# MEASUREMENT MANUAL

# PHILLIP CREEK COMPRESSOR STATION GAS MEASUREMENT MANUAL

GAS-310-OM-GM-001

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## AUTHORISATION

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# DOCUMENT HISTORY

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| 1 | 05/07/2019 | Maria Blanchard Delgado | Change of billing period to gas day and general review. Change of document number. |
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# REVIEW DETAILS

| | |
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# 1 SCOPE AND GENERAL

## 1.1 SCOPE

This manual is to provide a technical reference for the operation and maintenance of the Jemena gas measurement and monitoring systems on the Phillip Creek Compressor Station (**PCCS**), installed on the Northern Gas Pipeline (**NGP**).

A typical gas measurement system consists of the following processes:

- Equipment specifications
- Equipment calibration
- Data acquisition
- Data transmission
- Data, storage, manipulation and computation
- Data validation
- Billing procedures
- Discrepancy resolution and billing adjustments
- System auditing
- Gas Sales Contracts or Agreements

This manual includes general details on technical aspects of the overall measurement system and equipment. Other aspects of the measurement process, such as billing procedures, system auditing, and billing adjustments are covered under separate procedures. This manual is not intended to provide specific details of Nitrogen Removal Services Agreement terms and conditions.

This manual includes the below:

a. Identifying each meter installed on the PCCS facility;
b. Australian standard or other standard to which each meter complies;
c. Meter testing and replacement philosophy;
d. Tolerance for error for meters;
e. Duration of review of this measurement manual;
f. Installation and commissioning of meters;
g. Meter testing methods and frequency;
h. Meter maintenance processes;
i. Correction factor calculation;
j. Calibration and traceability of meter test equipment;
k. Meter security (incl protection during transportation, installation, operation and unauthorised alteration of meter readings);
l. Process for estimated meter readings, reasons for estimation, and procedures for reconciling actual and estimated reading;
m. Procedures for meter failure, incorrect operation or meter bypass;
n. Competency for persons working on the meters and training programs to maintain skill levels of person, and
o. Record keeping (Incl records of anomalies, complaints and actions and minimum period of record keeping).

Jemena is the controller and measurement authority of the meters installed on Phillip Creek Compressor Station (**PCCS**). This manual provides a technical reference for the operation and maintenance of the gas measurement and monitoring systems installed at PCCS. Where Delivery or Receipt Point measurement equipment is owned or operated by a 3rd party, they will be maintained in accordance with this manual and Jemena requirements or as otherwise agreed.

## 1.2 PIPELINE DESCRIPTION

### 1.2.1 NORTHERN GAS PIPELINE (NGP – NORTHERN TERRITORY SECTION)

The NGP consists of two sections of pipeline:

- PPL 34 (Pipeline licence No. 34): License for the section of pipeline in Norther Territory (**NT**)
- PPL 2015 (Pipeline licence No. 2015): License for the section of pipeline in Queensland.

This manual only covers the metering equipment installed in the Northern Territory section of the NGP pipeline in PCCS. The Queensland Measurement Manual applies to the section of the NGP and facilities located in Queensland.

# 2 METER SCHEME

## 2.1 METER IDENTIFICATION

The below sections details the meters installed at PCCS.

**Table 1: PCCS Meters (Owned and Validated by Jemena)**

| Location | Meter Description | Status | Custody Transfer | Meter Assembly | Meter Runs | Temperature Measurement | Pressure Measurement | Flow Computer | SCADA | Gas Chromatograph | Moisture Analyser |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Phillip Creek Compressor Station | Phillip Creek Compressor Station Meters | In use | Yes | Ultrasonic | Dual | √ | √ | √ | √ | √ | √ |
| | Phillip Creek Compressor Station Fuel Gas Meter | In use | No | Coriolis | Single | √ | √ | √ | √ | √ | |
| | Phillip Creek Compressor Station Fuel Gas Purge To Cold Flare Knockout Drum Meter | In use | No | Rotameter | Single | X | X | X | X | X | |

| Location | Meter Description | Status | Custody Transfer | Meter Assembly | Meter Runs | Temperature Measurement | Pressure Measurement | Flow Computer | SCADA | Gas Chromatograph | Moisture Analyser |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Phillip Creek Compressor Station Fuel Gas Purge To Warm Flare Knockout Drum Meter | In use | No | Rotameter | Single | X | X | X | X | X | |

## 2.2 APPLICABLE STANDARDS

All meters shall be designed and installed in compliance with the appropriate meter standards mentioned in Table 2 Meter Standards.

