Drip Irrigation Design

101
Know, Know, Know

1. Know your water supply
2. Know your system components
3. Know your limits

Install the Drip Irrigation System
Know your supply

• **Pressure** – (Pounds per Square Inch) PSI
  – At the start point of the drip system
  – Most municipal water systems range from 30 to 60 PSI
  – Domestic with well -30-50 PSI adjustable pressure switch
    • Can go over 100 PSI
  – Elevation change affects pressure
Know your supply

• Volume
  – Flow rate in Gallons Per Minute (GPM)
  – Available during tree watering time
    • Do you want to water trees during daylight hours
    • Will there be other demands on the system at that time
      Household use, watering yard, watering livestock
• Gallons/seconds × 60 = GPM

• i.e. 5 gal in 45 seconds

• 5/45 × 60 = 6.66 Gallons per minute

• 6.66 GPM × 60 min/hr = 399 gallons per hour
Know your Supply

• Water quality
  – Suspended solids
    • Sand or rust particles
  – Plug emitters
  – Can be removed by filter
Know your System Components

- Filters
- Regulators
- Tubing
- Valves
- Emitters
- Fittings
System Components

• THIS INFORMATION IS PROVIDED AS A PUBLIC SERVICE AND CONSTITUTES NO ENDORSEMENT OF ANY SERVICE, SUPPLY, OR EQUIPMENT LISTED.

• There are several manufacturers and dealers that sell drip irrigation supplies.

• Know what is available.
Filters

• Recommend 200 mesh
• Various types of filters
  – Inline - Lower Flow rate
    • Hard to clean
  – Canister – Higher flow rate
    • Flush to clean
    • Freeze and crack
    • Pipe thread
Regulators

• Used to reduce excessive pressure
  – Most drip components have maximum pressure rating of 50 PSI
  – If fittings are coming apart or emitters are blowing out of tubing may need a regulator
  – Available in 6 to 30 PSI
  – Directional installation
Tubing

Polyethylene blank tubing

- Many different sizes from 1/16 to 2 inch
- Also in metric sizes
- 1/2 inch is .700 OD X .600 ID
- 3/4 inch is .935 OD X .818 ID

Micro or spaghetti tubing to deliver water to individual plants
**POLYETHYLENE BLANK TUBING**

### SWISH POLYETHYLENE TUBING

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Model No.</th>
<th>Description</th>
<th>O.D.</th>
<th>I.D.</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>SW-455-100</td>
<td>455-100-1C</td>
<td>3/8&quot; Poly x 100'</td>
<td>0.455&quot;</td>
<td>0.375&quot;</td>
<td>$11.44</td>
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<td>SW-455-150</td>
<td>455-150-1C</td>
<td>3/8&quot; Poly x 150'</td>
<td>0.455&quot;</td>
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<tr>
<td>SW-300-100</td>
<td>300-100-1C</td>
<td>1/2&quot; Poly x 100'</td>
<td>0.700&quot;</td>
<td>0.600&quot;</td>
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<td>SW-300-150</td>
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<td>0.700&quot;</td>
<td>0.600&quot;</td>
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### BOWSMITH POLYETHYLENE TUBING

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<th>Part No.</th>
<th>Model No.</th>
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<th>O.D.</th>
<th>I.D.</th>
<th>Price</th>
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<tbody>
<tr>
<td>9444</td>
<td>9444-1M</td>
<td>1/16&quot; Poly x 100'</td>
<td>0.625&quot;</td>
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<td>9414</td>
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### NETAFIM POLYETHYLENE TUBING

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<th>Part No.</th>
<th>Model No.</th>
<th>Description</th>
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<tr>
<td>46510-000002</td>
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<td>3/8&quot; Poly x 100'</td>
<td>0.455&quot;</td>
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<td>48510-000004</td>
<td>48510-000004</td>
<td>1/4&quot; Poly x 150'</td>
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<td>48510-000006</td>
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<td>48510-000007</td>
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<td>1/4&quot; Poly x 400'</td>
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<td>48510-000008</td>
<td>48510-000008</td>
<td>1/4&quot; Poly x 500'</td>
<td>0.620&quot;</td>
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### JAIN POLYETHYLENE TUBING

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<th>Model No.</th>
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<td>11106-20</td>
<td>11106-20-1&quot;</td>
<td>1&quot; Poly x 100'</td>
<td>1.000&quot;</td>
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<td>11106-30</td>
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<td>1&quot; Poly x 150'</td>
<td>1.000&quot;</td>
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<td>11206-20</td>
<td>11206-20-1&quot;</td>
<td>1&quot; Poly x 200'</td>
<td>1.000&quot;</td>
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<td>11206-30</td>
<td>11206-30-1&quot;</td>
<td>1&quot; Poly x 300'</td>
<td>1.000&quot;</td>
<td>0.787&quot;</td>
<td>$32.92</td>
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### MICRO TUBING

