IS 10804 (1994): Recommended pumping system for agricultural purposes [MED 20: Pumps]

BLANK PAGE

IS 10804 : 1994
(Reaffirmed 1999)

भारतीय मानक

कृषि कार्यों के लिए अनुशंसित पंपिंग तंत्र

(दूसरा पुनरीक्षण)

Indian Standard

RECOMMENDED PUMPING SYSTEM FOR AGRICULTURAL PURPOSES

(Second Revision)

UDC 621·5·052 : 631·672·2

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

July 1994

Price Group 8

Pumps Sectional Committee, HMD 20

FOREWORD

This Indian standard (Second Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Pumps Sectional Committee had been approved by the Heavy Mechanical Engineering Division Council.

This Indian standard was first published in 1984 and revised in 1986. In this revision major changes are as follows:

1. Submersible pumpset is also included along with monoset and coupled pumpset.

2. For the proper selection of pump, correct computation of total head is required for the given installation. Tables are incorporated to compute total head for the given installation.

3. The purpose of this specification is to select a most efficient pumping system for given installation. The correct procedure and guidelines are given for proper selection of pumping system. If these guidelines are followed system would be most energy efficient.

4. Graphs giving minimum efficiency figures are incorporated for monoset, coupled pumpset and submersible pumpset from the latest IS specifications.

5. As per the experience various tables given in earlier standard giving maximum permissible energy consumption are not of much use for practical purposes, hence same have been eliminated. Now the maximum energy consumption can be correctly estimated for the computed total head, flow rate and minimum efficiency.

Indian Standard

RECOMMENDED PUMPING SYSTEM FOR AGRICULTURAL PURPOSES

(Second Revision)

1 SCOPE

This standard covers the recommended agricultural pumping system consisting of various matching and energy efficient components like centrifugal pump (monoset or coupled), submersible pumpset, electric motor, diesel engine or spark ignition engine, suction and delivery lines, foot valve, reflux valve or bore valve and necessary pipe fittings.

2 REFERENCES

The Indian Standards given in Annex A are necessary adjuncts to this standard.

3 RECOMMENDED PUMPING SYSTEM

Different components of pumping system shall conform to the following Indian Standards besides matching with the other components (*see* Fig. 1 and 2).

Sl No.	*Component*	*Indian Standards*	*Criteria*
i)	Centrifugal pump (coupled or monoset) (*see* Note 1)	IS 6595 (Part 1) : 1993 or IS 9079 : 1989 or IS 11501 : 1986	The pump shall be selected in such a way that it shall operate at near maximum pump efficiency during peak demand period in the ranges of discharge and head. It should also be capable to discharge in summer season.
ii)	Submersible pumpset	IS 8034 : 1989	The pump shall be selected in such a way that it shall operate at near maximum pump efficiency during peak demand period in the ranges of discharge and head. It should also be capable to discharge in summer season.
iii)	Prime mover (*see* Note 1) or spark ignition engine or electric motor	IS 11170 : 1985 or IS 7347 : 1974 or IS 7538 : 1975	The prime-mover rating shall be as per IS 6595 (Part 1) : 1993 recommendation.
iv)	Suction and delivery lines or piping system	IS 1239 (Part 1) : 1990 or IS 4984 : 1987 or IS 4985 : 1988 or IS 12231 : 1987	The sizes of pipes shall be selected in such a way that the friction head (h_f) shall not exceed 10 percent total equivalent length of piping system up to delivery point. The data given in Fig. 1 and 2 and Tables 1, 2, 3 and 4 shall be used to determine approximate sizes of pipes. If the delivery offset distance is more than 3 m, then larger pipe sizes shall be used to reduce the friction losses.
v)	Foot valve, reflux valve or bore valve	IS 10805 : 1986	Size of valve shall be equal to the size of suction pipe.
vi)	Pipe fittings (bends)	IS 1239 (Part 2) : 1982 or IS 10124 (Part 8) : 1982 or IS 13593 : 1992	The sizes of bends, and other fittings shall be matching with the sizes of M.S. pipes, HDPE pipes or RPVC pipes to be used for piping system.

NOTE 1 – Guidelines for the determination of pipe sizes are given in Table 1. The prime movers are selected by having 10 percent margin at the declared pump duty point. This is done to take care of the power requirements in the declared operating range. An example for selection of pumpset for agricultural requirement is given in Annex B.

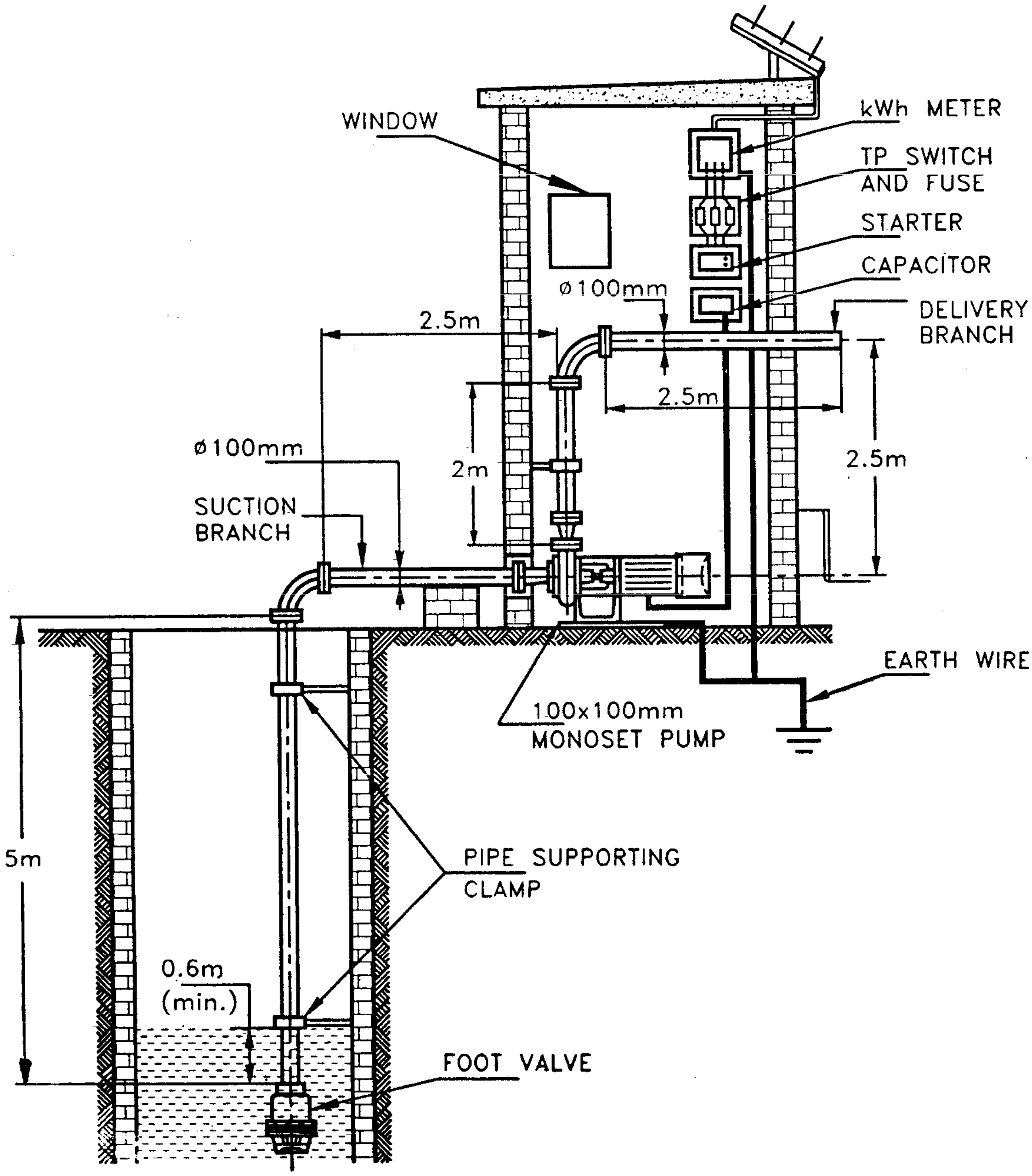
4 COMPUTATION OF FLOW RATE 'Q', TOTAL HEAD 'H' AND PRIME MOVER RATING

4.1 The determination of quantity of water required shall be obtained from the guidelines given in IS 9694 (Part 1) : 1987.

