

Areas

6,452 sq cm	1 sq in
144 sq in	1 sq ft
9 sq ft	1 sq yd
43,560 sq ft	1 acre
1 acre	43,560 sq ft
1 acre	4,840 sq yd
1 acre	160 sq rods
1 sq rod	272.25 sq ft
1 sq rod	30.25 sq yd
640 acres	1 sq mi
640 acres	1 section
Area of a Circle	$r^2 \times 3.1416$
Area of a Square	One Side Squared
Area of a Triangle	$\frac{1}{2}$ Base x Altitude
Area of a Rectangle	Length x Width
Area of a Parallelogram	Base x Altitude

Lineal Measurements

1 centimeter	0.3937 inches
1 cubit	18 inches
1 meter	39.37 inches
1 rod	16.5 feet
1 rod	5.5 yards
1 chain	4 rods
1 chain	66 feet
320 rods	1 mile
5280 feet	1 mile
Circumference of Circle	Diameter x 3.1416

Volume

1728 cu in	1 cu ft
231 cu in	1 gallon
27 cu ft	1 cu yd
1 cu ft	7.48052 gal (U.S.)
1 cu yd	202 gallons (U.S.)
16 drams	1 ounce
32 ounces	1 quart
4 quarts	1 gallon
1 gallon	3.785 liters
1 gallon	0.00379 cu m
1 gallon	0.833 imperial gallons
27,154 gallons	1 acre inch
325,851 gallons	1 acre foot
1,000,000 gallons	3.0689 acre ft
1 acre foot	43,560 cu ft
Volume of a Cube	Area of Base x Height
Volume of a Pyramid	$\frac{1}{2}$ Area of Base x Height
Volume of a Sphere	$Diameter^3 \times 0.5236$

Mass/Weight

1 kg	2.204 lbs
1 lb	454 g = 7,000 grains
1 slug	14.5 kg
1 stone	14 lb

Weights

1 U.S. Gallon (Water)	8.3357 lbs
1 Cu Foot (Water)	62.3554 lbs
1 Imperial Gallon	10.0 lbs
1 Liter	2.2 lbs
Earth, in Place Undisturbed	100 lbs/cu ft
Earth, Dry and Loose	82-90 lbs/cu ft
Earth, Moist	75-100 lbs/cu ft
Sand, Dry	90-106 lbs/cu ft
Shale or Red Rock	162 lbs/cu ft
Limestone	160-163 lbs/cu ft
Base Gravel	12.0 lbs/sq ft/inch Thick in Place
Asphalt	12.5 lbs/sq ft/inch Thick in Place
Sack Cement	94 lbs
Concrete (Plain)	140 lbs/cu ft
Concrete (Reinforced)	150 lbs/cu ft

Pressures

1 atmosphere	29.921 inches of hg @ 32° F
1 atmosphere	33.94 ft of water @ 62° F
1 atmosphere	14.6963 lbs/sq in
1 lb/sq inch	2.31 feet of head
1 foot of water	0.433 lbs/sq in
1 kg/sq cm	14.22 lbs/sq in
1 foot of water	62.3554 lbs/sq ft
1 bar	14.5 lbs/sq in

Flows

1 gallon/min (U.S.)	0.002228 cu ft/sec
1 gallon/min (U.S.)	0.13368 cu ft/min
1 gallon/min (U.S.)	8.0208 cu ft/hr
1 gallon/min (U.S.)	0.06309 liters/sec
1 gallon/min (U.S.)	3.78533 liters/min
1 gallon/min (U.S.)	0.0044192 acre ft/24 hrs
1 gallon/min (U.S.)	0.22712 cu m/hr
1 cu ft/sec	448.83 gpm
1 liter/sec	15.85 gpm
1 cu m/min	264 gpm
1 acre in/hr	452.57 gpm
1 acre ft/day	226.3 gpm
1,000,000 gallons/day	694.4 gpm
1 cu ft/sec	0.992 acre in/hr

Power

1 horsepower	33,000 ft lbs/min
1 horsepower	746 watts
1 horsepower	0.746 kilowatts

Temperature

F	$^{\circ}C \times 9/5 + 32$
C	$(^{\circ}F - 32) \times 5/9$

Design Formulas

Precipitation Rate (in/hr)	<i>S = Spacing</i>	Run-Time	Velocity
Square = $\frac{96.3 \times \text{GPM} \times 360}{S \times S \times \text{Sprinkler Arc}}$		Run-Time = $\frac{\text{Desired Application} \times 60}{\text{Precipitation Rate}}$	$V = \frac{0.480 \times Q}{(ID)^2}$
Triangular = $\frac{96.3 \times \text{GPM} \times 360}{S \times S \times 0.866 \times \text{Sprinkler Arc}}$			Where: V = Velocity in feet per second Q = Gallons per minute ID = Inside diameter of pipe
Single Row = $\frac{96.3 \times \text{GPM}}{S \times 0.8 \text{ Diameter}}$			

Power Formulas

Horse Power	Electrical Power	Pump Laws (Affinity Laws)
1 hp = 550 foot pounds per second = 746 watts or 0.746 kW = 1 second foot of water falling 8.8'	3 ϕ kVA = $\frac{1.732 \times \text{FLA} \times \text{Voltage}}{1000}$ 1 ϕ kVA = $\frac{\text{FLA} \times \text{Voltage}}{1000}$	RPM ₂ / RPM ₁ = Flow ₂ / Flow ₁ (RPM ₂ / RPM ₁) ² = Pressure ₂ / Pressure ₁ (RPM ₂ / RPM ₁) ³ = Power ₂ / Power ₁
Water HP = $\frac{\text{GPM} \times \text{TDH}}{3960}$ Where: GPM = Gallons per minute TDH = Total dynamic head	Ohm's Law: V = IR Where: V = Voltage in Volts I = Current in Amperes R = Resistance in ohms	<i>Example:</i> An irrigation pump operating at 1800 RPM and producing 600 gpm at 120 psi is switched to 3600 RPM: RPM ₂ / RPM ₁ = Flow ₂ / Flow ₁ = 3600 RPM / 1800 RPM = Flow ₂ / 600 gpm = 1200 gpm
Brake HP = $\frac{\text{GPM} \times \text{TDH}}{3960 \times E}$ Where: GPM = Gallons per minute TDH = Total dynamic head E = Pump efficiency	Amp Calculation Amps = Watts / Volts	(RPM ₂ / RPM ₁) ² = Pressure ₂ / Pressure ₁ = (3600 RPM / 1800 RPM) ² = Pressure ₂ / 120 psi = 480 psi
1 kilowatt (kW) = 1,000 watts = 1,341 HP = 735.5 foot pounds per second		(RPM ₂ / RPM ₁) ³ = Power ₂ / Power ₁ = (3600 RPM / 1800 RPM) ³ = Power ₂ / 60 HP = 480 HP

