
SPECIFICATION FOR

**GAS TRANSPORTER'S REQUIREMENTS FOR GAS
MEASUREMENT SYSTEMS CONNECTED TO THE
NATIONAL GRID GAS NETWORK**

Uncontrolled when printed

OCTOBER 2005

CONTENTS

	Page
FOREWORD	iii
BRIEF HISTORY	iii
INTRODUCTION	1
1 SCOPE	1
2 REFERENCES	1
3 DEFINITIONS	1
3.1 General	1
3.2 Mandatory and non-mandatory requirements	1
4 GAS QUALITY	1
5 CALORIFIC VALUE	1
5.1 Flow Weighted Calorific Value	1
5.2 Calorific Value Specific to a premises	2
6 DESIGN	2
6.1 Benchmark	2
6.2 Volume Flows	2
6.3 Energy Flows	3
6.4 Gas quality Measurement	4
6.5 Network Integrity Management	4
7 COMMISSIONING AND VALIDATION	5
7.1 Measurement System	5
8 MAINTENANCE	5
9 INSPECTION	5
10 TESTING	5
11 AUDIT	5
12 RECONCILIATION	5
12.1 Reconciliation Process	5
12.1 Reconciliation Data	5
APPENDICES	
A References	7

Uncontrolled when printed

FOREWORD

This Specification was approved by the Measurement and Process Policy Manager, on 2nd. March 2001 for use by managers, engineers and supervisors throughout National Grid Gas.

National Grid Gas documents are revised, when necessary, by the issue of new editions. Users should ensure that they are in possession of the latest edition by referring to the Gas Documents Library available on infonetUK (company intranet.)

Compliance with this Document does not confer immunity from prosecution for breach of statutory or other legal obligations.

BRIEF HISTORY

First published as T/SP/ME1 Editorial update to reflect demerger November 2000 Editorial update to comply with GRM Editorial update for National Grid re-branding	March 2001 June 2001 August 2004 October 2005	EPSG/L00/251
--	--	--------------

KEY CHANGES (Identify the changes from the previous version of this document)

Section	Amendments
All	Changes to reflect rebadging to National Grid. Removal of Transco and substitution of National Grid. Change of must to shall

DISCLAIMER

This document is provided for use by National Grid Gas and such of its contractors as are obliged by the terms and conditions of their contracts to comply with this document. Where this document is used by any other party it is the responsibility of that party to ensure that this document is correctly applied.

MANDATORY AND NON-MANDATORY REQUIREMENTS

In this document:

shall: indicates a mandatory requirement.

should: indicates best practice and is the preferred option. If an alternative method is used then a suitable and sufficient risk assessment shall be completed to show that the alternative method delivers the same, or better, level of protection.

Uncontrolled when printed

Uncontrolled when printed

SPECIFICATION FOR

GAS TRANSPORTER'S REQUIREMENTS FOR GAS MEASUREMENT SYSTEMS CONNECTED TO THE NATIONAL GRID GAS NETWORK

INTRODUCTION

There are certain measurement requirements that connections to National Grid Gas's network shall comply with before the equipment can be used for the purposes of transfer of gas. These requirements arise due to the need for National Grid Gas to balance its' National Transmission System (NTS) and Local Distribution Zones (LDZ) effectively.

1. SCOPE

This specification defines the minimum technical requirements for gas measurement systems connected to the National Grid Gas network and used for the following purposes:

- (i.) Gas quality measurement systems
- (ii.) Meter installations for NTS energy balancing
- (iii.) Meter installations for LDZ input and LDZ transfer
- (iv.) Meter installations for flow control and planning purposes

2. REFERENCES

This document makes reference to the documents listed in Appendix A. Unless otherwise specified the latest editions of the documents apply, including addenda and revisions.

3. DEFINITIONS

3.1 General

For the purposes of this Specification, the definitions given in 3.2 apply.