4.2 Based on the quantity of water required, the selection of suction and delivery pipe sizes shall be made from Table 1, 2, 3 or 4. (In case of submersible pumpset suction pipe is not required).

4.3 The length of piping system required shall be determined from the static head difference. This shall be increased by one metre required for the submergence of the foot valve to avoid air entrainment, plus length of pipe from well to pump and pump to delivery point.

4.3.1 The total head of the system shall be read from respective total head Tables 5, 7, 9 and 11. This should be further corrected for additional pipe fittings and offset pipe length.



NOTE – It is desirable to use non-return valve on delivery side, if the total head is more than 25m.

FIG. 1 TYPICAL INSTALLATION OF HORIZONTAL CENTRIFUGAL PUMP

4.4 Maximum Prime Mover Rating

Maximum prime mover rating is derived for the minimum efficiency of the pump. However, it can be lower, if pump efficiency is higher than minimum efficiency given in Fig. 3, 4 or 5.

5 SELECTION OF PUMPING SYSTEM

5.1 Decide whether monoset, coupled or submersible pump is required. For given H and Q select suitable pump and prime mover rating. Pump shall be selected such that the operating point will lie near the best efficiency point (bep) of the pump. Pipe size is selected as given in **4.2**.

Select foot valve of size equivalent to suction pipe size in case of monoset/coupled pumpset. No need of foot valve in case of submersible pumpset.

All the above components shall conform to relevant Indian standards referred in **3**.

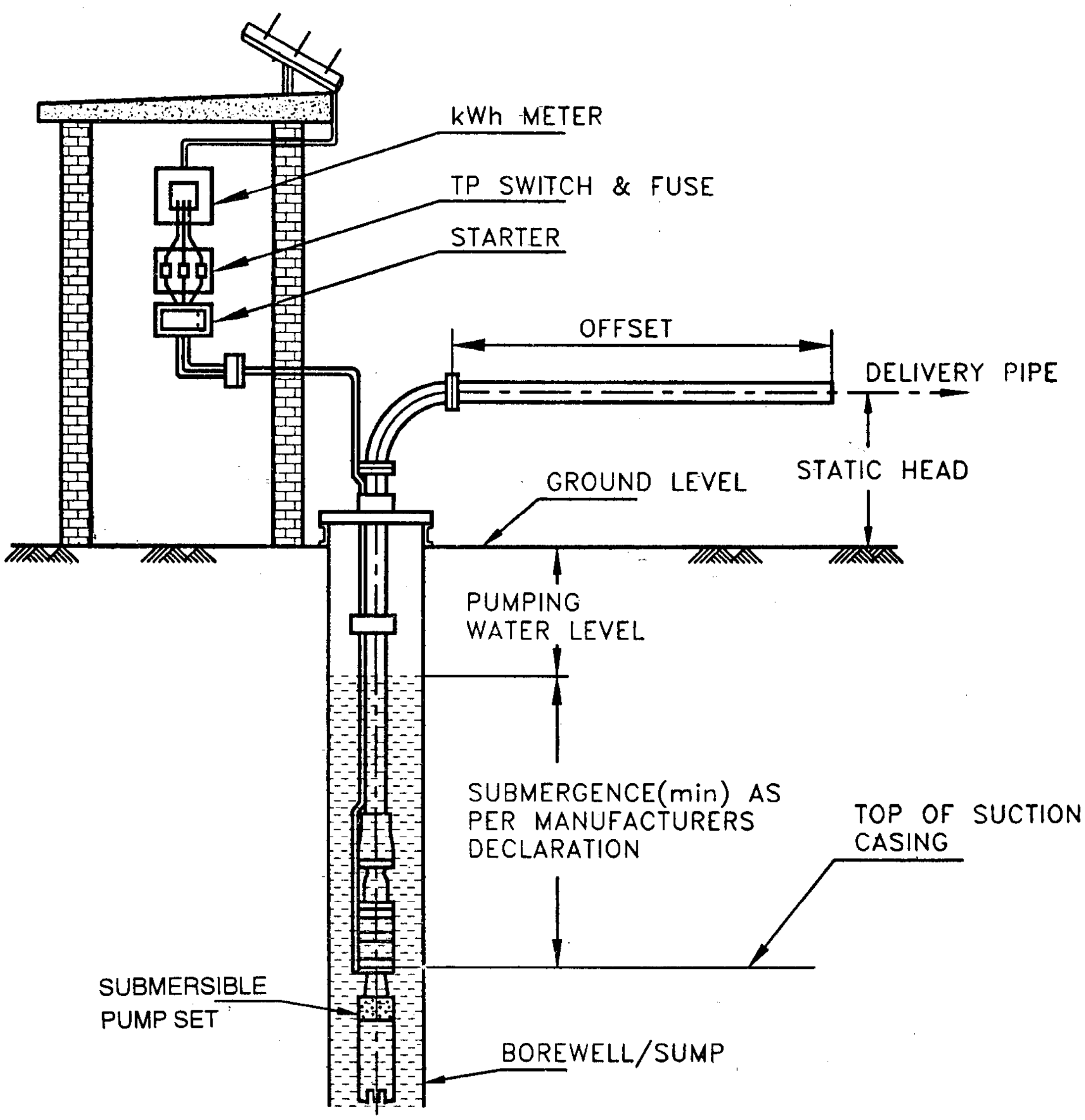


FIG. 2 TYPICAL INSTALLATION FOR BOREWELL SUBMERSIBLE PUMP

Table 1 Permissible Ranges of Volume Rates of Flow in l/s Through Galvanized Steel Pipes to Limit Friction Losses to 10 Percent of the Pipe Length (IS 1239, C = 140)

(*Clauses* 3 *and* 4.2 and *Annex B*)

Grade → / Nominal ↓	Light	Medium	Heavy
	Rate of Flow	Rate of Flow	Rate of Flow
mm	l/s	l/s	l/s
40	1.90 - 2.74	1.79 - 2.67	1.59 - 2.41
50	2.74 - 5.24	2.67 - 4.95	2.41 - 4.54
65	5.24 - 9.97	4.95 - 9.80	4.54 - 9.17
80	9.97 - 15.54	9.80 - 14.97	9.17 - 14.20
100	15.54 - 30.84	14.97 - 30.00	14.20 - 28.67
125	-	30.00 - 52.50	28.67 - 51.37
150	-	52.50 - 84.18	51.37 - 82.63

Table 2 Permissible Ranges of Volume Rates of Flow in l/s Through RPVC Pipes to Limit Friction Losses to 10 Percent of the Pipe Length (IS 4985, C = 150)

(*Clauses* 3 *and* 4.2)

Grade → / Nominal Outside Dia ↓	Class (0.25 MPa)	Class 2 (0.4 MPa)	Class 3 (0.6 MPa)
	Rate of Flow	Rate of Flow	Rate of Flow
mm	l/s	l/s	l/s
40	-	-	Up to 2.04
50	-	-	2.04 - 3.70
63	-	3.80 - 7.24	3.70 - 6.77
75	-	7.24 - 11.47	6.77 - 10.76
90	11.50 - 19.58	11.47 - 18.59	10.76 - 17.41
110	19.58 - 33.25	18.59 - 31.71	17.41 - 29.75
125	33.25 - 46.63	31.71 - 44.33	29.75 - 41.44
140	46.63 - 62.92	44.33 - 59.79	41.44 - 55.97
160	62.92 - 89.28	59.79 - 84.95	55.97 - 79.76

