Sizing of Header and Flushing Manifolds for Row Crop Drip

By Charles M. Burt and Stuart W. Styles

Permanent subsurface row crop drip systems typically have a unique design feature — the tapes are flushed through a common manifold, rather than as individual tapes. By opening one valve at the end of a block, an irrigator may flush anywhere from 50 to 800 tapes at once.

Pipe sizing for row crop drip designs has historically been done using accepted, standard principles taken from conventional drip. Such procedures can often be insufficient. In many cases, the flushing of the tapes, not the supply, dictates the size of *both* the header and the flushing manifolds.

There are many configurations for flushing manifolds. In some instances, flushing manifolds also serve as "header" or supply manifolds if tape is fed from both ends. In other cases, the flushing manifold is designed exclusively for flushing.

Because of the tremendous variability of designs, it is difficult to give a single rule for sizing which matches all conditions. However, the graphs and paragraphs in this article should shed some insight into proper design. At a minimum, once a designer understands these graphs, the tendency will be to increase the sizes of the headers and flushing manifolds, as well as to increase the size of the flush valves.

If individual tapes are flushed, there is no problem obtaining the required flushing velocities. Photos courtesy: ITRC.

Pressure During Flushing

During tape flushing, the pressure needed at the beginning of a tape (tape inlet pressure) depends upon:

1. The friction along the tape, caused by the flow which passes all the way through the tape as flushing water;
2. The friction along the tape, caused by the flow which exits the emitters; and
3. Any pressure required at the downstream end of the tape, in order to pass through the flushing manifold and out the flush valve. This must include:

— Friction in the flushing manifold

— Friction through the flush valve

— Elevation change between the tape itself and the final discharge into the air downstream of the flush valve

— Elevation change along the flush manifold

— Fitting friction between the manifold and individual tapes.

The items of #3 above can combine to create a higher pressure at the downstream end of the tape, which will cause a corresponding high flow out of the emitters during the flushing. This in turn causes an increase in friction along the tape. In other words, a small increase in pressure at the downstream end of a

tape will cause a large increase in required inlet pressure.

Figure 1 illustrates the concept of required inlet pressures to achieve a flushing flow rate of one GPM out the end of a 0.625-inch ID tape, to obtain a flushing velocity of one foot per second. Consider that if individual tapes are flushed, as with above ground drip, the downstream pressure is zero. With buried drip, it is almost impossible to have less than one psi for a downstream pressure (curve "d"), because of the factors listed earlier.

Curve "f" on *Figure 1*, with a six-psi downstream pressure, illustrates these key points:

- If the normal inlet pressure is eight to 12 psi, the pressure regulators must be re-set during the flushing mode;
- Non-adjustable pressure regulators, operating at typical inlet pressures of eight to 12 psi, would not provide sufficient pressure to adequately flush the tape;

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Flush valves for flushing manifolds should be large, such as this four-inch valve. However, this flush valve has a hose attached so the flush water can be put in a water trailer tank — a nice idea, but it puts too much backpressure on the tape for adequate flushing.

An adjustable pressure regulator is often needed at the head of a row crop drip tape block if a flushing manifold is used.

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• If there is a significant downstream pressure on the tape during flushing, the tape must have sufficient strength to withstand a high flushing pressure without busting.

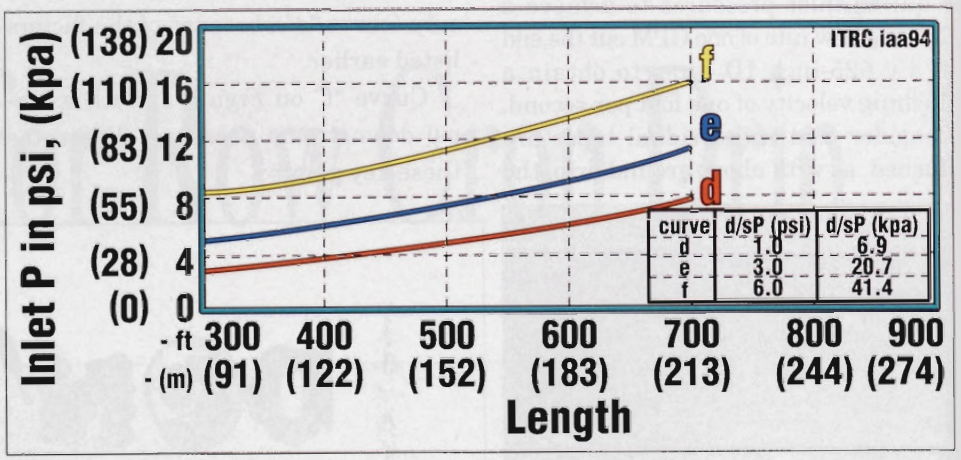

Figure 1. Inlet pressure vs. length for 0.625-inch ID drip tape. Q = 0.22 GPM/100 feet at eight psi (excluding c.v. consideration). Various downstream pressures and fixed flushing flow of one GPM, (0.063 LPS) x = 0.5, zero slope.

