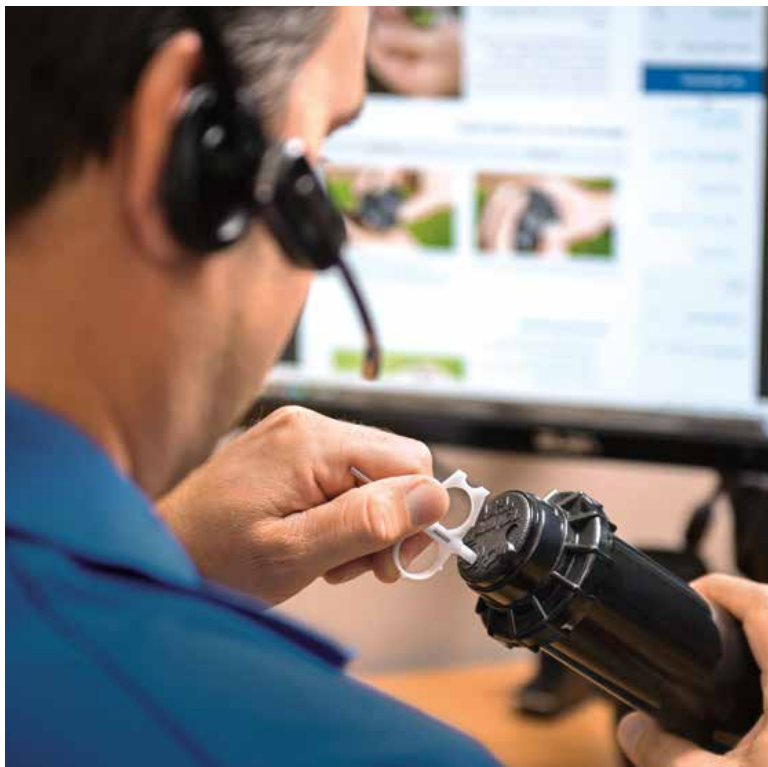


TECHNICAL INFORMATION



HUNTER

Technical Services



Our Hunter Technical Service Team has more than 197 years of combined industry expertise.

Anyone can sell you products. At Hunter, we've always believed the difference lies in providing world-class product support to make your job easier. When you need technical help, whether it's to ask a quick question or to get product-specific troubleshooting assistance, you can count on Hunter's Technical Services Team to provide the best support in the industry. Our knowledgeable experts are always available to help you.

In addition, our Field Service Team provides on-site training and troubleshooting assistance with central control, decoder system, and other commercial, residential, municipal, and golf course installations. Their combined experience of 200+ years in the industry is invaluable when you need factory support by phone, remote desktop, or at the job site.

Contact Us

Phone: +1 760-591-7383, Mon-Fri 6 a.m.-4 p.m. PST

Email: huntertechnicalsupport@hunterindustries.com

After Hours: Leave us a voice message and someone from our team will return your call the next business day

Online Product Information

Visit our Support Library for instructional videos, owner's manuals, installation details, articles, and more.

Rotors, Controllers, Sensors, Drip/Micro Irrigation, Valves, Sprays, Nozzles, FX Luminaire, and Water Management Software

www.hunterindustries.com/support



PRODUCT Specialist Program

This unique training program is designed to equip contractors, distributors, and other professionals with the knowledge to become familiar with Hunter products.

To get started:

1. Access the training website:

- Visit www.training.hunterindustries.com
- Log in or create a new account
- Click on courses, enroll at no cost, watch the training module, and take the quiz

2. Take courses for the level you choose:

- Click on the Specialist Program and choose the level you need
- Click on the courses required for each level and enroll in the courses
- Watch the training module and take the quiz

3. Apply for your certificate:

- Submit the Completion Notification Form for each level
- Obtain your certificate and use your membership card. You may use your certificates to apply for Continuing Education Unit Credits through the Irrigation Association

Choose from three levels of training:

Technician Level: Basic knowledge of the entire Hunter product line

Specialist Level: In-depth knowledge on a particular product

Expert Level: Thorough knowledge on a product category

REPLACEMENT GUIDE

Bringing together a combination of intelligent design, carefully controlled manufacturing, and regular testing to ensure conformity to the strictest standards, Hunter has been able to create truly exceptional nozzles. Essentially, we have made the science of developing superior nozzles—and thus, superior sprinklers—look easy. In the process, we have also made it easy for you to determine which of these high performance sprinklers can be used to replace other brands. Simply consult the following replacement guide to find the appropriate Hunter sprinkler for any irrigation need.

PGJ GEAR-DRIVEN ROTARY SPRINKLERS		
To Replace	Use Hunter Nozzle	
RAIN BIRD®	● Red	
3500	0.75	0.75
	1	1.0
	1.5	1.5
	2	2.0
	3	3.0
T-Bird T-22	4	4.0
	.65 (Blue)	0.75
	1.0 (Red)	1.0
	1.3 (Black)	1.5
	2.0 (Brown)	2.0
T-Bird T-30	2.5 (Grey)	2.5
	4.0 (Yellow)	4.0
	1.0 (Red)	1.0
	1.3 (Black)	1.5
	2.0 (Brown)	2.0
	2.5 (Grey)	2.5
	4.0 (Yellow)	4.0
	5.0 (Green)	5.0

To Replace	Use Hunter Nozzle	
TORO®	● Red	
300/340	1	0.75
Stream Rotor	2	1.5
	3	3.0

To Replace	Use Hunter Nozzle	
NELSON®	● Red	
5500	#51	0.75
	#52	1.5
	#53	2.0
	#54	2.5

PGP® GEAR-DRIVEN ROTARY SPRINKLERS			
To Replace	Use Hunter Nozzle		
RAIN BIRD®	● Red ● Blue		
Mini-Paw 15103	07 (Black)	6	2.5
	09 (Green)	7	3.0
Maxi-Paw 2045	06 (Red)	5	2.0
	07 (Black)	6	2.5
	08 (Blue)	8	4.0
	10 (Yellow)	9	5.0
R-50	12 (Beige)	10	8.0
	1.5 (Black)	5	2.0
	2.0 (Brown)	7	3.0
	3.0 (Grey)	8	4.0
T-Bird T-30	4.0 (Yellow)	9	5.0
	6.0 (Green)	10	8.0
	1.3 (Black)	4	1.5
	2.5 (Grey)	6	2.5
5000	5.0 (Green)	9	5.0
	1.5	4	1.5
	2.0	5	2.0
	3.0	7	3.0
	4.0	8	4.0
	6.0	9	5.0
	8.0	10	8.0
5505	2	5	2.0
	3	6	2.5
	4	7	3.0
	5	8	4.0
	6	9	5.0
	8	10	8.0
	10	10	8.0
12	11	8.0	

To Replace	Use Hunter Nozzle		
K-RAIN®	● Red ● Blue		
RPS75	0.50	1	--
	0.75	2	--
	1.0	4	1.5
	2.0	6	2.0
	2.5	7	2.5
	3.0	8	3.0
	4.0	9	4.0
	6.0	10	6.0
	8.0	11	8.0

PGP® GEAR-DRIVEN ROTARY SPRINKLERS			
To Replace	Use Hunter Nozzle		
TORO®	● Red ● Blue		
300/340	308-XX-02	4	1.5
Stream Rotor	308-XX-03	7	3.0
	316-XX-02	7	3.0
	316-XX-03	10	8.0
XP-300 Series	XP-300-090-07	4	1.5
	180-07	7	3.0
	360-07	10	8.0
	XP-300-090-09	5	2.0
	180-09	8	4.0
	360-09	11	--
	XP-300-090-10	5	2.0
Super 600	180-10	9	5.0
	360-10	12	--
	1.3	4	1.5
	2.5	7	3.0
Super 700	5.0	10	8.0
	6.0	10	8.0
	1.3	3	1.5
	1.5	4	1.5
	2.0	5	2.0
Super 800	3.0	7	3.0
	4.5	8	4.0
	6.0	9	5.0
	7.5	10	8.0
	9.0	11	8.0
	0.50	1	--
	0.75	2	--
TR50	1.0	4	1.5
	1.5	4	1.5
	2.0	5	2.0
	3.0	6	3.0
	4.5	8	4.0
	6.0	9	6.0
	7.5	10	8.0
	8.0	11	8.0
	1.0	3	--
	1.5	4	1.5
	2.0	5	2.0
	3.0	6	3.0
	4.5	8	4.0
	6.0	9	6.0
	7.5	10	8.0
	9.0	11	8.0

TECHNICAL

REPLACEMENT GUIDE

PGP® ULTRA / I-20 GEAR-DRIVEN ROTARY SPRINKLERS		
To Replace	Use Hunter Nozzle ● Blue	
RAIN BIRD®	07 (Black)	2.5
	09 (Green)	3.0
Maxi-Paw 2045	06 (Red)	2.0
	07 (Black)	2.5
	08 (Blue)	4.0
	10 (Yellow)	5.0
	12 (Beige)	8.0
R-50	1.5 (Black)	2.0
	2.0 (Brown)	3.0
	3.0 (Grey)	4.0
	4.0 (Yellow)	5.0
	6.0 (Green)	8.0
T-Bird T-30	1.3 (Black)	1.5
	2.5 (Grey)	2.5
	5.0 (Green)	5.0
5000	1.5	1.5
	2.0	2.0
	3.0	3.0
	4.0	4.0
	6.0	5.0
	8.0	8.0
5505	2	2.0
	3	2.5
	4	3.0
	5	4.0
	6	5.0
	8	8.0
	10	8.0
	12	8.0

To Replace	Use Hunter Nozzle ● Blue	
K-RAIN®		
RPS75	0.50	--
	0.75	--
	1.0	1.5
	2.0	2.0
	2.5	2.5
	3.0	3.0
	4.0	4.0
	6.0	6.0
	8.0	8.0

PGP® ULTRA / I-20 GEAR-DRIVEN ROTARY SPRINKLERS		
To Replace	Use Hunter Nozzle ● Blue	
TORO®		
300/340	308-XX-02	1.5
Stream Rotor	308-XX-03	3.0
	316-XX-02	3.0
	316-XX-03	8.0
XP-300 Series	XP-300-090-07	1.5
	180-07	3.0
	360-07	8.0
	XP-300-090-09	2.0
	180-09	4.0
	360-09	--
	XP-300-090-10	2.0
	180-10	5.0
	360-10	--
Super 600	1.3	1.5
	2.5	3.0
	5.0	8.0
	6.0	8.0
Super 700	1.3	1.5
	1.5	1.5
	2.0	2.0
	3.0	3.0
	4.5	4.0
	6.0	5.0
	7.5	8.0
	9.0	8.0
Super 800	0.50	--
	0.75	--
	1.0	1.5
	2.0	2.0
	2.5	2.5
	3.0	3.0
	4.0	4.0
	6.0	6.0
	8.0	8.0
TR50	1.0	--
	1.5	1.5
	2.0	2.0
	3.0	3.0
	4.5	4.0
	6.0	6.0
	7.5	8.0
	9.0	8.0

SPRAY SPRINKLERS		
To Replace	Use Hunter Product	
ANY MFRS NOZZLES		Nozzles
Nozzles	2.4 m Radius	8A
	3.0 m Radius	10A
	3.7 m Radius	12A
	4.6 m Radius	15A
	5.2 m Radius	17A
Rain Bird 1800	Pro-Spray	
1800 SAM	Pro-Spray-CV	
1800 SAM PRS	Pro-Spray-PRS30-CV	
Uni-Spray	PS Ultra	