4. GAS QUALITY

Gas quality specifications shall meet the minimum requirements of the Gas Safety (Management) Regulations 1998, Regulation 8 and Schedule 3 parts 1 & 2. They shall also meet the network entry gas specifications, as given in the current National Grid Gas '10 Year Statement', and any additional gas quality specification agreed for the connection.

NB. The gas in National Grid Gas's NTS is not odourised. Gas in National Grid Gas's network shall be odourised at all transfer points from the NTS to the local distribution zone (LDZ). Third parties connecting to National Grid Gas's NTS that require odourised gas shall be responsible for installing, operating and maintaining equipment for such purposes. Third parties injecting gas into National Grid Gas's LDZ network shall ensure that the gas is odourised in accordance with National Grid Gas's requirements.

5. CALORIFIC VALUE

5.1 Flow Weighted Average Calorific Value

Where gas enters a charging area or transfers from one charging area to another then the energy transfer shall be used in the calculation of the flow weighted average calorific value (FWACV) for the charging area as determined by the Gas (Calculation of Thermal of Energy) Regulations 1996 and Amendment 1997. These regulations require that CV is determined by the PGT in accordance with directions given by the Director General of Ofgem.

5.2 Calorific Value Specific to a Premises

Where calorific value is determined specifically for a premises i.e. consumers billed under contract, then under Regulation 2 paragraphs (3) & (4) of the Gas (Calculation of Thermal Energy) Regulations

1996, the PGT and the shipper, or the customer, agree to operate equipment for the determination of calorific value (CV) specific to a premises and use the CV so determined for calculating the energy conveyed. Equipment for determining CV used under this agreement are not subject to regulation in terms of the apparatus used or how it is operated, maintained and tested.

5.3 Calorific Value at Entry Points to the NTS

Where gas enters the NTS the calorific value shall be determined and used for calculating the amount of energy conveyed. Equipment for determining CV under this agreement are not subject to regulation in terms of the apparatus used or how it is operated, maintained and tested.

6. DESIGN

6.1 Benchmark

For loads within the scope of this document the Department of Trade & Industry (Oil & Gas Office) "Guidance Notes for Standards for Petroleum Measurement - Under the Petroleum Act 1998", which is a public domain document, has been adopted as a benchmark for measurement uncertainty. In section 3.1.22 (Gaseous Petroleum) it is stated that:

'The uncertainty of the measurement of a mass flowrate, q_m , should be calculated using the simplified formula given in ISO5167-1:1991 paragraph 11.2.2. Over the normal production flowrates the overall uncertainty should be better than $\pm 1.0\%$ '.

Whilst the above paragraph refers to flow measurement by means of pressure differential devices e.g. orifice plate meters, the uncertainty in mass flowrate can be interpreted such that the uncertainty of volume measurement systems e.g. turbine metering systems and ultrasonic metering systems, shall be $\pm 1.0\%$ over the specified flow range.

For metering installations that are used for flow control or planning purposes the uncertainty of mass or volume measurement shall be $\pm 3.0\%$ over the specified flow range.

6.2 Volume Flows

The Network System Operator will require instantaneous and integrated volume flows converted to metric standard conditions (MSC) i.e. at 15 degC, 1.01325 bar, dry

6.2.1 Volume Flow Measurement

The flow measurement system shall be designed, built and installed to BS EN 1776. Further guidance is given in the Institute of Gas Engineers' reports IGE/GM/1 and IGE/GM/4. For specific primary devices the following standards/guidelines also apply:

(i.)	Orifice plate metering systems	BS EN ISO 5167
(ii.)	Turbine metering systems	BS 7834 (ISO 9951)
(iii.)	Ultrasonic metering systems	BS 7965, BS ISO/TR 12765, AGA 9

Other flow measurement systems may be considered. However, traceability of the proposed measurement method shall be provided e.g. BS ISO 11631, and the uncertainty of the measurement shall be demonstrated.

e.g.: the methods of determining the flow into or out of a LNG tank is by stock change for which there are no traceable standards. However, the variables used in the calculation are easily identified i.e. tank diameter, tank level gauge etc. and can be assessed as to their uncertainty to provide an overall uncertainty for the measurement.

