National Grid Gas Engineering Standards

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T/PR/ME/2 Part 3

WORK PROCEDURE FOR

VALIDATION OF EQUIPMENT ASSOCIATED WITH MEASUREMENT SYSTEMS FOR THE CALCULATION OF MASS, VOLUME & ENERGY FLOWRATE OF GAS

PART 3: FLOW WEIGHTED AVERAGE CALORIFIC VALUE OFFTAKES.

OCTOBER 2004

CONTENTS

FOREWORD

This Work Procedure was approved by Measurement and Process Policy Manager on 21/10/04 for use by managers, engineers and supervisors throughout National Grid Gas.

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BRIEF HISTORY

First published as T/PR/ME2 Part3	March 2001	EPSG/T02/658
Editorial update to reflect demerger November 2000	June 2001	
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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.

WORK PROCEDURE FOR

VALIDATION OF EQUIPMENT ASSOCIATED WITH MEASUREMENT SYSTEMS FOR THE CALCULATION OF MASS, VOLUME & ENERGY FLOWRATE OF GAS

PART 3: FLOW WEIGHTED AVERAGE CALORIFIC VALUE OFFTAKES.

INTRODUCTION

This Work Procedure has been produced to ensure that validation of gas flow metering systems is performed consistently throughout National Grid Gas.

1. SCOPE

This Work Procedure shall be used to demonstrate that instrumentation and equipment associated with measurement systems for the calculation of mass, volume or energy flowrate of gas are functioning correctly, thus ensuring that the complete metering system continues to perform within the uncertainty requirements as defined in the Gas Requirements Manual (GRM).

This Work Procedure forms a suite to cover the validation of differing types of metering systems installed at connections to National Grid Gas's above 7 bar network:

Part 1: General Requirements
Part 2: Generic Procedures
Part 3: Flow Weighted Average Calorific Value Offtakes
Part 4: Power Stations (with Daniel S500 flow computers using firmware AGI 3V0_0)
Part 5: Very Large Daily Metered Consumers (with Flow Computers)

This Work Procedure is to be used within National Grid Gas for the following types of connection:

i) NTS to LDZ transfer

ii) Inter-LDZ transfer

iii) NTS supplied very large daily metered consumers (VLDMC)

iv) LTS supplied very large daily metered consumers (VLDMC)

This Work Procedure may also be used to validate 3rd party measurement systems for the calculation of mass, volume and energy flowrate of gas connected to the national balancing point (NBP) in the absence of any other procedures.

Part 3 applies specifically to sites where the measurements for volume and energy are directed by Ofgem. They typically apply to the following:

i) NTS to LDZ transfer

ii) Inter-LDZ transfer

iii) Entry points to LDZ (i.e. storage, landfill sites or onshore fields)

2. REFERENCES

This document makes reference to documents listed in Appendix A of T/PR/ME/2 Part 1. Unless otherwise specified the latest editions of the documents apply, including addenda and revisions.

3. DEFINITIONS

For the purpose of this Work Procedure the definitions given in T/PR/ME/2 Part 1 apply.

4. GENERAL PREPARATIONS AND PRECAUTIONS

The following list is intended as a guide to the preparations/precautions that are required prior to the commencement of validation/calibration work. It is not a substitute for the local safe working practices or controls.

A number of the procedures include additional advice as to the preparations and precautions that are appropriate to the activities defined within the procedure.

a) Ensure the appropriate permitry to work has been granted.

b) Check the calibration records of the equipment to be checked/calibrated. Assess the calibration stability and investigate any operating problems that occurred since its last check/calibration.

c) Ensure that the values of all entered data required by the flow computer is consistent with the latest revision of the configuration.

d) Ensure that all calibration/test equipment is fully charged/ready for use and covered by a current calibration certificate.

e) Where main process lines are broken/opened, ensure that a gas detector is available and suitable protective clothing is worn.

f) Confirm that suitable power supplies are available and observe work permit conditions.

5. STATUTORY COMPLIANCE DURING MAINTENANCE

During maintenance, the measured flow will not necessarily be the actual flow through the offtake, and an estimate of the volume flowing through the offtake shall be made by the System Operator (for the purposes of system balancing and the calculation of flow weighted average CV).

In order to comply with regulatory requirements during meter maintenance, the following *shall* be performed:-

a) Communication with the System Operator

i) The System Operator shall be advised of the intention to undertake work 4 weeks before commencement.

ii) If the maintenance period is estimated to exceed 8 hours, or if the CV sample point is by-passed, then System Operator shall be informed.

b) Procedures Before and After Maintenance

i) The System Operator shall be informed that maintenance is to be carried out on a site, and be given details of the effects on any values or processes.

ii) Prior to maintenance, the System Operator shall ensure that gas flows between 20% and 100% of maximum meter tube design capacity in order to establish a footprint to compare the pre and post work profile of the site.

iii) The following shall be recorded by the System Operator on the booking on/off form and the Site Operatives shall also record this in the Meter Logbook.

- date
- time
- CV
- SG
- Inlet, outlet & meter pressure
- flow control valve position/pressure set-point (where applicable)
- standby differential pressure (mbar) if present
- standard volume flowrate
- volume flow integrator reading (OMNI).
- volume flow integrator reading (Telemetry).

NB. All meter values should be obtained from the flow computer apart from the FCV/PSP which should be obtained from the site telemetry unit.

iv) To minimize the potential for errors occurring when estimating hourly flows. The control valves should be fixed in DVC and the signal from the System Operator isolated by disconnecting the appropriate loops. If this is not possible the site shall be shut down and the appropriate loops disconnected.

v) At the end of the maintenance, the System Operator shall attempt to replicate conditions at the start of the maintenance.

vi) Check and agree with the System Operator that the start and finish volume flow rates are comparable, considering the maintenance activities undertaken and the similarity of the flow conditions. For a Pressure Control site, Area Control will use a comparable demand day to assess whether the flows are as expected. If the values are not as expected, the Site Operative shall re-check that all instrumentation has been correctly re-instated. Maintenance should only be completed when reasons for any unexpected discrepancy have been found and corrected.

vii) Provided the checks are acceptable the valve shall be reinstated and the signal from the System Operator re-established.

c) Flow Rate Modification

If the volume flow calculated by the flow computer is being affected by the maintenance, the following shall be undertaken:-

i) Flow Computer Maintenance Mode (OMNI sites only)

The maintenance mode in the flow computer shall be enabled as follows: **This will result in a fixed LGT injection flow rate!**

- Press front panel keys PROG INPUT ENTER;
- Enter "1.0" to put the OMNI into Maintenance mode;
- Press PROG to return to DISPLAY mode.
- Enable the DANINT maintenance mode (second screen, F12)

At the end of the maintenance period, repeat the above, but enter "-1.0" into the OMNI to disable the maintenance mode. "Maintenance" is written into the alarm report when it is activated. At the end of the maintenance period, ensure that Danint and the Danalyzer are returned to their normal working state as detailed within T/PR/GQ/3.

ii) Local Gas Treatment

The LGT system injects odorant in proportion to the flowrate calculated within the OMNI flow computer. Any modifications that influence the injection rate of the LGT system shall be undertaken in accordance with T/PM/MAINT/8, as defined within procedure CP6 '**DAC Check / Manual over-ride (LGT)**'.

At the end of the maintenance period, ensure that the OMNI/Local Gas Treatment system is returned to the normal operating state by confirming that (with gas flowing) the instantaneous flow measured at the flow computer corresponds to the LGT injection flow rate.

d) Records

Meter Maintenance

Details of work undertaken on meter systems shall be recorded in the site log book

Validation results

On completion of any of the check procedures, the Site Validation record sheet within HPMIS shall be completed with:-

- date;
- check procedure number;
- stream number;
- status of the check ie. AF/AL, AF, AL or AF2;
- any relevant comment;
- who made the entry.

Meter Fault

Meter faults shall be recorded within the site log book. All faults found with the metering equipment shall be reported to the System Operator who shall record the details within their database logging system. Details shall also be reported to the Network Lead Group P&GQ.

NB The Danalyzer Record sheets shall be completed if the CV, RD or gas composition data are affected.

6. TESTING

The procedures detailed in Section 11 shall be undertaken at the stated frequency.

All results shall be recorded on the appropriate test results sheet and signed by the tester and, where appropriate, by a witness. All records shall be retained for future inspection and audit.

7. COMPLETING THE VALIDATION FORM

The maintenance forms within HPMIS shall be completed. The following instructions have been retained for sites where access to HPMIS has not been provided.

As much detail as possible has been included in the relevant check procedure to assist completion of the validation form. However, the following general advice is given:

- A yellow box requires an entry - data cannot be entered into any other cell.
- In the Status section, the following entries are automatically made:

"AF/AL"	As Found/As Left:	check acceptable without recalibration
"AF"	As Found	check unacceptable without recalibration
"AL"	As Left	check acceptable after recalibration
"AF2"	As Found no. 2	check unacceptable after recalibration

- Any recalibration shall be described in the Comments section of the form containing the data after any action was taken and the results recorded on the second form on the same sheet.
- On sites without RemoteWare, access to HPMIS is not available. A spreadsheet shall be issued to record the validation results. In such cases a completed spreadsheet shall be returned to the Network Lead Group P&GQ.

If access to HPMIS is not available on sites with RemoteWare, the operative shall contact the NLG P&GQ to report the fault and agree to default to using a spreadsheet to record results. The results for two stream sites shall be recorded on separate spreadsheets.

8. GENERAL REQUIREMENTS

All sites shall be validated annually with a maximum interval of eighteen months between validations.

The validation of a site is considered complete when all the tests for that site meet the acceptance criteria defined within each of the test procedures.

When validating a site if any test fails to meet the acceptance criteria defined within the test procedures, the affected equipment shall be repaired and revalidated within 14 working days.

The validation of a site shall be completed within one month of commencement.

When the validation of a meter is completed the site operative shall fill in a Validation Completion Certificate within HPMIS.

There are many ways the process of performing the validation can be made more efficient. This section outlines a few suggestions :-

i) Whilst undertaking the maintenance procedure it is necessary to edit the live OMNI file. There is the potential for errors to be introduced to the system once the maintenance is completed. The integrity of the system shall be protected by making a backup of the OMNI configuration.

This OMNI configuration file shall be saved to the Allen Bradley prior to making changes to the live file. Once the maintenance procedure is completed it shall then be transferred back to

the OMNI to ensure the OMNI configuration is left as it was found. The file shall be saved as follows.

Use SSSYMMDD.OMI format for file name.
SSS = Site abbreviation e.g. STF = St Fergus
Y = year as letter 2004=J, 2005 = K, 2006 = L etc.
MM = Month (e.g. March = 03)
DD = Day (e.g. 4th = 04).

ii) Several tests are easier if they are performed during the same day and in a particular order:

- CP1, CP2, CP3 - similar data values are required to be fixed in the flow computer for each of these checks;
- CP4, CP10, CP11- as the dead-weight tester is arranged to provide pressures which correspond to nominal current outputs (0%, 25%, 50%, 75%, 100%), the ADC of the flow computer can be checked at the same time;
- CP6a, CP6b - same process taking readings from different parts of the system.

9. HSE&E

It shall be noted that when undertaking work based upon this Work Procedure, activities shall be assessed in order to mitigate the risk of harm or injury. Guidance on precautions that should be put in place for various hazards that may be encountered are defined within the National Grid Gas Risk Assessments Hazards and Precautions handbook.

Risk assessments shall be undertaken to ensure that safe working procedures are established and applied. The following risks should be considered.

i) Working on high pressure systems.

ii) Lifting operations including lifting orifice plates and turbine meters in and out of pipes and during transit to and from site.

iii) Configuration of LGT injection flow rates.

iv) Isolation of electrical / instrumentation systems

v) Exposure to contaminated instrumentation systems.

vi) Working within potentially hazardous areas.

vii) Forcing the output of the OMNI computer can result in changes to the values displayed by GTMS. The operation of sites shall be managed to avoid valves operating in response to forced calibration signals.

viii) Debris may be ejected from high pressure pipes during venting operations.

ix) Waste oil and grease drained or cleaned from instrumentation systems shall be contained and disposed of in a controlled manner.

x) Turbine meters removed for calibration repair or shall be purged prior to transportation.

xi) Sites shall be reinstated with gas flowing. If this is not possible the site may be left incorrectly configured.

xii) All site work (including remote dial ins) shall be coordinated with the System Operator to address the risk of inadvertent operations.

xiii) Potential damage to plant caused by rapid changes in the flow rate

10. REINSTATEMENT

Whilst applying the validation procedures, a number of modifications may have to be made to the metering system in order to force and record values. Such modifications involve both disconnecting physical instruments (or wires) and software edits.

Upon completion of the validation the system shall be reinstated to correctly record energy and volume flows in accordance with the GRM. Checks shall be undertaken to ensure all circuits are intact and any forced values are removed. All default failure modes shall be reinstated.

All software edits shall reflect the As Left status of the meter system and a copy of the OMNI configuration shall be backed up onto the Allen-Bradley.