Electric Formulas for Calculating Amperes, Horsepower, Kilowatts and kVA

ALTERNATING CURRENT			
To Find:	Single Phase	Two Phase-Four Phase Wire	Three Phase
Amperes when "HP" is known	$\frac{\text{HP} \times 746}{E \times \% \text{EFF} \times \text{PF}}$	$\frac{\text{HP} \times 746}{E \times \% \text{EFF} \times \text{PF} \times 2}$	$\frac{\text{HP} \times 746}{E \times \% \text{EFF} \times \text{PF} \times 1.73}$
Amperes when "kW" is known	$\frac{\text{kW} \times 1000}{E \times \text{PF}}$	$\frac{\text{kW} \times 1000}{E \times \text{PF} \times 2}$	$\frac{\text{kW} \times 1000}{E \times \text{PF} \times 1.73}$
Amperes when "kVa" is known	$\frac{\text{kVA} \times 1000}{E}$	$\frac{\text{kVA} \times 1000}{E \times 2}$	$\frac{\text{kVA} \times 1000}{E \times 1.73}$
Kilowatts	$\frac{E \times I \times \text{PF}}{1000}$	$\frac{E \times I \times \text{PF} \times 2}{1000}$	$\frac{E \times I \times \text{PF} \times 1.73}{1000}$
Kilovolt-Amperes "kVA"	$\frac{E \times I}{1000}$	$\frac{E \times I \times 2}{1000}$	$\frac{E \times I \times 1.73}{1000}$
Horsepower	$\frac{E \times I \times \% \text{EFF} \times \text{PF}}{746}$	$\frac{E \times I \times \% \text{EFF} \times \text{PF} \times 2}{746}$	$\frac{E \times I \times \% \text{EFF} \times \text{PF} \times 1.73}{746}$

Where:

$$\text{Power Factor (PF)} = \frac{\text{Power Used (Watts)}}{\text{Apparent Power}} \text{ or } \frac{\text{kW}}{\text{kVA}}$$

$$\text{Power Efficiency (\%EFF)} = \frac{\text{Output (Watts)}}{\text{Input (Watts)}}$$

E = Volts

I = Amperes

W = Watts

Conductor Properties For Insulated Annealed Copper Direct Current Resistance

OHMS PER 1,000 FEET					
Copper Awg	Temperature				Cross Sectional Area Circular Mils
	167° F (75° C)	149° F (65° C)	77° F (25° C)	68° F (20° C)	
18 Solid	7.77	7.519	6.515	6.390	1,620
18 Stranded	7.95	7.693	6.666	6.538	1,620
16 Solid	4.89	4.732	4.100	4.021	2,580
16 Stranded	4.99	4.829	4.184	4.104	2,580
14 Solid	3.07	2.971	2.574	2.525	4,110
14 Stranded	3.14	3.039	2.633	2.582	4,110
12 Solid	1.93	1.868	1.618	1.587	6,530
12 Stranded	1.98	1.916	1.660	1.628	6,530
10 Solid	1.21	1.171	1.015	0.995	10,380
10 Stranded	1.24	1.200	1.040	1.020	10,380
8 Solid	0.764	0.739	0.641	0.628	16,510
8 Stranded	0.778	0.753	0.652	0.640	16,510
6 Stranded	0.491	0.475	0.412	0.404	26,240
4 Stranded	0.308	0.298	0.258	0.253	41,740
2 Stranded	0.194	0.188	0.163	0.160	66,360
1/0 Stranded	0.122	0.118	0.102	0.100	105,600
2/0 Stranded	0.097	0.094	0.081	0.080	133,100

Source: 2008 Edition of *National Electric Code* (NFPA 70), Chapter 9, Table 8.
System designer must use resistance values which correlate to temperatures and applications for each specific project.

Full Load Amperage (FLA)

Motor HP	Single Phase A-C		Three Phase A-C Induction Type Squirrel Cage & Wound Rotor		
	115 VOLTS	230 VOLTS*	230 VOLTS*	460 VOLTS	575 VOLTS
½	9.8	4.9	2.2	1.1	0.9
¾	13.8	6.9	3.2	1.6	1.3
1	16	8	4.2	2.1	1.7
1½	20	10	6.0	3.0	2.4
2	24	12	6.8	3.4	2.7
3	34	17	9.6	4.8	3.9
5	56	28	15.2	7.6	6.1
7½	80	40	22	11	9
10	100	50	28	14	11
15	—	—	42	21	17
20	—	—	54	27	22
25	—	—	68	34	27
30	—	—	80	40	32
40	—	—	104	52	41
50	—	—	130	65	52
60	—	—	154	77	62
75	—	—	192	96	77
100	—	—	240	120	96
125	—	—	296	148	118
150	—	—	350	175	140
200	—	—	456	228	182
250	—	—	558	279	223

*For 208V applications, increase the 230V FLA by 10%.

Horsepower to Kilowatts

Horsepower	Kilowatt
1	0.746
3	2.2
5	3.7
10	7.5
15	11.2
20	14.9
25	18.7
30	22.4
40	29.8
50	37.3
60	44.8
75	56.0

Pressure Conversion

psi	Feet	Meter	Bar	kPa
1	2.3090	0.7038	0.0689	6.8948
80	185	56	5.5	552
85	196	60	5.9	586
90	208	63	6.2	621
95	219	67	6.6	655
100	231	70	6.9	689
105	242	74	7.2	724
110	254	77	7.6	758
115	266	81	7.9	793
120	277	84	8.3	827
125	289	88	8.6	862
130	300	91	9.0	896
135	312	95	9.3	931
140	323	99	9.7	965
150	346	106	10.3	1034
160	369	113	11.0	1103
170	393	120	11.7	1172
180	416	127	12.4	1241
190	439	134	13.1	1310
200	462	141	13.8	1379

Flow Rate Conversion

gpm	ft ³ /s	m ³ /h	l/s	acre-ft/day
1	0.0022	0.2271	0.0002	0.004419
100	0.22	22.7	6.3	0.442
250	0.56	56.8	15.8	1.105
500	1.11	113.6	31.5	2.210
750	1.67	170.3	47.3	3.314
1000	2.23	227.1	63.1	4.419
1500	3.34	340.7	94.6	6.629
2000	4.46	454.2	126.2	8.838
2500	5.57	567.8	157.7	11.048
3000	6.68	681.4	189.3	13.258
3500	7.80	794.9	220.8	15.467
4000	8.91	908.5	252.4	17.677
4500	10.03	1022.1	283.9	19.886
5000	11.14	1135.6	315.5	22.096
6000	13.37	1362.7	378.5	26.515
7000	15.60	1589.9	441.6	30.934
8000	17.82	1817.0	504.7	35.353
9000	20.05	2044.1	567.8	39.773
10000	22.28	2271.2	630.9	44.192

Lake Intake Box Screen Sizing

Flow Rate In (gpm)	Box Screen Size
0 - 500	18" square
501 - 1000	24" square
1001 - 1800	30" square
1801 - 2800	36" square
2801 - 4000	42" square
4001 - 5000	48" square
5001 - 7000	54" square
7001 - 8500	60" square
8501 - 10000	66" square

Based on screen velocities of less than 0.5 feet per second.

