Design, Installation and Management of Irrigation Systems….

STMA, San Antonio, 2014

SportsTurf MANAGERS ASSOCIATION

Experts on the Field, Partners in the Game.

Let's talk "water"...

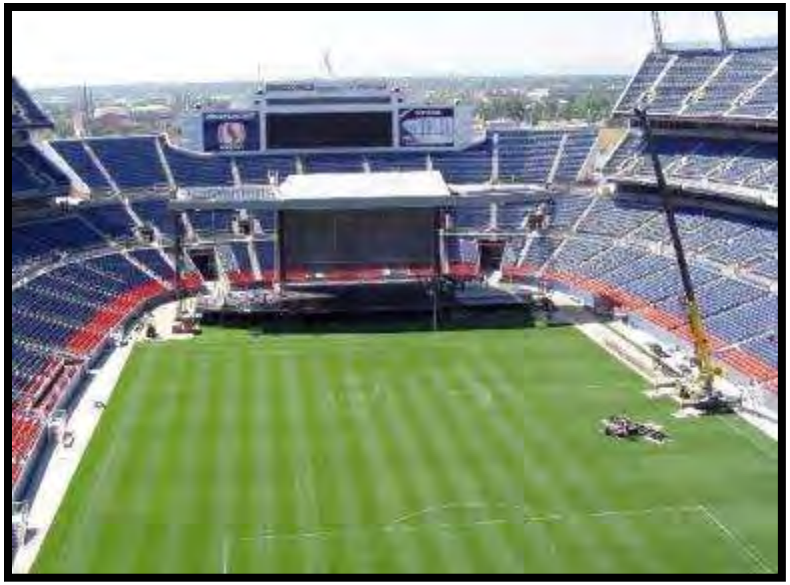
Why Am I Here?!

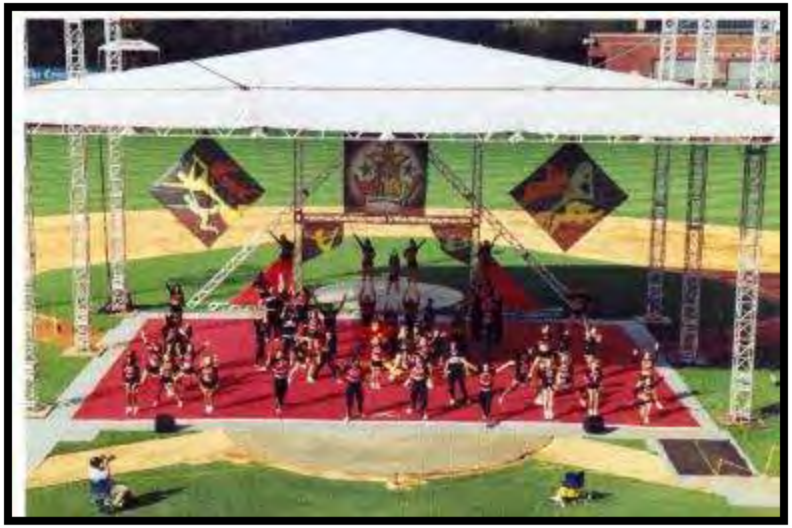
Understanding Irrigation Basic Design is the FIRST step to understanding outdoor water conservation and developing safe playing surfaces!

Irrigation System Design Workshop (1 day)

- Hydraulics
- Design Capacity
- Equipment Selection
- Precipitation Rates
- Equipment Layout/ Zoning
- Pipe Sizing
- Scheduling

Irrigating High Traffic Areas



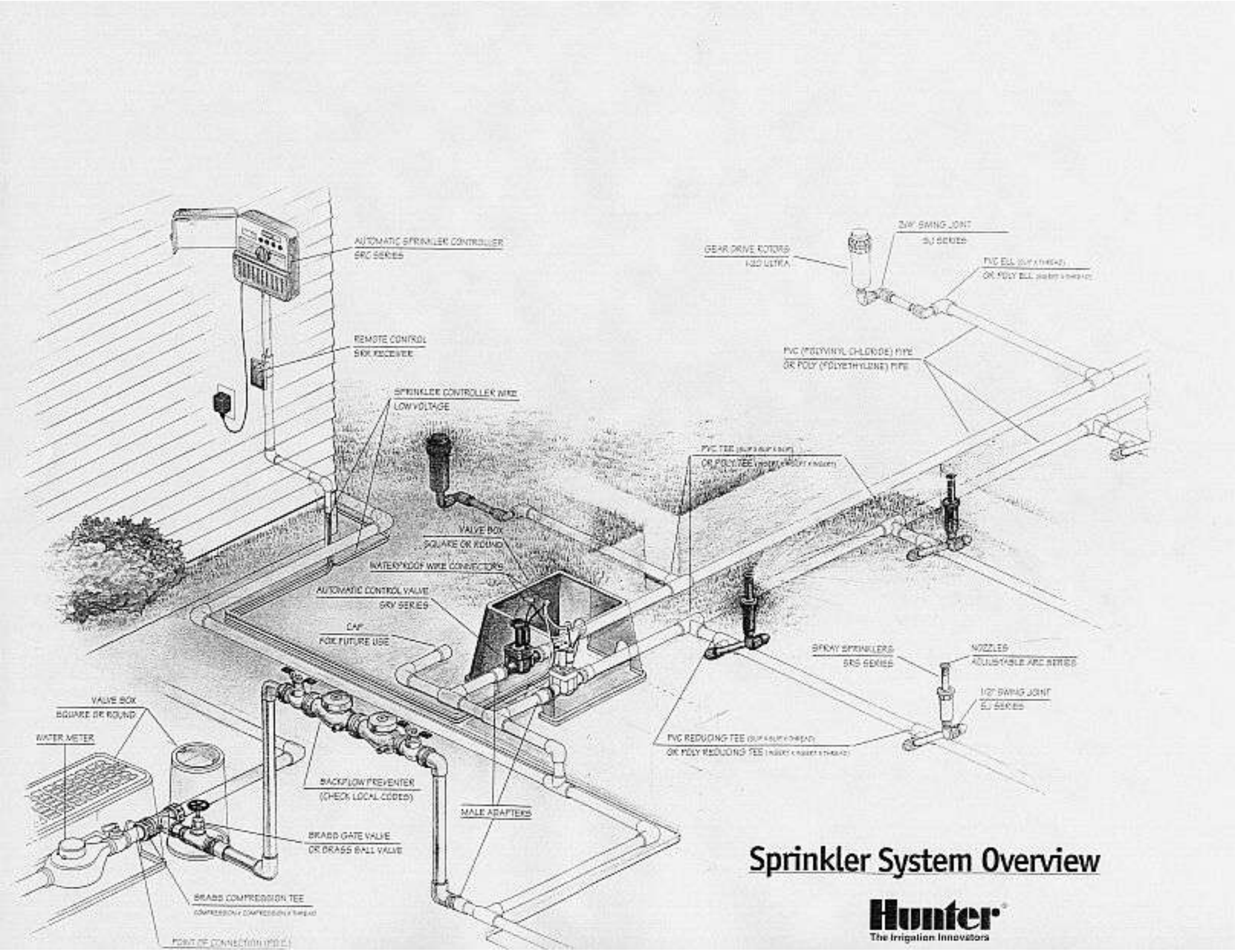



What Should I Consider for a Retro and/ or New System?

- Site specifics - problems and potentials
- Location
- Water source/ water quality
- Available hydraulics
- Equipment

Water Source & Water Quality

- Metered system
- Well & pump – sand/ silt
- Reclaimed - salts
- Gray – biodegradable fluids
- Gravity



AUTOMATIC SPRINKLER CONTROLLER
SRC SERIES
REMOTE CONTROL
SRR RECEIVER
SPRINKLER CONTROLLER WIRE
LOW VOLTAGE
VALVE BOX
SQUARE OR ROUND
WATERPROOF WIRE CONNECTORS
AUTOMATIC CONTROL VALVE
SRV SERIES
CAP
FOR FUTURE USE
GEAR DRIVE ROTORS
I-20 ULTRA
3/4" SWING JOINT
SJ SERIES
PVC ELL
OR POLY ELL
PVC (POLYVINYL CHLORIDE) PIPE
OR POLY (POLYETHYLENE) PIPE
PVC TEE
OR POLY TEE
SPRAY SPRINKLERS
SRS SERIES
NOZZLES
ADJUSTABLE ARC SERIES
1/2" SWING JOINT
SJ SERIES
PVC REDUCING TEE
OR POLY REDUCING TEE
VALVE BOX
SQUARE OR ROUND
WATER METER
BACKFLOW PREVENTER
(CHECK LOCAL CODES)
MALE ADAPTERS
BRASS GATE VALVE
OR BRASS BALL VALVE
BRASS COMPRESSION TEE
POINT OF CONNECTION (P.O.C.)
Sprinkler System Overview
Hunter
The Irrigation Innovators

Competent Irrigation Design

Core Basics:

Why Do We Need to Understand These?

- **Sites Specifics**
- **Hydraulics**
- **Design Capacity**
- **Precipitation Rates**
- **Equipment Selection**
- **ET**
- **IR**
- **KC**

Where to Start?

- **Design…..**

Available Hydraulics

Back to the basics…

- Pressure
- Volume
- Velocity

Irrigation Hydraulics

Affect:

- Sprinkler performance
- Uniform coverage
- System cost

*Irrigation Hydraulics

#1 Biggest Variable in a System?

*Pressure!!

Pressure…..

- The force of water, measured in **PSI** (pounds per square inch) or Feet of Head

Water Pressure

- **What are the two ways to create water pressure in a system?**

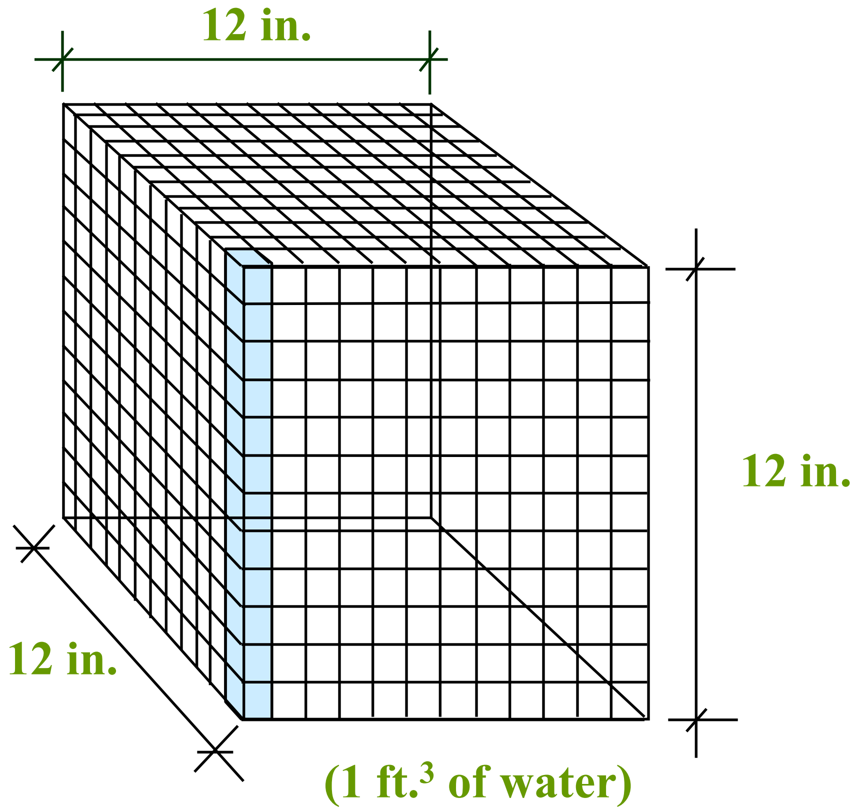
- **weight of water**
- **pump (mechanical pressurization)**

Water Facts

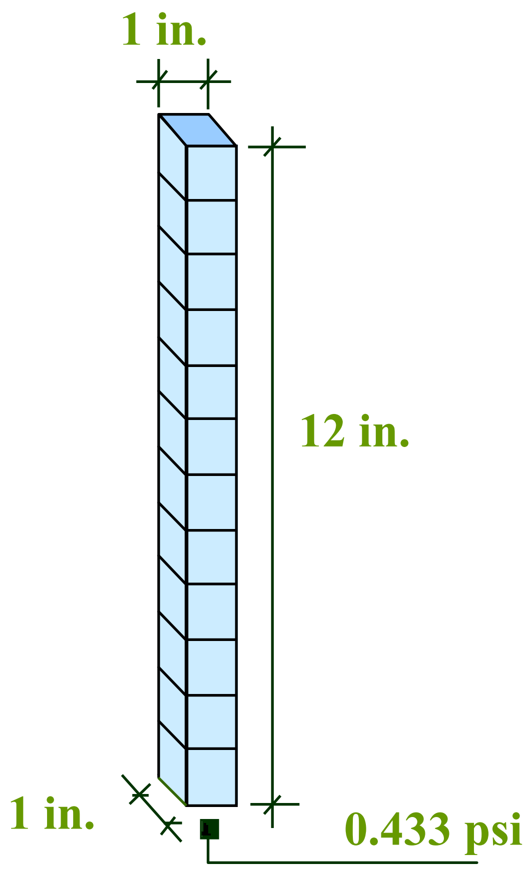
What water weighs at 60° F:

- 1 cubic foot (ft^3) = 1728 cu. in. = 62.43 lbs
- 1 cubic inch (in^3) = 0.0361 lbs

1 Cubic Foot of Water



Water Pressure from 1 Foot of Water

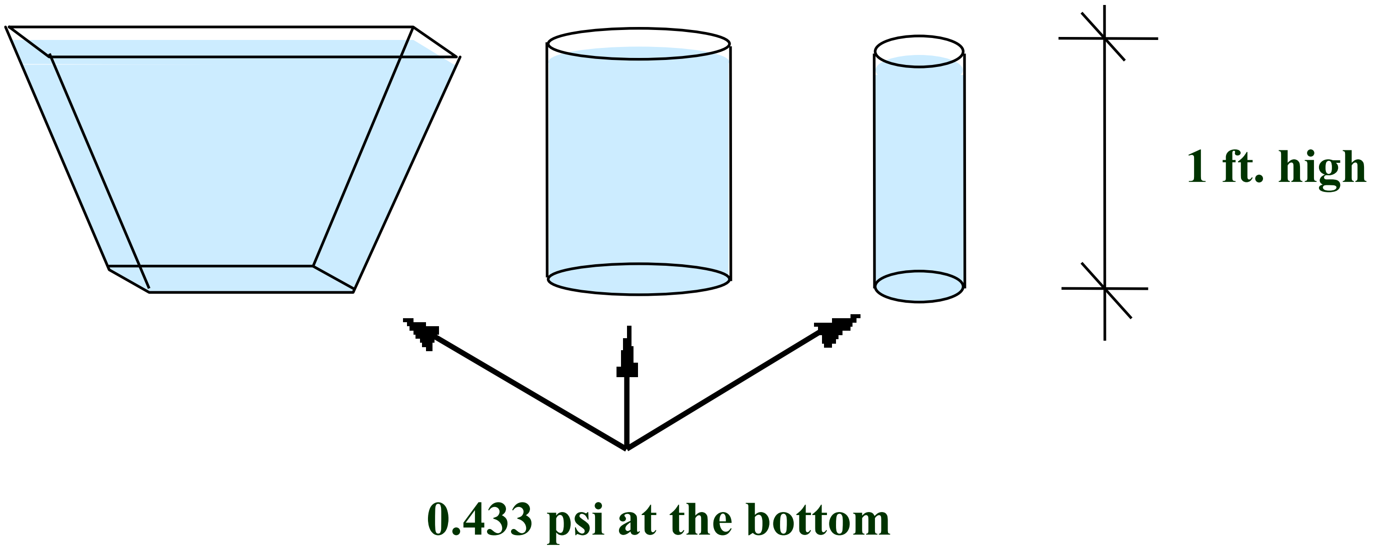


$12 \text{ in.}^3 \times 0.0361 \text{ lbs/in.}^3 = 0.433 \text{ lbs}$

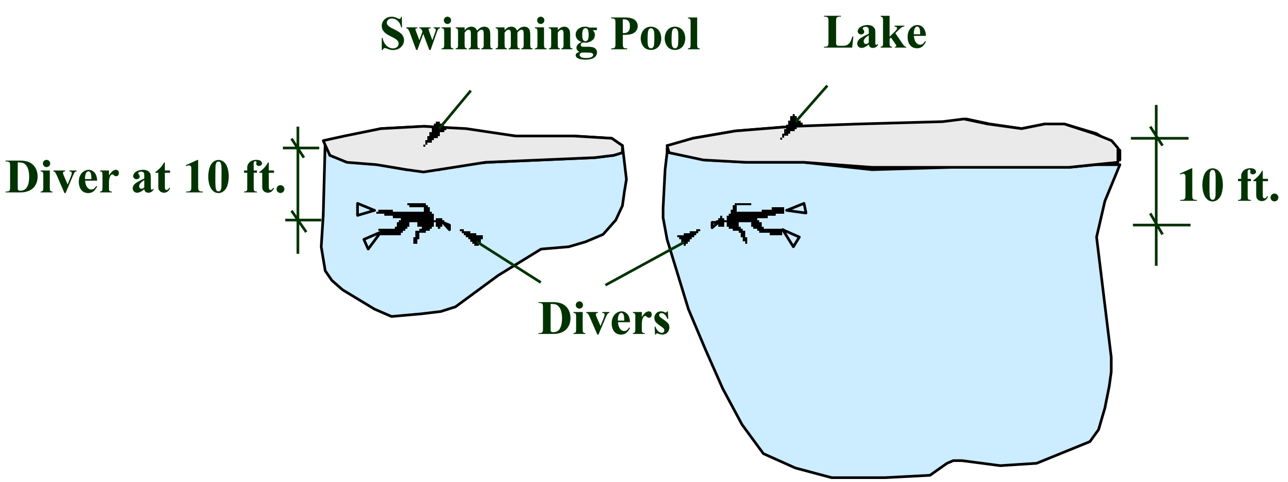
Facts to Memorize

- a column of water 1 ft. high = 0.433 psi
- a column of water 1 ft. high = 1 ft. of head
- 2.31 feet of head = 1 psi (2.31 x 0.433)

Does Container Shape Make a Difference?



