

FLOW METER



SPECIFICATIONS



FLOW METER

OPERATION

The Calsense Flow Meter consists of an impeller and a sensing device, which measures the flow in gallons per minute (GPM). The irrigation controller learns an average GPM value for each station. If a broken head or riser causes the flow to exceed the learned flow rate by a selected percent, the irrigation controller shuts off that station automatically and advances to the next station. When irrigation has finished, the controller marks that one station with a **HIGHFLOW** alert on the display. During the next irrigation, that station will again come on and a measurement will be taken, if the flow still exceeds the learned average flow for that station, the controller instantly turns it off and again displays a **HIGHFLOW** alert.

Calsense Irrigation Controllers monitor the flow meter continuously and will close a master valve if at any time the flow exceeds the user selected Mainline break number. A Flashing **MAINLINE BREAK** alert on the irrigation controller will alert the user to the problem. A normally closed or normally open master valve can be used. No irrigation will occur until the **MAINLINE BREAK** alert is cleared by the user.

If a valve does not open, or has a measured flow rate below the flow meter minimum, the irrigation controller will flash a **NO FLOW** alert on the display.

If the backflow preventer or water meter has been turned off, every station on the controller will have a **NO FLOW** alert.

RESTRICTIONS

Certain hydraulic restrictions should be considered when designing an irrigation system with the Calsense Flow Meter. Since the irrigation controller independently learns station flow rates, the flow meter must be installed in a pipe through which **only** the water regulated by the irrigation controller flows. Therefore there must be isolated supply lines for each controller.

If a loop system exists or if several irrigation controllers are fed off of one main line, the -FL option should be recommended.

AVAILABLE FLOW METER SIZES AND MODEL NUMBERS

Calsense Flow Meter sizes and model numbers:

SIZE	MODEL NUMBER
1" brass Tee	FM-1B
1-1/4" Brass Tee	FM -1.25B
1-1/2" Brass Tee	FM- 1.5B
1-1/2" Sch 80 PVC Tee	FM- 1.5
2" Sch 80 PVC Tee	FM-2
2" Brass Tee	FM-2B
3" Sch 80 PVC Tee	FM-3
4" thru 18"	FMBX (Saddle Mounted)

SIZE DETERMINATION FACTORS

The correct flow meter size to use is **NOT** determined by the size of the irrigation mainline, but based on station flow rates. Selection of flow meter size depends on three factors.

- Maximum GPM flow rate for system.
- Minimum GPM flow rate for the system.
- Permissible pressure loss through the flow meter.

The maximum GPM is the full scale reading of a flow meter, this must not be exceeded by the flow rate of any station on an irrigation system. The minimum GPM is the lowest flow rate at which a flow meter will read water flow. If the flow rate of a station does not exceed this minimum, a **NO FLOW** alert will be generated whenever irrigation occurs.

To determine the correct flow meter size when designing an irrigation system, first determine the station with the highest flow rate on the system, next determine the station with the lowest flow rate on the system, then make sure that both flow rates are within the operating range of the selected flow meter size in the chart.

SIZING CHART:

Model	Min Flow (.5 fps)	Recommended Range		Max Flow (15 fps)	PSI Loss @ gpm
		Min Flow (1 fps)	Max Flow (15 fps)		
FM-1B	2 gpm	3 gpm	50 gpm	50 gpm	0.5 PSI @ 36 gpm
FM-1.25B	3 gpm	5 gpm	81 gpm	81 gpm	0.5 PSI @ 69 gpm
FM-1.5B	4 gpm	7 gpm	105 gpm	106 gpm	0.5 PSI @ 96 gpm
Model	Min Flow (.5 fps)	Recommended Range		Max Flow (30 fps)	PSI Loss @ gpm
		Min Flow (1 fps)	Max Flow (15 fps)		
FM-1.5	4 gpm	7 gpm	105 gpm	212 gpm	0.5 PSI @ 96 gpm
FM-2	6 gpm	11 gpm	166 gpm	333 gpm	0.5 PSI @ 165 gpm
FM-2B	6 gpm	11 gpm	166 gpm	333 gpm	0.5 PSI @ 165 gpm
FM-3	12 gpm	24 gpm	363 gpm	727 gpm	0.5 PSI @ 390 gpm
Model	Min Flow (.5 fps)	Recommended Range		Max Flow (30 fps)	PSI Loss @ gpm
		Min Flow (1 fps)	Max Flow (15 fps)		
FMBX	.5 fps	1 fps	15 fps	30 fps	N/A