Micron to Mesh Conversion

Micron	U.S. Mesh	Inches
2000	10	0.0787
1680	12	0.0661
1410	14	0.0555
1190	16	0.0469
1000	18	0.0394
841	20	0.0331
707	25	0.028
595	30	0.0232
500	35	0.0197
420	40	0.0165
354	45	0.0138
297	50	0.0117
250	60	0.0098
210	70	0.0083
177	80	0.007
149	100	0.0059
125	120	0.0049
105	140	0.0041
88	170	0.0035
74	200	0.0029
63	230	0.0024
53	270	0.0021
44	325	0.0017
37	400	0.0015

Wet Well Intake Pipe Sizing

Flow Rate In gpm	Length of Pipe in Feet			
	50'	100'	200'	300'
0 - 500	12"	12"	12"	14"
501 - 1000	18"	18"	18"	18"
1001 - 1500	24"	24"	24"	24"
1501 - 2000	26"	26"	26"	26"
2001 - 2500	28"	28"	28"	28"
2501 - 3000	30"	30"	30"	30"
3001 - 3500	32"	32"	32"	32"
3501 - 4000	34"	34"	34"	34"
4001 - 5000	36"	36"	36"	36"

The nominal IPS pipe diameters listed in this chart assume a total equivalent pipe length as listed for friction loss calculations. A recommended internal pipe water velocity of up to 1.5 feet per second and/or a draw down of 1 inch or less is used to develop this conservative intake sizing table. Consult a Rain Bird engineer for values ranging outside of this chart.

Wet Well Open Area Sizing

Size	Shape	Number of Pumps
36"	Round	1 – Vertical Turbine
48"	Round	1 or 2 – Vertical Turbines
60"	Round	1 or 2 – Vertical Turbines
72"	Round	1 to 3 – Vertical Turbines
84"	Round	1 to 5 – Vertical Turbines
96"	Round	1 to 6 – Vertical Turbines
6' x 8'	Rectangular	1 to 7 – Vertical Turbines

PE 4710 IPS HDPE DR 13.5 (161 psi) Pipe

VELOCITY IN FEET PER SECOND — FRICTION LOSS IN PSI PER 100 FEET (C = 150)																				
Nominal Size (ID) Flow (gpm)	2" (2.002)		3" (2.950)		4" (3.793)		6" (5.585)		8" (7.271)		10" (9.062)		12" (10.748)		14" (11.801)		16" (13.487)		18" (15.173)	
	Vel	Loss	Vel	Loss	Vel	Loss	Vel	Loss	Vel	Loss	Vel	Loss	Vel	Loss	Vel	Loss	Vel	Loss	Vel	Loss
2	0.20	0.01	0.09	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.41	0.02	0.19	0.00	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.61	0.04	0.28	0.01	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.81	0.07	0.38	0.01	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	1.02	0.10	0.47	0.02	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	1.22	0.14	0.56	0.02	0.34	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	1.43	0.19	0.66	0.03	0.40	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	1.63	0.25	0.75	0.04	0.45	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	1.83	0.31	0.84	0.05	0.51	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	2.04	0.37	0.94	0.06	0.57	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	2.24	0.44	1.03	0.07	0.62	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	2.44	0.52	1.13	0.08	0.68	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	2.65	0.61	1.22	0.09	0.74	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	2.85	0.70	1.31	0.11	0.79	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	3.05	0.79	1.41	0.12	0.85	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
35	3.56	1.05	1.64	0.16	0.99	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40	4.07	1.35	1.88	0.20	1.13	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45	4.58	1.67	2.11	0.25	1.28	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50	5.09	2.04	2.34	0.31	1.42	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
55	5.60	2.43	2.58	0.37	1.56	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
60	6.11	2.85	2.81	0.43	1.70	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
65	6.62	3.31	3.05	0.50	1.84	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
70	7.13	3.80	3.28	0.58	1.99	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
75	7.63	4.31	3.52	0.65	2.13	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
80	8.14	4.86	3.75	0.74	2.27	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
85	8.65	5.44	3.99	0.82	2.41	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
90	9.16	6.04	4.22	0.92	2.55	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
100			4.69	1.11	2.84	0.33	1.31	0.05	0.77	0.01	0.50	0.00	0.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00
110			5.16	1.33	3.12	0.39	1.44	0.06	0.85	0.02	0.55	0.01	0.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00
120			5.63	1.56	3.40	0.46	1.57	0.07	0.93	0.02	0.60	0.01	0.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00
130			6.09	1.81	3.69	0.53	1.70	0.08	1.00	0.02	0.65	0.01	0.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00
140			6.56	2.08	3.97	0.61	1.83	0.09	1.08	0.03	0.70	0.01	0.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00
150			7.03	2.36	4.25	0.69	1.96	0.11	1.16	0.03	0.75	0.01	0.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00
160			7.50	2.66	4.54	0.78	2.09	0.12	1.23	0.03	0.79	0.01	0.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00
170			7.97	2.98	4.82	0.88	2.22	0.13	1.31	0.04	0.84	0.01	0.60	0.01	0.00	0.00	0.00	0.00	0.00	0.00
180			8.44	3.31	5.10	0.97	2.35	0.15	1.39	0.04	0.89	0.01	0.64	0.01	0.00	0.00	0.00	0.00	0.00	0.00
190			8.91	3.66	5.39	1.08	2.49	0.16	1.47	0.05	0.94	0.02	0.67	0.01	0.00	0.00	0.00	0.00	0.00	0.00
200			9.38	4.02	5.67	1.18	2.62	0.18	1.54	0.05	0.99	0.02	0.71	0.01	0.00	0.00	0.00	0.00	0.00	0.00
225			10.55	5.00	6.38	1.47	2.94	0.22	1.74	0.06	1.12	0.02	0.79	0.01	0.00	0.00	0.00	0.00	0.00	0.00
250			11.72	6.08	7.09	1.79	3.27	0.27	1.93	0.08	1.24	0.03	0.88	0.01	0.00	0.00	0.00	0.00	0.00	0.00
275			12.89	7.25	7.80	2.13	3.60	0.32	2.12	0.09	1.37	0.03	0.97	0.01	0.00	0.00	0.00	0.00	0.00	0.00
300			14.06	8.52	8.51	2.51	3.92	0.38	2.32	0.11	1.49	0.04	1.06	0.02	0.00	0.00	0.00	0.00	0.00	0.00

■ Use caution at shaded velocities.

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PE 4710 IPS HDPE DR 13.5 (161 psi) Pipe