Table 3 Permissible Ranges of Volume Rates of Flow in l/s through HDPE Pipes to Limit Friction Losses to 10 Percent of the Pipe Length (IS 4984, C = 150)

(*Clauses* 3 *and* 4.2)

Grade → / Outside Dia ↓	Class 2 (0.25 MPa)	Class 3 (0.4 MPa)	Class 4 (0.6 MPa)
	Rate of Flow	Rate of Flow	Rate of Flow
mm	l/s	l/s	l/s
40	–	Up to 1.87	Up to 1.62
50	–	1.87 - 3.40	1.62 - 2.92
63	3.40 - 6.92	3.40 - 6.29	2.92 - 5.40
75	6.92 - 11.01	6.29 - 9.86	5.40 - 8.59
90	11.01 - 17.80	9.86 - 15.96	8.59 - 13.86
110	17.80 - 30.21	15.96 - 27.65	13.86 - 23.60
125	30.21 - 42.30	27.65 - 38.23	23.60 - 33.00
140	42.30 - 57.11	38.23 - 51.33	33.00 - 44.63
160	57.11 - 81.33	51.33 - 72.89	44.63 - 63.41

Table 4 Permissible Ranges of Volume Rates of Flow in l/s Through RPVC Pipes to Limit Friction Losses to 10 Percent of the Pipe Length (IS 12231, C = 150)

(*Clauses* 3 *and* 4.2)

Grade → / Nominal Outside Dia ↓	Type 1 W (0.4 MPa) Rate of Flow	Type 2 W (0.6 MPa) Rate of Flow
mm	l/s	l/s
63	3.40 - 6.29	2.92 - 5.40
75	6.29 - 9.86	5.40 - 8.59
90	9.86 - 15.96	8.59 - 13.86
110	15.96 - 27.65	13.86- 23.60
140	27.65 - 51.33	23.60 - 44.63

Table 5 Total Head 'H' for Given Flow Rate 'O' Pipe Size and Static Head with New G. I. Pipe (C = 140)

(*Clause* 4.3.1)

Static Head in m		6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38
Nominal Pipe Size in mm	Discharge in l/s (Q)	Total Head in m (H)																
50	4	7.5	9.6	11.7	13.9	16.0	18.1	20.3	22.4	24.5	26.7	28.8	30.9	33.1	35.2	37.3	39.5	41.6
65	6	6.9	9.8	11.1	13.2	15.3	17.3	19.4	21.5	23.6	25.7	27.8	29.8	31.9	34.0	36.1	38.2	48.2
65	8	7.6	9.8	11.9	14.0	16.2	18.3	20.5	22.6	24.7	26.9	29.0	31.1	33.3	35.4	37.6	39.7	41.8
80	10	7.1	9.2	11.3	13.4	15.5	17.6	19.7	21.8	23.9	26.0	28.1	30.2	32.3	34.4	36.4	38.5	40.6
80	12	7.6	9.7	11.9	14.0	16.1	18.2	20.4	22.5	24.6	26.8	28.9	31.0	33.2	35.3	37.4	39.6	41.7
80	14	8.1	10.3	12.5	14.7	16.8	19.0	21.2	23.4	25.5	27.7	29.9	32.1	34.2	36.4	38.6	40.8	43.8
100	16	6.9	8.9	11.0	13.1	15.1	17.2	19.3	21.3	23.4	25.4	27.5	29.6	31.6	33.7	35.8	37.8	39.9
100	18	7.1	9.2	11.3	13.3	15.4	17.5	19.6	21.6	23.7	25.8	27.9	30.0	32.0	34.1	36.2	38.3	40.3
100	20	7.3	9.4	11.5	13.6	15.7	17.8	19.9	22.0	24.1	26.2	28.3	30.4	32.5	34.6	36.7	38.8	40.9
100	22	7.6	9.7	11.8	14.0	16.1	18.2	20.3	22.4	24.5	26.6	28.7	30.9	33.0	35.1	37.2	39.3	41.4
100	24	7.9	10.0	12.2	14.3	16.4	18.6	20.7	22.8	25.0	27.1	29.2	31.4	33.5	35.6	37.8	39.9	42.0
100	26	8.2	10.4	12.5	14.7	16.8	19.0	21.2	23.3	25.5	27.6	29.8	31.9	34.1	36.2	38.4	40.5	42.7
100	28	8.6	10.7	12.9	15.1	17.3	19.5	21.6	23.8	26.0	28.2	30.3	32.5	34.7	36.9	39.8	41.2	43.4
100	30	8.9	11.1	13.3	15.5	17.7	19.9	22.1	24.3	26.5	28.7	30.9	33.1	35.3	37.5	39.7	41.9	44.1
125	32	7.3	9.3	11.4	13.5	15.6	17.7	19.7	21.8	23.9	26.0	28.1	30.1	32.2	34.3	36.4	38.5	40.5
125	34	7.4	9.5	11.6	13.7	15.8	17.9	20.0	22.0	24.1	26.2	28.3	30.4	32.5	34.6	36.7	38.8	40.9
125	36	7.6	9.7	11.8	13.9	16.0	18.1	20.2	22.3	24.4	26.5	28.6	30.7	32.8	34.9	37.0	39.1	41.2
125	38	7.8	9.9	12.0	14.1	16.2	18.3	20.4	22.5	24.6	26.7	28.9	31.0	33.1	35.2	37.3	39.4	41.5
125	40	7.9	10.1	12.2	14.3	16.4	18.5	20.7	22.8	24.9	27.0	29.2	31.3	33.4	35.5	37.6	39.8	41.9
125	42	8.1	10.3	12.4	14.5	16.7	18.8	20.9	23.1	25.2	27.3	29.5	31.6	33.7	35.9	38.0	40.1	42.3
125	44	8.3	10.5	12.6	14.8	16.9	19.1	21.2	23.3	25.5	27.6	29.8	31.9	34.1	36.2	38.4	40.5	42.6
125	46	8.5	10.7	12.9	15.0	17.2	19.3	21.5	23.6	25.8	28.0	30.1	32.3	34.4	36.6	38.7	40.9	43.8
125	48	8.8	10.9	13.1	15.3	17.4	19.6	21.8	23.9	26.1	28.3	30.5	32.6	34.8	37.0	39.1	41.3	43.5
125	50	9.0	11.2	13.4	15.5	17.7	19.9	22.1	24.3	26.4	28.6	30.8	33.0	35.2	37.4	39.5	41.7	43.9

NOTES

1 The total head 'H' is computed as a sum of total static head, frictional losses in pipes, allied fittings and footvalve and discharge velocity head. While computing frictional losses an additional pipe length of 10 m is considered over and above pipe length equivalent to static head to take into account submergence of suction pipe (1 m), offset pipe length of suction and delivery side (5 m) and 2 bends (4 m equivalent pipe length).

2 New medium series galvanized MS pipe considered (C = 140).

3 For offset pipe line (more than 5 m) and additional fittings in the system, frictional losses are to be added over and above the total head given in the table. For each additional bend 2 m equivalent pipe length should be considered for frictional losses calculation. Compute the frictional losses h_f from Table 6 for offset (more than 5 m) and length equivalent to additional fittings. Add h_f to total head figure obtained from Table 5. This is the final total head 'H' of the system, for which pump is to be selected.