11. SUMMARY OF TEST PROCEDURES

CP1a Gas Flow Computer - Density Computation Check (AGA8) (Detailed method)
CP1b Gas Flow Computer - Density Computation Check (AGA8) (Gross method)

CP2a Gas Flow Computer - Flow Rate Check (Orifice Meter)
CP2b Gas Flow Computer - Flow Rate Check (Turbine Meter)
CP2c Gas Flow Computer - Flow Rate Check (Orifice Meter) – Transmitton
CP2d Gas Flow Computer - Flow Rate Check (Ultrasonic Meter)

CP3a Gas Flow Computer - Totalisation Check (Orifice Meter)
CP3b Gas Flow Computer - Totalisation Check (Turbine / Ultrasonic Meter)
CP3c Gas Flow Computer - Totalisation Check (Orifice Meter/ Transmitton unit)

CP4a Gas Flow Computer - ADC Check (4-20mA Input) Pressure
CP4b Gas Flow Computer - ADC Check (4-20mA Input) Low Differential Pressure
CP4c Gas Flow Computer - ADC Check (4-20mA Input) Standby Differential Pressure
CP4d Gas Flow Computer - ADC Check (4-20mA Input) High Differential Pressure
CP4e Gas Flow Computer - ADC Check (4-20mA Input) Temperature

CP5 Gas Flow Computer - ADC Check (RTD Input)

CP6a Gas Flow Computer - DAC Check (Site Control Volume signal)
CP6b Telemetry/GTMS - Telemetry ADC and GTMS Check
CP6c Gas Flow Computer - DAC Check / Manual over-ride (LGT)

CP7 Gas Flow Computer - Differential Pressure Cell Switch Point Check (Orifice Meter)

CP8a Gas Flow Computer - Gas Property Check (Chromatograph)
CP8b Gas Flow Computer - Gas Property Check (Tracker)

CP9 Gas Flow Computer - Flow Computer Configuration Check

CP10 Gauge Flow Pressure Transmitter Check

CP11 Differential Pressure Transmitter Check (Low/High/Standby) (Orifice Meter)

CP12 Temperature Transmitter Check

CP13 Temperature Element Spot Check

CP14a Orifice Meter Inspection/Replacement
CP14b Turbine Meter Inspection/Replacement
CP14c Ultrasonic Meter Inspection/Replacement/Maintenance

CP15 Equipment Replacement

CP16 Reinstatement check
CP17 Removed Orifice Meter: Workshop Inspection/Certification

12. INDEX OF TEST PROCEDURES: FOR FLOW METERING VALIDATION AT OFFTAKES

PROCEDURE	ISSUE	DATE	REVISION	BY
CP1a	B	16/9/03	Updated	GPMcG
CP1b	B	16/9/03	Updated	GPMcG
CP2a	C	16/9/03	Updated	GPMcG
CP2b	C	16/9/03	Updated	GPMcG
CP2c	C	16/9/03	Updated	GPMcG
CP2d	B	16/9/03	Updated	GPMcG
CP3a	C	16/9/03	Updated	GPMcG
CP3b	C	16/9/03	Updated	GPMcG
CP3c	B	16/9/03	Updated	GPMcG
CP3d		16/9/03	Removed and combined with CP3b	GPMcG
CP4abcde	B	16/9/03	Updated combined	GPMcG
CP5	B	16/9/03	Updated	GPMcG
CP6a	C	16/9/03	Updated	GPMcG
CP6b	C	16/9/03	Updated	GPMcG
CP6c	C	16/9/03	Updated	GPMcG
CP7	C	16/9/03	Updated	GPMcG
CP8a	C	16/9/03	Updated	GPMcG
CP8b	B	16/9/03	Updated	GPMcG
CP9	C	16/9/03	Updated	GPMcG
CP10	C	16/9/03	Updated	GPMcG
CP11	C	16/9/03	Updated	GPMcG
CP12	B	16/9/03	Updated	GPMcG
CP13	C	16/9/03	Updated	GPMcG
CP14a	C	16/9/03	Updated	GPMcG
CP14b	C	16/9/03	Updated	GPMcG
CP14c	B	16/9/03	Updated	GPMcG
CP15		16/9/03	Not issued	GPMcG
CP16	B	16/9/03	Updated	GPMcG
CP17	A		First issue	GPMcG

ALL TEST PROCEDURES

In relation to all procedures this document provides guidance for technicians regarding key stroke sequences on the Omni 6000 Flow Computer. These sequences predominately relate to Omni firmware v27.71. These sequences may be different for other firmware types.

FLOW COMPUTER

DENSITY COMPUTATION CHECK (AGA8 - DETAILED)

Proc No	**CP1a**
ISSUE	**B**

This check shall be carried out to verify that the flow computer is calculating upstream density correctly to the relevant density computation routine (AGA 8 - Detailed Method) by comparing the displayed value with an expected value of calculated upstream density.

FREQUENCY OF TEST:	12 months
ACCEPT/REJECT: CRITERIA	±0.002% of reading
FALLBACK PROCEDURE	Check all the data values used. Ensure the gas chromatograph derived composition has not changed. Repeat the check. If still out of specification, log the fault with the responsible Engineering Manager.

PREPARATIONS/PRECAUTIONS

The System Operator shall be advised prior to undertaking this procedure, in order that they may manage the operation of the site and account for errors introduced to the declared GTMS flow rate.

It shall be noted that when setting default values (for pressure, temperature and differential pressure), the calculated flow within the OMNI will be affected, resulting in an error in the declared flow signals. The following shall be considered:

i) GTMS will display a corresponding F1, which could result in unexpected valve movements if the site is not set in DVC and the signal to the valve is isolated by disconnecting the appropriate loops.

ii) The LGT system shall be configured as defined within CP6c to prevent the injection of odorant in proportion to the simulated flow.

TEST PROCEDURE

a) Stop communication to the Open Controller [ONLINE>OMNI CONFIG>CONFIG SERIAL I/O> SERIAL I/O#3: change MODBUS ID from 1 to 22].

b) Using the override facility, enter suitable data into the flow computer for the following:

(i) Temperature [ONLINE> TEMP/PRESS SETUP> TEMPERATURE #meter no: change OVERRIDE CODE from 3 to 1, set OVERRIDE VALUE to a suitable value];

(ii) Pressure [ONLINE> TEMP/PRESS SETUP> PRESSURE #meter no: change OVERRIDE CODE from 3 to 1, set OVERRIDE VALUE to a suitable value];

(iii) Differential Pressure [ONLINE> DIFF. PRESSURE SETUP>DIFF. PRESSURE #meter no: change OVERRIDE CODE from 3 to 1, set OVERRIDE VALUE to a suitable value].

c) Enter the following data onto the calibration form:-

(i) Temperature value entered;

(ii) Upstream Temperature [Front panel key press METER 1 TEMP, then DISPLAY and scroll down].

NB. Unless the OMNI has the new software 27.71, the downstream temperature will be used to calculate the density. In this case, leave the upstream temperature field blank.

(iii) Pressure value entered;

(iv) Gas Composition [ONLINE> FLUID DATA & ANALYSIS];

(v) Flow Computer calculated Compressibility [Front panel key press TEMP FACTOR DISPLAY] and Density [Front panel key press I,O (stream 1) or P (stream 2), then DISPLAY].

(vi) Calculate the Compressibility and Density using AGA8 (1994) -Detailed Method using the upstream conditions and enter the values onto results form.

REINSTATEMENT

a) Reinstate in accordance with CP16.

b) After completion enter YES in the "Reinstate Equipment?" box.

FLOW COMPUTER

DENSITY COMPUTATION CHECK (AGA8 - GROSS METHOD)

Proc No.	**CP1b**
Issue	**B**

This check shall be carried out to verify that the flow computer is calculating upstream density correctly to the relevant density computation routine (AGA 8 - Gross Method) by comparing the displayed value with an expected value of calculated upstream density.

FREQUENCY OF TEST:	12 months
ACCEPT/REJECT: CRITERIA	±0.02% of reading
FALLBACK PROCEDURE	Check all the data values used. Ensure the gas tracker values (RD, CV) have not changed. Repeat the check. If still out of specification, log the fault with the responsible Engineering Manager.

PREPARATIONS/PRECAUTIONS

The System Operator shall be advised prior to undertaking this procedure, in order that they may manage the operation of the site and account for errors introduced to the declared GTMS flow rate.

It shall be noted that when setting default values (for pressure, temperature and differential pressure), the calculated flow within the OMNI will be affected, resulting in an error in the declared flow signals. The following shall be considered:

i) GTMS will display a corresponding F1, which could result in unexpected valve movements if the site is not set in DVC and the signal to the valve is isolated by disconnecting the appropriate loops.

ii) The LGT system shall be configured as defined within CP6c to prevent the injection of odorant in proportion to the simulated flow.

TEST PROCEDURE

a) Stop communication to the Open Controller [ONLINE>OMNI CONFIG>CONFIG SERIAL I/O> SERIAL I/O#3: change MODBUS ID from 1 to 22].

b) Using the override facility, enter suitable data into the flow computer for the following:

(i) Temperature [ONLINE> TEMP/PRESS SETUP> TEMPERATURE #meter no: change OVERRIDE CODE from 3 to 1, set OVERRIDE VALUE to a suitable value];

(ii) Pressure [ONLINE> TEMP/PRESS SETUP> PRESSURE #meter no: change OVERRIDE CODE from 3 to 1, set OVERRIDE VALUE to a suitable value];

(iii) Differential Pressure [ONLINE> DIFF. PRESSURE SETUP>DIFF. PRESSURE #meter no: change OVERRIDE CODE from 3 to 1, set OVERRIDE VALUE to a suitable value].

c) Enter the following data onto the calibration form:-

(i) Temperature value entered;

(ii) Upstream Temperature [Front panel key press METER 1 TEMP, then DISPLAY and scroll down]. NB. Unless the OMNI has the new software 27.71, the downstream temperature will be used to calculate the density. In this case, leave the upstream temperature field blank.

(iii) Pressure value entered;

(iv) Relative Density and Calorific Value [Front panel key press I,O (stream 1) or P (stream 2), then DISPLAY];

(v) Mole percent Carbon Dioxide [ONLINE> FLUID DATA & ANALYSIS];

(vi) Flow Computer calculated Compressibility [Front panel key press TEMP FACTOR DISPLAY] and Density [Front panel key press I,O (stream 1) or P (stream 2), then DISPLAY].

d) Calculate the Compressibility and Density using AGA8 (1994) - Gross Method, using the upstream conditions and enter the values onto results form.

REINSTATEMENT

a) Reinstate in accordance with CP16.

b) After completion enter YES in the "Reinstate Equipment?" box.

FLOW COMPUTER

FLOW RATE CHECK (ORIFICE METER)

Proc No.	**CP2a**
Issue	**C**

This check shall be carried out to verify that the computer is calculating stream flow rates correctly by "setting" flow conditions and comparing displayed flow rates with expected values.

FREQUENCY OF TEST/: CALIBRATION	12 months
ACCEPT/REJECT: CRITERIA	±0.001% of reading
FALLBACK PROCEDURE	Check all the data values used and repeat the check. If still out of specification, log the fault with the responsible Engineering Manager.

PREPARATIONS/PRECAUTIONS

The System Operator shall be advised prior to undertaking this procedure, in order that they may manage the operation of the site and account for errors introduced to the declared GTMS flow rate.

It shall be noted that when setting default values (for pressure, temperature and differential pressure) within the OMNI flow computer, the calculated flow within the OMNI will be affected, resulting in a change in the analogue outputs #1 and #2. The following shall be considered:

i) GTMS will display a corresponding F1, which could result in unexpected valve movements if the site is not set in DVC and the signal to the valve is isolated by disconnecting the appropriate loops.

ii) The LGT system shall be configured as defined within CP6c to prevent the injection of odorant in proportion to the simulated flow.

TEST PROCEDURE

a) Stop communication to the Open Controller [ONLINE>OMNI CONFIG> CONFIG SERIAL I/O> SERIAL I/O#3: change MODBUS ID from 1 to 22].

b) Using the override facility, enter suitable data into the flow computer for the following:

i) Temperature [ONLINE> TEMP/PRESS SETUP> TEMPERATURE #meter no: change OVERRIDE CODE from 3 to 1, set OVERRIDE VALUE to a suitable value];

ii) Pressure [ONLINE> TEMP/PRESS SETUP> PRESSURE #meter no: change OVERRIDE CODE from 3 to 1, set OVERRIDE VALUE to a suitable value];

iii) Differential Pressure [ONLINE> DIFF. PRESSURE SETUP>DIFF. PRESSURE #meter no: change OVERRIDE CODE from 3 to 1, set OVERRIDE VALUE to a suitable value].

NB This test is repeated three times using varying data for Pressure and Differential Pressure to cover the flow range of the stream.

c) Enter the following data onto the calibration form Input Data section:

i) Pipe Diameter at Calibration Temperature [ONLINE> METER RUN SETUP];

ii) Pipe Diameter Calibration Temperature [ONLINE> METER RUN SETUP];

iii) Pipe Expansion Factor [ONLINE> METER RUN SETUP];

iv) Orifice Diameter at Calibration Temperature [ONLINE> METER RUN SETUP];

v) Orifice Plate Calibration Temperature [ONLINE> METER RUN SETUP];

vi) Orifice Plate Expansion Factor [ONLINE> METER RUN SETUP];

vii) (Dynamic) Viscosity [ONLINE> FLUID DATA & ANALYSIS];

viii) Isentropic Exponent [ONLINE> FLUID DATA & ANALYSIS];

ix) Relative Density [Front panel key press I,O (stream 1) or P (stream 2), then DISPLAY] (see note below);

x) Calorific Value [Front panel key press I,O (stream 1) or P (stream 2), then DISPLAY];

xi) Density of Air at Metric Standard Conditions [ONLINE>FACTOR SETUP+SYS CONSTANTS];

xii) Atmospheric Pressure [ONLINE>FACTOR SETUP+SYS CONSTANTS];

xiii) Entered Temperature value;

REINSTATEMENT

a) Reinstate in accordance with CP16.

b) After completion enter YES in the "Reinstate Equipment?" box.

FLOW COMPUTER

FLOW RATE CHECK (TURBINE METER)

Proc No.	**CP2b**
Issue	**C**

This check shall be carried out to verify that the computer is calculating stream flow rates correctly by "setting" flow conditions and comparing displayed flow rates with expected values.

FREQUENCY OF TEST/: CALIBRATION	12 months
ACCEPT/REJECT: CRITERIA	±0.001% of reading
FALLBACK PROCEDURE	Check all the data values used and repeat the check. If still out of specification, log the fault with the responsible Engineering Manager.

PREPARATIONS/PRECAUTIONS

The System Operator shall be advised prior to undertaking this procedure, in order that they may manage the operation of the site and account for errors introduced to the declared GTMS flow rate.

It shall be noted that when setting default values (for pressure, temperature and differential pressure), the calculated flow within the OMNI will be affected, resulting in an error in the declared flow signals. The following shall be considered:

i) GTMS will display a corresponding F1, which could result in unexpected valve movements if the site is not set in DVC and the signal to the valve is isolated by disconnecting the appropriate loops.

ii) The LGT system shall be configured as defined within CP6c to prevent the injection of odorant in proportion to the simulated flow.