VELOCITY IN FEET PER SECOND — FRICTION LOSS IN PSI PER 100 FEET (C = 150)																				
Nominal Size (ID)	2" (2.002)		3" (2.950)		4" (3.793)		6" (5.585)		8" (7.271)		10" (9.062)		12" (10.748)		14" (11.801)		16" (13.487)		18" (15.173)	
	Flow (gpm)	Vel	Loss	Vel	Loss	Vel	Loss	Vel	Loss	Vel	Loss	Vel	Loss	Vel	Loss	Vel	Loss	Vel	Loss	
325			15.24	9.88	9.22	2.91	4.25	0.44	2.51	0.12	1.61	0.04	1.15	0.02	0.00	0.00	0.00	0.00	0.00	0.00
350			16.41	11.34	9.93	3.34	4.58	0.51	2.70	0.14	1.74	0.05	1.24	0.02	0.00	0.00	0.00	0.00	0.00	0.00
375				12.88	10.63	3.79	4.91	0.58	2.89	0.16	1.86	0.05	1.32	0.02	0.00	0.00	0.00	0.00	0.00	0.00
400				14.52	11.34	4.27	5.23	0.65	3.09	0.18	1.99	0.06	1.41	0.03	0.00	0.00	0.00	0.00	0.00	0.00
425				16.24	12.05	4.78	5.56	0.73	3.28	0.20	2.11	0.07	1.50	0.03	0.00	0.00	0.00	0.00	0.00	0.00
450				18.06	12.76	5.31	5.89	0.81	3.47	0.22	2.24	0.08	1.59	0.03	0.00	0.00	0.00	0.00	0.00	0.00
475				19.96	13.47	5.87	6.21	0.89	3.67	0.25	2.36	0.08	1.68	0.04	0.00	0.00	0.00	0.00	0.00	0.00
500					14.18	6.46	6.54	0.98	3.86	0.27	2.48	0.09	1.77	0.04	0.00	0.00	0.00	0.00	0.00	0.00
550					15.60	7.71	7.19	1.17	4.24	0.32	2.73	0.11	1.94	0.05	0.00	0.00	0.00	0.00	0.00	0.00
600					17.02	9.05	7.85	1.38	4.63	0.38	2.98	0.13	2.12	0.06	0.00	0.00	0.00	0.00	0.00	0.00
650					18.43	10.50	8.50	1.60	5.02	0.44	3.23	0.15	2.30	0.07	0.00	0.00	0.00	0.00	0.00	0.00
700					19.85	12.05	9.16	1.83	5.40	0.51	3.48	0.17	2.47	0.08	0.00	0.00	0.00	0.00	0.00	0.00
750					21.27	13.69	9.81	2.08	5.79	0.58	3.73	0.20	2.65	0.09	0.00	0.00	0.00	0.00	0.00	0.00
800									6.17	0.65	3.97	0.22	2.83	0.10	2.34	0.06	1.79	0.03	1.42	0.02
850									6.56	0.73	4.22	0.25	3.00	0.11	2.49	0.07	1.91	0.04	1.51	0.02
900									6.95	0.81	4.47	0.28	3.18	0.12	2.64	0.08	2.02	0.04	1.59	0.02
950									7.33	0.89	4.72	0.31	3.36	0.13	2.78	0.08	2.13	0.04	1.68	0.02
1000									7.72	0.98	4.97	0.34	3.53	0.15	2.93	0.09	2.24	0.05	1.77	0.03
1050									8.10	1.08	5.22	0.37	3.71	0.16	3.08	0.10	2.36	0.05	1.86	0.03
1100									8.49	1.17	5.47	0.40	3.89	0.18	3.22	0.11	2.47	0.06	1.95	0.03
1150									8.88	1.27	5.71	0.44	4.06	0.19	3.37	0.12	2.58	0.06	2.04	0.04
1200									9.26	1.38	5.96	0.47	4.24	0.21	3.52	0.13	2.69	0.07	2.13	0.04
1250									9.65	1.49	6.21	0.51	4.41	0.22	3.66	0.14	2.80	0.07	2.22	0.04
1300									10.03	1.60	6.46	0.55	4.59	0.24	3.81	0.15	2.92	0.08	2.30	0.04
1350									10.42	1.71	6.71	0.59	4.77	0.26	3.96	0.16	3.03	0.08	2.39	0.05
1400									10.80	1.83	6.96	0.63	4.94	0.27	4.10	0.17	3.14	0.09	2.48	0.05
1450									11.19	1.96	7.20	0.67	5.12	0.29	4.25	0.19	3.25	0.10	2.57	0.05
1500									11.58	2.08	7.45	0.71	5.30	0.31	4.39	0.20	3.36	0.10	2.66	0.06
1550											7.70	0.76	5.47	0.33	4.54	0.21	3.48	0.11	2.75	0.06
1600											7.95	0.80	5.65	0.35	4.69	0.22	3.59	0.12	2.84	0.07
1650											8.20	0.85	5.83	0.37	4.83	0.24	3.70	0.12	2.92	0.07
1700											8.45	0.90	6.00	0.39	4.98	0.25	3.81	0.13	3.01	0.07
1750											8.69	0.95	6.18	0.41	5.13	0.26	3.93	0.14	3.10	0.08
1800											8.94	1.00	6.36	0.44	5.27	0.28	4.04	0.14	3.19	0.08
1900											9.44	1.11	6.71	0.48	5.57	0.31	4.26	0.16	3.37	0.09
2000											9.94	1.22	7.06	0.53	5.86	0.34	4.49	0.18	3.54	0.10
2100											10.43	1.33	7.42	0.58	6.15	0.37	4.71	0.19	3.72	0.11
2200											10.93	1.45	7.77	0.63	6.45	0.40	4.93	0.21	3.90	0.12
2300											11.43	1.57	8.12	0.69	6.74	0.44	5.16	0.23	4.08	0.13
2400											11.92	1.70	8.48	0.74	7.03	0.47	5.38	0.25	4.25	0.14
2500											12.42	1.84	8.83	0.80	7.32	0.51	5.61	0.27	4.43	0.15

■ Use caution at shaded velocities.

