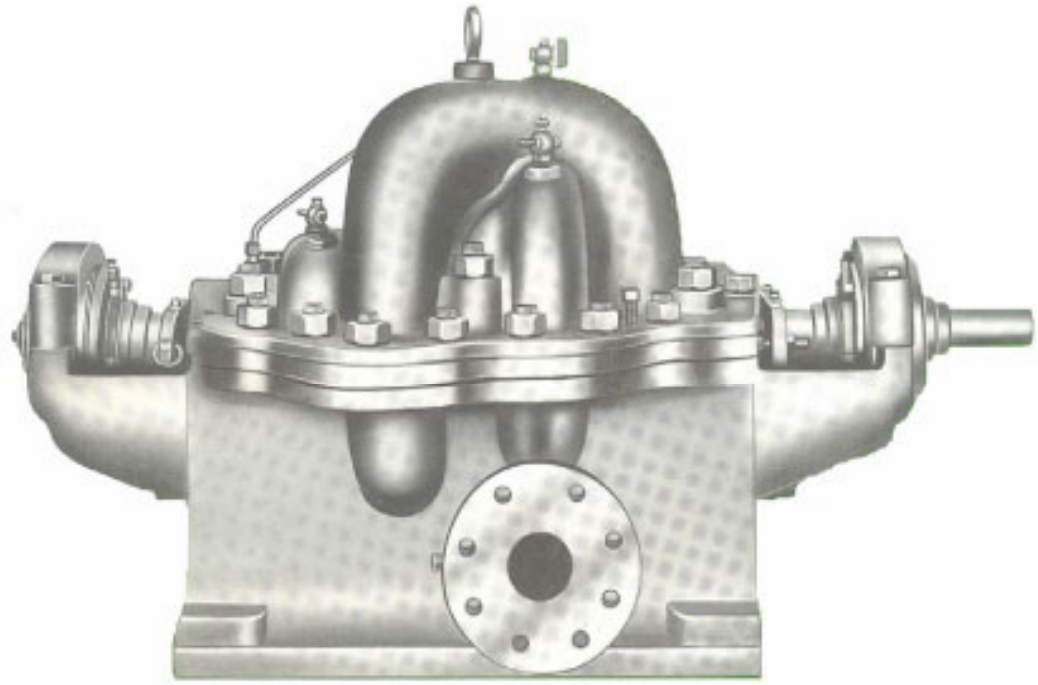
INSTRUCTIONS ON INSTALLATION, OPERATION AND MAINTENANACE FOR SAM TURBO PUMP TYPE "TU"



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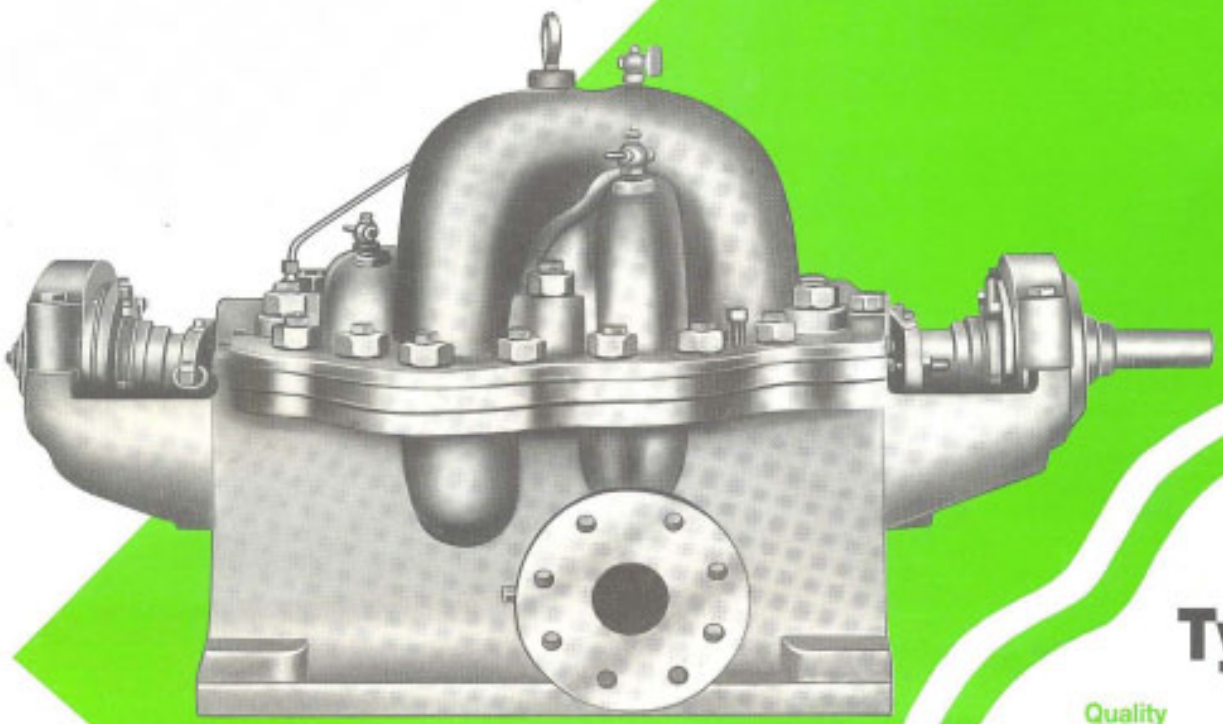


Type TU

Quality

Sturdy construction ensures very long life at high efficiency and optimum coverage.

Universally recognised for reliability, low operating cost with excellent hydraulic characteristics.

Versatility

Type TU pumps can handle water and clear liquids at high heads in a wide range of diverse applications.

Less investment required being versatile.

Simplicity

Standardised moving parts and servicing simplified.

