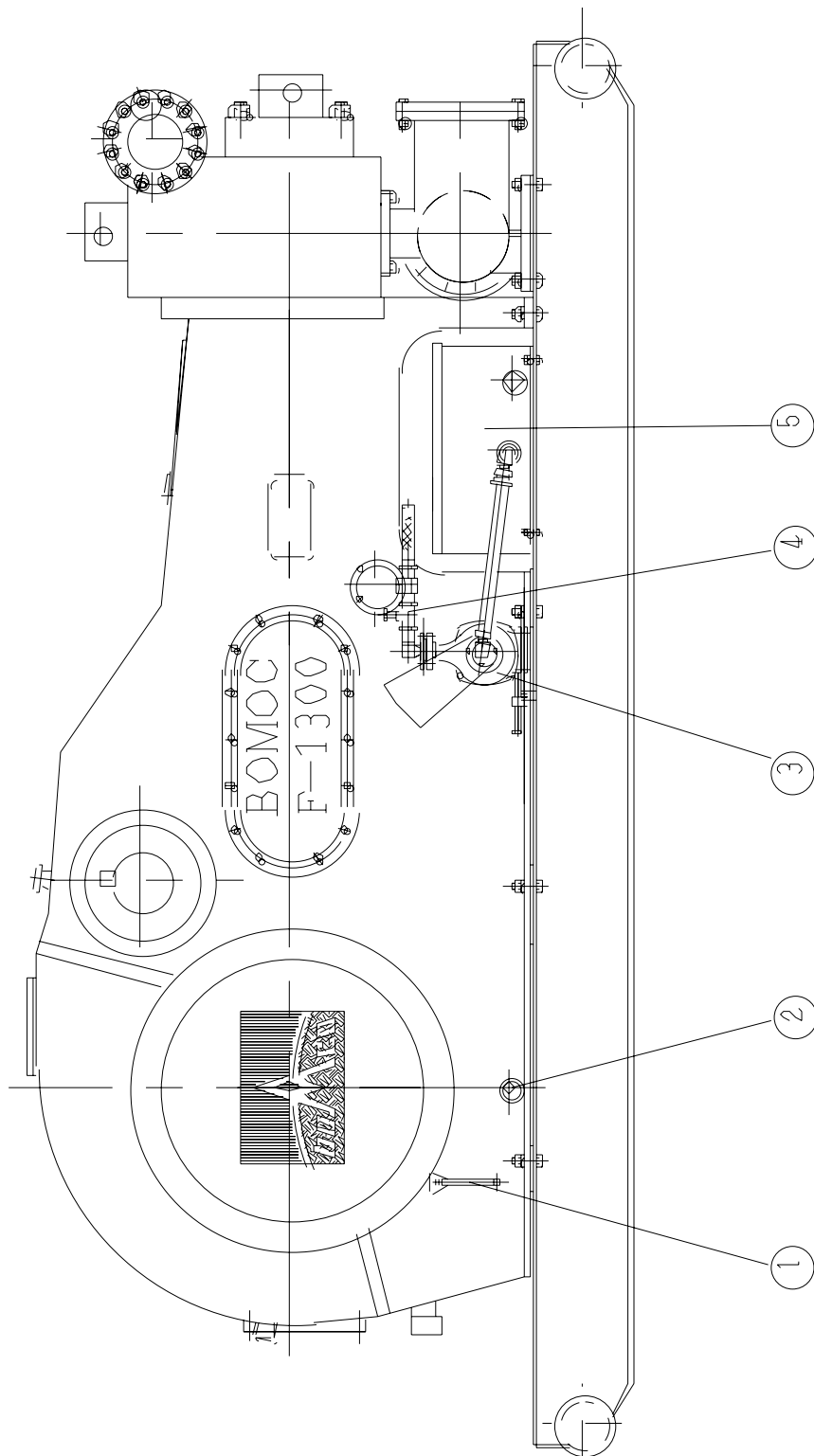


Fig. 7 Cooling and lubrication drawing

(1)Oil level indicator (2) Plug (3) Spray pump (4) Regulating valve (5) Water tank

3.4.3. The assembly of Fluid End Parts

A profile of the fluid end for F-1300/1600 is shown in Fig. 8. Refer to Fig. 8, clean and assemble the

fluid end parts as following:

Note: Most of the parts in fluid end are designed with metal to metal seating to alleviate friction wear from breathing action encountered in modern high pressure pump operation. For this reason it is essential that all parts should be clean and free of rust, nicks and burrs to ensure reliable seal before being assembled.

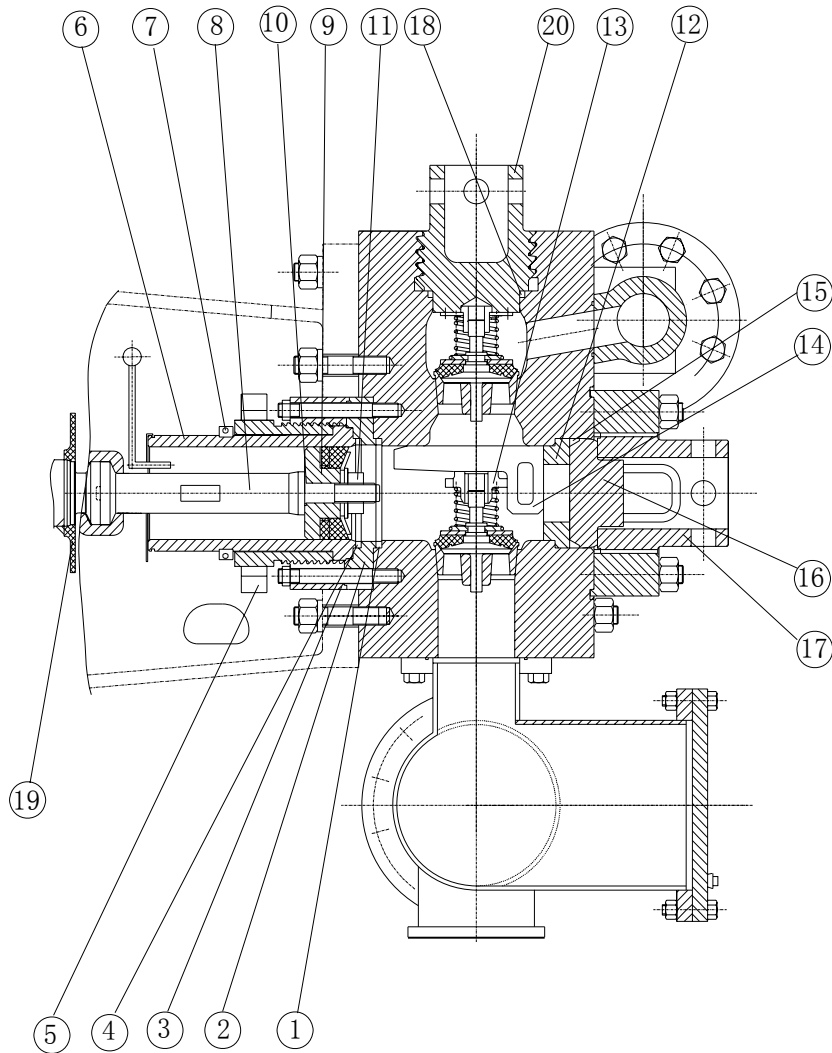


Fig. 8 F— 1300/1600 Fluid end assembly

1. Wear-resisting plate seal; 2. Wear-resisting plate; 3. Liner flange; 4. Liner seal ring; 5. Liner press cover; 6. Liner; 7. Liner locking ring; 8. Piston rod; 9. Piston; 10. Piston seal; 11. Nut; 12. Locating plate; 13. Valve rod guide; 14. Plug plate; 15. Cylinder head seal ring; 16. Cylinder head plug; 17. Cylinder head; 18. Valve cap seal ring; 19. Mud guard packing; 20. Valve cap

3.4.3.1. Valves and Seats

Remove three valve caps (20), three cylinder heads (17), and plugs (16) as shown in Fig.8. And thoroughly clean all machined surfaces in the fluid end with a good cleaning solvent.

Make sure all valve seat bores are very clean and dry (free of dirt, grease, anti-rust compound, etc).

THOROUGHLY CLEAN AND DRY the valve seats and installs suction and discharge valve seats into the valve pot bores. Drive seats firmly into place with a bar and hammer to ensure contact closely. Install valves and springs and the other parts.

3.4.3.2. Liners

Installs wear-resisting plate seal (1) in counter bore of fluid end (see Fig. 8). Install wear-resisting plate (2) through studs until it seats against fluid end. Mount liner flange (3) over studs with the starting thread at the 5 o'clock position and tighten bolts with 640~690N.m (470~510ft.lbs) torque.

Note: Placing the starting thread at 5 o'clock position to make the liner gland threads meshing much easier.

Place liner seal (4) in counter bore of wear-resisting plate (2). Apply thin coat of grease to ID of liner lock (5) and slide over rear of liner (6). Install two-piece liner lock ring (7) in liner groove and O-ring to hold them in position. Slide liner-handling tool over liner up against liner lock ring and tighten setscrew to secure it in place. Hoist liner assembly into position with jib hoist. Apply liberal coat of grease to liner lock threads. Align the starting thread of the liner lock (5) to the 7 o'clock position and insert the liner into the liner thread ring (3) screw liner lock in until liner seats in position. Tighten with sledgehammer on hammer lugs.