SDR 21 (Class 200) PVC Pipe

VELOCITY IN FEET PER SECOND — FRICTION LOSS IN PSI PER 100 FEET (C = 150)																						
Nominal Size (ID) Flow (gpm)	1" (1.189)		1¼" (1.502)		1½" (1.720)		2" (2.149)		2½" (2.601)		3" (3.166)		4" (4.072)		6" (5.993)		8" (7.805)		10" (9.728)		12" (11.538)	
	Vel	Loss	Vel	Loss	Vel	Loss	Vel	Loss	Vel	Loss	Vel	Loss	Vel	Loss	Vel	Loss	Vel	Loss	Vel	Loss	Vel	Loss
2	0.58	0.07	0.36	0.02	0.28	0.01	0.18	0.00	0.12	0.00	0.08	0.00	0.05	0.00	0.02	0.00	0.01	0.00	0.01	0.00	0.01	0.00
4	1.15	0.24	0.72	0.08	0.55	0.04	0.35	0.01	0.24	0.01	0.16	0.00	0.10	0.00	0.05	0.00	0.03	0.00	0.02	0.00	0.01	0.00
6	1.73	0.51	1.09	0.16	0.83	0.08	0.53	0.03	0.36	0.01	0.24	0.00	0.15	0.00	0.07	0.00	0.04	0.00	0.03	0.00	0.02	0.00
8	2.31	0.86	1.45	0.28	1.10	0.14	0.71	0.05	0.48	0.02	0.33	0.01	0.20	0.00	0.09	0.00	0.05	0.00	0.03	0.00	0.02	0.00
10	2.89	1.30	1.81	0.42	1.38	0.22	0.88	0.07	0.60	0.03	0.41	0.01	0.25	0.00	0.11	0.00	0.07	0.00	0.04	0.00	0.03	0.00
12	3.46	1.83	2.17	0.59	1.65	0.30	1.06	0.10	0.72	0.04	0.49	0.02	0.30	0.00	0.14	0.00	0.08	0.00	0.05	0.00	0.04	0.00
14	4.04	2.43	2.53	0.78	1.93	0.40	1.24	0.14	0.84	0.05	0.57	0.02	0.34	0.01	0.16	0.00	0.09	0.00	0.06	0.00	0.04	0.00
16	4.62	3.11	2.89	1.00	2.21	0.52	1.41	0.17	0.96	0.07	0.65	0.03	0.39	0.01	0.18	0.00	0.11	0.00	0.07	0.00	0.05	0.00
18	5.19	3.87	3.26	1.24	2.48	0.64	1.59	0.22	1.09	0.09	0.73	0.03	0.44	0.01	0.20	0.00	0.12	0.00	0.08	0.00	0.06	0.00
20	5.77	4.71	3.62	1.51	2.76	0.78	1.77	0.26	1.21	0.10	0.81	0.04	0.49	0.01	0.23	0.00	0.13	0.00	0.09	0.00	0.06	0.00
22	6.35	5.62	3.98	1.80	3.03	0.93	1.94	0.32	1.33	0.12	0.90	0.05	0.54	0.01	0.25	0.00	0.15	0.00	0.09	0.00	0.07	0.00
24	6.93	6.60	4.34	2.12	3.31	1.09	2.12	0.37	1.45	0.15	0.98	0.06	0.59	0.02	0.27	0.00	0.16	0.00	0.10	0.00	0.07	0.00
26	7.50	7.65	4.70	2.45	3.59	1.27	2.30	0.43	1.57	0.17	1.06	0.07	0.64	0.02	0.30	0.00	0.17	0.00	0.11	0.00	0.08	0.00
28	8.08	8.78	5.06	2.82	3.86	1.46	2.47	0.49	1.69	0.19	1.14	0.07	0.69	0.02	0.32	0.00	0.19	0.00	0.12	0.00	0.09	0.00
30	8.66	9.97	5.43	3.20	4.14	1.65	2.65	0.56	1.81	0.22	1.22	0.08	0.74	0.02	0.34	0.00	0.20	0.00	0.13	0.00	0.09	0.00
35	10.10	13.27	6.33	4.26	4.83	2.20	3.09	0.74	2.11	0.29	1.42	0.11	0.86	0.03	0.40	0.01	0.23	0.00	0.15	0.00	0.11	0.00
40	11.54	16.99	7.23	5.45	5.52	2.82	3.53	0.95	2.41	0.38	1.63	0.14	0.98	0.04	0.45	0.01	0.27	0.00	0.17	0.00	0.12	0.00
45			8.14	6.78	6.21	3.51	3.98	1.19	2.71	0.47	1.83	0.18	1.11	0.05	0.51	0.01	0.30	0.00	0.19	0.00	0.14	0.00
50			9.04	8.24	6.90	4.26	4.42	1.44	3.02	0.57	2.04	0.22	1.23	0.06	0.57	0.01	0.33	0.00	0.22	0.00	0.15	0.00
55			9.95	9.83	7.59	5.08	4.86	1.72	3.32	0.68	2.24	0.26	1.35	0.08	0.62	0.01	0.37	0.00	0.24	0.00	0.17	0.00
60			10.85	11.55	8.27	5.97	5.30	2.02	3.62	0.80	2.44	0.31	1.48	0.09	0.68	0.01	0.40	0.00	0.26	0.00	0.18	0.00
65			11.76	13.39	8.96	6.93	5.74	2.34	3.92	0.93	2.65	0.36	1.60	0.10	0.74	0.02	0.44	0.00	0.28	0.00	0.20	0.00
70					9.65	7.95	6.18	2.69	4.22	1.06	2.85	0.41	1.72	0.12	0.80	0.02	0.47	0.01	0.30	0.00	0.21	0.00
75					10.34	9.03	6.63	3.05	4.52	1.21	3.05	0.46	1.85	0.14	0.85	0.02	0.50	0.01	0.32	0.00	0.23	0.00
80					11.03	10.17	7.07	3.44	4.82	1.36	3.26	0.52	1.97	0.15	0.91	0.02	0.54	0.01	0.34	0.00	0.25	0.00
85					11.72	11.38	7.51	3.85	5.13	1.52	3.46	0.58	2.09	0.17	0.97	0.03	0.57	0.01	0.37	0.00	0.26	0.00
90							7.95	4.28	5.43	1.69	3.66	0.65	2.21	0.19	1.02	0.03	0.60	0.01	0.39	0.00	0.28	0.00
100							8.83	5.20	6.03	2.06	4.07	0.79	2.46	0.23	1.14	0.04	0.67	0.01	0.43	0.00	0.31	0.00
110							9.72	6.21	6.63	2.45	4.48	0.94	2.71	0.28	1.25	0.04	0.74	0.01	0.47	0.00	0.34	0.00
120							10.60	7.30	7.24	2.88	4.88	1.11	2.95	0.33	1.36	0.05	0.80	0.01	0.52	0.00	0.37	0.00
130									7.84	3.34	5.29	1.28	3.20	0.38	1.48	0.06	0.87	0.02	0.56	0.01	0.40	0.00
140									8.44	3.83	5.70	1.47	3.44	0.43	1.59	0.07	0.94	0.02	0.60	0.01	0.43	0.00
150									9.05	4.36	6.11	1.67	3.69	0.49	1.70	0.08	1.00	0.02	0.65	0.01	0.46	0.00
160									9.65	4.91	6.51	1.89	3.94	0.55	1.82	0.08	1.07	0.02	0.69	0.01	0.49	0.00
170									10.25	5.49	6.92	2.11	4.18	0.62	1.93	0.09	1.14	0.03	0.73	0.01	0.52	0.00
180											7.33	2.35	4.43	0.69	2.04	0.11	1.21	0.03	0.78	0.01	0.55	0.00
190											7.73	2.59	4.68	0.76	2.16	0.12	1.27	0.03	0.82	0.01	0.58	0.00
200											8.14	2.85	4.92	0.84	2.27	0.13	1.34	0.04	0.86	0.01	0.61	0.01
225											9.16	3.55	5.54	1.04	2.56	0.16	1.51	0.04	0.97	0.02	0.69	0.01
250											10.18	4.31	6.15	1.27	2.84	0.19	1.67	0.05	1.08	0.02	0.77	0.01
275													6.77	1.51	3.12	0.23	1.84	0.06	1.19	0.02	0.84	0.01
300													7.38	1.78	3.41	0.27	2.01	0.07	1.29	0.03	0.92	0.01

■ Use caution at shaded velocities.