(Flows based on CL 200 SDR 21 PVC pipe)

TECHNICAL SPECIFICATIONS:

Parameters: FM-1B, FM-1.25B, FM-1.5B

Accuracy: +/- 1% of full scale
 Linearity: +/- 0.7%
 Repeatability: +/- 0.7%
 Flow Range: 0.5 to 15 feet/second
 Max Pressure: 400 PSI @ 150F (65.5 C)

Parameters: FM-2B

Accuracy: +/- 1% of full scale
 Linearity: +/- 1%
 Repeatability: +/- 1%
 Flow Range: 1 to 30 feet/second
 Max Pressure: 200 PSI @ 150F (65.5 C)

Body Construction:

FM-B series: all bronze
 FM series: Schedule 80 PVC

Parameters: FM-1.5, FM-2, FM-3

Accuracy: +/- 1% of full scale
 Linearity: +/- 0.5%
 Repeatability: +/- 0.5%
 Flow Range: 1 to 30 feet/second
 Max Pressure: 100 PSI @ 68F (20 C)

Insert Construction:

Impeller: Glass reinforced nylon
 Bearing: Ultrahigh molecular Weight polyethylene
 Shaft: Tungsten Carbide
 Housing: Glass reinforced Polyphenylene sulfide
 O-rings: Ethylene propylene

PERMISSIBLE PRESSURE LOSS

The permissible pressure loss is important because there is pressure loss through the flow meter, through the pipe upstream of the flow meter and downstream of the flow meter. This pipe must be the same diameter as the flow meter to keep turbulence to a minimum. The length required upstream of the flow meter is ten times the flow meter size. The

length required downstream of the flow meter is five times the flow meter size. The table below provides pressure losses for several flow meters with appropriate pipe extensions.

Pressure Loss in Pounds Per Square Inch at Various Flow Rates

	10 GPM	20 GPM	30 GPM	40 GPM	50 GPM	60 GPM	70 GPM	80 GPM
FM-1B	.046	.166	.351	.597	.902	----	----	----
FM-1.25B	.014	.050	.106	.181	.274	.283	.510	.653

(Based on CL200 SDR21 PVC Pipe)

	40 GPM	60 GPM	100 GPM	160 GPM	220 GPM	280 GPM	340 GPM	400 GPM
FM-1.5B	.097	.206	.530	----	----	----	----	----
FM-2B	.036	.076	.196	.468	----	----	----	----
FM-1.5	.097	.206	.530	----	----	----	----	----
FM-2	.036	.076	.196	.468	----	----	----	----
FM-3	.007	.016	.040	.096	.0173	.270	.387	.522

(Based on CL200 SDR21 PVC Pipe)

MINIMUM FLOW METER RATES

The minimum GPM is important because this determines the minimum rate at which the flow meter impeller turns. If the impeller turns too slowly the flow meter reading will not be accurate.

MINIMUM FLOW RATES FOR CALSENSE FLOW METERS	
FLOW METER PART NUMBER	MINIMUM FLOW RATE (1 fps)
FM-1B	3 GPM
FM-1.25B	5 GPM
FM-1.5	7 GPM
FM-1.5B	7 GPM
FM2	11 GPM
FM-2B	11 GPM
FM-3	24 GPM

(Based on CL200 SDR21 PVC Pipe)

MAXIMUM FLOW METER RATES

The maximum GPM is important because the flow meter full scale reading exceeding the maximum flow rate will lead to premature flow meter failure due to excessive wear.

MAXIMUM FLOW RATES FOR CALSENSE FLOW METERS	
FLOW METER PART NUMBER	MAXIMUM FLOW RATE (15 fps)
FM-1B	50 GPM
FM-1.25B	81 GPM
FM-1.5	105 GPM
FM-1.5B	105 GPM
FM2	166 GPM
FM-2B	166 GPM
FM-3	363 GPM

(Based on CL200 SDR21 PVC Pipe)

MAXIMUM FLOW METER PRESSURE

It is important not to exceed the maximum recommended pressure rating of a flow meter. The flow meter body may be damaged and warranty is voided. If necessary a pressure regulator should be placed in the irrigation mainline, upstream of the flow meter. The following table provides the maximum recommended pressure rating for each size flow meter.

