

## IRRIGATION DESIGN RULES-OF-THUMB

### WATER METER

Meter Size and Maximum Flow considering a maximum of 75% of safe flow through the meter.

Size	Max. Flow
5/8"	15.0
3/4"	22.5
1"	37.5
1 1/2"	75.0
2"	120
3"	225
4"	375

### SERVICE LINE

The service line is the line in the street from the main to your water meter. Two service line types/velocities are indicated:

Size In.	Max GPM @ 7.5 FPS and 9 FPS			
	PVC Sch 40		Copper Type K	
	7.5 FPS	9.0 FPS	7.5 FPS	9.0 FPS
3/4"	12.5	15	10.2	12.2
1"	20.2	24.3	18.2	21.8
1 1/4"	28.5	34.2	28.5	34.2
1 1/2"	40.3	48.4	40.3	48.4
2"	78.5	94.3	70.6	84.6
2 1/2"	109.1	130.8	109	130.8
3"	173	207.6	155	185
4"	298	325		

### REMOTE CONTROL VALVE (RCV)

Allowable flow not exceeding about 10% of the static pressure. Two example valves are listed here w/ max flow.

Size In.	GPM @ PSI Loss	
	Irritrol 100	Rain Bird PEB
1"	30 @ 4.1	30 @ 5.6
1 1/2"	60 @ 5.2	75 @ 5.4
2"	130 @ 5.6	120 @ 6.0
3"	225 @ 5.3	

### MAIN LINE

Maximum mainline flows at 5 fps velocity, with slower velocity options at larger pipe.

#### **PVC Sch 40 and Class 315**

Size In.	GPM @ FPS	
3/4"	8.33 @ 5	
1"	13.5 @ 5	
1 1/4"	24.0 @ 5	
1 1/2"	32.0 @ 5	
2"	50 @ 5	
2 1/2"	73 @ 5	
3"	105 @ 4.6	110 @ 5
4"	160 @ 4.4	180 @ 5
6"	332 @ 4.25	385 @ 5

### RP BACKFLOW DEVICE

The manufacturer's graph of pressure loss should be examined, but general conclusions are indicated here:

#### **Febco 825Y and 860**

Size In.	GPM @ PSI Loss
3/4"	18 @ 13
1"	48 @ 12
1 1/2"	90 @ 13
2"	140 @ 13
2 1/2"	220 @ 12
3"	320 @ 13
4"	600 @ 10
6"	1800 @ 12

### MAX SOURCE FLOW AND REQUIREMENTS

Max allowable flow through water meters and the related system requirements if this flow is reflected in the design.

GPM	W.M.Size	Service	Mainline	Valve
15.0	5/8"	3/4"	1 1/4"	1"
22.5	3/4"	1"	1 1/4"	1"
37.5	1"	1 1/2"	2"	1 1/2"
75.0	1 1/2"	2"	2 1/2"	1 1/2"
120	2"	2 1/2"	4"	2"
225	3"	4"	6"	3"

### PRESSURE REQUIRED

Type	Design Pressure
Spray	30 psi
Rotors	40 psi minimum (1 psi per ft radius minimum)
Drip	20 psi

**System Pressure Loss:** The loss through the system to get to your last head and satisfy the Head Design Pressure: Here are "average" low and high losses that may occur.

Type of Loss	PSI Low	PSI High
Lateral pipe	1.5	3.5
Elevation	0	6
RCV	3.5	4.5
Mainline pipe	1.5	4.0
Backflow Device	12	13
Water Meter	4	5
<b>Total</b>	<b>22.50 psi</b>	<b>36.0 psi</b>

### **Typical pressure requirements:**

The system loss above varies by project, but anticipate a loss of about 25 to 30 psi that would have to be added to your Head Design Pressure, with some averages:

Drip:	42.5 to 50 psi
Spray:	52 to 66 psi
Small rotors:	62 to 76 psi
Medium large rotors:	73 to 86 psi
Large rotors:	88 to 100 psi

## PLANT WATER REQUIREMENT & RUNTIME RULES OF THUMB

### PWR – PLANT WATER REQUIREMENT

Plant Water Requirement (PWR) is the Evapotranspiration (ETo) times the Crop Coefficient (Kc).

### ET – Evapotranspiration

Water lost from soil and plant leaf (evaporation) and used by plants (transpiration). Reference ET (ETo) is based on cool season grass. Listed is a general average.