4 For old/rusted G.I. pipe final total head 'H' shall be multiplied by 1.05.

Table 6 Friction Losses in New G.I. Pipe of Medium Series
(*Note* 3 *to Table* 5)

Sl No.	Nominal Pipe Size mm	Inside Dia mm	Discharge l/s	Frictional Losses in m per 100 m Pipe Length
1	40.0	41.85	2.0	5.9
2	50.0	52.95	4.0	6.7
3	65.0	68.65	6.0	4.0
4	65.0	68.65	8.0	6.9
5	80.0	80.65	10.0	4.7
6	80.0	80.65	12.0	6.6
7	80.0	80.65	14.0	8.8
8	100.0	105.05	16.0	3.1
9	100.0	105.05	18.0	3.9
10	100.0	105.05	20.0	4.7
11	100.0	105.05	22.0	5.6
12	100.0	105.05	24.0	6.6
13	100.0	105.05	26.0	7.7
14	100.0	105.05	28.0	8.8
15	100.0	105.05	30.0	10.0
16	125.0	129.95	32.0	4.0
17	125.0	129.95	34.0	4.5
18	125.0	129.95	36.0	5.0
19	125.0	129.95	38.0	5.5
20	125.0	129.95	40.0	6.0
21	125.0	129.95	42.0	6.6
22	125.0	129.95	44.0	7.2
23	125.0	129.95	46.0	7.8
24	125.0	129.95	48.0	8.5
25	125.0	129.95	50.0	9.1
26	125.0	129.95	52.0	9.8
27	150.0	155.50	54.0	4.4
28	150.0	155.50	56.0	4.7
29	150.0	155.50	58.0	5.0
30	150.0	155.50	60.0	5.3

Table 7 Total Head 'H' for Given Flow Rate 'Q' Pipe Size and Static Head With RPVC Pipe (C = 150)

(*Clause* 4.3.1)

Static Head in m		6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38
Nominal Pipe Size in mm	Discharge in l/s	Total Head in m (H)																
63	4	6.8	8.9	11.0	13.1	15.2	17.3	19.4	21.4	23.5	25.6	27.7	29.8	31.9	34.0	36.0	38.1	40.2
63	6	7.8	10.0	12.2	14.3	16.5	18.7	20.9	23.1	25.2	27.4	29.6	31.8	34.0	36.2	38.3	40.5	42.7
75	8	7.3	9.5	11.6	13.7	15.9	18.0	20.1	22.3	24.4	26.5	28.7	30.8	32.9	35.1	37.2	39.3	41.4
75	10	8.1	10.3	12.5	14.7	16.8	19.0	21.2	23.4	25.6	27.8	30.0	32.2	34.4	36.6	38.8	41.0	43.2
90	12	7.2	9.4	11.5	13.6	15.7	17.8	19.9	22.0	24.2	26.3	28.4	30.5	32.6	34.7	36.8	39.0	41.1
90	14	7.7	9.8	12.0	14.1	16.3	18.4	20.6	22.7	24.9	27.0	29.2	31.3	33.5	35.6	37.8	39.9	42.1
90	16	8.1	10.3	12.5	14.7	16.9	19.1	21.3	23.5	25.7	27.9	30.1	32.3	34.5	36.7	38.9	41.1	43.2
110	18	7.0	9.1	11.2	13.3	15.4	17.5	19.6	21.7	23.8	25.9	27.9	30.0	32.1	34.2	36.3	38.4	40.5
110	20	7.3	9.4	11.5	13.6	15.7	17.8	19.9	22.0	24.1	26.3	28.4	30.5	32.6	34.7	36.8	38.9	41.0
110	22	7.5	9.7	11.8	13.9	16.1	18.2	20.3	22.4	24.6	26.7	28.8	31.0	33.1	35.2	37.4	39.5	41.6
110	24	7.8	10.0	12.1	14.3	16.4	18.6	20.7	22.9	25.0	27.2	29.3	31.5	33.6	35.8	37.9	40.1	42.2
110	26	8.1	10.3	12.5	14.6	16.8	19.0	21.2	23.3	25.5	27.7	29.9	32.1	34.2	36.4	38.6	40.8	42.9
110	28	8.4	10.6	12.8	15.0	17.2	19.4	21.6	23.8	26.0	28.2	30.5	32.7	34.9	37.1	39.3	41.5	43.7
125	30	7.5	9.7	11.8	13.9	16.0	18.2	20.3	22.4	24.5	26.7	28.8	30.9	33.0	35.2	37.3	39.4	41.5
125	32	7.8	9.9	12.0	14.2	16.3	18.5	20.6	22.7	24.9	27.0	29.2	31.3	33.4	35.6	37.7	39.9	42.0
125	34	8.0	10.1	12.3	14.4	16.6	18.8	20.9	23.1	25.2	27.4	29.5	31.7	33.9	36.0	38.2	40.3	42.5
125	36	8.2	10.4	12.5	14.7	16.9	19.1	21.2	23.4	25.6	27.8	29.9	32.1	34.3	36.5	38.6	40.8	43.0
125	38	8.4	10.6	12.8	15.0	17.2	19.4	21.6	23.8	26.0	28.2	30.4	32.6	34.8	36.9	39.1	41.3	43.5
125	40	8.7	10.9	13.1	15.3	17.5	19.7	22.0	24.2	26.4	28.6	30.8	33.0	35.2	37.4	39.7	41.9	44.1
140	42	7.8	9.9	12.0	14.2	16.3	18.4	20.6	22.7	24.8	27.0	29.1	31.2	33.4	35.5	37.6	39.8	41.9
140	44	7.9	10.1	12.2	14.4	16.5	18.6	20.8	22.9	25.1	27.2	29.4	31.5	33.7	35.8	38.0	40.1	42.2
140	46	8.1	10.2	12.4	14.6	16.7	18.9	21.0	23.2	25.3	27.5	29.7	31.8	34.0	36.1	38.3	40.5	42.6
140	48	8.3	10.4	12.6	14.8	16.9	19.1	21.3	23.5	25.6	27.8	30.0	32.1	34.3	36.5	38.7	40.8	43.0
140	50	8.4	10.6	12.8	15.0	17.2	19.4	21.6	23.7	25.9	28.1	30.3	32.5	34.7	36.8	39.0	41.2	43.4

NOTES

1 The total head 'H' is computed as a sum of total static head, frictional losses in pipes, allied fittings and foot valve and discharge velocity head. While computing frictional losses an additional pipe length of 10 m is considered over and above the pipe length equivalent to static head to take into account submergence of suction pipe (1 m), offset pipe length of suction and delivery side (5 m) and 2 bends (4 m equivalent pipe length).

2 Class 3 RPVC pipes considered (C = 150).

3 For offset pipe line (more than 5 m) and additional fittings in the system, frictional losses are to be added over and above total head given in the table. For each additional bend 2 m equivalent pipe length should be considered for frictional losses calculation. Compute the frictional losses h_f from Table 8 for offset (more than 5 m) and length equivalent to additional fittings. Add h_f to total head figure obtained from Table 7. This is the final total head 'H' of the system, for which pump is to be selected.

Table 8 Friction Losses in RPVC Pipe of Class 3

(*Note* 3 *to Table* 7)

Sl No.	Nominal Pipe Size mm	Inside Dia mm	Discharge l/s	Frictional Losses in m Per 100 m Pipe Length
1	40.0	36.80	2.0	9.7
2	63.0	58.10	4.0	3.8
3	63.0	58.10	6.0	8.0
4	75.0	69.30	8.0	5.8
5	75.0	69.30	10.0	8.7
6	90.0	83.20	12.0	5.0
7	90.0	83.20	14.0	6.7
8	90.0	83.20	16.0	8.6
9	110.0	102.00	18.0	3.9
10	110.0	102.00	20.0	4.8
11	110.0	102.00	22.0	5.7
12	110.0	102.00	24.0	6.7
13	110.0	102.00	26.0	7.8
14	110.0	102.00	28.0	8.9
15	125.0	115.70	30.0	5.5
16	125.0	115.70	32.0	6.2
17	125.0	115.70	34.0	6.9
18	125.0	115.70	36.0	7.7
19	125.0	115.70	38.0	8.5
20	125.0	115.70	40.0	9.4
21	140.0	129.70	42.0	5.9
22	140.0	129.70	44.0	6.4
23	140.0	129.70	46.0	7.0
24	140.0	129.70	48.0	7.5
25	140.0	129.70	50.0	8.1
26	140.0	129.70	52.0	8.7
27	140.0	129.70	54.0	9.4
28	160.0	148.40	56.0	5.2
29	160.0	148.40	58.0	5.5
30	160.0	148.40	60.0	5.9

