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भारतीय मानक मसौदा

**जेट अपकेन्द्री पम्प के चयन, संस्थापन एवं परिचालन और
रखरखाव — रीती सहिता**

(आईएस12699 का पहला पुनरीक्षण)

DRAFT Indian Standard

**SELECTION, INSTALLATION, OPERATION AND MAINTENANCE
OF CENTRIFUGAL JET PUMP — CODE OF PRACTICE**

(First Revision of IS 12699)

ICS 23.080

Pumps Sectional Committee, MED 20

Last date for receipt of
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FOREWORD

(Formal Clause will be added later)

This standard was first published in 1989.

This revision has been taken up to keep pace with the latest technological developments and the practices followed in pump industry. This revision incorporates the following major changes along with the amendments issued to the earlier version.

- a) New figures have been added for vertical twin type and packer type jet pumps for better clarity;
- b) Pipe assembly for horizontal jet pump has also been specified;
- c) A note has been added under clause **3.2**; and
- d) Editorial changes have been made

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in

accordance with IS 2: 2022 'Rules for rounding off numerical values (*second revision*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

DRAFT *Indian Standard*

**Selection, Installation, Operation and Maintenance
of Jet Centrifugal Pump Combination —
Code of Practice**

(*First Revision* of IS 12699)

1 SCOPE

This standard lays down general guidelines for selection, installation, operation and maintenance duplex and packer type jet centrifugal pump combinations.

2 REFERENCES

The standards listed in Annex A contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revisions, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed in Annex A.

3 SELECTION CRITERIA

The selection criteria are listed below:

- a) Water well size and capacity;
- b) Maximum depth from which water is lifted;
- c) Performance requirements, namely, quantity, jet setting depth and discharge head (delivery head of centrifugal pump);
- d) Type of prime mover;
- e) Type of installations; and
- f) Quality of water.

3.1 Water Well Size, Capacity And Depth

3.1.1 *Open Well*

In open wells, there is no restriction on selection of pipe size for the jet centrifugal pump combination.

3.1.2 *Bore Well*

In bore wells, the sizes of pipe lines depend on the diameter of the bore. For the same bore well, if more quantity of water is to be pumped, in order to accommodate bigger flow area for the pressure pipe

and delivery pipe (suction pipe of centrifugal pump) of the jet pump (assembly) packer/duplex type of jet pumps (assemblies) are preferred to twin type jet pumps (assemblies). In all bore wells for ease of erection, maximum jet unit outer dimension shall be always 6 mm (minimum) less than the clear bore well size. The maximum quantity of water that can be pumped by using these jet pumps (assemblies) with optimum percentage loss of friction in both pressure and delivery pipes (suction pipe of centrifugal pump) of the jet pumps (assemblies) shall be as given in Table 1 and Table 2.

Table 1 Dimensions and Maximum Output for Twin Type Jet Pump

(Clause 3.1.2)

Sl No.	Clear Bore Diameter	Jet pump (Assembly) Maximum Dimension	Delivery Pipe (Suction Pipe of Centrifugal Pump) Diameter	Pressure Pipe Diameter	'Maximum Recommended Output
	mm	mm	mm	mm	l/m
(1)	(2)	(3)	(4)	(5)	(6)
i)	80	76	25	20	12
ii)	100	92	32	25	20
iii)	110	102	40	32	35
iv)	125	114	40	40	50
v)	150	126	50	40	65
vi)	150	135	50	50	80
vii)	200	164	65	50	120
viii)	200	172	65	65	180
ix)	200	185	80	65	225
x)	250	230	100	80	320

NOTE — The discharges indicated are for an optimum combined pipe friction of about 10 percent. By allowing higher frictional losses, more output can be obtained.

