



AEROSPACE INFORMATION REPORT

AIR6202™

Issued 2012-04
Reaffirmed 2017-06

Test Cell Mass Fuel Flow Measurement Using Coriolis Flow Meters

RATIONALE

AIR6202 has been reaffirmed to comply with the SAE Five-Year Review policy.

TABLE OF CONTENTS

1.	SCOPE.....	2
2.	APPLICABLE DOCUMENTS.....	2
2.1	SAE Publications.....	2
2.2	ASTM Publications.....	2
3.	INTRODUCTION AND BENEFITS	2
4.	PRINCIPLE OF OPERATION	3
5.	BEST PRACTISE ADVICE FOR MECHANICAL CONFIGURATION/INSTALLATION – SINGLE METER (LIQUID).....	4
6.	BEST PRACTISE ADVICE FOR MECHANICAL CONFIGURATION/INSTALLATION – SINGLE METER (GAS)	6
7.	BEST PRACTISE ADVICE FOR MECHANICAL CONFIGURATION/INSTALLATION – TWIN METERS (LIQUID)	7
8.	MANAGEMENT OF "ZERO DRIFT"	8
9.	INITIAL AND PERIODIC CALIBRATION REQUIREMENTS	9
10.	NOTES	9

SAE Technical Standards Board Rules provide that: "This report is published by SAE to advance the state of technical and engineering sciences. The use of this report is entirely voluntary, and its applicability and suitability for any particular use, including any patent infringement arising therefrom, is the sole responsibility of the user."

SAE reviews each technical report at least every five years at which time it may be revised, reaffirmed, stabilized, or cancelled. SAE invites your written comments and suggestions.

Copyright © 2017 SAE International

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of SAE.

TO PLACE A DOCUMENT ORDER: Tel: 877-606-7323 (inside USA and Canada)
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
<http://www.sae.org>

SAE WEB ADDRESS:

Full document details: SAE AIR6202

SAE values your input. To provide feedback on this
Technical Report, please visit
<http://standards.sae.org/AIR6202>

Documents
Document Sharing Hub

1. SCOPE

The scope of this information report applies to the steady state measurement of direct mass fuel flow in gas turbine engine test cells. A measurement accuracy, and hence uncertainty of between ± 0.1 to $\pm 0.2\%$ of value is believed to be achievable for liquid flow applications with some meter models/installations.

Whilst capable of general transient measurement in 50 to 100 Hz region, this type of fuel meter is not capable of rapid transient measurement (in 100 to 250 Hz region). It is also not currently considered suitable for "in flight" fuel flow measurement.

2. APPLICABLE DOCUMENTS

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

AIR5026 Test Cell Instrumentation

ARP4990 Turbine Flowmeter Fuel Flow Calculations

AS5304 Standard Specification for Turbine Flowmeters

2.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM D1250 Standard Guide for Petroleum Measurement Tables

3. INTRODUCTION AND BENEFITS

Traditionally, test cell mass fuel flow measurement for gas turbine engines has been calculated following the measurement of multiple parameters that include volumetric fuel flow, density and temperature(s). This includes measuring the temperature of fuel at both the meter during flow and a static sample of the fuel used, in order to correct "real time" meter density relative to the static sample in accordance with ASTM D1250. In some cases, "on line" densimeters are used.

Also, there are other elements to consider in the measurement uncertainty chain "stack up" when using this traditional volumetric fuel flow measurement method, such as viscosity and pressure, particularly when using turbine flowmeters (see ARP4990). The total measurement uncertainty for the volumetric fuel flow measurement method is believed to be in the region of ± 0.25 to $\pm 0.5\%$ of value depending on the meter choice, installation, range and method being used. This accuracy is only likely to be achieved over the top 80% (5/1 turn down ratio) of range of a single application flow meter. Below this range there is likely to be a significant increase in measurement uncertainty. Typically, turbine flow meters have been used in the US and positive displacement bulk meters used in the UK.

The development of Coriolis fuel meters over the last 20 years has seen significant improvements in accuracy capability from ± 1.0 to $\pm 0.1\%$ of value, by some manufacturers. When taking temperature compensation into account over a realistic working range, a total uncertainty of approximately $\pm 0.2\%$ of value is considered to be more realistic for liquid flow applications. This accuracy can be achieved over the top 95% of range (20/1 turn down ratio) of a single application flow meter. Below this range there is likely to be a significant increase in measurement uncertainty.

