Roscoe Moss Company®

We make water work worldwide

A Note About Roscoe Moss Company

Roscoe Moss Company has designed and manufactured water well casing and screen since 1926. Producing hydraulically efficient, long lasting, and cost-effective products remains our core business.

This brochure provides information regarding our shutter screen and continuous slot screen. Specifications for various steels from which our products are produced are shown. Drawings and descriptions of important appurtenances, such as dissimilar steel connectors and compression sections, are presented.

From its inception, Roscoe Moss Company has found that consumers prefer to make purchasing decisions based on science and experience. We offer well owners and their representatives comprehensive technical information regarding ground water development. Our web site www.roscoemoss.com and our publication *Handbook of Ground Water Development* were developed as technical resources intended to assist those involved with water well design and construction.

We understand technical issues are only one-side of the purchasing decision. Economic concerns must also be addressed, as rigorous cost analysis is vital to capital investment decisions. For this reason, we are also prepared to discuss important options that take into account cost versus benefit when evaluating the intended life of a well.

Roscoe Moss Company well drilling – circa 1918

Roscoe Moss Company well casing manufacturing – circa 1937

Well Casing and Screen

Roscoe Moss Company designs and manufactures water well casing and screen from several grades of steel. Fabrication of our blank pipe is by the spiral process utilizing double submerged-arc welding. This method offers special advantages including: accurate geometrical tolerances, increased strength and assurance of full penetration. Our shutter screen is fabricated from these high-quality tubes.

Shutter screen employs a louver-shaped aperture to increase collapse strength, minimize plugging, and provide reliable control of sand and gravel packs. Another important feature of shutter screen is its smooth, unobstructed interior which allows proper development and redevelopment by tight swabbing and other effective procedures. Incrustation buildup may be removed by a variety of mechanical and chemical methods.

Shutter screen is available in three patterns: Ful Flo, Standard Flo and Super Flo. Ful Flo is the most common configuration and is selected for most wells. For low-yielding aquifers, Standard Flo offers an economical and efficient alternative. Super Flo is used when screening thin, highly prolific aquifers. Other shutter screen patterns and slotted screen for special purposes are also available.

Shutter screen ends are generally prepared for field assembly with factory-attached welding collars. This connection provides greater joint strength and economy than other types.

Roscoe Moss Company also produces continuous slot screen. These screens are manufactured by wrapping and resistance welding a shaped wire around an internal array of longitudinal rods. This process lends itself to close tolerances required for very fine aperture sizes. Continuous slot screen is usually produced from stainless steel types 304 or 316L in order to avoid problems associated with sand production that may result from corrosion of carbon steel wire.

Continuous slot screen is designed for wells when there are a limited number of thin, well-defined and highly permeable fine-grained aquifers. These screens are effective in wells of this type since they can be manufactured with very small slot openings and yet maintain the necessary open area to minimize frictional head loss. Ends of continuous slot screen are usually fitted with weld rings.

Steel Selection

Duplex Stainless Steel Types 2101, 2205, 2507

Duplex stainless steel is the appropriate material for specific environments where corrosion is extreme. Typical applications include brackish water, desalination, and brine injection. Duplex stainless steel offers superior corrosion resistance combined with high strength.

Stainless Steel Types 304 and 316L

Stainless steel is used for wells where corrosive elements limit the effective life of carbon, copper-bearing and HSLA steels. Stainless steel is particularly resistant to detrimental effects of hydrogen sulfide, carbon dioxide and saline water. Removal of incrustation by acidizing, a method not recommended for some other steels, may be accomplished in stainless steel screens.

High-Strength Low-Alloy (HSLA) Steel

Corrosion-resistant, high-strength low-alloy steel casing and screen is designed and produced for use in water wells when corrosion resistance, strength and durability are important requirements. Stronger than mild or copper-bearing steel, HSLA casing and screen is an excellent choice for deep, large-diameter wells. Although more corrosion-resistant than mild or copper-bearing steel, in wells where severe corrosive elements are present, an analysis must be made before selecting this material over stainless steel.

Copper-Bearing Steel

Used for wells where resistance to corrosion is an important requirement. Although not as corrosion-resistant as HSLA or stainless steel, copper-bearing casing and screen last significantly longer than mild steel products.

Mild Steel

Used for wells when short-term economic considerations are a priority.

	Steel Type	Manufacturing Specification	Yield Strength (psi)	Tensile Strength (psi)	PRE*
Duplex Stainless Steels	2507	ASTM 928	80,000	110,000	42
	2205	ASTM 928	65,000	95,000	35
	2101	ASTM 928	65,000	94,000	26
Austenitic Stainless Steels	316L	ASTM 778	30,000	75,000	24
	304L	ASTM 778	30,000	75,000	18
Carbon Steels	High Strength Low Alloy (A606 Type 4)	ASTM 139	50,000	70,000	n/a
	Copper Bearing	ASTM 139 B	35,000	60,000	n/a
	Mild Steel	ASTM 139 B	35,000	60,000	n/a

*Pitting Resistant Equivalent = %Cr + 3.3x%Mo + 16x%N

Stainless Steel Casing and Screen Specifications

Stainless Steel Casing

Well casing shall be manufactured in accordance with applicable parts of ASTM ______ with the following additions:

Welding shall be the automatic submerged arc process using at least one pass on the inside and one pass on the outside.

Lengths shall be furnished as specified, circumferentially welded joints will not be permitted.

Minimum wall thickness shall not be less than 5% of the nominal wall thickness specified.

Ovality of the casing supplied shall not exceed 1%.

Straightness of the casing will be determined by placing a 10-foot straightedge so that both ends are in contact with the pipe, a maximum gap of 0.125 inches is allowable. In addition, section ends shall be machined flat perpendicular to the axis of the casing and shall not vary more than 0.010 inches at any point from a true plane at right angles to the axis of the casing. Ends shall be machined flat perpendicular to the axis of the casing.

The steel from which the casing is manufactured shall be stainless steel type _____

Casing shall be _____ inches inside diameter and _____ inch wall thickness. Casing shall be furnished in ____ foot lengths with welding collars attached.

Stainless Steel Shutter Screen

Primary tubes for screen shall be manufactured in accordance with the aforementioned casing requirements:

Screen openings shall be machine made, horizontal to the axis of the casing and of a louver form with the aperture facing downward. The aperture size shall be ____ inches with ____ openings per lineal foot. The minimum area of opening shall be ___ square inches per lineal foot.

Field Assembly of Stainless Steel Casing and Screen

For field assembly by welding, section ends shall be furnished with collars in accordance with the following standard:

Collars shall be the same thickness and have the same physical and chemical properties as the corresponding casing section. Collars must be 5 inches wide, rolled to fit the outside diameter, and factory welded to one end of each section with 2" on and 3" off. Section ends shall be machined flat perpendicular to the axis of the casing and shall not vary more than 0.010 inches at any point from a true plane at right angles to the axis of the casing.

Three inspection windows must be provided in each collar to assure proper connection of the sections.

High-Strength Low-Alloy Steel Casing and Screen Specifications

High-Strength Low-Alloy Steel Casing

Well casing shall be manufactured in accordance with applicable parts of ASTM A 139 with the following additions:

Welding shall be by the automatic submerged-arc process using at least one pass on the inside and one pass on the outside.

The steel from which the casing is manufactured shall conform to ASTM A 606 Type 4. Casing shall be _____ inches inside diameter and _____ inch wall thickness. Casing shall be furnished in _____ foot lengths with welding collars attached.

High-Strength Low-Alloy Steel Shutter Screen

Primary tubes for screen shall be manufactured in accordance with the aforementioned casing requirements:

Screen openings shall be machine made, horizontal to the axis of the casing and of a louver form with the aperture facing downward. The aperture size shall be _____ inches with _____ openings per lineal foot. The minimum area of the opening shall be _____ square inches per lineal foot.

Field Assembly of HSLA Steel Casing and Screen Sections

For field assembly by welding, section ends shall be furnished with collars in accordance with the following standard:

Collars shall be the same thickness and have the same physical and chemical properties as the corresponding casing section. Collars must be 5 inches wide, rolled to fit the outside diameter, and factory welded to one end of each section with 2" on and 3" off. Section ends shall be machined flat perpendicular to the axis of the casing and shall not vary more than 0.010 inch at any point from a true plane at right angles to the axis of the casing.

Three inspection windows must be provided in each collar to assure proper connection of the sections.