Table 2 Dimensions and Maximum Output for Packer/Daplex Type Jet Pumps

(Clause 3.1.2)

Sl No.	Clear Bore Diameter	Outer Pipe Socket Diameter	Inner Pipe (Suction Pipe of Centrifugal Pump) Diameter	Outer Pipe Diameter	Maximum Recommended Output
	mm	mm	mm	mm	l/m
(1)	(2)	(3)	(4)	(5)	(6)
i)	80	70	25	50	15
ii)	100	89	40	65	35

iii)	100	96	50	80	75
iv)	110	102	50	80	75
v)	125	102	50	80	75
vi)	125	122	65	100	170
vii)	150	127	65	100	170
viii)	150	147	80	125	250
ix)	200	159	80	125	250

3.2 Quality of Water

The quality of water shall be taken into consideration for selection of jet pump and centrifugal pump components construction. When pumped water is neutral, the jet pump shall be made of cast iron (Minimum grade FG 200 of IS 210. When the water is acidic, jet pump and impeller of centrifugal pump shall be bronze as per grade LTB2 of IS 318.

Note - Due to advancement in technology of plastics, thermoplastics material such as polyphenylene oxide (PPO) poly carbonate, acetyl, nylon 66, polytetrafluoroethylene (PTFE), polyester PETP, Glass filled nylon UHMWPE (Ultra High Molecular Weight Polyethylene) etc may be used for pump parts like jet unit, casing, impeller etc.

3.3 Performance Requirements

3.3.1 Quantity

The quality of water required shall be decided by two factors:

- a) Actual consumer requirement; and
- b) Availability of yield of well or bore well.

The maximum quantity that may be tapped shall be 80 percent of the tested yield of the well.

3.3.2 Jet Setting Depth

To take care of frictional losses, the jet setting depth shall be taken 1.2 times the optimum spring depth of the bore well and jet pump shall be placed 3 m to 5 m above the bottom of the bore well for silt not to enter the jet pump and it shall be placed 2 m below the maximum drawn down level or to have adequate submergence as specified by manufacturer.

3.3.3 Discharge Head

The discharge head of the jet centrifugal pump combination shall be almost near the minimum operating head of the system which generally is taken as operating head of the centrifugal pump minus 6 m. This shall allow the system to operate at the optimum efficiency.

3.4 Type of Prime Mover

Jet centrifugal pump combination shall be selected according to the availability of the power source:

- a) Diesel Engine Shall be according to IS 11170; and
- b) Electric Motor, shall be according to IS 996 for single phase and IS 7538 for three phase.

NOTE — If jet centrifugal pump combination is to be driven by both, belt driven type centrifugal pump shall be preferred. If the pump is to be driven by only electric source, monobloc or direct coupled pump shall be preferred.

3.5 Types of Installations

a) Vertical

Whenever the centrifugal pump is to be placed in a separate room away from well, horizontal installation is preferred and whenever space availability is limited and where pump has to be placed above the well, vertical mounting of the centrifugal pump shall be preferred.

b) Horizontal

When centrifugal pump is mounted horizontally, the length of the horizontal pipeline shall not be more than 1.5 m to 2 m. In case the lengths are to be increased, one size higher diameter of pipe shall be used to keep the frictional losses minimum.

4 INSTALLATION

4.1 Installation of Centrifugal Pump

All requirement laid down in IS 9694 (Part 2) shall apply to the centrifugal pump. (For simplicity, the centrifugal pump of the system has been taken as a motorized monobloc horizontal-type centrifugal pump). The entire installation is given for pumps with flange ends; for screwed ends, the procedure is the same except that the pipes are screwed in and jointed with union joints slip coupling. Further, the pipe tapping to the jet pump (assembly) shall be provided in the centrifugal pump casing itself.

NOTE — Typical field installations for twin type centrifugal jet pump, packer type centrifugal jet pump, and duplex type centrifugal jet pump are given in Fig. 1, Fig. 2 and Fig. 3 respectively.

4.1.1 *Plumbing the Well*

Before erecting the jetpump (assembly) inside the borewell, lower a guide of outer diameter 6 mm bigger than the outer pipe coupling/jet pump (assembly)diameter with a minimum length of 2 m into the borewell. It shall be noted that it goes into the borewell freely. At every 3 m interval, a knot shall be tied in the inserting rope to find out the water depth. A yield test conducted in the bore with test pump will also help to assess the maximum length of pipe to be lowered.