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SDR 21 (Class 200) PVC Pipe

VELOCITY IN FEET PER SECOND — FRICTION LOSS IN PSI PER 100 FEET (C = 150)																						
Nominal Size (ID) Flow (gpm)	1" (1.189)		1¼" (1.502)		1½" (1.720)		2" (2.149)		2½" (2.601)		3" (3.166)		4" (4.072)		6" (5.993)		8" (7.805)		10" (9.728)		12" (11.538)	
	Vel	Loss	Vel	Loss	Vel	Loss	Vel	Loss	Vel	Loss	Vel	Loss	Vel	Loss	Vel	Loss	Vel	Loss	Vel	Loss	Vel	Loss
325													8.00	2.06	3.69	0.31	2.18	0.09	1.40	0.03	1.00	0.01
350													8.61	2.36	3.98	0.36	2.34	0.10	1.51	0.03	1.07	0.01
375													9.23	2.68	4.26	0.41	2.51	0.11	1.62	0.04	1.15	0.02
400													9.84	3.03	4.54	0.46	2.68	0.13	1.72	0.04	1.23	0.02
425													10.46	3.38	4.83	0.52	2.85	0.14	1.83	0.05	1.30	0.02
450															5.11	0.57	3.01	0.16	1.94	0.05	1.38	0.02
475															5.40	0.63	3.18	0.18	2.05	0.06	1.46	0.03
500															5.68	0.70	3.35	0.19	2.16	0.07	1.53	0.03
550															6.25	0.83	3.68	0.23	2.37	0.08	1.69	0.03
600															6.82	0.98	4.02	0.27	2.59	0.09	1.84	0.04
650															7.38	1.13	4.35	0.31	2.80	0.11	1.99	0.05
700															7.95	1.30	4.69	0.36	3.02	0.12	2.15	0.05
750															8.52	1.48	5.02	0.41	3.23	0.14	2.30	0.06
800															9.09	1.67	5.36	0.46	3.45	0.16	2.45	0.07
850															9.66	1.86	5.69	0.52	3.66	0.18	2.61	0.08
900															10.22	2.07	6.03	0.57	3.88	0.20	2.76	0.09
950																	6.36	0.63	4.10	0.22	2.91	0.09
1000																	6.70	0.70	4.31	0.24	3.06	0.10
1050																	7.03	0.76	4.53	0.26	3.22	0.11
1100																	7.37	0.83	4.74	0.28	3.37	0.12
1150																	7.70	0.90	4.96	0.31	3.52	0.13
1200																	8.04	0.98	5.17	0.33	3.68	0.15
1250																	8.37	1.05	5.39	0.36	3.83	0.16
1300																	8.71	1.13	5.60	0.39	3.98	0.17
1350																	9.04	1.21	5.82	0.42	4.14	0.18
1400																	9.38	1.30	6.04	0.44	4.29	0.19
1450																	9.71	1.39	6.25	0.47	4.44	0.21
1500																	10.05	1.48	6.47	0.51	4.60	0.22
1550																			6.68	0.54	4.75	0.23
1600																			6.90	0.57	4.90	0.25
1650																			7.11	0.60	5.06	0.26
1700																			7.33	0.64	5.21	0.28
1750																			7.54	0.67	5.36	0.29
1800																			7.76	0.71	5.52	0.31
1900																			8.19	0.78	5.82	0.34
2000																			8.62	0.86	6.13	0.38
2100																			9.05	0.94	6.44	0.41
2200																			9.48	1.03	6.74	0.45
2300																			9.92	1.11	7.05	0.49
2400																			10.35	1.21	7.36	0.53
2500																			10.78	1.30	7.66	0.57

■ Use caution at shaded velocities.

Integrated Control System™ (ICS) Wire Path Design

Recommended to load balance wire path.

Do not utilize the full system capacity of 750 ICMs on one wire path. Instead, leave room to expand the system and add sensing capability in the future.

The wire distance is the “trunk length” of the wire path.

The trunk length is the “longest single run of wire” needed for accommodating the installed ICMs.

Branches can be added to the trunk wire.

Branches do not increase the maximum number of ICMs on the wire path.

Wire Distance in Feet (ft)

No. of Units	1,000	2,000	3,000	4,000	5,000	6,000	7,000	8,000	9,000	10,000	11,000	12,000	13,000	14,000	15,000
50	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG
100	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG
150	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG
200	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG
250	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	12 AWG
300	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	12 AWG	12 AWG	12 AWG	12 AWG
350	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	12 AWG	12 AWG	12 AWG	12 AWG	12 AWG
400	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	12 AWG	12 AWG	12 AWG	12 AWG	12 AWG	12 AWG	12 AWG
450	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	12 AWG	12 AWG	12 AWG	12 AWG	12 AWG	12 AWG	12 AWG	12 AWG
500	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	12 AWG	12 AWG	12 AWG	12 AWG	12 AWG	12 AWG	12 AWG	10 AWG
550	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	12 AWG	12 AWG	12 AWG	12 AWG	12 AWG	12 AWG	10 AWG	10 AWG	10 AWG
600	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	12 AWG	12 AWG	12 AWG	12 AWG	12 AWG	12 AWG	10 AWG	10 AWG	10 AWG	10 AWG
650	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	12 AWG	12 AWG	12 AWG	12 AWG	12 AWG	10 AWG	10 AWG	10 AWG	—	—
700	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	12 AWG	12 AWG	12 AWG	12 AWG	10 AWG	10 AWG	10 AWG	—	—	—
750	14 AWG	14 AWG	14 AWG	14 AWG	12 AWG	12 AWG	12 AWG	12 AWG	10 AWG	10 AWG	10 AWG	10 AWG	—	—	—

Wire Distance in Meters (m)

No. of Units	1,000	1,250	1,500	1,750	2,000	2,250	2,500	2,750	3,000	3,250	3,500	3,750	4,000	4,250	4,500
50	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²
100	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²
150	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²
200	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²
250	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²
300	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	4.0 mm ²	4.0 mm ²
350	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	4.0 mm ²	4.0 mm ²	4.0 mm ²	4.0 mm ²
400	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	4.0 mm ²	4.0 mm ²	4.0 mm ²	4.0 mm ²	4.0 mm ²	4.0 mm ²
450	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	4.0 mm ²	4.0 mm ²	4.0 mm ²	4.0 mm ²	4.0 mm ²	4.0 mm ²	4.0 mm ²
500	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	4.0 mm ²	4.0 mm ²	4.0 mm ²	4.0 mm ²	4.0 mm ²	4.0 mm ²	4.0 mm ²	4.0 mm ²	4.0 mm ²
550	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	4.0 mm ²	4.0 mm ²	4.0 mm ²	4.0 mm ²	4.0 mm ²	4.0 mm ²	4.0 mm ²	4.0 mm ²	6.0 mm ²
600	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	4.0 mm ²	4.0 mm ²	4.0 mm ²	4.0 mm ²	4.0 mm ²	4.0 mm ²	4.0 mm ²	4.0 mm ²	6.0 mm ²	6.0 mm ²
650	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	4.0 mm ²	4.0 mm ²	4.0 mm ²	4.0 mm ²	4.0 mm ²	4.0 mm ²	4.0 mm ²	6.0 mm ²	6.0 mm ²	6.0 mm ²	6.0 mm ²
700	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	4.0 mm ²	4.0 mm ²	4.0 mm ²	4.0 mm ²	4.0 mm ²	4.0 mm ²	6.0 mm ²	6.0 mm ²	6.0 mm ²	6.0 mm ²	—
750	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²	4.0 mm ²	4.0 mm ²	4.0 mm ²	4.0 mm ²	4.0 mm ²	6.0 mm ²	6.0 mm ²	6.0 mm ²	6.0 mm ²	—	—