The use of Coriolis fuel meters enables the direct measurement of mass fuel flow as a single parameter rather than multiple parameters and corrections that are described above, and is also likely to have additional cost benefits to the overall measurement system with the removal of these measurements/routines. Also, there are no moving parts to this design of meter requiring less overhaul maintenance throughout its life.

These meters can also be used to measure gas flow, although it should be noted that the measurement accuracy capability is likely to be worse (typically ± 0.3 to $\pm 0.4\%$ of value).

Some manufacturers also provide the ability for their meters to output density or volumetric flow if required.

Two features of concern with this design are the management of the mechanical installation configuration (which is known to have sensitivity issues) and the risk of zero drift, particularly with ambient temperature variation. These issues and the principle of operation are covered in the following sections of this document.

4. PRINCIPLE OF OPERATION

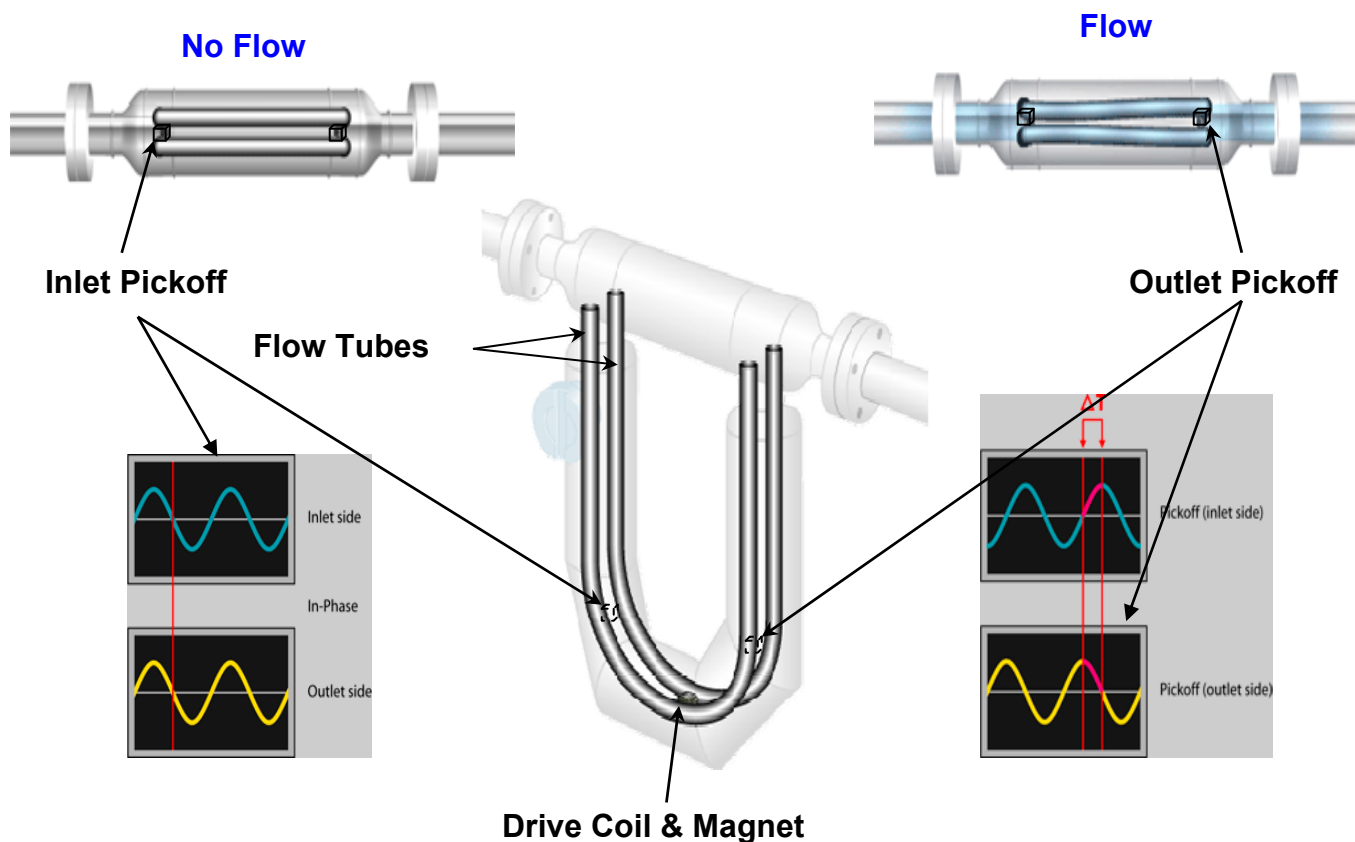


FIGURE 1