IRRIGATION ASSOCIATION CERTIFICATION PROGRAM

STEP 4 SPECIALTY DRIP/MICROIRRIGATION

SAMPLE PROBLEM (1 OF 2)

Allowable Pressure Differences Between Emitters

REFERENCE:

Burt & Styles. 2007. DRIP & MICRO IRRIGATION DESIGN & MANAGEMENT FOR TREES, VINES AND FIELD CROPS.

GIVEN:

Design DU = 0.9
C_V of emitter pressure = 0.03
Average emitter pressure = 15 psi
Emitter discharge exponent = 0.5
Emitters per tree = 3

REQUIRED:

What is the allowable pressure difference between emitters?

PERTINENT FORMULAS:

$$DU_{new} \cong \left(1 - \frac{1.27 \times C_v}{\sqrt{n}}\right) \times \frac{q_{min}}{q_{avg}} \quad (1) \quad \text{DMI pg. 30}$$

$$Q = k \times P^x \quad (2) \quad \text{DMI 29}$$

$$Q_{min} = k \times P_{min}^x \quad (2a) \qquad Q_{avg} = k \times P_{avg}^x \quad (2b)$$

$$\text{Allowable Pressure Difference} = 2.5 \times (P_{avg} - P_{min}) \quad (3) \quad \text{DMI pg. 148}$$

Continued page 2

SOLUTION problem 1:

- Substitute equations 2a and 2b into equation 1:

$$DU_{new} = \left(1 - \frac{1.27 \times C_v}{\sqrt{n}}\right) \times \left(\frac{P_{min}}{P_{avg}}\right)^{0.5}$$

- Rearrange new equation to solve for P_{min} (square both sides and rearrange):

$$P_{min} = \frac{DU_{new}^2 \times P_{avg}}{\left(1 - \frac{1.27 \times C_v}{\sqrt{n}}\right)^2}$$

- Solve for P_{min}

$$P_{min} = \frac{(0.9)^2 \times (15)}{\left(1 - \frac{1.27 \times (0.03)}{\sqrt{3}}\right)^2} = 12.7$$

- Solve for allowable pressure difference:

$$\text{Allowable Pressure Difference} = 2.5 \times (P_{avg} - P_{min})$$
$$= 2.5 \times (15 - 12.7)$$
$$= 5.75 \text{ psi}$$

See page 3 for example 2.

IRRIGATION ASSOCIATION CERTIFICATION PROGRAM

STEP 4 SPECIALTY DRIP/MICROIRRIGATION

SAMPLE PROBLEM (2 OF 2)
Friction Loss Calculation

REFERENCE:

Burt & Styles. 2007. DRIP & MICRO IRRIGATION DESIGN & MANAGEMENT FOR TREES, VINES AND FIELD CROPS.

GIVEN:

- Drip hose on a single row
- 25 trees
- 20 ft spacing
- Flat ground
- 3 emitters per tree
- 1.1 gph per emitter
- 0.500 in. ID hose
- Hazen-Williams “C” factor for hose = 135
- Multiple outlet friction factor = 0.36 (estimates for 75 outlets)

REQUIRED:

What is the estimated friction loss?

PERTINENT FORMULAS:

$$H_{f-psi} = 4.55 \times \frac{(Q/C)^{1.852}}{D^{4.87}} \times L \qquad (1) \qquad \text{DMI 112}$$

$$H_{f(lateral)} = H_{f(mainline)} \times F \qquad (2) \qquad \text{DMI 117}$$

See page 4 for solution.

SOLUTION problem 2:

- Combine equations 1 & 2 to obtain:

$$H_{f(lateral)} = F \times 4.55 \times \frac{(Q/C)^{1.852}}{D^{4.87}} \times L$$

- Determine flow in hose:

Q = 25 trees x 3 emitters per tree x 1.1 gph/emitter /60min/h

= 1.38 gpm

- Determine length of hose:

Length = 25 trees x20 ft spacing
= 500 ft

- Insert known values into new equation:

$$H_{f(lateral)} = 0.36 \times 4.55 \times \frac{(1.38/135)^{1.852}}{(0.5)^{4.87}} \times 500ft$$

= 4.93 psi