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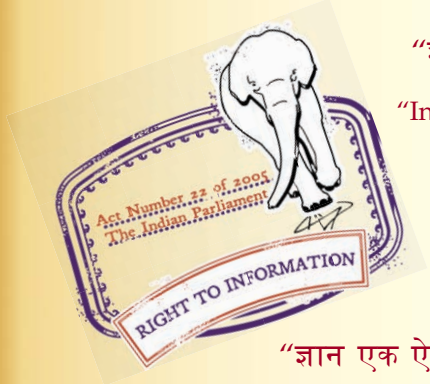

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(Reaffirmed 2006)

कूप जालियों और खांचित पाइप — विशिष्टि

(दूसरा पुनरीक्षण)

Indian Standard

WELL SCREENS AND SLOTTED PIPES — SPECIFICATION

(Second Revision)

ICS 23.040

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

October 2000

Price Group 7

FOREWORD

This Indian Standard (Second Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Diamond Core and Waterwell Drilling Sectional Committee had been approved by the Mechanical Engineering Division Council.

This standard was first published in 1976. Subsequently it was revised and first revision was published in November 1985. In the first revision, following modifications were included:

a) FRP Pipes have been included for the manufacture of screens and slot pipes.
b) In addition, the materials of manufacture have been clearly specified.
c) Additional design features have been added.
d) Requirement pertaining to FRP pipes have been included.
e) Selection criteria of slot sizes has been included.

The second revision has been undertaken to include requirements for wire wound cage type well screens. The present revision only gives a brief idea about this type of screen. This type of screens are widely used across the world, due to improved efficiency and life of tubewells thereby saving pumping energy. The production of these types of screens has recently commenced in India. Many government and semi-government bodies have started using these screens and the use is expected to widely increase due to its advantages.

Moreover, the well screen is the most critical element of tube well affecting its life, pump maintenance and efficiency. The present standard is not adequately providing the guideline and definition with regard to important parameter of well screen effecting the tube well efficiency, energy consumption and life.

During this revision the well screens and slotted pipes have been made amenable for product certifiction so that the users can be assured of consistent and right quality of well screens.

In the preparation of this standard assistance has been derived from the following standards:

ANSI/AWWA, A100-90 Water wells.

AISI - 304 : 1963 Stainless and heat resisting steels.

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 2:1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

WELL SCREENS AND SLOTTED PIPES — SPECIFICATION

(Second Revision)

1 SCOPE

Specifies the types and the technical requirements of well screens and slotted pipes used in tube wells. Further it gives detailed specifications, selection criterion, testing and inspection methods for wire wound cage type well screens.

2 REFERENCES

The following standards 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 revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

IS No.	*Title*
280 : 1978	Specification for mild steel wire for general engineering purposes (*third revision*)
531 : 1981	Leaded brass strips for instrument parts (*second revision*)
1239 (Part 1) : 1990	Mild steel tubes, tubulars and other wrought steel fittings: Part 1 Mild steel tubes (*fifth revision*)
3589 : 1991	Seamless or electrically welded steel pipes for water, gas and sewage (168.3 to 2 032 mm outside diameter) (*second revision*)
4270 : 1992	Steel tubes used for water wells (*second revision*)
4412 : 1981	Copper wires for general engineering purposes (*first revision*)
6528 : 1995	Stainless steel wire (*first revision*)
10151 : 1982	Polyvinyl chloride (PVC) and its copolymers for its safe use in contact with foodstuffs, pharmaceuticals and drinking water

3 TERMINOLOGY

3.1 Well Screens

Well screens are specially fabricated screen pipes from different materials which can have wider range of slot opening from much finer to coarse compared to slotted pipes.

3.2 Slotted Pipes

Slotted pipes are pipes with slots cut into them in a pattern suitable to the basic material of the pipe.

3.3 Terminology — Relating to Cage Type Wire Wound Screen

3.3.1 *Slot Opening*

It is the width of opening for entry of water.

3.3.2 *Percentage Open Area*

It is the open area available for entry of water as percentage of total outside surface area of pipe.

3.3.3 *Profile Wire*

Shaped wire which is spirally wound.

3.3.4 *Support Rods*

The longitudinal shaped/circular rods supporting the profile wire.

3.3.5 *End Rings*

These are rings or couplers welded at both ends of screen to facilitate joining with other pipes.

3.3.6 *Collapse Strength*

It is the strength of screen to withstand surrounding hydrostatic pressure on outside surface.

3.3.7 *Tensile Strength*

It is the strength of the screen to withstand tensile load.

3.3.8 *Push Strength*

It is the maximum separating force that weld joint between profile wire and support rod can withstand.

3.3.9 *Penetration*

It is the amount of penetration between profile wire and support rod after fusion welding.

3.4 Terminology — Relating to Performance Characteristics

3.4.1 *Tube Well Efficiency*

The formation loss (head loss) required to produce flow

divided by the total drawdown observed in the well.

3.4.2 *Drawdown/Depression*

The difference in elevation between the static and pumping water level.

3.4.3 *Specific Capacity*

Tha ratio of the discharge to the drawdown it produces, measured under the well (l/min/m of drawdown).

3.4.4 *Well Development*

Development of aquifers by compressed air or any other suitable method.

3.4.5 *Clogging*

Blockage of slots by sediment or sand particles.

3.4.6 *Entrance Velocity*

Velocity at which water flows from outside to inside the tube well through screen.

3.4.7 *Laminar Flow*

Movement of fluid particles in essentially parellel paths.

4 TYPES

4.1 The following are the various types of well screens and slotted pipes:

a)	Plain slotted pipes	Type A
b)	Bridge slotted pipes	Type B
c)	Mesh wrapped screens	Type C
d)	Cage type wire-wound screens	Type D
e)	Pre-packed resin bounded, gravel screens	Type E
f)	Brass screens	Type F

4.2 Brief Description

4.2.1 Following are the various types of well screens:

a) *Plain slotted pipes* — These are pipes with slots cut by milling.

b) *Bridge slotted pipes* — The slots here are not cut but pressed out.

c) *Mesh wrapped screens* — These are made by wrapping Copper mesh over perforated steel pipe using spacers about 3 mm thick in between the copper mesh and perforated pipe.

d) *Cage type wire wound screen* — These are special type of screens where in a continuous shaped profile wire is spirally wound around series of longitudinal support rods of circular or shaped section with each intersection of profile wire and support rod welded by Electric Resistance Fusion Welding Process. The longitudinal support rods are welded to end rings at both ends to facilitate joining with casing pipes or other screens by butt welding or threading.

e) *Pre-packed resin bonded gravel screens* — Gravel is pasted on the perforated pipe with the help of resin type adhesive material. The thickness of gravel bond varies between 10 to 15 mm depending upon the diameter of the base pipe used.

f) *Brass screen* — Brass screens are made from brass sheet in which slots of required sizes are cut before rolling.