REPLACEMENT GUIDE

I-25 GEAR-DRIVEN ROTARY SPRINKLERS

To Replace RAIN BIRD®		Use Hunter Nozzle
FALCON	4 (Black)	4 (Yellow)
	6 (Lt. Blue)	5 (White)
	8 (Dk. Green)	7 (Orange)
	10 (Grey)	8 (Lt. Brown)
	12 (Beige)	10 (Lt. Green)
	14 (Lt. Green)	13 (Lt. Blue)
	16 (Dk. Brown)	18 (Red)
	18 (Dk. Blue)	20 (Dk. Brown)
41-51A	18 x 11.5	20 (Dk. Brown)
41-51A	13 x 11	13 (Lt. Blue)
47A	16	13 (Lt. Blue)
37A	14	8 (Lt. Brown)
7005	4 (Black)	4 (Yellow)
	6 (Lt. Blue)	5 (White)
	8 (Dk. Green)	8 (Lt. Brown)
	10 (Grey)	10 (Lt. Green)
	12 (Beige)	13 (Lt. Blue)
	14 (Lt. Green)	15 (Grey)
	16 (Dk. Brown)	18 (Red)
	18 (Dk. Blue)	20 (Dk. Brown)
8005	12 (Beige)	13 (Lt. Blue)
	14 (Lt. Green)	15 (Grey)
	16 (Dk. Brown)	18 (Red)
	18 (Dk. Blue)	20 (Dk. Brown)
	20 (Red)	23 (Dk. Green)
	22 (Yellow)	25 (Dk. Blue)
	24 (Orange)	28 (Black)

To Replace TORO®		Use Hunter Nozzle
2001	6 (Yellow)	7 (Orange)
	9 (Red)	8 (Lt. Brown)
	12 (Brown)	10 (Lt. Green)
	18 (Blue)	18 (Red)
	24 (Green)	25 (Dk. Blue)
640	40	8 (Lt. Brown)
	41	10 (Lt. Green)
	42	13 (Lt. Blue)
	43	15 (Grey)
	44	20 (Dk. Brown)

To Replace NELSON®		Use Hunter Nozzle
7000 & 7500	1	7 (Orange)
	2	8 (Lt. Brown)
	3	10 (Lt. Green)
	4	13 (Lt. Blue)
	5	15 (Grey)
	6	20 (Dk. Brown)
	7	23 (Dk. Green)
	8	25 (Dk. Blue)

I-40 GEAR-DRIVEN ROTARY SPRINKLERS

To Replace RAIN BIRD®		Use Hunter Nozzle
41-51A	18 x 11.5	23 (Dk. Green)
41-51A	13 x 11	15 (Grey)
47A-SAM	16	13 (Lt. Blue)
37A	14	10 (Lt. Green)
65 SERIES	16	13 (Lt. Blue)
8005	12 (Beige)	10 (Lt. Green)
	14 (Lt. Green)	15 (Grey)
	16 (Dk. Brown)	15 (Grey)
	18 (Dk. Blue)	23 (Dk. Green)
	20 (Red)	25 (Dk. Blue)
	22 (Yellow)	25 (Dk. Blue)
TALON	14	13 (Lt. Blue)
	16	10 (Lt. Green)
	18	23 (Dk. Green)
	20	25 (Dk. Blue)
	22	25 (Dk. Blue)

To Replace TORO®		Use Hunter Nozzle
640	40	8 (Lt. Brown)
	41	10 (Lt. Green)
	42	13 (Lt. Blue)
	43	15 (Grey)
	44	23 (Dk. Green)

To Replace THOMPSON®		Use Hunter Nozzle
186/7	R-Nozzle	13 (Lt. Blue)
	S-Nozzle	15 (Grey)
	T-Nozzle	15 (Grey)
188/9	U-Nozzle	23 (Dk. Green)
	V-Nozzle	25 (Dk. Blue)

I-80 GEAR-DRIVEN ROTARY SPRINKLERS

To Replace RAIN BIRD®		Use Hunter Nozzle
41-51A	18 x 11.5	23 (Green)
41-51A	13 x 11	15 (White)
47A-SAM	16	13 (Lt. Blue)
37A	14	10 (Lt. Green)
65 SERIES	16	13 (Lt. Blue)
7005	10 (Gray)	10 (Lt. Green)
	12 (Beige)	13 (Lt. Blue)
	14 (Lt. Green)	15 (White)
	16 (Dk. Brown)	18 (Orange)
	18 (Dk. Blue)	20 (Tan)
	8005	12 (Beige)
8005	14 (Lt. Green)	15 (White)
	16 (Dk. Brown)	15 (White)
	18 (Dk. Blue)	23 (Green)
	20 (Red)	25 (Blue)
	22 (Yellow)	25 (Blue)
	TALON	14
16		10 (Lt. Green)
18		23 (Green)
20		25 (Blue)
22		25 (Blue)

To Replace TORO®		Use Hunter Nozzle
640	41	10 (Lt. Green)
	42	13 (Lt. Blue)
	43	15 (White)
	44	23 (Green)
TS-90	1 (Yellow)	15 (White)
	2 (Blue)	20 (Tan)
	3 (Brown)	23 (Green)
	4 (Orange)	33 (Gray)
	5 (Green)	38 (Red)
	6 (Gray)	38 (Red)
	7 (Black)	43 (Dk. Brown)
	8 (Red)	48 (Dk. Green)
	9 (Tan)	53 (Dk. Blue)

To Replace THOMPSON®		Use Hunter Nozzle
186/7	R-Nozzle	13 (Lt. Blue)
	S-Nozzle	15 (White)
	T-Nozzle	15 (White)
188/9	U-Nozzle	23 (Green)
	V-Nozzle	25 (Blue)

To Replace SINGLE NOZZLE		All Impact MFRS
	15/64"	10 (Lt. Green)
	1/4"	13 (Lt. Blue)
	17/64"	15 (White)
	9/32"	15 (White)

TECHNICAL

REPLACEMENT GUIDE

HQ - KEYS

To Replace RAIN BIRD®	To Replace TORO®	To Replace BUCKNER	To Replace WEST AG/STORM	Use Hunter
33K, 33DK 44K 4K-Acme 55K-1	075-SLK 100-SLK 100-AK	QB33K07 QB44K10 QB44KAT10 QB5RK10	4C075, C075 4C100, C100 4C100A, C100A 4C101, C101	HK-33 HK-44 HK-44A HK-55

HQ - SWIVELS

To Replace RAIN BIRD®	To Replace TORO®	To Replace BUCKNER	To Replace WEST AG/STORM	Use Hunter
SH-0 SH-1 SH-2	075-75MHS 075-MHS 100-MHS	HS075 HS100 HS101 HS100BS HS101BS	4HS-075, HS075 4HS-100, HS-100 4HS-101, HS-101 4HS-100-BS, HS-100-BS 4HS-101-BS, HS-101-BS	HS-0 HS-1 HS-2 HS-1-B HS-2-B

HQ - QUICK COUPLERS

To Replace RAIN BIRD®	To Replace TORO®	To Replace BUCKNER	To Replace WEST AG/STORM	Use Hunter
3RC 33DRC 33DLRC 33DNP 44RC	075-SLSC	QB3RC07 QB33RC07 QB33LRC07 QB33NP07 QB44RC10	4V075-RY, QCV075-R 4V133-4A-RY, QCV133-4A-R 4V133-4A-RLY, QCV133-4A-RL-2 4V133-4A-RL-NP, QVC133-4A-N-2 4V144-RY, QCV-144-R	HQ-3RC HQ-33DRC HQ-33DLRC HQ-33DLRC-R HQ-44RC
44LRC 44NP	100-SLVC, 100-SLVLC 100-2SLLVC	QB44LRC10 QB44N010 QB44RCATAR10 QB44LRCATAR10 QB44NPATAR10	4V144-RLY, QCV-144-RL 4V144-RL-NP, QCV-144-N	HQ-44LRC HQ-44LRC-R HQ-44RC-AW HQ-44LRC-AW HQ-44LRC-AW-R
4NP-Acme 5RC	100-ATLVC	QBRB5RC10	4V101-RY, QCV-101-R	HQ-5RC
5LRC 5NP 5RC-BSP 5LRC-BSP 5NP-BSP		QBRB5LRC10 QBRB5NP10 QBRB5RC10BS QBRB5LRC10BS QBRB5NP10BS	4V101-RLY, QCV-101-RL 4V101-RL-NP, QCV-101-N 4V101-RY-BS, QCV-101-R-BS 4V101-RLY-BS, QCV-101-RL-BS 4V101-RL-NP-BS, QCV-101-N-BS	HQ-5LRC HQ-5LRC-R HQ-5RC-BSP HQ-5LRC-BSP HQ-5LRC-BSPR

PRECIPITATION RATES




In this section, the “Sprinkler Spacing Method–Any Arc and Any Spacing” equation is used to calculate precipitation rates. The first set of equations with the ■ shows the precipitation rate for the sprinklers when they are laid out in a square pattern. The next set with the ▲ shows the precipitation rate for the sprinklers laid out in an equilateral triangular spacing pattern. This is the “Sprinkler Spacing Method–Equilateral Triangular Spacing” equation.

WHAT IS PRECIPITATION RATE?

If someone said they were caught in a rainstorm that dropped 25mm of water in an hour, you would have some idea of how hard or heavily the rain came down. A rainstorm that covers an area with 25mm of water in one hour has a precipitation rate of one meter per hour (25 mm/hr). Similarly, the precipitation rate is the speed at which a sprinkler or an irrigation system applies water.

MATCHED PRECIPITATION RATES

A zone or system in which all the heads have similar precipitation rates is said to have “matched precipitation rates.” Systems that have matched precipitation rates reduce wet and dry spots and excessive run times, which lead to high water consumption and increased costs. Knowing that sprinkler spacing, flow rates, and arcs of coverage affect precipitation rates, a general guideline is: as the spray arc doubles, so should the flow.