4.2 Installation of Twin Type Centrifugal Jet Pump (*see Fig. 1A and Fig. 1B*)

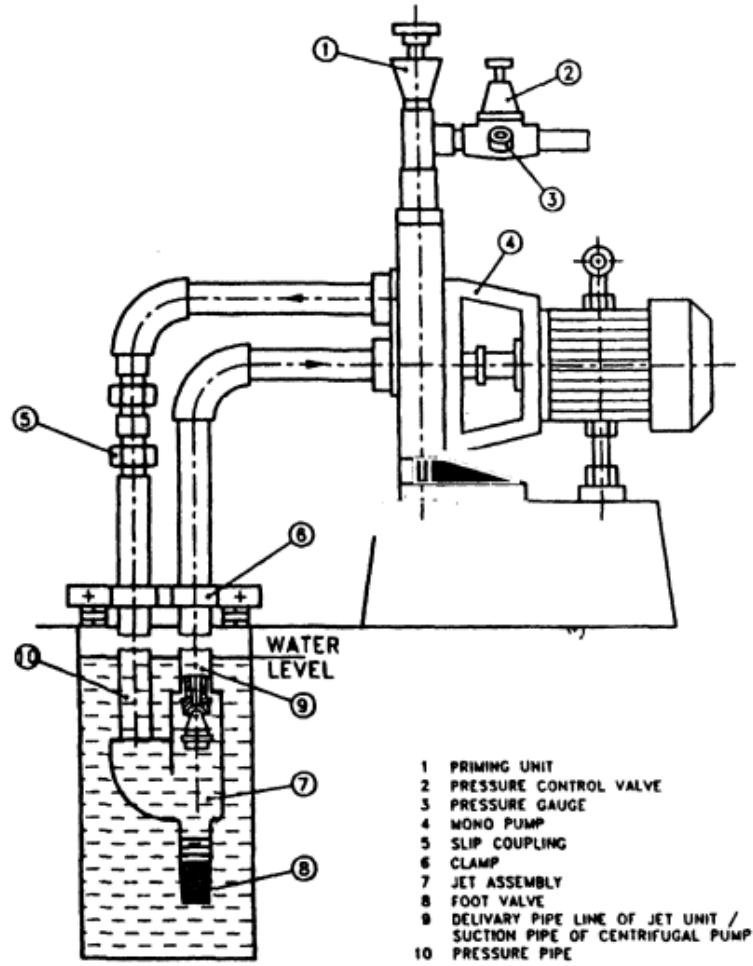


FIG. 1A TYPICAL FIELD INSTALLATION FOR TWIN TYPE JET
HORIZONTAL CENTRIFUGAL PUMP COMBINATION

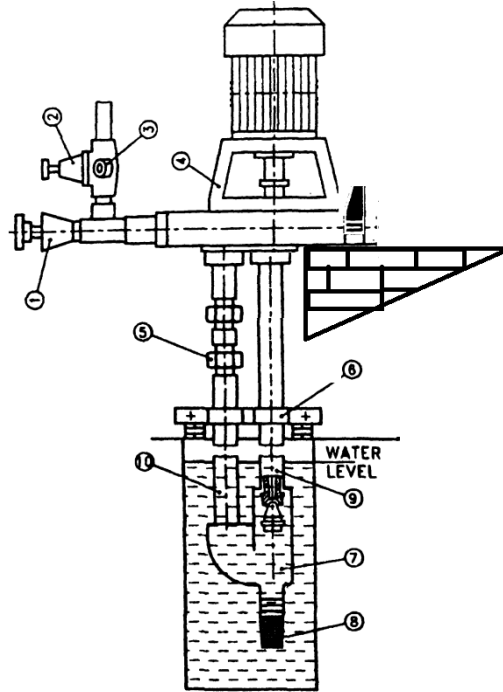


FIG. 1B TYPICAL FIELD INSTALLATION FOR TWIN TYPE JET
VERTICAL CENTRIFUGAL PUMP COMBINATION

4.2.1 Inspection

All components before erection, shall be inspected for possible damage in transit. Air shall be blown through the jet assembly to ensure that no dirt or foreign particles are trapped inside. Pour water inside the jet assembly up to pressure pipe housing level and find out whether there is any leakage in the jet body or the foot valve. If there is any leakage in the foot-valve where it is threaded with the jet assembly, tighten them with suitable pipe compound and thread packing. Over tightening will result in breakage.