MAXIMUM FLOW METER PRESSURE RATINGS	
FLOW METER PART NUMBER	MAXIMUM PRESSURE
FM-1B	400 PSI
FM-1.25B	400 PSI
FM-1.5B	400 PSI
FM2B	200 PSI
FM-1.5	100 PSI
FM-2	100 PSI

(Based on CL200 SDR21 PVC Pipe)

PHYSICAL SPECIFICATION

The flow meter is installed after the water meter or backflow device. The Master Valve can be installed on either side of the flow meter. The mainline pipe is usually sized down during the installation to accommodate the fitting of the flow meter. Note the intended direction of the flow as indicated by an arrow on the top of the flow meter. There must be free, unrestricted pipe of the same diameter as the flow meter, with a length of 10 times the flow meter size upstream, and 5 times the flow meter size downstream of the flow meter tee. This should apply to distance from any valve, fitting, meter, or backflow device.

- The flow meter shall be easily accessible, housed in a rectangular valve box, and marked 'FM'.
- There should be 6" to 8" of pea gravel beneath the flow meter in the valve box.
- The length of #14 AWG wire connecting the flow meter to the irrigation controller shall not exceed 2,000 feet.

See Figure 1

ELECTRICAL SPECIFICATION

Wires from the flow meter to the irrigation controller should consist of one (1) black and one (1) red standard #14 AWG irrigation wire. The flow meter has two wire leads, a black and a red. At the controller, the black wire in the black wire harness is connected to the black flow meter wire, and the red wire in the black wire harness is connected to the red flow meter wire.

The Calsense Flow Meter operates at 9 volts DC. The flow meter wires should be separated from other controller wires when pulled up at the irrigation controller site. **If 24 VAC is used to test field wires when determining proper sequencing, and is applied to the flow meter wires, the sensing unit in the flow meter could be damaged.**

It is very important that all electrical connections are tight and dry. Any water leaking into a connection will cause flow meter problems. Additionally, there should never be any buried splices between the flow meter and the irrigation controller. Use only Calsense recommended electrical connectors.

Recommended Electrical Connectors:

- Spears DS-100 Connectors with Spears DS-300 sealant.
- 3M Scotchlok No. 3570 connector sealing pack.

See Figure 2

FLOW METER INSTALLATION

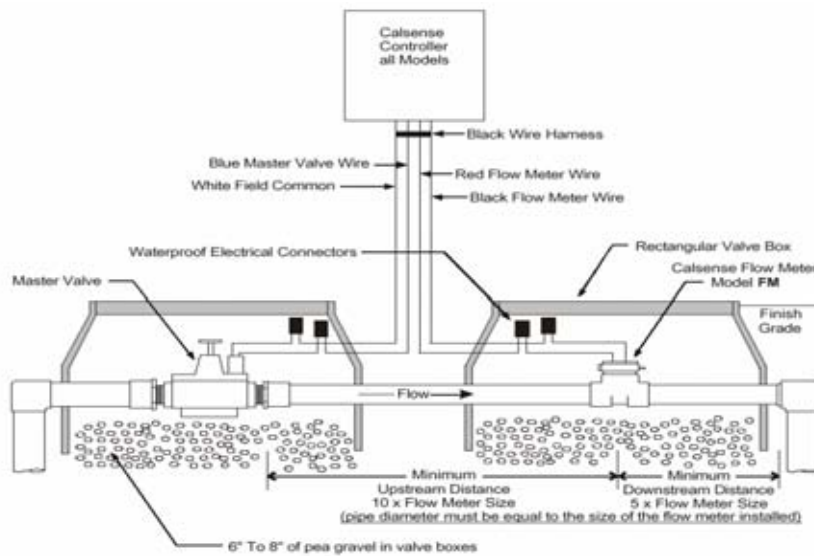


FIGURE 1

MINIMUM UPSTREAM AND DOWNSTREAM DISTANCE FOR VARIOUS FLOW METER SIZES

Flow Meter Size	Minimum Upstream Pipe Length	Minimum Downstream Pipe Length	Pipe Diameter
1.00"	10.00"	5.00"	1.00"
1.25"	12.50"	6.25"	1.25"
1.50"	15.00"	7.50"	1.50"
2.00"	20.00"	10.00"	2.00"
3.00"	30.00"	15.00"	3.00"

MULTIPLE FLOW METER INTERFACE (-F).

All models of Calsense controllers can receive up to three separate flow meter inputs on projects consisting of more than one water source for irrigating landscape when equipped with the optional (-F) interface. The controller will sum up the readings of all flow sensors connected. The irrigation controller is specified as a (-F) controller.

The first flow meter is wired to the irrigation controller using the standard Calsense red and black flow meter wires. The second and third flow meters are wired to the irrigation controller using an additional wire harness supplied when a (-F) option is specified.