HOOK UP PROCEDURE

Substitute the turbine meter input with a calibrated pulse generator with a switching voltage greater than 3.6v but less than 12v. The terminal connections are dependent upon the site configuration and are defined within GMR00005.

TEST PROCEDURE

a) Stop communication to the Open Controller [ONLINE>OMNI CONFIG> CONFIG SERIAL I/O> SERIAL I/O#3: change MODBUS ID from 1 to 22].

b) Using the override facility, enter suitable data into the flow computer for the following:

i) Temperature [ONLINE> TEMP/PRESS SETUP> TEMPERATURE #meter no: change OVERRIDE CODE from 3 to 1, set OVERRIDE VALUE to a suitable value];

ii) Pressure [ONLINE> TEMP/PRESS SETUP> PRESSURE #meter no: change OVERRIDE CODE from 3 to 1, set OVERRIDE VALUE to a suitable value] and set using the pulse generator:

iii) Pulse frequency.

NB This test is repeated three times using varying data for Pressure and Pulse Frequency to cover the flow range of the stream.

c) Enter the following data onto the calibration form Input Data section:

i) Relative Density [Front panel key press I,O (stream 1) or P (stream 2), then DISPLAY];

ii) Density of Air at Metric Standard Conditions [ONLINE>FACTOR SET-UP];

iii) Calorific Value [Front panel key press I,O (stream 1) or P (stream 2), then DISPLAY];

iv) Entered Temperature value.

REINSTATEMENT

a) Reinstate in accordance with CP16.

b) After completion enter YES in the "Reinstate Equipment?" box.

FLOW COMPUTER

TRANSMITTON UNIT

FLOW RATE CHECK (ORIFICE METER)

Proc No.	**CP2c**
Issue	**C**

This check shall be carried out to verify the accuracy of the Transmitton unit flow rate calculation and the overall flow metering accuracy by using test equipment to input required values into the Transmitton unit and comparing the flow rate displayed with the calculated value.

NB. The secondary instrumentation checks should be performed prior to this check.

FREQUENCY OF TEST/: CALIBRATION	12 months
ACCEPT/REJECT: CRITERIA	±0.8% of reading
FALLBACK PROCEDURE	Check all the data values used and repeat the check. If still out of specification; (i) check the Transmitton displayed input readings are appropriate for the actual inputs & (ii) check the ADC precision reference voltage levels across the following test points on the MT48 card:

TP12 -TP14	0.1221V
TP13 -TP14	4.8840V

and if incorrect, adjust the relevant pots on the MT48 card.
Then check the Transmitton values:

E1 BD24	2.44%
E1 BD25	97.68%

and if incorrect, adjust the relevant pots on the MT4(A) card for a MKI or MKII, or MT70 card for a MKIII Transmitton unit. If the test is still out of tolerance, log the fault with the responsible Engineering Manager.

PREPARATIONS/PRECAUTIONS

The System Operator shall be advised prior to undertaking this procedure, in order that they may manage the operation of the site and account for errors introduced to the declared GTMS flow rate.

It shall be noted that when setting default values (for pressure, temperature and differential pressure), the calculated flow within the Transmitton will be affected, resulting in an error in the declared flow signals. The following shall be considered:

i) GTMS will display a corresponding F1, which could result in unexpected valve movements if the site is not set in DVC and the signal to the valve is isolated by disconnecting the appropriate loops.

ii) The LGT system shall be configured as defined within CP6c to prevent the injection of odorant in proportion to the simulated flow.

HOOK-UP PROCEDURE

a) Pressure and differential pressure transmitters

i) Isolate the pressure and differential pressure transmitters being tested and vent to atmosphere. Leave to stabilise for a minimum period of 2 hours.

ii) Connect the dead weight tester to the differential pressure transmitter and vent in accordance with manufacturers instructions. Check that the dead-weight tester is level and free from vibration during the calibration activity.

iii) Site a digital thermometer as close as possible to the dead-weight tester to determine the ambient temperature during the validation.

b) Temperature

i) Connect a certified decade resistance box to the temperature transmitter in accordance with the manufacturers instructions.

TEST PROCEDURE

a) Record the input values, in engineering units, from the Transmitton configuration onto the spreadsheet for

i) Design density;

ii) Design RD;

iii) Design DP;

iv) Low DP span;

v) RD manual;

b) Set and maintain the test equipment to the required pressure, differential pressure and temperature input values.

NB This test is repeated three times using varying data for Pressure and Differential Pressure to cover the flow range of the stream. For the first run chose a DP value which is inside the range of the low range DP transmitter.

c) Enter the following data onto the calibration form Results section:

i) The input values for pressure, differential pressure and temperature in engineering units.

ii) The readings for each input displayed by the Transmitton unit

- density [CA01-loop 1, CA02-loop 2, CA60 - loop 3, CA61 - loop 4];
- meter pressure [CA29-loop 1, CA30-loop 2, CA44 - loop 3, CA45 - loop 4];
- low or high differential pressure [CA11, CA13-loop 1, CA12, CA14-loop 2, CA - loop 3, CA61 - loop 4];
- meter temperature [CA26-loop 1, CA27-loop 2, CA28 - loop 3, CA29 - loop 4];

iii) The displayed flow rate by the Transmitton unit [CA07-loop 1, CA08-loop 2, CA58 - loop 3, CA59 - loop 4];

iv) Contact the System Operator and record their value in % as displayed on GTMS.

d) Repeat the test twice for different values of Differential Pressure and Pressure to cover the range of operating conditions.

REINSTATEMENT

a) Reinstate in accordance with CP16.

b) After completion enter YES in the "Reinstate Equipment?" box.

FLOW COMPUTER

FLOW RATE CHECK (ULTRASONIC METER)

Proc No.	**CP2d**
Issue	**B**

This check shall be carried out to verify that the computer is calculating stream flow rates correctly by "setting" flow conditions and comparing displayed flow rates with expected values.

FREQUENCY OF TEST/: CALIBRATION	12 months
ACCEPT/REJECT: CRITERIA	±0.001% of reading
FALLBACK PROCEDURE	Check all the data values used and repeat the check. If still out of specification, log the fault with the responsible Engineering Manager.

PREPARATIONS/PRECAUTIONS

The System Operator shall be advised prior to undertaking this procedure, in order that they may manage the operation of the site and account for errors introduced to the declared GTMS flow rate.

It shall be noted that whilst injecting the frequency signal within the OMNI flow computer. The calculated flow within the OMNI will be affected, resulting in an error in the declared flow signals. The following shall be considered:

i) GTMS will display a corresponding F1, which could result in unexpected valve movements if the site is not set in DVC and the signal to the valve is isolated by disconnecting the appropriate loops.

ii) The LGT system shall be configured as defined within CP6c to prevent the injection of odorant in proportion to the simulated flow.

HOOK UP PROCEDURE

Substitute the ultrasonic meter pulse output with a calibrated pulse generator and disconnect the serial link from the meter.

TEST PROCEDURE

a) Stop communication to the Open Controller [ONLINE>OMNI CONFIG> CONFIG SERIAL I/O> SERIAL I/O#3: change MODBUS ID from 1 to 22].

b) Using the override facility, enter suitable data into the flow computer for the following:

i) Temperature [ONLINE> TEMP/PRESS SETUP> TEMPERATURE #meter no: change OVERRIDE CODE from 3 to 1, set OVERRIDE VALUE to a suitable value];

ii) Pressure [ONLINE> TEMP/PRESS SETUP> PRESSURE #meter no: change OVERRIDE CODE from 3 to 1, set OVERRIDE VALUE to a suitable value]; and set using the pulse generator:

iii) Pulse frequency.

NB This test is repeated three times using varying data for Pressure and Pulse Frequency to cover the flow range of the stream.

c) Enter the following data onto the calibration form Input Data section:

i) Relative Density [Front panel key press I,O (stream 1) or P (stream 2), then DISPLAY]. (See note below);

ii) Density of Air at Metric Standard Conditions [ONLINE>FACTOR SET-UP];

iii) Calorific Value [Front panel key press I,O (stream 1) or P (stream 2), then DISPLAY];

iv) Entered Temperature value.

d) Enter the following data onto the calibration form Results section:

i) Input Pulse Frequency;

ii) K-Factor of the USM [Front panel key press K, O (stream 1) or P (stream 2), then DISPLAY];

iii) Entered Pressure value;

iv) Density [Front panel key press I,O (stream 1) or P (stream 2), then DISPLAY];

v) Displayed Actual Volume, Standard Volume and Energy Flowrate [Front panel key press F, O (stream 1) or P (stream 2), then DISPLAY].

e) Repeat the test twice with different values of Pulse Frequency and Pressure.

f) Disconnect the pulse generator and connect the appropriate ultrasonic meter simulator to the ultrasonic meter serial input of the flow computer.

g) Repeat b - e above substituting “serial flowrate” for “pulse frequency”.

REINSTATEMENT

a) Reinstate in accordance with CP16.

b) After completion enter YES in the "Reinstate Equipment?" box.

FLOW COMPUTER

TOTALISATION CHECK (ORIFICE METER)

Proc No: **CP3a**

Issue **C**

This check shall be carried out to verify that the stream totalisers are functioning correctly by simulating flow over an accurately measured period of time and comparing the displayed total increments with expected values.

NB This test shall be run over a sufficient period of time to pass the required tolerance level. If gas is passing through the site, then do not run the test for more than 6 hours.

FREQUENCY OF TEST/: CALIBRATION	12 months
ACCEPT/REJECT: CRITERIA	±0.01% of reading
FALLBACK PROCEDURE	Check all the data values used and repeat the check. If still out of specification, log the fault with the responsible Engineering Manager.

PREPARATIONS/PRECAUTIONS

The System Operator shall be advised prior to undertaking this procedure, in order that they may manage the operation of the site and account for errors introduced to the declared GTMS flow rate.

It shall be noted that when setting default values (for pressure, temperature and differential pressure) within the OMNI flow computer. The calculated flow within the OMNI will be affected, resulting in an error in the analogue outputs #1 and #2. The following shall be considered:

i) GTMS will display a corresponding F1, which could result in unexpected valve movements if the site is not set in DVC and the signal to the valve is isolated by disconnecting the appropriate loops.

ii) The LGT system shall be configured as defined within CP6c to prevent the injection of odorant in proportion to the simulated flow.

TEST PROCEDURE

a) Stop communication to the Open Controller [ONLINE>OMNI CONFIG> CONFIG SERIAL I/O> SERIAL I/O#3: change MODBUS ID from 1 to 22].

b) Using the override facility set Differential Pressure to zero [ONLINE> DIFF. PRESSURE SETUP> DIFF. PRESSURE #meter no: change OVERRIDE CODE from 3 to 1, set OVERRIDE VALUE = 0].

c) Using the override facility, enter suitable data into the flow computer for the following:

i) Temperature [ONLINE> TEMP/PRESS SETUP> TEMPERATURE #meter no: change OVERRIDE CODE from 3 to 1, set OVERRIDE VALUE to a suitable value];

ii) Pressure [ONLINE> TEMP/PRESS SETUP> PRESSURE #meter no: change OVERRIDE CODE from 3 to 1, set OVERRIDE VALUE to a suitable value].

d) Record the flow computer's mass, standard volume and energy totaliser values [Front panel key press MASS then DISPLAY; NET, then DISPLAY; ENERGY, then DISPLAY. Use the downward arrow key to view the cumulative values].

e) Record the telemetry unit standard volume.

f) Record the GTMS standard volume [contact the System Operator].

g) Start the test by inputting a suitable differential pressure into the flow computer and at the same moment noting the test start time. **NB** Use an accurate chronometer, for instance the "speaking clock" (tel no 123 record hh.mm.ss). Using the override facility set Differential Pressure [ONLINE> DIFF. PRESSURE SETUP> DIFF. PRESSURE #meter no: set OVERRIDE VALUE = suitable value].

h) Enter the following input data onto the calibration form:

i) Entered Temperature value;

ii) Entered Pressure value;

iii) Entered Differential Pressure value;

iv) Relative Density [Front panel key press I,O (stream 1) or P (stream 2), then DISPLAY]. (See note below);

v) Upstream Density [Front panel key press I,O (stream 1) or P (stream 2), then DISPLAY];

vi) Calorific Value [Front panel key press I,O (stream 1) or P (stream 2), then DISPLAY];

vii) The flow computer pulse/unit [ONLINE>OMNI CONFIGURATION >CONFIG DIGITAL I/O>DIGITAL POINT #1>PULSES/UNIT];

viii) Start Time;

ix) Displayed Mass, Standard Volume and Energy Flowrate [Front panel key press F, O (stream 1) or P (stream 2), then DISPLAY].

i) End the test by setting differential pressure to zero simultaneously recording the stop time on the accurate chronometer. Note for best resolution stop the test just after the GTMS totaliser increments.

j) Enter onto the calibration from:

i) The stop time.

ii) The final totaliser values for mass, standard volume and energy for the flow computer.

iii) The final totaliser values for standard volume from the telemetry unit and GTMS.

REINSTATEMENT

a) Reinstate in accordance with CP16.

b) After completion enter YES in the "Reinstate Equipment?" box.

FLOW COMPUTER

TOTALISATION CHECK (TURBINE METER/ ULTRASONIC METER)

Proc No.	**CP3b**
Issue	**C**

This check shall be carried out to verify that the stream totalisers are functioning correctly by simulating flow over an accurately measured period of time and comparing the displayed total increments with expected values.

NB This test shall be run a sufficient period of time to pass the required tolerance level. If gas is passing through the site, then do not run the test for more than 6 hours.

FREQUENCY OF TEST/: CALIBRATION	12 months
ACCEPT/REJECT: CRITERIA	±0.01% of reading
FALLBACK PROCEDURE	Check all the data values used and repeat the check. If still out of specification, log the fault with the responsible Engineering Manager.

PREPARATIONS/PRECAUTIONS

The System Operator shall be advised prior to undertaking this procedure, in order that they may manage the operation of the site and account for errors introduced to the declared GTMS flow rate.