	90° Arc = 1 GPM; 0.23 m ³ /hr; 3.8 l/min		180° Arc = 2 GPM; 0.45 m ³ /hr; 7.6 l/min		360° Arc = 4 GPM; 0.91 m ³ /hr; 15.1 l/min
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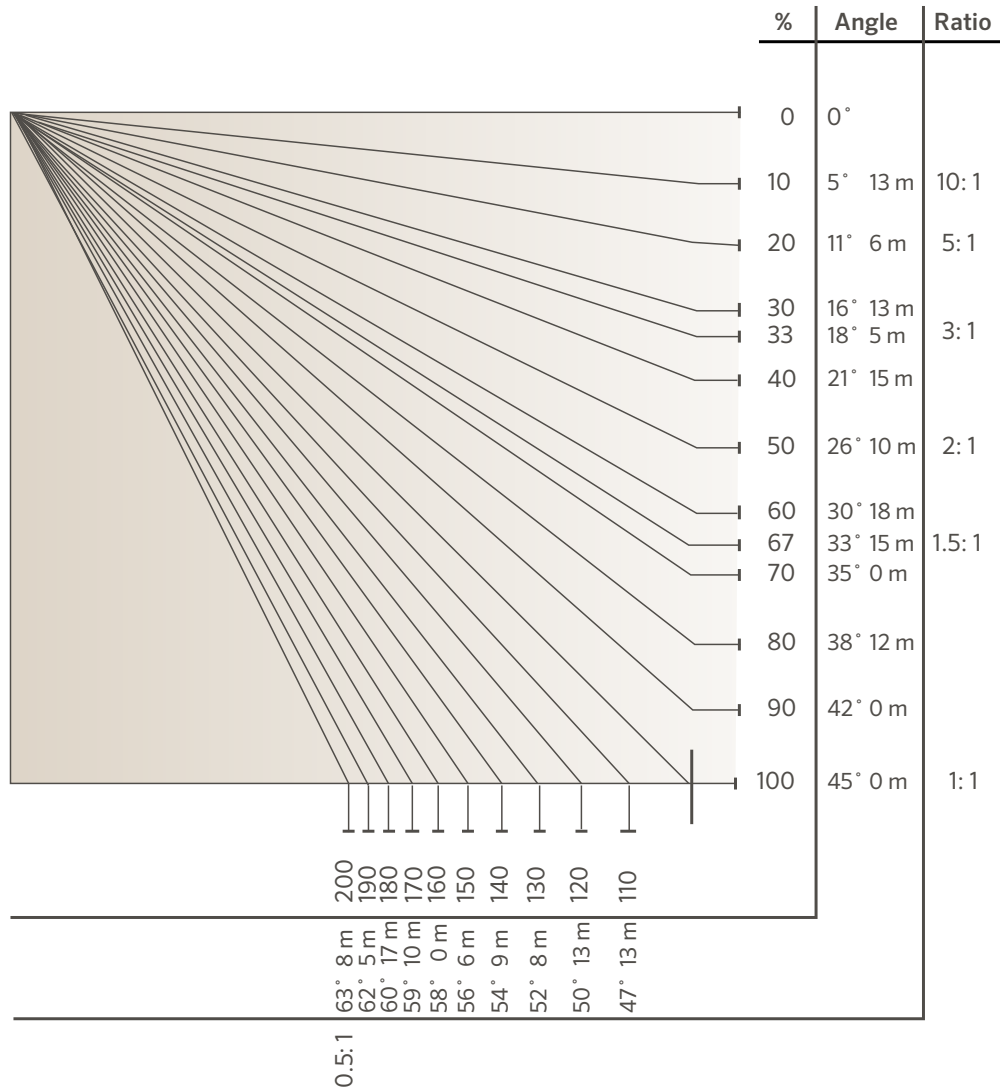
The flow rate of half-circle heads must be two times the flow rate of the quarter-circle heads, and the full-circle heads must have two times the flow rate of the half-circle heads. In the illustration, the same amount of water is applied to each quarter circle area and precipitation is therefore matched.

CALCULATING PRECIPITATION RATES

Depending upon the construction of the irrigation system, the precipitation rate may be calculated by either a Sprinkler Spacing or a Total Area method.

	Any Arc and Any Spacing (■):
Sprinkler Spacing Method (■) The precipitation rate should be calculated for each individual zone. If all sprinkler heads on the zone have the same spacing, flow rate, and arc of coverage, use one of the following formulas:	$\text{P.R. (in/hr)} = \frac{\text{Flow Rate (GPM) for any Arc} \times 34,650}{\text{Degrees of Arc} \times \text{Head Spacing (ft.)} \times \text{Row Spacing (ft.)}}$ $\text{P.R. (mm/hr)} = \frac{\text{Flow Rate (m}^3\text{/hr) for any Arc} \times 360,000}{\text{Degrees of Arc} \times \text{Head Spacing (m)} \times \text{Row Spacing (m)}}$ $\text{P.R. (mm/hr)} = \frac{\text{Flow Rate (l/min) for any Arc} \times 21,600}{\text{Degrees of Arc} \times \text{Head Spacing (m)} \times \text{Row Spacing (m)}}$
	Equilateral Triangular Spacing (▲):
Sprinkler Spacing Method (▲) The precipitation rate should be calculated for each individual zone. If all sprinkler heads on the zone have the same spacing, flow rate, and arc of coverage, use one of the following formulas:	$\text{P.R. (in/hr)} = \frac{\text{Flow Rate (GPM) for any Arc} \times 34,650}{\text{Degrees of Arc} \times (\text{Head Spacing})^2 \times 0.866}$ $\text{P.R. (mm/hr)} = \frac{\text{Flow Rate (m}^3\text{/hr) for any Arc} \times 360,000}{\text{Degrees of Arc} \times (\text{Head Spacing})^2 \times 0.866}$ $\text{P.R. (mm/hr)} = \frac{\text{Flow Rate (l/min) for any Arc} \times 21,600}{\text{Degrees of Arc} \times (\text{Head Spacing})^2 \times 0.866}$
Total Area Method The precipitation rate for a “system” is the average precipitation rate of all sprinklers in an area, regardless of the spacing, flow rate, or arc for each head. The Total Area Method calculates all the flows of all of the heads in any given area.	$\text{P.R. (in/hr)} = \frac{\text{Flow (GPM)} \times 96.25}{\text{Total Area (ft.)}}$ $\text{P.R. (mm/hr)} = \frac{\text{Flow (m}^3\text{/hr)} \times 1,000}{\text{Total Area (m}^2\text{)}}$ $\text{P.R. (mm/hr)} = \frac{\text{Flow (l/min)} \times 60}{\text{Total Area (m}^2\text{)}}$

SLOPE EQUIVALENTS/IRRIGATION



SLOPE IRRIGATION: Maximum precipitation rates for slopes in mm/hr

Soil Texture	0 to 5% Slope		5 to 8% Slope		8 to 12% Slope		12% + Slope	
	Cover	Bare	Cover	Bare	Cover	Bare	Cover	Bare
Coarse sandy soils	51	51	51	38	38	25	25	13
Coarse sandy soils over compact subsoils	44	38	32	25	25	19	19	10
Light sandy loams uniform	44	25	32	20	25	15	19	10
Light sandy loams over compact subsoils	32	19	25	13	19	10	13	8
Uniform silt loams	25	13	20	10	15	8	10	5
Silt loams over compact subsoil	15	8	13	6	10	4	8	3
Heavy clay or clay loam	5	4	4	3	3	2	3	2

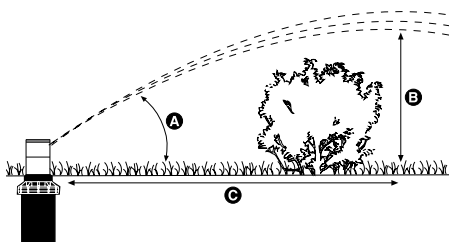
Notes:

Maximum precipitation rates for slopes in mm/hr

The maximum precipitation values listed below are those suggested by the United States Department of Agriculture. The values are average and may vary with respect to actual soil condition and condition of ground cover.

HEIGHT OF SPRAY

The trajectory and spray height of the water stream leaving a sprinkler nozzle is important information when designing and installing irrigation systems.



These rotor nozzle trajectory charts are designed to help determine how close a sprinkler can be placed to an object such as a fence or hedge without obstructing the spray pattern. All information shown is at optimum operating pressures.

HUNTER NOZZLE HEIGHT AND TRAJECTORY CHART

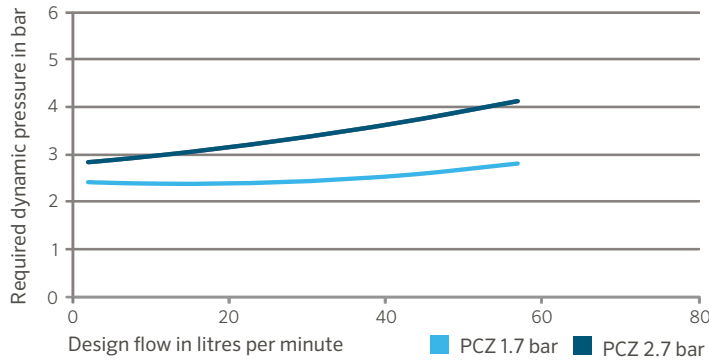
Model	Nozzle No.	Pressure		Degrees of Trajectory	Max Height of Spray (m)	Distance from Head to Maximum Height (m)
		bar	kPa			
MP ROTATOR®	815	2.8	280	15	0.3	Varies
	800SR	2.8	280	18	0.4	Varies
	1000	2.8	280	20	0.5	Varies
	2000	2.8	280	26	1.1	Varies
	3000	2.8	280	26	2.0	Varies
	3500	2.8	280	28	2.5	Varies
	Corner	2.8	280	14	0.4	Varies
	Side Strip Left Strip	2.8 2.8	280 280	16 16	0.5 0.5	Varies Varies
PGJ	0.75	2.8	280	10	0.6	1.2
	1.0	2.8	280	10	0.6	2.4
	1.5	2.8	280	10	0.9	3.7
	2.0	2.8	280	15	1.5	4.9
	2.5	2.8	280	12	1.5	6.1
	3.0	2.8	280	15	1.5	6.1
	4.0	2.8	280	15	1.5	6.7
	5.0	2.8	280	15	1.8	7.3
PGP® RED NOZZLES	1.0	3.5	350	26	2.1	6.7
	2.0	3.5	350	26	2.1	6.7
	3.0	3.5	350	26	2.4	7.0
	4.0	3.5	350	26	2.4	7.0
	5.0	3.5	350	27	2.7	7.9
	6.0	3.5	350	27	3.0	8.5
	7.0	3.5	350	26	3.4	9.1
	8.0	3.5	350	26	3.4	9.1
	9.0	3.5	350	27	3.7	9.8
	10.0	4.0	400	25	4.0	9.8
PGP LOW ANGLE GREY NOZZLES	1.0	4.0	400	25	4.0	11.6
	12.0	4.0	400	25	4.0	12.2
	4.0	3.5	350	15	1.5	6.7
	5.0	3.5	350	15	1.2	6.7
	6.0	3.5	350	14	1.2	6.7
	7.0	3.5	350	14	1.2	6.7
	8.0	3.5	350	14	1.5	7.3
	9.0	3.5	350	15	1.5	7.9
	10.0	4.0	400	15	1.8	9.1
	PGP BLUE NOZZLES	1.5	3.0	300	25	2.4
2.0		3.0	300	25	2.4	7.0
2.5		3.0	300	25	2.7	7.9
3.0		3.0	300	25	3.0	8.5
4.0		3.0	300	25	3.4	9.1
5.0		3.0	300	25	3.4	9.1
6.0		3.8	380	25	3.7	9.8
8.0		3.8	380	25	4.0	9.8
PGP ULTRA/1-20 DARK BLUE NOZZLES	1.0	3.5	350	26	2.4	7.0
	1.5	3.5	350	26	2.4	7.0
	2.0	3.5	350	27	2.7	7.9
	3.0	3.5	350	27	3.0	8.5
	3.5	3.5	350	26	3.4	9.1
	4.0	3.5	350	26	3.4	9.1
	6.0	3.5	350	27	3.7	9.8
	8.0	4.0	400	25	4.0	9.8
PGP ULTRA/1-20 BLUE NOZZLES	1.5	3.0	300	25	2.4	7.0
	2.0	3.0	300	25	2.4	7.0
	2.5	3.0	300	25	2.7	7.9
	3.0	3.0	300	25	3.0	8.5
	4.0	3.0	300	25	3.4	9.1
	5.0	3.0	300	25	3.4	9.1
	6.0	3.8	380	25	3.7	9.8
	8.0	3.8	380	25	4.0	9.8