#### **ETo in inches per day (worst case)**

Climate	Definition	ETo
Cool Humid	<70 F / >50% humidity	0.10 – 0.15
Cool Dry	<70 F / <50% humidity	0.15 – 0.20
Warm Humid	70 – 90 F / >50% humidity	0.15 – 0.20
Warm Dry	70 – 90 F / <50% humidity	0.20 – 0.25
Hot Humid	>90 F / >50% humidity	0.20 – 0.30
Hot Dry	>90 F / <50% humidity	0.30 – 0.45

### Kc – Crop Coefficient

Coefficient to modify the ETo for a specific plant type.

Vegetation	High	Average	Low
Trees	0.9	0.5	0.2
Shrubs	0.7	0.5	0.2
Ground Cover	0.9	0.5	0.2
Mixture of trees, shrubs, and GC.	0.9	0.5	0.2
Turf	0.8	0.75	0.6

### PWR – Plant Water Requirement (Weekly)

Listed here is the average for the climate and plant types.

$$\text{Weekly PWR} = (ETo) \times (Kc) \times (7 \text{ days})$$

Cool Humid	High	Average	Low
Trees and Shrubs	0.79	0.44	0.18
Turf	0.70	0.66	0.53

Cool Dry/Warm Humid	High	Average	Low
Trees and Shrubs	1.10	0.61	0.25
Turf	0.98	0.92	0.74

Warm Dry	High	Average	Low
Trees and Shrubs	1.42	0.79	0.32
Turf	1.26	1.19	0.95

Hot Humid	High	Average	Low
Trees and Shrubs	1.58	0.88	0.35
Turf	1.40	1.31	1.05

Hot Dry	High	Average	Low
Trees and Shrubs	2.36	1.31	0.53
Turf	2.10	1.97	1.58

### RUN TIME

The Run Time is the total time needed to apply the weekly water for either Trees and Shrubs or Turf considering the Plant Water Requirement (PWR) and the Precipitation Rate (PR). General averages for both of those were used in this listing.

$$\text{Run Time} = (PWR/PR) \times 60$$

### PR – Precipitation Rate

General Precipitation Rates which can widely vary between manufacturers, this will need careful review and adjustment.

Spray	1.9
Rotor 15-30'	0.64
Rotor 25-45'	0.50
Rotor 40-85' (Triang Spacing)	0.84
Rotor 40-85' (Square Spacing)	0.70
Hunter Rotator	0.45
RB/Toro Rotary	0.68
Dripline 0.4gph@12"	0.67
Dripline 0.6gph@12"	1.03
Dripline 0.9gph@12"	1.55

### Run Time (in Minutes)

CH = Cool Humid

CD/WH = Cool Dry / Warm Humid

WD = Warm Dry

HH = Hot Humid

HD = Hot Dry

### Trees and Shrubs

Head Type	CH	CD/WH	WD	HH	HD
Spray	14	19	25	28	41
Rotor 15-30'	41	57	74	82	123
Rotor 25-45'	52	73	95	105	157
Rotor 40-85' (Triang)	31	43	56	63	94
Rotor 40-85' (Square)	37	52	68	75	112
Hunter Rotator	59	81	105	117	175
RB/Toro Rotary	39	54	70	78	116
Dripline 0.4gph@12"	39	54	70	78	117
Dripline 0.6gph@12"	25	35	46	51	76
Dripline 0.9gph@12"	17	23	30	34	50

### Turf

Head Type	CH	CD/WH	WD	HH	HD
Spray	22	31	40	44	66
Rotor 15-30'	65	90	118	131	197
Rotor 25-45'	83	117	151	168	252
Rotor 40-85' (Triang)	49	71	90	100	150
Rotor 40-85' (Square)	49	85	108	120	180
Hunter Rotator	95	131	168	187	280
RB/Toro Rotary	62	87	111	124	185
Dripline 0.4gph@12"	62	87	111	124	185
Dripline 0.6gph@12"	40	57	73	82	122
Dripline 0.9gph@12"	27	38	49	54	81

## MAXIMUM CYCLE RUN TIME RULES OF THUMB

### AW – AVAILABLE WATER

Water available for plant to use.

Sand	0.08 in./in.
Sandy Loam	0.15 in./in.
Loam	0.21 in./in.
Clay Loam	0.17 in./in.
Clay	0.12 in./in.

### RZ - ROOT ZONE

Active root zone or soil depth for plant water extraction.

