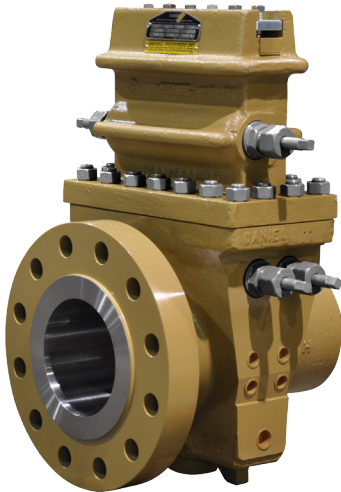


# Practical Guidelines for Specifying Orifice Fittings



This white paper provides detailed information on how to correctly specify an orifice fitting to meet oil and gas application requirements.

## Introduction



Daniel Senior Dual-Chamber Orifice Fitting

For over 80 years, Daniel Measurement and Control has been the leading provider of orifice fittings to the oil and gas industry. Today, the Daniel Senior™ Orifice Fitting continues to be the instrument of choice for many flow measurement applications. While orifice fittings may be less complex than alternative technologies, the meter specifying process can be challenging. This white paper provides detailed information on how to specify an orifice fitting to ensure an optimal return on investment. The primary instrument referenced in the paper is the Daniel Senior Orifice Fitting. However, the majority of the information also applies to the Daniel Junior and Simplex Orifice Fittings and Orifice Flange Union.

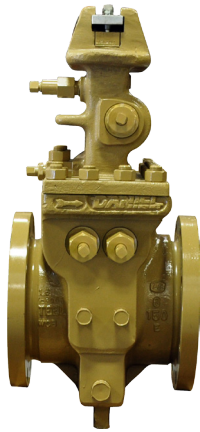
## Orifice Fitting Overview

*To properly specify an orifice fitting, the amount of media (i.e. gas, liquid, etc.) that may be present must be understood.*

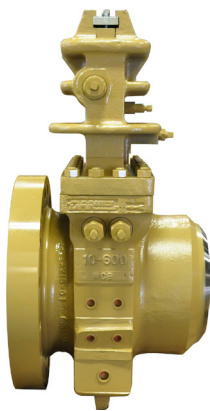
An orifice fitting is engineered to measure gas, liquid, steam and even fluids with a small amount of second phase. The accuracy achieved via orifice measurement can be maintained in liquid streams that contain up to 5% by volume of gas in liquids and up to 2% by weight of liquids in gas. These limits are very low and should not be stretched to higher-content mixed flow. In each of these cases, the accuracy tolerance of such measurement is at least double that expected by single-phase measurement with a given meter.<sup>1</sup> To properly specify an orifice fitting, the amount of media (i.e. gas, liquid, etc.) that may be present must be understood.

It is important for buyers who are new to flow measurement to identify this media prior to order placement to ensure the fitting operates properly as well as to minimize troubleshooting and maintenance. If this media and other variables are overlooked, instrument operation will be impacted. Furthermore, a complete list of specifications is required if the fitting will be measuring unusual media or if the fitting is needed for custody transfer applications. In fact, it is mandatory that the metering system comply with any applicable buy/sell contractual requirements. Finally, maintenance requirements once the fitting is installed in the field must also be taken into consideration.

## The Specification Process



Daniel Senior Orifice Fitting,  
Flanged Configuration



Daniel Senior Orifice Fitting,  
Flangenek™ Configuration

Orifice fittings are available in a wide range of line sizes and pressure ratings. The Daniel Senior Orifice Fitting is available for 2-inch to 48-inch line sizes and for a variety of pressure ratings, including 150# to 2,500# ANSI and up to 10,000# WOG. The Senior fitting can be repaired in the field without special tools, and it meets AGA3/API 14.3 and ISO 5167, if specified, and complies with PED without exception or penalties. Its field-proven, lubricated slide valve is used to isolate the upper and lower chambers and is available in a 'soft-seat' version.