Pressure in Pool vs.... Lake



Pressure on diver in pool and lake
4.33 psi (10 ft. x 0.433 psi/ft = 4.33 psi)

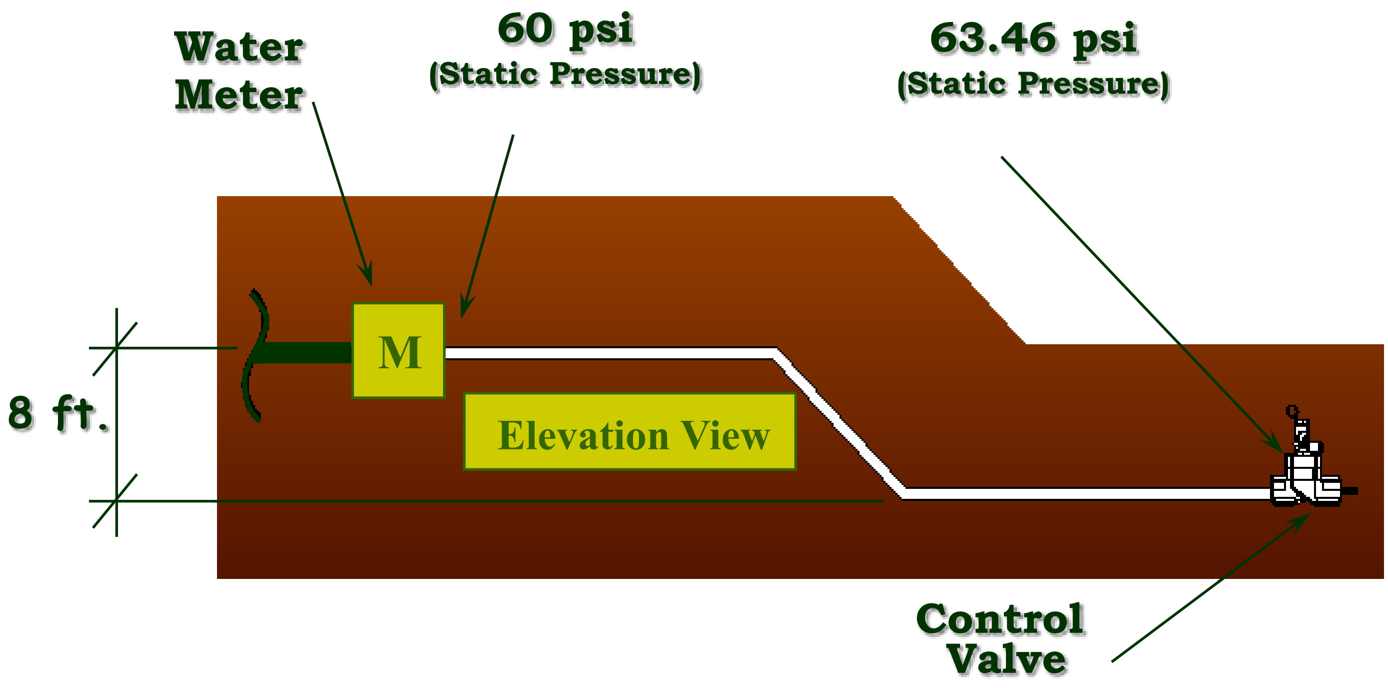
Pressure Change vs. Elevation

- **1 foot of elevation change = 0.433 psi change**

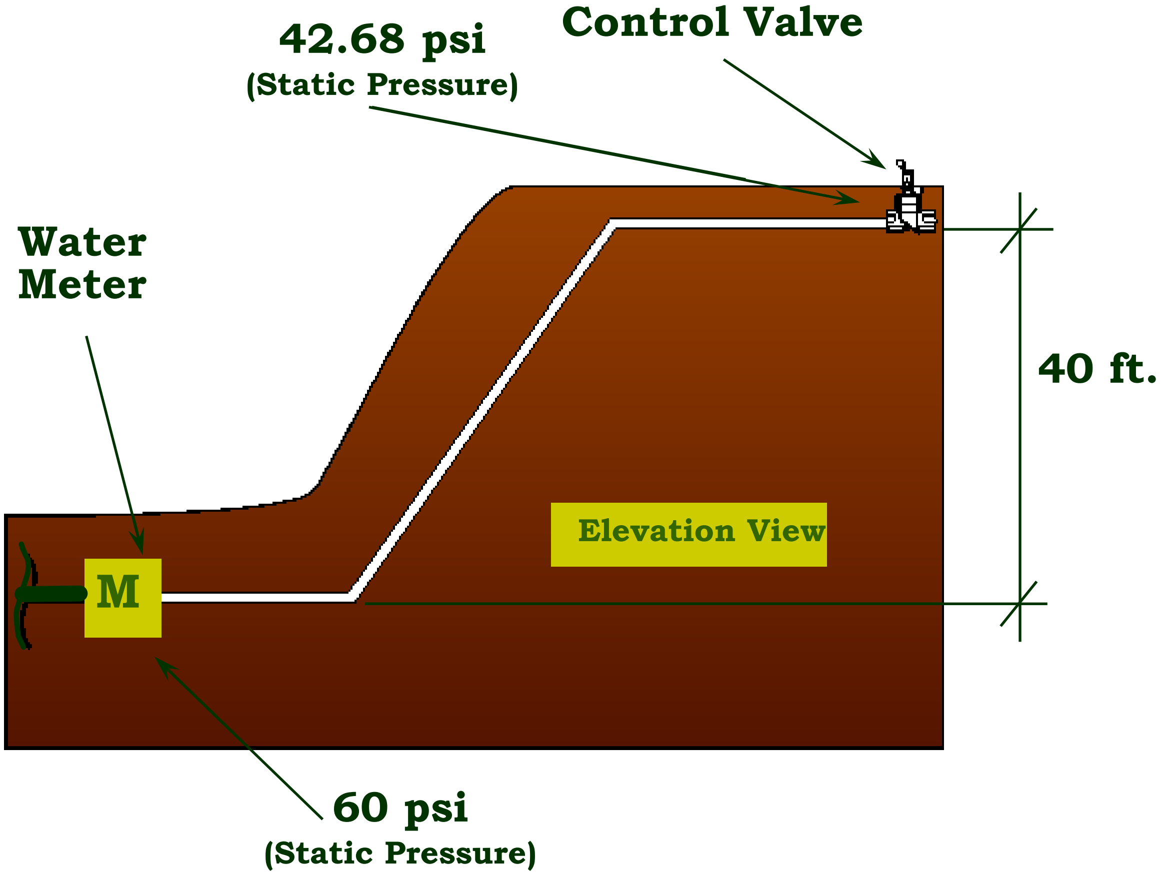
Static & Dynamic Pressure

- **Static Pressure: water at rest**
- **Dynamic Pressure: water in motion (working pressure)**

Sprinkler System Static Pressure - Gain



Sprinkler System Static Pressure - Loss



High Pressure…..

Low Pressure….

Determining Pressures….

Liquid filled Pitot Tube

Static pressure w/ gauge

Dynamic pressure w/ pitot tube

Pressure Gauges…

Pitot Tubes….

Water Movement in Irrigation Systems

Volume

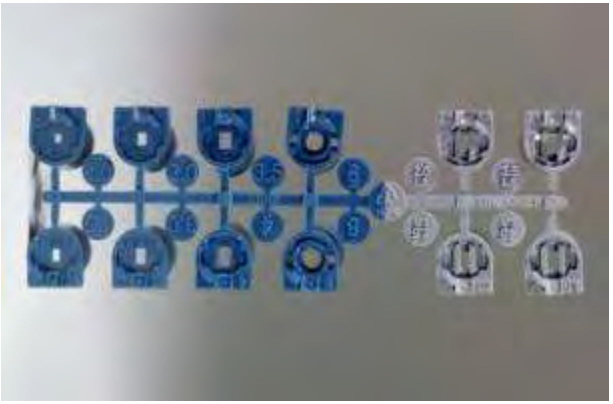
What is Volume?

Flow. The amount of water, measured in GPM (gallons per minute) or GPH (gallons per hour)

Volume....

- Different nozzles demand different flows
- Varying pressures cause differing flows

Flow....



I-40 DUAL OPPOSING NOZZLE PERFORMANCE DATA

VIEW NOZZLE

Nozzle	Pressure PSI	Radius ft	Flow GPM	Precip in/hr ■	Precip in/hr ▲
15 Grey	50	52	13.0	0.46	0.53
	60	54	13.2	0.44	0.50
	70	56	14.4	0.44	0.51
	80	57	15.5	0.46	0.53
18 Red	50	58	13.7	0.39	0.45
	60	59	15.2	0.42	0.49
	70	60	16.6	0.44	0.51
	80	62	17.8	0.45	0.51
20 Dk. Brown	60	63	19.1	0.46	0.53
	70	64	20.9	0.49	0.57
	80	66	22.3	0.49	0.57
	90	66	23.9	0.53	0.61
23 Dk. Green	60	65	20.4	0.46	0.54
	70	66	22.3	0.49	0.57
	80	67	24.0	0.51	0.59
	90	68	25.6	0.53	0.62
25 Dk. Blue	60	66	22.0	0.49	0.56
	70	68	24.0	0.50	0.58
	80	69	25.9	0.52	0.60
	90	70	27.2	0.53	0.62
28 Black	70	70	28.9	0.57	0.66
	80	72	30.9	0.57	0.66
	90	74	32.9	0.58	0.67
	100	76	33.7	0.56	0.65

Notes:
Precipitation rates for the ON-Opposing Nozzle model are calculated at 360 degrees.

Volume….

Flow….

Velocity

What is Velocity?

The speed at which water travels, measured in FPS (feet per second)

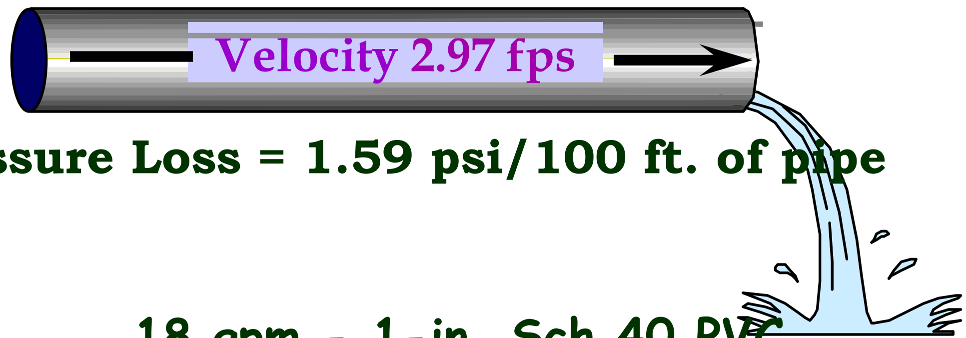
Maximum speed: 5 fps

Factors Affecting Friction Loss in Pipe

- velocity
- inside diameter
- roughness
- length

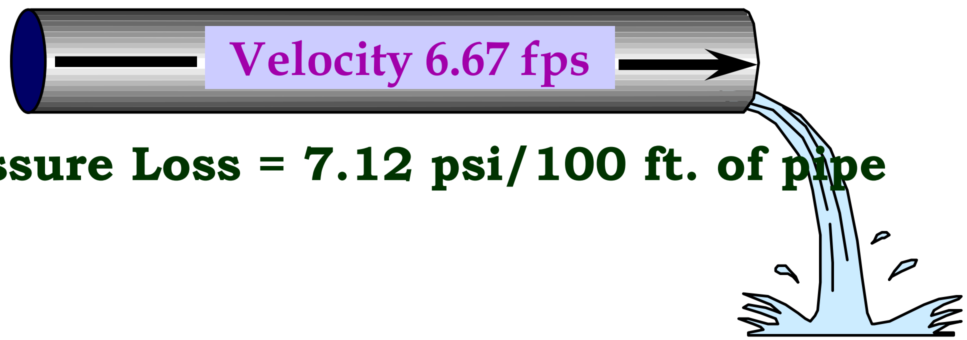
Velocity

8 gpm - 1-in. Sch 40 PVC



Pressure Loss = 1.59 psi/100 ft. of pipe

18 gpm - 1-in. Sch 40 PVC

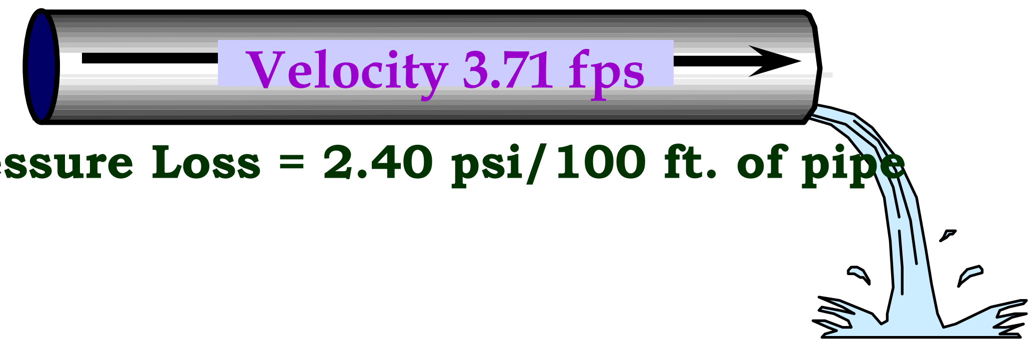


Pressure Loss = 7.12 psi/100 ft. of pipe

Roughness

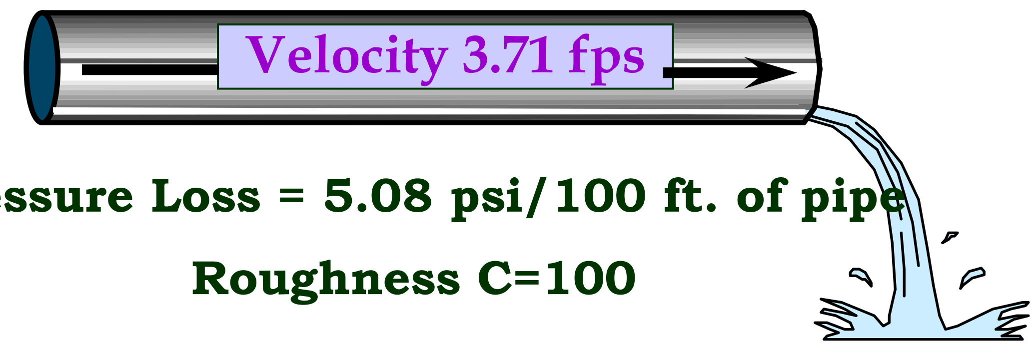
Roughness C=150

10 gpm - 1-in. Sch 40 PVC



Pressure Loss = 2.40 psi/100 ft. of pipe

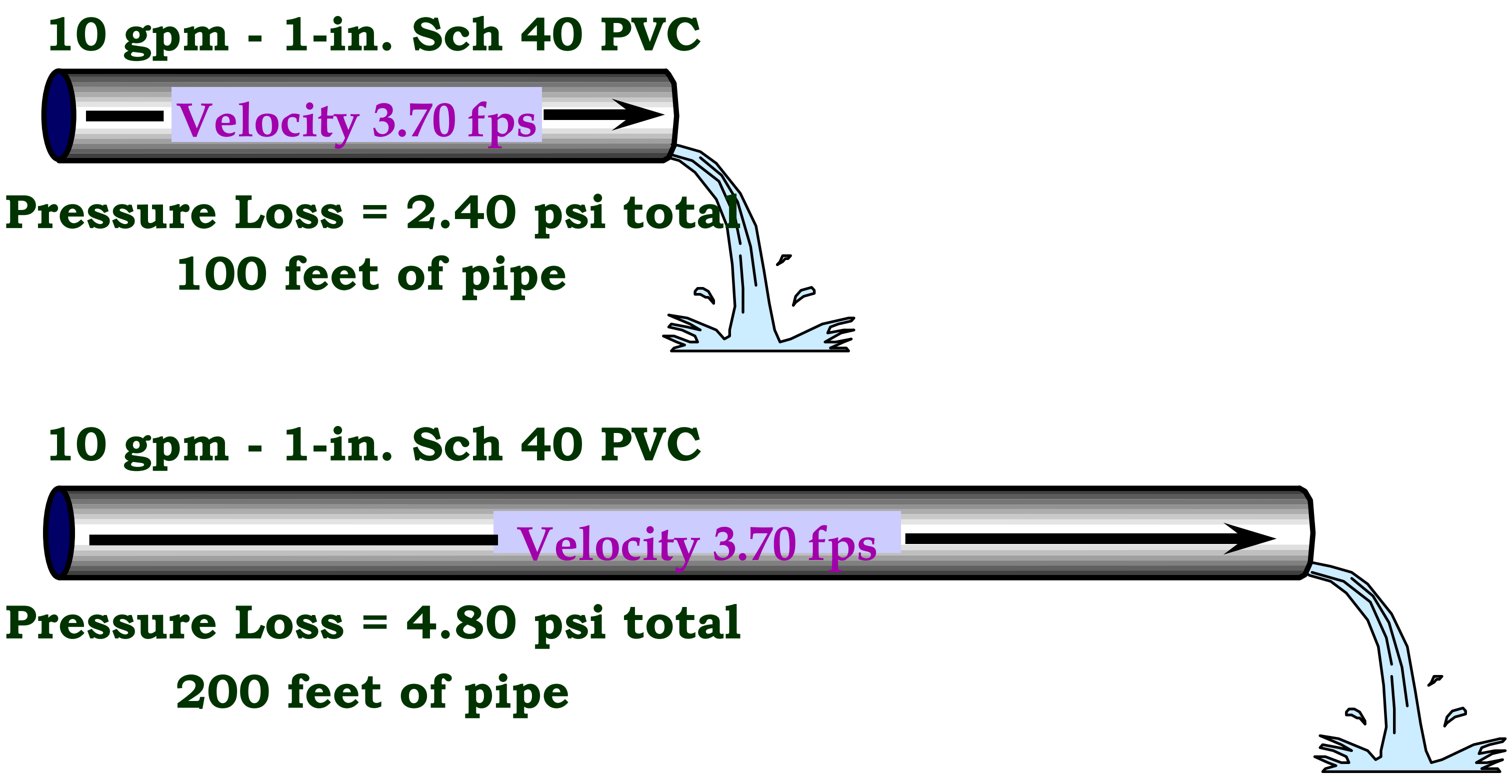
10 gpm - 1-in. Sch 40 Standard Steel Pipe



Pressure Loss = 5.08 psi/100 ft. of pipe

Roughness C=100

Length


10 gpm - 1-in. Sch 40 PVC
Velocity 3.70 fps
Pressure Loss = 2.40 psi total
100 feet of pipe
10 gpm - 1-in. Sch 40 PVC
Velocity 3.70 fps
Pressure Loss = 4.80 psi total
200 feet of pipe

Irrigation Hydraulics…

Minimize Your Friction Losses!

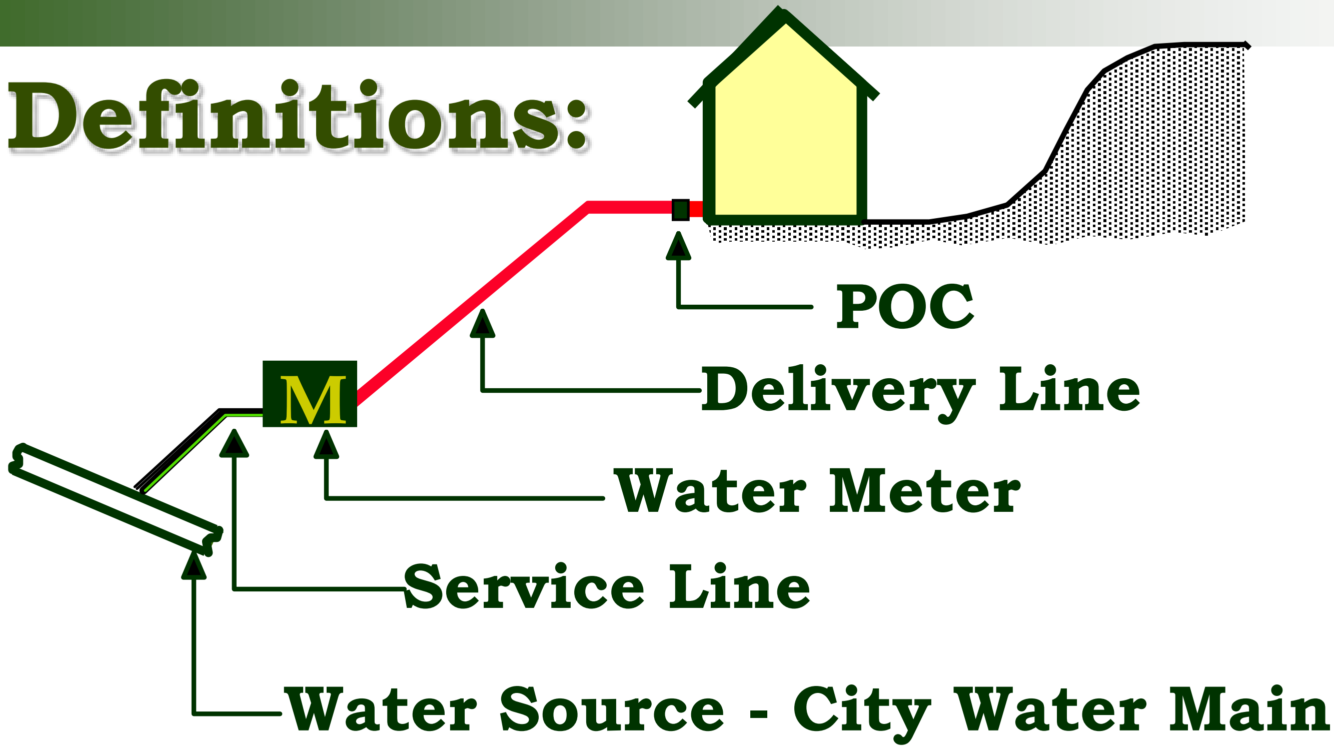
It affects your Pressure!!

*Design Capacity

What comes first in designing an efficient system?