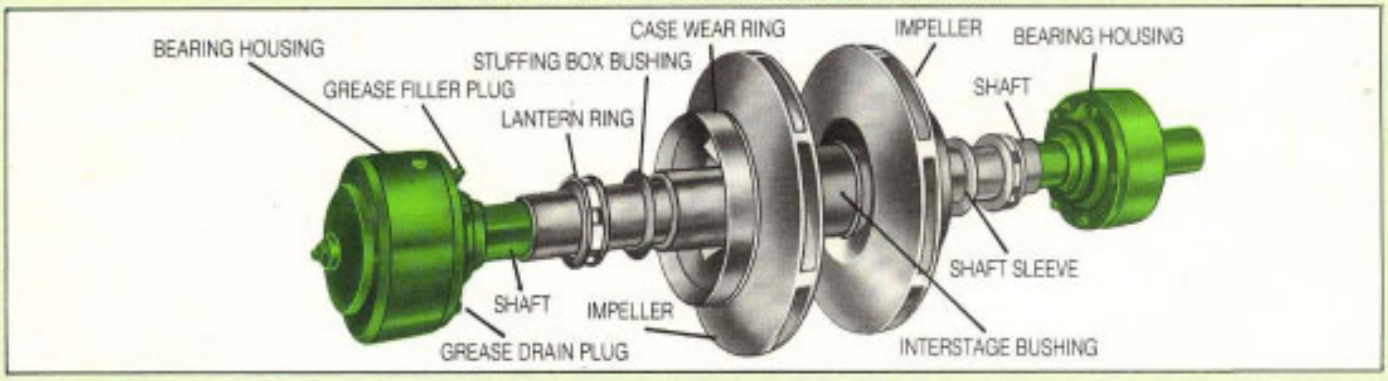
Easy maintenance and long-term saving in operating and maintenance cost.

Design Features

• Internal crossover in smaller sizes and highloop crossover for larger pumps. • Outboard duplex angular contact axial thrust ball bearings • Tested, graded-quality, high-density casting • High-strength shafts, accurately machined to gauge.

CONSTRUCTION FEATURES Type TU

Universal Design Stuffing Box/Packed or Sealed Types.



CASE CONSTRUCTION

Multi-stage pump-case is of horizontal split-case type, split at centre line of pump-shaft. This enables entire rotating element to be removed from pump-case without disturbing pump alignment or piping connections.

Upper case is provided with lifting eyebolt, air vent, and water-seal pipe to stuffing box on suction side of pump. Upper case is rigidly bolted to lower case. Faces between upper and lower case halves are accurately machined and provided with suitable gasket. Water passages through pump-case are scientifically designed for minimum friction loss and minimum turbulence. Alternate volutes are reversed, balancing transverse pressures on running members. Normally made of close-grained cast iron, bronze-fitted, multi-stage cases also available in bronze, ductile iron, or other alloys. In Type TU pumps upto 4" discharge size cross-over is cast integrally with upper half of case.

IMPELLER

Enclosed-type, single-suction impellers used on multi-stage pumps. Each carefully machined, hand-finished inside, and accurately balanced for smoothest operation. Impellers are keyed to shaft for positive driving. Material for standard-impeller construction, SAE 40 bronze. Other materials such as cast iron, stainless steel, Monel, or other alloys can be furnished. Interstage sleeve between impellers serrated with grooves for very effective breakdown in pressure between stages.

CASE-WEAR RINGS

Multi-stage pump-case fitted with heavy-duty, single-step, angle-type SAE 67 bronze wear rings, shouldered against seat in case, to provide proper sealing against leakage between ring and case.

STUFFING BOXES

Stuffing boxes in multi-stage pumps, large and deep; each box utilising five or more rings of graphited, braided, asbestos packing and wide lantern ring. Heavy SAE 40-bronze glands are of interlocking type which allow easy disassembly for packing replacement. Water-seal pipe in upper half of pump-case connects from first stage volute to lantern ring in stuffing box on suction side of pump. Maximum stuffing box pressure will be from suction pressure, if any, plus one-stage pressure, regardless of net pressure developed by pump.

SHAFT

Oversize, heavy-duty shaft, precision-made of AISI C-1040 high-tensile carbon steel, accurately machined to gauge. Shaft threaded to allow for adjustment of impellers by shaft sleeves.

IMPELLER-WEAR RINGS

All multi-stage pumps provided with impeller-wear rings, shrunk onto impeller. SAE 40 bronze standard material; alternate material, such as hardened stainless steel can be furnished.

SHAFT SLEEVES

Ample protection against shaft wear is provided by shaft sleeves. These are combination sleeve-and-nut, with threaded section next to impeller hub. Sleeves so designed as to prevent leakage between shaft and sleeve by use of O-ring. Shaft sleeves screwed on shaft against direction of rotation and secured by set screws to prevent back off. SAE 40 bronze standard material for shaft sleeves; alternate material can be furnished.

BEARINGS

Grease-lubricated ball-bearings provided on multi-stage pumps. Outboard bearing, duplex, angular-contact, axial-thrust ball-bearing. Inboard bearing, single-row, radial-thrust ball-bearing. Bearings housed in split saddle-bearing seats, cast and bored integrally with lower half of pump-case, assuring permanent alignment. Bearings mounted in cartridge-type housings. Housings provided with dust and grease seals,and pipe taps for adding grease and for draining. Water-slingers on shaft protect bearings from water. Provision for cooling housings can be made. Oil lubrication of bearings can be furnished.

• Size 3" to 8" • Capacity 35 m^3/hr to 600m^3/hr • Head upto 180m

SAM TURBO INDUSTRY LIMITED

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WARRANTY

We warrant that the pump supplied by us is free from defective material and faulty workmanship. This warranty holds good for a period of 12 months from the date of commissioning of the equipment or 18 months from the date of despatch from our factory, whichever is earlier.

Our liability in respect of any complaint is limited to replacing part/parts free of charge ex-works or repairs of the defective part/parts only to the extent that such replacement / repairs are attributable to or arise solely from faulty workmanship or defective material.

We warrant the materials for the chemical composition and mechanical properties of the relevant standard only and not for corrosion and erosion.

The warranty holds good only for the products manufactured by us.