It shall be noted that when setting default values (for pressure, temperature and differential pressure) within the OMNI flow computer. The calculated flow within the OMNI will be affected, resulting in an error in the analogue outputs #1 and #2. The following shall be considered:

i) GTMS will display a corresponding F1, which could result in unexpected valve movements if the site is not set in DVC and the signal to the valve is isolated by disconnecting the appropriate loops.

ii) The LGT system shall be configured as defined within CP6c to prevent the injection of odorant in proportion to the simulated flow.

TEST PROCEDURE

a) Stop communication to the Open Controller [ONLINE>OMNI CONFIG> CONFIG SERIAL I/O> SERIAL I/O#3: change MODBUS ID from 1 to 22].

b) Using the pulse generator, set the pulse frequency to zero. Check the input frequency is zero [Front panel key press K followed by O, or P, for a 2 stream site, then DISPLAY].

c) Using the override facility, enter suitable data into the flow computer for the following:

i) Temperature [ONLINE> TEMP/PRESS SETUP> TEMPERATURE #meter no: change OVERRIDE CODE from 3 to 1, set OVERRIDE VALUE to a suitable value];

ii) Pressure [ONLINE> TEMP/PRESS SETUP> PRESSURE #meter no: change OVERRIDE CODE from 3 to 1, set OVERRIDE VALUE to a suitable value].

d) Record the flow computer's standard volume and energy totaliser values [Front panel key press; NET, then DISPLAY; ENERGY, then DISPLAY. Use the downward arrow key to view the cumulative values].

e) Record the telemetry unit standard volume [Transmitton - E1 DC01].

f) Start the test by inputting a pulse frequency using the pulse generator into the flow computer and at the same moment noting the test start time.
NB Use an accurate chronometer, for instance the "speaking clock" (tel no 123).

g) Enter the following input data onto the calibration form:

i) K-Factor of the turbine [Front panel key press K, O (stream 1) or P (stream 2), then DISPLAY];

ii) Pulse Frequency [Front panel key press K, O (stream 1) or P (stream 2), then DISPLAY];

iii) Relative Density [Front panel key press I,O (stream 1) or P (stream 2), then DISPLAY].

iv) Density of Air at Metric Standard Conditions [ONLINE>FACTOR SET-UP];

v) Density [Front panel key press I,O (stream 1) or P (stream 2), then DISPLAY];

vi) Entered Temperature value;

vii) Entered Pressure value;

viii) Calorific Value [Front panel key press I,O (stream 1) or P (stream 2), then DISPLAY];

ix) Start Time;

x) Standard Volume and Energy Totals.

h) End the test by setting the pulse frequency to zero simultaneously recording the stop time on the accurate chronometer.

i) Enter onto the calibration from:

i) The stop time;

ii) The final totaliser values for standard volume and energy for the flow computer;

iii) The final totaliser values for standard volume from the telemetry unit and GTMS.

REINSTATEMENT

a) Reinstate in accordance with CP16.

b) After completion enter YES in the "Reinstate Equipment?" box.

FLOW COMPUTER

TOTALISATION CHECK (ORIFICE METER) TRANSMITTON UNIT

Proc No. **CP3c**

Issue **B**

This check shall be carried out on site when the flow calculation is undertaken within the Transmitton system to verify that the stream totalisers are functioning correctly by simulating flow over an accurately measured period of time and comparing the displayed total increments with expected values.

NB This test shall be run for a sufficient period of time to pass the required tolerance level. If gas is passing through the site, then do not run the test for more than 6 hours.

FREQUENCY OF TEST/: CALIBRATION	12 months
ACCEPT/REJECT: CRITERIA	±0.01% of reading
FALLBACK PROCEDURE	Check all the data values used and repeat the check. If still out of specification, log the fault with the responsible Engineering Manager.

PREPARATIONS/PRECAUTIONS

The System Operator shall be advised prior to undertaking this procedure, in order that they may manage the operation of the site and account for errors introduced to the declared GTMS flow rate.

It shall be noted that when setting default values (for pressure, temperature and differential Pressure) within the OMNI flow computer, the calculated flow within the OMNI will be affected, resulting in a change in the analogue outputs #1 and #2. The following shall be considered:

i) GTMS will display a corresponding F1, which could result in unexpected valve movements if the site is not set in DVC and the signal to the valve is isolated by disconnecting the appropriate loops.

ii) The LGT system shall be configured as defined within CP6c to prevent the injection of odorant in proportion to the simulated flow.

HOOK-UP PROCEDURE

a) Pressure and differential pressure transmitters

i) Replace the applied differential pressure transmitter with a calibrated mA source

ii) Replace the pressure transmitter with a calibrated mA source

b) Temperature

i) Connect a certified decade resistance box to the temperature transmitter in accordance with the manufacturers instructions.

TEST PROCEDURE

a) Set the temperature and pressure inputs to the required values.

b) Start the test by setting the differential pressure to the required value, ring the System Operator and be prepared to note the GTMS integrator reading. Establish a steady flow and at a suitable integrator value [E1 DC01-loop1, DC02-loop 2, DC03-loop 3, DC04-loop 4] note

i) the test start time;

ii) the GTMS volume integrator value;

iii) the Transmitton unit volume integrator value.

NB Use an accurate chronometer, for instance the "speaking clock" (tel no 123). Maintain the inputs steady while the test is carried out.

c) Enter the following input data onto the calibration form:

i) Design DP;

ii) RD manual;

iii) Density;

iv) Pressure value;

v) Differential Pressure value;

vi) Temperature value;

vii) The pulse significance;

viii) Maximum volume flow;

ix) Displayed Standard Volume Flowrate.

d) End the test at a suitable integrator value and simultaneously record the stop time and the GTMS integrator value.

e) Enter onto the calibration from:

i) the stop time;

ii) the final totaliser values for standard volume from the Transmitton unit and GTMS.

REINSTATEMENT

a) Reinstate in accordance with CP16.

b) After completion enter YES in the "Reinstate Equipment?" box.

FLOW COMPUTER

ADC CHECK (4-20MA INPUT)

Proc No. **CP4**

Issue **B**

This check shall be carried out to verify the accuracy of the analogue to digital conversion by simulating an input signal across the operating range and comparing each displayed input value with expected values.

NB For a 4-wire RTD input, use CP5 to validate the ADC.

FREQUENCY OF TEST: 12 months

ACCEPT/REJECT: CRITERIA ±0.03% of input span

FALLBACK PROCEDURE Check the flow computer settings. If still out of specification, recalibrate the flow computer and retest. If still out of specification, log the fault with the responsible Engineering Manager.

PREPARATIONS/PRECAUTIONS

The System Operator shall be advised prior to undertaking this procedure, in order that they may manage the operation of the site and account for errors introduced to the declared GTMS flow rate.

It shall be noted that when setting default values (for pressure, temperature and differential Pressure) within the OMNI flow computer, the calculated flow within the OMNI will be affected, resulting in a change in the analogue outputs #1 and #2. The following shall be considered:

i) GTMS will display a corresponding F1, which could result in unexpected valve movements if the site is not set in DVC and the signal to the valve is isolated by disconnecting the appropriate loops.

ii) The LGT system shall be configured as defined within CP6c to prevent the injection of odorant in proportion to the simulated flow.

HOOK-UP PROCEDURE

Connect a current source and a certified current meter in the appropriate loop.

One stream site

	Process & Gas Quality Cubicle TB1	OMNI Connection
FT-1	33,34	TB5 1,2
FP-1	35,36	TB5 3,4
DPLR-1	37,38	TB5 5,6
DPHR-1	39,40	TB5 7,8
DPST-1	45,46	TB6 5,6

Two-stream site - refer to the site-specific wiring diagram.

TEST PROCEDURE

a) Record the lower and upper range value of the pressure, differential pressure or temperature, as appropriate, on the results form.

b) Inject currents of 4, 8, 12, 16 and 20 mA.

c) Record the measured current and the computer displayed pressure [front panel key press PRESS, then DISPLAY], differential pressure [front panel key press D, P then DISPLAY] or temperature [front panel key press TEMP, then DISPLAY], as appropriate, onto the results form.

REINSTATEMENT

a) Reinstate in accordance with CP16.

b) After completion enter YES in the "Reinstate Equipment?" box.

FLOW COMPUTER

ADC CHECK (RTD INPUT)

Proc No. **CP5**

ISSUE **B**

This check shall be carried out to verify the accuracy of the resistance to temperature conversion for the flow computer by simulating temperature resistance inputs to the computer and comparing the display values with expected values.

FREQUENCY OF TEST: 12 months

ACCEPT/REJECT: CRITERIA ±0.2° C

FALLBACK PROCEDURE Check the flow computer settings. If still out of specification, recalibrate the flow computer and retest. If still out of specification, log the fault with the responsible Engineering Manager.

PREPARATIONS/PRECAUTIONS

The System Operator shall be advised prior to undertaking this procedure, in order that they may manage the operation of the site and account for errors introduced to the declared GTMS flow rate.

It shall be noted that when setting default values (for pressure, temperature and differential Pressure) within the OMNI flow computer, the calculated flow within the OMNI will be affected, resulting in a change in the analogue outputs #1 and #2. The following shall be considered:

i) GTMS will display a corresponding F1, which could result in unexpected valve movements if the site is not set in DVC and the signal to the valve is isolated by disconnecting the appropriate loops.

ii) The LGT system shall be configured as defined within CP6c to prevent the injection of odorant in proportion to the simulated flow.

HOOK-UP PROCEDURE

Connect a certified decade resistance box to the loop.

	Process & Gas Quality Cubicle TB1	OMNI Connections
FT-1	33,34,49,50	TB5 1,2,9,10
FT-2	41,42,51,52	TB6 1,2,9,10

TEST PROCEDURE

a) Adjust the certified decade resistance box to 0%, 25%, 50%, 75% and 100% of the temperature span as detailed below.

b) Enter onto the calibration form:

(i) the applied resistance (values for a range -10 to 40C are entered on the form);

(ii) expected temperature (values for a range -10 to 40C are entered on the form);

(iii) computer displayed temperature [front panel key press TEMP, then DISPLAY].

% Span	Temperature C	Resistance
0	-10	96.09
25	2.5	100.98
50	15	105.85
75	27.5	110.705
100	40	115.54

REINSTATEMENT

a) Reinstate in accordance with CP16.

b) After completion enter YES in the "Reinstate Equipment?" box.

FLOW COMPUTER

DAC CHECK (SITE CONTROL)

Proc No. **CP6a**

Issue **C**

This check shall be carried out to verify the computer digital to analogue conversion accuracy by varying the output value over its operating range and comparing the measured output values with expected values generated by the computer for the volume flow signal used for site control.

FREQUENCY OF TEST/: CALIBRATION	12 months
ACCEPT/REJECT: CRITERIA	±0.1~~0.01~~% of span
FALLBACK PROCEDURE	Check the flow computer settings. If still out of specification, recalibrate the flow computer and retest. If still out of specification, log the fault with the responsible Engineering Manager.

PREPARATIONS/PRECAUTIONS

The System Operator shall be advised prior to undertaking this procedure, in order that they may manage the operation of the site and account for errors introduced to the declared GTMS flow rate.

It shall be noted that when setting default values (for pressure, temperature and differential Pressure) within the OMNI flow computer, the calculated flow within the OMNI will be affected, resulting in a change in the analogue outputs #1 and #2. The following shall be considered:

i) GTMS will display a corresponding F1, which could result in unexpected valve movements if the site is not set in DVC and the signal to the valve is isolated by disconnecting the appropriate loops.

ii) The LGT system shall be configured as defined within CP6c to prevent the injection of odorant in proportion to the simulated flow.

HOOK-UP PROCEDURE

Connect the D.M.M. across the resistor between test points TB2 15 and 16 in the Calorimeter Junction Box.

TEST PROCEDURE

a) Put the OMNI into DIAGNOSTIC mode by pressing the keys **Alpha Shift**, **Diag**

b) Press the following keys, **Output, 1, Enter** (note 1 designates the location of the analogue output)

c) Scroll down to the Calibrate option then press **Y, Enter**

d) Determine the desired fixed value of the analogue output as a percentage of range (note the output may be varied over the range 0 to 100%). The following example will set the output at 25%

Enter the value by pressing keys **25, Enter**

e) To validate the D/A output, set the output at 0%, 25%, 50%, 75% and 100%, and enter the measured D.M.M. voltages onto the check form.

f) Reinstate the analogue loop by taking the OMNI out of diagnostic mode by pressing keys **Diag, Enter**

REINSTATEMENT

a) Put the Flow Computer back into normal operation (DISPLAY mode).

b) Reinstate in accordance with CP16.

c) After completion enter YES in the "Reinstate Equipment?" box.

TELEMETRY UNIT

ADC AND GTMS CHECK

Proc No. **CP6b**

Issue **C**

This check shall be carried out to verify the telemetry analogue to digital conversion accuracy by varying the output value over its operating range and comparing the displayed output values with expected values generated by the computer for the volume flow signal. The values received by the System Operator on GTMS are also checked.

NB CP6a should be performed before completing this test.

FREQUENCY OF TEST/: CALIBRATION	12 months
ACCEPT/REJECT: CRITERIA	±0.5% of reading
FALLBACK PROCEDURE	Check all values entered and the GTMS database. If still out of specification, recalibrate the telemetry ADC and retest. If still out of specification, log the fault with the responsible Engineering Manager.

PREPARATIONS/PRECAUTIONS:

The System Operator shall be advised prior to undertaking this procedure, in order that they may manage the operation of the site and account for errors introduced to the declared GTMS instantaneous flow rate.

It shall be noted that when setting default values (for pressure, temperature and differential Pressure) within the OMNI flow computer, the calculated flow within the OMNI will be affected, resulting in a change in the analogue outputs #1 and #2. The following shall be considered:

i) GTMS will display a corresponding F1, which could result in unexpected valve movements if the site is not set in DVC and the signal to the valve is isolated by disconnecting the appropriate loops.

ii) The LGT system shall be configured as defined within CP6c to prevent the injection of odorant in proportion to the simulated flow.