- **Determine available flow**
- **Determine pressure available at point of connection**
- **Estimate pressure available for sprinkler operation**
- **Estimate the number of sprinklers that can be operated on a single zone**

Definitions:



City Water Main: Municipal water line bringing water to project

Service Line: Connects city main to water meter

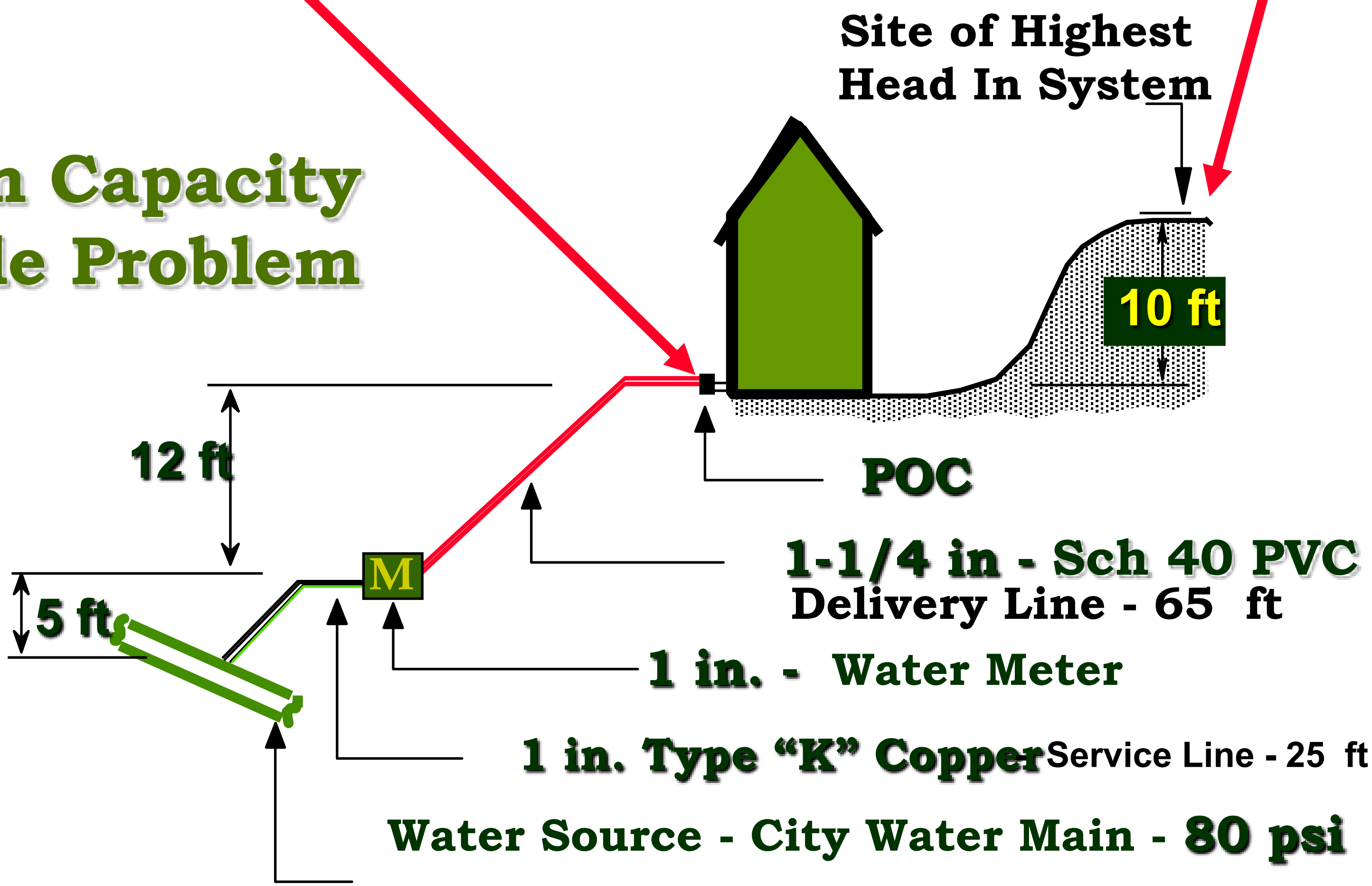
Delivery Line: Line between water meter and POC

Point of Connection [POC] Location where system is
connected to water supply

How Much Pressure is Available for Sprinkler Operation?

Dynamic Pressure (psi) at Design Capacity (gpm) at POC (67.00 psi)… but how much pressure will be available at the Highest Head?

Design Capacity Sample Problem



Calculation of Dynamic Pressure at Design Capacity

Estimate Dynamic Pressure at Point of Connection using Design Capacity

- pressure loss in the service line
- pressure loss in the delivery line
- pressure loss in the water meter
- pressure loss in the isolation valves
- pressure loss in the other system components

Determine Design Capacity

Three Factors Restricting Available Flow:

- pressure loss through the water meter
- volume through the meter
- velocity through the service line

Determine Design Capacity "*Rule of Three*"

B. Determine Design Capacity

	Factor	Restriction	GPM With Restriction	
10	**Pressure loss** through the water meter.	Not to exceed 10% of available psi at the source (Line 1)	________	GPM
11	**Volume** through the water meter.	Not to exceed 75% of maximum safe flow of the meter.	________	GPM
12	**Velocity** through the service line.	Velocity not to exceed 7.5 fps (Main to meter)	________	GPM
13	**Design Capacity**		________	**GPM**

Lowest GPM of the three flows rates - lines 10, 11, and 12.

Estimating the Pressure Available at the "Worst Case" Head

- pressure changes due to the change in elevation
- 1/3 of the dynamic pressure is lost through valves, pipe and fittings
- 2/3 of the dynamic pressure remains available for sprinkler operation

Design Capacity

Worksheet

Equipment Selection…

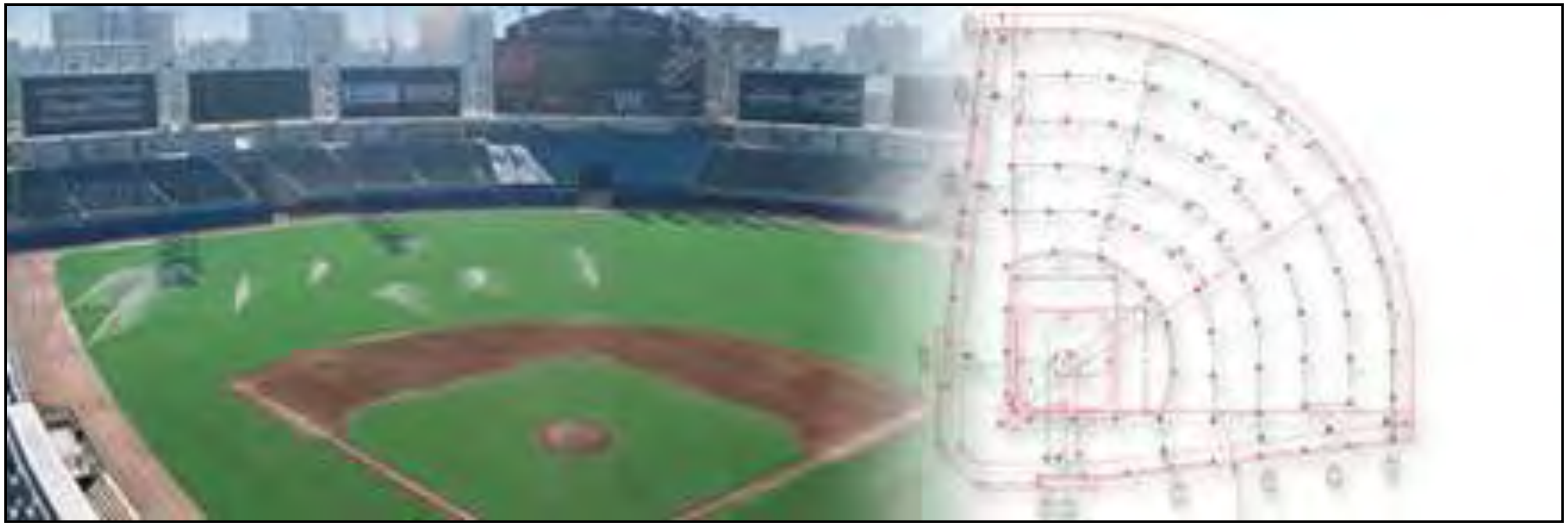




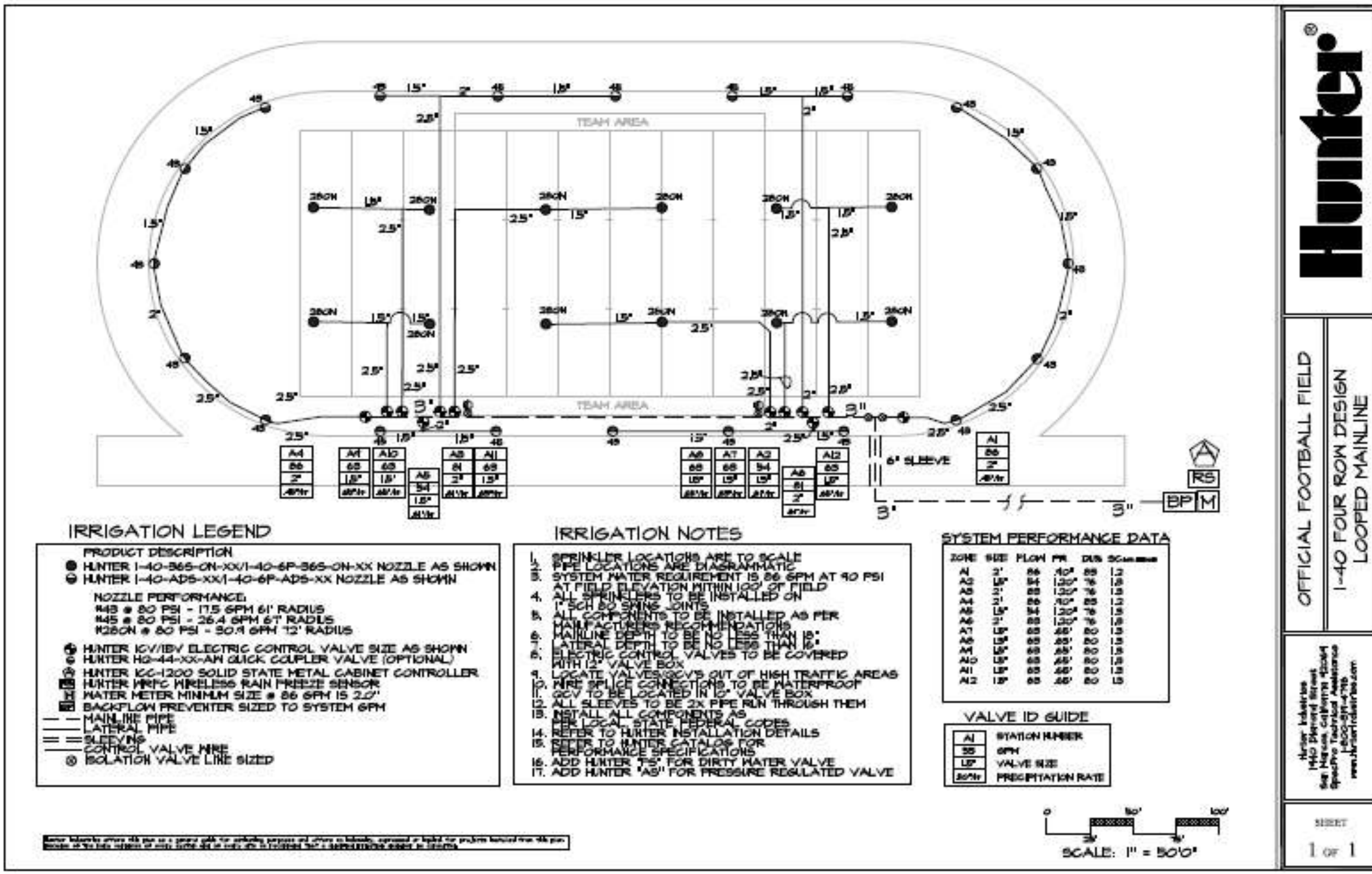

Equipment Selection

- What’s new? What saves water and could help you sell the job?
- Check with your local Irrigation distributor & manufacturer’s rep
- Obtain new product catalogues at tradeshows!
- Check with your local sales representative
- Ask your neighbor

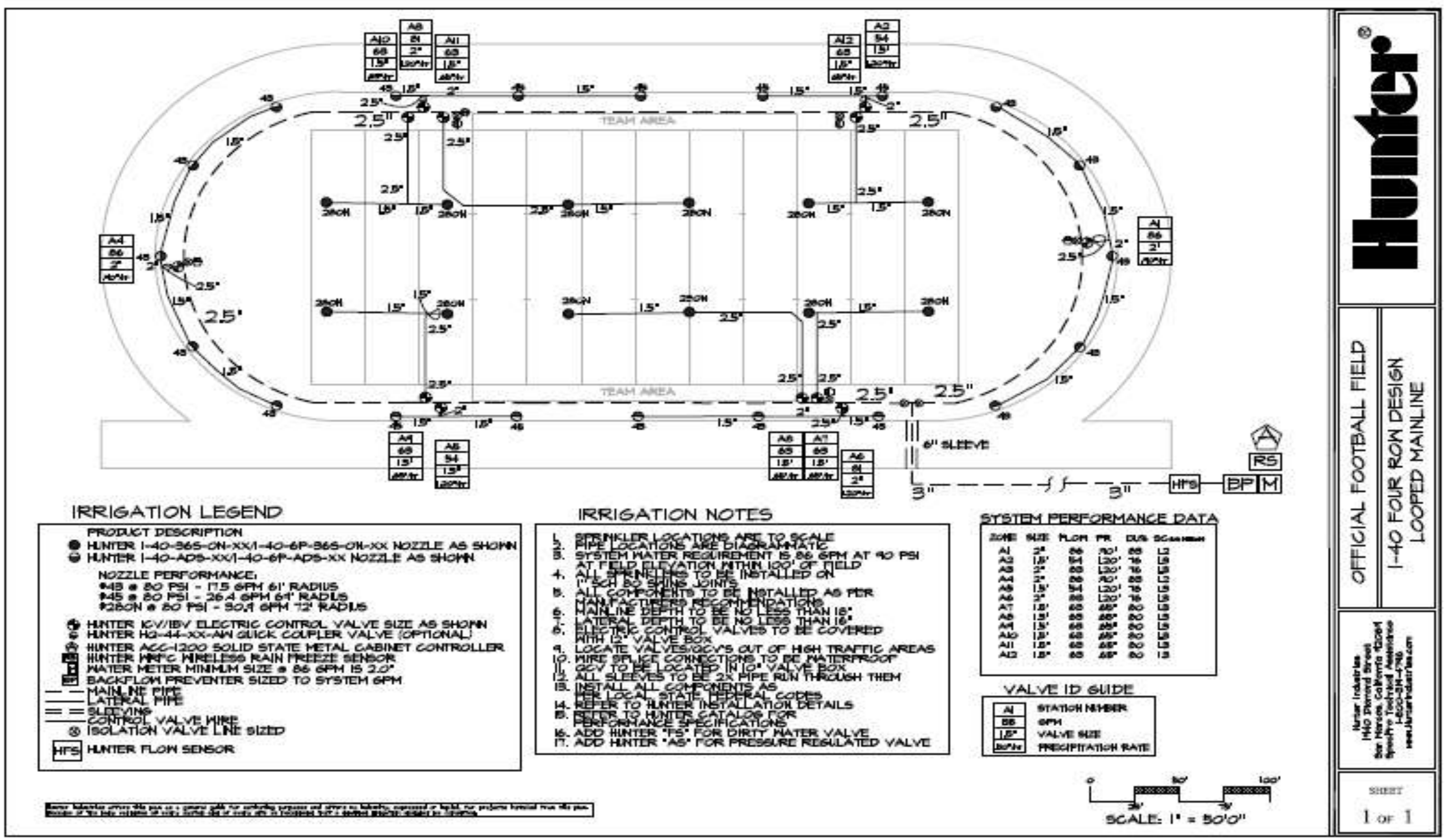
Component Locations…



Volkswagen


TEAM AREA
6" SLEEVE
IRRIGATION LEGEND
PRODUCT DESCRIPTION
HUNTER I-40-36S-ON-XX/I-40-6P-36S-ON-XX NOZZLE AS SHOWN
HUNTER I-40-ADS-XX/I-40-6P-ADS-XX NOZZLE AS SHOWN
NOZZLE PERFORMANCE:
HUNTER ICV/IBV ELECTRIC CONTROL VALVE SIZE AS SHOWN
HUNTER HQ-44-XX-AM QUICK COUPLER VALVE (OPTIONAL)
HUNTER ICC-1200 SOLID STATE METAL CABINET CONTROLLER
BACKFLOW PREVENTER SIZED TO SYSTEM GPM
MAINLINE PIPE
LATERAL PIPE
SLEEVING
CONTROL VALVE WIRE
ISOLATION VALVE LINE SIZED
IRRIGATION NOTES
1. SPRINKLER LOCATIONS ARE TO SCALE
2. PIPE LOCATIONS ARE DIAGRAMMATIC
4. ALL SPRINKLERS TO BE INSTALLED ON
10. WIRE SPLICE CONNECTIONS TO BE WATERPROOF
12. ALL SLEEVES TO BE 2X PIPE RUN THROUGH THEM
14. REFER TO HUNTER INSTALLATION DETAILS
16. ADD HUNTER "FS" FOR DIRTY WATER VALVE
17. ADD HUNTER "AS" FOR PRESSURE REGULATED VALVE
SYSTEM PERFORMANCE DATA
VALVE ID GUIDE
STATION NUMBER
GPM
VALVE SIZE
PRECIPITATION RATE
SCALE: 1" = 50'0"
OFFICIAL FOOTBALL FIELD
I-40 FOUR ROW DESIGN
LOOPED MAINLINE
Hunter
SHEET
1 OF 1

Cadillac…


TEAM AREA
TEAM AREA
6" SLEEVE
HFS
BP
M
RS
IRRIGATION LEGEND
PRODUCT DESCRIPTION
NOZZLE PERFORMANCE:
MAINLINE PIPE
LATERAL PIPE
SLEEVING
CONTROL VALVE WIRE
ISOLATION VALVE LINE SIZED
HUNTER FLOW SENSOR
IRRIGATION NOTES
SYSTEM PERFORMANCE DATA
VALVE ID GUIDE
STATION NUMBER
GPM
VALVE SIZE
PRECIPITATION RATE
SCALE: 1" = 50'0"
Hunter
OFFICIAL FOOTBALL FIELD
I-40 FOUR ROW DESIGN
LOOPED MAINLINE
SHEET
1 OF 1

Design Goal:

Have all sprinklers controlled by one valve within + or – 10% of the pressure at which they were designed to operate!

- **Example: 60 psi dynamic operating pressure = 54 psi to 66 psi at each sprinkler for optimum performance.**

Sprinkler Placement

- type and size of the planting areas (hydrozones)
- the manufacturer's maximum spacing ratings
- the effect of wind on spacing

Sprinkler Placement Considerations

- the size of the hydrozone
- flow and pressure available for the system
- select the sprinkler pattern that provides the least overspray

What You Need to Know

- design with head-to-head coverage
- place heads in corners
- place heads around the perimeters
- place heads in the middle

Friction Loss Charts

Use of Pressure Loss Charts

Figure 18 below represents a portion of one of the pressure loss charts taken from the Hunter Friction Loss Tables found in the back of this design manual.

Friction Loss Characteristics
Class 200 IPS PVC Plastic Pipe
(1120, 1220) SDR 21 C = 150 3/4" through 5"
Pressure Loss per 100

Nominal Size	3/4"		1"		1-1/4"		1-1/2"		2"		2-1/2"	
Pipe ID	0.93		1.189		1.502		1.720		2.149		2.601	
Pipe OD	1.050		1.315		1.660		1.900		2.375		2.875	
Wall Thick	0.060		0.063		0.079		0.090		0.113		0.137	
Flow GPM	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS
1	0.47	0.05	0.29	[illegible]	[illegible]	0.01	0.14	0.00	0.09	0.00	0.06	0.00
2	0.94	0.22	0.58	[illegible]	[illegible]	0.02	0.28	0.01	0.18	0.00	0.12	0.00
3	1.42	0.46	0.87	0.14	0.54	0.04	0.41	0.02	0.27	0.01	0.18	0.00
4	1.89	0.79	1.15	0.24	0.72	[illegible]	0.55	0.04	0.35	0.01	0.24	0.01
5	2.36	1.19	1.44	0.36	0.90	[illegible]	0.69	0.06	0.44	0.02	0.30	0.01
6	2.83	1.67	1.73	0.51	1.09	0.16	0.83	0.08	0.53	0.03	0.36	0.01
7	3.30	2.23	2.02	0.67	1.27	0.22	0.97	0.11	0.62	0.04	0.42	0.01
8	3.77	2.85	2.31	0.86	1.45	0.28	[illegible]	0.14	0.71	0.05	0.48	0.02
9	4.25	3.55	2.60	1.07	1.63	0.34	[illegible]	0.18	0.80	0.06	0.54	0.02
10	4.72	4.31	2.89	1.30	1.81	0.42	1.38	0.22	0.88	0.07	0.60	0.03
12	5.66	6.04	3.46	1.83	2.17	0.59	1.65	0.30	1.06	0.10	0.72	0.04
14	6.60	8.04	4.04	2.43	2.53	0.78	1.93	0.40	1.24	0.14	0.84	0.05
16	7.55	10.29	4.62	3.11	2.89	1.00	2.21	0.52	1.41	0.17	0.96	0.07
18	8.49	12.80	5.19	3.87	3.26	1.24	2.48	0.64	1.59	0.22	1.09	0.09
20	9.43	15.56	5.77	4.71	3.62	1.51	2.76	0.78	1.77	0.26	1.21	0.10
22	10.38	18.56	6.35	5.62	3.98	1.80	3.03	0.93	1.94	0.32	1.33	0.12
24	11.32	21.81	6.93	6.60	4.34	2.12	3.31	1.09	2.12	0.37	1.45	0.15
26	12.27	25.29	7.50	7.65	4.70	2.45	3.59	1.27	2.30	0.43	1.57	0.17
28	13.21	29.01	8.08	8.78	5.06	2.82	3.86	1.46	2.47	0.49	1.69	0.19
30	14.15	32.98	8.66	9.97	5.43	3.20	4.14	1.65	2.65	0.56	1.81	0.22

Friction Loss Charts

- determine “friction loss” in pipe
- determine velocity
- use pressure losses and/or velocities to size pipe

Friction Loss Charts

- **A = Type of pipe**
- **E = "C" factor**
- **F = PSI loss/ 100'**
- **G = Nominal size of pipe**
- **H – J = Actual sizes of pipe**
- **K = Flow quantities**
- **L = Velocity in FPS**
- **M = PSI loss/ 100' of pipe**
- **N = NO-NO Zone for Velocity**

Use of Pressure Loss Charts

Figure 18 below represents a portion of one of the pressure loss charts taken from the Hunter Friction Loss Tables found in the back of this design manual.