**SMALL DIAMETER VINYL & POLYETHYLENE (P.E.) TUBING**

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Model No.</th>
<th>Description</th>
<th>O.D.</th>
<th>I.D.</th>
<th>Price</th>
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<tr>
<td>11306-01</td>
<td>11306-01-3&quot;</td>
<td>3&quot; Poly x 100'</td>
<td>2.750&quot;</td>
<td>1.970&quot;</td>
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<tr>
<td>11306-02</td>
<td>11306-02-3&quot;</td>
<td>3&quot; Poly x 150'</td>
<td>2.750&quot;</td>
<td>1.970&quot;</td>
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<tr>
<td>SW-185-100</td>
<td>SW-185-1PiPE</td>
<td>1.8&quot; SWISH STIK™ P.E. Tube x 100'</td>
<td>0.185&quot;</td>
<td>0.132&quot;</td>
<td>$4.54</td>
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<tr>
<td>NW-100-100</td>
<td>NW-100-1PiPE</td>
<td>1.0&quot; Poly x 100'</td>
<td>0.375&quot;</td>
<td>0.310&quot;</td>
<td>$6.90</td>
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<td>NW-100-200</td>
<td>NW-100-2PiPE</td>
<td>1.0&quot; Poly x 200'</td>
<td>0.375&quot;</td>
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<td>NW-100-300</td>
<td>NW-100-3PiPE</td>
<td>1.0&quot; Poly x 300'</td>
<td>0.375&quot;</td>
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Our Polyethylene Tubing is extruded exclusively from virgin linear low density polyethylene (LLDPE) base resin and combined with a suitable virgin carbon concentrate compound to provide a minimum of 2% carbon black, which is blended, mixed and dispersed into the finished product for maximum UV protection. Strict quality control procedures followed during the extrusion process ensure the highest uniformity and product quality, because this tubing is a vital integral part of your irrigation system, we will only distribute the highest quality most reliable and dependable premium drip irrigation tubing available in the market.
Tubing

• Available in 100, 250, 500 and 1000 foot rolls
• Allow 10% extra length to allow for contraction and expansion with temperature changes.
• Snake it back and forth rather than laying it out straight.
• Emitters can crawl away from trees.
• 50 PSI is maximum pressure
Emitters

- Various manufacturers
- Flow rates of 1/2, 1 and 2 GPH
- Some are pressure compensating
- Some have self-piercing tip
- Some require punched hole to install
- All recommended for above ground use.
Fittings

- Wide selection of fittings to do about any layout you need
- Compression or Hose Thread
- Adapters to go to pipe thread
Know your limits

- Once you know your water supply and system components we will try to bring it all together.

- Every situation is different so evaluate to see if you have and can deliver required water amount to end points.
Know your limits

• Friction loss for water flowing in the tubing is a function of volume, length and inside diameter of the tubing.

• Higher flow rates, longer lengths and smaller diameters require more pressure
DRIP IRRIGATION DESIGN

Drip Irrigation Design using Hazen Williams Equation

\[ C = 140 \]

<table>
<thead>
<tr>
<th>Row #</th>
<th>Species</th>
<th>Spacing Ft</th>
<th>Row Length</th>
<th># Trees / Emitters</th>
<th>Emitter Output / GPH</th>
<th>Flow Required GPM</th>
<th>Hose ID</th>
<th>Hose Length</th>
<th>Elevation Change + or -</th>
<th>PSI</th>
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<tbody>
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<td>1550</td>
<td>195</td>
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<td>190</td>
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<td>1.58</td>
<td>0.58</td>
<td>1870</td>
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<tr>
<td>3</td>
<td>tree</td>
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<td>1800</td>
<td>181</td>
<td>0.5</td>
<td>1.51</td>
<td>0.58</td>
<td>1980</td>
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<td>8</td>
<td>1000</td>
<td>126</td>
<td>1</td>
<td>2.10</td>
<td>0.58</td>
<td>1100</td>
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<tr>
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<td>120</td>
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<td>29.44</td>
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<tr>
<td>6</td>
<td>tree</td>
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<td>1.93</td>
<td>0.58</td>
<td>1265</td>
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<td>29.37</td>
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<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td><strong>812</strong></td>
<td><strong>8.82</strong></td>
<td></td>
<td><strong>7837.5</strong></td>
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<td></td>
</tr>
</tbody>
</table>

Comments:

600 emitters @ 0.5 gph = 5 gpm

300 emitters @ 1 gph = 5 gpm
Know your limits

• General guidelines for 1/2 inch tubing
  – Do not exceed 3 GPM
  – Do not exceed 1500 feet length
  – Not exact values
Know your limits

• General guidelines for 3/4 inch tubing
  – Do not exceed 5 GPM
  – Do not exceed 1500 feet length
Know your limits

