Meter Tube Design

Technical Data Sheet

For the proper design of meter tubes, the most important factors to consider are (1) choosing the tube size necessary for flowing volume, (2) selecting proper materials for operating conditions involved, (3) selecting length of meter tubes to meet code recommendations, and (4) careful inspection of tubes to ascertain they meet recommendations for roundness and smoothness.

SIZING OF METER TUBES

Size of meter tubes can be determined from data published by the American Gas Association, API, the A.S.M.E., and from other fluid meter handbooks. A quick and simple way is to use the Daniel Orifice Flow Calculator slide rule, or CD which is available on request. To obtain the highest flow accuracy, the beta ratio should be limited to .20 minimum and .60 maximum for flange taps.

WORKING PRESSURES OF METER TUBES

The maximum allowable working pressure for complete meter tube assemblies is dependent on maximum allowable working pressures of the pipe, flanges, orifice fitting and valves that make up the assembly. Maximum pressure is controlled by the lowest rated unit in the assembly. Flanges for meter tubes are generally rated under the ANSI code B-16.5. Working pressure of pipe or tubing used in manufacturing meter tubes is determined from the American National Standard for Pressure Piping ANSI. Piping design is classified in the following categories: B-31.1, Power Piping; B-31.2, Fuel Gas Piping; B-31.3, Liquid Petroleum Transportation Piping Systems; B-31.5, Refrigeration Piping; B-31.8, Gas Transmission and Distribution Piping. B-31.8 covers design of piping used in production, transmission and distribution of natural or manufactured gas. Under this code, allowable working pressure of meter tubes varies with the construction factor and the location of the installation.

LENGTH OF METER TUBES

Meter tube lengths shown in the 2000 API 14.3 are based on the results of a comprehensive test and evaluation program conducted by API. Meter tubes are available without tube bundle or flow conditioner for certain very specific piping configurations. Upstream lengths are generally very long for these applications and Daniel has chosen not to list these in this catalog. These installations require careful study to determine if, in fact, the piping fully meets the very limiting requirements of the standard. Most metering sites will require designs utilizing some type of flow straightening or conditioning device to limit the required overall length. For these reasons, this Daniel catalog will only show tube bundle or conditioner plate equipped meter tubes. Daniel will entertain any meter tube design on customer request. The meter tube lengths shown in this catalog are based on the guidelines in the April 2000 version of API 14.3. The tube bundle equipped meter tubes use the 29D upstream length per API table 2-8b, which is suitable for beta ratios to .67 and can be used in any piping configuration. Downstream lengths allow for the addition of extra branch connections in the field, a frequent requirement. For certain specific piping arrangements and beta ratios, meter tubes can be designed with shorter overall lengths.

TOLERANCES FOR METER TUBES

The upstream I.D. must be within ± .25% within the first diameter from the plate. The remainder of the upstream must be within .5% with the resulting maximum difference between any 2 diameters of .5%. Downstream tolerances can be 1% of upstream diameter. I.D. roughness varies with size and beta ratio. Meter tubes should be designed for the maximum allowable beta ratio. All Daniel standard meter tubes are manufactured to meet tolerances recommended by A.P.I. Chapter 14, Section 3, Part 2 (14.3) April 2000/A.G.A. #3. Pipe and tubing to be used for meter tubes should have a smooth, uniform internal surface, meeting the standard roundness/diameter tolerances.

Design Factors: Location and Construction

Table II below lists allowable working pressure of A.S.T.M. A-53 pipe or A-106 Grade B, 35,000 lb. Yield pipe designed under the B-31.8 code.
See table at right for pipe yield strength and multipliers for allowable working pressures in Table II.

TO ADJUST PIPE WORKING PRESSURES IN TABLE II

Pipe Yield Strength	Multiplier
30,000 psi	0.857
42,000 psi	1.2
46,000 psi	1.314
52000 psi	1.486

Note: Table II working pressures are for B-31.8 piping code ONLY. Allowable working pressures for meter tubes up to 250° F.; Grade B seamless pipe; joint efficiency, E= 1.00 - Corrosion allowance, C=O; Gas Transmission and Distribution Piping - ANSI Code B-31.8.

TABLE II — Allowable Working Pressure for Location Classification and Construction type Design Factors — Class 3 *Type C-F = .50

Pipe Size	Pipe Schedule No.	Maximum Allowable Operational Pressure
2”	40	2269
	80	3213
	160	5055
3”	40	2160
	80	3000
	160	4380
	XXH	6000
4”	40	1843
	80	2621
	160	4130
	XXH	5242
6”	40	1479
	80	2282
	160	3793
	XXH	4564
8”	30	1124
	40	1307
	80	2029
10”	30	999
	40	1188
	60	1628
	80	1931
12"	30	906
	Std.	1029
	40	1114
	XS	1373
	60	1543
	80	1886
16"	30	820
	40	1094
	60	1435

Title 49 CFR 192 (D.O.T.-192.111)

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