TEST PROCEDURE

a) Enter onto the calibration form the maximum volume flow from the flow computer [ONLINE>OMNI CONFIGURATION>CONFIG D/A OUT>D/A OUTPUT @20mA].

b) Put the OMNI into DIAGNOSTIC mode by pressing the keys **Alpha Shift**, **Diag**

c) Press the following keys, **Output, 1, Enter** (note 1 designates the location of the analogue output)

d) Scroll down to the Calibrate option then press **Y, Enter**

e) Determine the desired fixed value of the analogue output as a percentage of range (note the output may be varied over the range 0 to 100%). The following example will set the output at 25%

Enter the value by pressing keys **25, Enter**

f) To validate the D/A output, set the output at 0%, 25%, 50%, 75% and 100%, and for each enter onto the check form:-

i) Telemetry Unit Volume flow (%);

ii) Volume flow from GTMS (mscm/d) (contact the Area Control Centre).

g) Reinstate the analogue loop by taking the OMNI out of diagnostic mode by pressing keys **Diag, Enter**

REINSTATEMENT

a) Put the Flow Computer back into normal operation (DISPLAY mode).

b) Reinstate in accordance with CP16.

c) After completion enter YES in the "Reinstate Equipment?" box.

FLOW COMPUTER

DAC CHECK (LGT)

Proc No. **CP6c**

Issue **C**

This procedure has been developed to.

i) Verify the flow computer digital to analogue conversion accuracy by varying the output value over its operating range and comparing the measured output values with expected values generated by the computer for the volume flow signal used for LGT. This provides a functional check on the signal to the SCIM panel; for full calibration of the NJEX controller flow input and current splitter refer to T/PM/MAINT/8.

ii) Maintain the LGT system whilst working upon the meter system.

iii) Operate the LGT system when the meter system fails.

iv) Maintain the LGT system during a planned power outage.

FREQUENCY OF TEST/: CALIBRATION	Annually during meter system validation and when a manually derived odorant injection rate is required
ACCEPT/REJECT: CRITERIA	±0.5% of reading and gas shall be odorised in accordance with GSMR.
FALLBACK PROCEDURE	If test fails check flow computer configuration settings. If D/A out of specification, recalibrate the flow computer and retest. If still out of specification, log fault with the responsible Engineering Manager. See also document T/PM/MAINT/8.

PREPARATIONS/PRECAUTIONS

Odorant is injected into the gas in direct proportion to the instantaneous standard volume flow rate signal derived from the flow computer. It shall be noted that the application of this procedure will result in a change in the odorant injection rate.

All activities that result in a change to the OMNI instantaneous flow signal (analogue #2), shall be managed such that the impact upon the injection rate is limited to 15 minutes.

For longer periods of interruption the injection rate shall be set via the N-200GM-controller as defined within T/PM/MAINT/8.

The following activities will determine the OMNI instantaneous flow signal (analogue #2) that is input into the LGT controller.

i) Normal operation - analogue o/p = F1

ii) Meter suspect - analogue o/p = fixed at last good value

iii) low flow (if set) - analogue o/p fixed at default value (site specific)

iv) OMNI in Maint mode - analogue o/p fixed at default value (typical 30%)

v) Forced analogue o/p - analogue defaults to fixed % output

vi) Loss of OMNI signal - analogue fails to zero and NJEX applies failure mode injection rate (typically 30%)

vii) NJEX not set proportional to flow - analogue not applied to injection rate.

viii) Loss of power - analogue fails to zero and NJEX applies failure mode injection rate (typically 30%)

PROCEDURES: To fix the odour injection rate for up to 15 minutes

To manually set the analogue value of the (4-20mA) signal to the LGT to a fixed value. Confirm that the LGT is connected to analogue output #2 and proceed as follows.

a) Put the OMNI into DIAGNOSTIC mode by pressing the keys **Alpha Shift**, **Diag**

b) Press the following keys, **Output, 2, Enter** (note 2 designates the location of the analogue output)

c) Scroll down to the Calibrate option then press **Y, Enter**

d) Determine the desired fixed value of the analogue output as a percentage of range (note the output may be varied over the range 0 to 100%). The following example will set the output at 10%

Enter the value by pressing keys **10, Enter**

e) To validate the D/A output, set the output at 0%, 25%, 50%, 75% and 100%, and enter onto the results form for each increment in the volume flow reading from the LGT SCIM (Standard Control Interface Module); TB1, Terminals 21+ve & 20 -ve.

f) Reinstate the analogue loop by taking the OMNI out of diagnostic mode by pressing keys **Diag, Enter**

PROCEDURES: To fix the injection rate for periods longer than 15 minutes planned power outage:

In the event of a planned power outage the procedure defined within GMR00057 'Management of odorant injection during power outage for RTU replacement' shall be applied.

To manually set the LGT to a fixed value for prolonged periods and for sites where the flow is calculated within the Transmitton system follow the procedure detailed within **T/PM/MAINT/8** 'Maintenance of local gas treatment'

REINSTATEMENT

Reinstate in accordance with CP16

Ensure that the site is configured such that the odorant injection system applies the instantaneous volume flow to operate the pump and that the NJEX controller is set with both controllers in proportional to flow mode.

With the site flowing ensure that

i) The SCIM % flow reading corresponds to the OMNI/Transmitton % flow reading.

ii) The operator confirms that the GTMS displayed concentration is within acceptable limits.

iii) All LGT alarms are clear

If following the above operations a flow cannot be applied, the site shall not be returned to operational duty until the above checks are completed

Put the Flow Computer back into normal operation (DISPLAY mode).
After completion enter YES in the "Reinstate Equipment?" box.

Make a note in the site log of the work undertaken, record details of the fixed values applied and the duration.

SECONDARY INSTRUMENTATION

DIFFERENTIAL PRESSURE CELL SWITCH POINT CHECK

Proc No. **CP7**

Issue **C**

This check shall be carried out to ensure that the switch between differential pressure cells occurs at the correct differential pressure.

FREQUENCY OF TEST/: CALIBRATION	12 months	
ACCEPT/REJECT: CRITERIA	Low Range: High Range:	±0.25% of calibrated span ±0.25% of calibrated span.
FALLBACK PROCEDURE	Check all the data values used. Repeat the check. If still out of specification, log the fault with the responsible Engineering Manager.	

PREPARATION/PRECAUTIONS

The System Operator shall be advised prior to undertaking this procedure, in order that they may manage the operation of the site.

It shall be noted that when setting default values for the applied differential pressure within the OMNI flow computer. The calculated flow within the OMNI will be affected, resulting in an error in the analogue outputs #1 and #2. The following shall be considered:

i) GTMS will display a corresponding F1, which could result in unexpected valve movements if the site is not set in DVC and the signal to the valve is isolated by disconnecting the appropriate loops.

ii) The LGT system shall be configured as defined within CP6c to prevent the injection of odorant in proportion to the simulated flow.

HOOK-UP PROCEDURE

Pull out the links of the appropriate test points on TB1 of the Process & Gas Quality Cubicle and connect current sources for both the low and high DP cells.

a) For the differential pressure cell switch up.

i) Switch on current source for low DP cell and set to 4mA.

ii) Switch on current source for high DP cell and set to 20mA.

iii) Check the rising switch-over % setting (High DP select) within the Diff Pressure Set-up menu of the OMNI configuration. Then calculate the corresponding current required to switch to the high cell

b) For the differential pressure cell switch down:-

i) Switch on current source for low DP cell and set to 20mA.

ii) Switch on current source for high DP cell and set to 20mA.

iii) Check the switch-over % setting (Low DP select %) within the Diff Pressure Set-up menu of the OMNI configuration. Then calculate the corresponding current required to switch to the low cell.

	Process & Gas Quality Cubicle TB1	OMNI Connection
DPLR-1	37,38	TB5 5,6
DPHR-1	39,40	TB5 7,8

TEST PROCEDURE

a) Note the in use differential cell from the computer display [Front panel key press DP, then DISPLAY: DPLR- low range, DPHR - high range].

b) Slowly apply a rising/falling simulated differential pressure using the relevant current source keeping the other fixed.

c) Note the applied current at the point that the in use differential pressure cell changes.

d) Enter the following information onto the calibration form:

i) Desired switch point (rising and falling); This is site specific and should be determined by referring to the OMNI flow computer configuration file 'Diff Pressure Setup

ii) Measured switch point (rising and falling);

iii) The low DP cell span.

REINSTATEMENT

a) Remove the test equipment and re-instate all connections.

b) Reinstate in accordance with CP16.

c) After completion enter YES in the "Reinstate Equipment?" box.

SECONDARY INSTRUMENTATION

GAS PROPERTY INFORMATION CHECK (GAS CHROMATOGRAPH)

Proc No. **CP8a**

Issue **C**

This check shall be carried out to verify that the gas composition from a chromatograph controller is transferred correctly to the flow computer.

FREQUENCY OF TEST/: CALIBRATION	12 months
ACCEPT/REJECT: CRITERIA	±0.001% of reading.
FALLBACK PROCEDURE	Check all data values used. Repeat the check. If still out of specification, log the fault with the responsible Engineering Manager.

PREPARATIONS/PRECAUTIONS:

The System Operator shall be advised prior to undertaking this procedure, in order that they may manage the operation of the site and account for errors introduced to the declared GTMS flow rate.

It shall be noted that when setting default values (for pressure, temperature and differential Pressure) within the OMNI flow computer, the calculated flow within the OMNI will be affected, resulting in a change in the analogue outputs #1 and #2. The following shall be considered:

i) GTMS will display a corresponding F1, which could result in unexpected valve movements if the site is not set in DVC and the signal to the valve is isolated by disconnecting the appropriate loops.

ii) The LGT system shall be configured as defined within CP6c to prevent the injection of odorant in proportion to the simulated flow.

TEST PROCEDURE

a) Obtain an analysis report from the chromatograph controller.

b) Within the cycle time of the chromatograph, obtain a Product File Report from the flow computer [ONLINE>REPORTS>PRODUCT FILE REPORT].

c) Record the following values from the analyser (Danint screen) and flow computer onto the results form:

i) Calorific Value (dry);

ii) Relative Density;

iii) Gas Composition to four decimal places.

d) Note that neo-Pentane and i-pentane components are summed within the OMNI flow computer and declared as i-Pentane. Data entered into the results form under the Analyser column shall be processed in the same manner.

REINSTATEMENT

a) Put the Flow Computer back into normal operation (DISPLAY mode).

b) Reinstate in accordance with CP16.

c) After completion enter YES in the "Reinstate Equipment?" box.

SECONDARY INSTRUMENTATION

GAS PROPERTY INFORMATION CHECK (ENERGY TRACKER)

Proc No. **CP8b**

Issue **B**

This check shall be carried out to verify that the calorific value and relative density from an energy tracker is transferred correctly to the flow computer.

FREQUENCY OF TEST:	12 months
ACCEPT/REJECT: CRITERIA	Live values ±0.001% of reading.
FALLBACK PROCEDURE	Check all data values used. Repeat the check. If still out of specification, log the fault with the responsible Engineering Manager.

TEST PROCEDURE

Verify live values provided to the OMNI flow computer from the Tracker.

a) Record the following values from TRINT onto the calibration form:

(i) Calorific Value;

(ii) Relative Density.

b) Before the tracker values are updated, record the same quantities onto the results form from the flow computer [Front panel key press I, O (stream 1) or P (stream 2), then DISPLAY].

REINSTATEMENT

a) Put the Flow Computer back into normal operation (DISPLAY mode).

b) Reinstate in accordance with CP16.

FLOW COMPUTER

CONFIGURATION CHECK

Proc No. **CP9**

Issue **C**

This check shall be carried out to ensure that the OMNI flow computer locations contain the data required to perform all computer functions correctly by

i) Checking each location against an as left backed-up copy of the previous validated configuration file

ii) Checking the changes to the configuration made during this validation to produce an updated version of the as left configuration file.

FREQUENCY OF TEST: 12 months

ACCEPT/REJECT: CRITERIA

i) As found computer configuration report to match approved previous as left configuration

ii) As left computer configuration to include the certified and approved fixed factors.

FALLBACK PROCEDURE Advise the responsible Engineering Manager of any discrepancies. On instruction alter computer data or approved list as required.

PREPARATIONS/PRECAUTIONS:

The System Operator shall be advised prior to undertaking this procedure, in order that they may manage the operation of the site and account for errors introduced to the declared GTMS flow rate.

It shall be noted that when setting default values within the OMNI flow computer, the calculated flow within the OMNI will be affected, resulting in a change in the analogue outputs #1 and #2. The following shall be considered:

i) GTMS will display a corresponding F1, which could result in unexpected valve movements if the site is not set in DVC and the signal to the valve is isolated by disconnecting the appropriate loops.

ii) The LGT system shall be configured as defined within CP6c to prevent the injection of odorant in proportion to the simulated flow.

TEST PROCEDURE

a) Obtain the approved flow computer configuration data.

b) Obtain calibration certificates for the meter system.

(i.) For orifice meters the tube and plate certificates are required.

(ii.) For turbine meters a high pressure calibration certificate is required.

c) Obtain a list of approved fixed factors from the responsible Engineering Manager for the site

~~(i.)For Tracker sites obtain the approved CO_2 value~~

(i.) For all Tracker only sites obtain the approved CO_2 value;

(ii.) For Tracker only sites with orifice plate meters obtain fixed factors for isentropic exponent and viscosity values;

(iii.) For sites with full chromatography and orifice plate meters obtain the approved isentropic exponent and viscosity values;

(iv.) For sites with full chromatography and either rotary turbine meters or ultrasonic meters no fixed factors are required.

d) Where suitable and traceable dynamic, live calculations can be used at site, the configuration, the raw data used and the calculation methods deployed shall be documented by the responsible Engineering Manager. Where system limitations do not allow the direct capture and logging of the actual on-site calculated values, the responsible Engineering Manager shall, where necessary, be able to reconsistute the values in question from the captured (and logged) raw data.

e) Check all locations for the flow computer against the approved configuration data.

f) Enter YES onto the calibration form, if all is correct.

g) Transfer a copy of the config file to disc and forward it to the asset owner.