4.2.2 Pipe Assembly

Clean all pipes from foreign particles before tightening with jet pump (assembly). Tighten the delivery (suction of centrifugal pump) and pressure pipes, applying suitable pipe compound to the proper threads with the jet pump (assembly). While tightening the delivery pipe (suction of centrifugal pump) care shall be taken to see that it does not on any account strike the protruding portion of the venturi tube. Do not overtighten the pipe in the jet body and while tightening the pressure pipe do not move away the two pipes too much as both the above actions may lead to breakage of the jet assembly. After tightening each length pour water and see that there is no leakage in the joints. A chain block of minimum two tonne capacity with tripod consisting of 6-metre long 50-mm dia pipes, can be used for deep well erection. The delivery (suction of centrifugal pump) and pressure pipes shall be clamped with proper size clamp securely, and while one clamp is for lowering (or lifting), the nuts of the other

clamp be loosened and positioned in the proper place and secured to fit the chain block hook for the subsequent operation. Tighten each end of pipe length by a binding wire to avoid damage to the jet assembly due to pipe chattering during subsequent pipe tightening. When the pipes have been fitted up to full length, fit two elbows with the delivery (suction of centrifugal pump) and pressure pipes with the proper centre distance between the pipes and fit them to the delivery (suction of centrifugal pump) and pressure pipe lines in the common flange of the centrifugal pumpset. The slip coupling in the pressure pipe line (*see* Fig. 1) facilitates easy erection. Then insert the slip coupling in the pressure line such that the cut is in the centre of the coupling. Then tighten pump common flange without any leakage with a rubber washer to the pump body. In vertical mounting fit directly the delivery pipe (suction of centrifugal pipe) to the common flange and assemble the slip coupling in the pressure pipe line vertically. For horizontal mounting the slip coupling can be conveniently fitted in the horizontal portion of the pressure pipe line.'

4.2.3 Assembly of Discharge Pipe to the Monopump

Fit the discharge (delivery of centrifugal pump) flange to the pump body using the rubber washer. To the discharge flange (delivery of centrifugal pump) using a nipple, tighten a T-coupling. To the top of the T-coupling, tighten the priming unit. To the other side, tighten the pressure regulating valve. Connect the discharge line (delivery of centrifugal pump) to the overhead tank on the other side of the pressure regulator valve. The arrow mark on the valve body shall point toward the direction of the flow of water in the discharge line (delivery of centrifugal pump). Tighten the delivery (suction of centrifugal pump) and pressure pipe lines in the horizontal portion by a twin clamp before starting. Give a proper support to the pipe lines so that they do not give any pressure on the pump body. Screw down the pressure gauge to the threaded opening provided in the pump casing/pressure regulator valve body.

4.3 Installation of Packer Type Centrifugal Jet Pump (*see* Fig. 2A and Fig. 2B)

The main components of packer type jet centrifugal pump combination are:

- a) Centrifugal monoblock pump/coupled pump/belt driven pump;
- b) Jet assembly components:
 - 1) Packer type jet assembly with foot-valve, packer and strainer assembly.
 - 2) Packer housing contained in a sealing pipe with stopper coupling.
 - 3) Packer head/well adopter.
 - 4) Flanges to connect pump and packer head.
 - 5) Clamps for outer pipe, inner pipe and well.
- c) Discharge (delivery of centrifugal pumps) assembly components:
 - 1) Pressure regulating valve.
 - 2) Priming unit.
 - 3) Pressure gauge.

- 4) Air releasing cock.
- 5) Discharge flange (delivery of centrifugal pump).