HEIGHT OF SPRAY

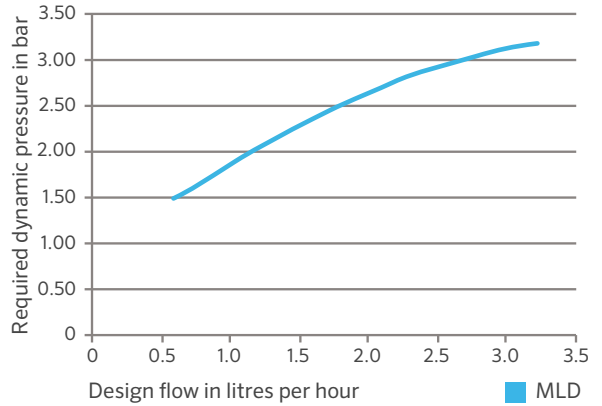
HUNTER NOZZLE HEIGHT AND TRAJECTORY CHART						
Model	Nozzle No.	Pressure		Degrees of Trajectory	Max Height of Spray (m)	Distance from Head to Maximum Height (m)
		bar	kPa			
PGP® Ultra/I-20 Low Angle Grey Nozzles	2.0 LA	3.5	350	13	1.5	6.7
	2.5 LA	3.5	350	13	1.2	6.7
	3.5 LA	3.5	350	13	1.2	6.7
	4.5 LA	3.5	350	13	1.2	6.7
PGP Ultra/I-20 Short Radius Black Nozzles	0.5	3.5	350	15	1.5	2.4
	1.0	3.5	350	14	1.8	2.7
	2.0	3.5	350	3	0.3	1.8
PGP Ultra/I-20 Short Radius Black Nozzles	0.75	3.5	350	22	2.1	4.0
	1.5	3.5	350	18	2.1	4.0
	3.0	3.5	350	8	0.3	1.8
PGP Ultra/I-20 MPR-25 Red Nozzles	Q - 90	3.0	300	22	0.9	4.6
	T - 120	3.0	300	21	1.2	4.2
	H - 180	3.0	300	24	1.2	4.2
	F - 360	3.0	300	22	1.2	3.0
PGP Ultra/I-20 MPR-30 Lt. Green Nozzles	Q - 90	3.0	300	28	1.5	5.4
	T - 120	3.0	300	14	0.9	5.1
	H - 180	3.0	300	16	1.2	4.8
	F - 360	3.0	300	18	0.6	3.9
PGP Ultra/I-20 MPR-35 Tan Nozzles	Q - 90	3.0	300	28	1.8	5.7
	T - 120	3.0	300	28	1.8	5.4
	H - 180	3.0	300	16	1.2	5.1
	F - 360	3.0	300	14	0.9	3.6
I-25	4	3.5	350	25	2.7	6.7
	5	3.5	350	25	3.4	8.5
	7	3.5	350	25	3.0	8.5
	8	3.5	350	25	3.4	8.5
	10	4	400	25	3.7	9.1
	13	4	400	25	4.0	9.4
	15	4	400	25	3.7	9.4
	18	4	400	25	4.6	10.4
	20	5	500	25	4.6	10.7
	23	5	500	25	4.9	11.6
	25	5	500	25	4.9	11.6
	28	5	500	25	5.2	12.2
I-40	8 (40)	3.5	350	25	3.7	9.8
	10 (41)	4	400	25	4.3	9.8
	13 (42)	4	400	25	4.3	10.4
	15 (43)	4	400	25	4.6	12.8
	23 (44)	5	500	25	5.2	14.0
	25 (45)	5	500	25	5.2	14.6
I-90 ADV	33	5.5	550	22	4.6	12.8
	38	5.5	550	22	4.9	14.6
	43	5.5	550	22	4.9	14.6
	48	5.5	550	22	5.2	16.5
	53	5.5	550	22	5.2	17.1
	63	5.5	550	22	5.5	19.5
I-90 36V	33	5.5	550	22	5.2	14.0
	38	5.5	550	22	5.2	15.2
	43	5.5	550	22	5.2	16.5
	48	5.5	550	22	5.2	17.1
	53	5.5	550	22	5.2	17.7
	63	5.5	550	22	5.5	18.9
I-90 ADV Low Angle	33	5.5	550	15	2.4	11.5
	38	5.5	550	15	2.7	12.1
	43	5.5	550	15	2.7	12.5
	48	5.5	550	15	3.0	13.1
	53	5.5	550	15	3.4	13.7
	63	5.5	550	15	3.7	14.6
I-90 36V Low Angle	33	5.5	550	15	2.4	11.5
	38	5.5	550	15	2.7	12.1
	43	5.5	550	15	2.7	12.5
	48	5.5	550	15	3.0	13.1
	53	5.5	550	15	3.4	13.7
	63	5.5	550	15	3.7	14.6

DRIP CONTROL ZONE KIT CHART

PCZ101: Inlet pressure required for designed outlet pressure



MINI LANDSCAPE DRIPLINE FLOW CHART



DRIPLINE MAXIMUM RUN LENGTHS

PLD (16 MM AND 17 MM)

16 MM DRIPLINE MAX LENGTH - 2.2 l/hr			16 MM DRIPLINE MAX LENGTH - 3.8 l/hr		
Pressure (bar)	Emitter Spacing (m)		Pressure (bar)	Emitter Spacing (m)	
	0.30	0.50		0.30	0.50
1.0	47	73	1.0	35	54
2.0	84	131	2.0	59	91
3.0	104	162	3.0	72	112

17 MM DRIPLINE MAX LENGTH - 1.5 l/hr				17 MM DRIPLINE MAX LENGTH - 2.2 l/hr				17 MM DRIPLINE MAX LENGTH - 3.8 l/hr			
Pressure (bar)	Emitter Spacing (m)			Pressure (bar)	Emitter Spacing (m)			Pressure (bar)	Emitter Spacing (m)		
	0.30	0.50	0.60		0.30	0.50	0.60		0.30	0.50	0.60
1.0	86	119	149	1.0	51	71	88	1.0	37	52	65
2.0	132	185	232	2.0	89	124	156	2.0	65	92	115
3.0	159	223	281	3.0	108	152	191	3.0	80	112	142

HDL 17 MM PRESSURE-COMPENSATING AND RECLAIMED - MINIMUM OPERATING PRESSURE OF 0.7 BAR

HDL-PC AND HDL-R - 1.5 L/hr				HDL-PC AND HDL-R - 2.1 L/hr				HDL-PC AND HDL-R - 3.4 L/hr			
Pressure (bar)	Emitter Spacing (cm)			Pressure (bar)	Emitter Spacing (cm)			Pressure (bar)	Emitter Spacing (cm)		
	30	45	60		30	45	60		30	45	60
1.0	87	123	156	1.0	72	101	129	1.0	50	71	89
2.0	125	177	224	2.0	103	147	186	2.0	72	101	128
3.0	149	210	266	3.0	123	174	220	3.0	85	120	153
4.0	167	235	299	4.0	137	194	247	4.0	96	134	171

HDL 17 MM CHECK VALVE - MINIMUM OPERATING PRESSURE OF 1 BAR

HDL-CV - 1.5 L/hr				HDL-CV - 2.1 L/hr				HDL-CV - 3.4 L/hr			
Pressure (bar)	Emitter Spacing (cm)			Pressure (bar)	Emitter Spacing (cm)			Pressure (bar)	Emitter Spacing (cm)		
	30	45	60		30	45	60		30	45	60
1.0	62	88	112	1.0	52	73	93	1.0	36	50	64
2.0	116	163	207	2.0	96	134	171	2.0	66	94	119
3.0	142	200	255	3.0	117	166	210	3.0	81	115	146
4.0	161	228	289	4.0	134	189	239	4.0	92	131	165

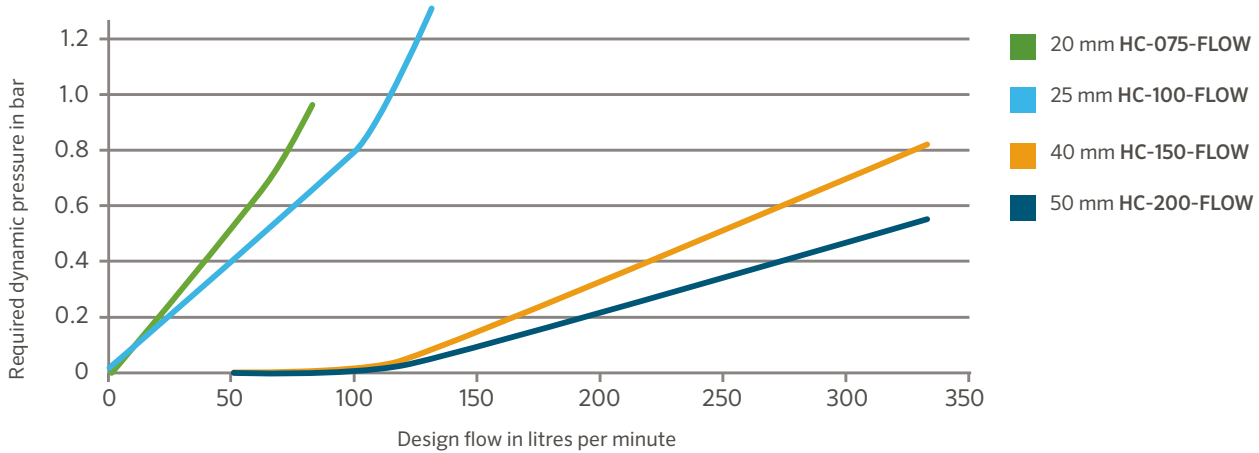
EMITTER APPLICATION FLOW RATE

16 MM EMITTER FLOW RATE - 2.2 l/hr			16 MM EMITTER FLOW RATE - 3.8 l/hr			16 MM QUICK REFERENCE CHART - l/min PER 100 M		
Row Spacing (m)	Emitter Spacing (m)		Row Spacing (m)	Emitter Spacing (m)		Emitter (l/hr)	Emitter Spacing (m)	
	0.30	0.50		0.30	0.50		0.30	0.50
0.30	24	15	0.30	42	25	1.5	12.2	7.3
0.35	21	13	0.35	36	22	3.8	21.1	12.7
0.40	18	11	0.40	32	19	Notes		
0.45	16	10	0.45	28	17	Eco-Mat has two lateral lines; calculating l/hr per 30.5 m should reflect two lines, not just one.		
0.50	15	9	0.50	25	15			
0.55	13	8	0.55	23	14			
0.60	12	7	0.60	21	13			

17 MM EMITTER FLOW RATE - 1.5 l/hr				17 MM EMITTER FLOW RATE - 2.2 l/hr				17 MM EMITTER FLOW RATE - 3.8 l/hr				17 MM QUICK REFERENCE CHART - l/min PER 100 M			
Row Spacing (m)	Emitter Spacing (m)			Row Spacing (m)	Emitter Spacing (m)			Row Spacing (m)	Emitter Spacing (m)			Emitter (l/hr)	Emitter Spacing (m)		
	0.30	0.45	0.61		0.30	0.45	0.61		0.30	0.45	0.61		0.30	0.50	0.60
0.30	17	11	8	0.30	26	17	13	0.30	42	28	21	1.5	8.1	5.4	4.2
0.35	14	10	7	0.35	22	15	11	0.35	36	24	18	2.3	12.6	8.5	6.4
0.40	13	8	6	0.40	19	13	9	0.40	32	21	16	3.8	20.2	13.6	10.2
0.45	11	7	5	0.45	17	11	8	0.45	28	19	14	Notes			
0.50	10	7	5	0.50	15	10	8	0.50	25	17	12	Eco-Mat has two lateral lines; calculating l/hr per 30.5 m should reflect two lines, not just one.			
0.55	9	6	4	0.55	14	9	7	0.55	23	15	11				
0.60	8	6	4	0.60	13	9	6	0.60	21	14	10				