**Table 2 Meter Standards**

| Meter Type & Associated Equipment | Applicable Standard |
|---|---|
| Orifice Plate Meter | AGA-3 |
| Turbine Meters | AGA-7 |
| Ultrasonic Meters | AGA-9 |
| Coriolis Meters | AGA-11 |
| Diaphragm Meters | AS 4647 |
| Compressibility Factor of Natural Gas and Related Hydrocarbon Gases | AGA-8 |
| Gas Chromatograph | ISO 6976 - Natural Gas: Calculation of Calorific Values, Density, Relative Density and Wobbe index from composition. |

Additional standards that will be followed are noted in the Table 3 Additional Standards.

**Table 3 Additional Standards**

| Standard Name | Standard Description |
|---|---|
| AS ISO 1000-1998 | The International System of Units (SI) and Its Application |
| AS 1376 -1996 | Australian Standard Conversion Factors |
| AS 4564 – 2020 | Australian Standard Specification for general purpose natural gas |
| National Greenhouse and Energy Reporting (Measurement) Determination 2008 Chapter 2, Part 2.3 Division 2.3.6 Section 2.36. | All installed flow computers for metering purposes shall be compliant with the accuracy requirements specified in this document. |
| National Greenhouse and Energy Reporting (Measurement) Determination 2008,, refer Chapter 2, Part 2.3 Division 2.3.6 Section 2.31. | All installed pressure transmitters for metering purposes shall be compliant with the transmitter accuracy requirements specified in this document. |

| Standard Name | Standard Description |
|---|---|
| National Greenhouse and Energy Reporting (Measurement) Determination 2008 Chapter 2, Part 2.3 Division 2.3.6 Section 2.31. | All installed temperature transmitters for metering purposes shall be compliant with the transmitter accuracy requirements specified in this document. |
| National Greenhouse and Energy Reporting (Measurement) Determination 2008 Chapter 2, Part 2.3 Division 2.3.6 Section 2.37. | All installed Gas Chromatograph shall be compliant with the accuracy requirements, specified in this document. |
| GPA 2172 | Gas Processors Association Standard 2172-84 (or subsequent revisions), and is the method used to calculate Gross Heating Value, Specific Gravity and Super compressibility of natural gas mixtures from compositional analysis. |
| ISO 6976 | Natural Gas calculation of Calorific values, density, relative density, and Wobbe index from Composition. |

## 2.3 METER TESTING AND REPLACEMENT PHILOSOPHY

Table 4 Testing and Replacement Philosophy contains the testing and replacement philosophy for custody transfer meters in PCCS. This philosophy is applicable only for the meters classified as “Custody Transfer” meters in Section 2.1 Meter identification. A custody transfer meter is marked as “Yes” in the column “Custody Transfer” against the meter in the tables containing the meters.

**Table 4 Testing and Replacement Philosophy**

| Meter Type | Testing or Replacement Philosophy |
|---|---|
| Ultrasonic Meters | The Ultrasonic flow meters are equipped with extensive self-diagnostic capabilities, which, in combination with the regular meter validations, allow detection of any loss or drift of accuracy over time.<br>In the event of a malfunctioning meter (unrecoverable fault), once identified, it will be replaced with a suitably calibrated meter of similar technology.<br>The below monitoring is performed on a continuous basis<br>- For meters in Z configuration, deviation in opposite direction will be detected by continuous monitoring. The deviations beyond tolerance of 1.5% in Energy flow will be investigated.<br>- Continuous Gas Unaccounted For (**GUF**) monitoring of the NGP will be performed. GUF values beyond the acceptable tolerance will be investigated. This is expected to provide indications on meter deterioration. |

Notes:

1. If meters are redundant, one meter will be re-calibrated first and installed, before the second meter is sent for re-calibration.

2. The above philosophy may be adopted for the non-custody transfer meters, but will depend on other factors like age, health status, cost etc. of the installed meter. The decision will be at the discretion of Jemena's Asset Management team.

## 2.4 TOLERANCE FOR ERRORS

### 2.4.1 OVERALL TOLERANCE FOR METERING

The overall acceptable tolerance of error for custody transfer meters (excluding flare gas meters and produced water meters) is detailed in Table 5: Acceptable Tolerance of Error for Custody Transfer Meters. The validation checks shall ensure the meters operate within these tolerances.