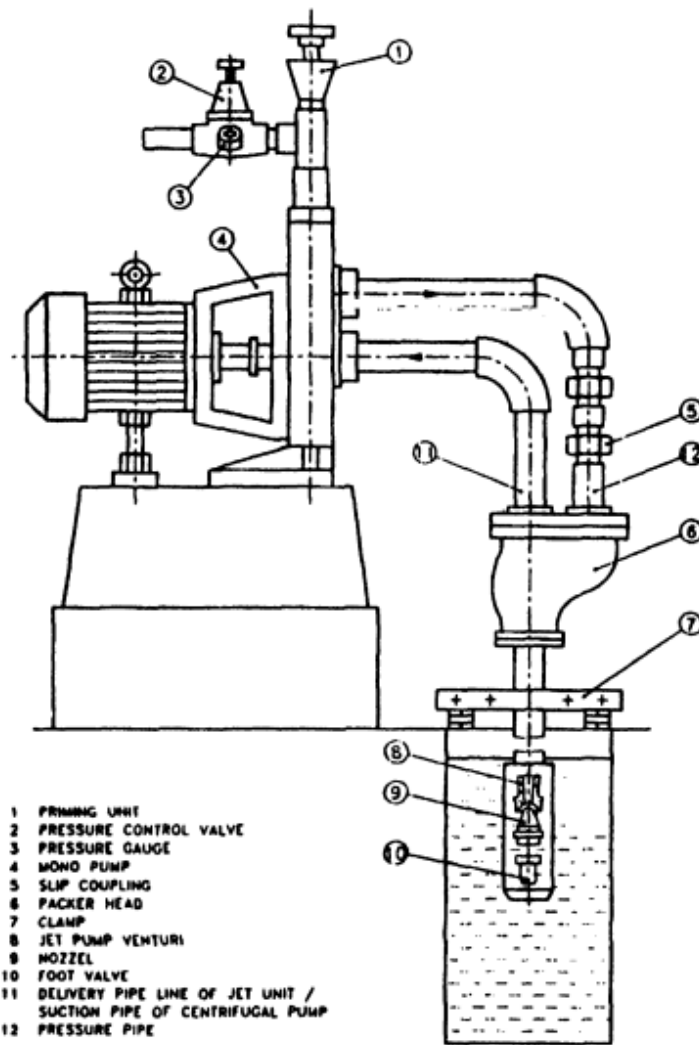


FIG. 2A TYPICAL FIELD INSTALLATION FOR PACKER TYPE JET
HORIZONTAL CENTRIFUGAL PUMP COMBINATION

4.3.1 Outer Pipe Assembly

The packer housing which forms the bottom most part of the outer pipe is always supplied with a screwed in stopper coupling. Clean the packer housing and see that the stopper coupling contains within it, a shock absorbing disc pasted to it. Then screw down the packer housing to the first length of outer pipe through a coupling firmly applying suitable pipe compounds. During the tightening operation, care must be taken to see that either the packer housing or the outer pipe does not collapse due to the excessive or improper tightening pressure. Lower first length inside the bore gently without striking the walls of the bore. Connect through couplings up to the required length, successive bits of

outer pipe to the first length. On the top of the last bit of the outer pipe, tighten the outer pipe flange and place above the bore well or open well, using a clamp on a bed, which may be bore casing pipe in borewells, or a platform of rails in open wells. For lowering the outer pipe within the bore well, a chain block mounted on a tripod post must be used. Each length of outer pipe must be checked for correct bore sizes and for bends, by passing through it a guide of the specified outer pipe bore size. Any burrs or welding lines inside the outer pipe protruding above the specified bore size dia will be removed and then only the pipe shall be used for erection.