5 MATERIALS

5.1 The well screens and slotted pipes shall be made of either corrosion-resistant material or steel pipes having sufficient thickness to guard against the affect of corrosion and to ensure reasonable life of tubewell. The following are the recommended materials for various types of well screens and slotted pipes:

a) Low carbon or mild steel;

b) Leaded brass sheet (*see* IS 531);

c) Fibre glass reinforced thermosetting plastics;

d) PVC (*see* IS 10151); and

e) Copper wire (*see* IS 4412), galvanized steel wire (*see* IS 280) and stainless steel wire (*see* IS 6528).

5.2 Suitable material other than those given above which has better properties may also be used as agreed to between the purchaser and the manufacturer.

6 DESIGNATION

The screens shall be designated by the following particulars:

a) Type of well screen, A, B, C, D, E and F;

b) Nominal bore;

c) Grade/Thickness; and

d) Slot opening.

7 SELECTION CRITERION

7.1 Length of Screen

The length of screen shall be governed by the thickness of aquifer and shall be sufficient to obtain the designed specified yield from tubewell. However, the minimum total lengths shall be such that the entrance velocity is less than the permissible entrance velocity of 0.03 m/s to ensure longer life of the well. The lengths of individual pipes shall be such as to afford easy handling for transport and lowering into wells, and removal in the case of recovery, etc. The lengths shall be such that there is minimum wastage

in using of various length inside the well and to ensure that the combinations from the nearest requirement to obtain the estimated specific yield of the well. They may be in random lengths specified by the user in consultation with the manufacturer. To account for possibility of inaccuracy in logging, screen shall not be placed in at least 0.3 m on both sides of the stratum.

7.2 Diameter of Screen

The criterion for determining the diameter of the well screen shall depend on the designed yield of the tubewell. It shall be ensured that the area of opening available in the screen for flow of water, after giving allowance for possible coverage of gravel, clogging, incrustation, etc, shall produce a screen entrance velocity of not more than 0.03 m/s. The screen diameter shall be so selected that the percentage of slot area to screen surface area is generally between 15 and 22 percent.

Illustration

The designed yield of a tubewell is 150 m^3/h and a screen having 20 percent open area is proposed to be used in a length of 20 m to tap aquifer of 25 m thick. Diameter, of the screen is to be worked out as:

$$Q = A \times V$$

where

Q = discharge in m^3/s,

A = effective open area of the screen in m^2/s, and

V = entrance velocity in m/s (to be limited to 0.03m/s).

$$\text{Therefore, } A = \frac{150}{3\,600} \times \frac{1}{0.03} = 1.39 \text{ m}^2$$

Taking effective open area as 50 percent of that provided, in order to take into account the reduction of the effective area of the screen openings with time due to incrustation rearrangement of the aquifer particles around the screen and coverage by gravel, etc.

The required open area = $2 \times 1.39 = 2.78$ m^2

Open area of a pipe = $\pi \times d \times l \times$ percentage of open area in the screen.

where

d = dia of pipe in m, and

l = length of pipe in m.

$$\text{Therefore, } d = \frac{2.78 \times 100}{\pi \times 20 \times 20} = 0.22 \text{ m}$$

$$= 220 \text{ mm}$$

The required screen diameter works out to 220 mm.

Screen diameters for various discharges to be pumped from the well, are given below for general guidance:

Discharge, l/min			Screen Dia, mm	
			Minimum	Recommended
Up to		475	100	100
475	-	1 125	150	150
1 300	-	3 000	200	250
3 000	-	5 250	250	300
5 200	-	9 500	300	350
9 500	-	13 300	350	400
13 300	-	19 000	400	450
19 000	-	26 500	450	500
26 500	-	34 000	500	550

7.3 Slot Size

The shapes and size of the slot shall be such that the gravel or aquifer material is not allowed to block the open space. Based on the sieve analysis of the aquifer material the size of the slot opening shall be determined in such a way that finer fraction of the formations are removed during the development stage of the well and the coarser fractions remain outside the slots. The slots shall not be too wide to casue entry of the gravel and result in plugging. Sharp edges on the periphery of the pipe may offer resistance to flow and hence it is preferable to have smooth rounded edges.

7.3.1 The slot size for gravel pack shall be so selected as to retain at least 90 percent of the pack material. However, in case where well is not provided with gravel pack, slot size shall be such that it would allow 40 to 60 percent of the aquifer material to pass through. The normal slot size shall be 1.0, 1.6, and 3.2 mm. For fibre reinforced plastic (FRP) pipes, the slot width shall not be less than 1.6 mm.

7.3.2 *Shape of Slots*

The shape of slot shall be inwardly widening to give no clogging property and shall have minimum geometrical resistance to water flow to reduce frictional head losses.

7.4 Percentage Opening

The percentage slot opening shall be such that the screen length provides sufficient inlet area to limit the entrance velocity as specified in **7.1**. This is the minimum criterion. But the percentage open area shall be selected as high as possible for better transmittivity and minimum resistance to water flow and minimum possible entrance velocity to achieve optimum well efficiency, higher specific capacity, less incrustation

and minimum drawdown to result into saving of pumping energy.

7.5 Distribution of Slots

The slots shall be cut in a pattern designed to get even distribution of flow all over the periphery of the pipe. The slots shall be distributed in rows as closely and evenly as possible, staggering the slots between each row.

The screens with evenly spaced continuous horizontal slot (perpendicular to screen axis) throughout the periphery without leaving blind spots shall be preferred for improved well performance.

7.6 Collapse Strength

Depending upon the depth of tube well, the static water level column and geological conditions, the screens with adequate collapsible strength shall be used.

7.7 Tensile Strength

The screens must have sufficient tensile strength to withstand the weight of pipe assembly under it.

8 SPECIFIC DESIGN FEATURE

8.1 Plain Slotted Pipes

8.1.1 *Low Carbon or Mild Steel Slotted Pipes*

The slots shall be cut by milling or by slitting saw. The recommended thicknesses of different diameters for various depths of tube well under normal conditions is given in Table 1.

8.1.1.1 Typical slot pattern of well screen is shown in Fig. 1 and Fig. 2.

8.1.1.2 The slots shall not be cut within 12 mm on either side of the longitudinal welded joints of the pipes.

8.1.1.3 The plain space after thread cutting over the larger diameter pipes shall not be less than 150 mm so that wrenches could easily be used on plain space only.

8.1.2 *FRP Pipes*

The FRP slotted pipes shall be manufactured by the filament winding process. The slots shall be cut by milling. The slotting pattern (*see* Fig. 3) shall be such as to ensure the minimum cutting of the glass fibre in the pipe and thereby maintaining maximum strength.