To maximize instrument uptime and increase durability, several non-corrosive trim packages can be specified for Daniel fittings. NACE is the standard trim for 2-inch to 8-inch fittings rated for 150# to 600# ANSI. Depending on user requirements, a 316 stainless steel (SS) trim package without NACE is available. 316 SS parts in contact (PIC) is also available with or without NACE. Other trim packages may be specified, including SS trim for sour gas and/or corrosive service, referred to as AASG. 'A' trim with limited SS PIC is the standard trim package for 10-inch fittings and larger and for 2-inch thru 8-inch 900# ANSI and larger fittings. If there is uncertainty regarding the trim to specify or if special materials are needed, a recommendation from a Daniel technical specialist is strongly advised.

The fitting flanges must also be carefully specified to meet application requirements. There are two primary flange configurations available. The flanged fitting is flanged on both the upstream side and the downstream side while the Flangenek® fitting is welded on the upstream side and flanged on the downstream side. Another important specification is the flange type. Raised face (RF) flanges are primarily used for low pressure (150 to 600# ANSI) applications while ring joint (RJ) flanges are primarily used for high pressure (900 to 2500# ANSI) applications. Telemetry flange taps are standard on 2-inch to 12-inch 150# to 600# ANSI Senior fittings and 2-inch thru 4-inch 600# ANSI Simplex fittings.

A discussion of the industry standards or codes that will apply to the fitting installation is recommended during the specification process, particularly since API 14.3 and other requirements call for tighter dimensional plate tolerances during the manufacturing process. Every Daniel orifice plate is inspected using a Coordinate Measurement Machine (CMM) to validate the dimensional compliance of the nominal plate bore with industry standards, including AGA3/API 14.3 and ISO 5167.

The orifice plate bore must be based on the flow range. When specifying the diameter of the nominal plate bore, consideration must be given to the minimum and maximum quantities of gas to be handled over short and long periods of time as well as the estimates of these values for the first, third and tenth year of use. If the gas quality will be other than standard pipeline quality (i.e. free of



A dual vulcanized plate seal optimizes the operation of 12" and larger Senior fittings.

debris, lacking fluid, etc.), this information should be noted during the instrument specification process.

Standard orifice plates have a 45° bevel that is machined on the bore hole periphery. Unless otherwise specified, the plates will be beveled to the smaller of 1/50 of the line ID or 1/8 of the orifice bore. A number of special designs are available, including counter bores to limit the plate-edge thickness (with no bevel), segmental bores for use where solids are entrained in gas or liquid flow, eccentric bores to help pass solids or slurries, and quarter-round bores for viscous media with Reynolds numbers above 4,000 cSt per AGA/API and above 5,000 cSt per ISO 5167.

Both universal and paddle type orifice plates are available. 304 SS or 316 SS are standard Daniel plate materials with Monel®, Inconel®, Hastelloy and other optional materials available upon request. The application will dictate the plate material and type.

Standard Daniel orifice plate seals are available in nitrile (NBR), Viton (FKM) and Teflon or in the form of metal-to-metal. To optimize the operation of 12-inch and larger fittings, a dual vulcanized seal (DVS) that is bonded to each side of the orifice plate is recommended. Daniel offers testing for this type of seal to ensure it can withstand various pressure requirements, including standard hydrostatic testing to 1.5 times the rated pressure and optional high- and low-pressure plate seal testing.

Daniel orifice fittings can also be components of meter tubes or complete metering stations. If so, meter tube and straightening vane specifications may apply depending on the application and end user preferences. Straightening vanes are only supplied when specified as part of a Daniel meter tube order.

### Additional Factors to Consider



A dual run Senior orifice fitting installation.

While not a factor during fitting or meter tube specification, the number of measuring runs will directly impact station design. Additional factors to consider include valve requirements and the probability of noise and/or vibration in the pipe.