Table 9 Total Head 'H' for Given Flow Rate 'Q' Pipe Size and Static Head With HDPE Pipe (C = 150)

(*Clause* 4.3.1)

Static Head in m		6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38
Nominal Pipe Size in mm	Dis-charge in l/s (Q)	Total Head in m (H)																
63	4	6.9	9.0	11.1	13.2	15.3	17.4	19.5	21.6	23.7	25.8	27.9	30.0	32.1	34.2	36.3	38.4	40.5
63	6	8.0	10.2	12.4	14.6	16.8	19.0	21.3	23.5	25.7	27.9	30.1	32.3	34.5	36.7	38.9	41.1	43.3
75	8	7.5	9.7	11.8	14.0	16.1	18.3	20.4	22.6	24.8	26.9	29.1	31.2	33.4	35.5	37.7	39.8	42.0
90	10	7.0	9.1	11.2	13.3	15.4	17.5	19.6	21.7	23.8	25.9	27.9	30.0	32.1	34.2	36.3	38.4	40.5
90	12	7.4	9.5	11.7	13.8	15.9	18.1	20.2	22.3	24.5	26.6	28.7	30.9	33.0	35.1	37.3	39.4	41.5
90	14	7.9	10.0	12.2	14.4	16.6	18.8	20.9	23.1	25.3	27.5	29.7	31.8	34.0	36.2	38.4	40.5	42.7
110	16	6.9	9.0	11.1	13.2	15.3	17.3	19.4	21.5	23.6	25.7	27.7	29.8	31.9	34.0	36.1	36.2	40.2
110	18	7.2	9.3	11.4	13.5	15.6	17.7	19.8	21.9	24.8	26.1	28.2	30.3	32.4	34.5	36.6	38.7	40.8
110	20	7.4	9.5	11.7	13.8	15.9	18.0	20.2	22.3	24.4	26.5	28.7	30.8	32.9	35.0	37.2	39.3	41.4
110	22	7.7	9.8	12.0	14.1	16.3	18.4	20.6	22.7	24.9	27.0	29.2	31.3	33.5	35.6	37.8	39.9	42.1
110	24	8.0	10.2	12.3	14.5	16.7	18.9	21.0	23.2	25.4	27.6	29.7	31.9	34.1	36.3	38.4	40.6	42.8
110	26	8.3	10.5	12.7	14.9	17.1	19.3	21.5	23.7	25.9	28.1	30.3	32.5	34.7	36.9	39.1	41.4	43.6
125	28	7.5	9.6	11.8	13.9	16.0	18.1	20.3	22.4	24.5	26.6	28.8	30.9	33.0	35.2	37.3	39.4	41.5
125	30	7.7	9.9	12.0	14.1	16.3	18.4	20.6	22.7	24.9	27.0	29.2	31.3	33.5	35.6	37.7	39.9	42.0
125	32	7.9	10.1	12.3	14.4	16.6	18.7	20.9	23.1	25.2	27.4	29.6	31.7	33.9	36.1	38.2	40.4	42.5
125	34	8.2	10.4	12.5	14.7	16.9	19.1	21.3	23.4	25.6	27.8	30.0	32.2	34.4	36.5	38.7	40.9	43.1
125	36	8.4	10.6	12.8	15.0	17.2	19.4	21.6	23.8	26.0	28.2	30.5	32.7	34.9	37.1	39.3	41.5	43.7
125	38	8.7	10.9	13.1	15.4	17.6	19.8	22.0	24.3	26.5	28.7	30.9	33.2	35.4	37.6	39.8	42.1	44.3
140	40	7.8	9.9	12.1	14.2	16.3	18.5	20.6	22.8	24.9	27.1	29.2	31.3	33.5	35.6	37.8	39.9	42.1
140	42	7.9	10.1	12.3	14.4	16.6	18.7	20.9	23.0	25.2	27.3	29.5	31.7	33.8	36.0	38.1	40.3	42.4
140	44	8.1	10.3	12.5	14.6	16.8	19.0	21.1	23.3	25.5	27.7	29.8	32.0	34.2	36.3	38.5	40.7	42.9
140	46	8.3	10.5	12.7	14.9	17.0	19.2	21.4	23.6	25.8	28.0	30.2	32.3	34.5	38.7	38.9	41.1	43.3
140	48	8.5	10.7	12.9	15.1	17.3	19.5	21.7	23.9	26.1	28.3	30.5	32.7	34.9	37.1	39.3	41.5	43.7
140	50	8.7	10.9	13.1	15.4	17.6	19.8	22.0	24.2	26.4	28.7	30.9	33.1	35.3	37.5	39.7	41.7	44.2

NOTES

1 The total head 'H' is computed as a sum of total static head, frictional losses in pipes, allied fittings and foot valve and discharge velocity head. While computing frictional losses an additional pipe length of 10 m is considered over and above pipe length equivalent to static head to take into account submergence of suction pipe (1 m), offset pipe length of suction and delivery side (5 m) amd 2 bends (4 m equivalent pipe length).

2 Class 3 HDPE pipes considered (C = 150).

3 For offset pipe line (more than 5 m) and additional fittings in the system, frictional losses are to be added over and above the total head given in the table. For each additional bend 2 m equivalent pipe length should be considered for frictional losses calculation. Compute the frictional losses h_f from Table 10 for offset (more than 5 m) and length equivalent to additional fittings. Add h_f to total head figure obtained from Table 9. This is the final total head 'H' of the system, for which pump is to be selected.

Table 10 Friction Losses in HDPE Pipe of Class 3

(*Note* 3 *to Table* 9)

Sl No.	Nominal Pipe Size mm	Inside Dia mm	Discharge l/s	Frictional Losses in m Per 100 m Pipe Length
1	50.0	44.70	2.0	3.7
2	63.0	56.50	4.0	4.3
3	63.0	56.50	6.0	9.2
4	75.0	67.10	8.0	6.8
5	90.0	80.50	10.0	4.2
6	90.0	80.50	12.0	5.9
7	90.0	80.50	14.0	7.8
8	110.0	99.20	16.0	3.6
9	110.0	99.20	18.0	4.5
10	110.0	99.20	20.0	5.5
11	110.0	99.20	22.0	6.5
12	110.0	99.20	24.0	7.7
13	110.0	99.20	26.0	8.9
14	125.0	112.20	28.0	5.6
15	125.0	112.20	30.0	6.4
16	125.0	112.20	32.0	7.2
17	125.0	112.20	34.0	8.1
18	125.0	112.20	36.0	9.0
19	125.0	112.20	38.0	9.9
20	140.0	125.50	40.0	6.3
21	140.0	125.50	42.0	6.9
22	140.0	125.50	44.0	7.5
23	140.0	125.50	46.0	8.2
24	140.0	125.50	48.0	8.8
25	140.0	125.50	50.0	9.5
26	160.0	143.40	52.0	5.4
27	160.0	143.40	54.0	5.7
28	160.0	143.40	56.0	6.1
29	160.0	143.40	58.0	6.6
30	160.0	143.40	60.0	7.0

Table 11 Total Head 'H' for Given Flow Rate 'Q' Pipe Size and Static Head with New G.I. Pipe of Medium Series (C= 140)

(*Clause* 4.3.1)