A B C D E F G H I J K L M N

Friction Loss Characteristics
Class 200 IPS PVC Plastic Pipe
(1120, 1220) SDR 21 C = 150 3/4" through 5"
Pressure Loss per 100

Nominal Size	3/4"		1"		1-1/4"		1-1/2"		2"		2-1/2"	
Pipe ID	0.93		1.189		1.502		1.720		2.149		2.601	
Pipe OD	1.050		1.315		1.660		1.900		2.375		2.875	
Wall Thick	0.060		0.063		0.079		0.090		0.113		0.137	
Flow GPM	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS
1	0.47	0.05	0.29	[illegible]	[illegible]	0.01	0.14	0.00	0.09	0.00	0.06	0.00
2	0.94	0.22	0.58	[illegible]	[illegible]	0.02	0.28	0.01	0.18	0.00	0.12	0.00
3	1.42	0.46	0.87	0.14	0.54	0.04	0.41	0.02	0.27	0.01	0.18	0.00
4	1.69	0.79	1.15	0.24	0.72	[illegible]	0.55	0.04	0.35	0.01	0.24	0.01
5	2.36	1.19	1.44	0.36	0.90	[illegible]	0.69	0.06	0.44	0.02	0.30	0.01
6	2.83	1.67	1.73	0.51	1.09	0.16	0.83	0.08	0.53	0.03	0.36	0.01
7	3.30	2.23	2.02	0.67	1.27	0.22	0.97	0.11	0.62	0.04	0.42	0.01
8	3.77	2.85	2.31	0.86	1.45	0.28	[illegible]	0.14	0.71	0.05	0.48	0.02
9	4.25	3.55	2.60	1.07	1.63	0.34	[illegible]	0.18	0.80	0.06	0.54	0.02
10	4.72	4.31	2.89	1.30	1.81	0.42	1.38	0.22	0.88	0.07	0.60	0.03
12	5.66	6.04	3.46	1.83	2.17	0.59	1.65	0.30	1.06	0.10	0.72	0.04
14	6.60	8.04	4.04	2.43	2.53	0.78	1.93	0.40	1.24	0.14	0.84	0.05
16	7.55	10.29	4.62	3.11	2.89	1.00	2.21	0.52	1.41	0.17	0.96	0.07
18	8.49	12.80	5.19	[illegible]	3.26	1.24	2.48	0.64	1.59	0.22	1.09	0.09
20	9.43	15.56	5.77	4.71	3.62	1.51	2.76	0.78	1.77	0.26	1.21	0.10
22	10.38	18.56	6.35	5.62	3.98	1.80	3.03	0.93	1.94	0.32	1.33	0.12
24	11.32	21.81	6.93	6.60	4.34	2.12	3.31	1.09	2.12	0.37	1.45	0.15
26	12.27	25.29	7.50	7.65	4.70	2.45	3.59	1.27	2.30	0.43	1.57	0.17
28	13.21	29.01	8.08	8.78	5.06	2.82	3.86	1.46	2.47	0.49	1.69	0.19
30	14.15	32.98	8.66	9.97	5.43	3.20	4.14	1.65	2.65	0.56	1.81	0.22

Velocity Limit Pipe Sizing

- Maintains low velocity to reduce potential water hammer
- Maximum velocities usually:
  - PVC: 5 fps
  - Polyethylene: 6 fps
  - Copper: 7 to 7.5 fps
- If used in lateral lines can result in excessive pressure variation

Velocity Limit Pipe Sizing Maximum PVC Mainline Flow Rates*

Pipe Size and Type	Maximum Flow Rate At 5 FPS
1/2” Schedule 40 PVC	4.7 GPM
3/4” Schedule 40 PVC	8.3 GPM
1” Schedule 40 PVC	13.5 GPM
1-1/4” Schedule 40 PVC	23.4 GPM
1-1/2” Schedule 40 PVC	31.8 GPM
2” Class 315 PVC	50.2 GPM
2-1/2” Class 315 PVC	73.5 GPM
3” Class 315 PVC	109 GPM

•If other pipe types are used, maximum flow rates determined by appropriate velocity for pipe type.

Velocity Limit Pipe Sizing Maximum SDR PE Mainline Flow Rates*

Pipe Size and Type	Maximum Flow Rate At 6 FPS
1/2” SDR Polyethylene	5.7 GPM
3/4” SDR Polyethylene	10.0 GPM
1” SDR Polyethylene	16.2 GPM
1-1/4” SDR Polyethylene	28.0GPM
1-1/2” SDR Polyethylene	38.1 GPM
2” SDR Polyethylene	62.8 GPM
2-1/2” SDR Polyethylene	89.6 GPM
3” SDR Polyethylene	138.4 GPM

- If other pipe types are used, maximum flow rates determined by appropriate velocity for pipe type.

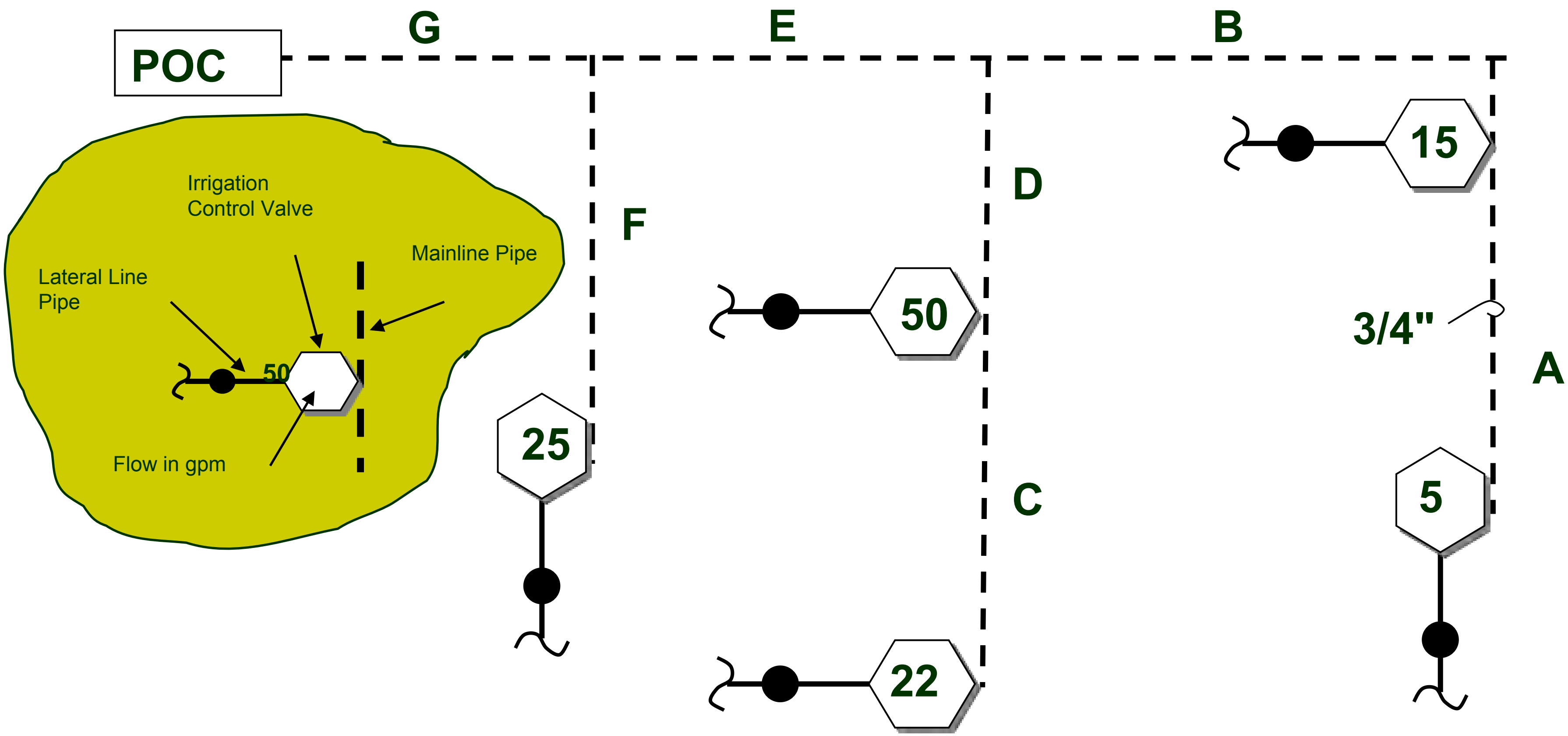
Zoning of Sprinklers

- Match precipitation rates or….
- Same type sprinklers zoned together
- Understand water windows
- + or – 10% rule

Mainline Sizing
Single Valve vs. Multiple Valve Operation

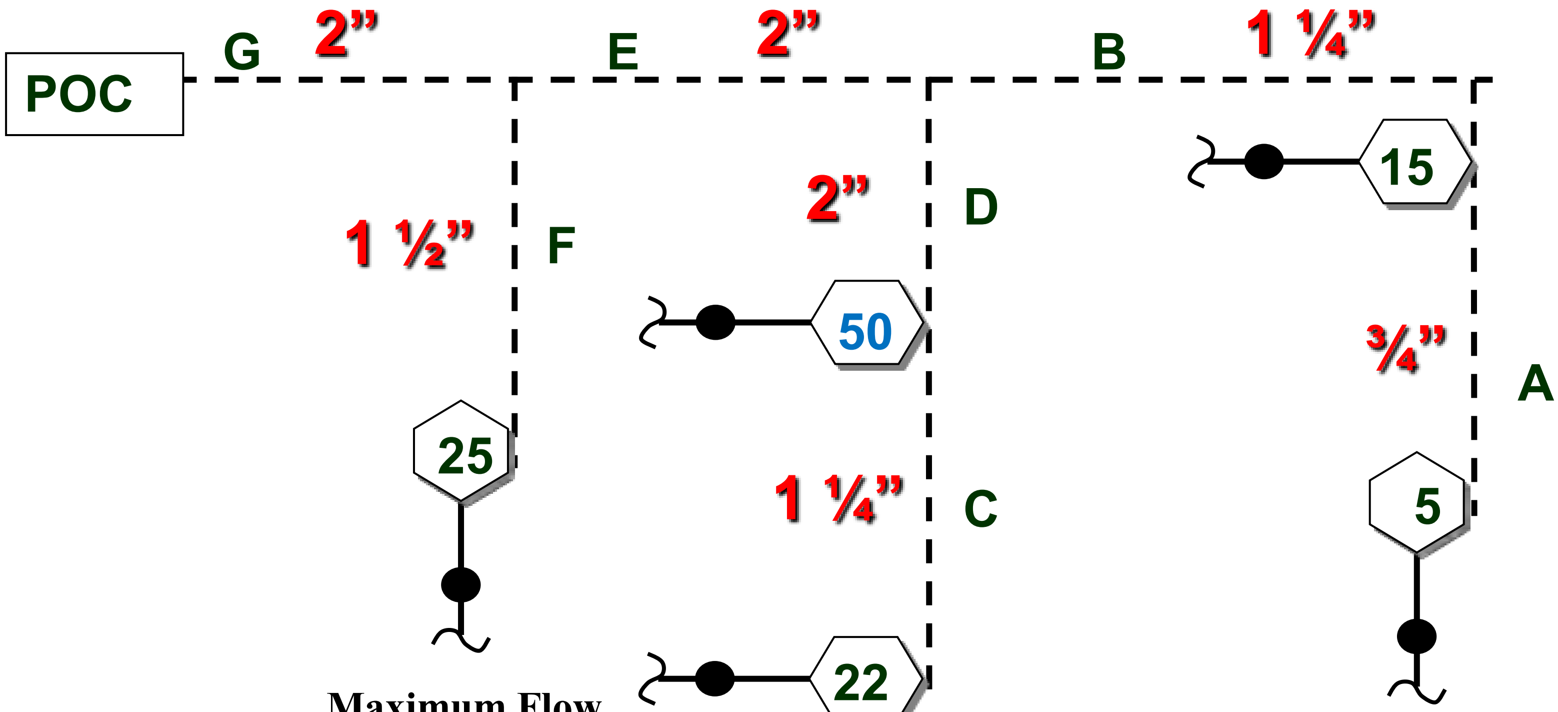
- Residential through medium commercial projects:
  - **ONLY ONE valve operates at a time.**
- Large commercial projects, parks, golf courses and agricultural projects:
  - **Multiple valves operate simultaneously.**

Velocity Limit Sizing



Sample Problem - PVC Mainline
Single Valve Operation

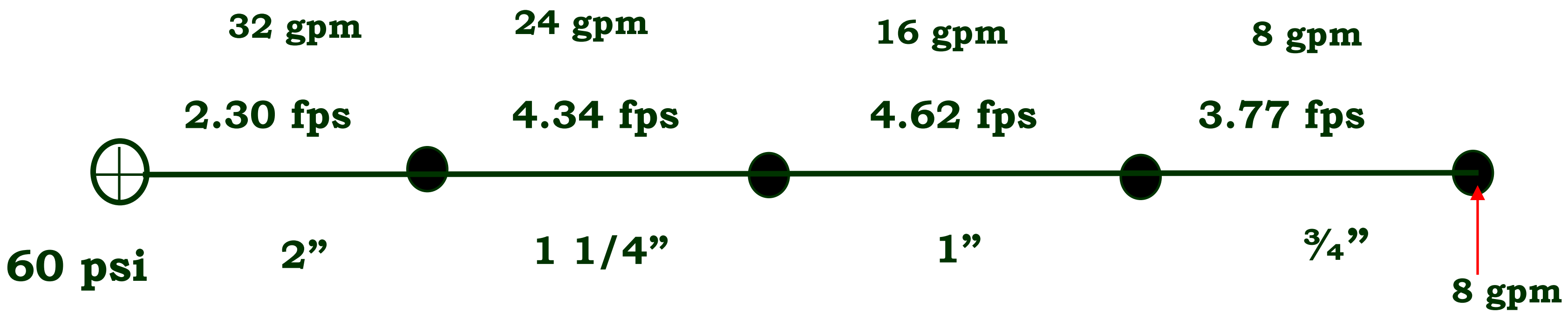
Velocity Limit Sizing



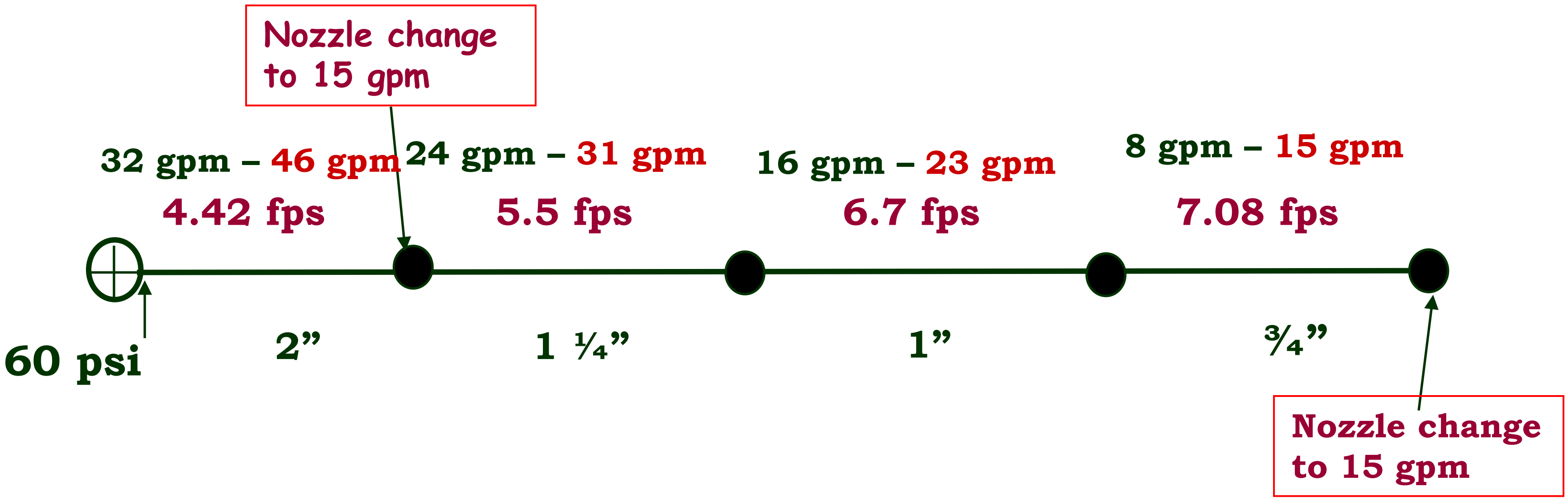
Pipe Size and Type	Maximum Flow Rate At 5 FPS (GPM)
1/2” Schedule 40 PVC	4
3/4” Schedule 40 PVC	8
1” Schedule 40 PVC	13
1-1/4” Schedule 40 PVC	23
1-1/2” Schedule 40 PVC	32
2” Class 315 PVC	50

Sample Problem
PVC Mainline
Single Valve Operation

Typical Zone Sizing



Sprinkler System Flow and psi Loss



● Hunter I20 ADS #8 nozzle = 8 gpm at 60 psi

—— PVC Class 200, sized appropriately

⊕ Hunter ICV, sized appropriately

What happens to friction loss? What are velocities?

Irrigation Hydraulics…

Minimize Your Friction Losses!

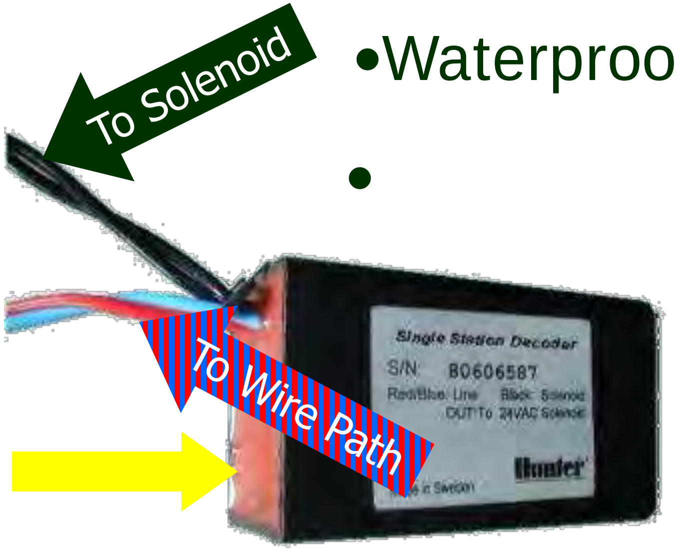
It affects your Pressure!!