To ensure proper distribution of flow in multiple meter runs, the velocity in the header must be minimized by making its area 1.5 to 2 times the combined area of all meter tubes connected to it. If proper distribution is not achieved, one tube may have excessive flow rates with resulting high differential pressure before the other tubes reach their maximum flow capacity. Station throughput will be unnecessarily limited.

A primary reason Senior fittings are a preferred measurement device is that no additional valves or piping are necessary. For a single chamber fitting, one of three control valve systems is commonly used: direct acting or self-actuated regulators, pilot-operated regulators or control valves, or controller-operated control valves. Most operators prefer the simplest configuration that will meet station requirements.

### The Importance of Maintenance



Proper maintenance of orifice fittings helps minimize lost and unaccounted for gas.

One of the best ways to reduce lost and unaccounted for gas and/or corresponding liquid is to properly maintain orifice fittings and plates. A periodic plate inspection is highly recommended. To determine timing of plate inspections, frequent inspections should be conducted until sufficient information is obtained to determine the optimum inspection schedule. If significant changes occur with the flowing media, temperature and/or pressure, it is recommended that the plates be inspected more frequently until a new routine can be defined.

Monthly operation of all Senior fittings is recommended, including opening, closing and lubricating the slide valve. If a plate inspection is not required, the gear shafts should be rotated to ensure the shafts turn freely. It is also important to check and/or clean drain plug holes to prevent the buildup of debris that could interfere with the plate carrier bottoming out on the locator pins. Frequent cleaning of the drain plug holes also ensures proper plate centering and closing of the slide valve. These steps should only be performed once the Senior fitting has been depressurized and the line has been completely blown down.

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

#### **It is important to take the following precautions:**

1. Do not install a blank orifice plate to block off the line. A plate cannot hold high pressures and may be blown down the line or 'dished' to the point that it will not be possible to extract the plate.
2. Use only factory certified parts. Metallurgical quality, stress concentrations or dimensional details cannot be seen by the human eye. Appearances can be deceiving and objects that look alike may actually be very different.

Service and support is available via a worldwide network of Daniel technical specialists. Several flow and calibration loops in North America and Europe allow customers to verify performance of Daniel flow measurement devices.

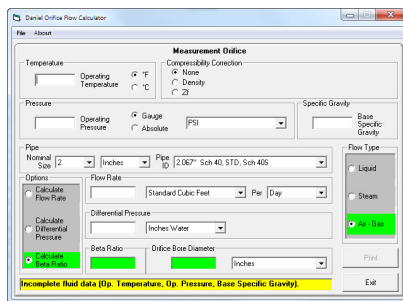


## Summary

Since its inception in the 1930's, the Daniel Senior orifice fitting remains the preferred means for custody transfer measurement in the oil and gas industry. Over one million Senior fittings are in operation today with installations in all geographic areas. The device is proven to easily, reliably and safely provide custody transfer measurement of natural gas under demanding conditions. Both operation and maintenance are straightforward.

During the specification process, clear and ongoing communication is critical to ensure all orifice fittings and plates are manufactured to meet the application. Once installed, routine maintenance is essential to maintain accurate readings and maximize instrument life.

## Daniel Orifice Calculator



The Daniel Orifice Calculator is available for download at [www.Daniel.com/SizingTools](http://www.Daniel.com/SizingTools)

Customers use the Daniel Orifice Calculator to get an approximation of the orifice fitting and plate dimensions that are required based on the application. This easy-to-use program prompts users to input variables such as flow rate, temperature and pressure. The free software is available to all industry professionals and can be downloaded at [www.Daniel.com/SizingTools](http://www.Daniel.com/SizingTools).

This tool is for estimation purposes only and is not to be used for the calculation of plate bores that will be put into service for custody transfer applications. All orifice fitting specifications must be verified by a Daniel technical specialist prior to order processing.

Daniel® Measurement and Control  
9750 W Sam Houston Pkwy N, Suite 100  
Houston, Texas 77064 USA

info@daniel.com | +1 (346) 509-3700 | daniel.com