Notes
Application rates in m per hour

HC FLOW METER PRESSURE LOSS CHART



CONVERSION FACTORS

CONVERSION FACTORS			
To Convert	From	To	Multiply By
Area	acres	foot ²	43560
	acres	meter ²	4046.8
	meter ²	foot ²	10.764
	foot ²	inch ²	144
	inch ²	centimeter ²	6.452
	hectares	meter ²	10000
	hectares	acres	2.471
Power	kilowatts	horsepower	1.341
Flow	foot ³ /minute	meter ³ /second	0.0004719
	foot ³ /second	meter ³ /second	0.02832
	yards ³ /minute	meter ³ /second	0.01274
	gallon/minute	meter ³ /hour	0.22716
	gallon/minute	liter/minute	3.7854
	gallon/minute	liter/second	0.06309
	meter ³ /hour	liter/minute	16.645
	meter ³ /hour	liter/second	0.2774
liter/minute	liter/second	60	
Length	foot	inch	12
	inch	centimeter	2.54
	foot	meter	0.30481
	kilometer	miles	0.6214
	miles	foot	5280
	miles	meter	1609.34
Pressure	PSI	kilopascals	6.89476
	PSI	bar	0.068948
	bar	kilopascals	100
	PSI	feet of head	2.31
Velocity	feet/second	meter/second	0.3048
Volume	feet ³	gallon	7.481
	feet ³	liter	28.32
	meter ³	feet ³	35.31
	meter ³	yard ³	1.3087
	yard ³	feet ³	27
	yard ³	gallon	202
	acres/feet	foot ³	43,560
	gallon	meter ³	0.003785
	gallon	liter	3.785
	imperial gallon	gallon	1.833

ADDITIONAL DATA

WIRE SIZE REFERENCE CHART										
Wire Size (mm ²)	25 mm	32 mm	40 mm	50 mm	63 mm	75 mm	90 mm	110 mm	160 mm	Wire Size (mm ²)
0.5	20	35	49	80	110	175	-	-	-	0.5
1	16	30	42	67	97	150	-	-	-	1
1.5	10	18	25	40	56	88	120	150	-	1.5
2.5	7	15	20	33	50	75	102	130	-	2.5
4	6	13	16	27	40	63	85	110	-	4
6	4	6	9	16	25	35	50	65	150	6

CLIMATE ETp TABLE	
Climate*	mm Daily
Cool Humid	2.5 to 3.8
Cool Dry	3.8 to 5.1
Warm Humid	3.8 to 5.1
Warm Dry	5.1 to 6.3
Hot Humid	5.1 to 7.6
Hot Dry	7.6 to 11.4

Notes:
Approximate number of wires to be installed in conduit or tubing. Maximum number of wires in conduit or sleeving

Notes:
* Cool = under 21°C as an average mid-summer high
* Warm = between 21° and 32° C as mid-summer highs
* Hot = over 32° C
* Humid = over 50% as average mid-summer relative humidity (dry=under 50%)

TECHNICAL

FRICITION LOSS CHARTS - UPVC PIPE CLASS 3 (6 BAR)

C=150 • PRESSURE LOSS (BAR/100 METERS)																	
Nominal Size		40 mm		50 mm		63 mm		75 mm		90 mm		110 mm		160 mm		200 mm	
Pipe ID		36.4 mm		46.4 mm		59.2 mm		70.6 mm		84.6 mm		103.6 mm		153.2 mm		188.2 mm	
Pipe OD		40 mm		50 mm		63 mm		75 mm		90 mm		110 mm		160 mm		200 mm	
Wall Thicck		1.8 mm		1.8 mm		1.9 mm		2.2 mm		2.7 mm		3.2 mm		3.4 mm		5.9 mm	
Flow l/min	Flow m ³ /hr	Velocity m/s	bar loss	Velocity m/s	bar loss	Velocity m/s	bar loss	Velocity m/s	bar loss	Velocity m/s	bar loss	Velocity m/s	bar loss	Velocity m/s	bar loss	Velocity m/s	bar loss
3.8	0.25																
7.6	0.5																
11.4	0.75																
15.1	1	0.3	0.03														
26.5	1.5	0.4	0.06	0.2	0.02												
34.1	2	0.5	0.09	0.3	0.03												
41.6	2.5	0.7	0.14	0.4	0.04												
49.2	3	0.8	0.20	0.5	0.06												
56.8	3.5	0.9	0.27	0.6	0.08												
68.1	4	1.1	0.34	0.7	0.10												
83.3	5	1.3	0.52	0.8	0.16												
98.4	6	1.6	0.72	1.0	0.22	0.6	0.07	0.4	0.03								
117.3	7	1.9	0.96	1.1	0.30	0.7	0.09	0.5	0.04								
132.5	8	2.1	1.23	1.3	0.38	0.8	0.12	0.6	0.05								
151.4	9	2.4	1.53	1.5	0.47	0.9	0.14	0.6	0.06								
166.6	10	2.7	1.86	1.6	0.57	1.0	0.17	0.7	0.07								
181.7	11			1.8	0.68	1.1	0.21	0.8	0.09	0.5	0.04						
200.6	12			2.0	0.8	1.2	0.24	0.9	0.10	0.6	0.04						
215.8	13			2.1	0.93	1.3	0.28	0.9	0.12	0.6	0.05						
234.7	14			2.3	1.07	1.4	0.33	1.0	0.14	0.7	0.06						
249.8	15			2.5	1.21	1.5	0.37	1.1	0.16	0.7	0.06	0.5	0.02				
265.0	16					1.6	0.42	1.1	0.18	0.8	0.07	0.5	0.03				
283.9	17					1.7	0.47	1.2	0.20	0.8	0.08	0.6	0.03				
299.0	18					1.8	0.52	1.3	0.22	0.9	0.09	0.6	0.03				
318.0	19					1.9	0.57	1.3	0.24	0.9	0.10	0.6	0.04				
333.1	20					2.0	0.63	1.4	0.27	1.0	0.11	0.7	0.04				
348.3	21					2.1	0.69	1.5	0.29	1.0	0.12	0.7	0.05				
367.2	22					2.2	0.75	1.6	0.32	1.1	0.13	0.7	0.05				
382.3	23					2.3	0.82	1.6	0.35	1.1	0.14	0.8	0.05				
401.3	24							1.7	0.37	1.2	0.16	0.8	0.06				
416.4	25							1.8	0.40	1.2	0.17	0.8	0.06				
431.5	26							1.8	0.43	1.3	0.18	0.9	0.07				
450.5	27							1.9	0.47	1.3	0.19	0.9	0.07				
465.6	28							2.0	0.50	1.4	0.21	0.9	0.08				
484.5	29							2.1	0.53	1.4	0.22	1.0	0.08				
499.7	30							2.1	0.57	1.5	0.23	1.0	0.09				
583.0	35									1.7	0.31	1.2	0.12				
666.2	40									2.0	0.40	1.3	0.15				
749.5	45									2.2	0.50	1.5	0.19				
832.8	50											1.6	0.23				
916.1	55											1.8	0.27				
999.3	60											2.0	0.32				
1082.6	65											2.1	0.37	1.0	0.05		
1165.9	70											2.3	0.42	1.1	0.06		
1249.2	75													1.1	0.07		
1332.5	80													1.2	0.08		
1415.7	85													1.3	0.09		
1499.0	90													1.4	0.10		
1665.6	100													1.5	0.12	1.0	0.04
1832.1	110													1.7	0.14	1.1	0.05
1998.7	120													1.8	0.17	1.2	0.06
2165.3	130													2.0	0.20	1.3	0.07
2331.8	140													2.1	0.23	1.4	0.08
2498.4	150													2.3	0.26	1.5	0.09

Notes: Shaded area represents velocities over 1.5 m/s. Use with caution where water hammer is a concern.

FRICITION LOSS CHARTS - UPVC PIPE CLASS 4 (10 BAR)

C=150 • PRESSURE LOSS (BAR/100 METERS)																						
Nominal Size Pipe ID Pipe OD Wall Thick		25 mm 22 mm 25 mm 1.5 mm		32 mm 28.4 mm 32 mm 1.8 mm		40 mm 36.2 mm 40 mm 1.9 mm		50 mm 45.2 mm 50 mm 2.4 mm		63 mm 57 mm 63 mm 3.0 mm		75 mm 67.8 mm 75 mm 3.6 mm		90 mm 81.4 mm 90 mm 4.3 mm		110 mm 99.4 mm 110 mm 5.3 mm		160 mm 144.6 mm 160 mm 7.7 mm		200 mm 180.8 mm 200 mm 9.6 mm		
Flow l/min	Flow m³/hr	Velocity m/s	bar loss	Velocity m/s	bar loss	Velocity m/s	bar loss	Velocity m/s	bar loss	Velocity m/s	bar loss	Velocity m/s	bar loss	Velocity m/s	bar loss	Velocity m/s	bar loss	Velocity m/s	bar loss	Velocity m/s	bar loss	
3.8	0.25	0.2	0.02																			
7.6	0.5	0.4	0.08																			
11.4	0.75	0.5	0.18																			
15.1	1	0.7	0.30																			
26.5	1.5	1.1	0.64	0.7	0.19																	
34.1	2	1.5	1.10	0.9	0.32																	
41.6	2.5	1.8	1.66	1.1	0.48	0.7	0.15															
49.2	3	2.2	2.33	1.3	0.67	0.8	0.21															
56.8	3.5	2.6	3.10	1.5	0.89	0.9	0.27															
68.1	4			1.8	1.14	1.1	0.35	0.7	0.12													
83.3	5			2.2	1.73	1.3	0.53	0.9	0.18													
98.4	6			2.6	2.42	1.6	0.74	1.0	0.25	0.7	0.08											
117.3	7					1.9	0.99	1.2	0.34	0.8	0.11											
132.5	8					2.2	1.27	1.4	0.43	0.9	0.14											
151.4	9					2.4	1.58	1.6	0.53	1.0	0.17	0.7	0.07									
166.6	10							1.7	0.65	1.1	0.21	0.8	0.09									
181.7	11							1.9	0.77	1.2	0.25	0.8	0.11									
200.6	12							2.1	0.91	1.3	0.29	0.9	0.13									
215.8	13							2.3	1.06	1.4	0.34	1.0	0.15									
234.7	14							2.4	1.21	1.5	0.39	1.1	0.17									
249.8	15							2.6	1.38	1.6	0.44	1.2	0.19									
265.0	16									1.7	0.50	1.2	0.22	0.9	0.09							
283.9	17									1.9	0.56	1.3	0.24	0.9	0.10							
299.0	18									2.0	0.62	1.4	0.27	1.0	0.11							
318.0	19									2.1	0.69	1.5	0.30	1.0	0.12							
333.1	20									2.2	0.76	1.5	0.33	1.1	0.13							
348.3	21									2.3	0.83	1.6	0.36	1.1	0.15							
367.2	22									2.4	0.90	1.7	0.39	1.2	0.16							
382.3	23									2.5	0.98	1.8	0.42	1.2	0.17							
401.3	24											1.8	0.46	1.3	0.19							
416.4	25											1.9	0.49	1.3	0.20							
431.5	26											2.0	0.53	1.4	0.22	0.9	0.08					
450.5	27											2.1	0.57	1.4	0.23	1.0	0.09					
465.6	28											2.2	0.61	1.5	0.25	1.0	0.09					
484.5	29											2.2	0.65	1.5	0.27	1.0	0.10					
499.7	30											2.3	0.69	1.6	0.28	1.1	0.11	0.5	0.02			
583.0	35													1.9	0.38	1.3	0.14	0.6	0.02			
666.2	40													2.1	0.48	1.4	0.18	0.7	0.03			
749.5	45													2.4	0.60	1.6	0.23	0.8	0.04			
832.8	50															1.8	0.28	0.8	0.04			
916.1	55															2.0	0.33	0.9	0.05			
999.3	60															2.1	0.39	1.0	0.06			
1082.6	65															2.3	0.45	1.1	0.07			
1165.9	70															2.5	0.51	1.2	0.08			
1249.2	75															2.7	0.58	1.3	0.09			
1332.5	80															2.9	0.66	1.4	0.11			
1415.7	85															3.0	0.74	1.4	0.12			
1499.0	90															3.2	0.82	1.5	0.13	1.0	0.04	
1665.6	100																	1.7	0.16	1.1	0.05	
1832.1	110																	1.9	0.19	1.2	0.06	
1998.7	120																	2.0	0.22	1.3	0.08	
2165.3	130																	2.2	0.26	1.4	0.09	
2331.8	140																	2.4	0.30	1.5	0.10	
2498.4	150																	2.5	0.34	1.6	0.11	