Static Head in m		25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120
Nominal Pipe Size in mm	Discharge in l/s (Q)	Total Head in m (H)																			
40	2	27.1	32.4	37.7	43.0	48.3	53.6	58.9	64.2	69.5	74.8	80.1	85.4	90.6	95.9	101.2	106.5	111.8	117.1	122.4	127.7
50	4	27.5	32.8	38.2	43.5	48.8	54.2	59.5	64.9	70.2	75.5	80.9	86.2	91.5	96.9	102.2	107.6	112.9	118.2	123.6	128.9
65	6	26.5	31.7	36.9	42.1	47.3	52.5	57.7	62.9	68.1	73.3	78.6	83.8	89.0	94.2	99.4	104.6	109.8	115.0	120.2	125.4
65	8	27.6	33.0	38.3	43.7	49.0	54.3	59.7	65.0	70.4	75.7	81.1	86.4	91.7	97.1	102.4	107.8	113.1	118.5	123.8	129.2
80	10	26.8	32.0	37.3	42.5	47.8	53.0	58.2	63.5	68.7	73.9	79.2	84.4	89.7	94.9	100.1	105.4	110.6	115.8	121.1	126.3
80	12	27.5	32.9	38.2	43.5	48.9	54.2	59.5	64.9	70.2	75.5	80.9	86.2	91.5	96.9	102.2	107.5	112.9	118.2	123.5	128.9
80	14	28.4	33.8	39.3	44.7	50.2	55.6	61.0	66.5	71.9	77.4	82.8	88.3	93.7	99.1	104.6	110.0	115.5	120.9	126.3	131.8
100	16	26.3	31.4	36.6	41.7	46.9	52.1	57.2	62.4	67.5	72.7	77.8	83.0	88.1	93.3	98.5	103.6	108.8	113.9	119.1	124.2
100	18	26.6	31.8	37.0	42.2	47.4	52.6	57.8	62.9	68.1	73.3	78.5	83.7	88.9	94.1	99.3	104.5	109.7	114.9	120.1	125.3
100	20	26.9	32.2	37.4	42.6	47.9	53.1	58.4	63.6	68.8	74.1	79.3	84.5	89.8	95.0	100.2	105.5	110.7	115.9	121.2	126.4
100	25	27.9	33.3	38.7	44.8	49.4	54.7	60.1	65.4	70.8	76.2	81.5	86.9	92.2	97.6	102.9	108.3	113.6	119.0	124.4	129.7
100	30	29.1	34.6	40.1	45.6	51.1	56.6	62.1	67.6	73.1	78.6	84.1	89.6	95.1	100.6	106.1	111.6	117.1	122.6	128.1	133.6
125	35	27.0	32.3	37.5	42.7	48.0	53.2	58.4	63.7	68.9	74.1	79.4	84.6	89.9	95.1	100.3	105.6	110.8	116.0	121.3	126.5
125	40	27.6	32.9	38.2	43.5	48.8	54.1	59.4	64.7	70.0	75.3	80.6	85.9	91.2	96.5	101.8	107.1	112.4	117.7	123.0	128.3
125	45	28.2	33.6	39.0	44.4	49.7	55.1	60.5	65.9	71.2	76.6	82.0	87.4	92.8	98.1	103.5	108.9	114.3	119.6	125.0	130.4
125	50	29.0	34.4	39.9	45.3	50.8	56.2	61.7	67.2	72.6	78.1	83.5	89.0	94.4	99.9	105.4	110.8	116.3	121.7	127.2	132.6
125	55	29.7	35.3	40.8	46.4	51.9	57.5	63.0	68.5	74.1	79.6	85.2	90.7	96.3	101.8	107.4	112.9	118.5	124.0	129.5	135.1
125	60	30.6	36.2	41.9	47.5	53.1	58.8	64.4	70.1	75.7	81.3	87.0	92.6	98.3	103.9	109.5	115.2	120.8	126.5	132.1	137.7

NOTES

1 The total head 'H' is computed as a sum of total static head, frictional losses in pipes, allied fittings and foot valve and discharge velocity head. While computing frictional losses an additional pipe length of 9 m is considered over and above the pipe length equivalent to static head to take into account submergence of suction pipe (5 m), offset pipe length of delivery side (2 m) and 1 bend (2 m equivalent pipe length).

2 New medium series galvanized MS pipe considered (C = 140).

3 For offset pipe line (more than 2 m) and additional fittings in the system, frictional losses are to be added over and above the total head given in the table. For each additional bend 2 m equivalent pipe length should be considered for frictional losses calculation. Compute the frictional losses h_f from Table 6 for offset (more than 2 m) and length equivalent to additional fittings. Add h_f to total head figure obtained from Table 11. This is the final total head 'H' of the system, for which pump is to be selected.

4 For old/rusted G.I. pipes final total head 'H' shall be multiplied by 1.05.

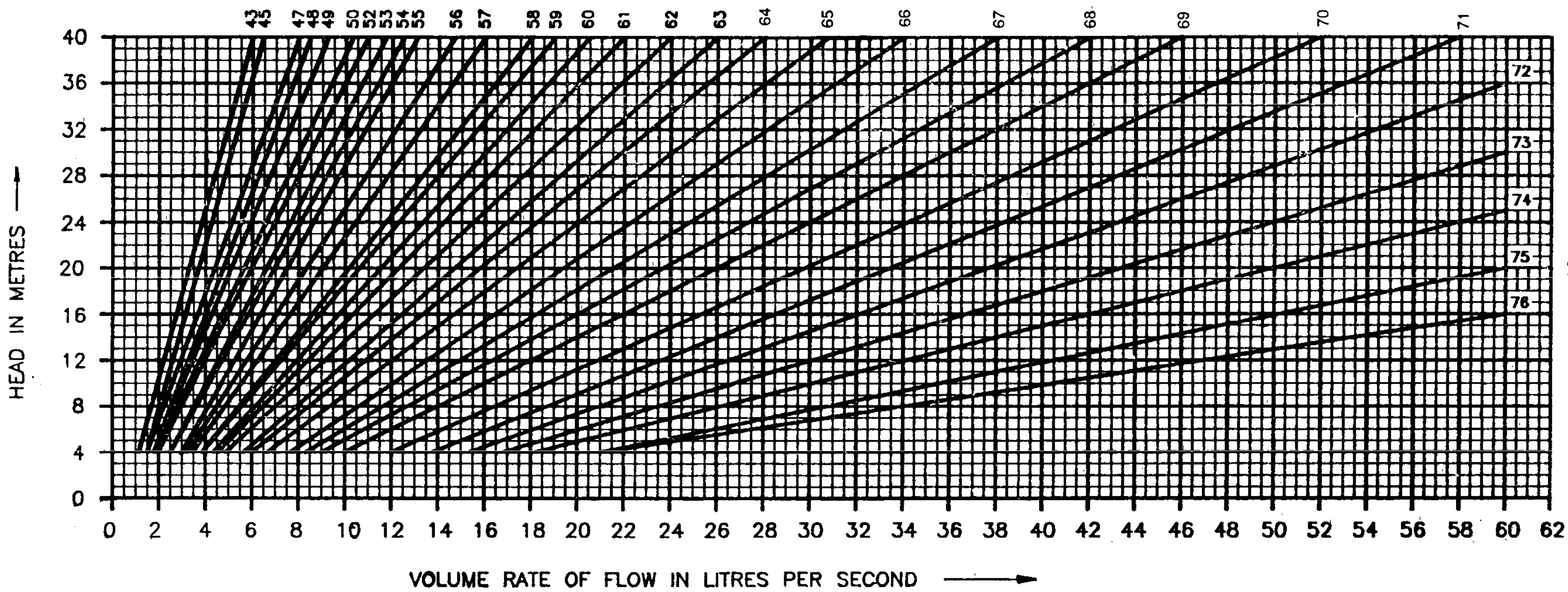


FIG. 3 MINIMUM PUMP EFFICIENCY IN PERCENT FOR HORIZONTAL CENTRIFUGAL PUMPS FOR AGRICULTURAL PURPOSES
(SPEED 1 200 TO 2 000 rpm)