Decoder Systems Usage and Applications

How Decoder Systems Work

The Basic Decoder

- Interprets *encoded* signal from controller
- Acts as a relay.
- Waterproof potting compound (solid epoxy)
-



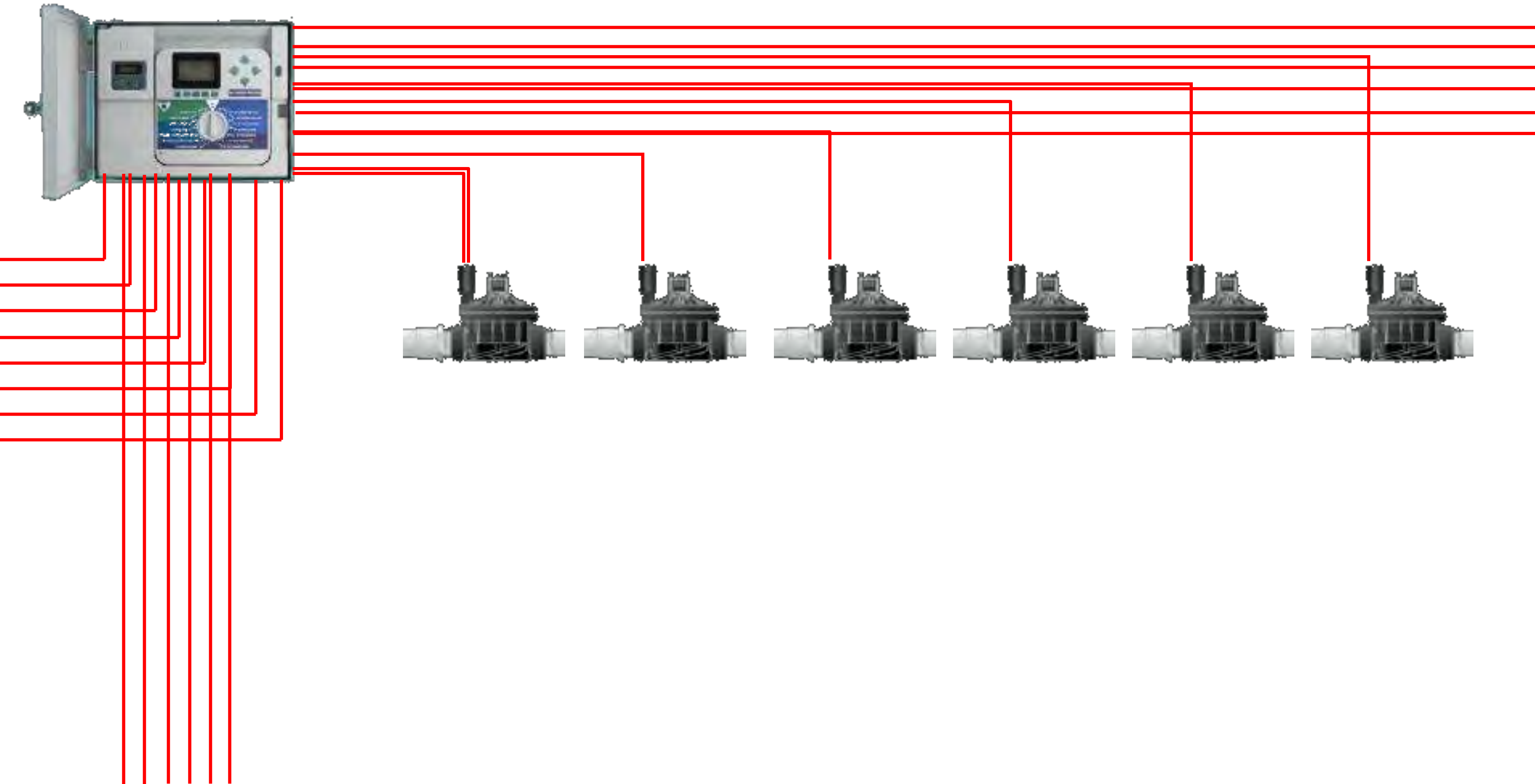
Decoders come in many sizes

- 1, 2, 4, & 6-station decoders
- Two-way decoders activation confirms & reports
- Each output can be individually activated

Why Decoders?

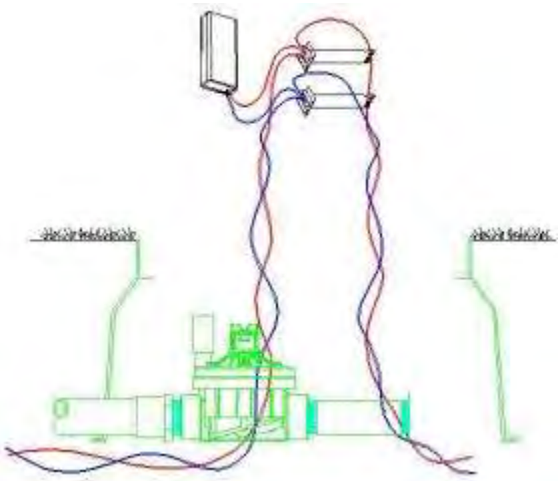
- Save Copper Wire
  - Decoder Systems typically use 60% less copper wire, an expensive, non-renewable resource.
- Less Labor
- Run More Stations, Over Longer Distances (up to 15,000ft/4.5km)
- Flexibility!
  - Easy to add valves after initial installation… no spare wires or trenching.
- Troubleshooting- only 2 wires to solve.
- Lightning Resistance- fewer copper paths in-ground
- Easy to Repair.

Two-wire technology for large systems



Conserving Time and Resources

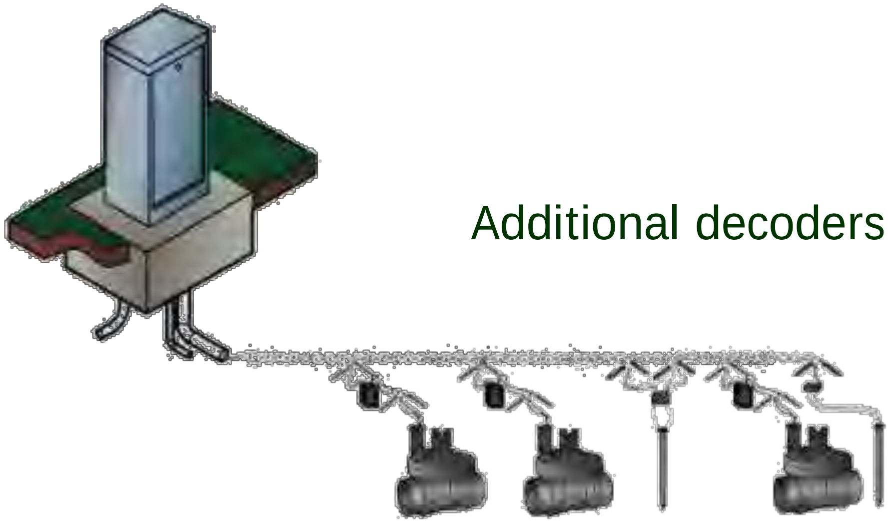
- Save wire (and labor) in large installations
- Electrically efficient: operate more stations with less power
- Expand systems after installation, without costly trenching
- Simplify large-system troubleshooting!



Decoder Wiring

How Decoder Systems Work

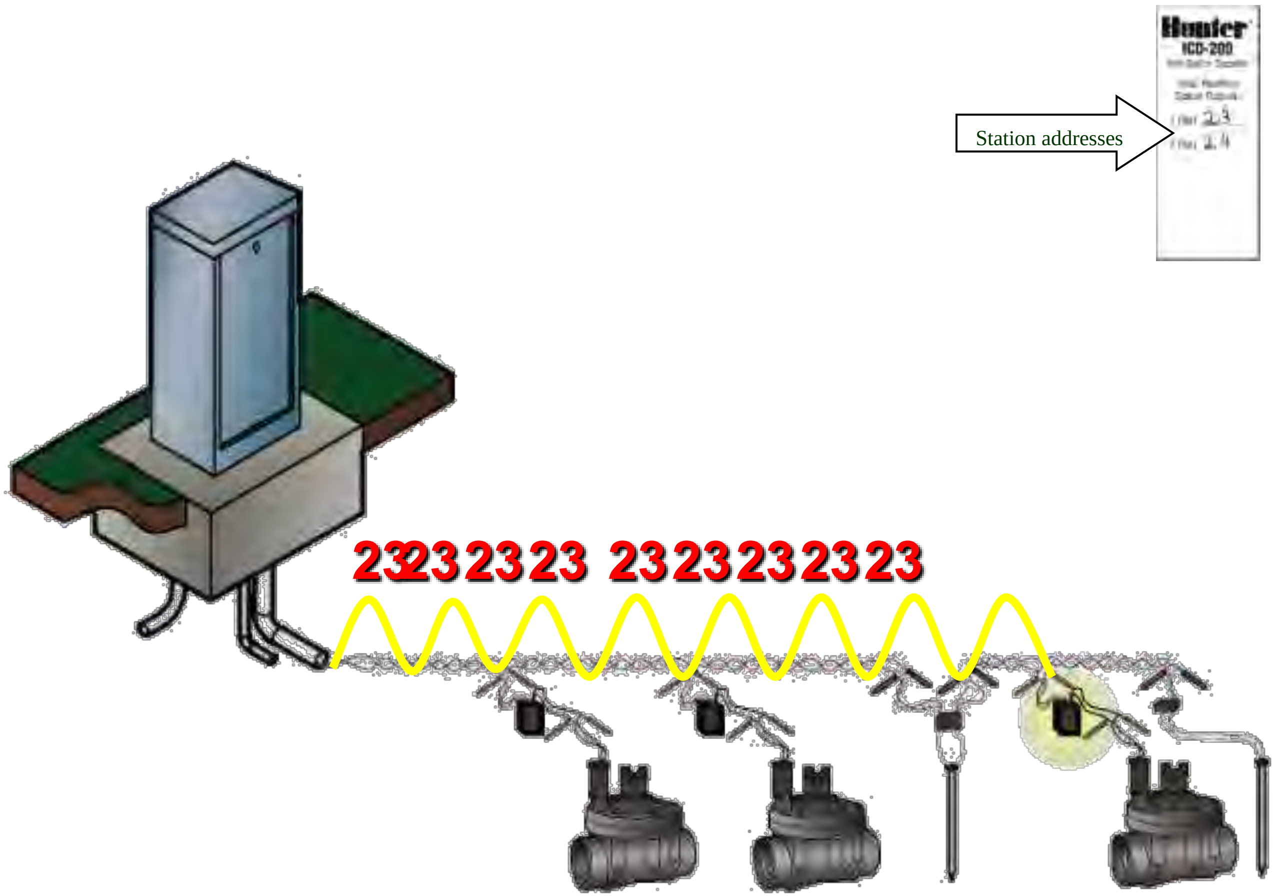
The single pair of wire is run from the controller through the area to be irrigated. Usually with the main pipeline.



Additional decoders are spliced in as needed.

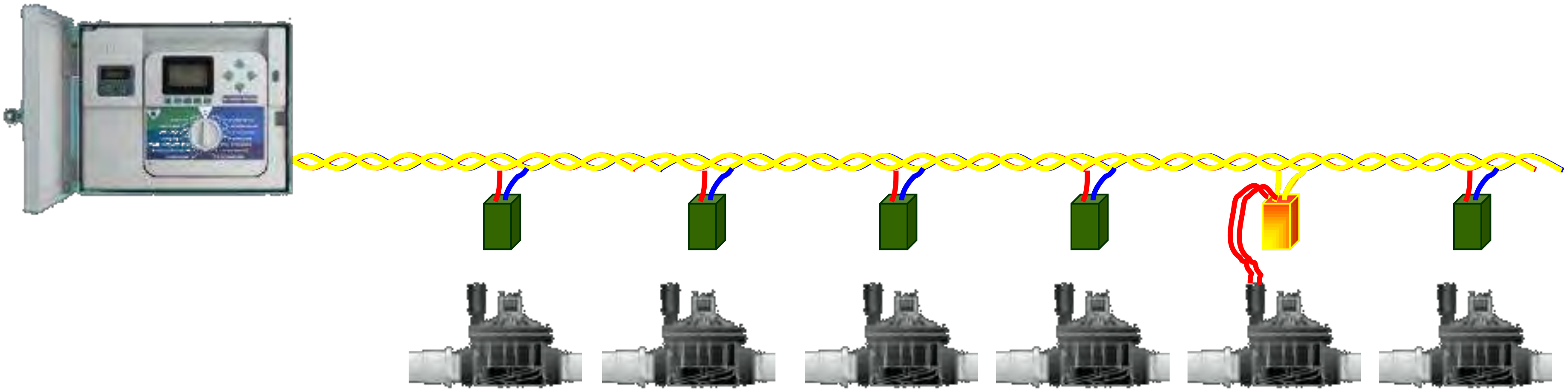
How Decoder Systems Work

When the controller turns on a station, it sends power down the wire pair, along with the digital Station Number for the decoder.



Two-wire technology for large systems

Decoder **technology allows us to run multiple valves over a** ***single pair*** **of wires… for miles!**



The power for the solenoids ***and*** **a digital signal (for the zone we want to operate), are sent over the same 2 wires.**

Where Decoder Systems Work Best

Industrial Parks

Estates

Sports Fields

Commercial Projects

Cemeteries

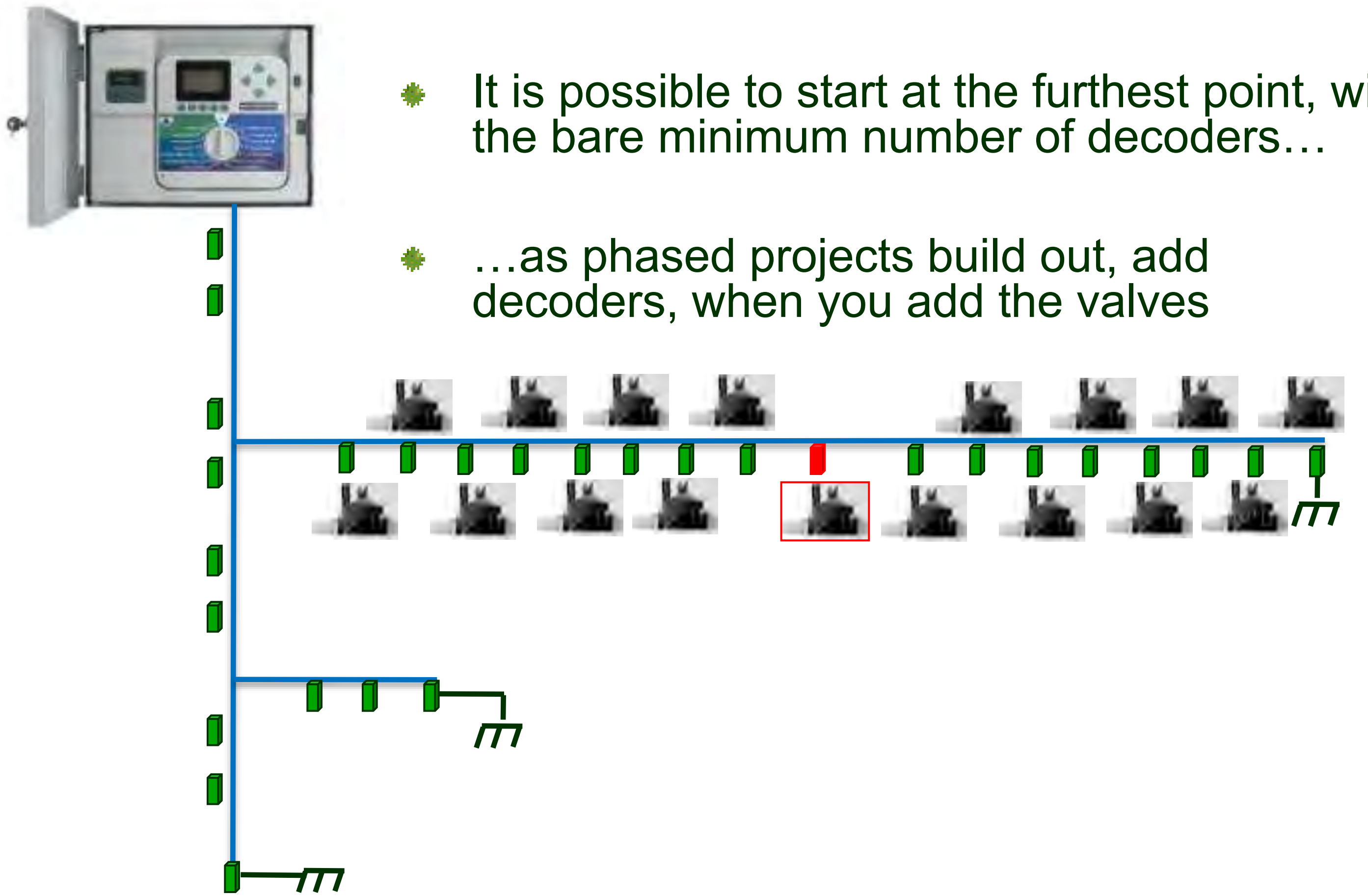
Multi-Family Home projects

Zoos…

- Systems with 24 valves and larger are usually the best candidates for decoder applications.

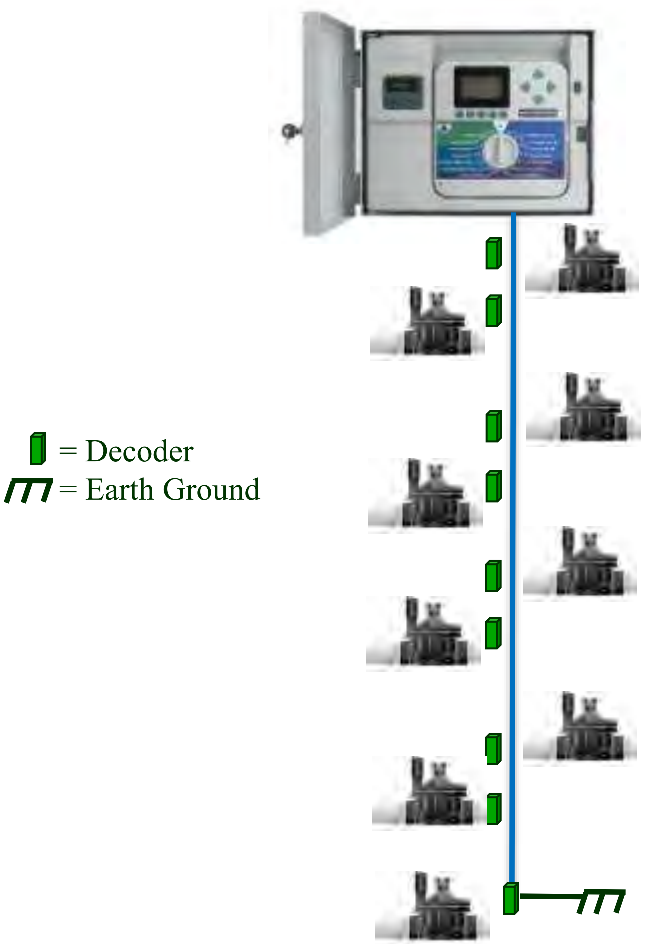
- Phased projects where it would be difficult and expensive to run wires back to a controller, or where the final number of zones is undetermined…

Decoders- the Flexible Choice for a Changing World



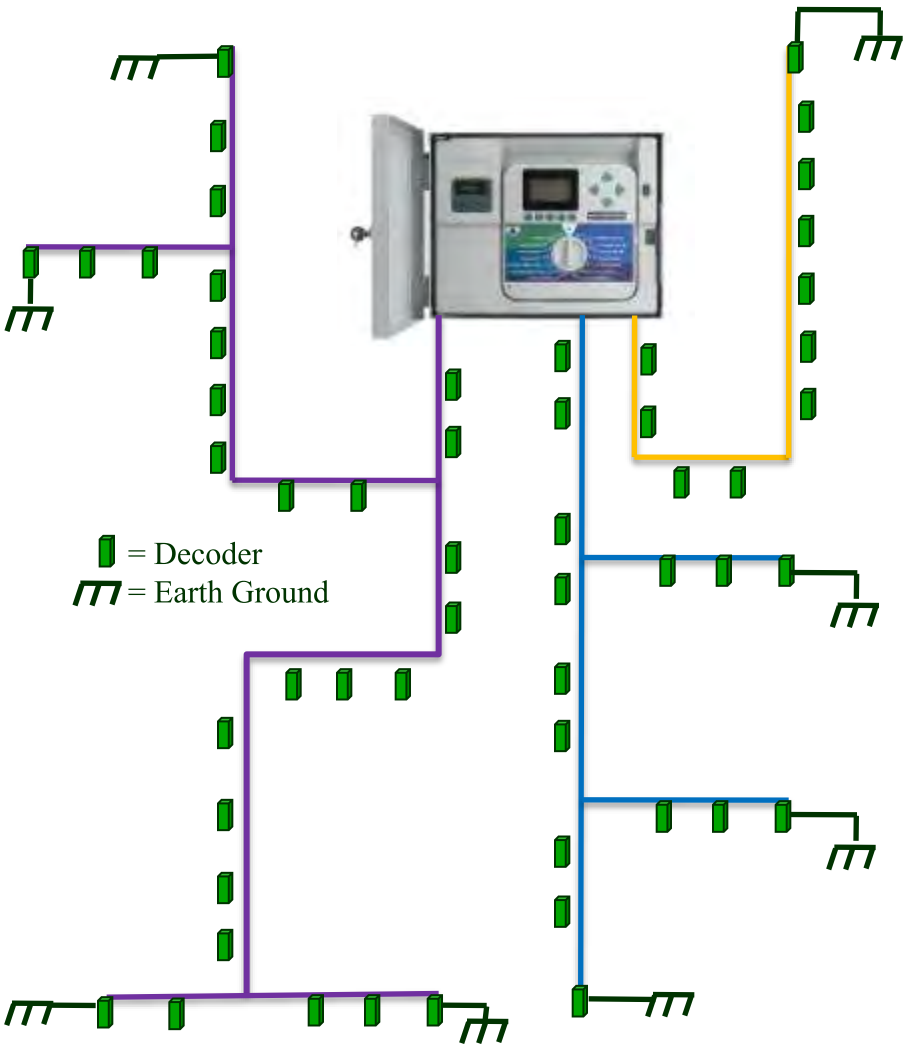
- Decoders are only required as they are needed
- It is possible to start at the furthest point, with the bare minimum number of decoders…
- …as phased projects build out, add decoders, when you add the valves

Planning Your Wire Paths



- Place a decoder by each 24VAC valve (standard solenoids)
- Max distance from controller to furthest decoder on each path:
  - Follow Manufacturer's specs.
- Max distance from decoder to solenoid, 150 ft (recommended maximum)

Planning Your Wire Paths

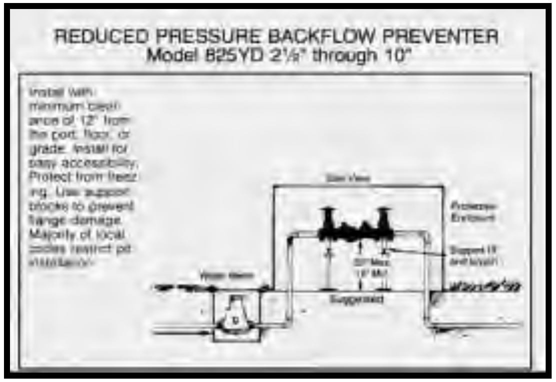


- Two-wire paths may be spliced!
  - Follow splice rules
  - Use pipe trenches to route wire cheapest way
- Use a different colored cable for each path.
- Max wire distance applies to each wire path- from controller to each end of each run (10k/15k ft.)

