Sonic Nozzles

Series 220

Cox® Turbine Flow Meters

DESCRIPTION

The Series 220 sonic nozzles are mass flow instruments designed for the accurate measurement and control of gas flow. The nozzles can handle flow from 0.04…10,000 standard cubic feet per minute. The internal design of the nozzle consists of a circular arc that leads to the minimum throat area. Tangent to the circular arc on the exhaust side is a conical diffuser section. Common applications of the sonic nozzle include use as a calibration standard, gas flow meter, flow controller and flow limiting device.

Standard nozzles are sized according to the inlet pressure available to give continuous and overlapping flow ranges. Sizes range from a minimum throat diameter of eleven thousandths of an inch to a maximum of one inch. The nozzles, as well as the flow straighteners, are available with AN-8, AN-16 or AN-32 flare tube fittings.

OPERATION

The sonic nozzle is similar to a subsonic variable head type flowmeter in that a constriction is present in the flowstream. As the gas flows through the converging section of the nozzle, the inlet pressure is converted to velocity, which reaches a maximum at the throat. When the fluid velocity reaches the speed of sound at the throat, the flow rate varies linearly with the inlet pressure and is not affected by downstream pressure fluctuations. The pressure drop across the nozzle must be sufficient to maintain sonic flow at the throat. Normally, sonic flow occurs when the downstream pressure is not greater than one-half the upstream pressure.

The determination of mass flow rate using the sonic nozzle requires only two measurements— the nozzle inlet absolute pressure and the inlet absolute temperature. For a particular nozzle and gas, the equation is:

$$W = \frac{K_I P_{IT}}{\sqrt{T_{IT}}}$$

Where:

W = Flow rate
K_I = Flow coefficient based on actual calibration
P_{IT} = Inlet stagnation pressure
T_{IT} = Inlet stagnation temperature, °R

NVLAP® CALIBRATION
NVLAP LAB CODE 200668-0

ACCURACY

The Series 220 sonic nozzles are available with accuracies of ±3% or ± 0.5% of the reading. Uncalibrated nozzles deliver the ±3% of reading accuracy using standard calculated data. The ±0.5% of reading calibration is available for all the nozzles at any given set of flow conditions. ISO/IEC 17025 calibrations are available for up to 1/2 in. throat and are performed by our NVLAP (Lab Code 200668-0) accredited calibration facility located in Racine WI, which uses primary standard gas calibrators.

SIZING INSTRUCTIONS

When determining the proper size of a sonic flow nozzle for gas flow applications where the temperature is 70° F (21° C) and flow is given in SCFM, the nozzle is selected directly from *"Sizing Graph" on page 2*. When temperature is at other than 70° F (21° C), corrected flow is approximated using the following formula, before selecting the nozzle from the graph in.

W_c = Corrected flow
W_{ref} = Desired flow
T_2 abs = Operating temperature in degrees Rankin (T = °F + 460)

$$W_c = W_{ref}\sqrt{\frac{530}{T_2\,abs}}$$

When the flow is given in units other than SCFM, use one of the following equations to convert to SCFM:

$$SCFM = \frac{pph}{60\ (std.\ density)} \qquad SCFM = 36.05\ (acfm)\ \frac{P}{T}$$

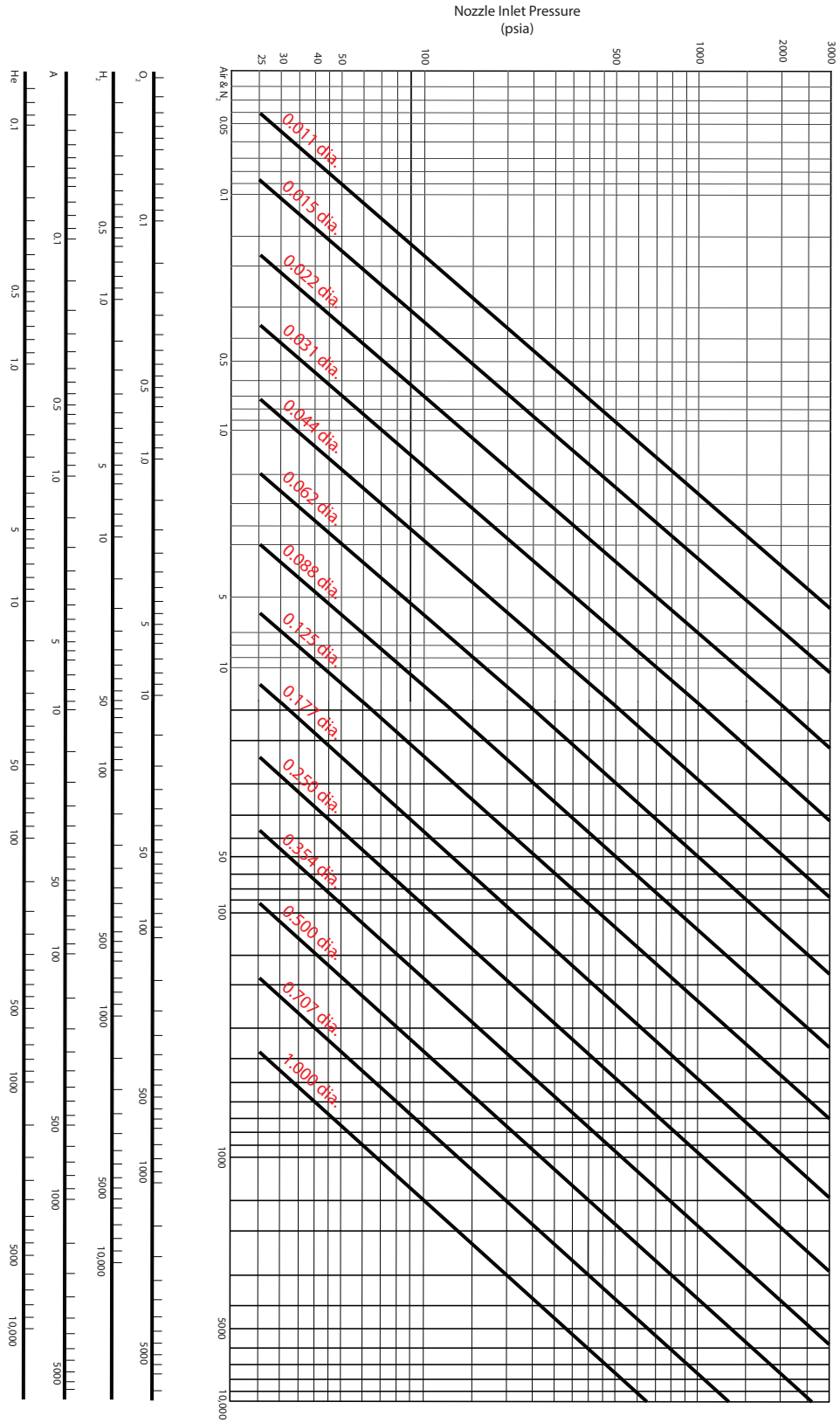
$$SCFM = \frac{ppm}{(std.\ density)} \qquad SCFM = \frac{pps\ 60}{(std.\ density)}$$

Badger Meter®

CXX-DS-01847-EN-04 (November 2021)

Product Data Sheet

SIZING GRAPH



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