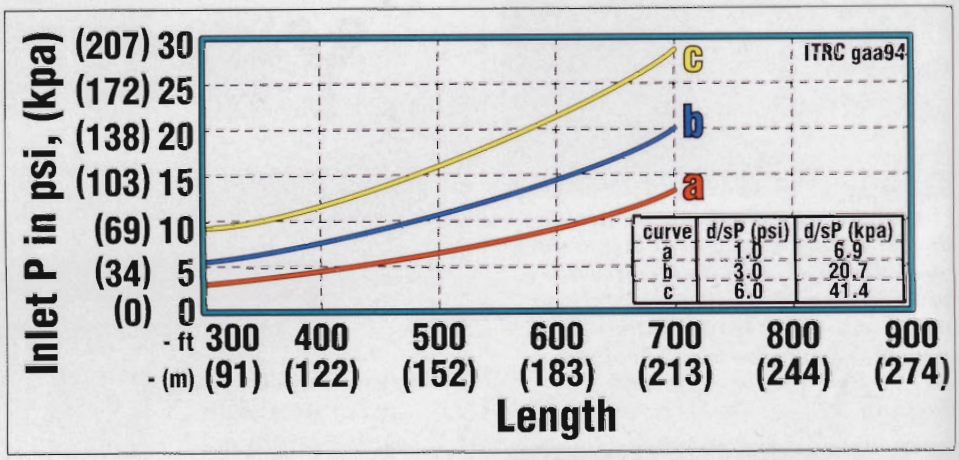

Figure 2. Inlet pressure vs. length for 0.0625-inch ID drip tape. Q = 0.45 GPM/100 feet at eight psi (excluding c.v. consideration). Various downstream pressures and fixed flushing flow of one GPM, (0.063 LPS) x = 0.5, zero slope.

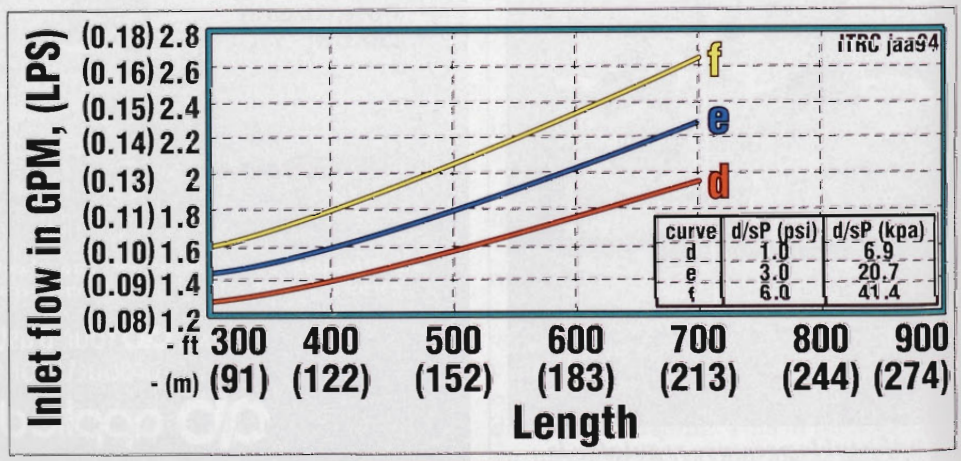

Figure 3. Inlet flow vs. length for 0.625-inch ID drip tape. Q = 0.22 GPM/100 feet at eight psi (excluding c.v. consideration). Various downstream pressures and fixed flushing flow of one GPM (0.063 LPS), x = 0.5, zero slope.

Some conclusions are:

- Adjustable pressure regulators have significant advantages for flushing in many designs, when compared to non-adjustable pressure regulators;
- Thick-walled tape may be necessary for adequate flushing, even though it may not be necessary for normal operating pressures; and
- The irrigation system pump may need to be "oversized" for regular water delivery, in order to be able to supply the higher pressure for flushing. The pump pressures must be based upon the required flushing pressures, not the supply pressures.

Figure 2 shows that all of the concerns noted for the low flow (.22 GPM per 100 feet) tape are amplified for high flow tape. In particular, the inlet pressures must be very high on long tapes if there is a substantial downstream pressure during flushing.

Required Flow Rate During Flushing

Figures 1 and *2* show that high inlet pressures are needed for flushing in many cases. Those high inlet pressures translate into high inlet flow rates. *Figure 3* and *Figure 4* provide some information on required inlet flow rates for the same selection of tapes and lengths.

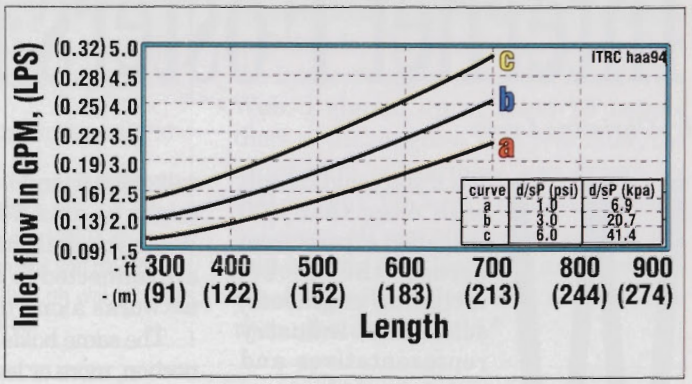

Figure 4. Inlet flow vs. length for 0.625-inch ID drip tape. Q = 0.45 GPM/100 feet at eight psi (excluding c.v. consideration). Various downstream pressures and fixed flushing flow of one GPM (0.063 LPS). x = 0.5, zero slope.

In most designs the flushing manifold is desirable — with PVC as recommended material. There is a tendency for drip system designers to make the lines too small. Hopefully this article will encourage designers to plan for larger flushing lines as well as larger valves and adjustable pressure regulators at the inlet to the blocks. ❑

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