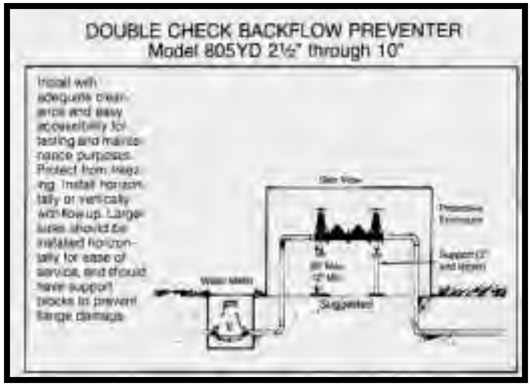
Design…..

"Other Considerations"…

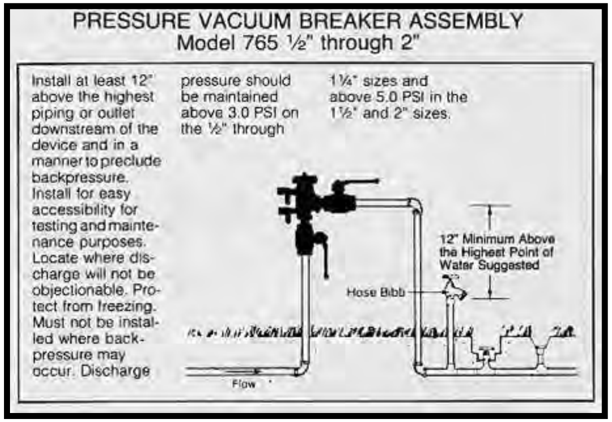
Local Codes…



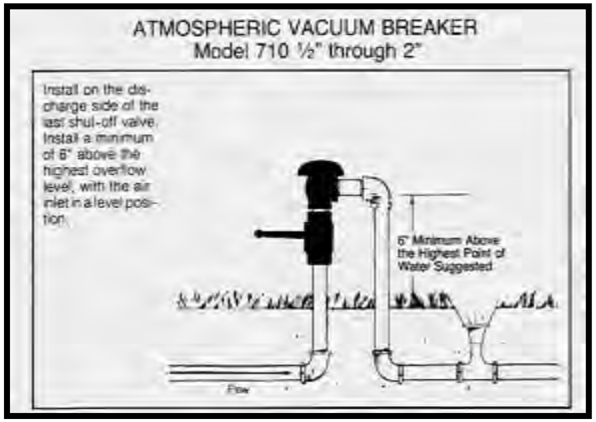
REDUCED PRESSURE BACKFLOW PREVENTER
Model 825YD 2½" through 10"
Suggested



DOUBLE CHECK BACKFLOW PREVENTER
Model 805YD 2½" through 10"
Suggested



PRESSURE VACUUM BREAKER ASSEMBLY
Model 765 ½" through 2"
Install at least 12" above the highest piping or outlet downstream of the device and in a manner to preclude backpressure. Install for easy accessibility for testing and maintenance purposes. Locate where discharge will not be objectionable. Protect from freezing. Must not be installed where backpressure may occur. Discharge pressure should be maintained above 3.0 PSI on the ½" through 1¼" sizes and above 5.0 PSI in the 1½" and 2" sizes.
12" Minimum Above the Highest Point of Water Suggested
Hose Bibb
Flow



ATMOSPHERIC VACUUM BREAKER
Model 710 ½" through 2"
Install on the discharge side of the last shut-off valve. Install a minimum of 6" above the highest overflow level, with the air inlet in a level position.
6" Minimum Above the Highest Point of Water Suggested
Flow

Local Codes…

Irrigation Wires and Cables & Electrical Code Requirements (NEC® and CEC®)

Paige

Local Codes…

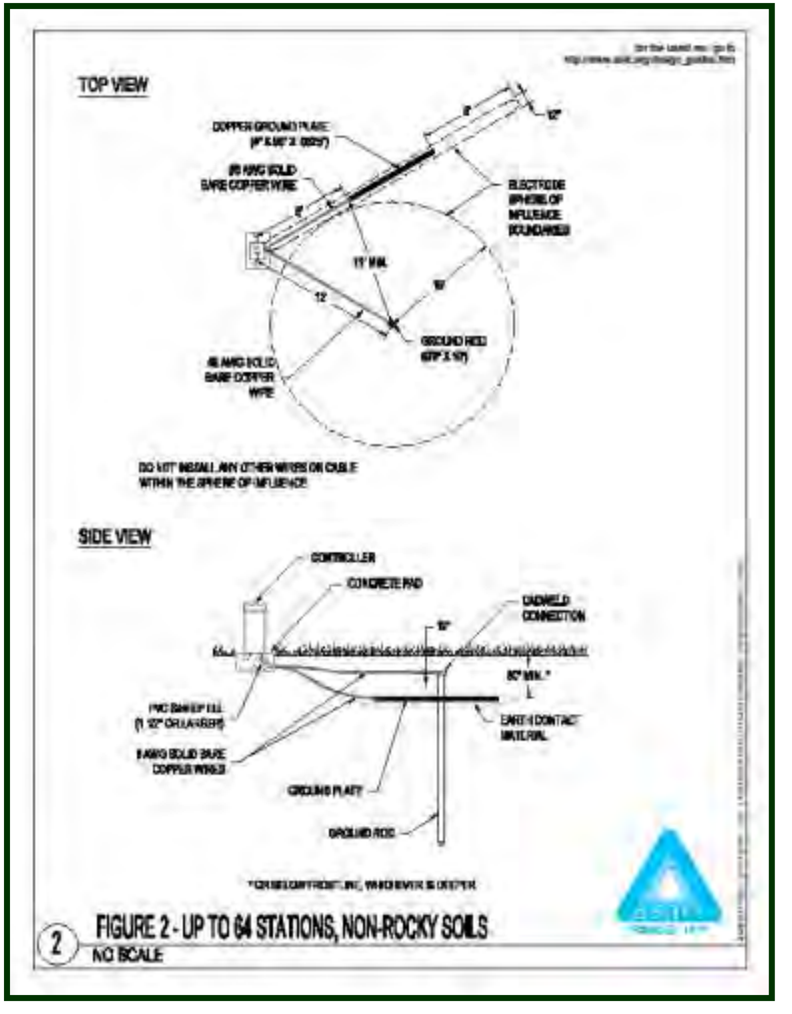
American Society of Irrigation Consultants

ASIC

ASIC Guideline 100-2002 (January 2, 2009)
For Earth Grounding Electronic Equipment in Irrigation Systems

For the latest rev. go to
http://www.asic.org/design_guides.htm

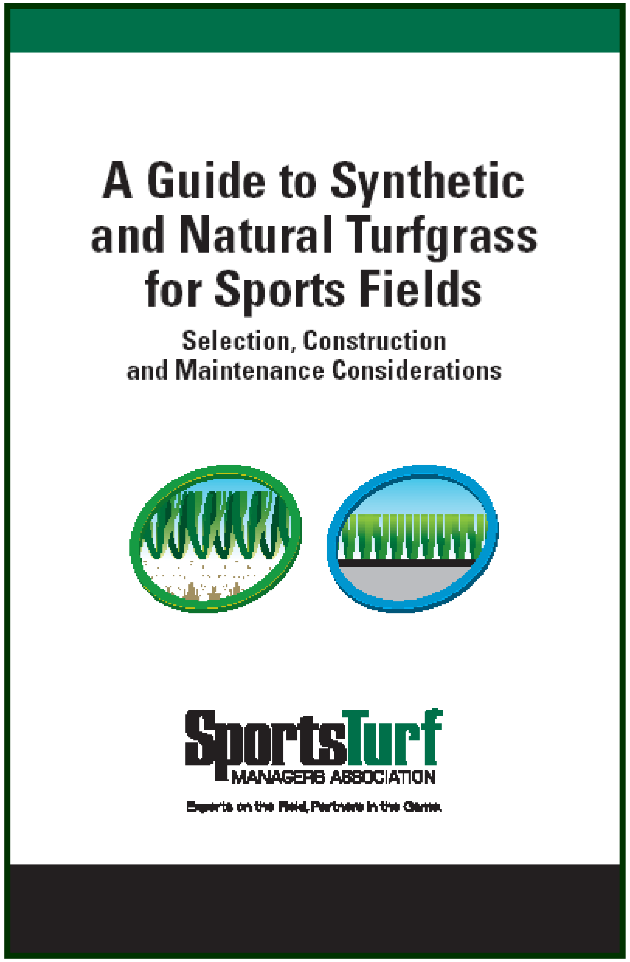
American Society of Irrigation Consultants
P.O. Box 426
125 Paradise Lane
Rochester, MA 02770
Phone: (508) 763-814
Fax: (508) 763-8102
Website: www.asic.org
E-mail: info@asic.org



Other Design Criteria

- Main line size – two zones at one time
- Equipment selection
- Hydro zones
- Infields
- Synthetic surfaces

Synthetic


A Guide to Synthetic and Natural Turfgrass for Sports Fields
Selection, Construction and Maintenance Considerations
SportsTurf
MANAGERS ASSOCIATION
Experts on the Field, Partners in the Game.

Synthetic

Equipment Selection

- Check with your local Irrigation distributor
- Obtain new product catalogues at this tradeshow!
- Check with your local sales representative
- Ask your neighbor

Equipment Selection






Back to the Basics…

Key Buzzwords…(quick quiz)

- Pr
- Ir
- Et
- Kc

Precipitation Rates…(Pr)

What is a “Precipitation Rate”?

A) How fast water is applied as measured in inches per hour (in/hr)

or

B) An amount of water applied over a period of time, usually measured in inches per hour

Are all Precipitation Rates the Same?

- high 1.0 in/hr and above
- medium 0.5 to 1.0 in/hr
- low 0.5 in/hr and below

High…

Medium

…

Low….

The Sprinkler Spacing Method…

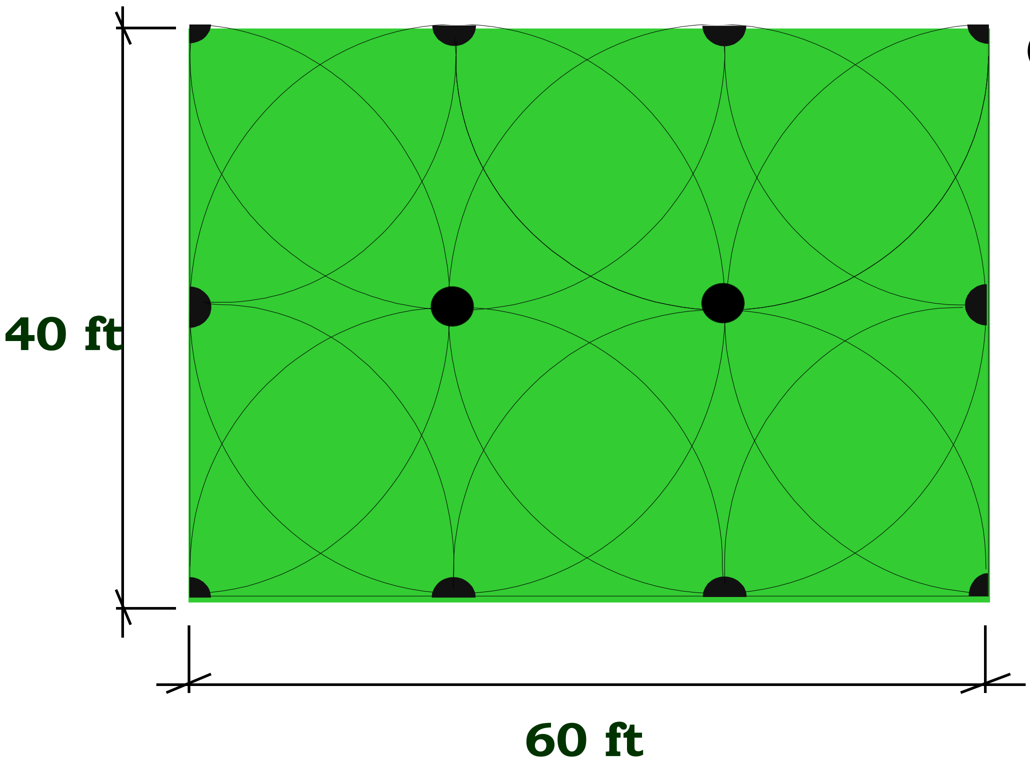
$$P_r = \frac{34650 \times \text{GPM (for any arc)}}{\text{Degrees Arc} \times \text{Head Spacing} \times \text{Row Spacing}}$$

The Sprinkler Spacing Method…

The Total Area Method…

$$P_r = \frac{96.25 \times \text{Total GPM}}{\text{Total Area}}$$

Total Area Method...



2 Full circle x 8.0 GPM = 16 GPM

6 Half circle x 4.0 GPM = 24 GPM

4 Quarter circle x 2.0 GPM = <u>8 GPM</u>

Total = 48 GPM

Total Area 40 ft. x 60 ft. = 2400 sq. ft.

- Full circle sprinkler - 8.0 GPM
- Half circle sprinkler - 4.0 GPM
- Quarter circle sprinkler - 2.0 GPM

Matched Precipitation Rates

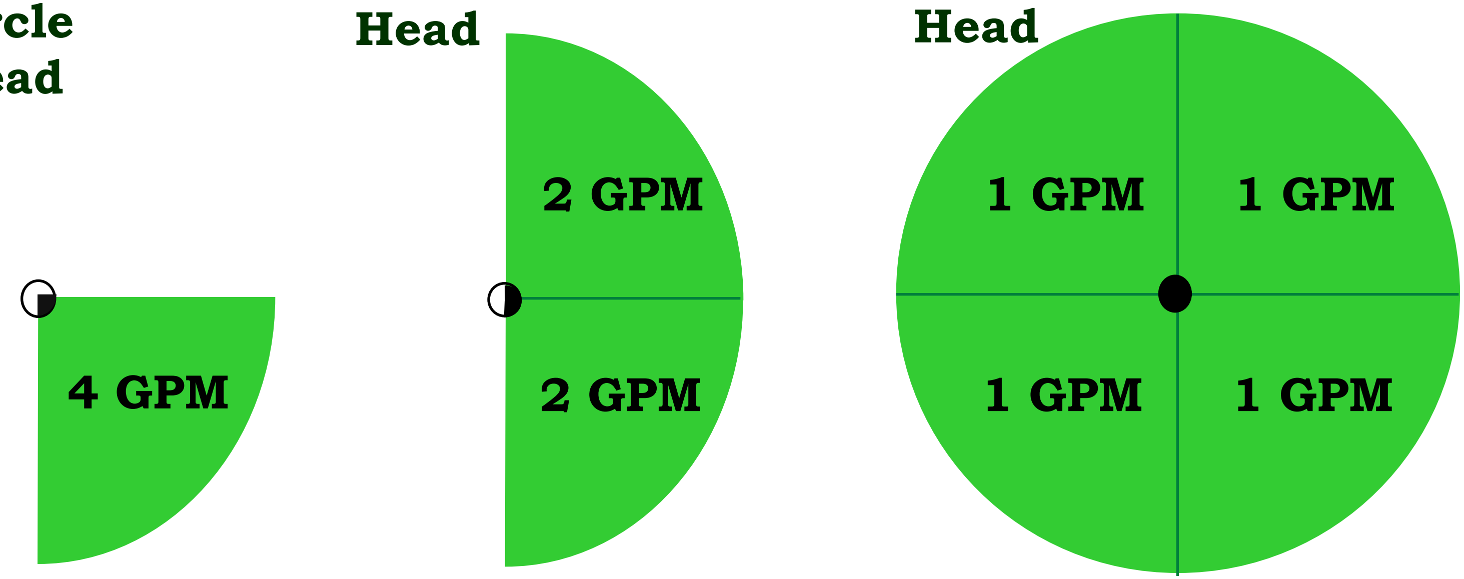
- all the heads have similar precipitation rates
- sprinklers by themselves do not have matched precipitation rates
- matched precipitation rates can help to avoid wet and dry spots AND help save water!