Copper-Bearing Steel Casing and Screen Specifications

Copper-Bearing Steel Well Casing

Well casing shall be manufactured in accordance with applicable parts of ASTM A 139 Grade B with the following additions:

Welding shall be by the automatic submerged-arc process using at least one pass on the inside and one pass on the outside.

The steel from which the casing is manufactured shall contain not less than 0.20% copper by ladle analysis.

Casing shall be _____ inches inside diameter and _____ inch wall thickness. Casing shall be furnished in _____ foot lengths with welding collars attached.

Copper-Bearing Shutter Screen

Primary tubes for well screen shall be manufactured in accordance with the aforementioned casing requirements:

Screen openings shall be machine made, horizontal to the axis of the casing and of a louver form with the aperture facing downward. The aperture size shall be _____ inches with _____ openings per lineal foot.

Field Assembly of Copper-Bearing Steel Casing and Screen Sections

For field assembly by welding, section ends shall be furnished with collars in accordance with the following standard:

Collars shall be the same thickness and have the same physical and chemical properties as the corresponding casing section. Collars must be 5 inches wide, rolled to fit the outside diameter, and factory welded to one end of each section with 2" on and 3" off. Section ends shall be machined flat perpendicular to the axis of the casing and shall not vary more than 0.010 inch at any point from a true plane at right angles to the axis of the casing.

Three inspection windows must be provided in each collar to assure proper connection of sections.

Mild Steel Casing and Screen Specifications

Mild Steel Casing

Well casing shall be manufactured in accordance with applicable parts of ASTM A 139 Grade B with the following additions:

Welding shall be by the automatic submerged-arc process using at least one pass on the inside and one pass on the outside.

Casing shall be _____ inches outside diameter and _____ inch wall thickness.

Casing shall be furnished in _____ foot lengths with welding collars attached.

Mild Steel Shutter Screen

Primary tubes for well screen shall be manufactured in accordance with the aforementioned casing requirements:

Screen openings shall be machine made, horizontal to the axis of the casing and of a louver form with the aperture facing downward. The aperture size shall be _____ inches with _____ openings per lineal foot. The minimum area of opening shall be _____ square inches per lineal foot.

Field Assembly of Mild Steel Casing and Screen Sections

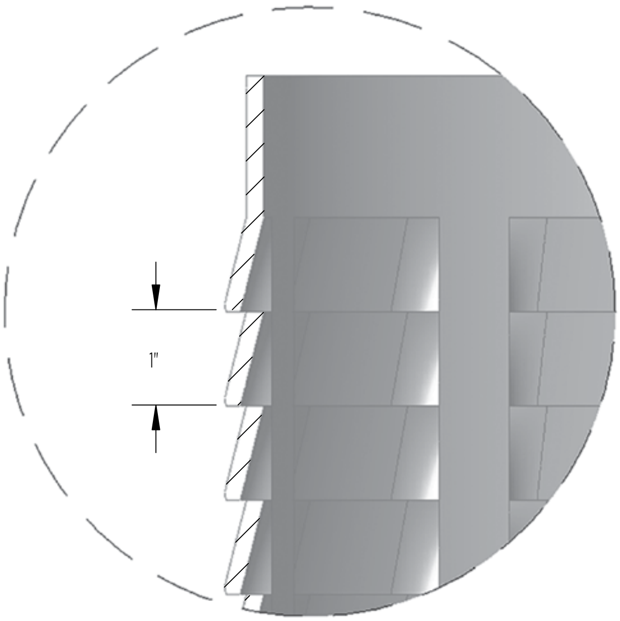
For field assembly by welding, section ends shall be furnished with collars in accordance with the following standard:

Collars shall be the same thickness and have the same physical and chemical properties as the corresponding casing section.

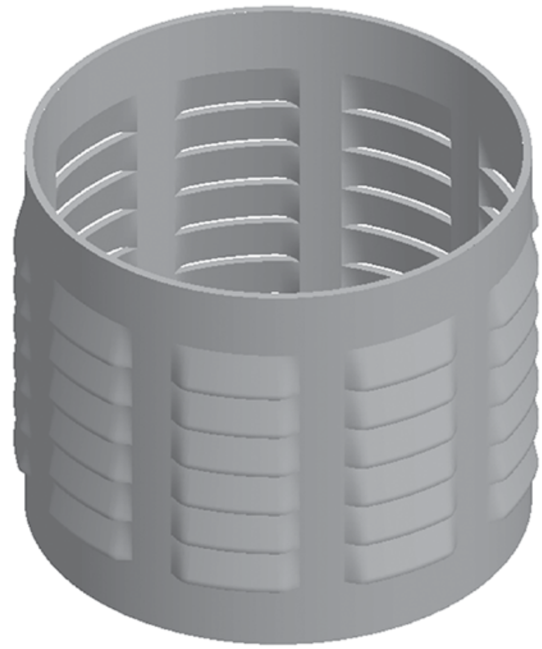
Collars must be 5 inches wide, rolled to fit the outside diameter, and factory welded to one end of each section with 2" on and 3" off. Section ends shall be machined flat perpendicular to the axis of the casing and shall not vary more than 0.010 inch at any point from a true plane at right angles to the axis of the casing.

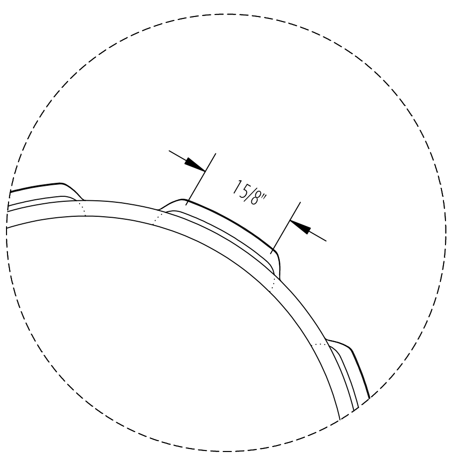
Three inspection windows must be provided in each collar to assure proper connection of the sections.

