

Getting the best value from Daniel Senior® Orifice Fittings

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For almost seven decades, Daniel has been supplying orifice fittings, meter tubes, and other ΔP products to the oil and gas industry. The discussion here focuses on Daniel Senior® Orifice Fittings but much applies to the other products in the line including Junior®, Simplex® and Orifice Flange fittings. Orifices measure most fluids: gas, liquid, steam, and even fluids with a small amount of second phase. Orifice accuracy can be maintained in liquid streams with as much as 5% (by volume) gas bubbles, and in gas streams with up to about 2% (by weight) of solids or liquids.

The hundreds of thousands of Daniel fittings supplied during the years have generally fit applications very well. However, a buyer has sometimes not been aware of options and exactly what should be specified in ordering, especially those new to flow measurement. Complete specifications are particularly important with unusual media and custody transfer applications. It is vital that the metering system comply with any buy/sell contract requirements involved.

The Senior fitting has earned a worldwide reputation for easy, fast and safe operation with high accuracy. Here are some of salient benefits for users of this venerable fitting.

User benefits

Senior Orifice Fittings are available in 2" through 42" sizes and in the highest pressure ratings of any dual-chamber fitting on the market — 150-2500# ANSI and 10,000# WOG. Most deliveries can be made from stock. The meter is field repairable without special tools, and it meets API "14.3 and ISO 5167 without exceptions or penalties. Its time-proven, lubricated slide valve to isolate upper and lower chambers is available in a "soft-seat" version for bubble-tight sealing.

Three trims are available: "A" is standard, "AASG" is for sour-gas and corrosive service, and "NACE" meets specific NACE requirements. If there is any doubt about which trim to specify or if special materials are needed, it is always safer to contract a Daniel specialist for advice. Seals are available made from nitrile, Teflon, and metal-to-metal. "DVS" seals are vulcanized to the orifice plate for best operation in larger sizes. Hydrostatic test to 1.5 times the rated pressure and both high- and low-pressure plate seal test are standard.

Size of the nominal bore diameter should be based on consideration of maximum and minimum quantities of gas to be handled over short and long time periods and estimates of these values for the first, third and tenth year of use. If gas quality is other than “normal pipe line quality,” it should be noted when ordering.

An order should also include notation about any standards or codes involved, especially since the introduction of API “14.3” and other requirements for tighter dimension tolerances. Flanges may be raised face (RF) or ring joint (RJ) Flangnek or Flanged, or Weld Neck. Telemetry taps are available.

Orifice Plate Bore(s) are based on flow ranges. Stock materials are 304 and 316 SS, Monel, and Hastelloy; other materials are available. Daniel can help guide a user who is not sure of which material to specify. Both disc and “paddle” types (for orifice flange fittings) are available. Plates are inspected with a Coordinate Measuring Machine to insure compliance with customer, Daniel, and “14.3/5167” requirements.

Standard plates have a 45° bevel machined on the bore hole periphery. Unless otherwise specified, plates will be beveled to the smaller of 1/50 of the line ID or 1/8 of the orifice bore. Special designs include: counterbores to limit plate-edge thickness (no bevel), segmental for use where solids are entrained in gas or liquid flow, eccentric bore to help pass solids or slurries, and quarter round for viscous media with Reynolds Numbers below 100,000.

Meter tube and straightening vane specifications depend on the application and user preferences. Many Daniel orifice fittings are supplied in meter tubes or complete meter stations.

Other factors

Not part of meter or meter-tube specifications but directly involved with station design is how many measuring runs will be required, valving needed, and noise/vibration problems likely.

A useful rule-of-thumb for proper distribution of flows in multiple meter runs is to minimize velocities in the header by making its area 1-1/2 to 2 times the combined areas of all meter tubes connected to it. If proper distribution is not achieved, it is possible that with high flow rates one tube will take excessive flow — with resulting high differential — before the other tubes reach their maximum flow capacity. Station throughput will be unnecessarily limited.

A major reason why Senior fittings are so popular is that no extra valving or piping is needed to inspect or change a plate without interrupting line flow. For single-chamber fittings, one of three control valve systems is commonly used: direct-acting or self-actuated regulators, pilot-operated regulators or control valves, controller-operated control valves. Most operators choose the simplest configuration that will meet station needs.

How much of a problem noise caused by high flow velocities will be varies with station location while vibration will be a problem anywhere. Dynamic fluid noise and vibration will generally be acceptable when flow velocity underground is limited to 200 fps and in above-ground piping to 100 fps. More sophisticated analysis of noise and vibration can be achieved considering mass-velocity values instead of simply velocity alone.

Maintain the fitting

One of the best ways to reduce “lost and unaccounted for” gas (or corresponding liquid losses) is to maintain orifice fittings and plates properly. The periodicity of plate inspections is best determined by frequent inspection until enough information is obtained to determine the optimum timing of routine inspections. Should flowing media, temperatures or pressures change significantly, inspect more frequently until a new routine can be defined.

All Senior fittings should be operated at least once a month with the slide valve opened, closed, and lubricated. If plate inspection is not required, rotate gear shafts to make sure they turn freely. Check and/or clean drain-plug holes to prevent buildup of debris that could interfere with the plate carrier bottoming out on locator pins or with proper closing.

If sediment is likely to accumulate in the fitting, install a blowdown valve in place of the pipe fitting. Blow down into a safe area, and make sure the plate carrier is raised before blowdown or cleaning through blowdown valves. A pigging ring is available to help prevent dirt from being forced into the plate carrier cavity in the fitting during pigging operations.

And some cautions. Don't install a blank orifice plate to block off the line. Such a plate cannot hold high pressures and may be blown down the line or “dished” so badly that it won't crank out. Use only factory certified Daniel parts; you cannot see metallurgical quality, stress concentrations or dimension details. What *looks* alike may actually be *importantly different*.

Some other “non-technical” factors are also important to users. As the leading orifice fitting manufacturer in the world for many years, Daniel has continued to participate actively in flow measurement committees and schools.

The company is financially sound and has earned an enviable reputation for customer service. It operates several dozen instrumented flow and calibration loops in the US and Europe for orifice fittings and other flowmeters. Hundreds of thousands of Daniel Senior and other orifice fittings have been supplied to the oil, gas, and process industries over the company's sixty-seven years.

Summary

There are more Daniel Senior Fittings in use than all other makes combined. Operation in all geographical areas and with virtually "every type fluid" has been clearly demonstrated to be easy and safe. Repair is straightforward. The custody of more gas is transferred every day by orifice measurement than by all other metering methods. There is at least ten times more historical test data on orifice measurement than for all other flow meters.

The more Daniel knows about a specific application, the more sure a buyer can be that the delivered product will fit the job. Proper operation is simple and easy to remember. Proper maintenance is essential for accurate readings and long service life.