See Figure 2

CALSENSE (-F) OPTION WIRING DIAGRAM

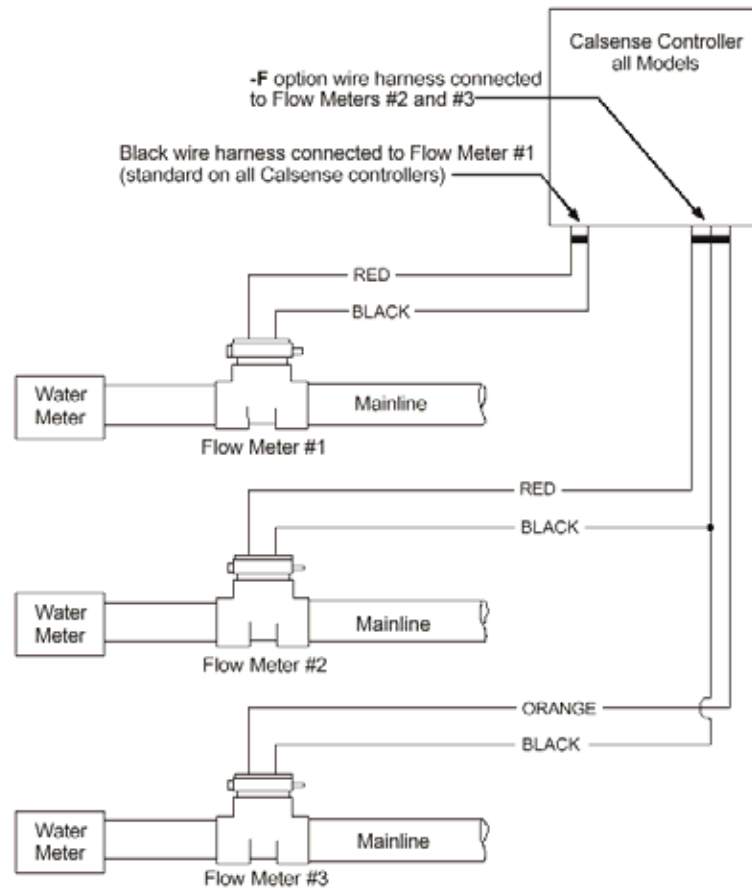


FIGURE 2

 **FMBX CALIBRATION**

The FMBX insertion sensor uses unique K and Offset numbers for calibration. These numbers are derived from calibration runs using NIST traceable

instruments. Using both a K and an Offset number provides higher accuracy than using a K (Pulse/ Gal) factor alone. K and Offset numbers for each tee configuration are listed in the following tables. The table on the following pages provide calibration and operation data for most scheduled pipe sizes from 3" through 18" .

 **FMBX DESCRIPTION OF CHART SECTION INFORMATION**

- SECTION 1:** Nominal Pipe Size.
- SECTION 2:** Pipe Outside Diameter defined by ASA B36.10 and other standards.
- SECTION 3:** Pipe Inside Diameter defined by ASA B36.10 and other standards.
- SECTION 4 AND 5:** The K value and Offset that should be used in our frequency equation:

Example:

$$\text{Freq} = \frac{\text{GPM}}{\text{K}} - \text{Offset}$$

This equation describes the frequency of the output signal of all Calsense flow sensors. By substituting the appropriate K and Offset values from the table, the sensor's output frequency can be calculated for each pipe size. This information is required when using the FMBX insertion sensor.

- SECTION 6:** This section indicates the suggested flow range of sensors in each pipe size. Calsense sensors will operate both above and below the indicated flow rates. However, good design practice dictates the use of this range for best performance. Sensors should be sized for flow rather than pipe size. To prevent disturbances to the flow profile always connect the sensor tee to pipe nipple measuring at least 10 pipe diameters in length on the upstream (supply) side and at least 5 pipe diameters in length on the downstream (delivery) side before making the transition in pipe size.