3.4.3.3. Piston Rod

Clean piston (9) and piston rod (8), making sure they are free of nicks and burrs. Install piston seal ring (10) in groove of piston head. Slide piston head (9) on rod while observing that O-ring does not fall out of groove. Tighten piston rod nut (11) with 1625~2165 N.m (1200~1600ft.lbs.)

Coat grease on liner I.D. and piston O.D. Check ends of piston rod and extension rod to be sure they are clean and free of burrs. Insert piston rod into liner through cylinder head opening holding piston rod centered at the rear of the liner. Drive the piston into the liner with a driving tool or a piece of hardwood and sledgehammer. Use caution as the piston rod approaches the crosshead extension rod that the dowel on the end of the piston rod is not damaged. The piston rod must be supported and the dowel guided into the pilot bore.

3.4.3.4. Piston Rod Clamps

The piston rod clamps are machined as one piece and then sawed in half. The two pieces are with matching numbers on each half and connected by chain. The two pieces with the same matching numbers should always be kept together as a set. Install the clamp around the rod end flanges. Tighten bolt with the following torque values: 330N.m (245ft.lbs). before the clamps are installed, mud guard packing (19) should be installed on the end of crosshead rod.

When piston rods and rod clamp are new, a gap in excess of 5.5mm could be present between the two halves of the clamp, this is satisfactory provided the faces of the rods are seating metal to metal. As wear occurs, the halves will pull closer together. Clamping action will be lost when a gap no longer exists. At this time clamps must be replaced. Install splash plate on rear of liner.

3.4.3.5. Lower valve Guide and Cylinder Head

Insert the lower valve guide (13), hook it around the stem, insert plug (14) into the locating groove of valve guide. Mount locating plate (12) in pump head bore, meanwhile install cylinder seal ring (15) on cylinder plug (16) Start the lock plate (14) and draw it down, compressing the valve spring and seating Coat seal ring and O.D. of plug with light lubricant. Push cylinder plug into the opening of fluid end. Grease the cylinder head threads; screw the cylinder head (17) in against the plug (16). Tighten cylinder head with wrench provided and sledge hammer.

Fluid leakage through the discharge hole indicates a defective seal or loose cylinder head. Should replace seal or tighten cylinder head in time. DO NOT plug the discharge hole since this can result in severe damage to cylinder head threads.

3.4.3.6. Valve Cover

Install valve cover seal ring (18) into bore, and after grease the valve cover seal area and threads area, tighten the valve covers into place using a sledge hammer and bar.

3.4.3.7 Discharge Manifold

API 5" (127mm) 5000psi flanges are provided on the discharge manifold. Remove discharge flange and seal gasket area before welding (customer's option for the welding methods) flange on the discharge piping. Tighten flange connection bolts with 1625-2165 N.m (1200~1600ft.lbs.) torque. Tighten nuts in a cross-criss order.

3.4.3.8 Suction Manifold Flange

The suction flange has 3 12" (305mm) connection flanges. Generally they are installed as per oilfield condition: one is connected with suction manifold inlet, one with suction dampener, and one is plugged by blankoff flange. An O-ring seals off the connection. Thoroughly clean O-ring groove and face of flanges before making up connection. Tighten flange bolts with 490~665N.m (360~490ft.lbs).

3.4.3.9 Auxiliary Manifold

An auxiliary manifold is shown in Fig.9. It can be installed on the discharge manifold opposite the discharge end. The manifold can connect with KB-75 pulsation dampener (1), shear relief pin (3) and pressure gauge (2).

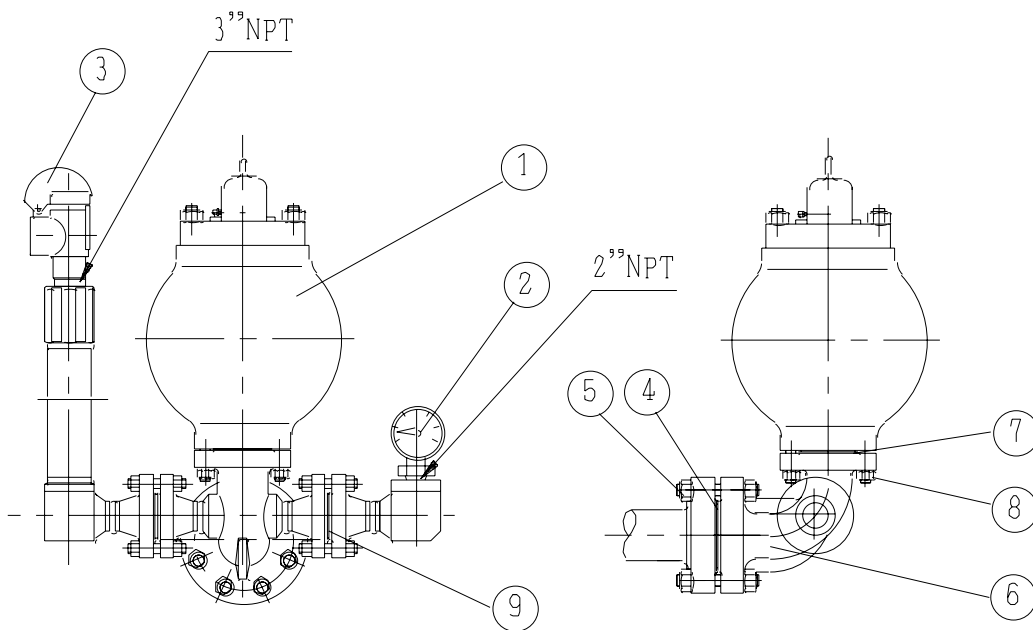


Fig. 9 Auxiliary Manifold and Discharge Manifold

(1) Pulsation dampener (2) pressure gauge (3) shear relief valve (4) Seal washer (5) flange bolt (6) Discharge four-way joint (7) Seal washer (8) nut (9) Seal washer

An auxiliary manifold connects with discharge manifold by flange. Before assembly thoroughly clean joint groove of flange, install seal washer (4) and tighten the flange bolts (5) with 1625-2165N.m. (1200-1600ft.lbs) torque. To assure uniform make-up of seal washer connection, the clearance between flange end faces should be even, tighten the nuts in a criss-cross order.

The shear relief valve (3) is installed on the auxiliary manifold for the purpose of protecting the pump from excessively high-pressure overloads. The relief valve must be installed correctly so that it will be directly contacted with the mud pump. DO NOT PUT ANY TYPE OF SHUT OFF VALAE between the relief valve and the manifold. Pipe the discharge end of the relief valve directly into the mud pit with

seamless steel pipe as few turns in the line as possible. If the turn must be made, the elbow should be over 120°. IT IS NOT RECOMMENDED for the discharge end of the relief valve to be piped into the suction line of the pump.

The mounting for KB-75 pulsation dampener (1) is a flange with R-39 seal washer. Before installing dampener, thoroughly clean ring groove and ring, and after setting dampener into place, tighten the nut (8) with 950-1265N.m (700-935ft.lbs) torque. Tighten nuts in a criss-cross order.

Both sides of discharge four-way joint are R-27 seal washer flange. Before installing, thoroughly clean gasket and groove. Connect the bolt and the nut with 495-660N.m (365-490ft.lbs) torque, tighten nuts in a criss-cross order.

Precharge air or N₂ to dampener before starting up pump. See details in “Dampener assembly” section.

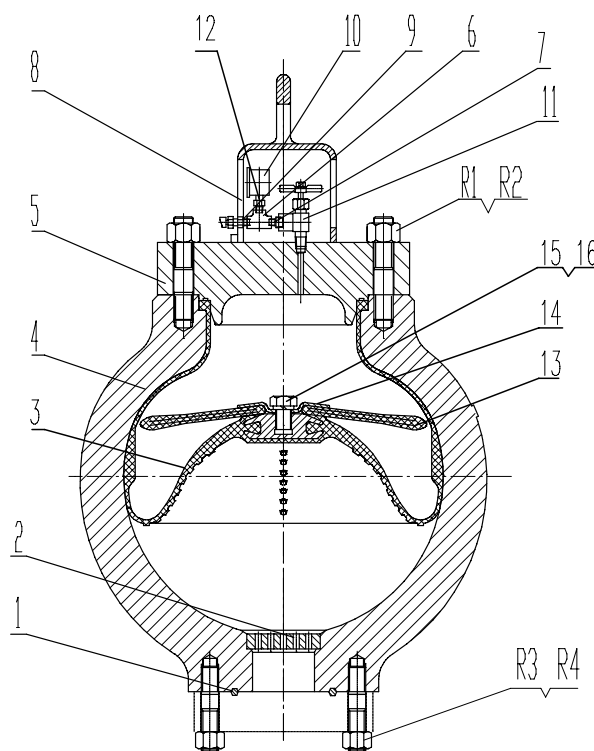


Fig.10 KB-75 Dampener assembly

(1) Gasket ring (2) bottom plug (3) bladder (4) shell assembly (5) cover (6) tee joint (7) Joint (8) shield of pressure gauge (9) exhaust valve (10) pressure gauge (11) stop valve (12) Washer (13) Balance disc (14) Press plate (15) Spring washer (16) Bolt (R₁) stud (R₂) nut (R₃) stud (R₄) nut

3.4.4 Dampener Assembly

Correct installation and usage of dampener can availablely reduce the pressure fluctuation of discharge system therefore obtaining smoother fluid. For the sake of acquiring long life span of dampener, usually make pressure of pump and precharge pressure of bladder to keep the suggestion proportion. It should not be more than 2/3 of the pump discharge pressure, or a maximum of 4.5Mpa. (650psi).