SAM TURBO INDUSTRY LIMITED

CONTENT

PLEASE FURNISH COMPLETE NAMEPLATE DETAILS, NAME OF THE PARTS, PART NOS AND MATERIAL OF CONSTRUCTION WHILE ORDER SPARE PARTS FOR THE PUMPS

1.0 TECHNICAL INFORMATION

1.1 CROSS SECTIONAL DRAWING WITH PARTS LIST.

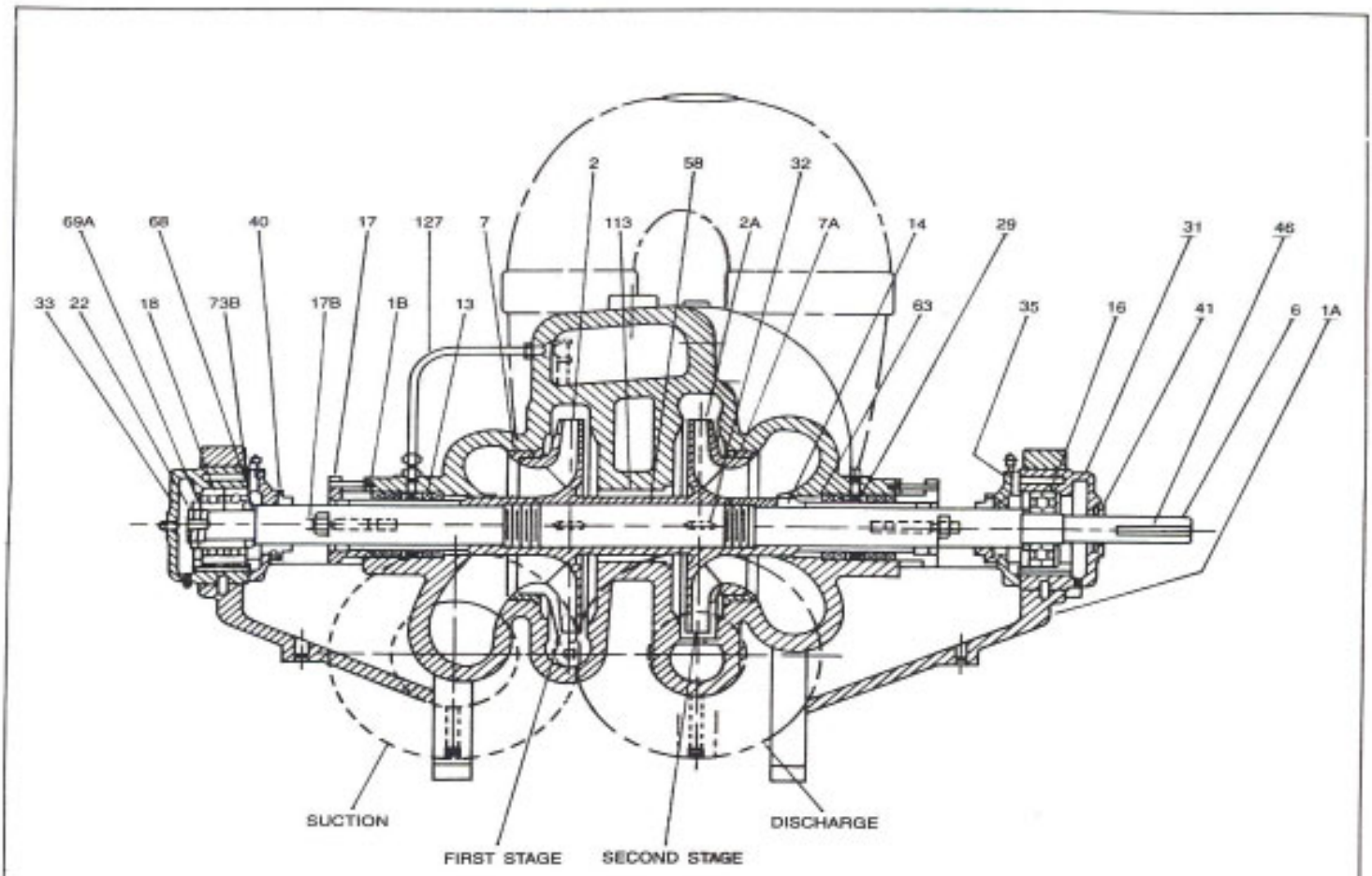

Fig. 1 - Cross Sectional Drawing of Horizontal Split Case Pump Type TU

MATERIALS OF CONSTRUCTION

Item No.	Description	Material
1A, 1B	Casing Assembly	Cast Iron
2	Right Hand Impeller	Bronze
2A	Left Hand Impeller	Bronze
6	Shaft	EN8
7	Right Hand Casing Ring	Bronze
7A	Left Hand Casing Ring	Bronze
13	Packing	Graphited Soft Asbestos
14	Shaft Sleeve	C.I.
16	Inboard Bearing	Steel
17	Gland	C.I.
17B	Gland Bolt	M.S.
18	Out Board Bearing	Steel
22	Bearing Lock Nut	M.S.
29	Lantern Ring	C.I.

Item No.	Description	Material
31	Inboard Bearing Housing	C.I.
32	Impeller Key	M.S.
33	Outboard Bearing Housing	C.I.
35	Bearing Cover	C.I.
40	Water Deflector	Rubber
41	Bearing Cap	C.I.
48	Coupling Key	M.S.
58	Interstage Sleeve	Bronze
63	Stuffing Box Bushing	M.S.
68	Shaft Collar	M.S.
69A	Bearing Lock Washer	M.S.
73A	Case Gasket (Not Shown)	TALFLEX - 55/IT-400
73B	Bearing Cover Gasket	TALFLEX - 55/IT-400
113	Interstage Bush	C.I.
127	Seal Piping	Braided Pipe

Flange Details - ANSI - B16.1 - Suc. 125cL, Del 250cL							
Pump Type	Suc	Del	O/D	PCD	THK	No. of Holes	Hole Dia.
3TU13	102	-	223	191	24	8	19
	-	76	229	168	24	8	22
4TU14	127	-	254	216	24	8	22
	-	102	254	200	32	8	22
5TU15	152	-	279	241	25	8	22
	-	127	279	235	35	8	22
6TU16	203	-	343	299	29	8	22
	-	152	318	270	38	12	22
8TU17	254	-	406	362	30	12	25
	-	203	381	330	44	12	25