4.3.2 Assembly of Inner Pipe to the Jet Assembly and Locating it within the Outer Pipe

All the jet assemblies fitted with foot-valve, packer assembly and a strainer are to be tested for proper operation before leaving the works. The complete assembly of jet, foot-valve, packer assembly and strainer are to be supplied as a single unit. They contain two bucket washers at the bottom fitted to the packer assembly. Screw down the packer jet assembly to the first length of inner pipe by using proper pipe compound so that there shall not be any leakage. During the operation, care shall be taken to see that the pipe is clean. During tightening operation, the bucket washer shall not be allowed to touch any surface which will lead to their damage. Lower the inner pipe with jet assembly into the outer pipe so that the rubber packer do not strike the walls of the outer pipe during lowering operation. A good suggestion is to use small lengths after cleaning them thoroughly. Care shall be taken to see that the joints are leak-proof. During the tightening operation of successive lengths of inner pipe, the bottom portion of the pipe lowered inside the casing pipe shall not be allowed to turn. As soon as the bottom portion of the jet assembly has touched the stopper coupling, see that the inner pipe protrudes above the outer pipe flange by 0.2 m. At the top, inner pipe shall not be threaded. Do not allow the inner pipe or jet assembly to strike the stopper couplings suddenly. This may lead to damage of the complete unit itself. Use chain block with tripod to lower the inner pipe.

4.3.3 Assembly of Outer and Delivery pipe to the Monopump Through Packer Head and Flanges

The concentric flow areas between outer and inner pipes are made twin flow areas by fitting a packer head above the outer pipe flange. Place its gasket above the outer pipe flange and then mount the packer head above it, passing it above the inner pipe outside diameter. In this condition, the inner pipe shall be protruding above the packer head top level by at least 40 to 50 mm. Cut the inner pipe using hacksaw to the top surface level of. packer head. Clean out all the burrs around the inner pipe and insert the sealing ring rubber gland above the outside diameter of the inner pipe which will sit in its seating in the packer head. Place its gasket above the packer head, now it is ready for connecting with the monopump. Two sets of flanges one for the packer head and other for monopump shall be supplied. Connect these flanges using two elbows and required length of pipes. A slip coupling may be used for the ease of erection in the pressure line. Using the gasket, tighten this assembly to the packer head and monopump.

NOTE — The inner pipe becomes the suction line of the centrifugal pump annular space between the inner and outer pipes functions as pressure pipeline.