8.1.2.1 The recommended thickness of FRP pipes is given below:

Depth of Well	*Thickness of Pipe for Given Dia in* mm				
m	150	200	250	300	350
150	5.00	6.00	6.50	8.25	8.50
300	6.00	6.75	8.00	9.00	9.50

8.1.2.2 The pipes made from FRP based material shall fulfill the requirements as given in Annex A.

8.2 Mesh Wrapped Screens

The pipes used in mesh wrapped screens shall be of mild steel or low carbon steel. The diameter of perforations shall not be less than 12 mm and the distance between the two adjacent holes shall be between 25 and 40 mm depending upon the diameter and the thickness of the pipes used. The pipe thickness shall be same as given in Table 1.

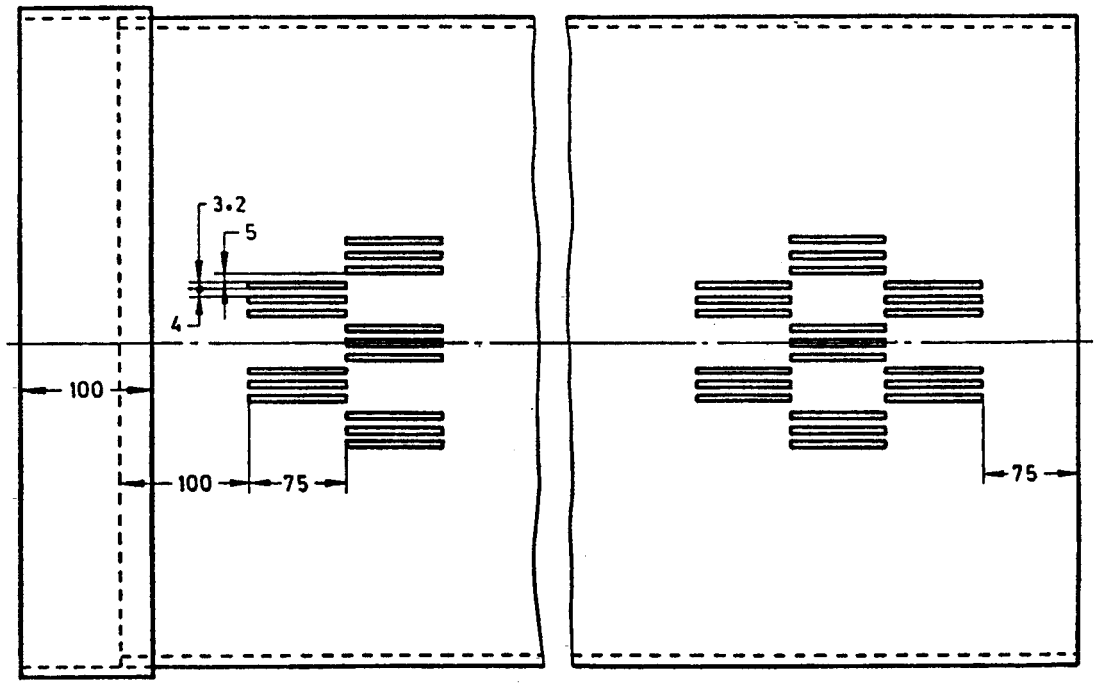
The spacers shall be of mild steel and shall be of thickness 3 mm minimum and shall be 6 mm wide. The distance between the two adjacent spaces shall be 75 mm minimum.

The copper mesh shall be made of copper wire according to IS 4412 and shall not be less than 0.710 mm in thickness.

Table 1 Thickness of Pipes

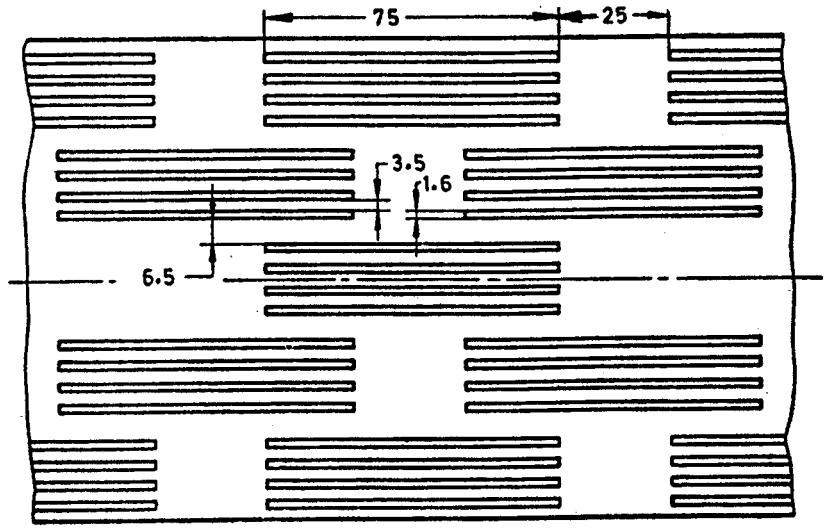
(*Clause* 8.1.1. *and* 8.2)

Depth of well	**Thickness for Pipe Size (OD) in mm**				
m	166.6/168.3	219.1	273.00	323.80	355.60
50	4.85	7.04	7.09	8.38	9.52
100	5.4	7.04	7.90	8.38	9.52
125	5.4	7.04	7.80	8.38	9.52
150	5.4	7.04	7.80	8.38	9.52
175	5.4	7.04	7.80	8.38	9.52
200	5.4	7.04	7.80	8.38	9.52
250	7.11	8.18	9.27	9.58	9.52
275	7.11	8.18	9.27	9.52	9.52
300	7.11	8.18	9.27	9.52	9.52



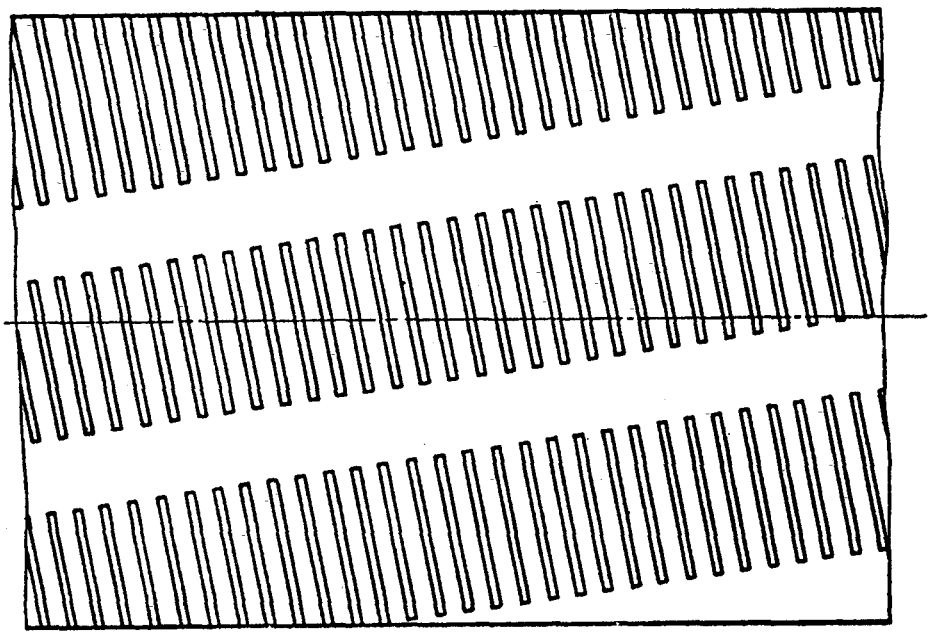
All dimensions in millimetres.