~~(ii.)For all sites obtain the approved isentropic and viscosity values~~

~~d)Check all locations for the flow computer against the approved configuration data.~~

~~e)Enter YES onto the calibration form, if all is correct.~~

~~f)Transfer a copy of the config file to disc and forward it to the asset owner.~~

Tracker sites:

The responsible Engineering Manager shall provide (and maintain a log of) the approved fixed CO_2 value to be set within the OMNI flow computer at Tracker sites. The value should be determined as the average value that passed through the site used for the attribution of CV for the previous year.

The fixed CO_2 value shall not be entered manually into the OMNI flow computer, as it will be over written on the next update cycle from the tracker. It shall be entered into the Open Controller file by following the appropriate procedure detailed below. Note: Prior to editing the CO_2 values establish the existing value in order to identify the appropriate fields for editing.

a) To edit fixed CO2 values > Tracker build 10.2 sites

i) Stop TR_VIEW, F8, F10, OK to exit.

ii) Stop TR_GO, click on TR_GO on bottom task bar, Click on top right 'x', OK to exit.

iii) Start Windows Explorer from start menu bottom left.

iv) Enter the DANINT folder

v) Double click on TR_GO.DAT (associate with notepad if it does not load).

vi) All Tracker sites are stream 3 only, so scroll along to the existing CO2 value on the 3rd line of values (this is the stream 3 line)

vii) Edit the existing CO_2 value to the new site-specific value from the data provided.

viii) Save the file (click on the file pull down menu, then save)

ix) Close the TR_GO.DAT Notepad window by clicking on the top right 'x'

x) Restart TR_VIEW by double clicking on the TR_VIEW icon

xi) Restart TR_GO by pressing F7 on TR_VIEW.

xii) Allow eight minutes and then check that the new value for CO_2 has appeared on the TR_VIEW results window.

xiii) If OK start OMNICOM, from the start applications menu

xiv) Establish communications with the OMNI Flow Computer and 'Receive the on line configuration'

xv) When up-loaded check the CO_2 value in the Fluid Data Analysis screen.

xvi) If this is in agreement with the new edited CO_2 value, save the configuration with the current date, and make a backup copy to floppy disc.

xvii) Exit OMNICOM, the update is now complete

xviii) Return the backup disc to the responsible Engineering Manager.

b) To edit fixed CO2 values > Tracker standard build sites

i) Stop TR_INT F8, F10, F7

ii) This should take you to the DOS prompt.

iii) At prompt '>' type CD\DANINT and enter, to ensure you are in the DANINT directory.

iv) Now type EDIT COMPS.ST3 and enter

v) This will put up a blue edit screen with a list of numbers

vi) The CO_2 value should be the 18th value in the list and is set to the existing CO2 value

vii) Change this value to the CO2 value provided for the site.

viii) Save the file – ALT F, scroll down to SAVE, return.

ix) Exit the file – ALT F, scroll down to EXIT, return.

x) Now repeat the above steps 4-9, but at step 4) type EDIT COMPS.GAS.

xi) When this 2nd file has been edited and saved Press Ctrl Alt, Del to reboot the computer.

xii) TR_INT will be started with the reboot.

xiii) The new CO_2 value should appear on the screen after one analysis (240 sec)

xiv) If OK use OMNICOM on the laptop and establish communications with the OMNI Flow

xv) Computer then 'Receive the on line configuration'

xvi) When up-loaded check the CO_2 value in the Fluid Data Analysis screen.

xvii) If this is in agreement with the new edited CO_2 value, save the configuration with the current date, and make a backup copy to floppy disc.

xviii) Exit OMNICOM, the update is now complete

xix) Return the backup disc to the responsible Engineering Manager.

All Sites – Isentropic exponent & viscosity

The responsible Engineering Manager shall provide (and maintain a log of) the approved fixed isentropic exponent & viscosity values to be set within the OMNI flow computer at all sites. The value should be determined as the average value that passed through the site for the previous year.

Where suitable and traceable dynamic, live calculations can be used at site, the configuration, the raw data used and the calculation methods deployed shall be documented by the responsible Engineering Manager. Where system limitations do not allow the direct capture and logging of the actual on-site calculated values, the responsible Engineering Manager shall, where necessary, be able to reconsistute the values in question from the captured (and logged) raw data.

REINSTATEMENT

a) Put the Flow Computer back into normal operation (DISPLAY mode).

b) Make a back-up copy of the as left configuration (as detailed within General Requirements).

c) Reinstate in accordance with CP16.

SECONDARY INSTRUMENTATION

GAUGE PRESSURE TRANSMITTER CALIBRATION

Proc No. **CP10**

Issue **C**

This check shall be carried out to ensure that the pressure measurement is maintained to the required level of accuracy by applying a known pressure across the calibrated range of the transmitter and comparing the displayed output with the expected output.

FREQUENCY OF TEST/: CALIBRATION	12 months
ACCEPT/REJECT: CRITERIA	±0.2% of the calibrated span, the impulse pipes shall be intact with no leaks, self-draining and clean of any contamination. Equalisation valve is closed.
FALLBACK PROCEDURE	Check measurements and associated data. Adjust transmitter zero and span to bring output within tolerance and recheck. If test still fails, replace the cell.

PREPARATION/PRECAUTIONS

The System Operator shall be advised prior to undertaking this procedure, in order that they may manage the operation of the site and account for errors introduced to the declared GTMS flow rate.

It shall be noted that when setting default values (for pressure, temperature and differential Pressure) within the OMNI flow computer, the calculated flow within the OMNI will be affected, resulting in a change in the analogue outputs #1 and #2. The following shall be considered:

i) GTMS will display a corresponding F1, which could result in unexpected valve movements if the site is not set in DVC and the signal to the valve is isolated by disconnecting the appropriate loops.

ii) The LGT system shall be configured as defined within CP6c to prevent the injection of odorant in proportion to the simulated flow.

Whilst depressurising the impulse pipework, debris may be projected under high pressure. Guidance on the appropriate precautions to adopt is defined within work hazard sheet RA/19 Valve maintenance contained within the Risk Assessment Booklet.

HOOK-UP PROCEDURE

a) It is necessary to disconnect the impulse lines to connect the deadweight tester. The integrity of the impulse pipes shall be established by inspection (with the system pressurised) before the calibration of the transmitter and again after reinstatement of the pipework.

b) The pressure transmitter may be connected via a block and bleed valve arrangement. Prior to operating the valve, check its porting arrangement and establish the isolation and venting arrangements.

c) Isolate the pressure transmitter being tested and vent to atmosphere.

d) If isolation valves are fitted at the orifice carrier the impulse pipeline should now be checked for contamination. Close the isolation valves at the carrier then use the trapped pressure within the impulse pipe to blow down the lines via the drain leg. If a drain leg is not fitted advise the responsible Engineering Manager that the procedure cannot be implemented and log the details in the comments field of the results form. If evidence of contamination is found record the

details within the comments field of the record sheet and advise the responsible Engineering Manager. Ensure the impulse lines are clean before reconnecting the pipework.

e) Connect the dead weight tester to the pressure transmitter and vent in accordance with manufacturers instructions. Check that the dead-weight tester is level and free from vibration during the calibration activity.

f) Site a digital thermometer as close as possible to the dead-weight tester to determine the ambient temperature during the validation.

g) Connect a certified current meter in the test loop.

	Process & Gas Quality Cubicle TB1	OMNI Connection
FP-1	35,36	TB5 3,4
FP-2	43,44	TB6 3,4

TEST PROCEDURE

a) When the transmitter has stabilised, exercise it through three full-range traverses prior to calibration.

b) Apply a differential pressure at nominal points equivalent to 0%, 25%, 50%, 75% and 100%, plus an over range of 125% of the calibrated transmitter span (rising and falling) and measure the current output. Record the measured values onto the calibration form. The form is detailed for points up to 100%, so the 125% point shall be recorded within the comments field of the form.

NB If the correct weights are not available to obtain the normal points from 0% to 125% then re-enter the nominal points used on the results form and 'NA' shall be entered in the % Span column and 4mA in the Measured Current column. When the descending tests are carried out, the output of the dead weight tester shall be isolated before the weights are removed.

c) Enter the following input data onto the calibration form;

i) local gravity correction factor (gravitational acceleration at site/9.80665);

ii) ambient temperature of the dead weight tester during the test;

iii) calibration temperature of the dead weight tester;

iv) temperature coefficient of the dead weight tester (see manufacturers manual);

v) calibrated lower and upper range value of the pressure cell.

REINSTATEMENT

a) Re-instate all wiring and the pressure transmitter installation.

b) Reinstate in accordance with CP16.

c) After completion enter YES in the "Reinstate Equipment?" box.

SECONDARY INSTRUMENTATION

DIFFERENTIAL PRESSURE TRANSMITTER CHECK

Proc No. **CP11**

Issue **C**

This check shall be carried out to ensure that differential pressure measurement is maintained to the required level of accuracy by applying known pressure across the calibrated range of the transmitter and comparing the displayed output with the expected output.

FREQUENCY OF TEST/: CALIBRATION	12 months
ACCEPT/REJECT: CRITERIA	±0.2% of the calibrated span, the impulse pipes shall be intact with no leaks, self-draining and clean of any contamination. Equalisation valve is closed.
FALLBACK PROCEDURE	Check all data values used and repeat the check. If still out of specification, recalibrate the zero and span as described by the manufacturer. Retest. If test still fails, contact the responsible Engineering Manager.

PREPARATION/PRECAUTIONS

The System Operator shall be advised prior to undertaking this procedure, in order that they may manage the operation of the site and account for errors introduced to the declared GTMS flow rate.

It shall be noted that when setting default values (for pressure, temperature and differential Pressure) within the OMNI flow computer, the calculated flow within the OMNI will be affected, resulting in a change in the analogue outputs #1 and #2. The following shall be considered:

i) GTMS will display a corresponding F1, which could result in unexpected valve movements if the site is not set in DVC and the signal to the valve is isolated by disconnecting the appropriate loops.

ii) The LGT system shall be configured as defined within CP6c to prevent the injection of odorant in proportion to the simulated flow.

Whilst depressurising the impulse pipework, debris may be projected under high pressure. Guidance on the appropriate precaution to adopt is defined within work hazard sheet RA/19 Valve maintenance contained within the Risk Assessment Booklet.

HOOK-UP PROCEDURE

a) The integrity of the impulse pipes shall be established by inspection (with the system pressurised) before the calibration of the transmitter and again after reinstatement of the pipework.

b) The differential pressure transmitter may be connected via a five-way equalisation valve. Prior to operating the valve check its porting arrangement and establish the isolation, equalisation and venting arrangements.

NB: Some differential pressure transmitters (Honeywell & Rosemount) will be damaged if the line pressure is applied across the transmitter.

c) Prior to undertaking work on the DP system check for contamination within the impulse lines or the transmitters as follows.

i) If possible arrange for the System Operator to reduce the flow through the meter to zero. Then confirm that the measured DP reduces to zero for all three cells. If an offset is noted record the values within the comments section of the HPMIS validation form and advise the responsible Engineering Manager.

ii) If with zero flow through the meter, an offset is recorded, the functionality of the DP cells shall be proven, by opening the equalising valve. Any remaining offset shall be noted as above and the responsible Engineering Manager informed.

iii) If contamination is discovered within the Cell or the impulse pipes, it shall be removed by blowing down the impulse pipes via the drain legs. If drain legs are not fitted inform the responsible Engineering Manager. The suitability of the installation is proved by repeating the above procedure until the offset is reduced to zero.

d) Once the system is proven to be clear of contamination proceed with the calibration. Isolate the differential pressure transmitter being tested. Then vent the transmitters to atmosphere.

e) Connect the dead weight tester to the differential pressure transmitter and vent in accordance with manufacturers instructions. Check that the dead-weight tester is level and free from vibration during the calibration activity.

f) Site a digital thermometer as close as possible to the dead-weight tester to determine the ambient temperature during the validation.

g) Connect a certified current meter in the test loop.

One Stream

	Process & Gas Quality Cubicle TB1	OMNI Connection	OMNI Input
DPLR-1	37,38	TB5 5,6	3
DPHR-1	39,40	TB5 7,8	4
DPST-1	45,46	TB6 5,6	7

For a two-stream site, refer to site-specific wiring diagram.

TEST PROCEDURE

a) When the transmitter has stabilised, exercise it through three full-range traverses prior to calibration.

b) Apply a differential pressure at nominal points equivalent to 0%, 25%, 50%, 75% and 100%, plus an over range of 125% of the calibrated transmitter span (rising and falling) and measure the current output. Record the measured values onto the calibration form. The form is detailed for points up to 100%, so the 125% point shall be recorded within the comments field of the form.

c) Whilst calibrating the standby transmitter a GTMS end-to-end check shall be undertaken. The pass/fail criterion for this test is 0.5% as defined within CP6b. The values reported by the control desk shall be recorded within the comments field on the result form. The System Operator shall also be requested to log the results.

NB If you do not have the correct weights available to obtain these nominal points, use 0%, 20%, 40%, 60%, 80%, 100% and 125%. In this case, re-enter the nominal point values on the calibration form and 'NA' shall be entered in the % Span column and 4mA in the Measured

Current column. When the descending tests are carried out, the output of the dead weight tester shall be isolated before the weights are removed.

d) Enter the following input data onto the calibration form:

i) local gravity correction factor;

ii) ambient temperature of the dead weight tester during the test;

iii) calibration temperature of the dead weight tester;

iv) temperature coefficient of the dead weight tester (see manufacturers manual);

v) calibrated lower and upper range value of the differential pressure transmitter.

e) Then check the zero differential pressure output of the transmitter at the operating static pressure and record the current value onto the calibration sheet.

REINSTATEMENT

a) Reinstate in accordance with CP16.

b) After completion enter YES in the "Reinstate Equipment?" box.

SECONDARY INSTRUMENTATION

TEMPERATURE TRANSMITTER CHECK

Proc No. **C12**

Issue **B**

This check shall be carried out to ensure that the temperature transmitter is maintained to the required level of accuracy by applying a known resistance across the calibrated range of the transmitter and comparing the displayed output with the expected output.

FREQUENCY OF TEST: 12 months

ACCEPT/REJECT: CRITERIA ±0.2% of the calibrated span

FALLBACK PROCEDURE Check measurements and associated data. Adjust transmitter zero and span to bring output within tolerance and recheck. If test still fails, replace the transmitter and inform the responsible Engineering Manager.