3.4.4.1 Installation

The structure of KB-75 dampener is shown in Fig.10. The pad eyes installed on the pressure gauge shield 8 is used for lifting dampener assembly. Before assembly thoroughly clean ring groove, gasket

ring ϕ and groove of mating flange and coat with grease.

Lifting the dampener to the corresponding position of mud pump discharge line, screw nut (R4) with 950~1265N.m (700~935ft.lbs) torque. Assure the connection part is flat and aligned by alternately tightening the nuts.

3.4.4.2 Air charging

A set of air charging device is attached when equipment leaves factory (air charging hose assembly of dampener) please Operate as following procedure: (See Fig. 11)

- a) Remove shield of pressure gauge of dampener, rotate valve cover of exhaust about 1/4-1/2 turn to release the air pressure existed in pressure gauge area, then remove the exhaust valve.
- b) Connect hose to the nitrogen cylinder valve and charge valve of dampener.
- c) Open the charge valve of dampener.
- d) Slowly open the nitrogen cylinder valve, use this valve to adjust incoming N_2 of dampener.
- e) When the pressure gauge of dampener indicates pressure required then shut the nitrogen cylinder valve.
- f) Shut the charge valve of dampener.
- g) Remove hose, cover the shield of pressure gauge, and then install the exhaust valve.

For getting best result, Precharge pressure should not be more than 2/3 of the pump discharge pressure, or a maximum of 4.5 Mpa. (650psi)

Warning:

1. Only charge with compressed nitrogen or air. Do not charge with inflammable and explosive gas such as oxygen and hydrogen etc.
2. When make maintenance to the dampener, insure both the dampener pressure gauge and the pump pressure gauge indications is zero. Low pressure can't be exactly shown by the dampener pressure gauge, which may cause an accident.

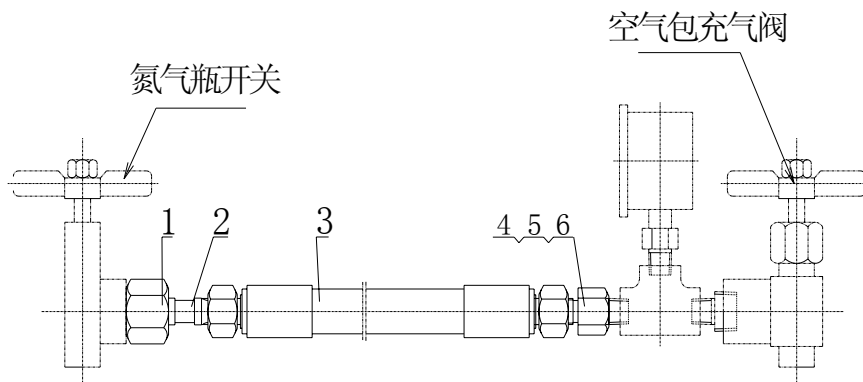


Fig. 11 Air charging pipelines of Dampener

- (1) Nut C5/8" (2) Seal connector (3) C-type connector hose M14x1.5 (4) Joint (5) Gasket (6) Plug

3.4.5 Shear safety Valve

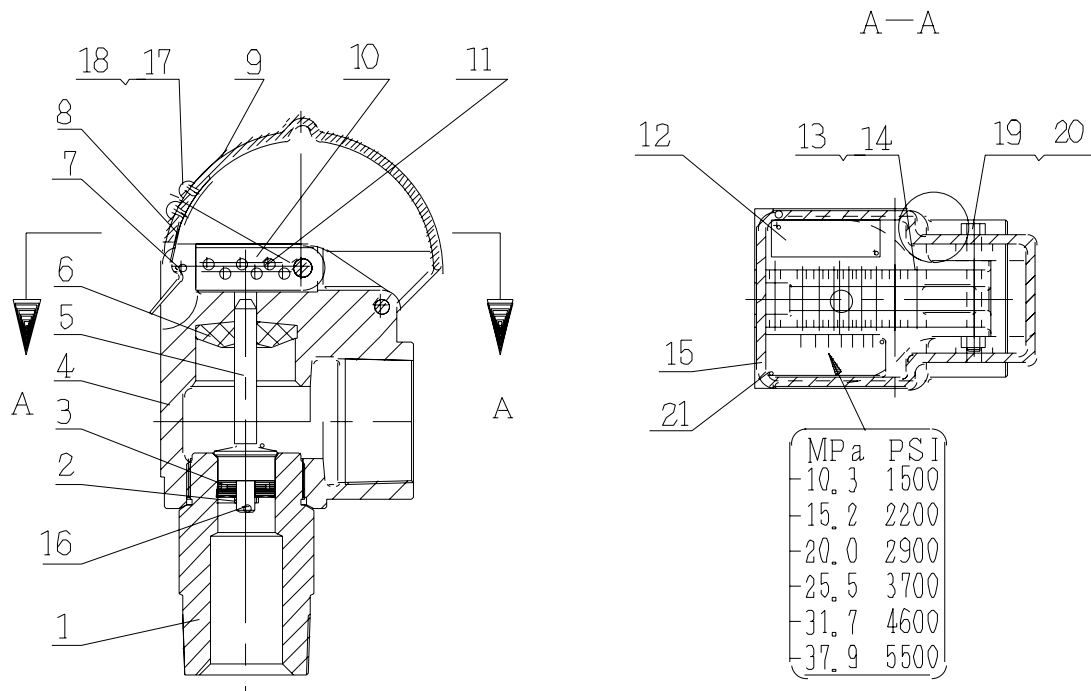


Fig 12 JA-3 Shear safety Valve

(1)Connector (2)Retainer Ring (3)Piston Assy. (4)Body (5)Piston Rod (6)Bumper (7)Pin (8)Locking spring (9)Safety Cap (10)Shear Bar (11)Shear Pin (12)Warning Plate (13)Pin shaft (14) Retainer Ring (15)Name Plate (16)Cotter Pin (17)Nut (18)Cap screw (19)Bolt (20)Nut (21) Cap screw

JA-3 shear pin safety valve structure refers to Fig 12. When the pump pressure exceeds the rating pressure, the force of piston (3) will jack up shear pin plate (10), which will cause the shear pin (11) broken and the fluid emptying fast.

Change the position of shear pin can adjust the release pressure value. The operation is simple and reliable.

Each classification work pressure is marked on the shear bar. When adjust the pressure, what to do is just to put the shear pin in the relevant hole according to the given pressure. Note: There must be only one shear pin in the shear bar one time! Adjust the pressure with the liner changes. (Refer to Section 1.1.2). Wire, arc welding or other alternative material are strictly forbidden, otherwise the valve pressure is affected which maybe a reverse accident.

3.4.6 Pinion shaft assembly

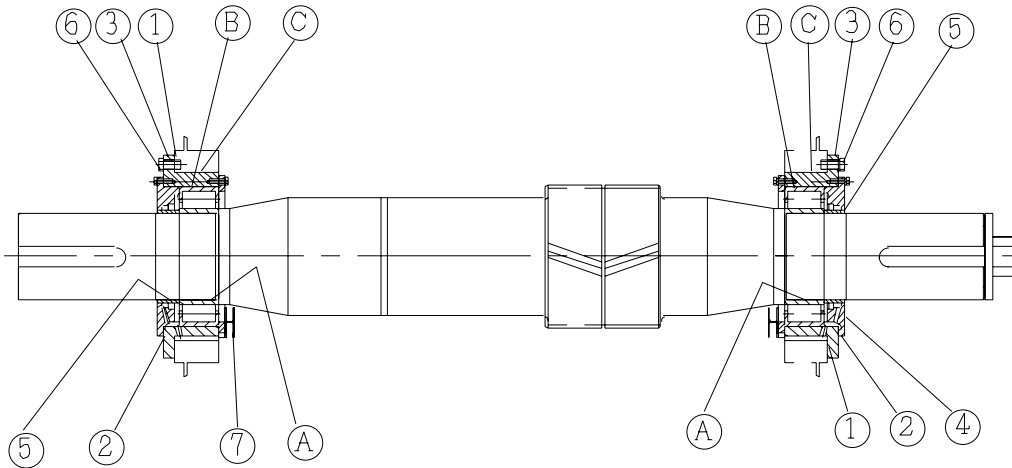


Fig.13 Pinion shaft assembly

(1) Washer (2) Cover washer (3) Bearing sleeve (4) Cover (5) Wear-resisting sleeve (6) Bolt

Table 3 (mm)

Description	Inner Race to shaft journal	Outer Race to Bore	Bearing sleeve to frame Bore
Position	A	B	C
Data mm	T0.050~T0.109	T0.115~L0.018	L0.203~L0.076

Note: T-shrink range L-Clearance range

Since the pinion is an integral part of the shaft, only install the bearings and oil seal anti-wear sleeve to complete the assembly (See Fig.13).