FIG. 1 DEVELOPED VIEW OF A TYPICAL WELL SCREEN, PLAIN SLOTTED TYPE



All dimensions in millimetres.

FIG. 2 SLOTTING ARRANGEMENT



All dimensions in millimetres.

FIG. 3 RECOMMENDED SLOT PATTERN

8.3 Cage Type Wire Wound Screen

The wrapping wire having a wedge profile with flat surface on the outside and producing expanding slots on the inside. This shape facilitates jetting and back washing operation and also avoids the screens being clogged by fine particles.

For obtaining a minimum of 15 percent open area, the screen aperture shall not be less than 0.375 mm. The number and cross-section of the vertical support rods and the profile of the wrapping wire shall be such as to give sufficient axial and collapse strength (*See* Fig. 4).

8.3.1 *General Requirements*

8.3.1.1 Electric Resistance Welded (ERW) Cage type Vee Wire Wound Screens shall be of continuous trapezoidal wire spirally wound around fabricated cage. The screen must consist of 'V'-shaped (wedge) profile wire of various dimensions, resistance welded to a cylindrical body made of number of longitudinal special high tensile support rods to provide smooth unrestricted bore which are in turn welded into cylindrical ring couplings at either end.

8.3.1.2 Screen must have evenly distributed continuous slot opening so that it has maximum open area for minimum turbulence and loss of energy.

8.3.1.3 Slot should be smooth, clean edges rounded off so that it gives better hydraulic performance and may reduce the rate of corrosion and encrustation.

8.3.1.4 The inwardly widening slots should be non-clogging so that sediment has only point contact which will give longer effective well life.

8.3.1.5 The wrapping wire having a wedge profile with flat surface on the outside and producing expanding slots on the inside. This shape must facilitate jetting and back washing operation and also avoids the screens being clogged by fine particles.

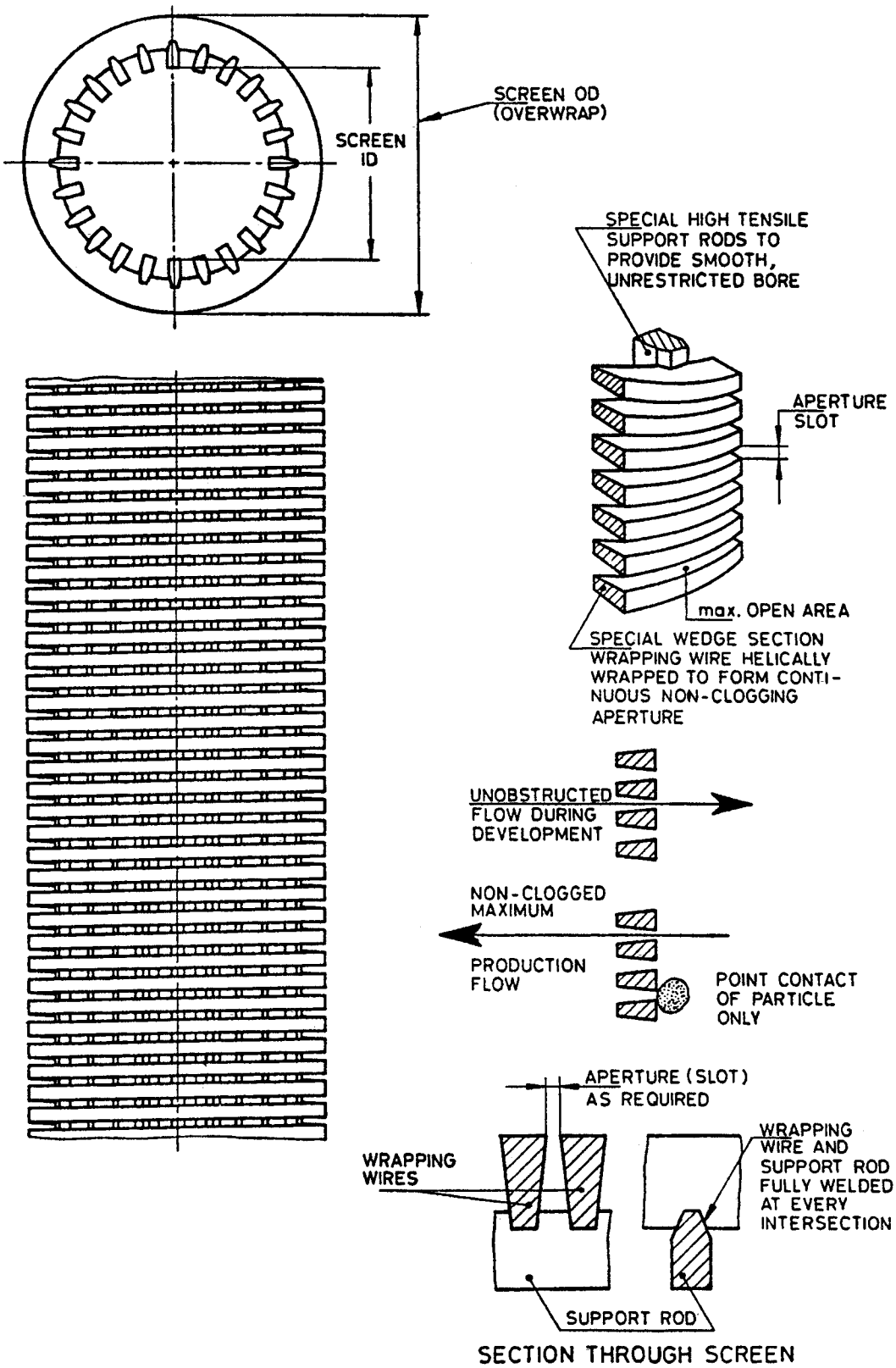
8.3.1.6 The number and cross-section of the vertical support rods and the size of the wrapping wire shall be such as to give specified tensile and collapse strength.

8.3.1.7 Screen should have inwardly widening slots and available Slot Width to be 0.15 mm, 0.25 mm, 0.50 mm, 0.75 mm, 1.00 mm, 1.50 mm, 2.00 mm and 3.00 mm.

8.3.1.8 The overall length of screen shall be 3 to 6 m without any circumferential joint in screen section. Screen length is measured between extreme ends of End Rings at both ends.

8.3.1.9 Each intersection of wrapping profile wire and support rods shall be fusion welded by Electrical Resistance welding process to import sufficient joint strength at each joint to sustain development pressures.