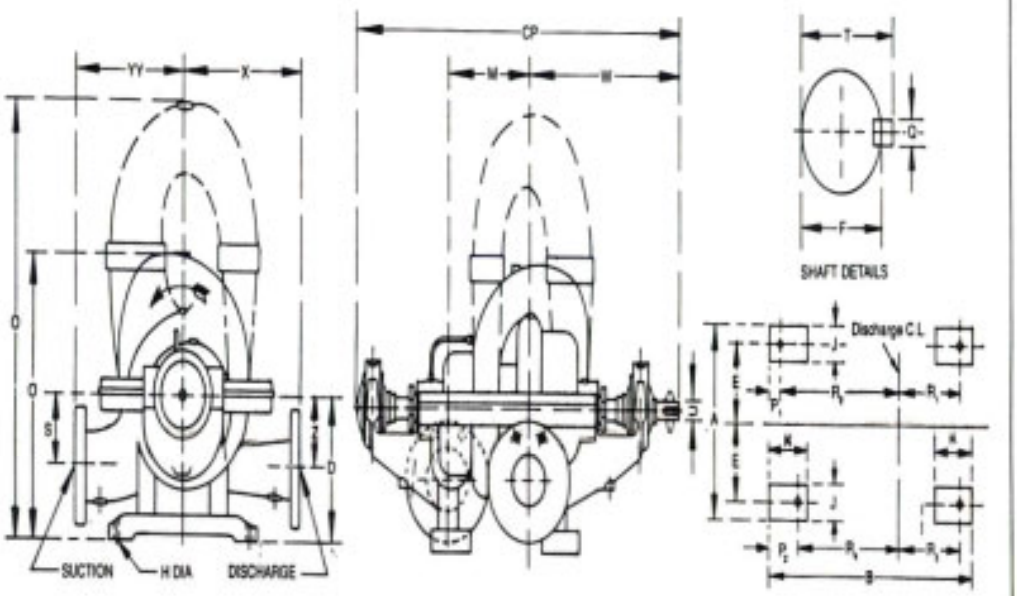

FIG.2 - PUMP DIMENSIONS

Pump Size	Suc	Del	A	B	CP	D	E	H	J	K	O	P1	P2	R1	R2	R3	R4	S	U	W	X	YY	M	Z	F	T	Q
3TU13	102	76	406	533	1048	279	181	19	76	83	594	22	60	178	311	178	273	121	39.1	498	305	305	248	210	32.1	45.0	12.7
4TU14	127	102	457	616	1153	305	206	19	76	83	660	22	60	210	362	210	324	140	44.5	549	356	356	283	229	39.0	48.7	9.5
5TU15	152	127	508	699	1267	356	229	22	76	101	1060	25	70	238	409	238	365	152	50.8	597	406	406	325	254	43.5	56.3	12.7
6TU16	203	152	610	876	1556	406	276	25	89	127	1165	51	102	279	495	279	446	191	57.1	727	457	406	381	273	49.9	62.8	12.7
8TU17	254	203	711	991	1803	457	318	32	102	152	1340	57	121	318	559	318	493	216	69.8	845	508	457	419	292	60.8	76.7	15.9

Notes :

1. Normal direction of rotation clockwise when viewed from driving end.
2. The dimensions are subject to change without prior notice.
3. All dimensions in mm.

2.0 INSTALLATION (ERECTION)

2.1 LOCATION

a) Select the location for the pumping unit (pump, base plate, coupling & drive) which will be clean, well ventilated, properly drained and provides accessibility for inspection and maintenance. Outdoor installation may require protection from rain and particularly from freezing.

b) If some connections of water, liquid are required for flushing, cooling, lubricating, etc. ensure that they are available for inspection, maintenance.

c) The suction system must provide the pump with Net Positive Suction Head (NPSH) equal to or greater than that required by the pump.

2.2 FOUNDATION

a) Prepare the foundation keeping in view the type of soil at site.

b) Grout is most widely used for foundation. In sufficient mass, it provides rigid support which minimizes deflection and vibration. It may be located on soil, structural steel or load bearing floor, provided the combined weight of the pumping unit and foundation does not exceed the allowable bearing load of the support. The allowable bearing loads of structural steel and floor can be obtained form Engineering Hand books; building codes of local community give the recommended bearing loads for different types of soil.

c) Before pouring the foundation, locate the foundation bolts which should provide anchorage as shown in Figure 4. See G. A. Drawing for location of foundation bolts. When pouring allow for a grouf thickness of 25 mm to 40 mm. Roughen the top surface by providing a good bond of the grout. For ordinary preparation use 1 part cement to 3 parts sand and 4 parts medium aggregates.

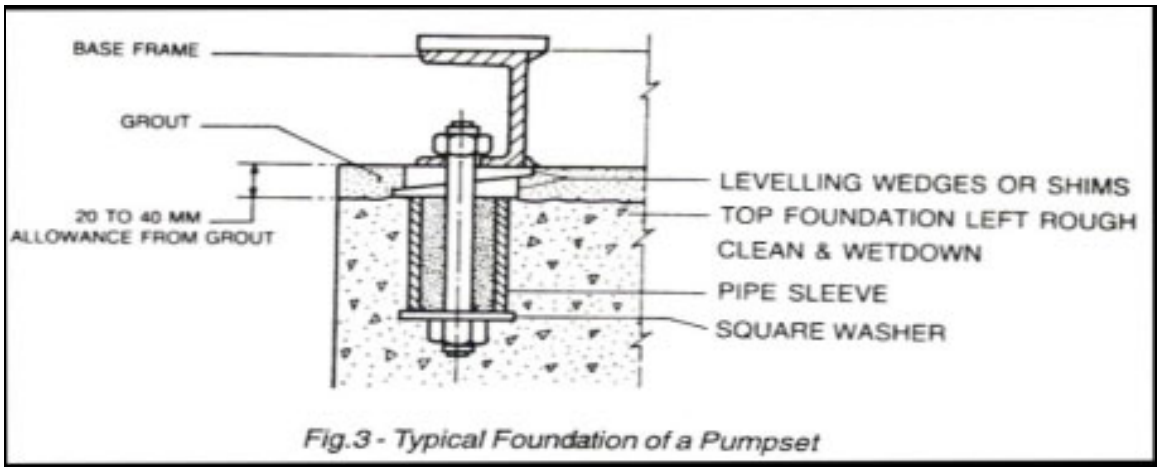

Fig.3 - Typical Foundation of a Pumpset

2.3 MOUNTING & LEVELLING

CAUTION (i) Use qualified personnel or riggers to lift or ship the unit at any time.
(ii) Never lift the unit by hook or sling on shaft.
(iii) Never place eyebolt in any tapped hole except for removing of a part to perform service work.