The running clearances of the bearings are predetermined by their precision fit to the shaft and the bearing carrier. When performing maintenance or overhaul, make sure the fits show in Table 3 is obtained.

When installing the pinion shaft assembly on the pump, observe the following precautions:

Insure pinion bearing carrier gasket (1) and oil seal carrier gasket (2) are in place and in good condition.

When installing the bearing sleeve (3) and the cover (4), make oil collecting groove face to (7) and correctly align with oil return bore.

Remove burrs, dents or gouges from the outer surface of the anti-wear sleeve (5) before sliding cover (4) into place. When sliding lip of seal over end of shaft exercise care to prevent it from being damaged by the sharp edge of the keyway. Also pay particular attention to insure oil seal lip IS NOT TURNED by edge of the sleeve when sliding seal into the anti-wear sleeve.

Tighten bearing bolts (6) with the approximate torque 110~215N.m (80-160ft .lbs)

Check condition of the pinion bearing inner and outer races and rollers. If there is any indication of galling, flaking or grooving, or if diametric clearance exceeds 0.3mm, it is recommended the entire bearing be replaced.

3.4.7 Crankshaft Assembly

The crankshaft assembly consists of the crankshaft, gear ring, connecting rod with bearings, and the

main bearings. The running clearances of the bearings are predetermined by their precision fit to the shaft and their respective bores. When performing any maintenance or overhaul, make sure the fit shown in Table 4 are obtained.

Table 4 Matching requirements of crankshaft assembly

Description	Inner Race. to Shaft journal	Outer Race. to Bore	Inner Race. to Shaft	Outer Race. to Bore
Position	A	B	C	D
Data mm	T0.098~T0.165	L0.095~0	T0.175~T0.300	T0.100~L0.050
Description	Gear ring to Flange	Carrier to Frame Bore	Outer Race. to Bore	Inner Race. to Pin
Position	E	F	G	H
Data mm	L0.025~L0.127	L0.051~T0.051	T0.015~T0.075	T0.031~T0.090

Note: T-shrink range L-Clearance range

Assemble the crankshaft in the following manner :(Refer to Fig.14)

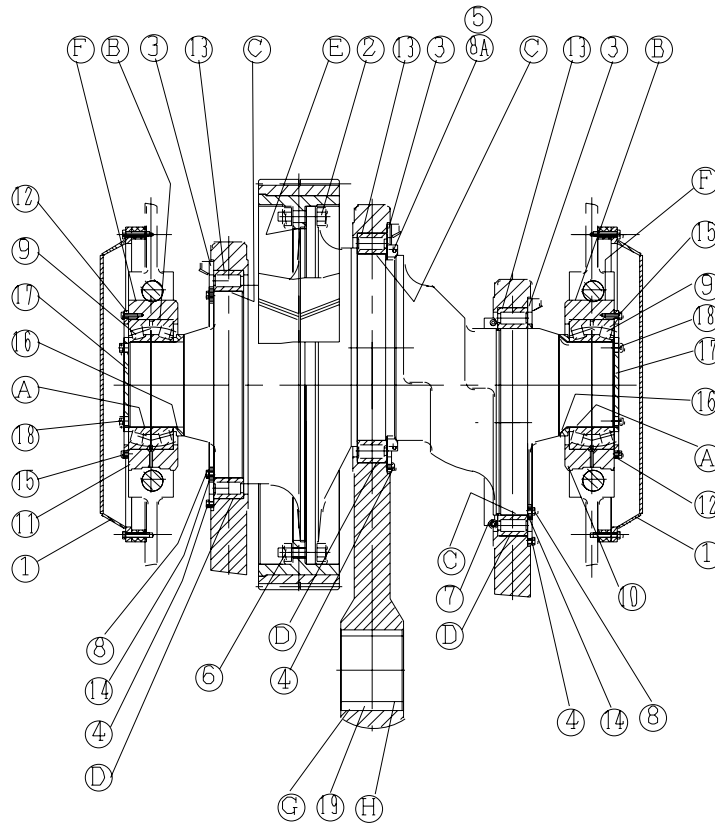


Fig.14 Crankshaft Assembly

(1) Cover (2) Bolt (3) Retainer ring (4) Bolt (5) Bearing retainer ring (7) Retainer ring (8) Bolt (8A) Inner hex bolts (9) Main bearing (10) Right bearing sleeve (11) Left bearing sleeve (12) Outer retainer ring (13) Connecting rod bearing (14) Inner retainer ring (15) Bolt (16) Main bearing retainer (17) Inner race retainer (18) Bolt (19) Crosshead bearing

1) Install gear ring and check run-out.

Thoroughly clean mating faces of gear ring and crankshaft flange, fasten gear ring into position with

bolts. Tighten flange bolts (2) to the torque: 2455 N.m (1810ft .lbs)

Install a set of roller bearing on both ends of crankshaft, and measure gear ring face run-out with dial indicator. Because of the effect of roller bearing clearance, it is required to measure synchronously on shaft end and gear end face with dial indicator; the real run-out on any position is the D-value of the two readings. When the run-out exceeds 0.224mm (0.0088in), take down gear ring and check the reason of over D-value.

2) Install the outer races of the connecting rod bearings (13) and the outer race retainer ring (3) in the three connecting rods separately. Outer retainer ring should be installed as following: when the pump is at the middle strokes, oil collecting ring should be at the bottom; tighten bearing retainer bolts (4) with the torque 75 N.m (55ft .lbs) and lock with wires. NOTE: The inner/outer races and rollers of the connecting rod bearings are matched by group and must not be intermixed.

3) Install the outer race of the crosshead bearings (19) into three connecting rod small ends .It is preferred that the outer race assembly be "pressed" into position of frozen in "dry ice" (CO₂) or a deep freeze until it can be inserted into the bore. Under emergency circumstances, the outer race assembly can be installed by using a large torch and heating the eye of the connecting rod. DO NOT EXCEED 149°C (300°F) (Use TemilStick) and DO NOT USE WATER to cool the strap.

NOTE: The inner and outer races of the crosshead bearings are matched by group and should not be intermixed.

4) Install the inner race of the crosshead bearing on the crosshead pin and mark respective items (like 1,2,3 or left/mid/right) according to their positions. Remove all nicks and burrs before shrinking race into place. Refer to bearing fit Position H Table 3.

5) Install inner race of the center eccentric bearing on the shaft. Slide center strap into position and install inner race clamp (5). Tighten socket head screws (8A) in clamp with the torque 60~90 N.m (44~66ft .lbs).

6) Install retainer ring (7) in the groove on RH eccentric and shrink inner race of eccentric bearing on shaft. After installing the connecting rod into position, install inner bearing retainer (14).Tighten inner race retainer bolts (8) with the torque 60~90 N.m (44~66ft .lbs).

7) Install the LH eccentric bearing and connecting rod etc.(refer to item 6) above).

8) Place main bearings (9) in the main bearing sleeve (10 RH and 11 LH) and install outer race retainer (12). Tighten bolts (15) with the torque 60~90 N.m (44~66ft .lbs):

9) After installing the two main bearing retainer rings (16), shrink main bearings (9) on each end of the shaft. Install inner race retainers (17) and bolts (18) .Tighten bolts with the torque: 60~90 N.m (44~66ft .lbs)

3.4.8 Installing Crankshaft Assembly in the Frame

In order to obtain a more precise fit between the main bearing housing and the frame bore on F-Series pumps, the installation procedures outlined below are to be followed (Refer to Fig. 15)

1) Place a piece of wood between small end of connecting rod and crosshead guide (as shown in Fig. 16) to protect guide from scoring or gouging as the connecting rod are sliding into position.

2) Rotate the main bearing sleeve so that the two flat spots (at 180° position) are parallel with the main bearing bolt holes, and slowly lower the crankshaft into position. (The two flat spots provide clearance for the main bearing bolts.)

3) After placing crankshaft in the frame, and before installing the main bearing covers, check the rollers in the main bearings to assure that each row of rollers in each bearing is equally loaded. The

exact method to check is: drive each row roller by hands, there should be 4-6 rollers seized because of the gravity, while it is not allowed that some row can be driven by hands. The two sides of floating bearing outer race should have roughly equivalent axial clearance. Check out and then install main bearing covers.

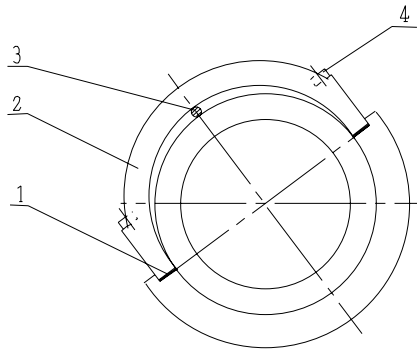


Fig.15 Adjusting of main bearing clearance

(1) Washer (2) Bearing cover (3) Wire (4) Main bearing bolt

4) Install shims under bearing press covers to obtain 0.06-0.10mm (0.0024-0.0040in) clamp to get preload pressure. The preload pressure is obtained by placing the correct amount of shims under the bearing cap. The required amount of shims is determined as follows:

- Place a piece of wire (about 0.8mm diameter) or plastic clearance gauge between the bearing sleeve outer race and bearing press cover inner race, press it at the middle place of bearing press cover so far as possible. Fasten main bearing bolt, and see the table 4 for torque.
- Remove bearing press cover and determine clearance between bore of cap and OD of bearing carrier by either measuring thickness of compressed lead or measuring compressed dimension (Max. size) of plastic gage.
- Use this dimension to calculate the required thickness of shims as follows:

Shims thickness required = original shim thickness (here 1mm) – wire compressed thickness- clamp shrink range (0.06~0.10) mm.