The method used for the determination of the uncertainty in the measurement of volume flow rate shall be that given in BS ISO TR 5168. Other methods may be used by agreement.

6.2.2 Relative Density and Standard Density

Relative density, or standard density, is required in the calculation of standard volume flowrate.

Relative density may be determined either by measurement, using a relative density transducer, or by calculation, using a gas composition obtained from a gas chromatograph. Standard density may be obtained by calculation using a gas composition obtained from a gas chromatograph. Where quantities are calculated then they will be in accordance with the latest version of BS 7859 (ISO 6976) at MSC.

6.2.3 LINE DENSITY

Line density is required in the calculation of mass flowrate (orifice plate metering systems) or in the conversion of actual volume flowrate (turbine & ultrasonic metering systems).

Line density may be determined either by measurement, using an in-line densitometer, or by calculation, using a gas composition obtained from a gas chromatograph. If the former is adopted then one densitometer will be required per metering stream and shall be installed in a 'pressure recovery' mode of operation to minimise the amount of gas vented to atmosphere. If the latter is employed then the calculation will be in accordance with the latest version of BS ISO 12213-2

6.2.4 VOLUME FLOW COMPUTATION

Volume flowrate should be calculated in a dedicated flow computer which shall accept all signals necessary for the calculation of the total station volume flowrate. The flow computer shall also provide, to an external device, integrated volume flow signals.

For an orifice plate metering system the live input signals shall include (per stream), but not be limited to:

- differential pressure transmitter low range
- differential pressure transmitter high range
- pressure transmitter
- temperature transmitter
- line density *
- relative density *
- gas composition (if a chromatograph is installed)

For a turbine metering system the live input signals shall include (per stream), but not be limited to:

- turbine meter pulses
- pressure transmitter
- temperature transmitter
- line density *
- relative density *
- gas composition (if a chromatograph is installed)

For an ultrasonic metering system the live inputs shall include (per stream), but not be limited to:

- ultrasonic meter pulses (or ultrasonic meter parameters via serial link)
- pressure transmitter
- temperature transmitter
- line density *
- relative density *
- gas composition (if a chromatograph is installed)

* these signals are required if the chromatograph option is not used.

The flow computer shall accept the results of a calibration carried out at a suitably accredited facility to minimise the error of measurement. For turbine and ultrasonic meter calibrations the number of calibration points that can be entered shall not be less than five

6.3 Energy Flows

In certain situations the network operator may require instantaneous and integrated energy flows converted to metric standards conditions. The uncertainty of the energy flowrate shall be better than $\pm 1.1\%$ of reading over the specified flow range.

6.3.1 Calorific Value Determination

Calorific value will be required in the calculation of energy flowrate.

In situations where the Gas (Calculation of Thermal Energy) Regulations 1996 and Amendment 1997 apply (typically where gas enters a charging area or transfers from one charging area to another) then the apparatus used for the determination of calorific value will be operated and maintained under direction from Ofgem and will be used for the purposes of calculating flow weighted average calorific value (FWACV) applied to that charging area.

In situations where the Gas (Calculation of Thermal Energy) Regulations 1996 do not apply then calorific value may be determined either by measurement, using a calorimeter, or by calculation, using a gas composition obtained via a gas chromatograph. If the latter is employed then the calculation will be in accordance with the latest version of BS 7859 (ISO 6976) at MSC for both combustion and metering.

In either of the above cases the connecting party (PGT) will require the rights to evaluate all instruments used in the determination of the CV in addition to the right to witness the calibrations or perform tests on the apparatus.

The accuracy of the determined CV will be better than ± 0.1 MJ/m³.