Ground Cover	6" to 12"
Shrubs	12" to 24"
Trees	18" to 36"

### PAW – PLANT AVAILABLE WATER

Water stored within root zone - field capacity to wilting point.

$$PAW = (AW) \times (RZ)$$

Soil	G.C.	Shrubs	Trees
Sand	0.5-1.0 in.	1.0-2.0 in.	1.5-2.9 in.
Sandy Loam	0.9-1.8 in.	1.8-3.6 in.	2.7-5.4 in.
Loam	1.25-2.5 in.	2.5-5 in.	3.8-7.6 in.
Clay Loam	1.0-2.0 in.	2.0-4.0 in.	3.1-6.2 in.
Clay	0.7-1.5 in.	1.5-3.0 in.	2.2-4.3 in.

### IR – INFILTRATION RATE

Inches per hour of intake or infiltration rate.

Sand	0.75 – 1.0 in./hr.
Sandy Loam	0.5 – 0.75 in./hr.
Loam	0.35 – 0.50 in./hr.
Clay Loam	0.25 – 0.40 in./hr.
Clay	0.10 – 0.25 in./hr.

### RUN TIME MULTIPLIER

The Run Time Multiplier relates to the Distribution Uniformity (DU).

#### **DU - Distribution Uniformity**

Average of lowest 25% of catchment readings divided by the average of all catchments, with a general guide as follows:

Head Type	Odd Shape	Open, Flat
Spray	0.50	0.65
Rotors	0.65	0.80
Dripline	0.85	0.90

#### **Run Time Multiplier**

1 divided by the DU above, with general averages below. This will be multiplied by the Initial Run Time for a total Run Time

Head Type	Odd Shape	Open, Flat	Average
Spray	2	1.54	1.77
Rotors	1.54	1.25	1.40
Dripline	1.18	1.11	1.15

### MAXIMUM CYCLE RUN TIME

Maximum water cycle to avoid runoff.

$$Cycle\ Run\ Time = (IR/PR) \times 60 \times (Slope\ Factor)$$

Slope Factor: Flat=1, 5:1=0.9, 4:1=0.75, 3:1=0.5, 2:1=0.25

#### Irrig. Type for Soil      Flat    5:1    4:1    3:1    2:1

#### **Sand**

Spray	20	18	15	10	5
Rotor 15-30'	82	74	62	41	20
Rotor 25-45'	105	95	78	53	26
Rotor 40-85'	62	56	47	31	15
Hunter Rotator	117	105	87	58	29
RB/Toro Rotary	77	69	57	38	19
Dripline 0.4gph@12"	78	70	58	39	19
Dripline 0.6gph@12"	51	45	38	25	12
Dripline 0.9gph@12"	34	30	25	17	8

#### **Sandy Loam**

Spray	19	17	14	9	4
Rotor 15-30'	58	52	43	29	14
Rotor 25-45'	75	67	56	37	18
Rotor 40-85'	44	39	33	22	11
Hunter Rotator	83	74	62	41	20
RB/Toro Rotary	55	49	41	27	13
Dripline 0.4gph@12"	55	49	41	27	13
Dripline 0.6gph@12"	36	32	27	18	9
Dripline 0.9gph@12"	24	21	18	12	6

#### **Loam**

Spray	13	11	9	6	3
Rotor 15-30'	39	35	29	19	9
Rotor 25-45'	51	45	38	25	12
Rotor 40-85'	30	27	22	15	7
Hunter Rotator	56	50	42	28	14
RB/Toro Rotary	37	33	27	18	9
Dripline 0.4gph@12"	38	33	27	18	9
Dripline 0.6gph@12"	24	21	18	12	6
Dripline 0.9gph@12"	16	14	12	8	4

#### **Clay Loam**

Spray	10	9	7	5	2
Rotor 15-30'	30	27	22	15	7
Rotor 25-45'	39	33	27	18	9
Rotor 40-85'	23	21	18	12	6
Hunter Rotator	43	39	33	22	11
RB/Toro Rotary	28	25	21	14	7
Dripline 0.4gph@12"	29	25	21	14	7
Dripline 0.6gph@12"	18	16	13	9	4
Dripline 0.9gph@12"	12	10	9	6	3

#### **Clay**

Spray	5	4	3	2	1
Rotor 15-30'	16	14	12	8	4
Rotor 25-45'	21	18	15	10	5
Rotor 40-85'	12	10	9	6	3
Hunter Rotator	23	21	18	12	6
RB/Toro Rotary	15	13	11	7	3
Dripline 0.4gph@12"	15	13	11	7	3
Dripline 0.6gph@12"	10	9	7	5	2
Dripline 0.9gph@12"	6	5	4	3	1