Example:

0.040" Original shims – 0.025" Lead Thickness – (0.0024~0.0040") Clamp shrink range =0.0126~0.0110" Shim Thickness requires

NOTE: The tolerances on left/right sides are not be all the same after machining, which makes it necessary to measure and calculate individual shim requirements for each (right hand and left hand) main bearing cover.

5) Place the correct amount of shims as stated above under main bearing press cover, and tighten main bearing bolt with torque values in table 5.

6) Again check inner and outer row of rollers on each bearing as previously outlined to assure equal loading is still present on each bearing.

Table 5 Tighten torque of main bearing

Description	Torque		Thread Size	Wrench Size	
	N.m	ft.lbs		mm	in
Data	13210	9750	3"-8UN	92.0	3 5/8"

3.4.9 Installing of Crosshead Guides

- 1) Thoroughly clean all dirt or contamination and remove all burrs or rough edges from the surface of the guides and in the frame compartment.
- 2) If old guides are to be reused, inspect the friction surfaces for wear and scoring streaks. Otherwise it should be replaced.

NOTE: For F-1300/F-1600 upper and lower crosshead guides are NOT interchangeable. The lower guide places the crosshead on frame centerline, and upper guides are machined to afford proper clearance between crosshead and upper guide. Upper guide is thinner, a big chamber is at its rear part and oil bore at the middle.

- 3) Install upper and lower guides, torque guide screws with 205~270N.m (150~200ft.lbs)
- 4) Check compactness between frame and guides at points A (Fig. 17); it is appropriate that 0.05mm (0.002") feeler can not press into.

3.4.10 Installing of Crosshead

The crossheads in the pumps can be installed through the front (fluid end) or back end of the crosshead guide. Refer to Fig.16, when installing crossheads, and observe the following precautions:

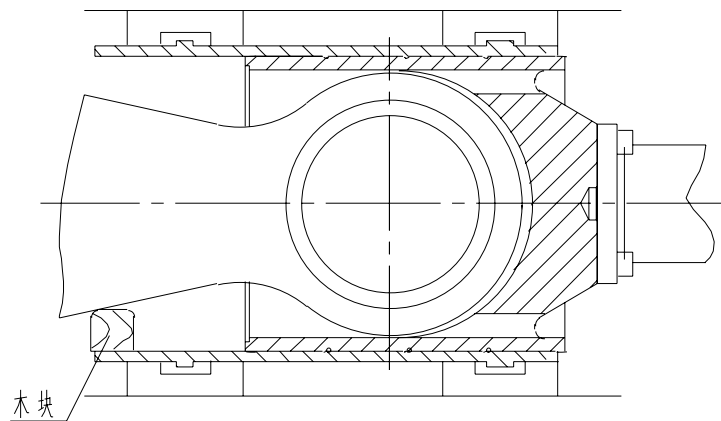


Fig.16 Installation of connecting rod

- 1) Thoroughly clean all dirt or contamination and remove all burrs or rough edges from OD of the crosshead, crosshead pin bores, and inner bore of crosshead guide. Dry crosshead pin bore so taper bore connection will make up metal to metal See Note.
- 2) Position "eye" of eccentric at the opening in the side of the crosshead guide. Block eccentric strap so that crosshead will clear the "eye" as it is sliding into position to where the crosshead pin holes are in alignment. Refer. Fig 16.
- 3) Install the left hand crosshead first, rotate crankshaft assembly to make "eye" into center crosshead and right hand eccentric strap "eye" back, take down mud guard (1 in Fig.17), and push right crosshead to the frame for enough space to install Mid-crosshead and then right crosshead.

Note: If an old crosshead is reused again, do check the sliding surface for wear or score. If necessary, the crosshead can be switched to opposite sides of pumps, that is L/R crossheads interchange their positions, and turn it 180° to make the smooth surface at the bottom of crosshead. Mid-crosshead also can be rotated by 180°, and at this time crosshead pin should be inserted from opposite side of original side. Do not insert crosshead pin into cone bore until crosshead pin retainer has been installed.

4) Install crosshead pin retainer (2) and bolts (3) and rotate pin until the four crosshead retainer holes with crosshead bolt holes (4) are in an alignment. Install the crosshead retainer bolts and tight by hand. Ref. to Fig 17. The oil groove of crosshead pin retainer should be upward.

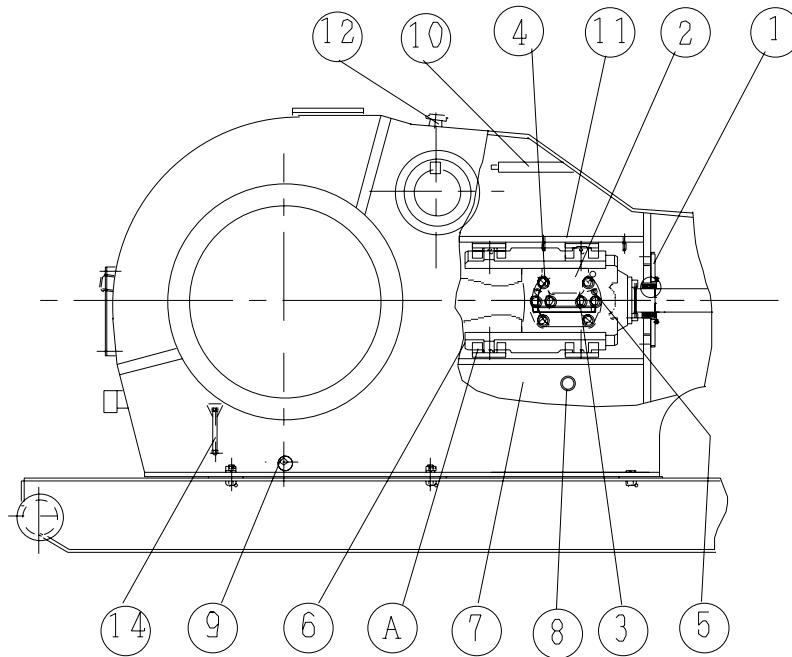


Fig.17 Crosshead assembly

(1) Mud guard (2) Crosshead pin retainer (3) Bolt (4) Bolt (5) Jack screw bore (6) Lower guide (7) Frame (8) Dirt discharge bore (9) Pipe plug (10) Oil accumulating box (11) Upper guide (12) Air shield (14) Oil level gauge

Strike gently the crosshead large end into cone bore, fasten retainer bolt (3) and (4) (see Fig.17) with torque 225~240 N.m (165~175ft. 1bs) and wire.

USE TORQUE WRENCH AND DO NOT EXCEED THE SETTING VALUES..

NOTE: To pull out the crosshead pin, first remove the four crosshead retainer bolts (4) and screw two of the bolts into the “jack screw” holes (5). Tighten the two jack screw bolts until the pin breaks loose. Complete removal of crosshead pin retainer plate (2) and slide pin out of bore.

5) Check running clearance of crosshead by sliding long “feeler” gauges between crosshead upper surface and guide. The clearance should be in 0.45-0.56mm (0.018-0.022in). Check with long feeler gauge over entire surface of crosshead.

NOTE: Over tightening the crosshead pin retainer bolts (4) will cause crosshead outer race contact circular arc deformation and increase the possibility of worn. Now loosen pin and retighten into place by using the make-up torques shown in item 4) above.

3.4.11 Checking Crosshead Alignment

In order for the pistons to run normally in the liners, the crosshead must travel in a straight line along the horizontal centerline of the frame bore. To check and adjust crosshead alignment, proceed as follows:

- 1) Remove diaphragm stuffing box from the diaphragm plate. Do not remove the plate.
- 2) Position crosshead at the extreme front of its stroke. With inside calipers or telescoping gauges, accurately measure the distance from the diaphragm plate bore to the crosshead extension rod at the

top and bottom. Compare the two measurements to determine the position of the rod relative to the centerline of the bore.

3) Rotate pump to extreme rear of stroke and take measurement again at the same place. Compare these measurements to the ones taken at the front of the stroke to determine if crosshead is running horizontally.

4) If the centerline of the extension rod is more than 0.381mm (0.015") low in the diaphragm plate bore, shims should be inserted under the lower guide to bring the extension rod back to center, provided there is ample clearance between the top of crosshead and upper crosshead guide. It is normal for the lower guide to wear more at the rear due to heavier loading at this point because of the angle of the eccentric strap. It is permissible to shim the guides on a taper if it is done accurately to provide firm support for the guide.

Do not shim guides to make the clearance less than 0.50mm (0.020") between upper guide and crosshead. The large crosshead clearances are acceptable due to characteristics of triplex pump operation; the crosshead pressure is always on the lower guide when forward-rotating.

Note: When the mud pump must run in reverse situation because of power, the crosshead pressure is on the upper guide; now guide clearance must be controlled in 0.25~0.40mm (0.010-0.016in).