8.3.1.10 Since the quality and consistency of strength depends largely upon control of manufacturing process, all the process parameters shall be automatically/semi-automatically controlled to



All dimensions in millimetres.

FIG. 4 CAGE TYPE WIRE WOUND SCREENS

ensure quality and consistency of strength.

8.3.2 *Material of Construction*

8.3.2.1 The screens shall be made from wires of either of the following materials:

a) Low Carbon Galvanized (LCG) Steel (*see* IS 280)

b) Stainless Steel (SS) (*see* designation X04 Cr 18 Ni10 of IS 6528)

8.3.2.2 The screens are classified as regular and heavy depending on their thickness.

8.3.3 *Dimensional Parameters*

The dimensions of screen shall be as given below for two classes and two materials.

8.3.3.1 LCG screens suitable for well depth up to 200 m:

Nom. Size mm	*I.D.* mm	*O.D.* mm	*Thickness* mm	*Open Area for Different Slot Openings*, mm								
				0.15	0.20	0.25	0.50	0.75	1.00	1.50	2.00	3.00
				Percentage Open Area								
40	40	48.7	4.4	9	12	14	25	33	40	–	–	–
50	52	61	4.4	9	12	14	25	33	40	–	–	
75	76	88	6.0	6	8	10	18	25	30	40	47	–
100	101	113	6.0	6	8	10	18	25	30	40	47	
150	153	165	6.0	6	8	10	18	25	30	40	47	–
200	205	219	7.0	6	8	10	18	25	30	40	47	–
250	256	272	8.0	5	6	8	14	20	25	33	40	50
300	306	322	8.0	5	6	8	14	20	25	33	40	50
350	338	362	12.0	4	6	7	13	19	23	32	38	48

8.3.3.2 LCG screens suitable for well depth up to 400 m:

Nom. Size mm	*I.D.* mm	*O.D.* mm	*Thickness* mm	*Open Area for Different Slot Openings*, mm								
				0.15	0.20	0.25	0.50	0.75	1.00	1.50	2.00	3.00
				Percentage Open Area								
150	153	167	7.0	6	8	10	18	25	30	40	47	–
200	205	221	8.0	5	6	8	14	20	25	33	40	50
250	256	276	10.0	4	6	7	13	19	23	32	38	48
300	306	326	10.0	4	6	7	13	19	23	32	38	48
350	338	363	12.5	3	5	6	11	15	19	26	32	42

8.3.3.3 SS screens suitable for well depth up to 200 m:

Nom. Size mm	*I.D.* mm	*O.D.* mm	*Thickness* mm	*Open Area for Different Slot Openings*, mm								
				0.15	0.20	0.25	0.50	0.75	1.00	1.50	2.00	3.00
				Percentage Open Area								
40	40	48.4	4.2	9	12	14	25	33	40	50	–	–
50	52	60	4.0	9	12	14	25	33	40	50	–	–
75	76	86.5	5.2	6	8	10	18	25	31	40	47	–
100	101	111	5.0	6	8	10	18	25	31	40	47	–
150	153	163	5.0	6	8	10	18	25	31	40	47	–
200	205	217.5	6.3	6	8	10	18	25	30	40	47	–
250	256	271	7.3	5	6	8	14	20	25	33	40	50
300	306	322	8.0	5	6	8	14	20	25	33	40	50
350	338	358	10.0	5	7	8	15	21	26	35	41	51

8.3.3.4 SS screens suitable for well depth up to 400 m:

Nom. Size	*I.D.*	*O.D.*	*Thickness*	*Open Area for Different Slot Openings,* mm								
mm	mm	mm	mm	0.15	0.20	0.25	0.50	0.75	1.00	1.50	2.00	3.00
				Percentage Open Area								
150	153	165.5	6.3	6	8	10	18	25	30	40	47	-
200	205	221	8.0	5	6	8	14	20	25	33	40	50
250	256	272.5	8.2	5	7	8	15	21	26	35	41	51
300	306	330	12.0	4	5	6	11	16	20	27	33	42
350	338	363.5	12.75	4	5	6	11	16	20	27	33	42

8.3.4 *Strength Parameters*

The minimum acceptable values of strength parameters shall be as follows for two classes and two materials.

8.3.4.1 LCG screens, for tube well depth up to 200 m:

Nom. Size	*Collapse Pressure,* MPa								*Tensile Load*
	Slot Opening								
m	0.15	0.20	0.25	0.50	0.75	1.00	1.50	2.00	3.00	kN
40	27.5	26.5	25.5	22.1	20.4	18.1	15.2	–	–	29.43
50	14.2	14.0	13.7	11.8	10.6	9.6	7.8	–	–	29.43
75	14.7	14.4	14.2	12.7	11.8	10.8	9.5	8.3	–	39.24
100	7.1	6.9	6.8	6.2	5.7	5.2	4.5	4.0	–	49.05
150	2.5	2.4	2.4	2.2	2.0	1.9	1.6	1.4	–	58.86
200	1.1	1.0	1.0	0.9	0.9	0.8	0.7	0.6	–	137.34
250	1.2	1.2	1.1	1.1	1.0	1.0	0.9	0.8	0.6	176.58
300	0.7	0.7	0.7	0.6	0.6	0.5	0.5	0.4	0.4	206.01
350	1.7	1.6	1.6	1.5	1.4	1.3	1.2	1.1	0.9	461.07

8.3.4.2 LCG screens, for tube well depth up to 450 m:

Nom. Size	*Collapse Pressure, MPa*								*Tensile Load*
	Slot Opening								
mm	0.15	0.20	0.25	0.50	0.75	1.00	1.50	2.00	3.00	kN
150	2.5	2.4	2.4	2.2	2.0	1.9	1.6	1.4	-	98.10
200	2.3	2.3	2.2	2.1	1.9	1.8	1.6	1.4	1.2	137.34
250	3.8	3.8	3.7	3.4	3.2	3.0	2.7	2.5	2.1	176.58
300	2.3	2.3	2.3	2.1	2.0	1.9	1.7	1.5	1.3	206.01
350	1.8	1.8	1.8	1.7	1.6	1.5	1.4	1.3	1.1	461.07

8.3.4.3 SS screens, for tube well depth up to 200 m:

Nom. Size	*Collapse Pressure, MPa*									*Tensile Load*
	Slot Opening									
mm	0.15	0.20	0.25	0.50	0.75	1.00	1.50	2.00	3.00	kN
40	30.2	29.4	28.4	25.0	22.1	20.1	16.7	–	–	39.24
50	15.7	15.2	14.7	12.7	11.3	10.3	8.3	–	–	39.24
75	5.6	5.4	5.2	4.7	4.4	4.0	3.4	3.0	–	49.05
100	2.6	2.6	2.5	2.3	2.1	2.0	1.7	1.5	–	78.48
150	0.9	0.9	0.9	0.8	0.7	0.7	0.6	0.5	–	107.91
200	1.1	1.1	1.1	1.0	0.9	0.8	0.7	0.6	–	186.39
250	1.3	1.3	1.2	1.2	1.1	1.0	0.9	0.8	0.7	235.44
300	0.8	0.8	0.7	0.7	0.6	0.6	0.5	0.5	0.4	392.40
350	1.2	1.2	1.1	1.0	1.0	0.9	0.8	0.7	0.6	716.13m