4.3.4 For assembly of discharge (delivery of centrifugal pump) pipeline to the monopump *see* **4.2.3.**

4.4 Installation of Duplex Type Jet Pump (see Fig. 3)

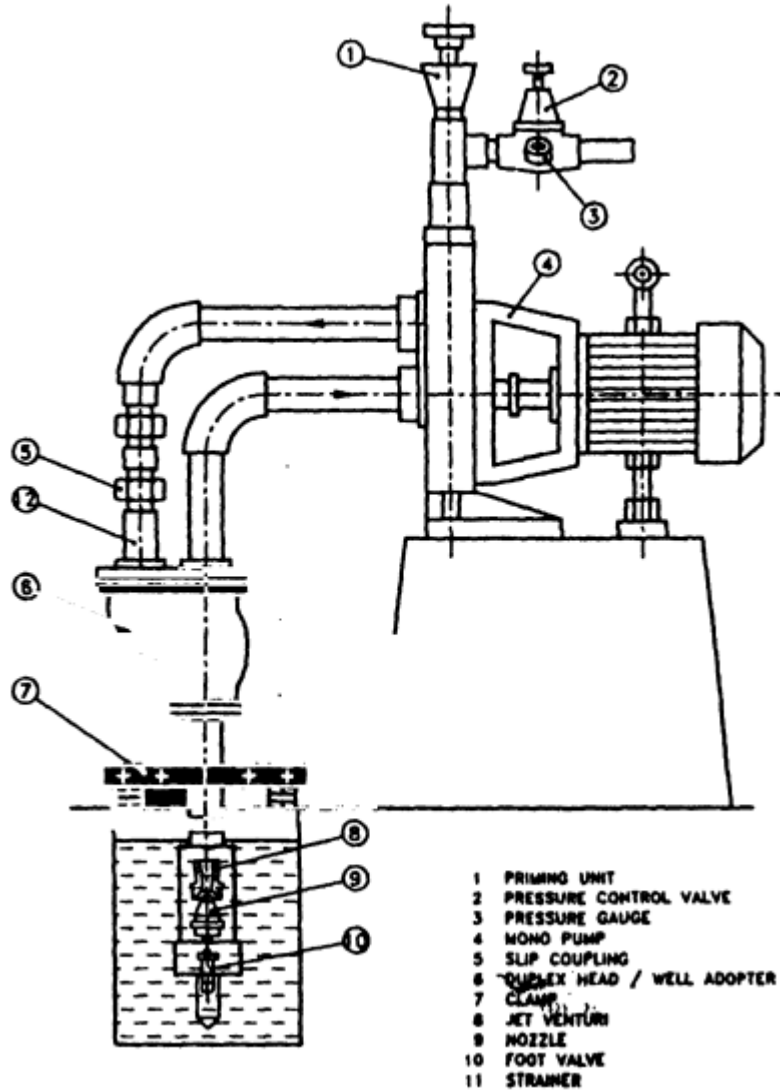


FIG. 3 TYPICAL FIELD INSTALLATION FOR DUPLEX TYPE JET CENTRIFUGAL PUMP COMBINATION

It shall be born in mind that in duplex jet pump, both outer and delivery pipe are screwed to jet assembly together and then lowered in the wall. The foot-valve of the duplex jet pump may be either external to the duplex assembly or internal within duplex assembly. The main components of a duplex type jet centrifugal pump combination are:

- a) Centrifugal monopump/coupled/belt driven pump;
- b) The jet pump assembly components; and
 - 1) Duplex-type jet pump assembly with foot-valve, strainer and duplex unit.
 - 2) Outer pipe flange.
 - 3) Duplex head/well adopter.
 - 4) Flanges to connect pump and duplex.

- 5) Outer and inner pipe clamps.
- c) Delivery assembly components.
- 1) Pressure regulating valve.
 - 2) Priming unit.
 - 3) Pressure gauge.
 - 4) Air-releasing cock.
 - 5) Delivery flanges.

4.4.1 The installation of duplex type jet assembly with pipes and monopump is done in three phases:

- a) Assembly of outer pipe and inner pipe to the duplex jet assembly;
- b) Assembly of outer and inner pipe to the monopump through duplex head/well adopter through flanges; and
- c) Assembly of discharge line (delivery of centrifugal pump).

4.4.2 *Assembly of Outer Pipe and Delivery Pipe to the Duplex Jet Assembly*

For ease of erection, the length of individual bits of pipes are generally kept less than three metres since both pipes are assembled together. Keep the length of the inner pipe at least 3 m longer than outer pipe for easy tightening of the inner and outer pipe separately.

Check the duplex jet assembly for any damage in transit and blow air through the jet assembly so that no foreign particles have clogged the venturi or nozzle. If the foot valve forms an internal part of the jet assembly, fit a small column of inner pipe and pour water to check water tightness of seating of the foot valve.

If the foot valve is external, it should be only fitted after the assembly of first length of inner and outer pipe to jet assembly before lowering. Tighten the jet assembly with first bit of inner pipe with proper sealing compound. Above the duplex nut seating, place the gasket and place the first bit of the outer pipe and tighten both through outer pipe coupling using proper sealing compound.

Using one clamp on the outer pipe and one on the inner pipe, lower the pipes within the bore. Pour water within these pipes and check for any leakage. If both the inner and the outer pipes are lowered to the required length, fix a clamp on the outer pipe and house it on the well casing. Tighten the outer pipe flange using proper sealing compound to the outer pipe. It shall be seen that in this position, the inner pipe shall be protruding above the outer pipe flange by a length of at least duplex head height plus 50 mm.

4.4.3 *Assembly of Outer and Inner Pipe to Monopump Through Duplex Head and Flanges*

The concentric flow areas between outer and inner pipes are made twin flow areas by fitting a duplex head otherwise known as well adopter above the outer pipe flange. Place its gasket above the outer pipe flange and then mount the duplex head above it passing it above the inner pipe. In this condition, the

inner pipe will be protruding above the duplex head top level by at least 40 to 50 mm. Cut the inner pipe using hacksaw to the top surface level of the duplex head. Clean out all the burrs around the inner pipe and insert the sealing ring rubber gland above the outside diameter of the inner pipe which will sit in its seating in this duplex head. Place its gasket above the duplex head. Now it is ready for connecting it with the monopump. Two sets of flanges, one for the duplex head and the other for the monopump shall be supplied. Connect these flanges using two elbows and the required length of pipes. A slip coupling shall be used for ease of erection in the pressure line. Using the gasket, tighten this assembly to the duplex head and to the monopump.