5) Cut shims from steel shim stock long enough to reach completely across the guides. Cut tabs on the side to bend down over frame supports to hold them in place. Refer to items 3 and 4 under Installation of Crosshead Guides.

3.4.12 Fluid End

3.4.12.1 Fluid Cylinder

See Fig.18 for the structure of cylinder and dimension data in table 6.

The three separate fluid cylinders (1) connect metal –to-metal with the power end frame through retainer studs (2); alignment of the power end and cylinder is realized through power end frame bores and the “pilot” boss on fluid end. However, to obtain accurate alignment, all nicks or burrs must be removed from “pilot” boss and frame bore and all dirt and foreign matter cleaned from the mating surfaces; otherwise it could make up in a “cocked” or misaligned position after the two parts connecting.

Table 6 Cylinder size and tolerance

Position	Dimension (mm)	Dimension (in)
A	209.55-209.68	8.250-8.255
B	180.97-181.10	7.125-7.130
C	209.60-209.68	8.252-8.255
D	368.27-368.32	14.499-14.501
E	6.35×45°	0.250×45°
F	76.07-76.20	2.995-3.000
G	15.87-16.00	0.625-0.630
H	28.45-28.70	1.120-1.130

J	149.10-149.35	5.870-5.880
K	158.67-158.90	6.247-6.252
L	168.40-168.53	6.630-6.635
M	187.32-187.45	7.375-7.380
N	12.57-12.83	0.495-0.505
P	Taper 1: 6	2" Taper per ft. on dia.

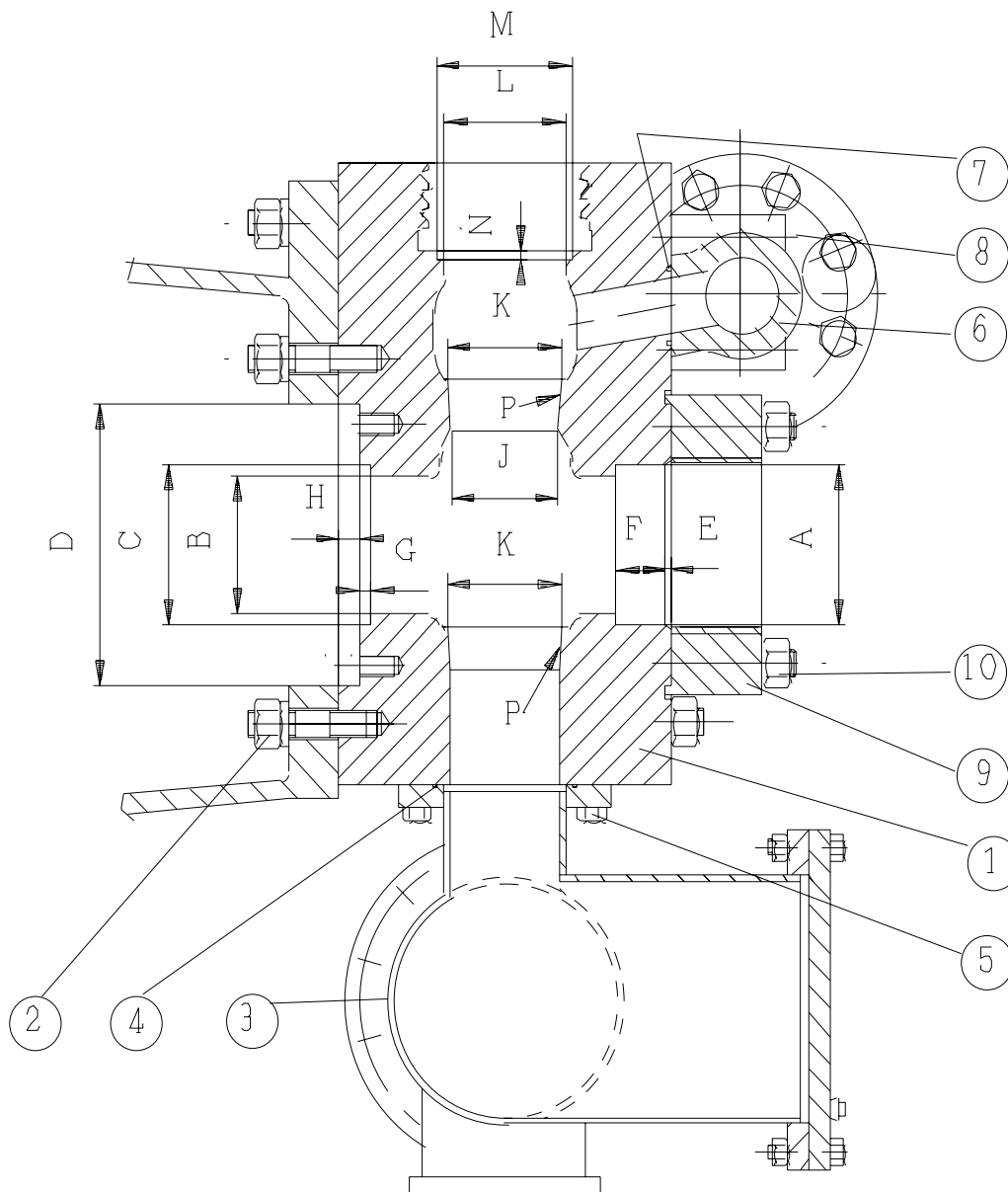


Fig.18 Fluid end assembly

(1) Cylinder (2) Bolt (3) Suction pipe (4) O ring (5) Bolt (6) Discharge pipe (7) O ring (8) Bolt (9) Cylinder head flange (10) Bolt

3.4.12.2 Suction Manifold

The suction manifold (3) bolts to each cylinder block and seal the flange connection face through the O-ring. Thoroughly clean o-ring groove, the O-ring sealing surface at bottom of the cylinder block. Put o-ring in before bolting suction manifold into position; the flange connection **MUST** make up metal-to-metal to ensure the o-ring seal, therefore any nicks, grooves or washouts on the sealing surface must be repaired before installation.

Screw the three cylinder blocks bolts (loose and no fasten) before tightening suction manifold bolts (5), and then tighten with torque values shown in table 7.

3.4.12.3 Discharge Manifold

The discharge manifold bolts to each cylinder block and is sealed through the 0-ring in the connection flange. Thoroughly clean the 0-ring groove, the 0-ring sealing surface on face of the cylinder block before bolting the manifold into position. The flange connection MUST make up metal-to-metal to retain the 0-ring seal; therefore any nicks, grooves, or washouts on this sealing surface must be repaired before installation.

Screw the three cylinder blocks bolts (8) (loose and no fasten) before tightening discharge manifold bolts (5), and then tighten the connecting bolts of cylinder and frame with torque wrench values shown in table 7.

3.4.12.4 Cylinder Head flange

A replaceable cylinder head flange (9) is screwed on the face of the cylinder blocks. The flange must make up metal-to-metal with face of cylinder blocks in order for the axis vertical of the end face and cylinder. Therefore, make sure all burrs, extrusions, or foreign matter removed from the mating faces before installing.

NOTE: When install the flange, make sure the “bleed hole” is in the down position. Tighten the nuts (10) with the torque values shown in table 7.

Table 7 Tighten torque of fluid end

Position	ITEM	TORQUE N.m	TORQUE ft. lbs
TO THE FRAME	2	2170	1600
SUCTION MANIFOLD	5	325	240
DISCHARGE MANIFOLD	8	1355	1000
CYLINDER HEAD FLANGE	10	2170	1600

4. Lubrication

Proper lubrication of the moving parts in any piece of machinery is the most important since this directly affects its ultimate life. To obtain maximum trouble-free service life from the power end of pump, it is necessary to perform routine maintenance care and an inspection to insure the proper amount of CLEAN lubricant is being provided on the friction surface of moving parts.

4.1 Minimum Operating Speeds

The F-Series pumps utilize the controlled flow oil bath splash and pressure system to lubricate the entire power end. The type of pressure system provided in each individual pump will govern the minimum stroke at which the pump can be operated. The pressure lubricating system of F-1300/1600 mud pump is shown in Fig.19, which can be operated at 25 strokes/minute (oil pressure is 0.035 Mpa; 5psi)

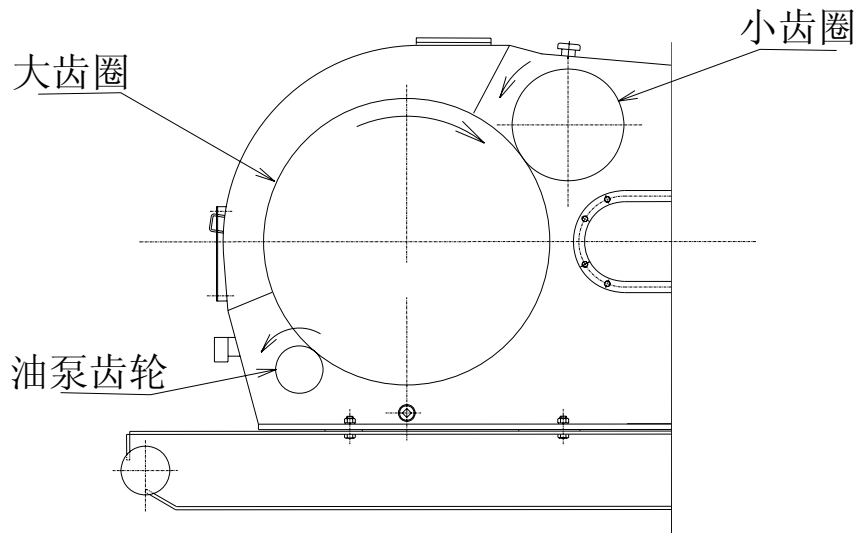


Fig. 19 Pressure lubricating system

NOTE: The pressure lubricating oil pump can be mounted on the external of drilling pump and driven by V-belt; or install the oil pump in the drilling pump driven by the gear ring. When an internally mounted oil pump is used, the direction of pinion shaft rotation should be as shown in Fig. 19; when reversing the pump, the inlet/outlet of lubricating pump must be reversed.