Heads WITHOUT Matched Precipitation Rates

Quarter Circle Head

Half Circle Head

Full Circle Head



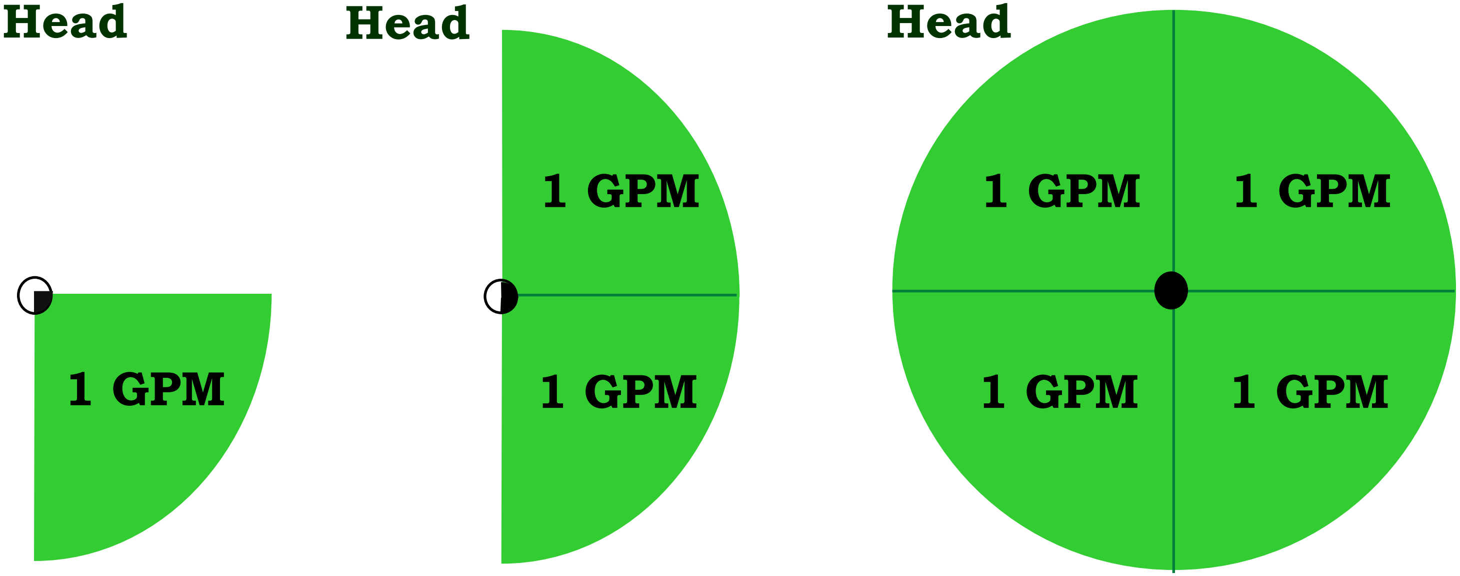
Area Covered
78.5 sq. ft. - 4 GPM

Area Covered
157 sq. ft. - 4 GPM

Area Covered
314 sq. ft. - 4 GPM

Matched Precipitation Rates

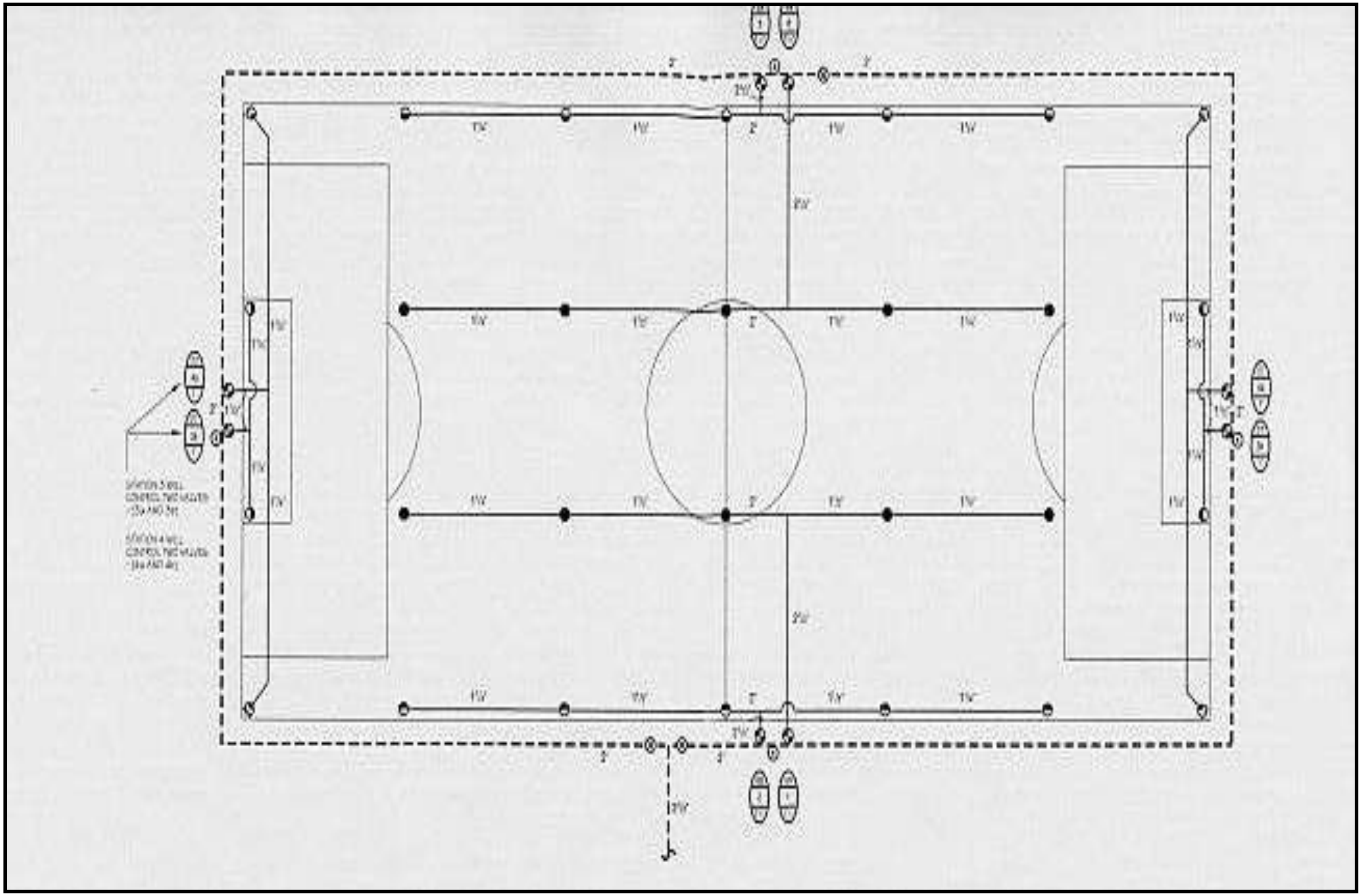
Quarter Circle Head | Half Circle Head | Full Circle Head



Area Covered 78.5 sq. ft. - 1 GPM

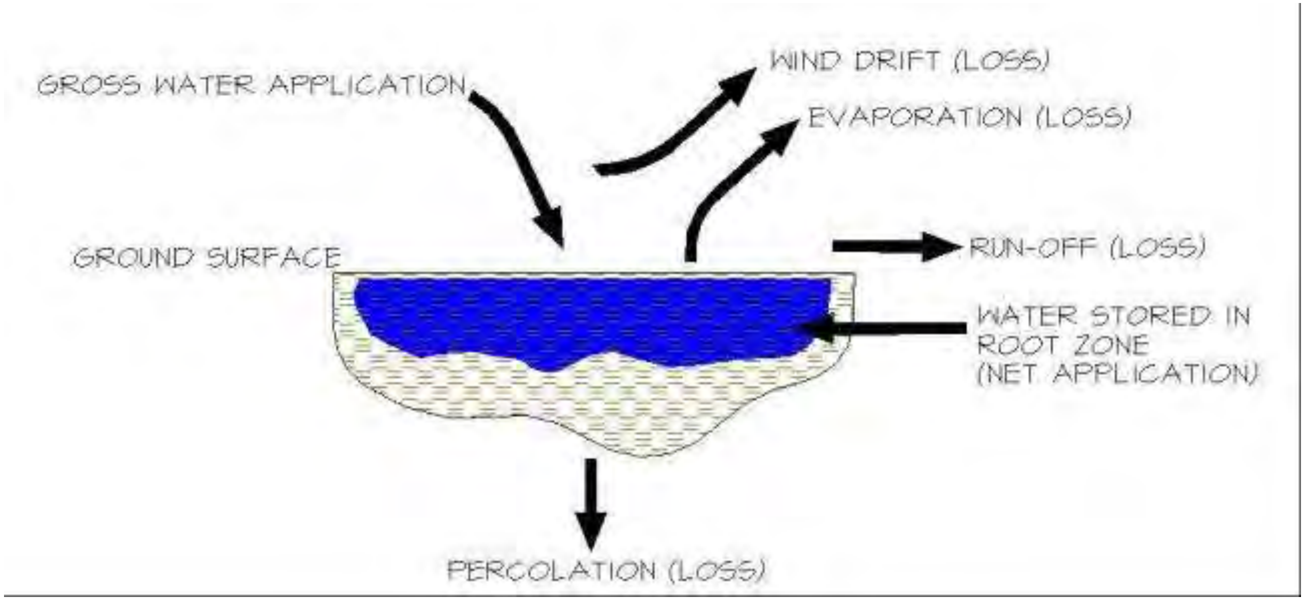
Area Covered 157 sq. ft. - 2 GPM

Area Covered 314 sq. ft. - 4 GPM



Match precipitation rates through scheduling the controller

Infiltration Rate – (IR)



What is an Infiltration Rate?

The rate that water moves into the soil surface, measured in in./hr (inches per hour)

Sprinkler Head Selection

When selecting sprinkler heads, it is necessary to limit their precipitation rate to the infiltration rate of the soil

SOIL TEXTURE	MAXIMUM PRECIPITATION RATES (inches per hour):							
	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	2.00	2.00	2.00	1.50	1.50	1.00	1.00	0.50
Coarse sandy soils over compact subsoils	1.75	1.50	1.25	1.00	1.00	0.75	0.75	0.40
Uniform light sandy loams	1.75	1.00	1.25	0.80	1.00	0.60	0.75	0.40
Light sandy loams over compact subsoils	1.25	0.75	1.00	0.50	0.75	0.40	0.50	0.30
Uniform silt loams	1.00	0.50	0.80	0.40	0.60	0.30	0.40	0.20
Silt loams over compact subsoil	0.60	0.30	0.50	0.25	0.40	0.15	0.30	0.10
Heavy clay or clay loam	0.20	0.15	0.15	0.10	0.12	0.08	0.10	0.06

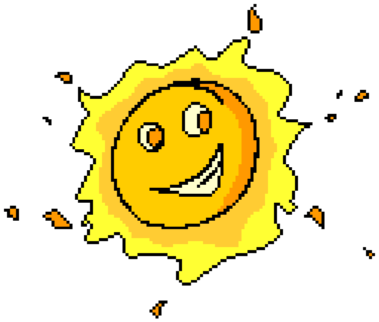
Evapotranspiration Rate (ET)

Evapotranspiration Rate…

The rate at which water is transpired by the plant and evaporated from the soil.

What Affects ET?

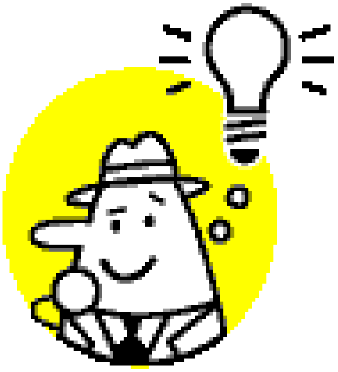
- **Wind**
- **Humidity**
- **Temperature**
- **SOLAR RADIATION**



Potential ET Rates

Cool Humid	0.10 – 0.15
Cool Dry	0.15 – 0.20
Warm Humid	0.15 – 0.20
Warm Dry	0.20 – 0.25
Hot Humid	0.20 – 0.30
Hot Dry	0.30 – 0.50

Crop Coefficient (Kc) or Plant Factor



Crop Coefficient…

Factor used to compensate for differences in plant usage. (% of ET)

Different Plants Have Different Needs.

Scheduling:

$$T = \frac{60 \times Eto \times Kc}{PR \times EA}$$

Scheduling

- **EXAMPLE:**
- **Kc = cool season turf = .80**
- **ETo = .25"/ day**
- **DU = 70%**
- **Soil = sandy loam**
- **PR = .50"/ hr.**

- $T = \dfrac{60 \times ETo \times Kc}{PR \times DU}$ $\qquad T = \dfrac{60 \times .25 \times .80}{.50 \times .70}$

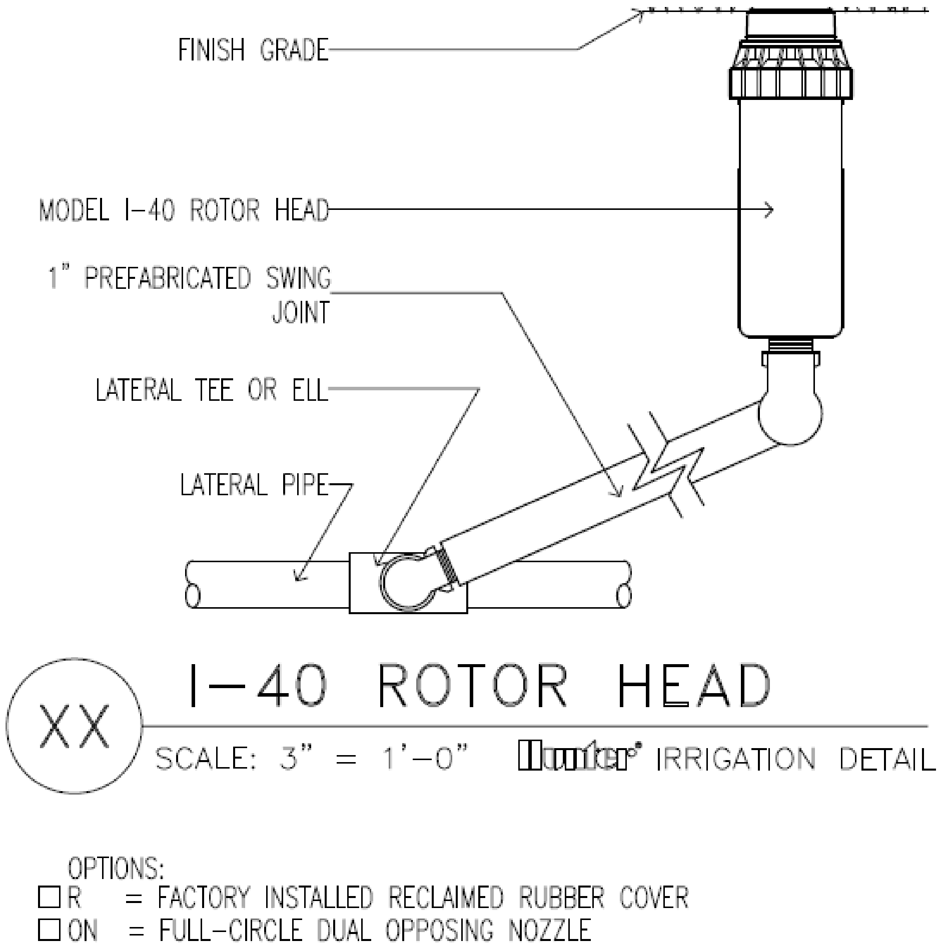
- $T = \dfrac{12.0}{.35}$ $\qquad$ **T = 34 minutes run time**

How it All Comes Together in the Field

Installation Criteria

- **Main line & lateral depth**
- **Sprinklers and quick couplers**
  - **Grade**
  - **Boxes**
- **Trenches properly backfilled and compacted**
- **Provide a color-coded, laminated**
- **"As-Built" for controller box**

Installation…



Proper Installation Heights

Proper Installation Practices…

DBRY-6

Professional Irrigation Installation

Site inspections are *cheap* insurance policies!

Efficient Irrigation Maintenance/ Management

Efficient Irrigation Maintenance/ Management…

Efficient Irrigation Maintenance/ Management

Maintenance Check-list

- **Set pressures to specifications**
- **Adjust heads to correct grades**
- **No missing heads or broken sprinklers**
- **No interference to heads by landscape**
- **Annual equipment check-up**
- **Understand proper winterization & spring start-up techniques**

Education Opportunities

Irrigation ASSOCIATION™

Join IA | Get Certified | Find a Member | Find a Certified Professional

HOME | LOGOFF | MANAGE PROFILE | CALENDAR | REGISTER | STORE | MY CART

ABOUT | MEMBERSHIP | EDUCATION | CERTIFICATION | EVENTS | POLICY | RESOURCES | NEWS | Search | GO

Enhance your expertise with IA and Foundation classes and education resources. Basic to advanced tools improve the performance of your team, paying off in the office and in the field.

Home > Education > Online Learning

EDUCATION

- Calendar
- Register
- Classes
- Online Learning
  - Online Class Descriptions
- Sponsor a Class
- Education Resources

Learning on Demand

Training for Today's Mobile Workforce

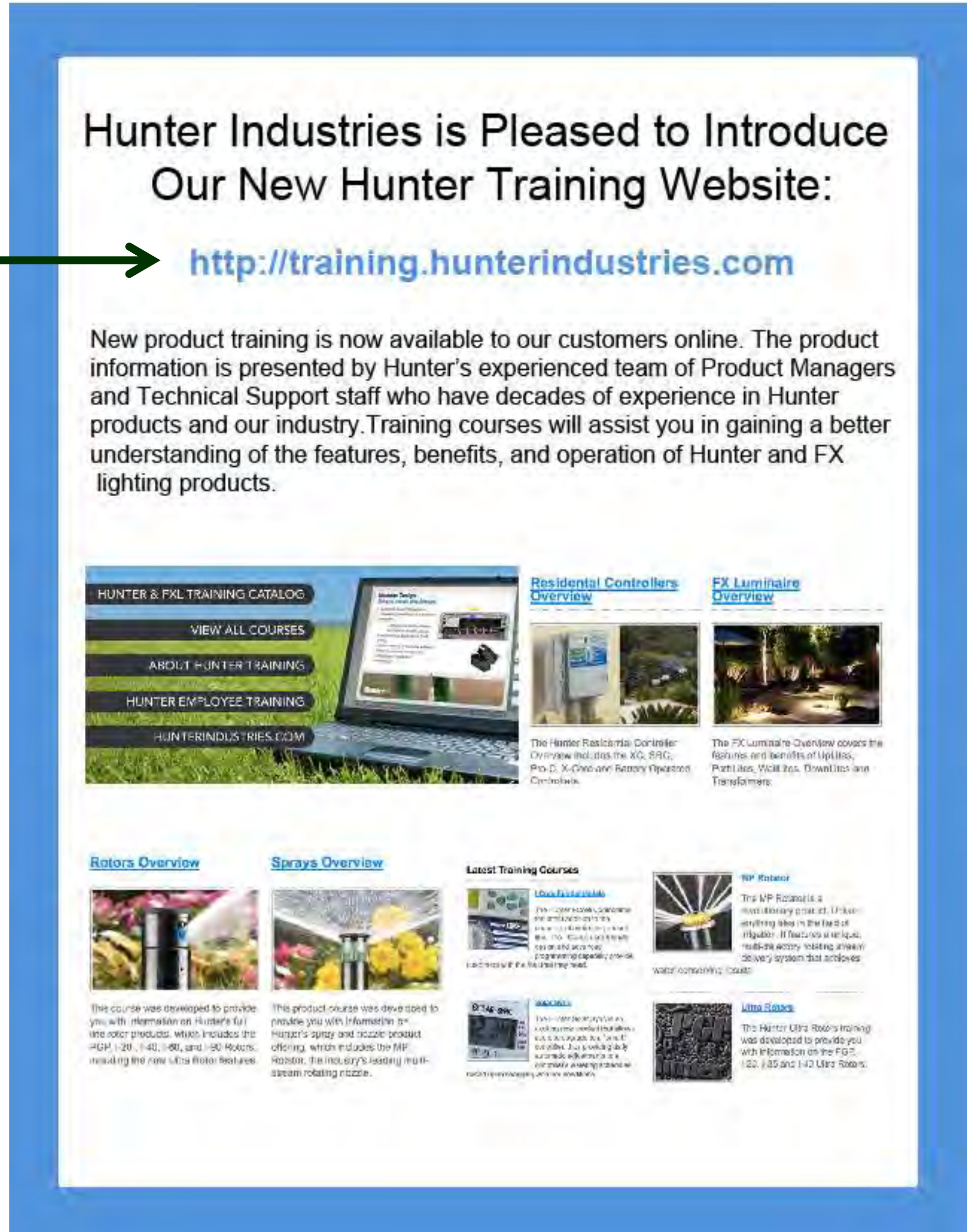
IA's online learning center — Learning on Demand — makes continuing education easier and more affordable than ever. Learning on Demand lets you and your employees study whenever and wherever you're most focused and ready to learn.

Lessons are hands-on and interactive, allowing students to assess their performance and move forward at their own pace.

- Lesson summaries review each section.
- Sample calculations walk though complex formulas step by step.
- Practice problems apply learning to real-world situations.
- A final assessment completes each course.

Earn four CEUs for each online class.

Fantastic!!

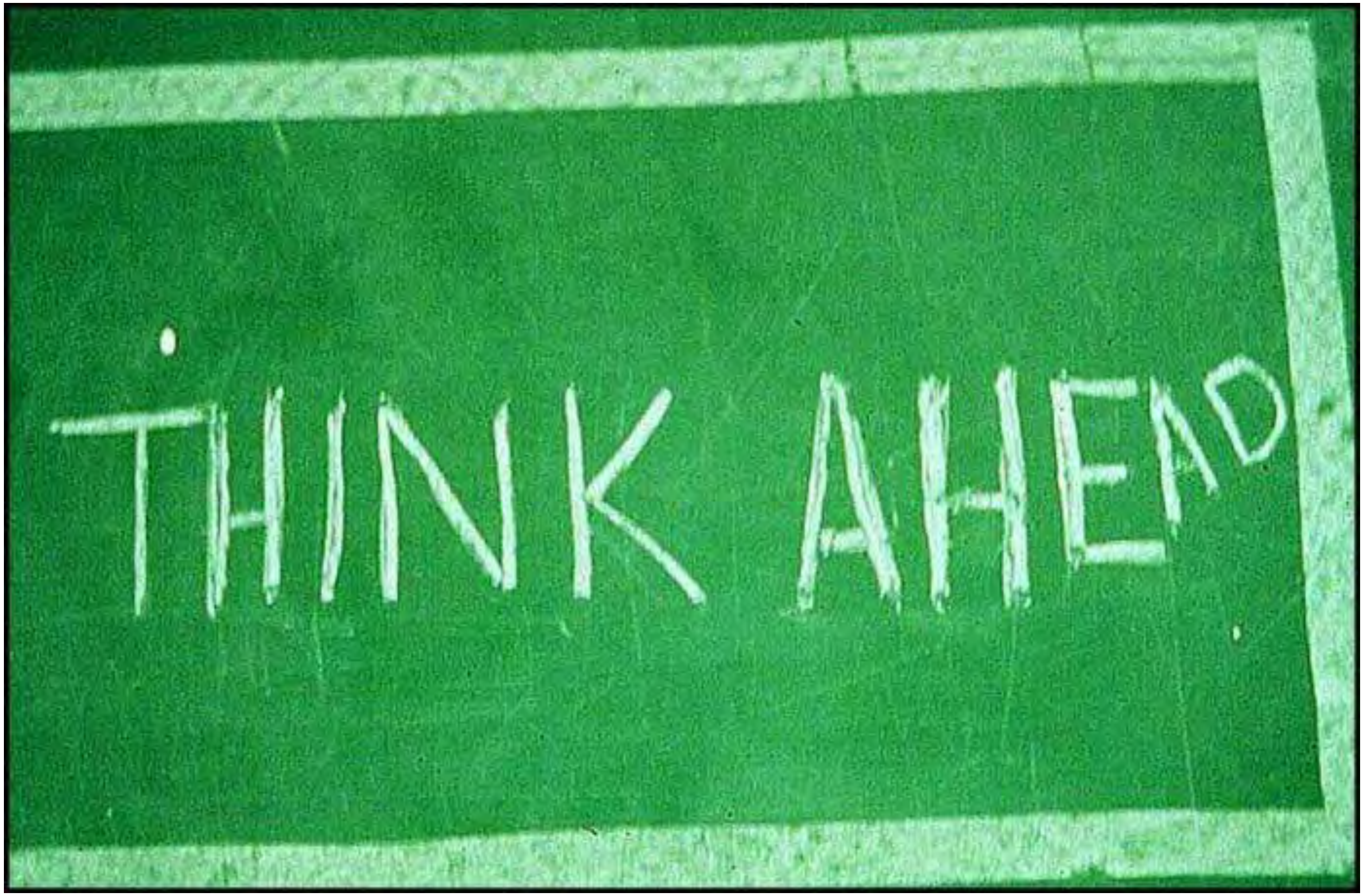


Hunter Industries is Pleased to Introduce Our New Hunter Training Website:
http://training.hunterindustries.com
New product training is now available to our customers online. The product information is presented by Hunter's experienced team of Product Managers and Technical Support staff who have decades of experience in Hunter products and our industry. Training courses will assist you in gaining a better understanding of the features, benefits, and operation of Hunter and FX lighting products.
HUNTER & FXL TRAINING CATALOG
VIEW ALL COURSES
ABOUT HUNTER TRAINING
HUNTER EMPLOYEE TRAINING
HUNTERINDUSTRIES.COM
Residential Controllers Overview
FX Luminaire Overview
Rotors Overview
Sprays Overview
Latest Training Courses
MP Rotator
Ultra Rotors

What does it all mean?