• Let's play some what if to see how this works.
Scenario 1  3 GPM 30 PSI

One row of shrubs 500' long 4 foot spacing

\[ \text{Hydrant} \times \frac{500'}{4'} = \]

Total tubing length 550 ft

500'/4' = 125 emitters

\[ .5 \text{GPH} \times 125 = 62.5 \text{ GPH} / 60 \text{ min/hr} = 1.04 \text{ GPM} \quad \text{OK} \]

\[ 1 \text{GPH} \times 125 = 125 \text{ GPH} / 60 \text{ min/hr} = 2.08 \text{ GPM} \quad \text{OK} \]

\[ 2 \text{GPH} \times 125 = 250 \text{ GPH} / 60 \text{ min/hr} = 4.16 \text{ GPM} \quad \text{NO} \]
Scenario 2  3 GPM 30 PSI

One row of shrubs 1000' long 4 foot spacing

Total tubing length 1100 ft

1000'/4'=250 emitters

\[ .5 \text{GPH} \times 250 = 125 \text{ GPH} / 60 \text{ min/hr} = 2.08 \text{ GPM} \quad \text{OK} \]
\[ 1 \text{GPH} \times 250 = 250 \text{ GPH} / 60 \text{ min/hr} = 4.16 \text{ GPM} \quad \text{NO} \]
\[ 2 \text{GPH} \times 250 = 500 \text{ GPH} / 60 \text{ min/hr} = 8.33 \text{ GPM} \quad \text{NO} \]
Scenario 3  3 GPM 30 PSI

One row of shrubs 1000’ long 4 foot spacing with Hydrant in middle and valves to water two 500 foot rows

Total tubing length per row 550 ft

500’/4’=125 emitters

\[
\begin{align*}
0.5 \text{GPH} \times 125 &= 62.5 \text{ GPH} / 60 \text{ min/hr} = 1.04 \text{ GPM} \quad \text{OK} \\
1 \text{GPH} \times 125 &= 125 \text{ GPH} / 60 \text{ min/hr} = 2.08 \text{ GPM} \quad \text{OK} \\
2 \text{GPH} \times 125 &= 250 \text{ GPH} / 60 \text{ min/hr} = 4.16 \text{ GPM} \quad \text{NO}
\end{align*}
\]
Scenario 4  5 GPM 30 PSI  1/2" tubing

Row 1  1000 feet shrubs 4 foot spacing = 250 emitters

Row 2  960 feet RMJ 8 foot spacing = 120 emitters

Row 1

\[
\begin{align*}
.5\text{GPH} \times 250 &= 125 \text{ GPH} / 60 \text{ min/hr} = 2.08 \text{ GPM} & \text{OK} \\
1\text{GPH} \times 250 &= 250 \text{ GPH} / 60 \text{ min/hr} = 4.16 \text{ GPM} & \text{NO} > 3\text{GPM}
\end{align*}
\]

Row 2

\[
\begin{align*}
.5\text{GPH} \times 120 &= 60 \text{ GPH} / 60 \text{ min/hr} = 1.00 \text{ GPM} & \text{OK} \\
1\text{GPH} \times 120 &= 120 \text{ GPH} / 60 \text{ min/hr} = 2.00 \text{ GPM} & \text{OK}
\end{align*}
\]

Might water row 1 and 2 together with .5 GPH emitters
Scenario 5  5 GPM 30 PSI  1/2" tubing with 3/4" manifold
Row 1  1000 feet shrubs 4 foot spacing = 250 emitters
Row 2  1000 feet RMJ 8 foot spacing = 125 emitters
Row 3  1000 feet PP 12 foot spacing = 83 emitters

Row 1
  .5GPH X 250 =125 GPH / 60 min/hr = 2.08 GPM  OK
Row 2
  .5GPH X 125 =62.5 GPH / 60 min/hr = 1.04 GPM  OK
  1GPH X 125 = 125 GPH / 60 min/hr = 2.08 GPM  OK
Row 3
  .5GPH X 83 = 41.6 GPH / 60 min/hr = .65 GPM  OK
  1GPH X 83 = 83 GPH /60 min/hr = 1.38 GPM  OK
  2GPH X 83 = 166 GPH/60min/hr = 2.76 GPM  OK

Do not exceed total of 5 GPM for all rows watering at same time.
Always sketch, measure and plan your windbreak or landscape design before installation to determine best options for the situation.
Water requirements

Seedling trees

year 1 – 1 gal /week
year 2 -  2 gal/10 days
year 3 -  3 gal/ 14 days
Water requirements

Think ahead 10 – 20 years

D4 drought – how can you put on enough water to keep trees alive.
• Any answers?
• Or questions
• Marvin Watson
• USDA-NRCS
• Eads, CO
• 719 438-5851 X101