6.3.2 Energy Flow Computation

Flow computers installed at connections where energy measurement is a requirement shall be capable of accepting signals necessary for the calculation of energy flowrate. The flow computer shall also be capable of providing integrated energy flow signals.

6.4 Gas Quality Measurement

6.4.1 Sampling Systems

The sampling systems used to obtain the sample of gas for quality measurements shall ensure that no change to the gas composition occurs between the sample point and the analytical instrument. The time taken for the sample of gas to travel from the sample point to the analytical instrument shall be less than one hour. Pipewall sampling is acceptable except for gas samples for determining hydrocarbon dewpoint etc.

6.4.2 Standards/Guidelines

Gas quality measurements should comply with the current versions of the following standards/guidelines:

- BS 3156-10.3 (ISO 6327);
- BS 3156-11.1.2 (ISO 6975).
- BS 3156-11.2 (ISO 6570);
- BS 3156-11.4 (ISO 6326);
- BS 3156-11.5 (ISO 10723);
- BS EN ISO 10715
- BS EN ISO 14111;

6.5 Network Integrity Measurement

Network connection agreements will define safe operating limits for the connection. The measurement system shall include measurements associated with instrumentation and control systems used to constrain the gas within safe operating limits, principally pressure and temperature.

Pressure measurements may be associated with pressure transmitters or pressure switches but may include pressure relief devices. Limits for these shall be agreed between the network operator and the gas facility operator.

Temperature measurements may be associated with temperature transmitters or temperature elements. Limits for these shall be agreed between the network operator and the gas facility operator.

7. COMMISSIONING AND VALIDATION

7.1 Measurement System

The PGT will accept the metering system for custody transfer of gas once the system has been validated in accordance with procedures that have been agreed.

Validation of the metering system requires each installed component of the metering system to be checked to ensure it is still operating in the manner required by the design specification. The combined uncertainty of all installed components shall be within the contractually agreed uncertainty limit for the system. The procedures used for checking each component shall be agreed between all parties to ensure they are sufficiently comprehensive for the items being checked. Reliance on test certificates for each component produced under ideal conditions in a laboratory is not acceptable.

All test equipment used in the proving of the installed components shall have a current calibration certificate i.e. within one year, from a laboratory which is accredited at a suitable level to a recognised standard e.g. UKAS

8. MAINTENANCE

The measurement system shall be maintained in such a manner to ensure that the combined uncertainty of all installed components is within the contractually agreed uncertainty limit for the system. The procedures used for the maintenance of each component shall be agreed between all parties to ensure they are sufficiently comprehensive for the items being maintained. Maintenance will be carried out at a frequency of at least once per year. However, this frequency may be increased upon agreement of all parties concerned.

9. INSPECTION

National Grid Gas shall be afforded the opportunity to inspect the measurement system at any time upon giving reasonable notice of intention to inspect.

10. TESTING

National Grid Gas shall have the rights to require that the system be tested at any time upon giving reasonable notice of intention to test if they believe that the measurement system may be operating outwith the design specification such that the uncertainty of measurement is not within the contractually agreed limit.

11. AUDIT

National Grid Gas shall be afforded the opportunity to audit the measurement system and associated records/documentation annually.

12. RECONCILIATION

12.1 Reconciliation Process

All metering faults/errors shall be documented in a mis-measurement report and the reconciliation of the metering errors will be in accordance with reconciliation procedures that have been agreed between the PGT, gas facility operator and gas facility user.

The gas flows during the period since the most recent revalidation shall be recalculated on the basis that half the metering error is applied during that period except where it is proved that the metering error occurred on some other date or during such other period as agreed with the PGT when the flows shall be recalculated from that date or in respect of that period.

12.2 Reconciliation Data

The reconciliation data shall be recorded to enable reconstruction of the flowrate should a metering fault occur. Reconciliation data shall comprise records of all of the live field signals for the metering system.