Water Velocity

Flow gpm	Internal Pipe Diameter																							
	2"	4"	6"	8"	10"	12"	14"	16"	18"	20"	22"	24"	26"	28"	30"	32"	34"	36"	38"	40"	42"	44"	46"	48"
10	1.0	0.3	0.1	0.1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
20	2.0	0.5	0.2	0.1	0.1	0.1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
30	3.1	0.8	0.3	0.2	0.1	0.1	0.1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
40	4.1	1.0	0.5	0.3	0.2	0.1	0.1	0.1	0.1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
50	5.1	1.3	0.6	0.3	0.2	0.1	0.1	0.1	0.1	0.1	—	—	—	—	—	—	—	—	—	—	—	—	—	—
60	6.1	1.5	0.7	0.4	0.2	0.2	0.1	0.1	0.1	0.1	0.1	—	—	—	—	—	—	—	—	—	—	—	—	—
70	7.2	1.8	0.8	0.4	0.3	0.2	0.1	0.1	0.1	0.1	0.1	—	—	—	—	—	—	—	—	—	—	—	—	—
80	8.2	2.0	0.9	0.5	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.1	—	—	—	—	—	—	—	—	—	—	—	—
90	9.2	2.3	1.0	0.6	0.4	0.3	0.2	0.1	0.1	0.1	0.1	0.1	0.1	—	—	—	—	—	—	—	—	—	—	—
100	10.2	2.6	1.1	0.6	0.4	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	—	—	—	—	—	—	—	—	—	—
150	15.3	3.8	1.7	1.0	0.6	0.4	0.3	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	—	—	—	—	—	—	—	—
200	20.4	5.1	2.3	1.3	0.8	0.6	0.4	0.3	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	—	—	—	—
250	25.5	6.4	2.8	1.6	1.0	0.7	0.5	0.4	0.3	0.3	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	—	—
300	30.7	7.7	3.4	1.9	1.2	0.9	0.6	0.5	0.4	0.3	0.3	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
350	35.8	8.9	4.0	2.2	1.4	1.0	0.7	0.6	0.4	0.4	0.3	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
400	40.9	10.2	4.5	2.6	1.6	1.1	0.8	0.6	0.5	0.4	0.3	0.3	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
450	46.0	11.5	5.1	2.9	1.8	1.3	0.9	0.7	0.6	0.5	0.4	0.3	0.3	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1
500	51.1	12.8	5.7	3.2	2.0	1.4	1.0	0.8	0.6	0.5	0.4	0.4	0.3	0.3	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1
600	61.3	15.3	6.8	3.8	2.5	1.7	1.3	1.0	0.8	0.6	0.5	0.4	0.4	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1
700	71.5	17.9	7.9	4.5	2.9	2.0	1.5	1.1	0.9	0.7	0.6	0.5	0.4	0.4	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1
800	81.7	20.4	9.1	5.1	3.3	2.3	1.7	1.3	1.0	0.8	0.7	0.6	0.5	0.4	0.4	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.1
900	92.0	23.0	10.2	5.7	3.7	2.6	1.9	1.4	1.1	0.9	0.8	0.6	0.5	0.5	0.4	0.4	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2
1000	102.2	25.5	11.4	6.4	4.1	2.8	2.1	1.6	1.3	1.0	0.8	0.7	0.6	0.5	0.5	0.4	0.4	0.3	0.3	0.3	0.2	0.2	0.2	0.2
1250	127.7	31.9	14.2	8.0	5.1	3.5	2.6	2.0	1.6	1.3	1.1	0.9	0.8	0.7	0.6	0.5	0.4	0.4	0.4	0.3	0.3	0.3	0.2	0.2
1500	153.3	38.3	17.0	9.6	6.1	4.3	3.1	2.4	1.9	1.5	1.3	1.1	0.9	0.8	0.7	0.6	0.5	0.5	0.4	0.4	0.3	0.3	0.3	0.3
1750	178.8	44.7	19.9	11.2	7.2	5.0	3.6	2.8	2.2	1.8	1.5	1.2	1.1	0.9	0.8	0.7	0.6	0.6	0.5	0.4	0.4	0.4	0.3	0.3
2000	204.4	51.1	22.7	12.8	8.2	5.7	4.2	3.2	2.5	2.0	1.7	1.4	1.2	1.0	0.9	0.8	0.7	0.6	0.6	0.5	0.5	0.4	0.4	0.4
2500	255.4	63.9	28.4	16.0	10.2	7.1	5.2	4.0	3.2	2.6	2.1	1.8	1.5	1.3	1.1	1.0	0.9	0.8	0.7	0.6	0.6	0.5	0.5	0.4
3000	306.5	76.6	34.1	19.2	12.3	8.5	6.3	4.8	3.8	3.1	2.5	2.1	1.8	1.6	1.4	1.2	1.1	0.9	0.8	0.8	0.7	0.6	0.6	0.5
3500	357.6	89.4	39.7	22.4	14.3	9.9	7.3	5.6	4.4	3.6	3.0	2.5	2.1	1.8	1.6	1.4	1.2	1.1	1.0	0.9	0.8	0.7	0.7	0.6
4000	408.7	102.2	45.4	25.5	16.3	11.4	8.3	6.4	5.0	4.1	3.4	2.8	2.4	2.1	1.8	1.6	1.4	1.3	1.1	1.0	0.9	0.8	0.8	0.7
4500	459.8	114.9	51.1	28.7	18.4	12.8	9.4	7.2	5.7	4.6	3.8	3.2	2.7	2.3	2.0	1.8	1.6	1.4	1.3	1.1	1.0	0.9	0.9	0.8
5000	510.9	127.7	56.8	31.9	20.4	14.2	10.4	8.0	6.3	5.1	4.2	3.5	3.0	2.6	2.3	2.0	1.8	1.6	1.4	1.3	1.2	1.1	1.0	0.9
5500	562.0	140.5	62.4	35.1	22.5	15.6	11.5	8.8	6.9	5.6	4.6	3.9	3.3	2.9	2.5	2.2	1.9	1.7	1.6	1.4	1.3	1.2	1.1	1.0
6000	613.1	153.3	68.1	38.3	24.5	17.0	12.5	9.6	7.6	6.1	5.1	4.3	3.6	3.1	2.7	2.4	2.1	1.9	1.7	1.5	1.4	1.3	1.2	1.1

Main line pipe diameter under standard practice is sized to achieve < 5 feet-per-second water velocity. Wet-well intake pipe diameter under standard practice is sized to achieve < 1.5 feet-per-second water velocity. Velocities listed are based on the actual internal diameter for the pipe. Verify internal diameter based on class or type of pipe being used.

Controller Power Wiring Sizing Worksheet

	PAR+ES	PAR+ES Link with Radio	PAR+ES SAT Decoder**	PAR+ES SAT Decoder Link with Radio**
Input (VAC)	117	117	117	117
Output (VAC)	26.5	26.5	26.5	26.5
Simultaneous Rain Bird Solenoids at 60 Hz (50 Hz) per Controller†	16 (12)	16 (12)	16 (12)	16 (12)
Simultaneous Rain Bird Solenoids at 60 Hz (50 Hz) per Station	4	4	2	2
AMP Draw at Rest‡	0.15	0.17	0.235	0.250
1	0.22	0.24	0.250	0.265
2	0.30	0.32	0.258	0.273
3	0.37	0.40	0.264	0.281
4	0.45	0.47	0.272	0.289
5	0.52	0.54	0.280	0.297
6	0.60	0.62	0.288	0.305
7	0.67	0.70	0.296	0.313
8	0.75	0.77	0.304	0.321
9	0.82	0.84	0.312	0.329
10	0.90	0.92	0.320	0.337
11	0.97	0.99	0.328	0.345
12	1.05	1.07	0.336	0.353
13	1.12	1.14	0.344	0.361
14	1.20	1.22	0.352	0.369
15	1.27	1.29	0.360	0.377
16	1.35	1.37	0.368	0.385

*Includes Master Valve. **Considering 72 decoders installed. † Total AMP Draw in chart is based on 117 VAC input. For 220/240 VAC input controllers, use 50% of amp draw shown in chart.