Ful Flo

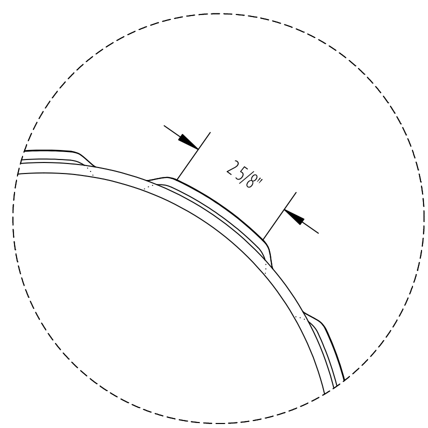


CROSS-SECTIONAL VIEW
SCALE 1:2



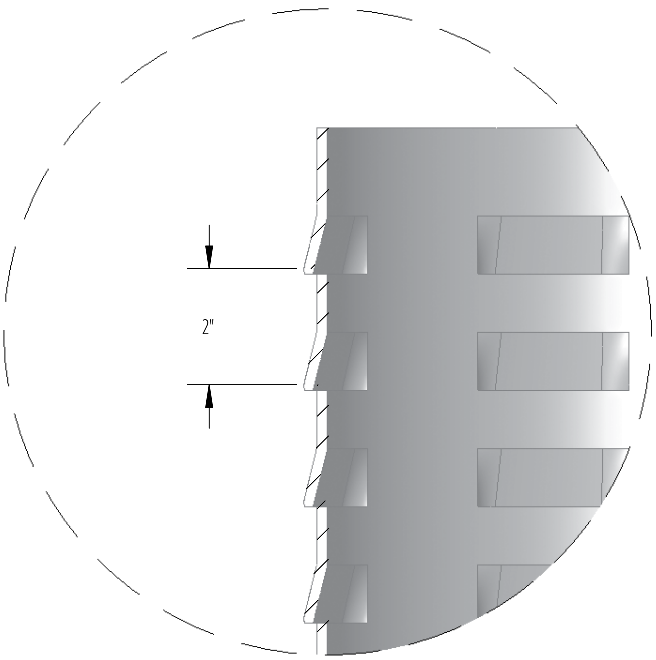


SLOT LENGTH
6"-8" DIAMETER

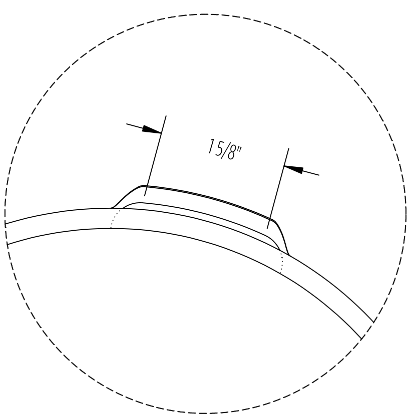


SLOT LENGTH
10"-24" DIAMETER

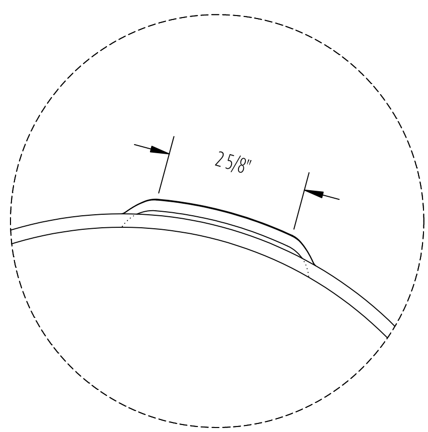
Standard Flo



CROSS-SECTIONAL VIEW
SCALE 1:3

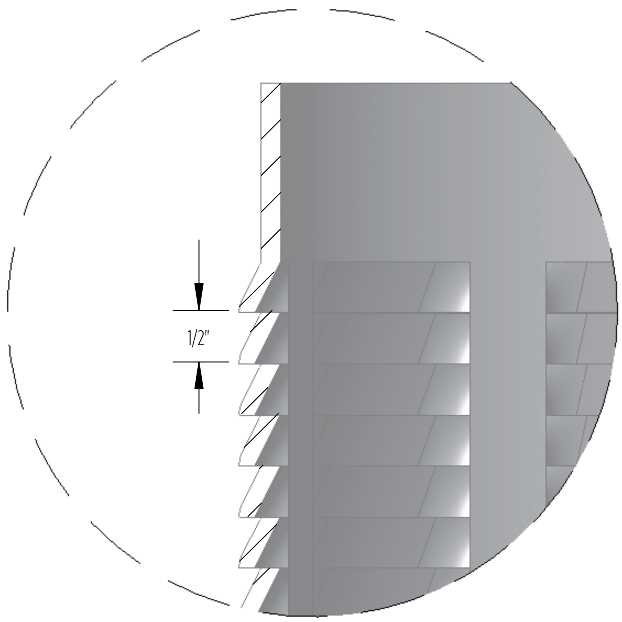


SLOT LENGTH
6"-8" DIAMETER

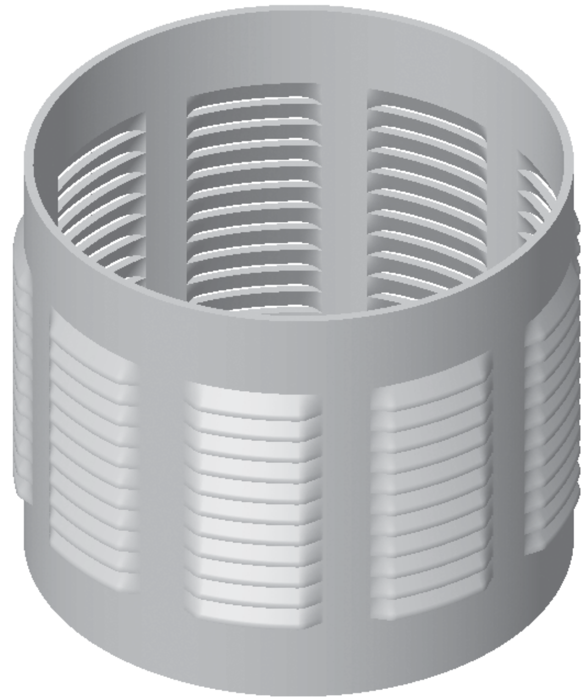


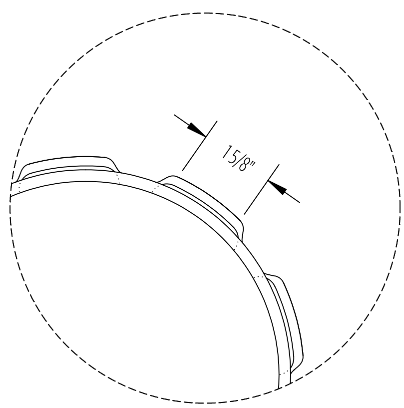
SLOT LENGTH
10"-24" DIAMETER

Super Flo



CROSS-SECTIONAL VIEW
SCALE 1:2





SLOT LENGTH
6"-24" DIAMETER

Screen and Casing Technical Data

Ful Flo Shutter Screen

Open Area for Stainless, HSLA, and Copper-Bearing Steels

Casing Diameter (in.)	Holes/ Circle	Holes/ Foot	Holes/ Meter	Slot Size (in.)					Slot Size (mm.)					
				0.060	0.075	0.090	0.105	0.120	0.5	1.0	1.5	2.0	3.0	4.0
6.625	6	72	236	7.0	8.8	10.5	12.3	14.0	48.7	97.4	146.1	194.8	292.2	389.6
8.625	8	96	315	9.4	11.7	14.0	16.4	18.7	65.0	130.0	195.0	260.0	390.0	520.1
10.75	8	96	315	15.1	18.9	22.7	26.5	30.2	105.0	210.0	315.0	420.1	630.1	840.1
12.75	10	120	394	18.9	23.6	28.4	33.1	37.8	131.3	262.7	394.0	525.4	788.1	1050.8
14.5	10	120	394	18.9	23.6	28.4	33.1	37.8	131.3	262.7	394.0	525.4	788.1	1050.8
16.625	12	144	472	22.7	28.4	34.0	39.7	45.4	157.4	314.7	472.1	629.4	944.1	1258.8
18.625	14	168	551	26.5	33.1	39.7	46.3	52.9	183.7	367.4	551.1	734.8	1102.1	1469.5
20.625	16	192	630	30.2	37.8	45.4	52.9	60.5	210.0	420.1	630.1	840.1	1260.2	1680.2
22.5	16	192	630	30.2	37.8	45.4	52.9	60.5	210.0	420.1	630.1	840.1	1260.2	1680.2
24.5	16	192	630	30.2	37.8	45.4	52.9	60.5	210.0	420.1	630.1	840.1	1260.2	1680.2

Open Area = Sq. in. per Lineal Foot

Open Area = Sq. cm. per Lineal Meter

Ful Flo Shutter Screen

Open Area for Mild Steel

Casing Diameter (in.)	Holes/ Circle	Holes/ Foot	Holes/ Meter	Slot Size (in.)					Slot Size (mm.)					
				0.060	0.075	0.090	0.105	0.120	0.5	1.0	1.5	2.0	3.0	4.0
6.625	6	72	236	7.0	8.8	10.5	12.3	14.0	48.7	97.4	146.1	194.8	292.2	389.6
8.625	8	96	315	9.4	11.7	14.0	16.4	18.7	65.0	130.0	195.0	260.0	390.0	520.1
10.75	8	96	315	15.1	18.9	22.7	26.5	30.2	105.0	210.0	315.0	420.1	630.1	840.1
12.75	8	96	315	15.1	18.9	22.7	26.5	30.2	105.0	210.0	315.0	420.1	630.1	840.1
14	8	96	315	15.1	18.9	22.7	26.5	30.2	105.0	210.0	315.0	420.1	630.1	840.1
16	10	120	394	18.9	23.6	28.4	33.1	37.8	131.3	262.7	394.0	525.4	788.1	1050.8
18	12	144	472	22.7	28.4	34.0	39.7	45.4	157.4	314.7	472.1	629.4	944.1	1258.8
20	14	168	551	26.5	33.1	39.7	46.3	52.9	183.7	367.4	551.1	734.8	1102.1	1469.5
22	14	168	551	26.5	33.1	39.7	46.3	52.9	183.7	367.4	551.1	734.8	1102.1	1469.5
24	16	192	630	30.2	37.8	45.4	52.9	60.5	183.7	367.4	551.1	734.8	1102.1	1469.5