a) The base frame on which the pump unit is coupled with the motor should be placed on the foundation.

b) Disconnect coupling halves.

c) The base frame should be supported on a rectangular metal blocks or shims or metal wedges having small taper. The support pieces should be placed close to the foundation bolts. On large units metal wedges made of cap screws and nuts are very convenient for lifting purpose. In each case the supports should be directly under (he part of the base plate carrying the greatest weight and spaced closely enough to give uniform support. Spacing of around 600 mm is suggested on medium size units. A gap of about 20 mm to.40 mm should be allowed between the base plate and foundation for grouting.

d) Level the base plate by adjusting the metal support or wedges.

e) Machined surface of base frame can be used as reference for levelling purpose. The levelling should be done with the help of precision Engineer's level

f) Please Note that all base plates are flexible to some extent and therefore must not be relied upon to maintain the factory alignment. A realignment may be necessary after the complete unit has been leveled on the foundation and again after the grout has set and foundation bolts are tightended.

2.4 ALIGNMENT OF PUMP & DRIVER

2.4.1 Factors that may disturb alignment

a) Setting of the foundation
b) Springing of the base plate.
c) Piping strain.
d) Settling of the building.
e) Shift of the pump or drive on foundation.
f) Wear of the bearing.

If the pump and motor are aligned correctly you will get trouble-free service. Even slight misalignment will cause:

a) Vibration.
b) Premature bearing failure.
c) Excessive coupling wear and
d) Noisy operation of the pump.

To avoid the above the pump should be aligned correctly.

2.4.2 Procedure for aligning pump with driver

a) Disconnect the coupling halves
b) Set the required coupling gap depending upon the coupling size recommendation of the coupling manufacturer.
c) Place a straight edge exactly on both coupling halves as shown in Figure 5.
d) Ensure that the distance of the coupling halves from each shaft is same from all the points around the circumference.
e) Measure gap between the two coupling halves with the aid of a feeler gauge or dial gauge to ensure that the gap remains same at all the points around the circumference.
f) When significant operating temperature differential will exist between the pump and diver (i.e. steam turbine driver with pump handling cooling liquid). Thermal expansion will cause the hotter unit to rise. To compensate form his expansion, the hotter unit should be low by 0.075 mm to 0.125 mm initially. When both units are on normal operating temperature a final check of coupling alignment must be made. Correct he direction if required.

An alternate test for parallel and angular alignment may be made with a dial indicator.

g) Check direction of rotation of electric motor when the coupling halves are disconnected, and correct direction if required.

h) Correct excessive parallel and angular misalignment by slightly shifting levelling wedges under the base plate. Reset the alignment after shifting of each wedge.

i) If wedges are shifted or shims changed, by a substantial amount to obtain proper alignment, recheck the piping alignment and level of the shafts.

NOTE: Pumping unit shafts must be levelled, have proper alignment and the pipe must mate with the pump flange without a stain. All these three conditions must be correct to provide proper performance and long life of the pumping unit.

Recheck the alignment and correct as required after:

a) Mounting
b) The grout has hardened.
c) Foundation bolts are tightened.
d) Piping is connected
e) Pump, driver, base plate is moved for any reason.

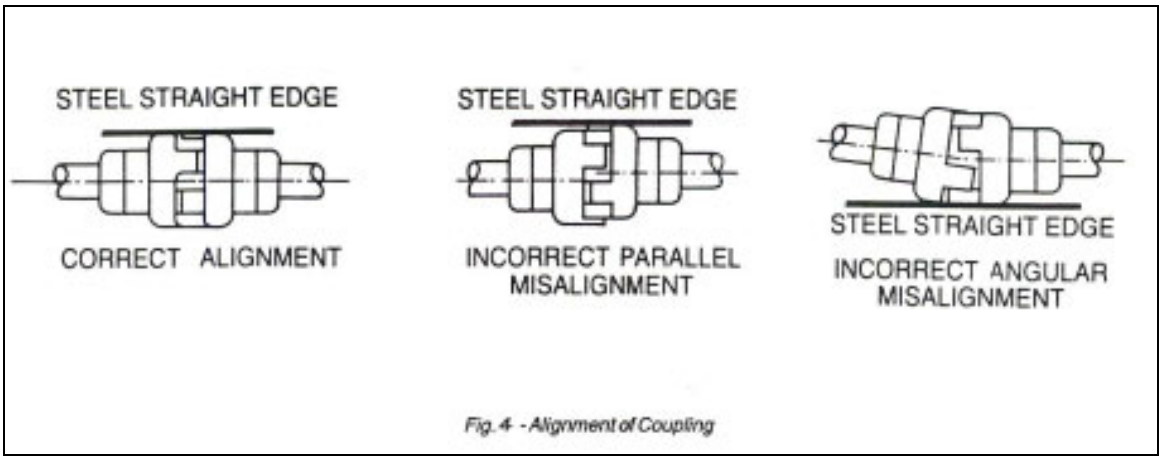

Fig. 4 - Alignment of Coupling

2.5 GROUTING

Unless otherwise specified on the outline drawing, the base plate must be completely filled with grout and level wedges grouted in place. When the alignment is correct the foundation bolts should be tightened evenly. The unit should then be grouted to the foundation. The foundation bolts should not be tightened until the grout is hardened, usually about 48 hours after pouring. Grout which completely fills the base plate is also necessary for minimizing vibration. Grout compensates for unevenness in the foundation and base plate. It distributes the weight of the unit uniformly over the foundation. It is essential that the pumping unit should be expertly grouted by use of no shrinkage grout.