Notes: Shaded area represents velocities over 1.5 m/s. Use with caution where water hammer is a concern.

FRICITION LOSS CHARTS - UPVC PIPE CLASS (16 BAR)

C=150 • PRESSURE LOSS (BAR/100 METERS)																					
Nominal Size		25 mm		32 mm		40 mm		50 mm		63 mm		75 mm		90 mm		110 mm		160 mm		200 mm	
Pipe ID		21.2 mm		27.2 mm		34 mm		42.6 mm		53.6 mm		63.8 mm		76.6 mm		93.6 mm		136.2 mm		170.2 mm	
Pipe OD		25 mm		32 mm		40 mm		50 mm		63 mm		75 mm		90 mm		110 mm		160 mm		200 mm	
Wall Thick		1.5 mm		1.8 mm		1.9 mm		2.4 mm		3 mm		3.6 mm		4.3 mm		5.3 mm		7.7 mm		14.9 mm	
Flow l/min	Flow m³/hr	Velocity m/s	bar loss	Velocity m/s	bar loss	Velocity m/s	bar loss	Velocity m/s	bar loss	Velocity m/s	bar loss	Velocity m/s	bar loss	Velocity m/s	bar loss	Velocity m/s	bar loss	Velocity m/s	bar loss	Velocity m/s	bar loss
3.8	0.25	0.2	0.03																		
7.6	0.5	0.4	0.10																		
11.4	0.75	0.6	0.21	0.4	0.06																
15.1	1	0.8	0.36	0.5	0.11	0.3	0.04														
26.5	1.5	1.2	0.77	0.7	0.23	0.5	0.08	0.3	0.03												
34.1	2	1.6	1.32	1.0	0.39	0.6	0.13	0.4	0.04												
41.6	2.5	2.0	1.99	1.2	0.59	0.8	0.20	0.5	0.07												
49.2	3	2.4	2.79	1.4	0.83	0.9	0.28	0.6	0.09												
56.8	3.5			1.7	1.10	1.1	0.37	0.7	0.12												
68.1	4			1.9	1.41	1.2	0.48	0.8	0.16												
83.3	5			2.4	2.13	1.5	0.72	1.0	0.24												
98.4	6					1.8	1.01	1.2	0.34	0.7	0.11										
117.3	7					2.1	1.34	1.4	0.45	0.9	0.15										
132.5	8					2.4	1.72	1.6	0.57	1.0	0.19										
151.4	9							1.8	0.71	1.1	0.23										
166.6	10							1.9	0.87	1.2	0.28										
181.7	11							2.1	1.03	1.4	0.34	1.0	0.14								
200.6	12							2.3	1.21	1.5	0.40	1.0	0.17								
215.8	13									1.6	0.46	1.1	0.20								
234.7	14									1.7	0.53	1.2	0.23								
249.8	15									1.8	0.60	1.3	0.26								
265.0	16									2.0	0.68	1.4	0.29	1.0	0.12						
283.9	17									2.1	0.76	1.5	0.32	1.0	0.13						
299.0	18									2.2	0.84	1.6	0.36	1.1	0.15						
318.0	19									2.3	0.93	1.7	0.40	1.1	0.16						
333.1	20									2.5	1.02	1.7	0.44	1.2	0.18						
348.3	21											1.8	0.48	1.3	0.20						
367.2	22											1.9	0.52	1.3	0.21						
382.3	23											2.0	0.57	1.4	0.23						
401.3	24											2.1	0.61	1.4	0.25	1.0	0.09				
416.4	25											2.2	0.66	1.5	0.27	1.0	0.10				
431.5	26											2.3	0.71	1.6	0.29	1.0	0.11				
450.5	27											2.3	0.76	1.6	0.31	1.1	0.12				
465.6	28											2.4	0.82	1.7	0.33	1.1	0.13				
484.5	29											2.5	0.87	1.7	0.36	1.2	0.13				
499.7	30													1.8	0.38	1.2	0.14				
583.0	35													2.1	0.51	1.4	0.19				
666.2	40													2.4	0.65	1.6	0.24				
749.5	45													2.7	0.81	1.8	0.30				
832.8	50															2.0	0.37	1.0	0.06		
916.1	55															2.2	0.44	1.0	0.07		
999.3	60															2.4	0.52	1.1	0.08		
1082.6	65															2.6	0.60	1.2	0.10		
1165.9	70															2.8	0.69	1.3	0.11		
1249.2	75															3.0	0.78	1.4	0.13		
1332.5	80															3.2	0.88	1.5	0.14		
1415.7	85																	1.6	0.16		
1499.0	90																	1.7	0.18		
1665.6	100																	1.9	0.21	1.2	0.07
1832.1	110																	2.1	0.26	1.3	0.09
1998.7	120																	2.3	0.30	1.5	0.10
2165.3	130																	2.5	0.35	1.6	0.12
2331.8	140																	2.7	0.40	1.7	0.14
2498.4	150																	2.9	0.45	1.8	0.15

Notes: Shaded area represents velocities over 1.5 m/s. Use with caution where water hammer is a concern.

FRICION LOSS CHARTS - SCHEDULE 40 IPS PVC PLASTIC PIPE

C=150 • PRESSURE LOSS (BAR/100 METERS)

Nominal Size		1"		1¼"		1½"		2"		2½"		3"		4"		6"		8"	
Pipe OD		1.315"		1.66"		1.900"		2.375"		2.375"		3.500"		4.500"		6.625"		8.625"	
Pipe ID		1.049"		1.380"		1.610"		2.067"		2.469"		3.068"		4.026"		6.065"		7.981"	
Pipe ID mm		26.64		35.05		40.89		52.50		62.71		77.93		102.26		154.05		202.72	
Wall Thick		0.133"		0.140"		0.145"		0.154"		0.203"		0.216"		0.237"		0.280"		0.322"	
Flow l/min	Flow m³/hr	Velocity m/s	bar loss	Velocity m/s	bar loss	Velocity m/s	bar loss	Velocity m/s	bar loss	Velocity m/s	bar loss	Velocity m/s	bar loss	Velocity m/s	bar loss	Velocity m/s	bar loss	Velocity m/s	bar loss
3.8	0.25	0.1	0.01																
7.6	0.5	0.2	0.03																
11.4	0.75	0.4	0.07	0.2	0.02														
15.1	1	0.5	0.12	0.3	0.03	0.2	0.01												
26.5	1.5	0.7	0.25	0.4	0.07	0.3	0.03	0.2	0.01										
34.1	2	1.0	0.43	0.6	0.11	0.4	0.05	0.3	0.02										
41.6	2.5	1.2	0.65	0.7	0.17	0.5	0.08	0.3	0.02										
49.2	3	1.5	0.92	0.9	0.24	0.6	0.11	0.4	0.03										
56.8	3.5	1.7	1.22	1.0	0.32	0.7	0.15	0.4	0.04										
68.1	4	2.0	1.56	1.2	0.41	0.8	0.19	0.5	0.06										
83.3	5	2.5	2.36	1.4	0.62	1.1	0.29	0.6	0.09										
98.4	6			1.7	0.87	1.3	0.41	0.8	0.12	0.5	0.05	0.3	0.02						
117.3	7			2.0	1.16	1.5	0.55	0.9	0.16	0.6	0.07	0.4	0.02						
132.5	8			2.3	1.48	1.7	0.70	1.0	0.21	0.7	0.09	0.5	0.03						
151.4	9			2.6	1.84	1.9	0.87	1.2	0.26	0.8	0.11	0.5	0.04						
166.6	10			2.9	2.24	2.1	1.06	1.3	0.31	0.9	0.13	0.6	0.05						
181.7	11					2.3	1.26	1.4	0.37	1.0	0.16	0.6	0.05						
200.6	12					2.5	1.48	1.5	0.44	1.1	0.18	0.7	0.06						
215.8	13					2.7	1.72	1.7	0.51	1.2	0.21	0.8	0.07						
234.7	14					3.0	1.97	1.8	0.58	1.3	0.25	0.8	0.09						
249.8	15					3.2	2.24	1.9	0.66	1.3	0.28	0.9	0.10						
265.0	16							2.1	0.75	1.4	0.31	0.9	0.11						
283.9	17							2.2	0.84	1.5	0.35	1.0	0.12						
299.0	18							2.3	0.93	1.6	0.39	1.0	0.14						
318.0	19							2.4	1.03	1.7	0.43	1.1	0.15						
333.1	20							2.6	1.13	1.8	0.48	1.2	0.17						
348.3	21							1.9	0.52	1.2	0.18								
367.2	22							2.0	0.57	1.3	0.20								
382.3	23							2.1	0.62	1.3	0.21								
401.3	24							2.2	0.67	1.4	0.23								
416.4	25							2.2	0.72	1.5	0.25								
431.5	26							2.3	0.77	1.5	0.27								
450.5	27							2.4	0.83	1.6	0.29								
465.6	28									1.6	0.31								
484.5	29									1.7	0.33								
499.7	30									1.7	0.35								
583.0	35									2.0	0.47	1.2	0.12						
666.2	40									2.3	0.60	1.4	0.16						
749.5	45									2.6	0.74	1.5	0.20						
832.8	50									2.9	0.90	1.7	0.24						
916.1	55											1.9	0.29						
999.3	60											2.0	0.34						
1082.6	65											2.2	0.39	1.0	0.07				
1165.9	70											2.4	0.45	1.0	0.08				
1249.2	75											2.5	0.51	1.1	0.09				
1332.5	80											2.7	0.57	1.2	0.10				
1415.7	85											2.9	0.64	1.3	0.11				
1499.0	90											3.0	0.71	1.3	0.12	0.8	0.03		
1665.6	100													1.5	0.15	0.9	0.03		
1832.1	110													1.6	0.18	0.9	0.04		
1998.7	120													1.8	0.21	1.0	0.04		
2165.3	130													1.9	0.25	1.1	0.05		
2331.8	140													2.1	0.28	1.2	0.06		
2498.4	150													2.1	0.32	1.3	0.07		

Notes: Shaded area represents velocities over 1.5 m/s. Use with caution where water hammer is a concern.