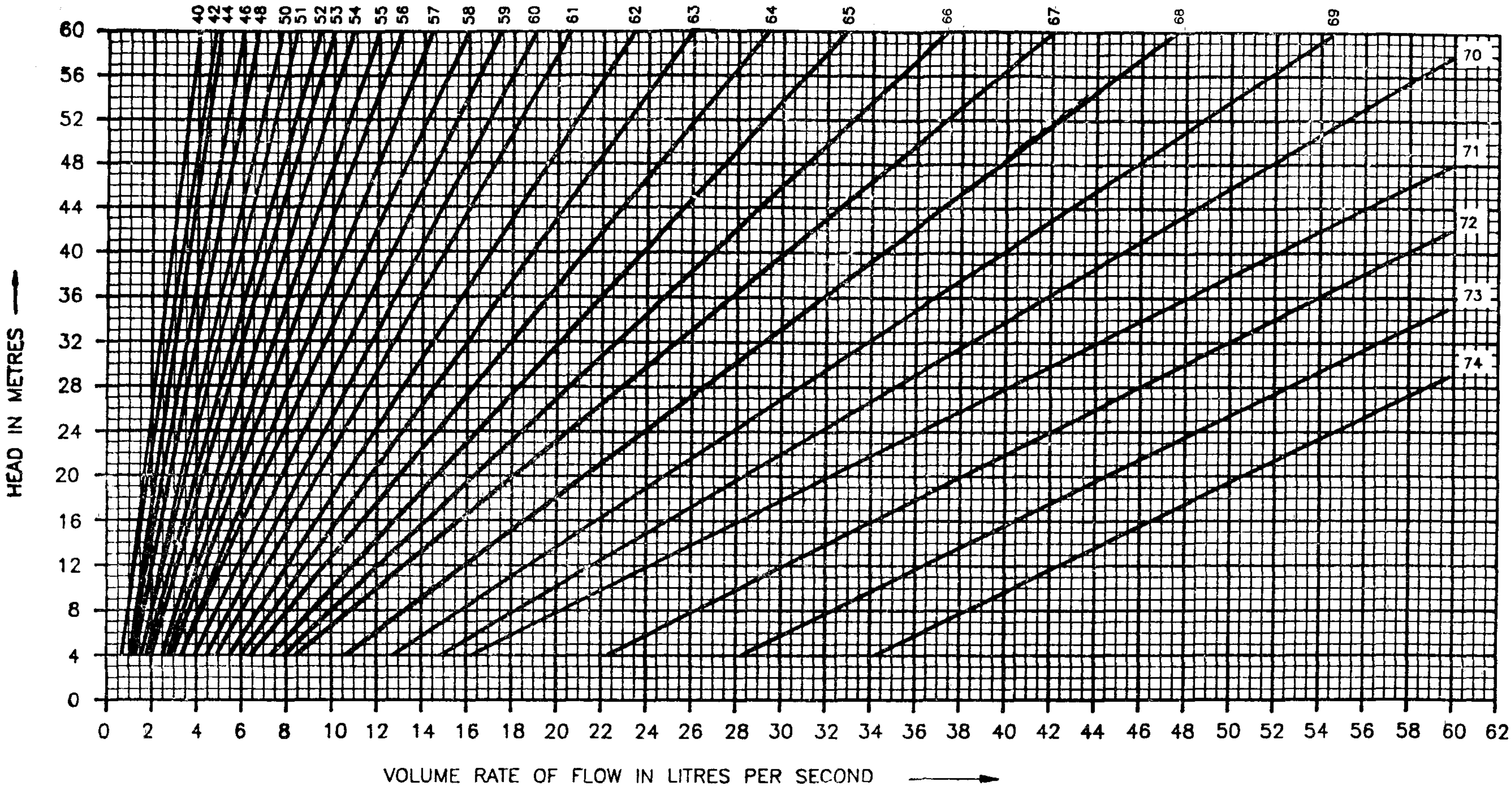
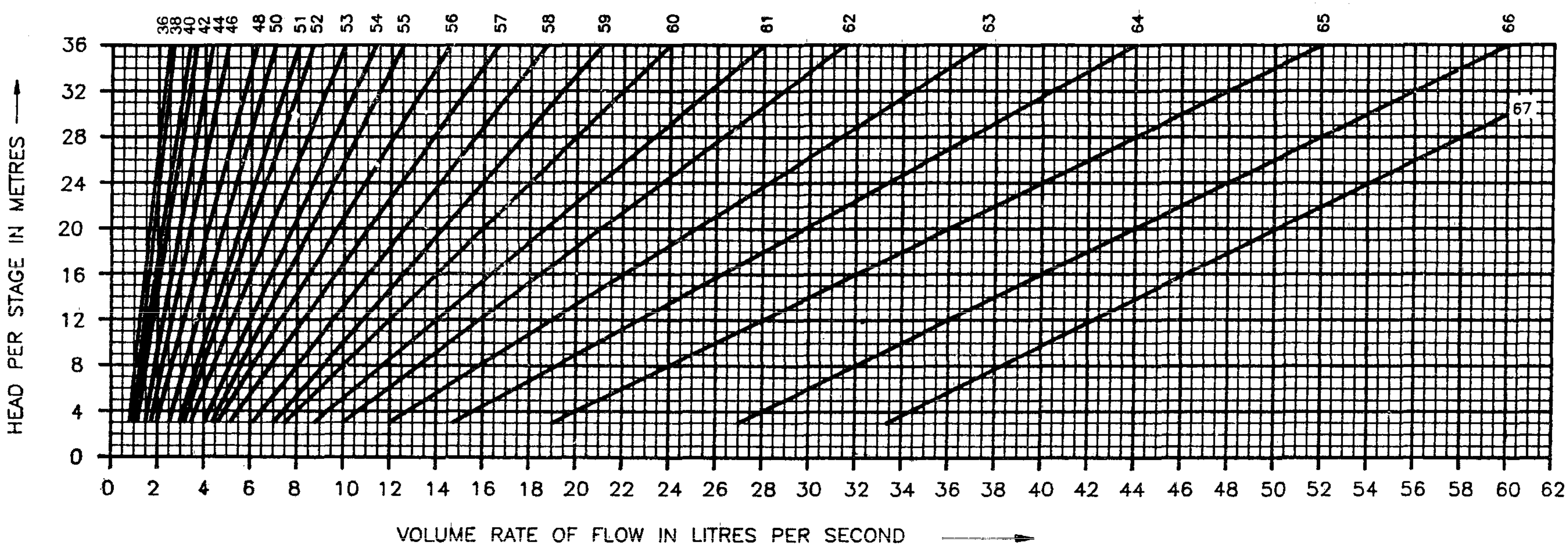


FIG. 4 MINIMUM PUMP EFFICIENCY IN PERCENT FOR HORIZONTAL CENTRIFUGAL PUMPS FOR AGRICULTURAL PURPOSES
(SPEED 2 001 TO 3 600 rpm)



NOTES

1 The efficiency in figure represents three or more stages :

a) For two stage pump multiply efficiency given by a factor 0.98.

b) For single stage pump, multiply efficiency given by a factor 0.97.