Open Area = Sq. in. per Lineal Foot

Open Area = Sq. cm. per Lineal Meter

Standard Flo Shutter Screen

Open Area for All Steel Types

Casing Diameter (in.)	Holes/ Circle	Holes/ Foot	Holes/ Meter	Slot Size (in.)					Slot Size (mm.)					
				0.060	0.075	0.090	0.105	0.120	0.5	1.0	1.5	2.0	3.0	4.0
6.625	6	36	118	3.5	4.4	5.3	6.1	7.0	24.4	48.7	73.1	94.4	146.1	194.8
8.625	6	36	118	3.5	4.4	5.3	6.1	7.0	24.4	48.7	73.1	94.4	146.1	194.8
10.75	6	36	118	5.7	7.1	8.5	9.9	11.3	39.3	78.7	118.0	157.4	236.0	314.7
12.75	8	48	157	7.6	9.5	11.3	13.2	15.1	52.3	104.7	157.0	209.4	314.0	418.7
14	8	48	157	7.6	9.5	11.3	13.2	15.1	52.3	104.7	157.0	209.4	314.0	418.7
16	10	60	197	9.5	11.8	14.2	16.5	18.9	65.7	131.3	197.0	262.7	394.0	525.4
18	10	60	197	9.5	11.8	14.2	16.5	18.9	65.7	131.3	197.0	262.7	394.0	525.4
20	12	72	236	11.3	14.2	17.0	19.8	22.7	78.7	157.4	236.0	314.7	472.1	629.4
22	14	84	276	13.2	16.5	19.8	23.2	26.5	92.0	184.0	276.0	368.0	552.1	736.1
24	14	84	276	13.2	16.5	19.8	23.2	26.5	92.0	184.0	276.0	368.0	552.1	736.1

Open Area = Sq. in. per Lineal Foot

Open Area = Sq. cm. per Lineal Meter

Super Flo Shutter Screen

Open Area for Stainless, HSLA, and Copper-Bearing Steels

Casing Diameter (in.)	Holes/ Circle	Holes/ Foot	Holes/ Meter	Slot Size (in.)					Slot Size (mm.)					
				0.060	0.075	0.090	0.105	0.120	0.5	1.0	1.5	2.0	3.0	4.0
6.625	8	192	630	18.7	23.4	28.1	32.8	37.4	130.0	260.0	390.0	520.1	780.1	1040.1
8.625	10	240	787	23.4	29.3	35.1	41.0	46.8	162.4	324.8	487.3	649.7	974.5	1299.3
10.75	12	288	945	45.4	56.7	68.0	79.4	90.7	195.0	390.0	585.1	780.1	1170.1	1560.2
12.75	14	336	1102	52.9	66.2	79.4	92.6	105.8	227.4	454.9	628.3	909.7	1364.6	1819.4
14.5	16	384	1260	60.5	75.6	90.7	105.8	121.0	260.0	520.1	780.1	1040.1	1560.2	2080.3
16.625	18	432	1417	68.0	85.1	102.1	119.1	136.1	292.4	584.9	877.3	1169.7	1754.6	2339.5
18.625	20	480	1574	75.6	94.5	113.4	132.3	151.2	325.0	650.1	975.1	1300.2	1950.2	2600.3
20.625	22	528	1732	83.2	104.0	124.7	145.5	166.3	357.4	714.9	1072.3	1429.8	2144.6	2859.5
22.5	24	576	1889	90.7	113.4	136.1	158.8	181.4	390.0	780.1	1170.1	1560.2	2340.3	3120.4
24.5	26	624	2047	98.3	122.9	147.4	172.0	196.6	422.4	844.9	1267.3	1689.8	2534.7	3379.6

Open Area = Sq. in. per Lineal Foot

Open Area = Sq. cm. per Lineal Meter

Weights and Strengths of Stainless Steel Casing

NOMINAL SIZE	THICKNESS		OD		ID		WEIGHT		COLLAPSE STRENGTH*				TENSILE STRENGTH	
in.	in.	mm.	in.	mm.	in.	mm.	lb/ft.	kg/m.	psi	ft. water	kg./cm.^{2}	m. water	tons	Mt.
6	3/16	4.76	6-5/8	168	6-1/4	159	13.19	19.67	646	1490	45.4	454	142.1	129.2
6	1/4	6.35	6-5/8	168	6-1/8	156	17.42	25.97	1136	2622	79.9	799	187.7	170.6
8	3/16	4.76	8-5/8	219	8-1/4	210	17.29	25.78	361	833	25.4	254	186.3	169.3
8	1/4	6.35	8-5/8	219	8-1/8	206	22.88	34.12	679	1566	47.7	477	246.5	224.1
10	3/16	4.76	10-3/4	273	10-3/8	263	21.65	32.27	213	492	15.0	150	233.2	212.0
10	1/4	6.35	10-3/4	273	10-1/4	260	28.69	42.78	421	972	29.6	296	309.1	281.0
10	5/16	7.94	10-3/4	273	10-1/8	257	35.65	53.15	683	1576	48.0	480	384.1	349.1
12	3/16	4.76	12-3/4	324	12-3/8	314	25.75	38.38	139	320	9.7	97	277.4	252.1
12	1/4	6.35	12-3/4	324	12-1/4	311	34.16	50.92	283	654	19.9	199	368.0	334.5
12	5/16	7.94	12-3/4	324	12-1/8	308	42.48	63.34	474	1093	33.3	333	457.7	416.0
12	3/8	9.53	12-3/4	324	12	305	50.72	75.62	699	1614	49.2	492	546.4	496.7
14	3/16	4.76	14 -1/2	368	14-1/8	359	29.33	43.73	99	229	7.0	70	316.0	287.2
14	1/4	6.35	14 -1/2	368	14	356	38.94	58.05	207	478	14.6	146	419.5	381.3
14	5/16	7.94	14 -1/2	368	13-7/8	352	48.46	72.25	354	817	24.9	249	522.1	474.5
14	3/8	9.53	14 -1/2	368	13-3/4	349	57.89	86.32	533	1230	37.5	375	623.7	566.9
16	3/16	4.76	16-5/8	422	16-1/4	413	33.69	50.22	69	159	4.9	49	362.9	329.9
16	1/4	6.35	16-5/8	422	16-1/8	410	44.74	66.71	147	339	10.3	103	482.0	438.2
16	5/16	7.94	16-5/8	422	16	406	55.72	83.07	256	590	18.0	180	600.2	545.6
16	3/8	9.53	16-5/8	422	15-7/8	403	66.60	99.30	393	907	27.6	276	717.5	652.2
18	3/16	4.76	18-5/8	473	18-1/4	464	37.79	56.33	51	117	3.6	36	407.1	370.0
18	1/4	6.35	18-5/8	473	18-1/8	460	50.21	74.86	109	253	7.7	77	540.9	491.7
18	5/16	7.94	18-5/8	473	18	457	62.55	93.25	193	447	13.6	136	673.8	612.5
18	3/8	9.53	18-5/8	473	17-7/8	454	74.80	111.52	302	696	21.2	212	805.9	732.5
20	3/16	4.76	20-5/8	524	20-1/4	514	41.88	62.45	38	89	2.7	27	451.2	410.2
20	1/4	6.35	20-5/8	524	20-1/8	511	55.67	83.01	84	193	5.9	59	599.8	545.2
20	5/16	7.94	20-5/8	524	20	508	69.38	103.44	150	345	10.5	105	747.4	679.4
20	3/8	9.53	20-5/8	524	19-7/8	505	83.00	123.75	236	544	16.6	166	894.2	812.8
22	3/16	4.76	22-1/2	572	22-1/8	562	45.73	68.17	30	70	2.1	21	492.6	447.8
22	1/4	6.35	22-1/2	572	22	559	60.80	90.64	66	153	4.7	47	655.0	595.4
22	5/16	7.94	22-1/2	572	21-7/8	556	75.78	112.99	120	276	8.4	84	816.4	742.1
22	3/8	9.53	22-1/2	572	21-3/4	552	90.68	135.20	190	439	13.4	134	977.0	888.1
24	3/16	4.76	24-1/2	622	24-1/8	613	49.83	74.29	24	55	1.7	17	536.8	487.9
24	1/4	6.35	24-1/2	622	24	610	66.26	98.79	53	122	3.7	37	713.9	648.9
24	5/16	7.94	24-1/2	622	23-7/8	606	82.62	123.17	96	221	6.7	67	890.0	809.0
24	3/8	9.53	24-1/2	622	23-3/4	603	98.88	147.42	153	354	10.8	108	1065.3	968.3

*Source: Timoshenko's Elastic Formula with Eccentricity

Weights and Strengths of Corrosion-Resistant High-Strength Low-Alloy Steel Casing