The mix required varies with the type of unit to be grouted, location and amount of grout; grout unit as follows:-

a) Build a form of plywood or thick plan around the foundation to contain the grout.
b) Stock the top of the grout thoroughly with water before grouting.
c) Remove all surface water before grouting.
d) Use recommended mix of grout.
e) Pour the grout through the holes provided in the base plate or the open ends of steel channel in base plate. While pouring tamp liberally in order to fill all the cavities and preventing air pockets.
f) If pouring and tamping the grout will trap air at some places, place small diameter tubes (Thick rubber walled hoses) to provide venting. Remove the tubes after grout has filled the cavities before pouring the remainder.

g) After the grout has thoroughly hardened tighten the foundation bolts and connect the piping. Ensure that the piping does not exert any strain on the pump flanges.
h) Check the alignment after piping is connected and the foundation bolts are tightened.
i) Connect the coupling halves.
j) Approximately 14 days after the grout has been poured or when the grout has thoroughly dried apply an oil base paint to the exposed edges on the grout to prevent air or moisture corning into contact with the grout.

2.6 PIPING ARRANGEMENT

The following care should be taken while connecting the piping to suction and delivery flanges of the pump:

a) The pipe line should be free from foreign materials such as scales, welding residue, etc.
b) The suction and delivery piping should be independently supported and arranged sot that the expansion and contraction due to temperature fluctuation will into cause misalignment.
c) The pipe must never be pulled into position by the flange bolts in order to avoid strain on the pump flange.
d) To minimize the friction losses use minimum number of bends and other fittings.
e) The check valve (non-return valve) should be installed in the discharge line to prevent liquid running back through the pump in case of sudden stoppage due to power failure.

2.6.1 Suction piping

If the suction pipe is not installed properly it will become a source of faulty operation. To achieve best performance provide the following:

a) The suction pipe should be a short as possible and must be free of air leaks.
b) The suction pipe diameter must be one pipe dia. Larger than the pump suction opening.
c) If a foot valve is used in the suction piping it must have a minimum flow area of 1.5 times the area of the suction opening.
d) Any loops or high spots which can trap air should be avoided.
e) When the pump is operating under suction lift never use a gate valve or globe valve in the suction line.
f) Available NPSH should be greater than NPSH required by the pump.
g) The piping should be cleaned mechanically and chemically and flushed prior to installing the pump.

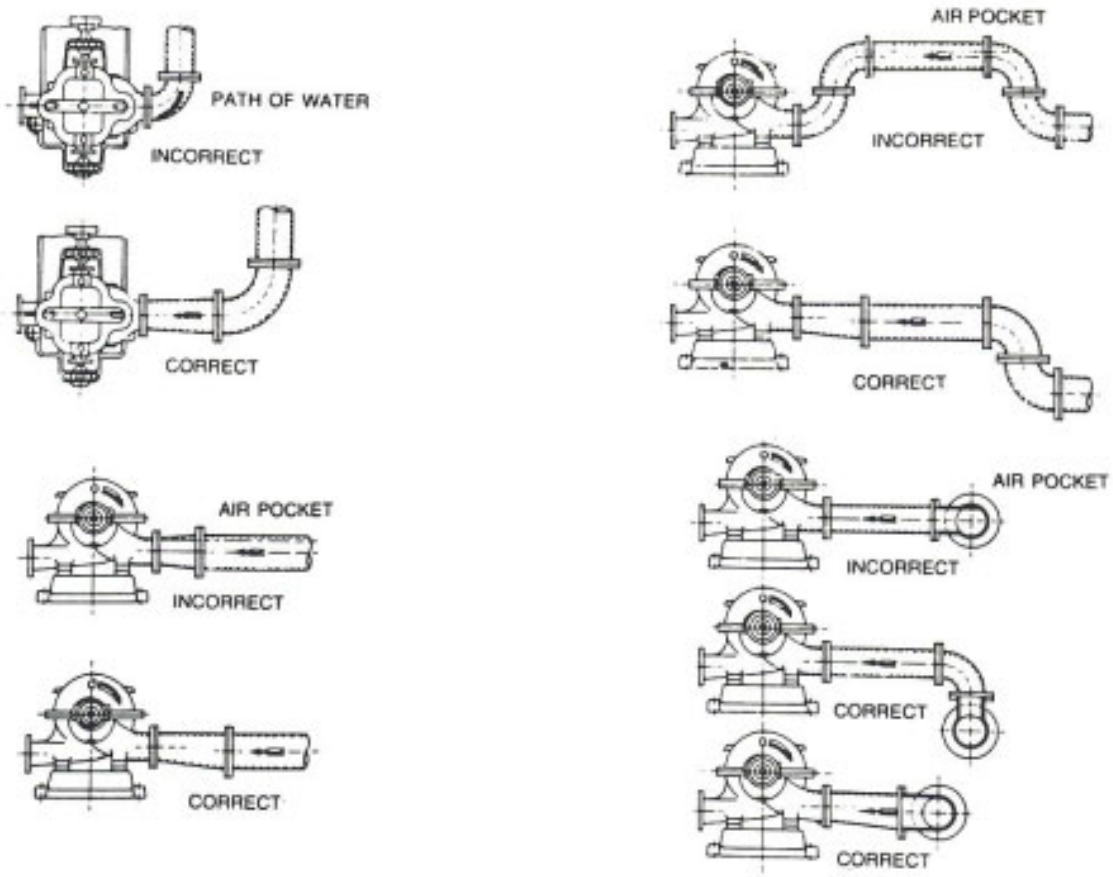

Fig. 5 - Suction Piping Layuut

2.7 VACCUM EQUALISATION

In case the pump has to pump liquid through a system under vacuum, it is advisable to install a vacuum equalization line. The vacuum equalization line must be taken from the highest point from the suction line (as close as possible to the pump suction tank) to keep away gas bubbles, which might get entrapped, form entering the system. In case of gland packed pump it is necessary to have a sealing liquid in the stuffing box to prevent entry of air. This sealing liquid can be tapped form the pump discharge itself.

2.8 COUPLING GUARD

A coupling guard is necessary which will cover the shaft and the coupling of pump unit to prevent any accident. The coupling guard should be fitted to the base frame after alignment of pump and motor.