Rain Bird will repair or replace at no charge any Rain Bird professional product that fails in normal use within the warranty period stated below. You must return it to the dealer or distributor where you bought it. Product failures due to acts of God including without limitation, lightning and flooding, are not covered by this warranty. This commitment to repair or replace is our sole and total warranty.

Implied Warranties of Merchantability and Fitness, if Applicable, are Limited to One Year from the Date of Sale. We will not, under any circumstances be liable for incidental or consequential damages, no matter how they occur.

I. Landscape Irrigation Products

1800® Series Pop-Up Spray Heads, U-Series Nozzles, Brass MPR Nozzles, A-8S and PA-8S-PRS Shrub Adapters, and 1300 and 1400 Bubblers, 5000 Series Rotors, 5500 Series Rotors, 7005/8005 Rotors, Falcon® 6504 Series Rotors, PEB and PESB Plastic Valves – **5 Years**

All other Landscape Irrigation products – **3 years**

II. Golf Products

Golf Rotors: EAGLE™ Series and EAGLE IC™ Series, Rain Bird® Series and Rain Bird IC™ Golf rotors – **3 years**. Additionally, EAGLE Series and EAGLE IC Series, Rain Bird Series and Rain Bird IC Golf Rotor sold and installed in conjunction with a Rain Bird swing joint – **5 years**. Proof of concurrent installation is required.

Swing Joints – **5 years**

Brass Remote Control Valves and Brass Quick Coupling and Keys – **3 years**

Filtration system controllers – **3 years**

LINK™ Radios – **3 years**

TSM-3 SDI12 Soil Sensor (ISS) – **3 years**

All other golf products – **1 year**

III. Agricultural Products

LF Series Sprinklers – **5 years**

Other Impact Sprinklers – **2 years**

All other AG products – **1 year**

IV. Pump Stations

Rain Bird guarantees that its pump station will be free of manufacturer defects for three years from the date of start-up but not beyond forty months from the date of purchase by the original customer with a copy of the seller's invoice required for coverage under this Policy. Start-up or service by anyone other than a Rain Bird authorized representative, when required, will void these terms and conditions.

Provided that all installation, start-up, operation responsibilities, and recommended maintenance procedures have been properly executed and performed by authorized Rain Bird representatives, when required, Rain Bird will replace or repair, at Rain Bird's option, any Rain Bird part found to be defective under normal recommended use during the effective period of this Policy, such evaluation to be solely determined by Rain Bird. Rain Bird's only obligation and customer's exclusive remedy under this Policy is limited to repair or replacement, at Rain Bird's option, of the parts or the products the defects of which are reported to Rain Bird within the applicable Policy period, which prove to be defective and such evaluation will be solely determined by Rain Bird.

In no case will Rain Bird cover labor costs associated with repair or replacement of parts beyond one year from date of start-up. Repairs performed and parts used at Rain Bird's expense must be authorized by Rain Bird, in writing, prior to repairs being performed. Product repairs or replacement under this Policy will not extend this Policy. Coverage for repaired or replaced product shall end when this Policy terminates. Rain Bird's sole obligation and customer's exclusive remedy under this Policy shall be limited to such repair or replacement.

Upon request, Rain Bird may provide advice on trouble-shooting a defect during the effective period of this Customer Satisfaction Policy. Repair service must be performed by a Rain Bird authorized representative regardless of whether the labor is covered by Rain Bird or is at the owner's expense during the effective period of this Policy. However, no service, replacement or repair under this Customer Satisfaction Policy will be rendered while the customer is in default of any payments due to Rain Bird.

Rain Bird will not accept responsibility for costs associated with the removal, replacement or repair of equipment in difficult-to-access locations and such evaluation will be solely determined by Rain Bird. Difficult-to-access locations include (but are not limited to) locations where any of the following are required:

- 1) Cranes larger than 15 tons
- 2) Divers
- 3) Barges
- 4) Helicopters
- 5) Dredging
- 6) Roof removal or other such construction/deconstruction requirements
- 7) Any other unusual means or requirements

Such extraordinary cost associated with difficult-to-access locations shall be the sole responsibility of the customer, regardless of the reason requiring removal, repair or replacement of the equipment.

The terms and conditions of this Customer Satisfaction Policy do not cover damage, loss or injury caused by or resulting from the following:

- 1) Misapplication, abuse, or failure to conduct routine maintenance (to include winterization/winter lay-up procedures).
- 2) Pumping of liquids other than fresh water as defined by the U.S. Environmental Protection Agency, unless the pump station quoted by Rain Bird specifically lists these other liquids and their concentrations.
- 3) Use of pesticides (to include insecticides, fungicides and herbicides), free chlorine or other strong biocides.
- 4) Exposure to electrolysis, erosion, or abrasion.
- 5) Use or presence of destructive gases or chemicals unless these materials and their concentrations are specified in the Rain Bird quotation.
- 6) Electrical supply voltages above or below those specified for correct pump station operation.
- 7) Electrical phase loss or reversal.
- 8) Use of a power source other than that specified in the original quotation.
- 9) Non-WYE configured power supplies such as open delta, phase converters or other forms of unbalanced three phase power supplies.
- 10) Improper electrical grounding or exposure to incoming power lacking circuit breaker or fused protection.
- 11) Using the control panel as a service disconnect.
- 12) Lightning, earthquake, flood, windstorm or other Acts of Nature.
- 13) Failure of pump packing seal (unless the failure occurs on initial start-up).
- 14) Any damage or loss to plants, equipment or groundwater or injury to people caused by the failure of or improper use of an injection system or improper concentration of chemicals or plant nutrients introduced into the pump station by an injection system.
- 15) Any failure of nutrient or chemical storage or spill containment equipment or facilities associated with the pump station location.

The foregoing terms and conditions constitute Rain Bird's entire pump station customer satisfaction policy. This policy is exclusive and in lieu of any other warranties whatsoever, whether express, implied, or statutory including the implied warranties of merchantability and fitness for a particular purpose, which are all hereby expressly disclaimed. The sole remedy under this policy shall be limited to the repair or replacement of the pump station or its components pursuant to the terms and conditions contained herein. In the case of any components or injection systems manufactured by others (as noted on the pump station quotation), there is no warranty provided by Rain Bird and these items are covered solely by and to the extent of the warranty if any, offered by those other manufacturers.

Rain Bird shall not be liable to the customer or any other person or entity for any liability, loss, delay or damage caused or alleged to be caused, directly or indirectly, by any use, defect, failure or malfunction of the pump station or by any injection system whether a claim for such liability, loss, delay or damages is based upon warranty, contract, tort or otherwise. Rain Bird shall not be liable for incidental, consequential, collateral or indirect damages or delay or loss of profit or loss of use or any damages related to the customer's business operations, nor for those caused by acts of nature. In no case and under no circumstances shall Rain Bird's liability exceed the Rain Bird Corporation's net sale price of the pump station.

Laws concerning customer warranties and disclaimers vary from state to state, jurisdiction to jurisdiction, province to province or country to country and therefore some of the foregoing limitations may not apply to you. The exclusions and limitations set out above are not intended to, and should not be construed so as to contravene mandatory provisions of applicable law. If any part or term of this policy is held to be illegal, unenforceable or in conflict with applicable law by a court of competent jurisdiction, the validity of the remaining portions of this policy shall not be affected, and all rights and obligations shall be construed and enforced as if this policy did not contain the particular part or term held to be invalid.

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