NOMINAL SIZE	THICKNESS		OD		ID		WEIGHT		COLLAPSE STRENGTH*				TENSILE STRENGTH	
in.	in.	mm.	in.	mm.	in.	mm.	lb/ft.	kg/m.	psi	ft. water	kg./cm.^{2}	m. water	tons	Mt.
6	3/16	4.76	6-5/8	168	6-1/4	159	12.89	19.22	890	2055	62.6	626	132.7	120.6
6	1/4	6.35	6-5/8	168	6-1/8	156	17.02	25.38	1685	3889	118.5	1185	175.2	159.2
8	3/16	4.76	8-5/8	219	8-1/4	210	16.90	25.19	465	1073	32.7	327	173.9	158.0
8	1/4	6.35	8-5/8	219	8-1/8	206	22.36	33.34	942	2173	66.2	662	230.1	209.2
10	3/16	4.76	10-3/4	273	10-3/8	263	21.15	31.53	261	603	18.4	184	217.7	197.8
10	1/4	6.35	10-3/4	273	10-1/4	260	28.04	41.80	552	1274	38.8	388	288.5	262.2
10	5/16	7.94	10-3/4	273	10-1/8	257	34.84	51.94	948	2188	66.7	667	358.5	325.8
12	3/16	4.76	12-3/4	324	12-3/8	314	25.16	37.51	165	380	11.6	116	258.9	235.3
12	1/4	6.35	12-3/4	324	12-1/4	311	33.38	49.76	356	822	25.1	251	343.4	312.2
12	5/16	7.94	12-3/4	324	12-1/8	308	41.51	61.89	629	1452	44.2	442	427.2	388.3
12	3/8	9.53	12-3/4	324	12	305	49.56	73.89	974	2249	68.5	685	510.0	463.6
14	3/16	4.76	14-1/2	368	14-1/8	359	28.66	42.73	115	266	8.1	81	294.9	268.1
14	1/4	6.35	14-1/2	368	14	356	38.05	56.73	253	585	17.8	178	391.5	355.9
14	5/16	7.94	14-1/2	368	13-7/8	352	47.35	70.60	455	1050	32.0	320	487.3	442.9
14	3/8	9.53	14-1/2	368	13-3/4	349	56.57	84.34	717	1656	50.5	505	582.1	529.2
16	3/16	4.76	16-5/8	422	16-1/4	413	32.92	49.08	79	182	5.5	55	338.7	307.9
16	1/4	6.35	16-5/8	422	16-1/8	410	43.72	65.18	175	404	12.3	123	449.9	409.0
16	5/16	7.94	16-5/8	422	16	406	54.44	81.17	319	736	22.4	224	560.2	509.3
16	3/8	9.53	16-5/8	422	15-7/8	403	65.08	97.03	511	1179	35.9	359	669.7	608.8
18	3/16	4.76	18-5/8	473	18-1/4	464	36.92	55.05	57	132	4.0	40	379.9	345.4
18	1/4	6.35	18-5/8	473	18-1/8	460	49.06	73.15	128	295	9.0	90	504.9	458.9
18	5/16	7.94	18-5/8	473	18	457	61.12	91.12	235	543	16.6	166	628.9	571.7
18	3/8	9.53	18-5/8	473	17-7/8	454	73.09	108.97	382	881	26.8	268	752.1	683.7
20	3/16	4.76	20-5/8	524	20-1/4	514	40.93	61.02	43	99	3.0	30	421.1	382.8
20	1/4	6.35	20-5/8	524	20-1/8	511	54.40	81.11	96	223	6.8	68	559.8	508.9
20	5/16	7.94	20-5/8	524	20	508	67.79	101.07	179	412	12.6	126	697.6	634.1
20	3/8	9.53	20-5/8	524	19-7/8	505	81.10	120.91	292	674	20.5	205	834.6	758.6
22	3/16	4.76	22-1/2	572	22-1/8	562	44.68	66.62	33	77	2.3	23	459.8	417.9
22	1/4	6.35	22-1/2	572	22	559	59.41	88.57	76	174	5.3	53	611.3	555.7
22	5/16	7.94	22-1/2	572	21-7/8	556	74.05	110.40	141	325	9.9	99	762.0	692.7
22	3/8	9.53	22-1/2	572	21-3/4	552	88.61	132.11	231	534	16.3	163	911.8	828.9
24	3/16	4.76	24-1/2	622	24-1/8	613	48.69	72.59	26	60	1.8	18	501.0	455.4
24	1/4	6.35	24-1/2	622	24	610	64.75	96.53	59	137	4.2	42	666.3	605.6
24	5/16	7.94	24-1/2	622	23-7/8	606	80.73	120.36	111	256	7.8	78	830.7	755.1
24	3/8	9.53	24-1/2	622	23-3/4	603	96.62	144.05	184	424	12.9	129	994.3	903.8

*Source: Timoshenko's Elastic Formula with Eccentricity

Weights and Strengths of Copper-Bearing Steel Casing

NOMINAL SIZE	THICKNESS		OD		ID		WEIGHT		COLLAPSE STRENGTH*				TENSILE STRENGTH	
in.	inches	mm.	in.	mm.	in.	mm.	lb./ft.	kg/m.	psi	ft. water	kg./cm.^{2}	m. water	tons	Mt.
6	3/16	4.76	6-5/8	168	6-1/4	159	12.89	19.22	718	1656	50.5	505	113.7	103.4
6	1/4	6.35	6-5/8	168	6-1/8	156	17.02	25.38	1288	2973	90.6	906	150.1	136.5
8	3/16	4.76	8-5/8	219	8-1/4	210	16.90	25.19	393	908	27.7	277	149.0	135.5
8	1/4	6.35	8-5/8	219	8-1/8	206	22.36	33.34	756	1744	53.2	532	197.2	179.3
10	3/16	4.76	10-3/4	273	10-3/8	263	21.15	31.53	228	527	16.1	161	186.6	169.6
10	1/4	6.35	10-3/4	273	10-1/4	260	28.04	41.80	461	1064	32.4	324	247.3	224.8
10	5/16	7.94	10-3/4	273	10-1/8	257	34.84	51.94	760	1755	53.5	535	307.3	279.3
12	3/16	4.76	12-3/4	324	12-3/8	314	25.16	37.51	147	339	10.3	103	221.9	201.7
12	1/4	6.35	12-3/4	324	12-1/4	311	33.38	49.76	306	707	21.5	215	294.4	267.6
12	5/16	7.94	12-3/4	324	12-1/8	308	41.51	61.89	521	1202	36.6	366	366.1	332.8
12	3/8	9.53	12-3/4	324	12	305	49.56	73.89	779	1799	54.8	548	437.1	397.4
14	3/16	4.76	14-1/2	368	14-1/8	359	28.66	42.73	105	241	7.4	74	252.8	229.8
14	1/4	6.35	14-1/2	368	14	356	38.05	56.73	222	512	15.6	156	335.6	305.0
14	5/16	7.94	14-1/2	368	13-7/8	352	47.35	70.60	385	889	27.1	271	417.6	379.6
14	3/8	9.53	14-1/2	368	13-3/4	349	56.57	84.34	588	1358	41.4	414	499.0	453.6
16	3/16	4.76	16-5/8	422	16-1/4	413	32.92	49.08	72	167	5.1	51	290.3	263.9
16	1/4	6.35	16-5/8	422	16-1/8	410	43.72	65.18	156	360	11.0	110	385.6	350.5
16	5/16	7.94	16-5/8	422	16	406	54.44	81.17	276	636	19.4	194	480.2	436.5
16	3/8	9.53	16-5/8	422	15-7/8	403	65.08	97.03	429	991	30.2	302	574.0	521.8
18	3/16	4.76	18-5/8	473	18-1/4	464	36.92	55.05	53	122	3.7	37	325.7	296.0
18	1/4	6.35	18-5/8	473	18-1/8	460	49.06	73.15	116	267	8.1	81	432.7	393.4
18	5/16	7.94	18-5/8	473	18	457	61.12	91.12	207	478	14.6	146	539.1	490.0
18	3/8	9.53	18-5/8	473	17-7/8	454	73.09	108.97	327	754	23.0	230	644.7	586.0
20	3/16	4.76	20-5/8	524	20-1/4	514	40.93	61.02	40	92	2.8	28	361.0	328.1
20	1/4	6.35	20-5/8	524	20-1/8	511	54.40	81.11	88	203	6.2	62	479.8	436.2
20	5/16	7.94	20-5/8	524	20	508	67.79	101.07	159	367	11.2	112	597.9	543.5
20	3/8	9.53	20-5/8	524	19-7/8	505	81.10	120.91	254	586	17.8	178	715.3	650.2
22	3/16	4.76	22-1/2	572	22-1/8	562	44.68	66.62	31	72	2.2	22	394.1	358.2
22	1/4	6.35	22-1/2	572	22	559	59.41	88.57	69	160	4.9	49	524.0	476.3
22	5/16	7.94	22-1/2	572	21-7/8	556	74.05	110.40	126	292	8.9	89	653.1	593.7
22	3/8	9.53	22-1/2	572	21-3/4	552	88.61	132.11	203	470	14.3	143	781.6	710.4
24	3/16	4.76	24-1/2	622	24-1/8	613	48.69	72.59	25	57	1.7	17	429.4	390.3
24	1/4	6.35	24-1/2	622	24	610	64.75	96.53	55	127	3.9	39	571.1	519.1
24	5/16	7.94	24-1/2	622	23-7/8	606	80.73	120.36	101	233	7.1	71	712.0	647.2
24	3/8	9.53	24-1/2	622	23-3/4	603	96.62	144.05	163	377	11.5	115	852.2	774.7