2.9 PRECAUTION FOR ENGINE DRIVE

When the pump is to be run by engine (whether diesel, gas or gasoline) it requires installation to satisfy the following:

a) The installation should be well ventilated so as to keep the ambient temperature as low as possible. Any rise in ambient temperature will reduce the horse power of engine.

b) Provide ample air for combustion.

c) Provide the engine with efficient exhaust system so that the combustion gases are discharged with a minimum of back pressure.

d) Provide a fuel system of adequate capacity.

e) Provide ample accesability to service the engine.

f) Provide correct rotation of the pump, as engine rotation is decided at the factory. No change inengine rotation can be made in the field.

g) Follow the instruction manual supplied by the engine manufacturer.

3.0 PRE-COMMISSIONING PREPARATION

3.1 LUBRICATION

a) When the pumps are supplied with grease lubrication and if the pumps are lying in storage for long, the grease may get dried up. Hence it is necessary to remove this grease and fill new grease in the bearing housing.

b) Do not put excessive or inadequate grease as this will overheat the bearings.

3.2 BEARING LUBRICATION

The bearings are lubricated by grease. Lubrication provides a film between the roller elements and races which reduces the friction and prevents excessive temperature rise of the bearings. The normal life of the bearing is terminated by fatigue only. Improper lubrication practices are the main reason for failure of the bearings. One can follow the following practice:

a) Keep lubricant clean, free form dust, rain, moisture, etc., by storing in dust-tight container.

b) Clean up the lubricant fitting s before re-lubricating with grease.

c) Use clean dispensing equipment.

d) Use proper amount of lubricant. If too much lubricant is used it will result in churning and unnecessary power consumption and heat generation. Inadequate lubrication will also cause overheating of the bearings.

e) The lubricant should be of correct specification. In case of grease lubrication a good quality lithium ball & roller bearing grease, free form resin & acid and possessing rust preventive properties, should be used. The grease should have a penetration number between 220 - 295. Its temperature drop point should not be less than 175 ^{0} C.

f) The bearing temperature may be allowed to rise 40^{0}C above room temperature, but should not exceed 80^{0}C.

g) The period of refilling is every 300 hours.

h) The grease used could be of following make and grade:

i) Indian Oil	-	Servogem-3
ii) Caltex	-	Starfak-3
iii) Hindustan Petroleum	-	Netra-3 or Litton-3

3.2.1 RE-LUBRICTION WITH GREASE

The pumps are provided with grease filled in the bearing housing initially. This requires replacing only when it gets

contaminated by dust, metal particles, moisture, etc. Re-lubricate the bearings as follow:

a) Thoroughly clean outside of the bearing housing and grease it.

b) Inject clean new grease, forcing out the old grease through the small opening between the shaft and bearing housing.

c) Run the pump for a short time to eject any excessive grease.

d) Wipe off all excessive grease.

3.3 SEALING & COOLING LIQUID DETAILS

The sealing liquid is forced into the gland and lantern ring area by a pressure higher than the pump pressure so that the pump liquid does not come out of gland area. In horizontal split case pumps where the impellers are designed for double entry (suction) the gland are placed on suction side and therefore sealing liquid must have pressure higher than the pump suction pressure. If the required temperature is more than 90 ^{0} C the gland region needs cooling. This cooling enhances the life of gland packing. Please ensure that the sealing liquid is:

a) Free from solids

b) Compatible with pumping fluid

c) Pressure higher than the pump pressure (at least 1 Kg / cm2 higher)

d) Flow rate is around 2 to 3 Ltrs. / min.

3.4 FLUSHING OF PIPING SYSTEM

When the pump material is of CI or all iron construction, the pump must be thoroughly flushed prior to initial starting to avoid contamination of the piping system.

4.0 COMMISSIONING

4.1 PRIMING·

The pump must be primed before it can be operated, if the pump is running dry, it will cause, damages to close running parts. Hence it is essential that before starting the pump, the casing and suction pipe is completely filled with liquid and all air removed. Remove all air from pump casing and suction pipe by opening the valve at the top of the pump. Rotate the shaft a few times to evacuate any air that may be inside the impeller passage.

If the system is with suction lift and there is a foot valve in the suction pipe, fill the pump with liquid from outside source till the air is expelled and liquid flows out through the air vent provided on the top of the pump casing.

If the system is with suction lift but with no foot valve, use a vacuum pump or ejector operated by means of water, air, steam, engine exhaust, etc., to remove air from the pump casing and suction pipe by connecting the ejector to the priming connection at the top of the pump.

4.2 CHECK POINTS BEFORE STARTING THE PUMP

When making an initial start after installation check the following:

a) Correct installation and direction of rotation of driver.

b) Coupling alignment.

c) Bearing lubrication on pump and driver.

d) Proper lubrication for stuffing box.

e) For pumps with mechanical seals ensure that liquid. temperature, pressure, cooling and lubrication of seal faces meet the seal manufacturer's requirements.

f) If gauges are used they should be of correct rating and in good condition.

g) Isolating cock for pressure gauge connection is closed.

h) Auxiliary pipe line and system, if any, are in order.

i) Recirculation orifice must be open during starting. However it should be closed during normal operation.

j) The pump is properly primed.

k) When possible rotate the pump shaft by hand to make sure that parts are not rubbing inside the pump.

l) Close the discharge valve, open the suction valve.

4.3 SWITCHING ON

a) Start the pump and let the prime mover attain its full operating speed.

b) Now open the discharge valves slowly gradually adjust to the required flow rate by operating discharge valve.

c) Open the cock of pressure gauge connection.

WARNING

Avoid prolonged running of the pump with delivery valve in closed condition as this will generate heat due to churning of liquid in the pump casing. This will also cause corrosion, short life of the bearings and cracking of mechanical seals due to stress or vibration. It may also damage the shaft and wear on the stationary parts. This is also applicable to prolonged operation of the pump for 15% to 20% of its rated capacity at best efficiency point.

4.3.1 During the initial test for checking out if the pump is to be run at part load or for prolonged operation at less than 50% of rated capacity, it is recommended to use a bypass line from the discharge piping back to the suction sources. This bypass valve should be open when the pump is started, and when the pump operates near its normal capacity the bypass valve should be closed.

4.3.2 Operation for prolonged periods at flow rates higher than those given by the manufacturer can cause cavitations, overloading of the driver, noise and other problems. Consult us if operating conditions are different than those given when the pump was purchased.