2 The efficiency chart includes non-return valve.

FIG. 5 MINIMUM PUMP EFFICIENCY IN PERCENT FOR SUBMERSIBLE PUMPSET (3 PHASE, 2 POLE)

ANNEX A
(*Clause* 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
1239 (Part 1) : 1990	Mild steel tubes, tubulars and other wrought steel fittings: Part 1 Mild steel tubes (*fifth revision*)
1239 (Part 2) : 1982	Mild steel tubes, tabulars and other wrought steel fittings. Part 2 Mild steel tubulars and other wrought steel pipe fittings (*third revision*)
4984 : 1987	Specification for high density polyethylene pipes for potable water supplies; sewage and industrial effluents (*third revision*)
4985 : 1988	Specification for unplasticised PVC pipes for potable water supplies (*second revision*)
6595 (Part 1) : 1993	Horizontal centrifugal pumps for clear, cold water: Part 1 Agricultural and rural water supply purposes (*second revision*)
7347 : 1974	Performance of small size spark ignition engines for agricultural sprayers and similar applications
7538 : 1975	Specification for three phase squirrel cage induction motors for centrifugal pumps for agricultural applications
8034 : 1989	Submersible pumpsets (*first revision*)
9079 : 1989	Monoset pumps for clear, cold water for agricultural purposes (*first revision*)
9694 (Part 1) : 1987	Code of practice for the selection, installation, operation and maintenance of horizontal centrifugal pumps for agricultural applications: Part 1 Selection (*first revision*)
10124 (Part 8) : 1988	Specification for fabricated PVC fittings for potable water supplies: Part 8 Specific requirements for 90 degree bends (*first revision*)
10805 : 1986	Foot valve, reflux valve or nonreturn valve and bore valve to be used in suction lines of agricultural pumps (*first revision*)
11170 : 1985	Performance requirements for constant speed compression ignition (diesel) engines for agricultural purposes (up to 20 kW)
11346 : 1985	Testing set up for agricultural pumps
11501 : 1986	Engine monoset pumps for clear, cold, fresh water for agricultural purposes
12231 : 1987	Specification for unplasticized PVC (rigid) pipes for use in suction and delivery lines of agricultural pumpsets
13593 : 1992	UPVC pipe fittings for use with UPVC pipes in the suction and delivery lines of agricultural pumps – Specification

ANNEX B
(*Clause* 3)

EXAMPLE FOR SELECTION OF PUMPSET FOR AGRICULTURAL REQUIREMENT

A typical example is described for selection of a monoset :

1 Installation details

SUCTION BRANCH

a) Height of pump centre line from water level — 4 m
b) Submergence — 1 m
c) Offset pipe length — 2.5 m
d) One bend
e) One foot valve

DELIVERY BRANCH

a) Vertical height of delivery pipe from pump centre line — 2 m
b) Offset pipe length — 125 m
c) One bend

2 Estimation of flow rate for irrigation

It is required to determine the volume rate of flow of a pump to irrigate a piece of land of 10.5 ha area for rice cultivation.

The various parameters as applicable are given below:

a) Area to be irrigated =10.5 ha
b) Interval of irrigation for rice crop = 7 days
c) Depth of irrigation for rice crop = 75 mm

Hence area to be irrigated per day = 10.5/7
= 1.5 ha

The volume rate of flow required to irrigate 1.5 ha per day (12 hours of pumping)

$$= \frac{1.5 \times 10\,000 \times .075}{12} \ m^3/h$$

$$= 93.75 \ m^3/h$$

To allow for conveyance losses of water flowing from the pump to the field, multiply the volume rate of flow by 1.1.

Volume rate of flow required = 93.75 x 1.1

= 103.125 m^3/h

= 28.65 l/s

3 Selection of Pipe Size

Decide to use clear G.I. pipe of medium series.

For selecting galvanized steel pipe for a flow rate of 28.65 l/s refer Table 1. The nominal pipe size for medium class is 100 mm.

a) Suction 100 mm

b) Delivery 100 mm

4 Determination of Total Head

Total static head considered for the system is 6 m.

Total head of the system can be read from Table 5 for corresponding flow rate.

Total head for 28 l/s discharge = 8.6 m

Total head for 28.65 l/s discharge = 8.7 m (approx.)

But total offset pipe length is 127.5 m. Hence additional offset pipe length is 122.5 m.

NOTE – As 5 m offset length has already been included for determination of total head as per Tables 5, 7, 9 and 11, the same has been deducted from total offset pipe length.

To obtain final total head, frictional losses of additional offset pipe length shall be added to the total head.

To get frictional losses refer Table 6. Read frictional losses in m per 100 m of pipe length for corresponding pipe size and flow rate.

While we refer the table, frictional losses are given for 28 and 30 l/s flow rate, hence for flow rate 28.65 l/s, we can interpolate the frictional losses figure say 9 m per 100 m pipe length, that is for 28.65 l/s discharge rate in 100 mm pipe size of 100 m length, frictional losses are 9 m.

∴ In 122.5 m pipe length frictional losses

$$= 9 \times \frac{122.5}{100} \ m$$

$$= 11 \ m$$

Final total head comes out = 8.7 + 11 = 19.7 m

5 Maximum Prime Mover Rating of Monoset

Decided to use monoset with 4 pole motor (around 1 450 rpm).

For flow rate 28.65 and total head 19.7 m read the minimum efficiency from Fig. 4.

Minimum pump efficiency	69.9 %
Maximum primemover rating	9.3 kW

6 Pump and Piping System Specifications

Therefore, the pumpset and the pumping system details for this typical irrigation requirement are :

i) Monoset pump as per IS 9079 : 1989

Total head (H) = 19.7 m

Volume rate of flow (Q) = 28.65 l/s

Motor rating (P) *Max.* = 9.3 kW

ii) Prime mover

Since monoset pump is selected, no separate prime mover is required.

iii) Piping System

Foot Valve	100 mm
Straight galvanized pipe 100 mm size	134.5 m
Long radius bands 100 mm size	2 Nos.

iv) Energy Consumption Levels

The energy Consumption Levels

The energy consumption levels are worked out for the following pumps :

a) With minimum values of efficiency from the pump and motor.

b) With pumps and motors of better efficiency available in the country.

c) With minimum efficiency figure of pump and motor.

Volume rate of flow	28.65 l/s
Total head	19.6 m
Minimum pump efficiency from Fig. 1.	69.9 %

Nominal pump input power = (28.65 x 19.6)/(102 x 0.699)

= 7.876 kW

The nominal pump input is multiplied by a factor 1.1 to take care of tolerance on pump efficiency and variation in duty. Hence, the maximum permissible pump input.

Maximum pump input = 8.664 kW

Minimum motor efficiency = 85 %

Maximum permissible motor input = 8.664/0.85

= 10.193 kW

Maximum permissible electrical energy consumption per hour = 10.193 kWh

d) With pumps and motor of better efficiency.

The pump efficiency for a better designed centrifugal pump for the same duty 77%

Nominal pump input power = (28.65 x 19.6)/(102 x 0.77) = 7.15 kW

Max. permissible pump input power

= 1.1 x 7.15

= 7.865 kW

Motor efficiency of a better design = 86%

Maximum motor input = 7.865/0.86

= 9.145 kW

Maximum electrical energy consumption per hour = 9.145 kWh

Brueau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act, 1986* to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

Copyright

Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition.

This Indian Standard has been developed from Doc : No. HMD 20 (0085).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones : 331 01 31, 331 13 75

Telegrams : Manaksanstha
(Common to all offices)

Regional Offices :	Telephone
Central : Manak Bhavan, 9 Bahadur Shah Zafar Marg NEW DELHI 110002	331 01 31 331 13 75
Eastern : 1/14 C. I. T. Scheme VII M, V. I. P. Road, Maniktola CALCUTTA 700054	37 84 99, 37 85 61 37 86 26, 37 86 62
Northern : SCO 445-446, Sector 35-C, CHANDIGARH 160036	53 38 43, 53 16 40 53 23 84
Southern : C. I. T. Campus, IV Cross Road, MADRAS 600113	235 02 16, 235 04 42 235 15 19, 235 23 15
Western : Manakalaya, E9 MIDC, Marol, Andheri (East) BOMBAY 400093	632 92 95, 632 78 58 632 78 91, 632 78 92

Branches : AHMADABAD. BANGALORE. BHOPAL. BHUBANESHWAR. COIMBATORE. FARIDABAD. GHAZIABAD. GUWAHATI. HYDERABAD. JAIPUR. KANPUR. LUCKNOW. PATNA. THIRUVANANTHAPURAM.

Printed at New India Printing Press, Khurja, India