8.3.4.4 SS screens, for tube well depth up to 450 m:

Nom. Size	*Collapse Pressure, MPa*									*Tensile Load*
	Slot Opening									
mm	0.15	0.20	0.25	0.50	0.75	1.00	1.50	2.00	3.00	kN
150	2.3	2.3	2.2	2.0	1.9	1.7	1.5	1.3	-	137.34
200	2.4	2.3	2.3	2.1	2.0	1.9	1.6	1.5	1.2	264.87
250	1.7	1.7	1.6	1.5	1.4	1.3	1.1	1.0	0.8	343.35
300	3.4	3.3	3.3	3.1	2.9	2.7	2.5	2.4	2.0	578.79
350	2.5	2.5	2.5	2.4	2.2	2.1	1.9	1.8	1.5	716.13

8.3.5 *Tolerances*

The maximum permissible values of tolerances on dimensions shall be as given below:

Screen ID	± 1.5 percent
Screen OD	± 1.5 percent
Screen Thickness	± 1.0 percent
End Ring ID	± 1.5 percent
End Ring OD	± 1.5 percent
End Ring Thickness	±12.5 percent
Screen overall length	± 50 mm

Slot Opening:

Slot Size	*Tolerance (70 percent of the readings)*	*Max Deviation (30 percent of the readings)*
0.15 mm	± 0.05 mm	± 0.10
0.20 mm	± 0.05 mm	± 0.10
0.25 mm	± 0.07 mm	± 0.15
0.50 mm	± 0.10 mm	± 0.2
0.75 mm	± 0.10 mm	± 0.2
1.00 mm	± 0.15 mm	± 0.3
1.50 mm	± 0.15 mm	± 0.3
2.00 mm	± 0.30 mm	± 0.6
3.00 mm	± 0.30 mm	± 0.6

8.3.6 *Inspection and Testing Procedures*

8.3.6.1 *Sampling plan*

Tests	*Sampling*	
	Nominal size	Sample size
a) Type Tests		
i) Collapse Pressure test	Up to 100 mm	One for every 400 pipes or part thereof
	Above 100 mm and up to 300 mm	One for every 200 pipes or part thereof
	Above 300 mm	One for every 100 pipes or part thereof
ii) Tensile Strength test	Minimum number of samples per lot	Two
b) Routine Tests		
i) Visual	Each piece	
ii) Dimensional	One in ten pieces	
iii) Slot opening	One in ten pieces	
iv) Weld joint strength	One in twenty five pieces	

8.3.6.2 *Method of testing*

a) *Dimensional check* — With the help of measuring instruments to verify dimensions to be within tolerance limits.

b) *Slot opening — With feeler gauges:* Slot size to be measured for all slots over 100 mm length in each metre length of screen randomly. 70 percent of the slots shall fall within the tolerance and no slot shall exceed maximum deviation.

c) *Visual checks*

i) There should not be any sudden change in I.D. or O.D. of screen.

ii) No profile wire or support rod shall be bent or twisted.

iii) No profile wire and support rod intersection shall be found without welding.

iv) Welding of support rods to end rings shall be uniform with each support rod.

v) Screens shall be reasonably concentric and straight with end faces reasonably square to axis.

vi) At the joining point of screen and end ring, there shall be no gap larger than slot opening.

d) *Collapse pressure* — Screen sample of appropriate length should be closed at one end by welding plain M.S. Plate. The screen outside surface to be wrapped with strong plastic film to block all slots and shall be leak proof. The sample to be bolted inside bigger pressure pipe to leave an annular space of more than 25 mm radially. Hydraulic oil to be pumped in this annular space and pressure to be built up to the specified limit of collapse strength for that size. Screen sample shall not collapse at this pressure.

e) *Tensile strength* — Screen sample of appropriate length with end rings should be closed at one end by welding strong mild steel plate and flange welded at another end for bolting. The sample is to be bolted on hydraulic cylinder such that its piston pushes against the closed end. Hydraulic piston pressure is to be applied to bring screen under tension up to the specified value of tensile load as given in **8.3.4**. The screen shall not break or support rod should not loosen from end ring. Any other suitable method may also be used.

f) *Weld joint strength* — A small strip over one support rod to be cut from the end of the screen in push test apparatus, with the help of two metallic fingers the profile wire shall be pushed by hydraulic cylinder to separate it from support rod. It shall not separate at specified value of load as agreed to between the purchaser and the manufacturer.

8.3.6.3 *Criteria for conformity*

a) *Dimensional check* — All dimensions shall conform to the drawin or contract and tolerances shall be as given in **8.3.5**.

b) *Slot opening* — The actual values shall be within the tolerance limit applicable as given in **8.3.5**.

c) *Visual check* — No abnormalities shall be found.

d) *Collapse pressure* — The collapse shall not take place at collapse pressure lesser than that specified for the respective size as given in **8.3.4**.

e) *Tensile strength* — The failure shall not take place at tensile load lesser than that specified for the respective size as given in **8.3.4**.

f) *Weld joint strength*— The separation of wrapping wire and support rod shall not occur at push load lesser than that specified for the respective size as given in **8.3.4**.

8.3.6.4 *Retests of samples*

In case any one of the test pieces first selected fail to pass any of the tests specified, two further samples shall be selected for testing in respect of each failure from the same lot. Should the test pieces from both these additional samples pass, the material represented by the test samples shall be deemed to comply with the requirement of that particular test. Should the test pieces from either of the additional samples fail, the material represented by the test samples shall be rejected.

NOTE — Weld strength requirements shall be included later as sufficient data is not available. Till such time the requirements are not included in the specification, the weld strength may be as agreed to between the manufacturer and the purchaser.

8.4 Brass Screens

8.4.1 The screens shall be manufactured from brass sheets conforming to IS 531 unless otherwise specified. The minimum thickness of the sheet shall be as given below:

Depth of Tubewell,	*Thickness,* mm *Min of Diameter of Screens*			
	150mm	200mm	250mm	300mm
Up to 100	3.2	4.5	5.4	5.4
Above 100	4.5	5.4	5.4	5.4

8.4.2 Distance between slots and rows shall be as given in Fig. 5A and 5B.

9 GENERAL REQUIREMENTS

9.1 The screens shall possess adequate resistance to corrosion and incrustation due to chemical content of soil and water. Where water is of highly incrusting nature, the screen shall be such as to permit the water to enter the well with minimum resistance. Also, wherever incrustation commonly occurs it should be desirable to choose the material for the screen that can withstand subsequent acid treatment for removing incrustation.