FMBX FLOW METER					
CALIBRATION TABLE FOR PIPE SIZES 3" THROUGH 36"					
Section 1	Section 2	Section 3	Section 4	Section 5	Section 6
Pipe Size	Pipe Outside Diameter	Pipe Inside Diameter	K value	Offset	Suggested Operating Range (GPM)
3" Sch 10S	3.500"	3.260"	5.009	.090	12-400
Std. Wt., Sch 40	3.5"	3.068"	4.362	.063	12-400
Extra Strong, Sch 80	3.5"	2.900"	3.858	.043	12-400
PVC Class 125	3.5"	3.284"	5.094	.093	12-400
PVC Class 160	3.5"	3.230"	4.902	.085	12-400
PVC Class 200	3.5"	3.166"	4.682	.076	12-400
4" Sch 10S	4.5"	4.260"	9.597	.241	20-600
Std. Wt., Sch 40	4.5"	4.026"	8.34	.229	20-600
Extra Strong, Sch 80	4.5"	3.826"	7.354	.188	20-600
PVC Class 125	4.5"	4.224"	9.396	.240	20-600
PVC Class 160	4.5"	4.154"	9.013	.240	20-600
PVC Class 200	4.5"	4.072"	8.578	.239	20-600
5" Sch 10S	5.563"	5.295"	16.305	.250	30-900
Std. Wt., Sch 40	5.50"	5.047"	14.674	.248	30-900
Extra Strong, Sch 80	5.50"	4.813"	13.165	.246	30-900
6" Sch 10S	6.625"	6.357"	24.089	.260	50-1,500
Std. Wt., Sch 40	6.5"	6.065"	21.574	.257	50-1,500
Extra Strong, Sch 80	6.5"	5.761"	19.457	.254	50-1,500
PVC Class 125	6.625"	6.217"	22.853	.258	50-1,500
PVC Class 160	6.625"	6.115"	21.968	.257	50-1,500
PVC Class 200	6.625"	5.993"	21.068	.256	50-1,500
8" Sch 10S	8.625"	8.329"	43.914	0.286	80-2,500
Sch 20	8.625"	8.125"	41.653	0.283	80-2,500
Sch 30	8.625"	8.071"	41.063	0.283	80-2,500
Std. Wt., Sch 40	8.625"	7.981"	40.086	0.281	80-2,500
Sch 60	8.625"	7.813"	38.288	0.279	80-2,500
Extra Strong, Sch 80	8.625"	7.625"	36.315	0.276	80-2,500
PVC Class 125	8.625"	8.095"	41.324	0.283	80-2,500
PVC Class 160	8.625"	7.961"	39.869	0.281	80-2,500
PVC Class 200	8.625"	7.805"	38.203	0.279	80-2,500
10" Sch 10S	10.75"	10.420"	70.195	0.321	125-4,000
Sch 20	10.75"	10.250"	67.668	0.318	125-4,000
Sch 30	10.75"	10.136"	66.069	0.316	125,4000
Std. Wt., Sch 40	10.75"	10.020"	64.532	0.314	125-4,000
Sch 60	10.75"	9.750"	61.016	0.309	125-4,000
Extra Strong, Sch 80	10.75"	9.564"	58.644	0.306	125-4,000
PVC Class 125	10.75"	10.088"	65.431	0.315	125-4,000
PVC Class 160	10.75"	9.924"	63.272	0.312	125,4000
PVC Class 200	10.75"	9.728"	60.733	0.309	125,4000