FRICITION LOSS CHARTS - SCHEDULE 80 IPS PVC PLASTIC PIPE

C=150 • PRESSURE LOSS (BAR/100 METERS)																			
Nominal Size		1"		1¼"		1½"		2"		2½"		3"		4"		6"		8"	
Pipe OD		1.315"		1.660"		1.900"		2.375"		2.875"		3.500"		4.500"		6.625"		8.625"	
Pipe ID		0.957"		1.278"		1.500"		1.939"		2.323"		2.900"		3.826"		5.761"		7.625"	
Pipe ID mm		24.31		32.46		38.10		49.25		59.00		73.66		97.18		146.33		193.68	
Wall Thick		0.179"		0.191"		0.200"		0.218"		0.276"		0.300"		0.337"		0.432"		0.500"	
Flow l/min	Flow m³/hr	Velocity m/s	bar loss	Velocity m/s	bar loss	Velocity m/s	bar loss	Velocity m/s	bar loss	Velocity m/s	bar loss	Velocity m/s	bar loss	Velocity m/s	bar loss	Velocity m/s	bar loss	Velocity m/s	bar loss
3.8	0.25	0.1	0.01																
7.6	0.5	0.3	0.05																
11.4	0.75	0.4	0.11	0.3	0.03														
15.1	1	0.6	0.19	0.3	0.05	0.2	0.02												
26.5	1.5	0.9	0.40	0.5	0.10	0.4	0.04	0.2	0.01										
34.1	2	1.2	0.68	0.7	0.17	0.5	0.08	0.3	0.02										
41.6	2.5	1.5	1.02	0.8	0.25	0.6	0.11	0.4	0.03										
49.2	3	1.8	1.43	1.0	0.35	0.7	0.16	0.4	0.05										
56.8	3.5	2.1	1.90	1.2	0.47	0.9	0.21	0.5	0.06										
68.1	4	2.4	2.44	1.3	0.60	1.0	0.27	0.6	0.08										
83.3	5	3.0	3.69	1.7	0.90	1.2	0.41	0.7	0.12										
98.4	6			2.0	1.26	1.5	0.58	0.9	0.17	0.6	0.07	0.4	0.02						
117.3	7			2.3	1.68	1.7	0.77	1.0	0.22	0.7	0.09	0.5	0.03						
132.5	8			2.7	2.15	1.9	0.99	1.2	0.28	0.8	0.12	0.5	0.04						
151.4	9			3.0	2.68	2.2	1.23	1.3	0.35	0.9	0.15	0.6	0.05						
166.6	10					2.4	1.49	1.5	0.43	1.0	0.18	0.7	0.06						
181.7	11					2.7	1.78	1.6	0.51	1.1	0.21	0.7	0.07						
200.6	12					2.9	2.09	1.7	0.60	1.2	0.25	0.8	0.08						
215.8	13							1.9	0.69	1.3	0.29	0.8	0.10						
234.7	14							2.0	0.80	1.4	0.33	0.9	0.11						
249.8	15							2.2	0.91	1.5	0.38	1.0	0.13						
265.0	16							2.3	1.02	1.6	0.42	1.0	0.14						
283.9	17							2.5	1.14	1.7	0.47	1.1	0.16						
299.0	18							2.6	1.27	1.8	0.53	1.2	0.18						
318.0	19									1.9	0.58	1.2	0.20						
333.1	20									2.0	0.64	1.3	0.22						
348.3	21									2.1	0.70	1.4	0.24						
367.2	22									2.2	0.76	1.4	0.26						
382.3	23									2.3	0.83	1.5	0.28						
401.3	24									2.4	0.90	1.6	0.30						
416.4	25									2.5	0.97	1.6	0.33						
431.5	26											1.7	0.35						
450.5	27											1.8	0.38						
465.6	28											1.8	0.41	1.0	0.11				
484.5	29											1.9	0.43	1.1	0.11				
499.7	30											2.0	0.46	1.1	0.12				
583.0	35											2.3	0.61	1.3	0.16				
666.2	40											2.6	0.78	1.5	0.20				
749.5	45													1.7	0.25				
832.8	50													1.9	0.31				
916.1	55													2.1	0.37				
999.3	60													2.2	0.43				
1082.6	65													2.4	0.50	1.1	0.07		
1165.9	70													2.6	0.57	1.2	0.08		
1249.2	75													2.8	0.65	1.2	0.09		
1332.5	80													3.0	0.73	1.3	0.10		
1415.7	85													3.2	0.82	1.4	0.11		
1499.0	90													3.4	0.91	1.5	0.12		
1665.6	100															1.7	0.15	0.9	0.04
1832.1	110															1.8	0.18	1.0	0.05
1998.7	120															2.0	0.21	1.1	0.05
2165.3	130															2.1	0.25	1.2	0.06
2331.8	140															2.3	0.28	1.3	0.07
2498.4	150															2.5	0.32	1.4	0.08

Notes: Shaded area represents velocities over 1.5 m/s. Use with caution where water hammer is a concern.

FRICION LOSS CHARTS - HDPE PRESSURE PIPE PE80 SDR 17.6 PN6

C=140 • PRESSURE LOSS (BAR/100 METERS)

Nominal Size Pipe ID mm Wall Thick		25 mm 21.40 1.8		32 mm 28.40 1.8		40 mm 35.40 2.3		50 mm 44.20 2.9		63 mm 55.80 3.6		75 mm 66.40 4.3		90 mm 79.80 5.1		110 mm 97.40 6.3		160 mm 141.80 9.1		200 mm 177.20 11.4	
Flow l/min	Flow m ³ /hr	Velocity m/s	bar loss	Velocity m/s	bar loss	Velocity m/s	bar loss	Velocity m/s	bar loss	Velocity m/s	bar loss	Velocity m/s	bar loss	Velocity m/s	bar loss	Velocity m/s	bar loss	Velocity m/s	bar loss	Velocity m/s	bar loss
3.8	0.25	0.2	0.03																		
7.6	0.5	0.4	0.11																		
11.4	0.75	0.6	0.23	0.3	0.06																
15.1	1	0.8	0.40	0.4	0.10	0.3	0.03														
26.5	1.5	1.2	0.84	0.7	0.21	0.4	0.07	0.3	0.02												
34.1	2	1.5	1.43	0.9	0.36	0.6	0.12	0.4	0.04												
41.6	2.5	1.9	2.16	1.1	0.54	0.7	0.19	0.5	0.06												
49.2	3	2.3	3.03	1.3	0.76	0.8	0.26	0.5	0.09												
56.8	3.5	2.7	4.03	1.5	1.01	1.0	0.35	0.6	0.12												
68.1	4	3.1	5.16	1.8	1.30	1.1	0.44	0.7	0.15												
83.3	5			2.2	1.96	1.4	0.67	0.9	0.23												
98.4	6			2.6	2.75	1.7	0.94	1.1	0.32	0.7	0.10	0.5	0.04								
117.3	7			3.1	3.66	2.0	1.25	1.3	0.42	0.8	0.14	0.6	0.06								
132.5	8			3.5	4.69	2.3	1.60	1.4	0.54	0.9	0.17	0.6	0.07								
151.4	9					2.5	2.00	1.6	0.68	1.0	0.22	0.7	0.09								
166.6	10					2.8	2.43	1.8	0.82	1.1	0.26	0.8	0.11								
181.7	11							2.0	0.98	1.2	0.32	0.9	0.14								
200.6	12							2.2	1.15	1.4	0.37	1.0	0.16								
215.8	13							2.4	1.34	1.5	0.43	1.0	0.18								
234.7	14							2.5	1.53	1.6	0.49	1.1	0.21								
249.8	15							2.7	1.74	1.7	0.56	1.2	0.24								
265.0	16							2.9	1.96	1.8	0.63	1.3	0.27								
283.9	17							3.1	2.20	1.9	0.71	1.4	0.30								
299.0	18							3.3	2.44	2.0	0.79	1.4	0.34								
318.0	19									2.2	0.87	1.5	0.37								
333.1	20									2.3	0.95	1.6	0.41								
348.3	21									2.4	1.04	1.7	0.45	1.2	0.18						
367.2	22									2.5	1.14	1.8	0.49	1.2	0.20						
382.3	23									2.6	1.24	1.8	0.53	1.3	0.22						
401.3	24									2.7	1.34	1.9	0.57	1.3	0.23						
416.4	25									3.8	1.44	2.0	0.62	1.4	0.25						
431.5	26											2.1	0.67	1.4	0.27	1.0	0.10	0.5	0.02		
450.5	27											2.2	0.71	1.5	0.29	1.0	0.11	0.5	0.02		
465.6	28											2.2	0.76	1.6	0.31	1.0	0.12	0.5	0.02		
484.5	29											2.3	0.81	1.6	0.33	1.1	0.13	0.5	0.02		
499.7	30											2.4	0.87	1.7	0.35	1.1	0.13	0.5	0.02		
583.0	35											2.8	1.15	1.9	0.47	1.3	0.18	0.6	0.03		
666.2	40											3.2	1.48	2.2	0.60	1.5	0.23	0.7	0.04		
749.5	45													2.5	0.75	1.7	0.28	0.8	0.05		
832.8	50													2.8	0.91	1.9	0.35	0.9	0.06		
916.1	55													3.1	1.09	2.1	0.41	1.0	0.07		
999.3	60													3.3	1.28	2.2	0.48	1.1	0.08		
1082.6	65															2.4	0.56	1.1	0.09		
1165.9	70															2.6	0.64	1.2	0.10		
1249.2	75																	1.3	0.12		
1332.5	80																	1.4	0.13		
1415.7	85																	1.5	0.15		
1499.0	90																	1.6	0.16		
1665.6	100																	1.8	0.20	1.1	0.07
1832.1	110																	1.9	0.24	1.2	0.08
1998.7	120																	2.1	0.28	1.4	0.09
2165.3	130																	2.3	0.33	1.5	0.11
2331.8	140																			1.6	0.13
2498.4	150																			1.7	0.14

Notes: Shaded area represents velocities over 1.5 m/s. Use with caution where water hammer is a concern.