*Source: Timoshenko's Elastic Formula with Eccentricity

Weights and Strengths of Mild Steel Casing

NOMINAL SIZE	THICKNESS		OD		ID		WEIGHT		COLLAPSE STRENGTH*				TENSILE STRENGTH	
in.	in.	mm.	in.	mm.	in.	mm.	lb/ft.	kg/m.	psi	ft. water	kg./cm.^{2}	m. water	tons	Mt.
6	3/16	4.76	6-5/8	168	6-1/4	159	12.89	19.22	718	1656	50.5	505	113.7	103.4
6	1/4	6.35	6-5/8	168	6-1/8	156	17.02	25.38	1288	2973	90.6	906	150.1	136.5
8	3/16	4.76	8-5/8	219	8-1/4	210	16.90	25.19	393	908	27.7	277	149.0	135.5
8	1/4	6.35	8-5/8	219	8-1/8	206	22.36	33.34	756	1744	53.2	532	197.2	179.3
10	3/16	4.76	10-3/4	273	10-3/8	263	21.15	31.53	228	527	16.1	161	186.6	169.6
10	1/4	6.35	10-3/4	273	10-1/4	260	28.04	41.80	461	1064	32.4	324	247.3	224.8
10	5/16	7.94	10-3/4	273	10-1/8	257	34.84	51.94	760	1755	53.5	535	307.3	279.3
12	3/16	4.76	12-3/4	324	12-3/8	314	25.16	37.51	147	339	10.3	103	221.9	201.7
12	1/4	6.35	12-3/4	324	12-1/4	311	33.38	49.76	306	707	21.5	215	294.4	267.6
12	5/16	7.94	12-3/4	324	12-1/8	308	41.51	61.89	521	1202	36.6	366	366.1	332.8
12	3/8	9.53	12-3/4	324	12	305	49.56	73.89	779	1799	54.8	548	437.1	397.4
14	3/16	4.76	14	356	13-5/8	346	27.66	41.24	115	265	8.1	81	244.0	221.8
14	1/4	6.35	14	356	13-1/2	343	36.71	54.74	242	560	17.1	171	323.8	294.3
14	5/16	7.94	14	356	13-3/8	340	45.68	68.11	419	966	29.5	295	402.9	366.3
14	3/8	9.53	14	356	13-1/4	337	54.57	81.36	636	1468	44.7	447	481.3	437.5
16	3/16	4.76	16	406	15-5/8	397	31.66	47.21	80	185	5.6	56	279.3	253.9
16	1/4	6.35	16	406	15-1/2	394	42.05	62.70	172	398	12.1	121	370.9	337.2
16	5/16	7.94	16	406	15-3/8	391	52.36	78.06	303	700	21.3	213	461.8	419.8
16	3/8	9.53	16	406	15-1/4	387	62.58	93.30	470	1084	33.0	330	552.0	501.7
18	3/16	4.76	18	457	17-5/8	448	35.67	53.18	58	134	4.1	41	314.6	286.0
18	1/4	6.35	18	457	17-1/2	445	47.39	70.66	126	292	8.9	89	418.0	380.0
18	5/16	7.94	18	457	17-3/8	441	59.03	88.01	226	521	15.9	159	520.7	473.3
18	3/8	9.53	18	457	17-1/4	438	70.59	105.24	355	819	25.0	250	622.6	565.9
20	3/16	4.76	20	508	19-5/8	498	39.67	59.15	43	100	3.1	31	349.9	318.1
20	1/4	6.35	20	508	19-1/2	495	52.73	78.62	95	220	6.7	67	465.1	422.8
20	5/16	7.94	20	508	19-3/8	492	65.71	97.96	172	398	12.1	121	579.6	526.8
20	3/8	9.53	20	508	19-1/4	489	78.60	117.18	274	632	19.3	193	693.3	630.2
22	3/16	4.76	22	559	21-5/8	549	43.68	65.12	33	77	2.3	23	385.3	350.2
22	1/4	6.35	22	559	21-1/2	546	58.07	86.58	74	170	5.2	52	512.2	465.6
22	5/16	7.94	22	559	21-3/8	543	72.38	107.92	134	310	9.4	94	638.4	580.3
22	3/8	9.53	22	559	21-1/4	540	86.61	129.13	215	497	15.2	152	763.9	694.4
24	3/16	4.76	24	610	23-5/8	600	47.68	71.09	26	60	1.8	18	420.6	382.3
24	1/4	6.35	24	610	23-1/2	597	63.41	94.54	58	134	4.1	41	559.3	508.4
24	5/16	7.94	24	610	23-3/8	594	79.06	117.87	107	246	7.5	75	697.3	633.8
24	3/8	9.53	24	610	23-1/4	591	94.62	141.07	172	398	12.1	121	834.6	758.6

*Source: Timoshenko's Elastic Formula with Eccentricity

Continuous Slot Screen

Summary

Continuous slot screen is designed for wells when there are a limited number of thin, well-defined and highly permeable aquifers. Continuous slot screen is very effective in wells of this type since they can be manufactured with very small slot openings and yet maintain the necessary open area to minimize frictional head loss.

Continuous slot screen is manufactured by wrapping and resistance welding a shaped wire around an internal array of longitudinal rods. This process lends itself to close tolerances required for very fine aperture sizes. This type of screen is usually produced from stainless steel types 304 or 316L in order to avoid problems associated with pumping sand that may result from corrosion of carbon steel wire.

Users of continuous slot screen are cautioned against using this product for purposes other than those for which it was originally designed because of inherent disadvantages associated with its relatively low strength and limited durability. As a result of these restrictions, special handling during installation and development may be required. For example, the use of highly effective well development techniques such as swabbing is precluded since the screen's interior is obstructed by rods. In addition, the extent of future well maintenance and repair efforts may be restricted as repair by swaging is impractical.

A thorough technical discussion of the selection of well casing and screen can be found in the *Handbook of Ground Water Development* (published by John Wiley and Sons, 1990). Additional information is also available on our website roscoemoss.com.

Design of continuous slot screen

Specifiers of continuous slot screen must determine: type of steel, slot, wire and rod size, number of rods, screen length, and the type of end fitting required. Slot size most likely will be determined from information collected from test well samples and logs. The other construction components must be determined prior to bidding.

Steel selection

Stainless steel should always be considered as the material of choice for continuous slot screen. Mild steel material seldom, if ever, provides adequate corrosion resistance for long-lived wells. Stainless steel types 304 or 316L are most commonly used for continuous slot screen.

Selection of wire size

Wire shape, slot size, and screen diameter determines collapse strength of continuous slot screen. As a general rule, the wire width should never be less than the slot size.

Collapse strength

Continuous slot screen should have collapse resistance at least equal to that determined by Equation 1. In no case should screen with collapse strength less than 50 psi be considered for use.

Equation 1: Minimum collapse strength (psi) = [Maximum depth setting (feet)/10] + 50.

Example: Screen will be set to a maximum depth of 500 feet

Minimum collapse strength (psi) = (500/10) + 50

Minimum collapse strength = 100 psi

Note: this is the minimum collapse strength requirement. Site-specific requirements and the designer's experience may dictate significantly higher collapse strength.

Calculating collapse strength of the continuous slot screen

The pressure at which a single wire ring will collapse is calculated by Equation 2. This same formula can be used to approximate collapse strength of continuous slot screen.

Equation 2: $$Pww = \frac{24\,EI}{(w + s)D^3}$$

Where: Pww = collapse pressure of the continuous slot screen (psi)

E = Young's modulus (3×10^7) for steel

I = moment of inertia of the external face $[\text{in.}]^4$

w = width of the wire on the external face [in.]

S = slot width of the screen [in.]

D = mean diameter of the screen

The moment of inertia (1) depends on the wire shape, but is generally between $wt^3/12$ (a rectangle) and $wt^3/36$ (a triangle), where it's the wire thickness. An interactive program to determine collapse strength can be found on our website roscoemoss.com and is also available from your Roscoe Moss Company representative.

