1. SCOPE
The work shall consist of furnishing, installing and testing irrigation flowmeter(s) at the location(s) shown on the attached plans or data sheets. This shall include the meter and all necessary appurtenances, such as flow straighteners, straightening vanes, couplers, joints, gaskets, and elbows.

2. MATERIALS
The meter shall be of the propeller, saddle type, or an approved equivalent. The meter shall be capable of measuring within an accuracy of +/- 2% of actual flow. Flowmeter will have rate (gpm) and totalizer (ac-ft) measurements.

Over-run bearings will be installed to insure that the meter can run at maximum flows without excessive wear.

Appurtenances needed to attach the meter to the existing pipeline shall be of a pressure rating equal to or greater than the existing pipeline or in excess of the maximum anticipated operation pressure of the existing pipeline, including surge pressures capable of withstanding the operating pressure of the pipeline without leaks or creating an obstruction that could affect the operation of the meter.

Meters installed in an underground pipeline shall be supplied with a meter pit or a remote sensing monitor. The pit dimension shall allow a minimum of three inches of space horizontally from the flanged ends of the meter to the pit wall, but the total width of the meter pit shall not be less than 3 feet in any case. The pit shall be constructed with a standard pre-cast concrete manhole or concrete culvert section, 16-gauge minimum corrugated metal pipe, or 4” nominal treated lumber. Notches shall be field cut to allow the pit walls to slip over the pipe so that the bottom of the pit is at the bottom of the pipe. In lieu of a meter pit, an extension may be installed which connects the meter sensor to an above ground readout.

3. INSTALLATION AND OPERATION
The manufacturer's recommendations for the installation of the flowmeter shall be obtained prior to installation, and a copy shall be supplied to the NRCS Technician or Engineer, if they differ from this specification. The recommendations shall include the requirements for straight pipe distance both upstream and downstream of the meter. These distances shall be detailed for various appurtenances, such as elbows, valves, sudden enlargements, and contractions. The meter shall be placed in the pipe in a position, which is correct for the pipe diameter and wall thickness. In the absence of manufacturer’s recommendations for
straight pipe, distance up and downstream of the meter the general requirements for the location of the meter are as follows:

**JETTING FLOW CONDITIONS (E.G. D.S. OF CHECK VALVE)**

All meters except vortex meters

<table>
<thead>
<tr>
<th>Without straightening vanes:</th>
<th>Upstream</th>
<th>Downstream</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without straightening vanes:</td>
<td>10 diameters</td>
<td>2 diameters</td>
</tr>
<tr>
<td>With straightening vanes:</td>
<td>Upstream</td>
<td>Downstream</td>
</tr>
<tr>
<td>With straightening vanes:</td>
<td>5 diameters</td>
<td>2 diameters</td>
</tr>
<tr>
<td>With flow straightener:</td>
<td>Upstream</td>
<td>Downstream</td>
</tr>
<tr>
<td>With flow straightener:</td>
<td>1.5 diameters</td>
<td>1 diameters</td>
</tr>
<tr>
<td>Flow tube w/flow straightener:</td>
<td>Upstream</td>
<td>Downstream</td>
</tr>
<tr>
<td>Flow tube w/flow straightener:</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Flow Tubes**

Flow tubes are manufacturer supplied sections of pipe that contain the saddle flow meter, flow straightener, and necessary upstream and downstream distances for accurate flow readings. Flow tubes are selected by the pipe size they are to be installed in line with.

Flow tube length requirements per diameter are:

- 6” pipe size  – 30” tube length
- 8” pipe size  – 34” tube length
- 10” pipe size - 40” tube length
- 12” pipe size - 46” tube length

Flow tubes with flow straightener are only to be installed with groundwater sources.

Supplier manufactured flow tubes must consist of flow straightener and meter in appropriate length tube with meter certified for specific I.D. of tube material.

**Measurement Reach**

The flow tube or section of pipeline used to install the flow meter must be no smaller in diameter than the diameter of the pump discharge.

**Water Source and positioning of meter**

If surface water is the source, an appropriate surface water meter will be supplied and the meter must be identified as such. With surface water, only open center straightening vanes are acceptable to allow debris to pass.

All meters are to be installed in a horizontal position. If the meter is to be positioned vertically (e.g. center pivot tower), the appropriate meter must be obtained and meter must be identified as correct for vertical installation.

**Full Pipe Flow**

If the Technician or Engineer determines that there is not full pipe flow at the meter site, a hump shall be installed downstream of the meter. The top of the hump shall be at least one-pipe diameter above the top of
the line. Air, pressure, and vacuum relief valves may be installed on the hump, if they are needed for the proper functioning of the pipeline system.

"HUMP" shall be defined as a rise in the outlet pipe on a given angle (usually 45 degrees) to a point at which the bottom of the downstream portion of the outlet pipe is higher than the top of the upstream portion of the outlet pipe. After a short distance (1 to 2 feet), the pipe may be angled back down to the preceding pipeline gradeline.

NRCS underground line (430) designs incorporate a full pipe flow feature.

**Installation Check**
The installer will insure that the flowmeter is functioning properly at the time of installation or within 6 months. The meter shall be examined with water flow through the pipeline to determine if the meter is functioning properly and accurately measuring water. If operation problems, abnormal fluctuations in reading, or other deficiencies occur, the installation shall be re-evaluated and the cause of the problem and/or deficiencies corrected.

**Operation and Maintenance**
The manufacturer’s recommendations for maintenance shall be obtained and followed. It is recommended that a drain feature be installed in the meter reach to prevent the threat of ice formation which may damage the meter or pipe.
**Fully developed pipeline flow**

Flow meters provide accurate measurements only when measuring fully developed pipeline flow. “Fully developed pipeline flow occurs in long/straight/uniform/clean pipe when the pipe wall friction effects completely control the fluid flow characteristics. It occurs at the point where these characteristics no longer change as the fluid flows further downstream in long/straight/uniform/clean pipe. Characteristics such as swirl, flow profile, and turbulence intensity can be used to describe pipeline flow.”(1).

If sufficient upstream and downstream distances from the meter cannot be reasonably obtained, straightening vanes, flow conditioners, and flow straighteners are often installed upstream of the flowmeter to reduce the required distances to achieve reasonable accuracy.

**Straightening vanes:** installed upstream of the flow meter to reduce excessive turbulence. Typically an arrangement of three vanes installed radially across the pipe cross section. The center is unobstructed to allow debris to pass. Straightening vanes can be used with both surface and groundwater sources, if pipeline center remains unobstructed.

**Flow Straightener:** conditions flow to remove swirl and other disturbances. Because of additional components (e.g. cone) across the pipe diameter, can only be used with groundwater sources.

**Manufacturer Certification Test**

A copy of the Certification Test form from the meter manufacturer must be provided for the specific meter installed by S/N. The I.D. of pipeline for which the test was conducted must be included in the Certification Test form.

In lieu of a manufacturer Certification Test, a field Certification Test can be submitted. This will require that the installed flowmeter be field checked by a test meter with its own test section, installed on the discharge on an open system or a riser for a closed system. A picture of the test set-up will be provided, along with the date of field test, S/N of both meters, type of each meter, description of test meter/section the respective I.D. of each pipe, the measured flow of each meter, and if diesel powered the RPM of the engine.

**References:**