Continued on next page

FMBX FLOW METER					
CALIBRATION TABLE FOR PIPE SIZES 3" THROUGH 36"					
Section 1	Section2	Section 3	Section 4	Section 5	Section 6
Pipe Size	Pipe Outside Diameter	Pipe Inside Diameter	K value	Offset	Suggested Operating Range (GPM)
12" Sch 10S	12.75"	12.390"	104.636	0.367	175-5,000
Sch 20	12.75"	12.250"	102.553	0.364	175-5,000
Sch 30	12.75"	12.090"	99.347	0.36	175-5,000
Std. Wt., Sch 40S	12.75"	12.000"	97.576	0.358	175-5,000
Sch 40	12.75"	11.938"	96.369	0.356	175-5,000
Sch 60	12.75"	11.625"	90.441	0.348	175-5,000
Extra Strong	12.75"	11.750"	92.775	0.351	175-5,000
Sch 80	12.75"	11.376"	85.922	0.342	175-5,000
PVC Class 125	12.75"	11.966"	96.912	0.357	175-5,000
PVC Class 160	12.75"	11.770"	93.152	0.352	175-5,000
PVC Class 200	12.75"	11.538"	88.842	0.346	175-5,000
14" Sch 10S	14.00"	13.500"	122.307	0.391	200-6,000
Sch 20	14.00"	13.375"	120.216	0.388	200-6,000
Std. Wt., Sch 30	14.00"	13.250"	118.151	0.385	200-6,000
Sch 40	14.00"	13.124"	116.096	0.382	200-6,000
Sch 60	14.00"	12.814"	111.148	0.376	200-6,000
Extra Strong	14.00"	13.00"	114.098	0.33	200-6,000
Sch 80	14.00"	12.50"	106.299	0.369	200-6,000
16" Sch 10S	16.00"	15.500"	159.243	0.44	300-9,000
Sch 20	16.00"	15.375"	156.742	0.436	300-9,000
Std. Wt., Sch 30	16.00"	15.250"	154.267	0.433	300-9,000
Sch 60	16.00"	14.688"	143.456	0.419	300-9,000
Extra Strong, Sch 40	16.00"	15.000"	149.394	0.427	300-9,000
Sch 80	16.00"	14.314"	136.548	0.41	300-9,000
18" Sch 10S	18.00"	17.500"	202.739	0.498	350-10,000
Sch 20	18.00"	17.375"	199.828	0.494	350-10,000
Sch 30	18.00"	17.124"	194.061	0.486	350-10,000
Std. Wt.	18.00"	17.250"	196.943	0.49	350-10,000
Sch 40	18.00"	16.876"	188.464	0.479	350-10,000
Sch 60	18.00"	16.500"	180.171	0.469	350-10,000
Extra Strong	18.00"	17.000"	191.25	0.482	350-10,000
Sch 80	18.00"	16.126"	172.152	0.457	350-10,000
20" Std. Wt., Sch 20	20.00"	19.25"	246.179	0.555	400-12,000
Sch 40	20.00"	18.812"	234.836	0.540	400-12,000
Extra Strong, Sch 30	20.00"	19.000"	239.666	0.547	400-12,000
Sch 80	20.00"	17.938"	213.14	0.511	400-12,000
22" Std. Wt., Sch 20	22.00"	21.25"	301.975	0.621	500-15,000
Extra Strong, Sch 30	22.00"	21.00"	294.642	0.616	500-15,000
Sch 80	22.00"	19.75"	259.513	0.573	500-15,000

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FMBX FLOW METER					
CALIBRATION TABLE FOR PIPE SIZES 3" THROUGH 36"					
Section 1	Section 2	Section 3	Section 4	Section 5	Section 6
Pipe Size	Pipe Outside Diameter	Pipe Inside Diameter	K value	Offset	Suggested Operating Range (GPM)
24" Std. Wt., Sch 20	24.00"	23.25"	364.331	0.666	600-18,000
Extra Strong	24.00"	23.00"	356.178	0.660	600-18,000
Sch 40	24.00"	22.624"	344.109	0.652	600-18,000
Sch 80	24.00"	21.562"	311.271	0.628	600-18,000
26" Sch 10	26.00"	25.376"	437.809	0.719	700-21,000
Std. Wt.	26.00"	25.25"	433.247	0.716	700-21,000
Sch 20, Extra Strong	26.00"	25.00"	424.274	0.709	700-21,000
28" Sch 10	28.00"	27.376"	513.698	0.774	900-23,000
Std. Wt.	28.00"	27.25"	508.723	0.770	900-23,000
Sch 20, Extra Strong	28.00"	27.00"	498.930	0.763	900-23,000
30" Sch 10	30.00"	29.376"	596.147	0.833	1,000-30,000
Std. Wt.	30.00"	29.25"	590.759	0.829	1,000-30,000
Sch 20, Extra Strong	30.00"	29.00"	580.146	0.822	1,000-30,000
32" Sch 10	32.00"	31.376"	685.156	0.897	1,200-35,000
Std. Wt.	32.00"	31.25"	679.355	0.893	1,200-35,000
Sch 20, Extra Strong	32.00"	31.00"	667.922	0.885	1,200-35,000
Sch 40	32.00"	30.624"	650.919	0.873	1,200-35,000
34" Sch 10	34.00"	33.312"	777.566	0.964	1,300-40,000
Std. Wt.	34.00"	33.25"	774.511	0.962	1,300-40,000
Sch 20, Extra Strong	34.00"	33.00"	762.258	0.953	1,300-40,000
Sch 40	34.00"	32.624"	744.022	0.940	1,300-40,000
36" Sch 10	36.00"	35.376"	882.855	1.040	1,500-45,000
Std. Wt.	36.00"	35.25"	876.227	1.035	1,500-45,000
Sch 20, Extra Strong	36.00"	35.00"	863.154	1.025	1,500-45,000
Sch 40	36.00"	34.50"	837.315	1.007	1,500-45,000



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