Selection of rod size and number

The amount of static weight that can be safely supported by the uppermost screen is referred to as the safe hanging weight. The cross sectional rod area of the screen determines the screen's load limit. The safe hanging weight of continuous slot screen can be determined from Equation 3.

Equation 3: T = 5.25A

Where: T = safe hanging weight (tons)

A = cross sectional rod area (sq. in.)

Example: If the screen is constructed with 60 rods and each rod is 0.250" in diameter, the total cross sectional area of the screen is 2.94 sq. in. Therefore the safe hanging weight is:

T = 5.25 x 2.94

T = 15.44 tons

Users are cautioned that many factors determine joint efficiency between the screen body and fitting. Also, many dynamic forces are applied during installation, gravel packing and well development. For these reasons, the actual safe hanging weight of the continuous slot screen may be less than indicated by this theoretical formula.

End fittings

Continuous slot screen manufactured by Roscoe Moss Company may be fabricated with weld rings, weld collars, flush threaded ends or threaded and coupled connections. It's the designer's responsibility to select the most suitable end fittings.

Specification Language for the Continuous Slot Screen

Continuous slot screen shall be constructed of shaped wire helically wrapped over a circular array of internal rods. Using electrical resistance welding, each wire and rod junction will be fusion welded under water. The slot size will be based on sieve analysis of the water-bearing sediments or selected pack materials.

Materials

Screen shall be constructed from stainless type _____

Diameter

Screen shall have a maximum outside diameter of _____ inches and a minimum clear inside diameter of _____ inches.

Strength

Screen shall meet the following minimum strength requirements:

Collapse pressure _____ psi at _____ slot size
Safe hanging weight _____ lb.

Field Assembly

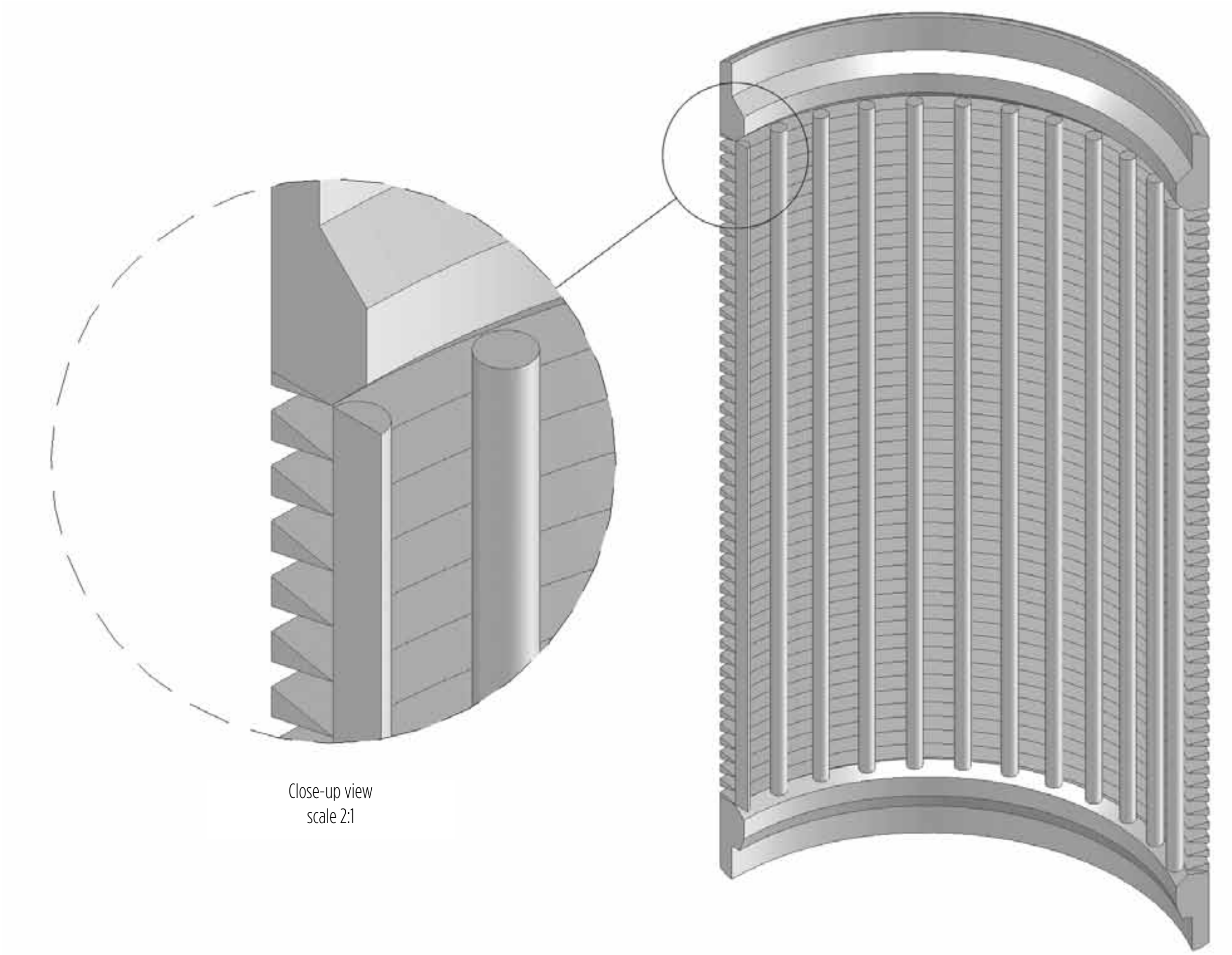
For field assembly the screen shall be furnished with _____ .

If welding rings are used they shall be _____ inches long and _____ inches thick. Weld rings shall be fabricated from the same grade of steel used for the screen bodies.

If flush threaded joints are used they shall be compatible with those described by ASTM F480 standards. Material used to fabricate these fittings shall be from the same grade of steel used for the screen bodies.

Documentation

If required, the manufacturer will provide documentation that the screen meets contract specifications. Examples of such documentation are: mill test reports, manufacturer's certification of compliance, and calculations used to determine collapse strength and safe hanging weight.



Close-up view
scale 2:1

End Fittings

Plain End

Casing and screen joints prepared with square ends (or plain ends) for welding are generally satisfactory up to 3/16-inch wall thickness. With heavier wall thickness ends should be beveled to facilitate weld penetration, leaving approximately 1/8" flat. Advantages of these connections are economy and smoothness of external diameter. Disadvantages include greater assembly time and difficulty of welding casing in the vertical position.

Threaded and Coupled

Threaded and coupled fittings are commonly employed in 6 inch and smaller diameter wells. This type of connection provides relatively inexpensive, fast and convenient assembly. The cost of large diameter threaded and coupled joints increases substantially. Threaded and coupled connections aren't readily available in diameters larger than 12 inches.

Weld Collars

A properly made welding collar connection is at least as strong as the casing. Should it be necessary to extract the casing and screen sections, only removal of the field weld at the top of the collar is required. Such sections are easily reinstalled since the original ends have not changed.

Double Spline Lock

Double spline lock fittings were developed for fast installation of casing and screen with no field welding required. The double grooves and spring locking mechanism allow for quick connection and separation. This coupling is available in a variety of steel types and diameters.

Dielectric Coupling

Electro-galvanic corrosion can occur between dissimilar metals (i.e. carbon steel to stainless steel). When joined together, an electronic reaction occurs between the two, corroding the less noble material at an accelerated rate. This coupling is used to connect dissimilar metals, while mitigating the risk of electro-galvanic corrosion.

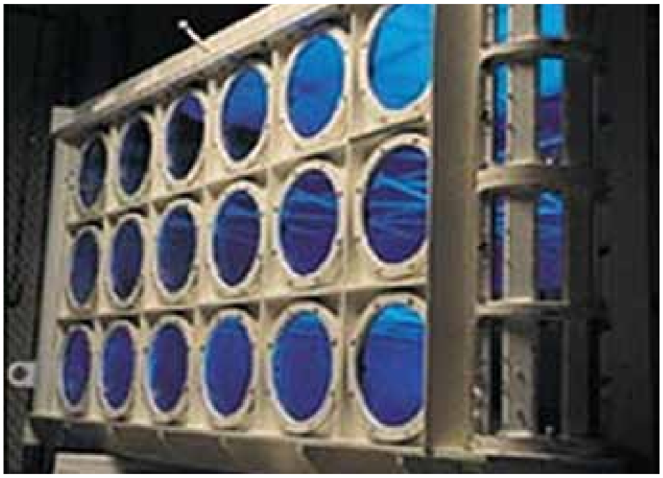
Compression Section

In many regions of the world, a cause of well failure is buckling of casing from ground subsidence because of overpumping. Use of compression sections can solve this problem.

