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Measurement of Gas Flow by Bellmouth Inlet Flowmeters

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The American Society of Mechanical Engineers

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FOREWORD

The bellmouth is a common device for flow conditioning and flow measurement in the aerospace industry. Specifically, the bellmouth is attached to the front end of a turbofan gas turbine engine. Turboshaft engine applications also use the bellmouth but typically for flow conditioning and less frequently for flow measurement. The automotive industry also uses the bellmouth in some test applications. This Standard was prepared by Subcommittee 26, Bellmouth Inlet Flowmeters, of the ASME Standards Committee on Measurement of Fluids in Closed Conduits (MFC).

This is the initial release of this Standard.

This Standard provides information in both SI (metric) units and U.S. Customary units.

Suggestions for improvement of this Standard are welcome. They should be sent to The American Society of Mechanical Engineers; Secretary, MFC Standards Committee; Three Park Avenue; New York, NY 10016-5990.

This Standard was approved by the American National Standards Institute on March 30, 2011.

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MEASUREMENT OF FLUID FLOW IN CLOSED CONDUITS

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MEASUREMENT OF GAS FLOW BY BELLMOUTH INLET FLOWMETERS

1 GENERAL

1.1 Scope

This Standard applies only to the steady flow of single-phase gases and gas mixtures and applies only to bellmouth inlet flowmeters in which the flow remains subsonic throughout the measuring section and the flow is steady or varies only slowly with time. It also addresses procedures by which calibration of the device can be made to allow for application with consistent conclusions and within known limits of uncertainty.

Bellmouth inlet flowmeters should be used only within the limits for which a given unit is tested, or if additional uncertainty can be tolerated, over a range within which extrapolation is reliable.

This Standard outlines the general geometry and method of use of bellmouth inlet flowmeters to determine the mass or volumetric flow rate of the gas or gas mixture flowing through the device. It also gives necessary information for calculating the flow rate and its associated uncertainty.

A bellmouth inlet flowmeter is a device that provides flow conditioning and flow measurement whose inlet is located or positioned in a large reservoir or supply source. The reservoir can be outside ambient, room, or plenum conditions depending on the application. The bellmouth inlet flowmeter is also referred to as an airbell, nozzle with zero beta ratio, borda tube, etc. Typical geometry consists of a convergent inlet followed by a constant throat area. This flowmeter is a differential pressure type device that allows determination of the flow rate from the differential pressure between the total pressure and static pressure at a single specified axial location in the constant area throat of the bellmouth.

1.2 Purpose

The purpose of this Standard is to provide guidance and recommendations for fluid flow measurement of gaseous applications using the bellmouth inlet flowmeter.

This Standard addresses the following:

(a) principle of operation
(b) design parameters and considerations
(c) calibration methods and procedures
(d) instrumentation and calculation methods
(e) installation requirements and considerations
(f) measurement uncertainty

1.3 Field of Application

The bellmouth inlet flowmeter is a common device that both conditions the flow and measures its rate and is widely used in the aerospace industry. Specifically, the discharge of the bellmouth flowmeter is often attached to the front end of a test article such as a turbofan gas turbine engine. Turboshaft engine applications also use the bellmouth but typically for flow conditioning and less frequently for flow measurement. The automotive industry also uses the bellmouth in some test applications.

2 REFERENCES

The following documents form a part of this Standard to the extent specified herein. Unless otherwise specified, the latest edition shall apply.

ASME Fluid Meters, 6th Edition, 1971

ASME MFC-1M, Glossary of Terms Used in the Measurement of Fluid Flow in Pipes

ASME MFC-3M, Measurement of Fluid Flow in Pipes Using Orifice, Nozzle, and Venturi

ASME PTC 19.5, Flow Measurement

Publisher: The American Society of Mechanical Engineers (ASME), Three Park Avenue, New York, NY 10016-5990; Order Department: 22 Law Drive, P.O. Box 2900, Fairfield, NJ 07007-2900 (www.asme.org)

ISO 5167, Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full

Publisher: International Organization for Standardization (ISO), Central Secretariat, 1, ch. de la Voie-Creuse, Case postale 56, CH-1211 Geneva 20, Switzerland (www.iso.org)