4.4 CHECK POINTS DURING RUNNING OF THE PUMP

During running of the pump check the following:

a) The pump is running smooth and free from vibration or noise.

b) Ensure that there is no mechanical friction in the pump.

c) The bearings are not getting abnormally hot.

d) Check the pipeline for leakages.

e) Check the leakage through the gland packing. Also check that the temperature of stuffing box is not too high and is same as pumping liquid.

f) Motor is not overheated. Check current drawn by the motor.

g) The pump is developing the required capacity.

h) Auxiliary connections in the pipeline are not closed when the pump is running.

i) Stop the pump immediately in case any defects are noticed.

j) Do not start the pump unless these defects are rectified.

4.5 SWITCHING OFF (SHUTDOWN)

The pump may be stopped with the discharge valve open as no damage results if water goes back to the casing. It is unwise to leave the discharge valve open. Therefore, during shutdown please follow these instructions:

a) Close the discharge valve.

b) Recirculation orifice must be open during shutdown.

c) Stop the electric motor. If the pump is driven by engine, follow the procedure recommended by the engine manufacturer.

d) In case the pump is to remain out of operation for a long period, then casing to be drained completely.

5.0 TROUBLE SHOOTING

TROUBLE	CAUSE	REMEDY
1. Failure to deliver liquid or sufficient pressure	Pump not primed	Reprime
	Pump not up to speed.	Check for low motor voltage or motor overloaded. For other drives, increase driver speed when possible.
	Discharge head too high.	Check to see that all discharge valves are opened and the discharge line is free from obstructions. In some cases are installation has to be altered or a pump of suitable rating must be provided.
	Insufficient available NPSH	Check NPSH requirement of pump and increase system NPSH accordingly
	Incorrect direction of rotation	Check rotation of driver
	Air leaks in suction line or through suction end stuffing box, suction pressure below atmospheric.	Tighten packing. Check for air leaks past O-ring under sleeve. Passage from eye side shroud of first stage impeller to suction stuffing box must be open to deliver sealing fluid to packing. Check suction line joints for air leakage, Check mechanical seal if installed.
	Impeller passages restricted.	Disassemble the pump and clean impeller.
	Worn impeller sealing diameters or mating stationary part bores.	Repair or replace impeller and/or stationary parts.
	Damaged impeller.	Repair or replace impeller
	Foot valve too small or restricted by dirt.	Replace with adequate size foot valve or clean foot valve.
	Leaking discharge check valve on stand-by pump.	Repair or replace.
	Recirculation valve open or leaking.	Close, repair or replace.
2. Pump loses prime after starting.	Air-leaks in suction line.	Tighten packing. Check for air leaks between sleeve and shaft and replace O-ring if there is an air leak. Check all suction line joints for bad gaskets and loose joints.
	Insufficient available NPSH	Check NPSH requirements of the pump and increase the system available NPSH accordingly.
3. Overload on driver.	Pump speed high.	Motor voltage higher than name plate rating will cause the motor run faster. Either reduce motor voltage or trim impeller, diameter. On other drives reduce speed if possible. If speed reduction not realized trim impeller diameter.

	Total head lower than rating.	Check suction and discharge pressure and determine the total dynamic head. If TDH lower than ratings, throttle discharge to rated TDH or, if this is not possible reduce impeller diameter.
	Tight Packing.	Stop pump – follow proper repacking procedure. Check for scored sleeve; and for sleeve run out if packing wears rapidly. Replace sleeve and packing as required.
	Liquid is of higher specific gravity or viscosity than rating.	Check with Greaves representative to determine if a larger motor is required.
	Mechanical trouble of pump or driver.	See if pump and motor turn freely. Check impeller fit, shaft straightness and bearings.
4. Pump vibrates or is noisy.	Driver unbalanced, pump clogged.	Disconnect driver and operate it alone. Check pump for large pieces of debris, such as wood, rags, etc.
	Misalignment.	Realign pumping unit.
	Cracked foundation.	Replace foundation.
	Worn bearings.	Replace bearings. Check lubricants. For proper grade. Check pumps alignment.
	Unbalanced impeller	Rebalance.
	Bent shaft.	Replace.

6.0 BEARING DEFECTS

DEFECTS	APPEARANCE	PROBABLE CAUSE
1. Flaking and cracking	In the early stages, the surface of the inner and outer races develop small cracks, which flake. The cracks and flaking ultimately spread over the entire race surface.	1. Normal fatigue failure. 2. Bearing loads in excess of bearings capacity causes misalignment.
2. Indentations	Indentations cavities in the inner and outer races.	1. Dirt in the bearing. 2. Excessive impact loading of the bearings such as improper mounting or removal.
3. Broken separator (cage)	Cracked separator or separator in pieces.	1. Poor Lubrication 2. Misalignment of shaft. 3. Excessive shaft deflection.
4. Wear	Bore and OD of outer ring of bearing galled or braided.	1. Fit on shaft or in housing too loose or braided. 2. Bearing locked by dirt and turning on shaft or in housing.
5. Fractured ring	Hairline cracks or complete ring fracture	1. Forcing a cocked bearing on or off a shaft. 2. Too heavy a press fit.
6. Discoloration	Rolling elements and races darker than normal appearance of bearing metal. (Moderate discoloration of rolling elements and races not a reason for discard).	1. Inadequate lubrication.
7. Corrosion	Rolling elements and raceways rusted.	1. Water entering the housing. 2. Condesation inside the housing. 3. Lubricant breaks down into acid (Wrong lubricant).

7.0 IMPELLER/CASE WEAR RING DIAMETRICAL CLEARANCE IN M.M

0.254 **0.356**	**0.305** **0.406**	**0.356** **0.457**	**0.457** **0.559**
3TU13	4TU14 5TU15	6TU16	8TU17

Clearances are of standard bronze or cast iron fitted pumps. For materials with a tendency to gall, Such as stainless steel, increase clearance approximately 0.25mm for worn case ring Maximum allowable diametrical clearances add 0.762 to the higher tolerance limit.

NOTE: All information contained in this manual are for reference only and are subject to changes without prior notice.