For an orifice plate metering system these shall include:

- meter differential pressure
- meter pressure
- meter temperature
- meter density *
- base density *
- calorific value *
- gas composition (if a chromatograph is installed)

For a turbine metering system these shall include:

- turbine meter pulse count
- meter pressure
- meter temperature
- meter density *
- base density *
- calorific value *
- gas composition (if a chromatograph is installed)

For an ultrasonic metering system these shall include:

- ultrasonic meter pulse count (or ultrasonic meter velocity measurement)
- meter pressure
- meter temperature
- meter density *
- base density *
- calorific value *
- gas composition (if a chromatograph is installed)

* these signals will be required if the densities and calorific value are not calculated but instead are a live measurement

Reconciliation data shall be held at the gas facility and, where agreed, it may be transmitted to the PGT. It is envisaged that the most appropriate platform for transmission of these signals will be in serial format using an appropriate protocol. The PGT shall provide an appropriate device to receive the signals thus enabling reconstruction of the flowrate using an agreed algorithm. The reconstructed flowrate and the above signals shall be logged every [4] mins to allow reconciliation in the event of a process measurement error being detected.

Uncontrolled when printed

APPENDIX A

REFERENCES

American Gas Association

AGA 9 Measurement of Gas by Multipath Ultrasonic Meters

British Standards

BS 3156-10.3 Gas Analysis - Determination of the Water Dewpoint of Natural gas - Cooled Surface Condensation Hygrometers

BS 3156-11.1.2 Natural Gas - Extended Analysis - Gas Chromatographic Method

BS 3156-11.2 Natural Gas - Determination of Potential Hydrocarbon Liquid Content

BS 3156-11.4 Natural Gas - Determination of Sulphur Compounds

BS 3156-11.5 Natural Gas - Performance Evaluation for On-line Analytical Systems

BS 7834 Measurement of fluid flow in closed conduits – Turbine Meters

BS 7859 Natural Gas - Calculation of Calorific Values, Density, Relative Density and Wobbe Index From Composition

BS 7965 The Selection, Installation, Operation and Calibration of Diagonal Path Transit Time Ultrasonic Flowmeters for Industrial Gas Applications

BS EN 1776 Gas Supply. Natural Gas Measuring Stations. Functional Requirements

BS EN ISO 5167 Measurement of Fluid Flow in Closed Conduits. Part 1 - Pressure Differential Devices. Orifice Plates, Nozzles, and Venturi Tubes Inserted in Circular Cross-Section Conduits Running Full

BS EN ISO 10715 Natural Gas - Sampling Guidelines

BS EN ISO 14111 Natural Gas - Guidelines to Traceability in Analysis

BS ISO 11631 Measurement of Fluid Flow. Methods of Specifying Flowmeter Performance

BS ISO 12213-2 Natural Gas - Calculation of Compression Factors. Calculation Using a Molar Composition Analysis

BS ISO TR 5168 Measurement of Fluid Flow. Evaluation of Uncertainties

BS ISO/TR 12765 Measurement of Fluid Flow in Closed Conduits. Methods Using Transit-Time Ultrasonic Flowmeters

Institute of Gas Engineers

IGE/GM/1 Gas meter installations for pressures not exceeding 100 bar

IGE/GM/4 Flowmetering practice for pressures between 38 and 250 bar

Uncontrolled when printed

ENDNOTE

Comments

Comments and queries regarding the technical content of this document should be directed to:

Safety and Engineering Registrar
SHE Directorate
National Grid
National Grid House
Warwick Technology Park
Gallows Hill
Warwick
CV34 6DA

Buying documents

Contractors and other users external to National Grid Gas should direct their requests for further copies of National Grid Gas documents to the department or group responsible for the initial issue of their contract documentation.

Copyright *National Grid Gas plc* 2006 ©, all rights reserved. No part of this publication may be reproduced in any material form (including photocopying and restoring in any medium or electronic means and whether or not transiently or incidentally) without the written permission of National Grid plc except in accordance with the provisions of the Copyright, Designs and Patents Act 1988.