4.2 Controlled Flow Splash System

The controlled flow splash lubrication system is the same on all F-Series pumps, regardless of the type of oil pump drive provided for the pressure system. In the controlled flow splash system, the main gear picks oil up from the reservoir, and when the teeth mesh with the pinion, the oil is displaced into various troughs and compartments in the frame. With reference to Figure 21, the oil thrown into oil trough (7) is directed through the oil tube (8) to the two pinion bearings.

Oil passage from the top of the crosshead guide compartment to the crosshead bearing is shown in Figure 20; oil accumulates in the compartment over the crossheads. The oil runs through the nipple (1) into the crosshead retainer to the oil passages (5) and on to the crosshead pin bearing. As noted, the duplicate set of oil passages (5) in the crosshead pin permits the crosshead pins to be rotated without having to give attention to hole alignment. This permits the installation of crosshead pins from either direction.

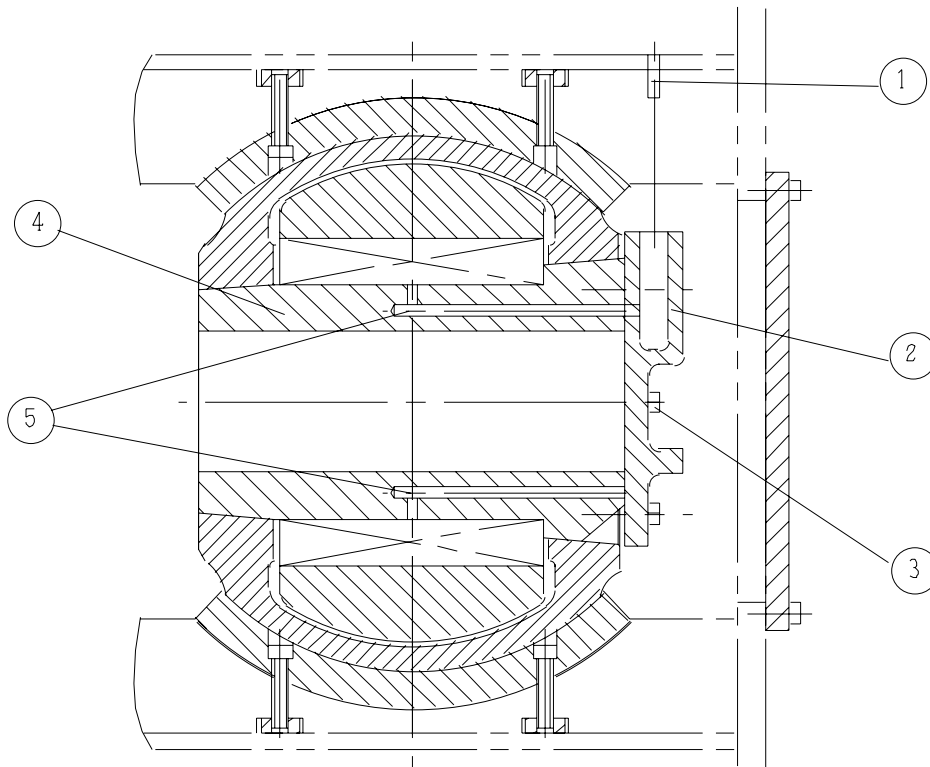


Fig. 20 Lubrication oil path of crosshead bearing

(1) Nozzle (2) retainer (3) bolt (4) crosshead pin (5) oil passage

4.3 Pressure Lubrication System

The pressure lubrication system, incorporating the oil pump for the F-series pumps, is shown in Figure 21: In this system, filtered oil is supplied to the pump through the suction filter (1) and is discharged from the pump into the manifold block (2) and nozzle (3A). Oil is distributed into the main bearing oil line (4) and the crosshead compartment oil distributor (4A) located above the crosshead compartment. The crosshead compartment oil distributor (4A) distributes oil to the crosshead, crosshead bearings and extension rods.

A pressure gauge (5) is mounted on the back wall of the frame to show oil pressure being maintained in the oil distributor. The oil pressure will, of course, vary with the speed of the main pump, however if a sudden pressure drop or increase occurs, refer to the section on maintenance of lubrication system for possible cause.

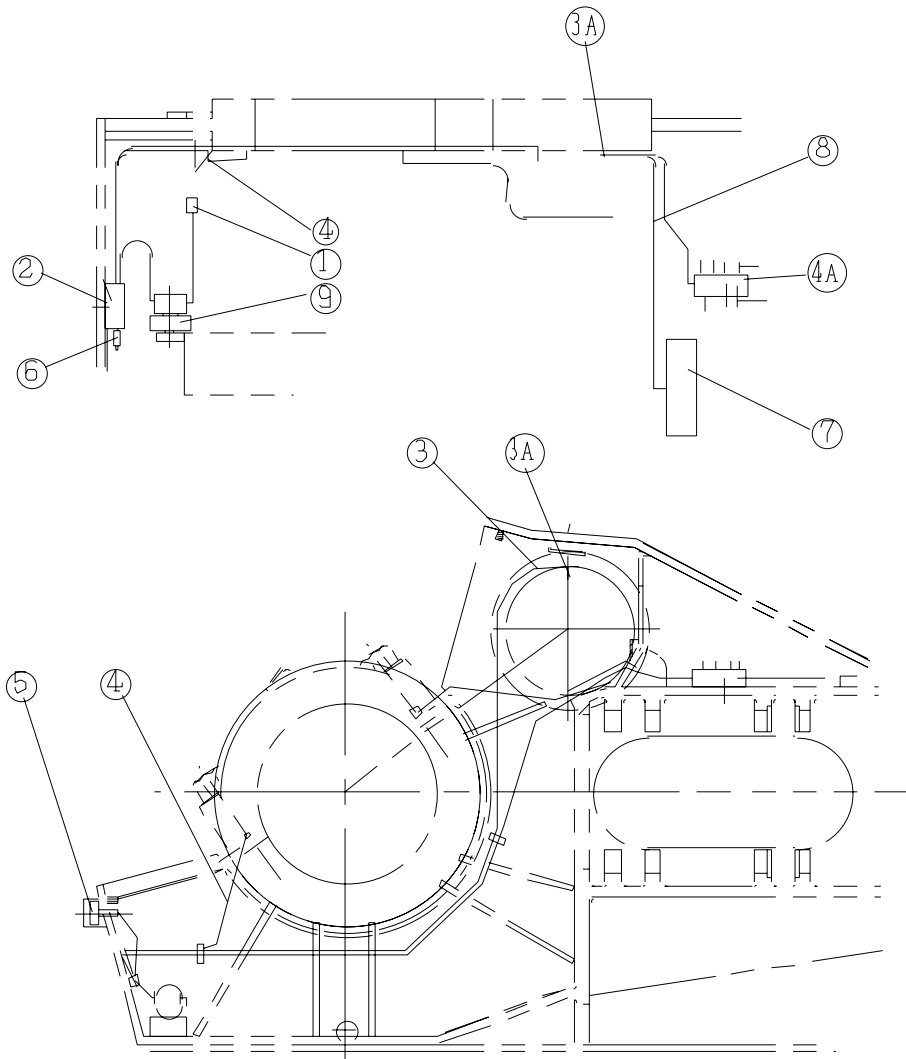


Fig.21 Pressure lubrication system

- (1) Filter (2) Oil distributor (3) Oil line (3A) Spray nozzle (4) Main bearing oil line (4A) Oil distributor
 (5) Pressure gauge (6) Relief valve (7) Oil trough (8) Oil tube (9) Lubrication pump

A pressure relief valve (6) is mounted to the oil distributor (2) to prevent excess pressure from damaging oil pump and drive. The relief valve is preset at 0.27Mpa (40 PSI) and must be tighten (to prevent adjusted pressure change).

When installing the internally mounted oil pump (9 Fig .21), position pump so that the back face of the drive gear is flush and parallel with the edge of the main gear, and gear teeth have 0.60~0.90mm clearance.