Fabricated using three 6-foot sections of casing, two of which are the same diameter and wall thickness as the well casing. Joints are furnished with beveled steel rings. One ring is welded to the bottom of the upper section and one ring to the top of the lower section. Thus, the joints are free to telescope within the outer section which is equipped with rings at each end.

Research and Development

Since its establishment, Roscoe Moss Company has engaged in research in the field of ground water development. Below are examples of Roscoe Moss Company's contributions to advance this science.



Aquifer Model

To further the understanding of ground water development and design of efficient wells, Roscoe Moss Company designed and built the world's largest and most sophisticated well aquifer model. Research focused on understanding the aquifer relationship with the gravel pack and well screen, and corresponding effects on well efficiency, production, and sand control.

A summary of some key findings, using this well aquifer model are highlighted below:

Entrance Velocity on Well Efficiency

Throughout testing it was apparent that below a certain entrance velocity no appreciable gain in well efficiency was achieved. Research findings confirm entrance velocity as high as 4 feet per second allow well efficiency of 97%.

Entrance Velocity Effects on Corrosion

When protective films such as calcite form, velocities up to 5 feet per second promote denser and more protective coatings. In fact, within this range, the higher the velocity, the better coating.

Open Area

Well efficiency is maximized at 5%. More open area will not result in increased efficiency.

Filter Pack

The primary purpose of the filter pack is to stabilize the aquifer. The well screen is designed to stabilize the filter pack. There is general agreement that pack-aquifer ratios should be between 4:1 and 6:1, typically allowing for 20% passing. However, research confirms higher pack-aquifer ratios are effective and often required in very fine grade formations.

Fountain Valley Corrosion Study

A comprehensive corrosion study undertaken by Geoscience Support Services Inc. was conducted to identify the corrosion rate of five types of steel: mild steel, copper-bearing, high-strength low-alloy (HSLA) steel and stainless steel types 304 and 316L. Three sets of five types of metal coupons were placed down hole in Well No. 7 on March 11, 1998 in Fountain Valley, California. One control set of samples was saved for comparison.

- **The first set was removed after seven weeks on July 1, 1998**
- **The second set was removed after eleven weeks on July 29, 1998**
- **The last set was removed after eleven months on April 2, 1999**

Results of the Corrosion Study for each of the five alloys listed are shown here.

Summary of Metal Loss in MILS/YR

Summary of Metal Loss in MILS./YR.		
Material	**11 months**	**Corrosion Resistance**
Mild	2.8794	x
CB	0.9389	4x
HSLA	0.3131	9x
304	0.0118	244x
316L	0.0061	472x

Well Development

The most effective means of well development is simultaneous swabbing and pumping/air lifting. Studies confirm this method produces sufficient energy at the gravel pack aquifer interface to:

1. Repair borehole damage done during drilling
2. Restore hydraulic conductivity
3. Remove fine material from the gravel pack

This research also calculated the effectiveness of a commonly employed jetting tool that often produces less than optimum results. This study indicated use of this tool, with a jet orifice of 1/4-inch to 1/2-inch producing velocities in the range of 150-190 feet/second is not an effective way to develop wells. In fact most of the energy produced by this device is dissipated within the gravel pack and never reaches the gravel pack/aquifer interface.

Field and Laboratory Analysis of Gravel Pack Selection

Roscoe Moss Company sponsored research conducted at the University of Southern California Geohydrology laboratory in Claremont, California. The purpose of this program was to study the relationship between formation and gravel pack graduations and screen slot size. The goal was to set design perimeters required to minimize sand production and maximize well efficiency.

Conclusions

1. Well losses associated with plugging of small (≤0.040") slot openings resulted in decreased well efficiency.
2. Because of its slot geometry, shutter screen is less likely to plug than continuous slot screen.
3. Filter pack/aquifer ratio should be much greater than previously recommended under certain conditions.

Well Efficiency Results from Step Drawdown Test

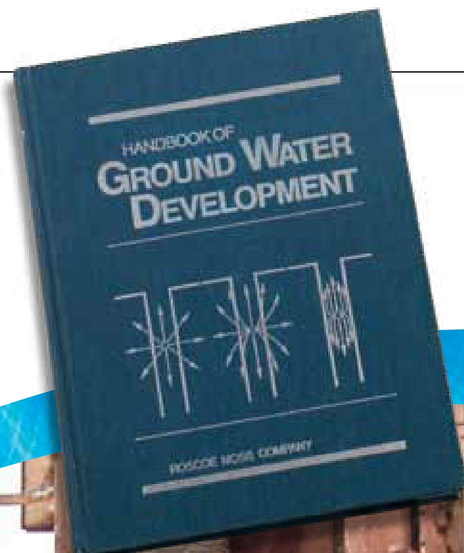
Pumping Rate (GPM)	CWW .040"	Shutter .040"	CWW .080"	Shutter .080"	CWW .125"	Shutter .125"
100	50.1%	50.3%	55.1%	56.2%	58.5%	58.5%
150	40.1%	40.3%	45.0%	46.1%	48.5%	48.4%
200	33.4%	33.6%	38.0%	39.1%	41.4%	41.3%

Recommended Water Well Design Based on Aquifer Type

Aquifer Type	Filter Pack / Aquifer Ratio (D50/d50)	Uniformity Coefficient (d60/d10)	% Filter Pack Passing	Slot Size
Fine	11.2	5.7	14.4	.060"
Medium	8.1	7.9	16.2	.070"
Coarse	6.3	8.9	15.0	.080"
Very Coarse	2.3	7.6	15.5	.080"
Avg. Design Recommendation	4-10	1.3-12	<25	.050"-.125"

Handbook of Ground Water Development

The *Handbook of Ground Water Development* is a comprehensive text covering subjects related to this industry. Written by distinguished experts, this book was edited by Roscoe Moss Company and published by John Wiley and Associates. Used by professionals as a reference, it also serves as a graduate level textbook in many major colleges and universities.



Conversion Chart

Common Conversions		
Acre Foot	=	325,851 Gallons (U.S.)
Acre Foot	=	1,233 Cubic meters (m.^{3})
Barrel	=	5.615 Cubic Feet (ft.^{3})
Barrel	=	42 Gallons
Centimeter (cm.)	=	0.394 inches (in.)
Cubic Foot (ft.^{3})	=	7.481 Gallons (U.S.)
Cubic Feet/Second (cfs)	=	448.8 Gallons/minute (GPM)
Cubic Meter (m.^{3})	=	264.17 Gallons (U.S.)
Gallon (U.S.)	=	3.785 Liters (l.)
Gallon (U.S.)	=	0.134 Cubic Feet (ft.^{3})
Gallons Per Minute (GPM)	=	0.063 Liters/second (l./s.)
Horsepower	=	0.7457 Kilowatts (kw.)
Inch (in.)	=	2.54 Centimeters (cm.)
Inch (in.)	=	25.40 Millimeters (mm.)
Kilograms (kg.)	=	2.205 Pounds (lb.)
Kilometer (km.)	=	0.621 Miles (mi.)
Liter (l.)	=	0.264 Gallons (U.S.)
Liters/second (l./s.)	=	15.85 Gallons/minute (GPM)
Liters/second (l./s.)	=	0.035 Cubic Feet/second (cfs)
Meter (m.)	=	3.281 Feet (ft.)
Meter (m.)	=	39.37 Inches (in.)
Mile (mi.)	=	1.609 Kilometer (km.)
Millimeter (mm.)	=	0.039 Inches (in.)
Million Gallons/day (MGD)	=	3,788 Cubic Meters/day (m^{3}d)
Pounds (lb.)	=	0.454 kilograms (kg.)
Pounds per inch^2	=	0.703 Kilograms per cm.^{2}
Temperature (°C)	=	5/9 (Temp °F -32)
Temperature (°F)	=	9/5 (Temp °C +32)
Ton (long)	=	2,240 Pounds (lb.)
Ton (metric)	=	1,000 Kilograms (kg.)
Ton (metric)	=	2,205 Pounds (lb.)
Ton (metric)	=	1.102 Short Ton
Cubic Meter (m^3)	=	35.314 Cubic feet (ft.^{3})
Square Meter (m^2)	=	10.76 Square Feet (ft.^{2})

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