9.2 The screen shall be as far as possible of single metal construction to avoid galvanic corrosion.

9.3 Well screens shall be threaded and socketed, plain bevel ended, collared or male and female types so that convenient lengths could be added. The slotted pipe screens shall have adequate strength to withstand axial, collapse and hydrostatic loads to be experienced during development and use.

10 GUIDELINES FOR SELECTION OF SLOT SIZE

The guidelines for selection of slot size is given in Annex B.

11 MARKING

11.1 Each pipe shall be marked with the following details:

a) Nominal size in mm,
b) Overall length in m,
c) Manufacturer's trade-mark,
d) Grade or thickness in mm,
e) Slot size in mm,
f) Material.

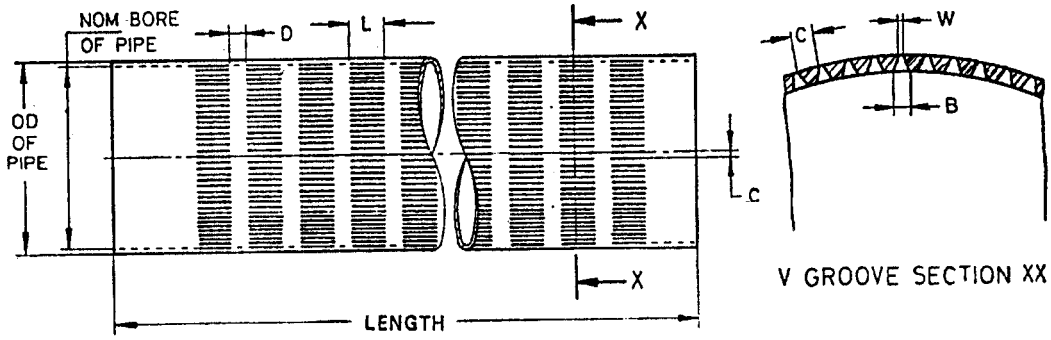
11.2 BIS Certification Marking

11.2.1 The pipes may also be marked with the Standard Mark.

11.2.2 The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act,* 1986 and the Rules and Regulations made thereunder. The details of condition under which a license for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

12 PACKING

The pipes shall be packed as agreed to between the purchaser and the manufacturer.

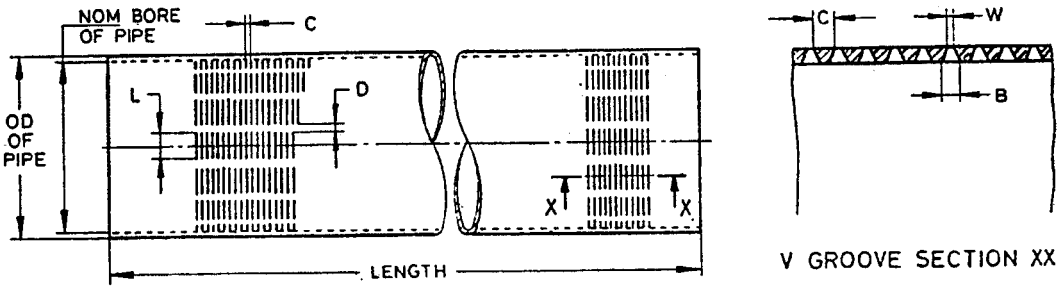


NB of Pipe	OD of Pipe	Sizes of Slots		No. of Rows In Dia	Total Slots per Metre	Area of Slots per Metre in mm²	Water Way Area Percent	*B*	Distance Between Slots *C*	Distance Between Rows *D*
		W	*L*							
152	162	0.793	40	16	2 128	67 500.160	13.25	2.778	2.627	19.050
152	162	1.587	40	16	1 216	77 191.680	15.18	4.762	6.350	19.050
204	213	0.793	40	16	2 800	88 816.000	13.28	2.778	3.627	19.050
204	213	1.587	40	16	1 600	101 568.00	15.17	4.762	6.350	19.050

Metal — Brass sheets according to IS 531

All dimensions in millimetres.

5A Brass Screens with Vertical Slots



NB of Pipe	OD of Pipe	Sizes of Slots		No. of Rows In Dia	Total Slots per Metre	Area of Slots per Metre in mm²	Water Way Area Percent	*B*	Distance Between Slots *C*	Distance Between Rows *D*
		W	*L*							
152	162	0.793	30	12	3300	78 507.000	15.41	2.778	3.627	9.525
152	162	1.587	30	12	1884	89 697.240	17.79	4.762	6.350	19.525
204	213	0.793	30	12	4400	104 676.000	15.63	2.770	3.627	11.303
204	213	1.507	30	12	2512	119 596.320	17.86	4.762	4.762	11.303

Metal — Brass sheets according to IS 531

All dimensions in millimetres.

5B Brass Screens with Vertical Slots

FIG. 5 BRASS SCREENS

ANNEX A

(*Clause* 8.1.2.2)

MECHANICAL PROPERTIES OF FIBRE GLASS REINFORCED PLASTIC (FRP) PIPES

A-1 The FRP pipes shall withstand the following tests

A-1.1 Mechanical Strength

A-1.1.1 *Axial Tensile Strength*

The ultimate tensile strength of the pipe shall not be less than 102 kN or ten times the weight of a hypothetical well string comprising 18 m of upper well casing, 4 m of screen, and 6 m of lower well casing, whichever is greater.

A-1.1.2 *Axial Compression Strength*

The compressive strength of the pipe when tested in the axial direction shall not be less than 102 kN.

A-1.1.3 *Internal Hydrostatic Pressure Test*

The pipe shall withstand a hydraulic pressure of 210 N/cm^2 continuously.

A-1.1.4 *External Collapse Pressure Test*

The slotted pipes shall withstand the following external pressures:

Well Depth m Over Up to and Including			*Collapse Pressure,* N/cm^2
0	-	100	28
100	-	150	49
150	-	225	70
225	-	300	84
300	-	400	98

A-1.1.5 *Water Absorption and Retention of Strength*

Water absorption in boiling water for 72 hours shall be less than one percent.

Strength retention after boil test shall be at least 50 percent of original strength.

NOTES

1 Axial tension and axial compression values given are based on required handling strength, chiefly from previous experience. Further the axial tensile value includes with a safety factor, the load required to withdraw the well string after gravel packing but before full development.

2 Internal hydrostatic pressure strength is based on the ability of slotted pipes to withstand cleaning by explosive of masked string of cordtex.

3 External collapse pressure is based on estimated maximum pressure likely to be experienced in development.

ANNEX B

(*Clause* 10)

SELECTION OF SLOT SIZE

B-1 DETERMINATION OF SLOT SIZE

B-1.1 The size of slot openings suitable for different formations shall be based on sieve analysis of the aquifer material. Following procedure and design criterion is laid down for general guidance.