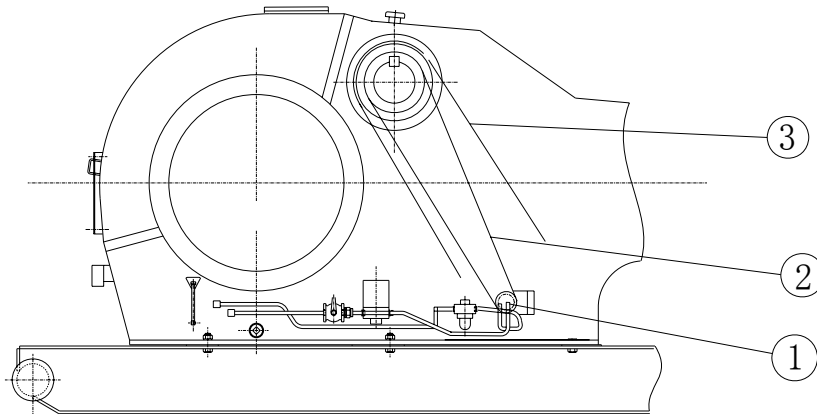


Fig. 22 Outside mounted oil pump

(1) Oil pump (2) V-belt (3) Guard

A typical outside mounted oil pump is shown in Fig. 22. The oil pump (1) is piped into the oil system through the suction and discharge joints at the bottom of power end left/right wall plates. Do not adjust V-belt drive (2) too tight. Over tightening can cause premature failure of the pump. To prevent possible injury, always install guard (3) over V-belts before putting pump into service.

4.4 Maintenance of Lubrication System

Adequate lubrication of the moving parts is, as stated, the most important single factor affecting the ultimate service life of the pump, CARE AND MAINTENANCE of the system is the sole responsibility of the operator or crew to which it has been assigned, and the extent to which this is applied will determine the amount of trouble – free service life that will be obtained.

4.4.1 Lubrication specifications:

4.4.1.1 Gear box of mud pump (Note: lubrication oil contains anti-rust, anticorrosion, anti-foam and sulfur phosphorous type extreme pressure anti-worn additive)

a) At ambient temperature $+10^{\circ}\text{C} \sim +68^{\circ}\text{C}$, choose AGMA Mild EP # 7L-CKD 460 Gear oil、API GL-5, SAE 85W-140 Gear oil; Recommended to use: Mobil gear oil 634, Esso Spartan EP 460.

b) At ambient temperature $-7^{\circ}\text{C} \sim +38^{\circ}\text{C}$, choose AGMA Mild EP # 6L-CKD 320 Gear oil、API GL-5, SAE 85W-90 Gear oil; Recommended to use: Mobil gear oil 632, Spartan EP 320.

c) At ambient temperature $-29^{\circ}\text{C} \sim +16^{\circ}\text{C}$, choose AGMA Mild EP # 2、API GL-5, SAE 80W-90 Gear oil; Recommended to use: Mobil gear oil 626, Esso Spartan EP 68.

d) At ambient temperature $-40^{\circ}\text{C} \sim +27^{\circ}\text{C}$, choose API GL-5, SAE 75W-90 Gear oil; Recommended to use: Mobil gear oil SHC 220.

4.4.1.2 Bearing lubricated by grease (for spray pump, driving shaft and Cardan shaft etc.)

a) At ambient temperature $0^{\circ}\text{C} \sim +50^{\circ}\text{C}$, choose NLGI 2 extreme pressure lithium base grease; Recommend to use Mobilux grease EP, Esso 2 Beacon EP 2.

b) At ambient temperature $-30^{\circ}\text{C} \sim +5^{\circ}\text{C}$, choose NLGI 0 extreme pressure lithium base grease; Recommend to use Mobilux grease Beacon EP 0.

c) At ambient temperature $-40^{\circ}\text{C} \sim +50^{\circ}\text{C}$, choose NLGI 2 extreme pressure complex lithium base grease; Recommend to use Mobilith SHC 220.

4.4.2 Oil reservoir capacity

Oil reservoir capacity: 379 liters (100 U.S. Gallons)

5. Operation of mud pump

Generally F-1300/1600 drilling pump and power package make up one drilling pump unit. It can be divided into three types according to different power package:

- 1) Drilling pump diesel engine pump unit;
- 2) Drilling pump electric motor pump unit;
- 3) Drilling pump driven directly by paralleling engine.

It is recommended that the strokes are less than 120 strokes/minute whichever type of power source. The suction system of pump can be installed independently as requirement. F series pump must have positive pressure head (positive pressure) and then can get proper suction performance. Pump can gain its max. capacity efficiency and longest service life of vulnerable parts when the pressure of suction manifold is within 0.14~0.21 MPa (20~30psi). This pressure head can be gained by 6x8 spray pump (equipped with 45kw, 1450rpm motor). Spray pump and drilling pump start or stop synchronously and automatically. Generally on drilling rig driven by DC motors, get a signal from DC control disc to excite electromagnetic starter.

Spray pump also can be driven by v-belt and the driving force comes from pinion shaft of drilling pump.

The by-pass of spray pump should be connected, drilling pump can continue working when spray pump is in failure or maintained. If drilling pump works without spray pump, change some soft suction valve spring to improve suction performance.

Suction dampener is very coeffective auxiliary device, which can improve suction performance, emilinate fluid flow pulsation of suction pipelines and make discharge fluid stably.

5.1 Preparation before starting pump

- 1) Open the mud valves of suction pipelines, check fluid level height of mud and ensure fluid level 1500mm and more higher than the center of suction lines.
- 2) Check fluid level height of lubrication pool and ensure fluid level height above the scale mark.
- 3) Check whether the connection and fasteners of mud pump lfluid end, power end and driving device are loose, whether there are tools or other things on/around moving parts.
- 4) Chcek whether air line is smooth and clutch is flexible.
- 5) Check whether pressure gauge and safety valve are in normal and coeffective status, pay attention that the pressure of safety pin inserted hole should be controlled in rated pressure and drilling technology required pressure.
- 6) Check the water tank of spray pump and fill fresh water fully and open water inlet valve. Start electric spray pump and observe spray effect of piston liner.
- 7) Charge gas to discharge dampener as working status. The gas should only be N₂ or air, must not O₂ or inflammable explosive gas. At the same time install relief pipeline of safety valve.

5.2 Start mud pump

Whichever electric driven pump unit or diesel engine pump unit should be started as *operation manual of pump unit*.

5.3 Operation of mud pump

- 1) Pressure of engine oil lubrication pump should be within the required scope.
- 2) Listen and adjust whether there is abnormal sound vertically or levelly.
- 3) Observe whether clamp bolt is loose and if the tail part of piston has prick mud when it runs.
- 4) Observe warning display openings of liner flange seat、liner press cover seat and cylinder upper valve press cover has mud leakage.
- 5) Observe whether liner sways, loosens and moves.
- 6) Observe whether pupm pressure is stable and hose swings.
- 7) Test whether driving shaft bearing, crankshaft bearing and frame overheat locally.
- 8) Whether there is impact abnormal sound on power end.
- 9) Whether spray pump leaks water or the water decreases.
- 10) Whether mud purification is coeffective.
- 11) Whether start/close position of ground manifold valve unit is correct to avoid mud short circulation.
- 12) Observe whether sei parts are leaked and fasteners are loose anytime.
- 13) Use special tools attached with pumps correctly and do not operate unprofessionally.

5.4 Stop of pump

- 1) It is unallowable to close suction valve before stop the pump.
- 2) Close spray pump, charging pump and outside mounted lubrication pump (if there is) after stop the pump.
- 3) Maintain after ensure clutch has been disengaged or power is cut off and maintain mark is hanged.

5.5 Operation of mud pump under special climate

- 1) Heat preservation should be done to drilling pump under frigid zones, like add auxiliary heat device to drilling pump base through heat steam and water tank.
- 2) Check whether suction and discharge pipelines are frozen before start drilling pump. Otherwise, pumps can not be started until totally unfreeze.
- 3) Wind/sand proof measures should be taken on desert zone, like install wind stop wall and motor air gap with sand filter.

6. Transportation and storage

6.1 Hoisting and transportation

Checked visually the base of F-1300/1600 drilling pump before hoisting and observe whether hoisting lever has deformation or cracks. Ifther is any problem, weld up or strengthen. At the same time, check the sling before hoisting to ensure they are within the service life and without broken wire.

Choose proper cranes and sling as drilling pump weight. Overload hoisting is forbidden.

Equipment should be fixed well on the vehicle during transportation. Strictly forbid to transport the equipment without fixation.

6.2 Storage

Store it in the warehouse when mud pump stops using. Pay attention to the following items:

- 1) Check the appearance of mud pump in time. If any damage or paint fall-off is found, repair or repaint in time.

- 2) Put mud pump on the good-rigidity and flat ground, level the ground with washers if it is not flat locally.
- 3) Put mud pump in a dry and ventilated place; cover it with tarpaulin if it is outdoor.
- 4) Maintain all grease lubricating points.
- 5) Other protective measures.

7. Matters need attention for storage

When the pumps are not used for a long time, they should be stored.

- 1) Before storing, clean it carefully, empty each part of fluid end and clean it with water.
- 2) Discharge the lubricant oil in the bottom of gear box of power end completely and remove the deposits.
- 3) Coat viscous lubricants on the finished surface of all bearings, crossheads, gears, piston rods, extension rods etc.
- 4) Coat grease on the machined surface of each parts of fluid end.
- 5) Cover the suction inlet and discharging outlet with blind flange.
- 6) The nose end cover, rear cover and the inspection hole cover of crosshead should be covered.