**Table 5: Acceptable Tolerance of Error for Custody Transfer Meters**

| Flow Range | Acceptable Error % |
|---|---|
| Flow < 25 m3/Hr | ± 1.5% |
| Flow **>** 25 m3/Hr + up to 100 TJ/year | ± 1.0% |
| Flow: 100 TJ/year to 1 PT/year | ± 1.0% |
| Flow: > 1 PT / year | ± 1.0% |

### 2.4.2 TOLERANCE FOR TRANSMITTERS

The overall acceptable tolerance of error for transmitters is detailed in Table 6: Acceptable Tolerance of Error for Transmitters.

**Table 6: Acceptable Tolerance of Error for Transmitters**

| Equipment | Acceptable Error % |
|---|---|
| Pressure Transmitter | ± 0.1% |
| Differential Pressure Transmitter | ± 0.1% |
| Temperature Transmitter | ± 0.2% |

## 2.5 REVIEW OF MEASUREMENT MANUAL

This measurement manual shall be revised if any of the below scenarios occur:

- If a new meter type is installed, or proposed to be installed, which is not mentioned in this measurement manual;
- If there is an amendment of an applicable standard(s) referred to in this measurement manual;
- If an event (such as a significant development in the technical knowledge) relevant to the measurement manual becomes known; and
- If Jemena becomes aware of a significant anomaly or likelihood of inaccurate measurement as mentioned in this measurement manual.

If none of the above scenarios occur, then this measurement manual will be reviewed in a 2-year period to ensure changes in regulation, technological advancement and operating procedures are captured.

## 2.6 INSTALLATION AND COMMISSIONING OF METERS

All meters shall be designed and installed in compliance with the associated AGA standards for the meter and details mentioned in this document. Industry and manufacturers best practices shall be taken into consideration for design and installation. Any deviation to the standard or this document for meter installation will require approval from the Principle E&I engineer.

The custody transfer flow meters shall be factory calibrated and certified prior to installation and commissioning. A Factory Acceptance Testing (**FAT**) shall be undertaken to verify the system is functioning as per design prior to transporting to site for installation. Site Acceptance Testing (**SAT**) shall be undertaken before the meter is placed into operation.

## 2.7 METER TESTING METHODS AND FREQUENCY

### 2.7.1 VALIDATION OVERVIEW

Validation is the process of ensuring the conditions of measurement equipment is in order, for it to function within agreed tolerances.

### 2.7.2 VALIDATION (TESTING) METHODS

A validation excel spreadsheet is used for the validation process. Jemena uses GOF, a proprietary software to perform meter validations. This software is "called" from the validation spreadsheet to calculate gas flow data in accordance with the AGA standards. The validation spreadsheets performs a comparison of the GOF calculated flows Vs the flow computer calculated flows and provides any discrepancies between the two readings. If the discrepancies are outside the acceptable tolerances for the meter, then appropriate action is taken to rectify the discrepancy.

Following is a typical list of relevant validation forms within the validation spreadsheet that is used to validate the meter installation:

- Test Equipment form

- Pressure Transmitter form
- Temperature Transmitter form
- Gas Chromatograph Tolerance Check Form
- Moisture Analyser Tolerance Check form
- Series Meter Comparison Form
- Ultrasonic Diagnostic Check form
- Ultrasonic Meter FC V's GOF form

The details of the appropriate validation forms for each facility can be found under each facilities validation procedures.

### 2.7.3 FREQUENCY OF VALIDATIONS

The frequency of periodic validations is shown in Table 7 Frequency of Meter Periodic Validations for all facilities. These periods may be shortened due to gas quality or when Energy Accounting equipment are found to be outside of tolerances. They shall never be extended beyond the times noted in Table 7.

**Table 7 Frequency of Meter Periodic Validations**

| | Flow less than 25 m3/Hr | Flow Greater than 25 m3/Hr<br>+<br>Accumulation < 100 TJ / Year | Flow Greater than 25 m3/Hr<br>+<br>Accumulation = 100 TJ to 1 PT / Year | Flow Greater than 25 m3/Hr<br>+<br>Accumulation > 1 PT / Year |
|---|---|---|---|---|
| Frequency of Validations | None | None | 6 Months | 3 Months |

## 2.8 METER MAINTENANCE

Maintenance procedures as defined by the meter manufacturer should be carried out during the scheduled validation process if any of the validation or diagnostics checks result in out of tolerance. The maintenance procedures are site and equipment specific and are based on manufactures guidance and history of the equipment.