=

Complexities? Simplicities? Pitfalls!



STMA…

SportsTurf
MANAGERS ASSOCIATION

Experts on the Field, Partners in the Game.

www.stma.org

Thank You!

- **Lynda Wightman**

406.273.3073 (o)

406.544.1911 (m)

lynda.wightman@hunterindustries.com

Q & A

Troubleshooting Irrigation Systems

Irrigation Troubleshooting

Minimize the need to "Troubleshoot" a System by Maintaining and Inspecting Your System on a Regular Basis!

Troubleshooting Sequence

- Confirm Water Supply
- Backflow devices
- Automatic Controller
- Field Wiring
- Valves
- Sprinkler Heads
- Pipe and Fittings

Confirm Water Supply…

- Is system pressurized?
- Is supply line connected?
- Is master valve flow control open?
- Are any manual/ isolation valves closed?

Backflow Devices…

- Is device open and operating?
- Check petcocks for debris in lines
- Check isolation valves
- Consult manufacturer's instructions

Electrical Problems Troubleshooting Sequence

Seek to Isolate the Problem into One of Three Areas (in this order):

1) Clock
2) Field Wiring
3) Solenoid

Automatic Controller…

- No Operation or Display
  - No 120V power supply
  - Blown fuse, overload or short
  - Tripped circuit breaker
  - Damaged controller

Automatic Controller…

- No Program Execution
  - Bad programming
  - No field connection (cut, loose, disconnected wiring)
  - Sensors activated
  - Valve and/ or meter turned off
  - No controller output power

Automatic Controller…

- No Controller Output
  - No power supply to field
  - Blown field common line fuse (24V)
  - Tripped field common line breaker (24V)
  - Loose connector for field wiring
  - No output operated device connected

Most Common Controller Problems

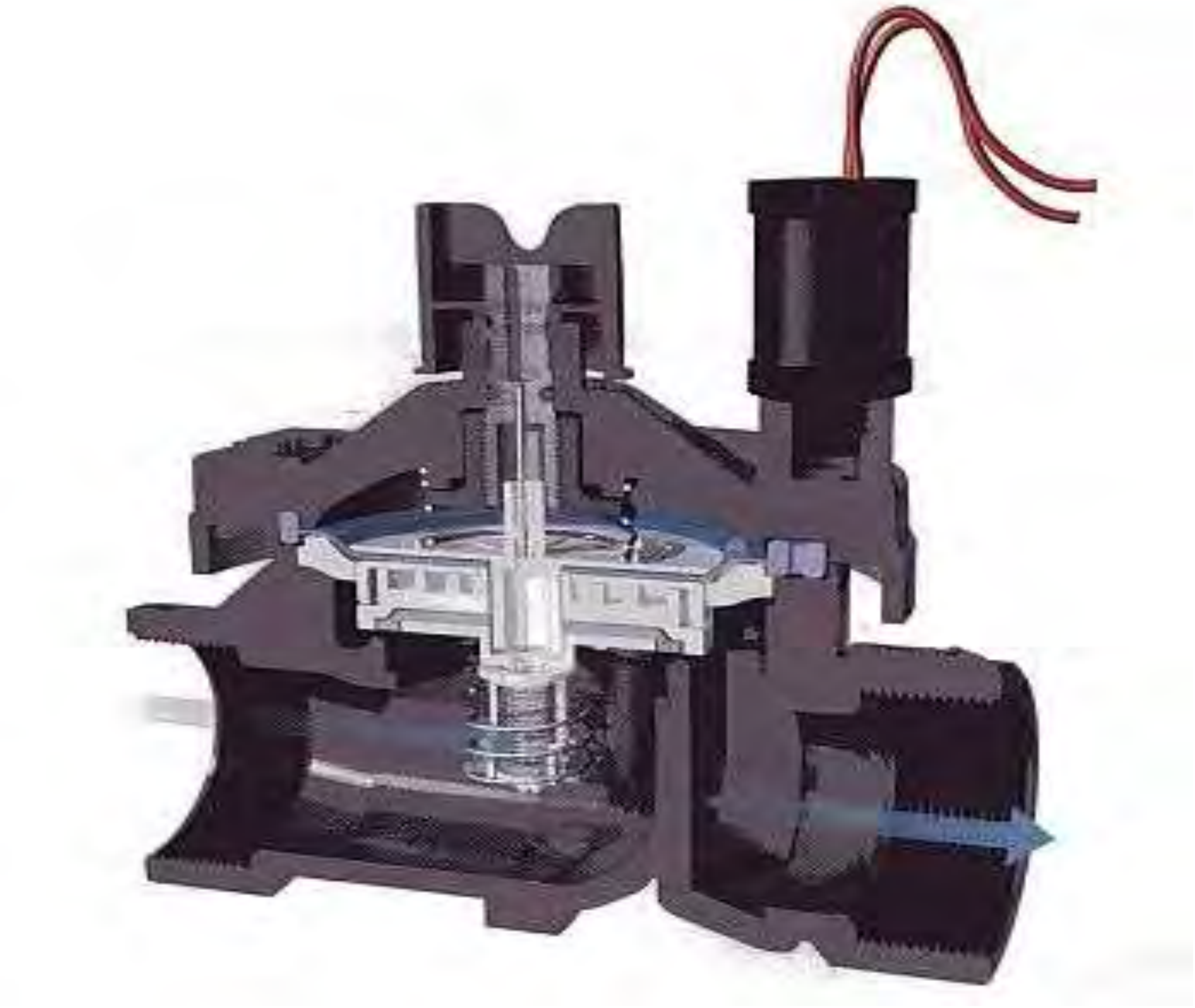
Programming Error - must have: Start Time, Run Time, Days to Water, Correct day and Time

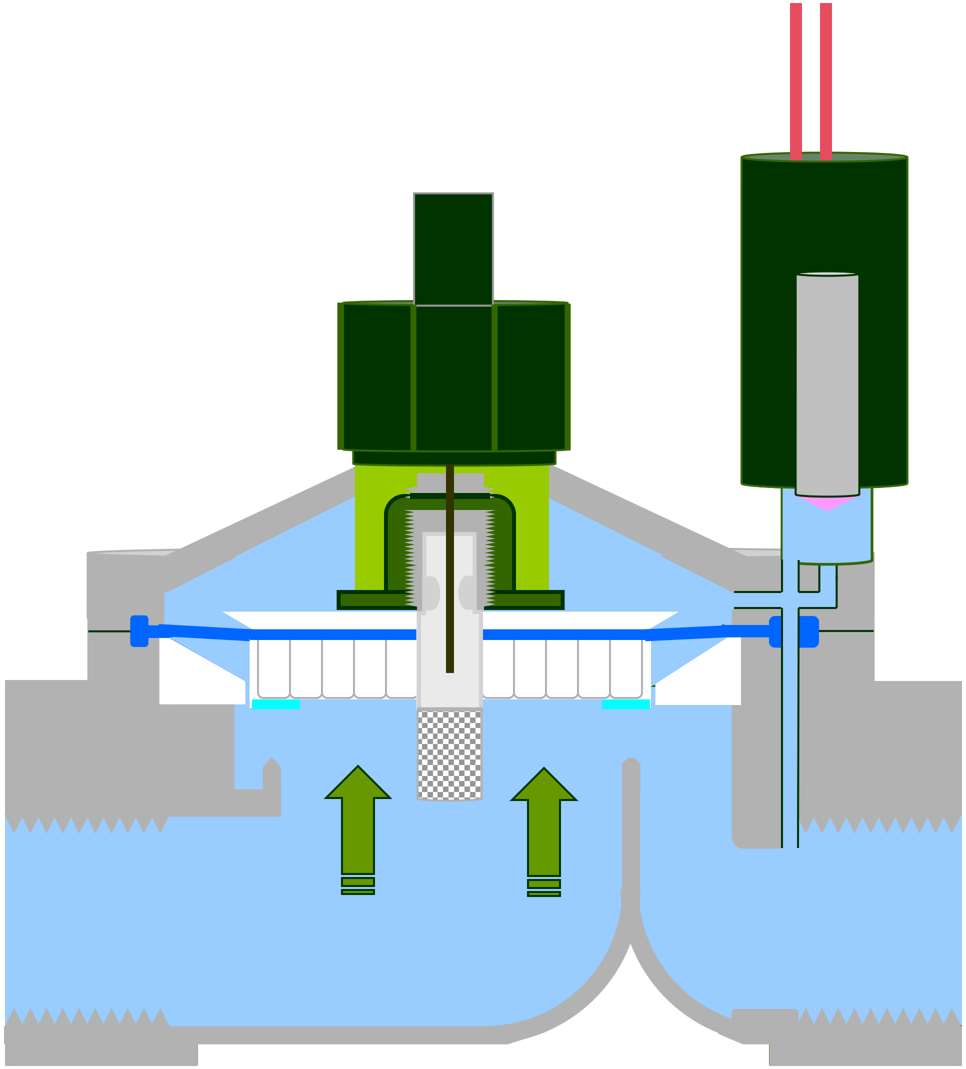
- Total System Failure (no 120 V incoming)
- No Output to Valves (no 24 V outgoing)
- Is A Sensor (rain, wind or freeze) Active?
- Meters – (Voltmeter: to check controller; Ohm meter: to check field wiring)

Field Wiring…

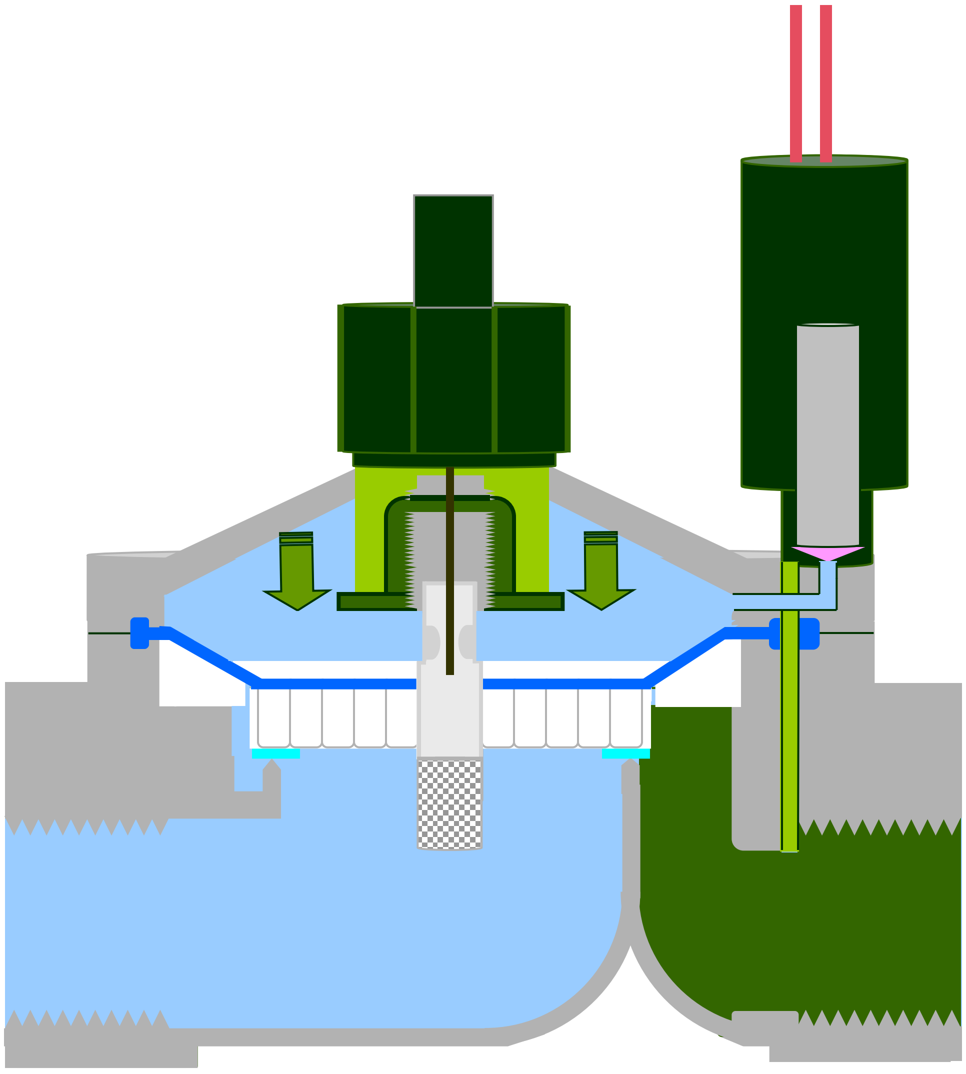
- Bad splices due to improper use of connectors
- Broken or nicked field wires
- Use cable fault locators to track problems
- Ohm meter for field wiring checks

Electric Control Valves…

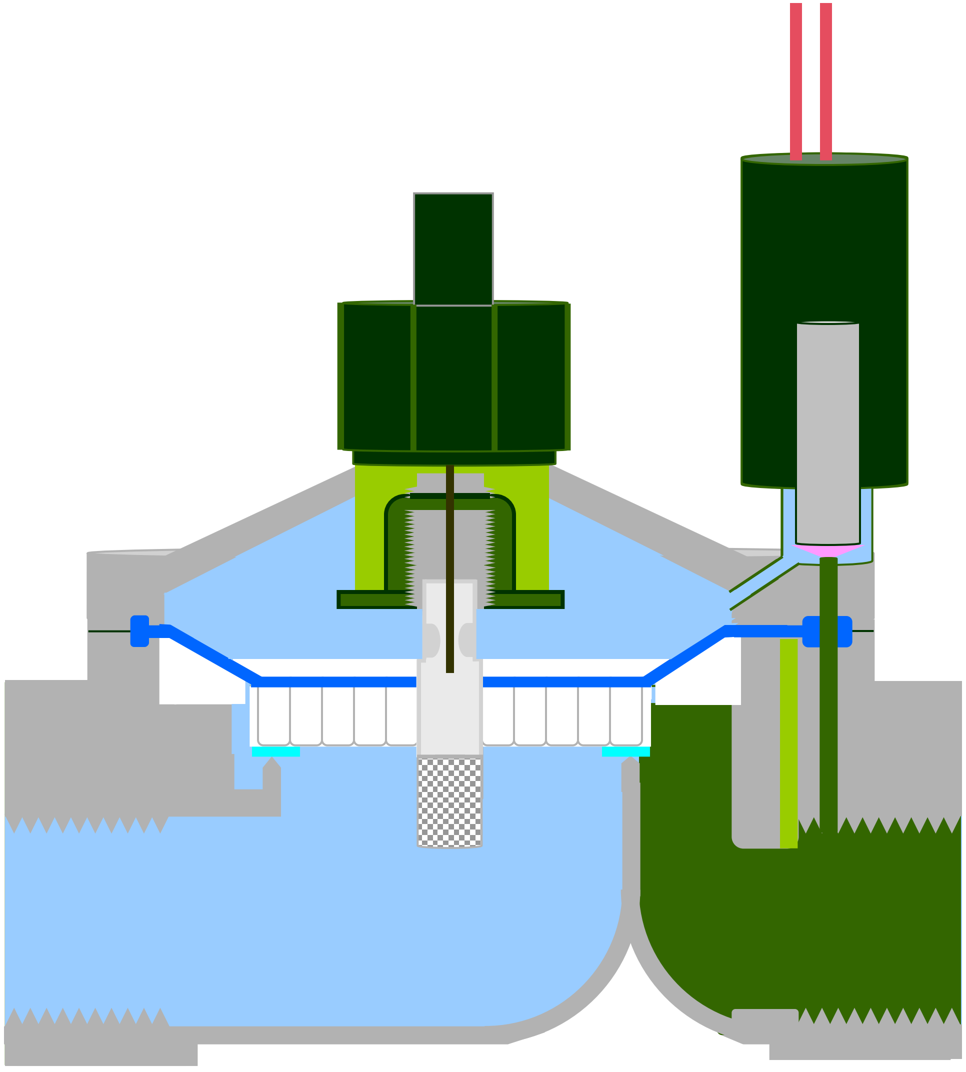




Forward Solenoid Flow Valve



Forward Solenoid Flow Valve



Forward Solenoid Flow Valve

Electric Control Valves…

- **Valve does not close**
  - Damaged diaphragm
  - Seats are corroded or broken
  - Upper chamber filter is plugged
  - Worn or damaged solenoid
  - Flow control handle turned full open
  - Manual bleed screw is corroded
  - Valve has been disassembled in field and reassembled improperly

Electric Control Valves…

- **Valve does not open**
  - Bad solenoid
  - No power to solenoid from controller
  - Insufficient voltage at valve
  - Flow control turned down
  - Solenoid port/ path is plugged
  - Flow demand to low for valve specs
  - If pressure regulated, regulator could be damaged or incorrectly adjusted

Sprays Heads…

- **Severe misting…too much pressure**
  - Install regulating device or turn down flow control handle on valve
- **Spray pattern spiking** – plugged orifice
- **Water puddling at sprinkler**
  - Popup stroke too small
  - Head buried too low
  - Low head drainage – check valve
- **Vertical stream of water around riser**
  - Worn or damaged wiper seal; cap not on tight

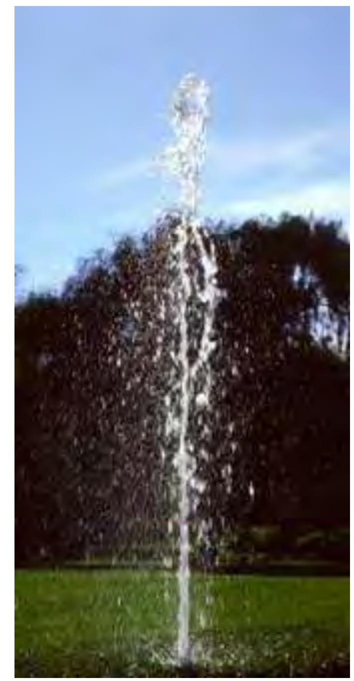
Spray Heads…

High psi

Adj. psi

Internal psi regulator

Leaky cap/ wiper seal



Rotors…

- **Gear (ball & cam) Drives**
  - Non-rotation
    - Stator mechanism is blocked by debris
    - Reversing springs misaligned
  - Water leaking around riser
    - Worn or damaged wiper seal
  - Water puddling around sprinkler
    - Head buried too low
    - Low head drainage
  - Spray distorted by adjustment screw
    - Back off screw

Rotors…

Rotors…

- **Gear Drives**
  - Too low of pressure
    - Change nozzle to smaller flow (increase run-time)
    - Open flow control handle on valve
    - Check for semi-closed isolation valves
    - Divide zone; add another valve
    - Add booster pump

Pipe and Fittings Maintenance Check-list

- Use Swing Joints on all Heads
- Solvent Cement PVC fittings Properly
- Clamp Poly Pipe Properly
- Proper Burial Depth for all Piping
- Thrust blocks where required
- Winterize (Blow-out) System Properly

Irrigation System Troubleshooting…

"The Ideal System applies water uniformly, is easy to repair and maintain and is operationally simple."