B-1.2 A weighed quantity of the thoroughly mixed sample is passed through a set of Indian Standard sieves from No. 75 onwards. The sieves are arranged such that the coarsest sieve is placed at the top and the finest at the bottom. After proper shaking, the sieve set is opened and material retained on each sieve is correctly weighed. The cumulative weight passing through each sieve is plotted on semilogarithmic graph paper having percentage weight as ordinate on arithmetic scale and size of the sieve opening as abscissa on logarithmic scale. A smooth graph is then drawn through the points.

B-1.3 The normal slot size for well without gravel pack (that is, naturally developed) shall be 0.15, to 0.5 mm, and for gravel packed well shall be 0.5 mm, 0.75 mm, 1.0 mm, 1.5 mm, 2.0 mm and 3.0 mm.

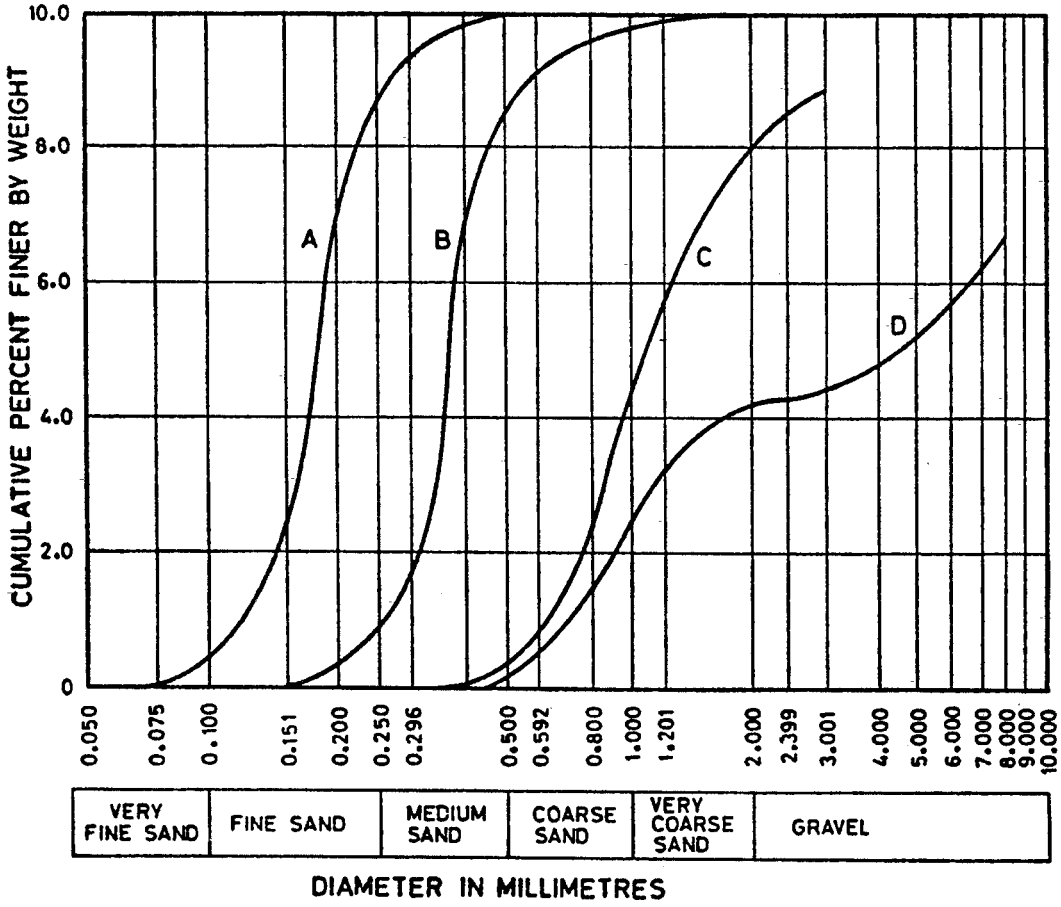


FIG. 6 TYPICAL GRAIN SIZE DISTRIBUTION CURVES (USER CLASSIFICATION)

B-2 AQUIFER MATERIAL CLASSIFICATION

B-2.1 The aquifer material may be classified into various categories according to the following ranges of the particle size:

Fine gravel	above 2.0 mm
Coarse sand	0.5 to 2.0 mm
Medium sand	0.25 to 0.5 mm
Fine sand	0.05 to 0.25 mm
Silt	0.002 to 0.06 mm
Clay	below 0.000 mm

B-2.2 Grain size curves of a few typical aquifer materials covering fine to coarse sand are shown in Fig. 6.

B-2.3 Effective Diameter

The effective diameter is an index of the measure of the fineness of an aquifer. For permeability, d_{10} is generally taken as the effective size.

B-2.4 Uniformity Co-efficient (C_u)

Uniformity co-efficient gives the slope of the major portion of the grain size distribution curve and is defined as below:

$$C_u = \frac{d_{60}\ (40 \text{ percent retained})}{d_{10}\ (90 \text{ percent retained})}$$

B-3 GRAVEL PACK

B-3.1 Criteria for design of artificial gravel pack is generally expressed in terms of gravel pack ratio which is defined as the ratio between the average size of the gravel pack material and the average size of the aquifer material. However following design criterion for gravel pack is recommended based on minimum head loss through gravel pack and minimum sand movement:

Pack	*Aquifer Ratio*
Uniform aquifer with uniform gravel pack	9 : 12.5
Non-uniform aquifer with uniform gravel pack	11 : 15.5

B-3.1.1 The above criterion is based on minimum head loss through gravel pack and minimum sand movement.

B-3.2 In case gravel pack has to be provided to a well where more than one formation are to be tapped, the

gravel pack designed for the finest formations should be provided for all the formations, provided average grain size of the material in the coarsest aquifer is less than 4 times the 50 percent size of the materials in the finest aquifer.

B-3.3 To avoid trouble in placing and irrespective of gradation packs should not contain particles greater than 13 mm.

B-3.4 The size of the slot opening is governed by the size of gravel or aquifer material which it has to retain. The slot size for gravel packed well should be such that it retains about 90 percent of the gravel.

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Amendments Issued Since Publication

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AMENDMENT NO. 1 MAY 2002
TO
IS 8110 : 2000 WELL SCREENS AND SLOTTED PIPES — SPECIFICATION

(Second Revision)

(*Page* 10, *clause* **8.3.5**) — Substitute '± 10 percent' *for* '± 1.0 percent' for Screen thickness tolerance.

(*Page* 13, *Fig.* 5B, *Caption*) — Substitute 'Brass Screens with Horizontal Slots' *for* 'Brass Screens with Vertical Slots'.

(*Page* 15, *Fig.* 6, *Caption*) — Substitute the following for the existing:

'TYPICAL GRAIN SIZE DISTRIBUTION CURVES (USBR CLASSIFICATION)'

(ME 21)

Reprography Unit, BIS, New Delhi, India