PREPARATION/PRECAUTIONS

The System Operator shall be advised prior to undertaking this procedure, in order that they may manage the operation of the site and account for errors introduced to the declared GTMS flow rate.

It shall be noted that when setting default values (for pressure, temperature and differential Pressure) within the OMNI flow computer, the calculated flow within the OMNI will be affected, resulting in a change in the analogue outputs #1 and #2. The following shall be considered:

i) GTMS will display a corresponding F1, which could result in unexpected valve movements if the site is not set in DVC and the signal to the valve is isolated by disconnecting the appropriate loops.

ii) The LGT system shall be configured as defined within CP6c to prevent the injection of odorant in proportion to the simulated flow.

HOOK-UP PROCEDURE

a) Connect a certified decade resistance box to the temperature transmitter in accordance with the manufacturers instructions.

b) Connect a certified current meter in the test loop.

	Process & Gas Quality Cubicle Connections TB1	OMNI Connection
FT-1	33,34	TB5 1,2
FT-2	41,42	TB6 1,2

TEST PROCEDURE

a) Apply a resistance at nominal points equivalent to 0%, 25%, 50%, 75% and 100% of the calibrated transmitter span (rising and falling) and measure the current output. Record the measured values onto the calibration form.

% Span	Temperature C	Resistance
0	-10	96.09
25	2.5	100.98
50	15	105.85
75	27.5	110.705
100	40	115.54

REINSTATEMENT

a) Reconnect the temperature element.

b) Reinstate in accordance with CP16.

c) After completion enter YES in the "Reinstate Equipment?" box.

SECONDARY INSTRUMENTATION

TEMPERATURE ELEMENT SPOT CHECK

Proc No. **CP13**

Issue **C**

This test is carried out to verify the accuracy of the stream temperature measurement by comparing the displayed temperature with the temperature indicated by a certified thermometer.

NB This test should be carried out following successful completion of the flow computer ADC validation and the temperature transmitter validation if applicable.

FREQUENCY OF TEST/: CALIBRATION 12 months

ACCEPT/REJECT: CRITERIA ±0.5° C.

Thermowell located downstream of orifice plate within 5D and 15D, protrudes 75mm into pipe bore (where possible) and is filled with oil or conductive paste.

PREPARATION/PRECAUTIONS

The System Operator shall be advised prior to undertaking this procedure, in order that they may manage the operation of the site and account for errors introduced to the declared GTMS flow rate.

It shall be noted that when setting default values (for pressure, temperature and differential Pressure) within the OMNI flow computer, the calculated flow within the OMNI will be affected, resulting in a change in the analogue outputs #1 and #2. The following shall be considered:

i) GTMS will display a corresponding F1, which could result in unexpected valve movements if the site is not set in DVC and the signal to the valve is isolated by disconnecting the appropriate loops.

ii) The LGT system shall be configured as defined within CP6c to prevent the injection of odorant in proportion to the simulated flow.

FALLBACK PROCEDURE: Check the value being displayed on the flow computer. If still out of tolerance carry out procedure CP4/5/12, as applicable, and repeat the spot check. If the test still fails contact the responsible Engineering Manager.

TEST PROCEDURE

a) Place a digital thermal probe in an oil filled thermowell adjacent to the RTD under test. If a spare thermowell is not available place the RTD under test in a suitable water filled container together with the digital thermal probe. The temperature element/probe shall be left to stabilise for a minimum of 10 minutes.

b) Simultaneously read then enter the following data onto the calibration form:

i) digital thermal probe reading;

ii) computer displayed temperature [Front panel key press TEMP, then DISPLAY].

REINSTATEMENT

a) Re-instate the temperature element into the thermowell.

b) Reinstate in accordance with CP16

c) After completion enter YES in the "Reinstate Equipment?" box.

PRIMARY INSTRUMENTATION

ORIFICE METER INSPECTION/REPLACEMENT

Proc No. **CP14a**

Issue **C**

This check shall be carried out to verify that the orifice plate and carrier are maintained in good condition and are in compliance the calibration certificate.

FREQUENCY OF TEST: All plates shall be replaced annually. If the plate fails the calibration procedure, it shall be replaced every quarter until it passes. There after replace annually. Inspections should be performed as part of ad-hoc site audits.

ACCEPT/REJECT:

All dimensional details within the flow computer shall match the tube and plate certificates. The orifice carrier shall be clean and the orifice plate shall be clean, flat, undamaged and comply with its current calibration certificate.

If the meter system fails the accept criteria, it may result in the under-registration of gas. In addition to recording the details (as defined within this procedure) the responsible Engineering Manager shall be informed in order that the extent of meter errors may be assessed.

All plates shall be calibrated prior to installation. Plates should be calibrated shortly after removed from service, before being placed in storage for application next year. If a plate (that has been removed from service) fails calibration the following actions shall be implemented.

i) The plate shall be removed from service.

ii) The responsible Engineering Manager shall be informed.

iii) The meter error shall be assessed and a meter error report produced.

iv) The suitability of the meter system shall be assessed and, if appropriate, a new plate manufactured.

FALLBACK PROCEDURE Replace the orifice plate, repair or clean the meter system and inform the responsible Engineering Manager.

PREPARATIONS/PRECAUTIONS

In addition to the general preparations/precautions the following also apply:

a) A complete set of spares shall be available for the orifice plate and carrier prior to starting the checks.

b) A copy of the calibration certificate for the replacement orifice plate/plates shall be available at the site. The orifice plate calibration certificate shall have a separate summary sheet detailing in bold.

i) The site

ii) Plate serial number

iii) Calibration date

iv) Data that is to be entered into the flow computer (Certified bore and calibration temperature).

c) Lifting operations associated with lifting orifice plates in and out of pipes and during transit to and from site shall be assessed.

d) Waste oil and grease drained or cleaned from instrumentation systems shall be contained and disposed of in a controlled manner.

e) Whilst depressurising the impulse pipework, debris may be projected under high pressure. The guidance within work hazard sheet RA/19 Valve maintenance contained within the Risk Assessment Booklet shall be followed.

f) Prior to commencing work ensure that

i) The direction of gas flow is identified so as to ensure the downstream side of the orifice plate is installed facing downstream.

ii) The certified bore diameter and calibrated temperature that shall be applied within the flow computer should be determined from the plate calibration certificate.

iii) The replacement orifice plate downstream face is clearly marked.

iv) The replacement orifice plate is engraved with its serial number, which matches the details on the certificate.

v) On multi-stream sites the meter stream identity shall be established, to ensure that any modifications to the flow computer configuration correspond to the appropriate changes in the field.

TEST PROCEDURE

a) Enter the following data into the HPMIS calibration form, for both the plate which is removed from service and the plate which is installed if appropriate: Note if access to HPMIS is not available at a site, contact the responsible Engineering Manager to agree for the data to be recorded within a spreadsheet, for entry by desktop network connection.

i) Manufacturer

ii) Serial number;

iii) Certified bore;

iv) Calibration temperature;

v) Orifice plate certifying authority;

vi) Certificate number;

vii) Certificate date.

b) The removed orifice plate shall be visually inspected and checked. The plate's orientation and condition shall be noted on the results form (as detailed below). Take a digital photograph and forward a copy to the responsible Engineering Manager.

A hand written note detailing the site/meter ref and date shall be placed next to the plate when taking the picture. An object such as a ruler or pen pointing at the plate should be included to provide a sense of proportion.

c) Note whether the orifice plate has sustained any damage on the upstream edge of the orifice bore. This shall be sharp, and without any wire edges, burrs or visible defects.

d) Note whether the upstream face of the orifice plate appears flat and that it was correctly installed with the engraved downstream face pointing downstream

e) Visually inspect the orifice fitting noting whether areas of corrosion are present.

f) Visually inspect the orifice carrier, seal ring, and top cover-plate and gasket. Any damage shall be repaired and the details recorded within the comments filed in the results sheet.

g) When single chamber orifice carriers are depressurised to remove the orifice plate, the chamber shall be inspected to determine if any contamination is present. Note that the action of removing the plate will result in such liquids settling within the bottom of the pipe and carrier.

h) Once depressurised orifice carriers that are contaminated shall be cleaned and the details recorded within the comments field of the results sheet. All contamination shall be disposed in accordance with H&P booklet 'waste disposal' relevant ICE sheets.

i) The following data shall be recorded within the comments field of the results sheet:

i) Orientation of orifice plate within the carrier;

ii) Whether the orifice plate carrier operation is satisfactory;

iii) Visually inspected conditions of the orifice plate;

iv) Comments pertinent to the conditions of the orifice plate and carrier.

If the plate is contaminated (coatings of grease, oil or deposits):
Record the details in the comments field - of the area covered, depth and texture of the deposits. The plate shall be cleaned as necessary using a soft cloth and a suitable solvent taking care not to damage the upstream face and square edge of the plate.

j) If a new plate is installed the following details shall be entered onto the Data Modification section of the results form:-

i) If the maximum flow rate needs to be modified, enter YES in the Station Flow Max Change? field and enter the value in the New Station Maximum Flow field;

ii) If the pulse significance needs to be modified, enter YES in the pulse Significance Change? Field and enter the value in the New Pulse Significance field.

k) The flow computer configuration shall be checked to ensure that it has the correct data for:

- new station maximum flow rate (scm/hr) for GTMS **and** LGT
- new pulse significance (pulses/unit)
- new certified orifice bore to four decimal places (mm). For multi-stream sites it is important to ensure that the appropriate meter configuration data field is edited to match the hardware changes.
- New certified temperature.
- new low and high differential pressure span (mbar)
- if the configuration has been changed, enter YES in the appropriate field when the flow computer has been updated (see GMR5).

Note: Whilst editing the flow configuration file via OMNICOM, the Danint window may become active. This occurs when the Chromatograph data is read from its controller. The operator shall take care whilst editing the OMNI configuration file to ensure that the details are logged within the flow computer. If the Danint window becomes active whilst entering data

into OMNICOM, the operator shall click the mouse onto the OMNICOM window in order to make it the active window.

l) The System Operator shall be informed of the changes and YES shall be entered in the ACC Informed? field:

i) If the maximum station flow rate has changed, the NJEX controller for local gas treatment shall be updated. Enter the new maximum flowrate in the controller in scm/s. Enter YES in the NJEX controller updated? Field when completed.

ii) The telemetry unit labels and configuration records shall be updated with the new max flow/standby DP span. Enter YES in the Telemetry Unit Updated? field when completed.

iii) Other associated equipment may need updating. Enter YES in the Other Signals Updated? field when completed. NB. This generic field is to remind the on-site engineer to think about other affected systems specific to the site.

NB. Removed orifice plate shall be returned to an appropriate facility within fourteen days, e.g. Technical Services Workshop at Hinckley, for re-certification annually. If a plate fails the re-certification process the workshop shall advise: Network Lead Group P&GQ.

REINSTATEMENT

a) Re-instate all the equipment.

b) Reinstate in accordance with CP16

c) After completion enter YES in the "Reinstate Equipment?" box.

PRIMARY INSTRUMENTATION

TURBINE METER INSPECTION/REPLACEMENT/MAINTENANCE

Proc No. **CP14b**

Issue **C**

This check shall be carried out to verify that the turbine meter is maintained in good condition and is in compliance with the calibration certificate.

FREQUENCY OF TEST: 12 months

FREQUENCY OF LUBRICATION: Apply oil to the bearings of lubricated meters every 4 months

ACCEPT/REJECT: CRITERIA

Turbine Meter shall be undamaged and comply with its current calibration certificate. The k-factor applied within the flow computer shall be traceable back to its high-pressure calibration certificate.

If the meter system fails the accept criteria, it may result in the under-registration of gas. In addition to recording the details (as defined within this procedure) the appropriate responsible Engineering Manager shall be informed in order that the extent of meter errors may be assessed.

All pulses generated by the turbine meter shall be recorded within the OMNI flow computer.

FALLBACK PROCEDURE Repair / replace the Turbine Meter and inform the responsible Engineering Manager.

PREPARATION/PRECAUTIONS

The System Operator shall be advised prior to undertaking this procedure, in order that they may manage the operation of the site and account for errors introduced to the declared GTMS flow rate.

It shall be noted that whilst working on the turbine meter the calculated flow within the OMNI may be affected, resulting in a change in the analogue outputs #1 and #2. The following shall be considered:

a) GTMS will display a corresponding F1, which could result in unexpected valve movements if the site is not set in DVC and the signal to the valve is isolated by disconnecting the appropriate loops.

b) The LGT system shall be configured as defined within CP6c to prevent the injection of odorant in proportion to the simulated flow.

In addition to the general preparations/precautions the following also apply:

a) Obtain (and check) a copy of the calibration certificate for the meter

b) Lifting operations associated with lifting meters in and out of pipes and during transit to and from site shall be assessed.

c) Waste oil and grease drained or cleaned from instrumentation systems shall be contained and disposed of in a controlled manner.

d) Whilst depressurising the impulse pipework, debris bay be projected under high pressure. Guidance on the appropriate precaution to adopt is defined within work hazard sheet RA/19 Valve maintenance contained within the Risk Assessment Booklet.

TEST PROCEDURE

a) Obtain a current high-pressure calibration certificate for the turbine meter.

i) Lubricated meters shall be recalibrated every twelve years.

ii) Non-lubricated meters shall be recalibrated every eight years.

b) If a meter has been calibrated with air at low pressure or if the certificate is no longer current the meter shall be removed and recalibrated in accordance with ISO9951 at a UKAS accredited facility. The following exceptions apply.