NOTE — The inner pipe becomes the suction line of the centrifugal pump and the annular space between the inner and outer pipes functions as pressure pipe line.

4.4.4 For assembly of delivery pipeline to the monopump *see* **4.2.3**

4.4.4.1 *Electrical connections*

Use proper capacity switch and starter with overload and under voltage protections. While giving connection, take care to avoid loose contacts. Do not use oversize fuse. Before starting, see that the motor runs in the correct direction as indicated by the arrow mark on the casing. In single phase jet pumps, test with a voltmeter to ensure that the line voltage does not go below 180 volts while starting the pump,

5 OPERATION

5.1 All the instructions laid down for centrifugal pump in IS 9694 (Part 3) shall apply to the operation of jet centrifugal pump combination. Further, the following recommendations shall be followed.

5.1.1 After starting the pump, the pressure regulating valve/throttle valve shall be adjusted to a pressure which is 20 percent higher than the minimum operating pressure specified on the name plate. Pump shall be allowed to run at least for 3 hours to 4 hours and fall in operating pressure shall be recorded. Pressure regulating valve shall now be readjusted to the minimum operating pressure. Failure of the pump to operate at minimum operating pressure shall mean that the yield of well is lesser than the capacity of the pump. In such cases, readjust the pressure to a higher value so that the continuous flow of water is established. The failure of jet centrifugal pump combination to deliver water after starting may be due to the following additional factors:

- a) Clogging of foreign particles in jet nozzle or venture;
- b) Foot valve strainer clogging due to mud in the well — It is recommended that foot valve shall be at least 2 m above the bottom most point of well in bore wells and at least 0.3 m above the bottom in open wells;
- c) Inner changing pressure and delivery pipe;
- d) Leaky joints of duplex nut;
- e) Leaky joints of coupling in pressure and delivery pipes; and
- f) Damage of packer washers during erection in packer-type jet pump.

6 MAINTENANCE

6.1 All the maintenance requirements laid down for centrifugal pump in IS 9694 (Part 4) shall apply for the maintenance of jet centrifugal pump combination.

7 SHIPMENT

7.1 IS 9694 (Part 2) shall apply to the centrifugal pump part.

7.2 Jet Pump Assembly

- a) All the important components, such as, venturi, nozzle, foot valve, etc shall be clearly protected and covered from foreign particles entry;
- b) The venturi and foot valve stem portion shall be thoroughly protected from damage due to accidental throwing of the packing; and
- c) Pressure gauge supplied with the pump shall be thoroughly protected from damages to the dial and the glass cover from shock.

ANNEX A

(Clause 2.1)

LIST OF PEFERRED INDIAN STANDARDS

<i>IS No.</i>	<i>Title</i>
IS 210: 2009	Grey iron castings — Specification (<i>fifth revision</i>)
IS 318: 1981	Specification for leaded tin bronze ingots and castings (<i>second revision</i>)
IS 996: 2009	Single phase a.c. induction motors for general purpose (<i>third revision</i>)
IS 7538 : 1996	Three phase squirrel cage induction motor for centrifugal pumps for agricultural application – Specification (<i>first revision</i>)
IS 9694 (Part 2): 2023	Selection, Installation, Operation and Maintenance of Horizontal Centrifugal Pumps for Agriculture Application — Code of Practice Part 2 Installation (<i>first revision</i>)
IS 9694 (Part 3): 2023	Selection, Installation, Operation and Maintenance of Horizontal Centrifugal Pumps for Agriculture Application — Code of Practice Part 3 Operation
IS 9694 (Part 4): 2023	Selection, Installation, Operation and Maintenance of Horizontal Centrifugal Pumps for Agriculture Application — Code of Practice Part 4 Maintenance (<i>first revision</i>)
IS 11170: 1985	Specification for 1 performance requirements for constant speed compression ignition (Diesel) engines for agricultural purposes (Up To 20 KW)
IS 12225: 1987	Centrifugal jet pump — Specification (<i>first revision</i>)