TECHNICAL

FRICION LOSS CHARTS - HDPE PRESSURE PIPE PE80 SDR 11 PN10

C=140 • PRESSURE LOSS (BAR/100 METERS)																						
Nominal Size Pipe ID mm Wall Thick		25 mm 20.40 2.3		32 mm 26.20 2.9		40 mm 32.60 3.7		50 mm 40.80 4.6		63 mm 51.40 5.8		75 mm 61.40 6.8		90 mm 73.60 8.2		110 mm 90.00 10		160 mm 130.80 14.6		200 mm 163.60 18.2		
Flow l/min	Flow m ³ /hr	Velocity m/s	bar loss	Velocity m/s	bar loss	Velocity m/s	bar loss	Velocity m/s	bar loss	Velocity m/s	bar loss	Velocity m/s	bar loss	Velocity m/s	bar loss	Velocity m/s	bar loss	Velocity m/s	bar loss	Velocity m/s	bar loss	
3.8	0.25	0.2	0.04																			
7.6	0.5	0.4	0.14																			
11.4	0.75	0.6	0.29	0.4	0.09																	
15.1	1	0.8	0.50	0.5	0.15																	
26.5	1.5	1.3	1.06	0.8	0.31	0.5	0.11															
34.1	2	1.7	1.80	1.0	0.53	0.7	0.18															
41.6	2.5	2.1	2.73	1.3	0.81	0.8	0.28	0.5	0.09													
49.2	3	2.5	3.82	1.5	1.13	1.0	0.39	0.6	0.13													
56.8	3.5	3.0	5.08	1.8	1.50	1.2	0.52	0.7	0.17													
68.1	4			2.1	1.92	1.3	0.66	0.8	0.22	0.5	0.07											
83.3	5			2.6	2.91	1.7	1.00	1.1	0.34	0.7	0.11											
98.4	6			3.1	4.08	2.0	1.41	1.3	0.47	0.8	0.15											
117.3	7					2.3	1.87	1.5	0.63	0.9	0.20											
132.5	8					2.7	2.40	1.7	0.8	1.1	0.26											
151.4	9					3.0	2.98	1.9	1.00	1.2	0.32											
166.6	10							2.1	1.21	1.3	0.39											
181.7	11							2.3	1.45	1.5	0.47	1.0	0.20									
200.6	12							2.5	1.70	1.6	0.55	1.1	0.23									
215.8	13							2.8	1.97	1.7	0.64	1.2	0.27									
234.7	14							3.0	2.27	1.9	0.74	1.3	0.31									
249.8	15									2.0	0.84	1.4	0.35									
265.0	16									2.1	0.94	1.5	0.40									
283.9	17									2.3	1.05	1.6	0.44	1.1	0.18							
299.0	18									2.4	1.17	1.7	0.49	1.2	0.20							
318.0	19									2.5	1.30	1.8	0.54	1.2	0.23							
333.1	20									2.7	1.42	1.9	0.60	1.3	0.25							
348.3	21									2.8	1.56	2.0	0.66	1.4	0.27							
367.2	22									2.9	1.70	2.1	0.71	1.4	0.30							
382.3	23									3.1	1.84	2.2	0.78	1.5	0.32							
401.3	24											2.3	0.84	1.6	0.35							
416.4	25											2.3	0.91	1.6	0.37							
431.5	26											2.4	0.97	1.7	0.40	1.1	0.15					
450.5	27											2.5	1.04	1.8	0.43	1.2	0.16					
465.6	28											2.6	1.12	1.8	0.46	1.2	0.17					
484.5	29											2.7	1.19	1.9	0.49	1.3	0.19					
499.7	30											2.8	1.27	2.0	0.53	1.3	0.20					
583.0	35											3.3	1.69	2.3	0.70	1.5	0.26					
666.2	40													2.6	0.89	1.7	0.34					
749.5	45													2.9	1.11	2.0	0.42					
832.8	50													3.3	1.35	2.2	0.51	1.0	0.08			
916.1	55															2.4	0.61	1.1	0.10			
999.3	60															2.6	0.71	1.2	0.12			
1082.6	65															2.8	0.83	1.3	0.13			
1165.9	70															3.1	0.95	1.4	0.15			
1249.2	75															3.3	1.08	1.6	0.17			
1332.5	80																	1.7	0.20			
1415.7	85																	1.8	0.22	1.1	0.07	
1499.0	90																	1.9	0.24	1.2	0.08	
1665.6	100																	2.1	0.30	1.3	0.10	
1832.1	110																	2.3	0.35	1.5	0.12	
1998.7	120																	2.5	0.42	1.6	0.14	
2165.3	130																	2.7	0.48	1.7	0.16	
2331.8	140																			1.8	0.19	
2498.4	150																			2.0	0.21	

Notes: Shaded area represents velocities over 1.5 m/s. Use with caution where water hammer is a concern.

FRICION LOSS CHARTS

TABLE OF APPROXIMATE PRESSURE LOSSES FOR PIPE FITTINGS

Steel Fitting Type	½"	¾"	1"	1¼"	1½"	2"	2½"	3"	4"	6"	8"
Coupling	0.18	0.24	0.30	0.37	0.46	0.61	0.76	0.91	1.21	1.82	2.40
Run of St. Tee	0.30	0.30	4.60	0.60	0.60	0.76	0.91	1.21	1.52	2.13	3.05
Tee, Side Outlet	0.91	1.38	1.50	2.13	2.74	3.35	4.0	4.90	6.1	9.44	12.1
Tee, Run Reduced ½"	0.45	0.76	0.91	1.21	1.50	1.82	2.13	2.4	3.65	4.90	6.10
Elbow, 90°	0.45	0.76	0.91	1.21	1.50	1.82	2.13	2.4	3.65	4.90	6.10
Elbow, 45°	0.22	0.30	0.40	0.52	0.60	0.76	0.91	1.06	1.5	2.28	3.04
Corporation Stop	2.74	2.74	2.74	2.74	2.74	2.74					
Curb Stop	1.82	1.82	2.13	2.13	2.43	2.43					

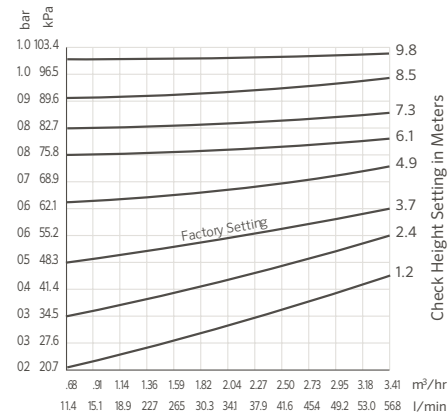
Plastic IPS or Copper Fitting Type	½"	¾"	1"	1¼"	1½"	2"	2½"	3"	4"	6"	8"
Coupling	0.46	0.76	0.91	0.91	1.22	1.82	2.13	2.43	3.35	5.50	7.31
Run of St. Tee	0.76	0.91	1.22	1.52	1.83	2.43	2.74	3.35	4.57	6.40	8.53
Tee, Side Outlet	2.13	2.74	3.65	4.57	5.48	7.31	9.14	11.0	13.71	21.33	27.43
Tee, Run Reduced ½"	1.06	1.37	1.82	2.43	2.74	3.35	4.26	5.18	7.31	10.36	13.71
Elbow, 90°	1.06	1.37	1.82	2.43	2.74	3.35	4.26	5.18	7.31	10.36	13.71
Elbow, 34°	0.46	0.60	0.91	1.06	1.22	1.52	2.13	2.44	3.04	4.90	6.10

Notes:

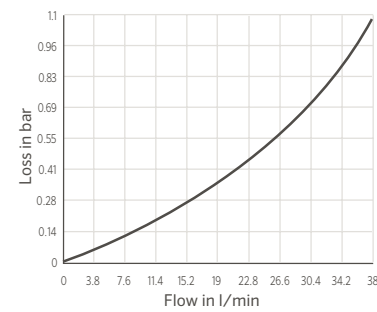
It is recommended that the above chart be used only when the manufacturers recommended pressure loss values are not available.

ACCESSORY PRESSURE LOSS CHARTS

HCV PRESSURE LOSS CHART



SWING JOINT FRICTION LOSS



WIRE DATA

STANDARD ANNEALED COPPER AT 20° C					
American Wire Gauge	Metric Wire Gauge	Diameter (Mils)	Diameter (mm)	Resistance (Per mft Ohms)	Resistance (Per km Ohms)
1		289.3	7.348	0.9239	0.4065
	7		7		0.448
2		257.6	6.543	0.1563	0.5128
	6		6		0.6098
3		229.4	5.827	0.1971	0.6466
4		204.3	5.189	0.2485	0.8152
	5		5		0.08781
5		181.9	4.62	0.3134	1.028
	4.5		4.5		1.084
6		162	4.115	0.3952	1.297
	4		4		1.372
7		144.3	3.665	0.4981	1.634
	3.5		3.5		1.792
8		128.5	3.264	0.6281	2.061
	3		3		2.439
9		114.4	2.906	0.7925	2.6
10		101.9	2.588	0.9988	3.277
	2.5		2.5		3.512
11		90.7	2.3	1.26	4.14
12		80.8	2.05	1.59	5.21
	2		2		5.49
13		72	1.83	2	6.56
	1.8		1.8		6.78
14		64.1	1.63	2.52	8.28
	1.6		1.6		8.58
15		57.1	1.45	3.18	10.4
	1.4		1.4		11.2
16		50.8	1.29	4.02	13.2
	1.2		1.2		15.2
17		45.3	1.15	5.05	16.6
18		40.3	1.02	6.39	21
	1		1		22
19		35.9	0.912	8.05	26.4
	0.9		0.9		27.1
20		32	0.813	10.1	33.2

WIRE SIZING

REQUIRED INFORMATION

Actual one-way length of wire between the controllers and the power source or the controllers and valves

Allowable voltage loss along the wire circuit

Accumulative current flowing through the wire section being sized in amperes

RESISTANCE IS CALCULATED USING THIS FORMULA:

$$R = \frac{1,000 \times AVL}{2L \times I}$$

R = Maximum Allowable Resistance of wire in ohms per 300 m
 AVL = Allowable voltage loss
 L = Wire length (one way)
 I = Inrush current

AVL for controller power wire sizing is calculated by subtracting the minimum operating voltage required by the controller from the minimum available voltage at the power source.

AVL for valve wire sizing is calculated by subtracting minimum solenoid operating voltage from controller output voltage. This number will vary depending on the manufacturer and in some cases with line pressure.

VALVE WIRE SIZING EXAMPLE

Given: The distance from the controller to the valve is 600 m. The controller output is 24 V. The valve has a minimum operating voltage of 20 V and an inrush current of 370 mA (0.37 A).

$$R = \frac{1,000 \times 4}{2(600) \times 0.37}$$

$$R = \frac{4,000}{444}$$

$$R = 9.01 \text{ ohms}/1,000 \text{ m}$$

So, wire resistance cannot exceed 9 ohms per 305 m. Now go to table #1 and select the proper wire size. Since 1.5 mm² gauge wire has more resistance than 9 ohms per 300 m, choose 2.5 mm² wire.

Table 2 is a quick reference and is set up to provide maximum wire runs given the information at the bottom of the table.

TABLE 1 - RESISTANCE OF COPPER WIRE		TABLE 2 - VALVE WIRE SIZING							
Wire Size (mm ²)	Resistance at 20° C (68° F) (ohms per 1000 m)	Ground Wire			Control Wire				
		0.5	1	1.5	2.5	4	6	6	
0.5	38.4	0.5	140	190	210	235	250	260	1590
1.0	18.7	1.0	190	290	335	415	465	495	2440
1.5	13.6	1.5	208	335	397	515	595	647	3700
2.5	7.4	2.5	235	415	515	730	900	1030	5400
4.0	4.6	4.0	250	465	595	900	1175	1405	7690
6.0	3.1	6.0	260	495	647	1030	1405	1745	10530

Notes:
 Maximum one-way distance in meters between controller and valve Heavy-duty solenoid: 24 VAC, 350 mA inrush current, 190 mA holding current, 60 Hz; 370 mA inrush current, 210 mA holding current, 50 Hz