For sites with a single stream where the site cannot be isolated. The responsible Engineering Manager if necessary will provide a calibrated replacement meter, so that the meter may be removed, recalibrated and made available for another single stream site.

c) Enter the following data onto the calibration form for both the turbine meter, which is removed from service, and the new turbine meter if appropriate:

i) Manufacturer;

ii) Serial number;

iii) K-factor or factors;

iv) Maximum flowrate;

v) Minimum flowrate;

vi) Maximum pressure;

vii) Certifying authority;

viii) Certificate number;

ix) Certificate date.

d) Turbine meter shall be inspected by applying the following procedure:

i) Check the direction of flow through the turbine meter is correct;

ii) Using a Oscilloscope or frequency counter confirm (with gas flowing) that the number of pulses (frequency) generated by the meter pickup corresponds with that recorded by the OMNI flow computer. Record the results in the comments section within HPMIS. Check that all the impellors are detected on the turbine wheel by checking that the profile of the pulse train.

iii) Remove the turbine meter from the pipeline following detailed instructions where appropriate (in accordance with MAINT8). Note that whilst depressurising the line, restrict the rate of venting such that the meter speed does not exceed qmax.

iv) Visually inspect the turbine meter casing and rotors for evidence of damage or contamination and enter the required data onto the validation form.

v) Visually inspect the pipe (from which the meter was removed) for evidence of contamination. If liquid or solid deposits are found record the details of the nature of and extent of the contamination within the comments section of the record sheet and notify the asset owner.

vi) Spin test the meter as follows :

i) Transfer the meter to a draught free room and support the meter in the horizontal plane (for lubricated meters do not apply oil prior to the test).

ii) Accelerate the meter above 10% of qmax by applying compressed nitrogen.

iii) Switch off the nitrogen jet and record the time (within the comments section in HPMIS) taken for the meter to reduce to 1 Hz by recording the output of the meter on a suitable frequency meter.

iv) Repeat the test two more times.

v) Fit the meter back into the pipe and re-commission in accordance with MAINT8. Note that whilst pressurising the line the rate of gas flow shall be restricted such that the meter speed does not exceed qmax.

Note : Whilst inspecting and testing the turbine meter if any damage is observed, the fault shall be logged with the asset owner

e) If a new meter is installed enter the following details onto the Data Modification section of the results form:-

i) If the maximum flow rate needs to be modified, enter YES in the Station Flow Max Change? field and enter the value in the New Station Maximum Flow field;

ii) If the pulse significance needs to be modified, enter YES in the Pulse Significance Change? field and enter the value in the New Pulse Significance field;

iii) The flow computer may need updating with

- new station maximum flow rate (scm/hr) for GTMS **and** LGT
- new pulse significance (pulses/unit)
- new K-Factor (pulses/m3)
- Enter YES in the appropriate field when the flow computer has been updated (see GMR5)

iv) GTMS may need updating with

- maximum flow rate (mscm/d)
- pulse significance (pulses/scm)
- new high alarm limits
- Ensure that the System Operator has been informed of the changes and then enter YES in the ACC Informed? field;

v) If the maximum station flow rate has changed, the NJEX controller for Local Gas Treatment shall be updated. Enter the new maximum flow rate in the controller in scm/s. Enter YES in the NJEX Controller Updated? field when completed;

vi) The telemetry unit labels and configuration records may need updating with the new max flow. Enter YES in the Telemetry Unit Updated? field when completed;

vii) Other associated equipment may need updating. Enter YES in the Other Signals Updated? field when completed. NB. This generic field is aimed to remind the on-site engineer to think about other effected systems specific to the site.

REINSTATEMENT

a) Reinstate the turbine meter and apply oil to the bearings of lubricated meters.

b) Reinstate in accordance with CP16

c) After completion enter YES in the "Reinstate Equipment?" box.

PRIMARY INSTRUMENTATION

ULTRASONIC METER INSPECTION/REPLACEMENT/MAINTENANCE

Proc No: **CP14c**

Issue: **B**

This check shall be carried out to verify that the Ultrasonic Meter is maintained in good condition and is traceable to its calibration certificate.

FREQUENCY OF TEST: 12 months

ACCEPT/REJECT: CRITERIA

Ultrasonic Meter shall be undamaged and comply with its current calibration certificate. All transducers are operating within defined limits and the measured VOS matches the calculated value. If the meter is damaged or does not perform satisfactorily the responsible Engineering Manager shall be informed

FALLBACK PROCEDURE Repair / replace the Ultrasonic meter and inform the responsible Engineering Manager.

PREPARATIONS/PRECAUTIONS:

The System Operator shall be advised prior to undertaking this procedure, in order that they may manage the operation of the site and account for errors introduced to the declared GTMS flow rate.

It shall be noted that working on the Ultrasonic meter may affect the calculated flow within the OMNI, resulting in a change in the analogue outputs #1 and #2. The following shall be considered:

a) GTMS will display a corresponding F1, which could result in unexpected valve movements if the site is not set in DVC and the signal to the valve is isolated by disconnecting the appropriate loops.

b) The LGT system shall be configured as defined within CP6c to prevent the injection of odorant in proportion to the simulated flow.

In addition to the general preparations/precautions the following also apply:

a) Obtain (and check) a copy of the calibration certificate for the meter

b) Lifting operations associated with lifting meters in and out of pipes and during transit to and from site shall be assessed.

c) Waste oil and grease drained or cleaned from instrumentation systems shall be contained and disposed of in a controlled manner.

d) Whilst depressurising the impulse pipework, debris bay be projected under high pressure. Guidance on the appropriate precaution to adopt is defined within work hazard sheet RA/19 Valve maintenance contained within the Risk Assessment Booklet.

If the meter fails to meet the test criteria it may be necessary to remove one or more probes for inspection or replacement. Note that the probes are under pressure. If the meter is designed such that it is possible to extract the probes whilst under pressure the operator shall ensure that.

a) The required tools are available.

b) A procedure is available.

c) They are trained.

Once removed the probes should be inspected to ensure that they are undamaged and free from contamination or corrosion. It is IMPORTANT that each probe shall be replaced in its original port. Note at this point it is advisable to carry out the appropriate steps iii) to vi) & viii) of the procedures below, again to ensure the action of removing and returning probes has not affected the meter performance

TEST PROCEDURES

The meter shall have a valid calibration certificate. If the meter does not have a current certificate then the meter shall be removed and calibrated

Additional testing should be carried out. There is a choice of two test procedures, which increase in complexity and cost. If the basic test cannot be implemented the responsible Engineering Manager shall be advised who will provide instruction whether to proceed to the full test.

The basic test can be carried out with the meter in situ and will indicate if the meter is operating satisfactorily at an operational level. This will not indicate if the bore is contaminated or damaged.
A more thorough test involves removing the meter from the line. This is required if zero flow across the meter cannot be guaranteed. In this case, it is also possible to check for damage or contamination of the meter that may affect performance that would not be detected in the basic test.

a) Basic

i) Communicate with the USM from the OMNI by PRESSING [Meter] [N] [Display] and [Setup] [N] [Display]

ii) Note the test conditions, i.e. gas composition, temperature, pressure.

iii) Record the following data for each transducer (for entry into HPMIS) which will calculate the pass/fail status of the meter.

i) Transducer id and corresponding serial number

ii) Transducer performance

iii) No of valid samples

iv) AGC

v) AGC limit

vi) VOS

iv) Record the overall performance of the USM

v) Obtain a measurement of the velocity of sound (using Danint) for the gas composition used in the test by an independent means. Ensure the velocities of sound for the chords agree with each other and the independent value to within the parameters recommended as acceptable by the meter manufacturer.

vi) Check that the cables from the probes are in good condition.

vii) Ensure the correct probes (by serial number) are in the correct ports (as designated by the most recent installation data sheet).

viii) Using the manufacturers software make a backup copy of the USM configuration

b) Full

i) Remove the meter from the line

ii) Check that the meter bore is undamaged and free from contamination or corrosion

iii) Place the meter in a temperature controlled environment or thoroughly lag the meter.

iv) Seal both ends of the meter using blocking flanges.

v) Fill the meter with Nitrogen, to a pressure of 20 bar.

vi) Allow the meter to thermally stabilise.

vii) Note the test conditions, i.e. temperature, pressure.

viii) Check the meter diagnostics and note down for each chord, the gain, flow rate and velocity of sound.

ix) Check that for each chord, the gain and the flow measurements are within the parameters recommended as acceptable by the meter manufacturer. This is for zero flow at the given gas composition, temperature and pressure.

x) Obtain a measurement of the velocity of sound for the gas composition used in the test by an independent means. Ensure the velocities of sound for the chords agree with each other and the independent value to within the parameters recommended as acceptable by the meter manufacturer.

xi) Check that the cables from the probes are in good condition.

xii) Ensure the correct probes (by serial number) are in the correct ports (as designated by the most recent data installation sheet).

xiii) If satisfactory return the meter to the line. Ensure the orientation is as before.

REINSTATEMENT

a) Reinstate in accordance with CP16

b) After completion enter YES in the "Reinstate Equipment?" box.

REINSTATEMENT CHECK

Proc No: **CP16**

Issue : **B**

This procedure has been developed to support the reinstatement of the metering system following modifications introduced during maintenance activities.

NB In order to validate the meter system a number of modifications will have to be made, these comprise both disconnecting physical instruments (or wires) and software edits. Upon completion of the validation the system shall be reinstated.

This procedure identifies the modifications introduced during each procedure. It is intended as a guide to ensure that the modifications are removed and the system is reinstated.

Following the site works associated with the validation the appropriate reinstatement checks CP1 to CP14 shall be recorded within this procedure.

The application of procedure CP17 shall be undertaken and recorded by the calibration workshop.

FREQUENCY OF TEST: Following the application of one or more validation procedures.

ACCEPT/REJECT: CRITERIA A metering or LGT error has not been introduced.
The site activities associated with the meter validation have been completed. The responsible Engineering Manager shall be informed if one or more of the reinstatement checks fail.

Procedure	Reinstatement check to be undertaken			Name/date
CP1a	Modbus address reset to 1	TE, PT & DPT over-ride = 3	confirm live composition is transferred into OMNI	
CP1b	Modbus address reset to 1	TE, PT & DPT over-ride = 3	confirm live composition is transferred into OMNI	
CP2a	Modbus address reset to 1	TE, PT & DPT over-ride = 3		
CP2b	Modbus address reset to 1	TE & PT over-ride = 3	Confirm the live frequency is applied within the OMNI	
CP2c	Confirm live TE, PT & DPT processed in Transmitton			
CP2d	Modbus address reset to 1	TE & PT over-ride = 3	Confirm the live composition & frequency is applied within the OMNI	
CP3a	Modbus address reset to 1	TE & PT over-ride = 3	confirm live composition is transferred into OMNI	
CP3b	Modbus address reset to 1	TE & PT over-ride = 3	confirm the live composition & frequency is applied within the OMNI	
CP3c	Confirm live TE, PT & DPT processed in Transmitton			

Procedure	Reinstatement check to be undertaken			Name/date
CP3d	Modbus address reset to 1	TE & PT over-ride = 3	confirm the live composition & frequency is applied within the OMNI	
CP4a, b, c, d, e	Confirm live TE, PT & DPT processed in the OMNI			
CP5	Confirm live TE processed in the OMNI			
CP6a	Confirm the OMNI is operating in its normal mode	confirm the scim % flow matches the OMNI flow	Comfirm LGT alarms are clear and that the GTMS displayed concentration matches the as found level.	
CP6b	Confirm the OMNI is operating in its normal mode	confirm the GTMS flow matches the OMNI flow		
CP6c	Confirm the OMNI is operating in its normal mode	confirm the GTMS flow matches the OMNI flow		
CP7	Confirm the OMNI is operating in its normal mode	confirm live DPT applied		
CP8a	Confirm the OMNI is operating in its normal mode	confirm that live composition applied within the OMNI		
CP8b	Confirm the OMNI is operating in its normal mode	confirm that live RD is applied within the OMNI		
CP9	n/a			
CP10	Confirm live PT	confirm equalisation valve is closed		
CP11	Confirm live DPT	confirm equalisation valve is closed		
CP12	Confirm live TE			
CP13	n/a			
CP14a	Ensure that the updated OMNI file is active	Ensure that ACC are advised of any changes		

Procedure	Reinstatement check to be undertaken			Name/date
CP14b	Ensure that the updated OMNI file is active	Ensure that ACC are advised of any changes		
CP14c basic				
CP14c full				
CP17	Workshop confirm that removed plate passes calibration			

PRIMARY INSTRUMENTATION

REMOVED ORIFICE METER: WORKSHOP INSPECTION/CERTIFICATION

Proc No. **CP17**

Issue **A**

Following the replacement of an orifice plate the removed plate shall be returned to an appropriate facility e.g. The Workshop at Hinckley, for recertification.

FREQUENCY OF TEST/: CALIBRATION

All plates shall be replaced annually. If the plate fails the calibration procedure it shall be removed from service and the responsible Engineering Manager shall be informed.

ACCEPT/REJECT:

The plate shall pass the calibration/inspection procedure and a certificate shall be issued. In addition the plate shall not exceed a flatness limit of 0.2%, as defined within ISO 5167.

If the meter system fails the accept criteria, it may result in the under-registration of gas. In addition to recording the details (as defined within this procedure) the appropriate responsible Engineering Manager shall be informed in order that the extent of meter errors may be assessed.

FALLBACK PROCEDURE

Inform the responsible Engineering Manager who will determine if the orifice plate shall be repaired or replaced.

PREPARATIONS/PRECAUTIONS

Waste oil and grease drained or cleaned from instrumentation systems shall be contained and disposed of in a controlled manner.

Lifting operations associated with lifting the orifice plate shall be assessed.

TEST PROCEDURE

All plates shall be inspected and calibrated prior to installation. Plates returned from site should be calibrated within two working weeks of receipt, before being placed in storage for application next year. If a plate (that has been removed from service) fails calibration the following actions shall be implemented.

a) The plate shall be removed from service.

b) The asset owner shall be informed.

c) The meter error shall be assessed and a meter error report produced.

d) The suitability of the meter system shall be assessed and if appropriate a new plate manufactured.

All plates shall be engraved with its serial number and have its downstream face clearly marked.

Following calibration a copy of the calibration certificate shall be sent to the responsible Engineering Manager.

The workshop representative shall enter the following details into HPMIS:

a) The Plate serial number

b) The certified bore

c) The calibration temperature

d) The certified plate thickness

e) Drain hole details

REINSTATEMENT

a) The certified data associated with the orifice plate shall be entered into HPMIS.

b) Record the calibration pass status of the plate within CP16.

c) The calibrated plate shall be stored in a suitable environment until it is dispatched to site.