## 2.9 CORRECTION FACTOR CALCULATION

The meter assembly measures actual flow. The pressure and temperature transmitters and Resistance Temperature Detectors (**RTD**) are mounted with each meter assembly.

Each meter is connected to a local flow computer (**FC**), which receives and records the instantaneous values for all primary measurement inputs, i.e. volume flow signals from the meter, pressure, temperature and Gas Chromatograph data.

The correction factor calculation is implemented in the flow computer. The flow computer performs temperature and pressure compensation of the measured flow (Actual) to produce instantaneous volumetric and energy based flow rates at standard conditions using the gas composition data from gas chromatographs. AGA calculation standards relevant to the type of meter are implemented in the flow computer to perform these calculation for e.g. AGA9 for USM. All flow computers accumulate volume and energy totals.

The below typical data are transferred to SCADA from the flow computer:

- Pressure
- Temperature
- Flow Rate
- Energy Rate
- Accumulated Flow
- Accumulated Energy
- Specific Gravity
- Heating Value
- Gas component data
- Yesterday's energy
- Yesterday's volume
- Contract energy accumulator
- Contract volume accumulator

The equipment specification varies between various facilities, however the schematic shown in Figure 1 identifies and links the key repeated components.

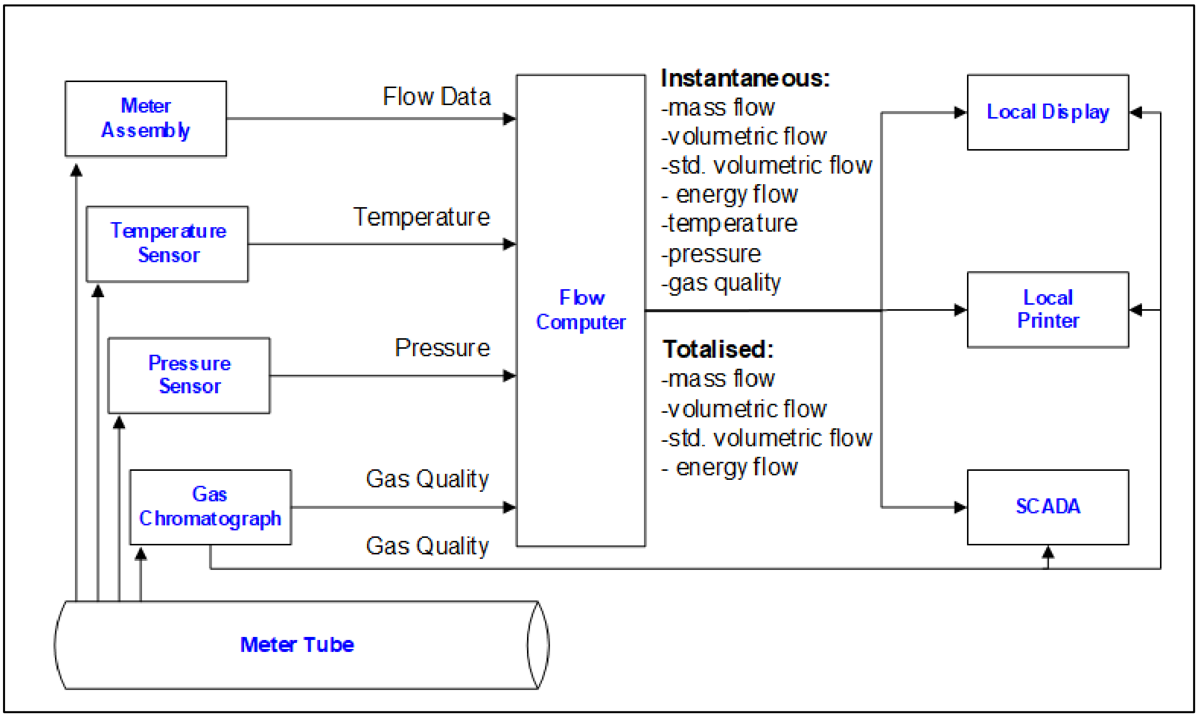


**Figure 1: Measurement Facility Schematic**

## 2.10 CALIBRATION AND TRACEABILITY OF METER TEST EQUIPMENT

A standard set of equipment for the meter validations comprises the following items:

1) Multifunction Calibrator
2) Hydraulic Dead Weight Tester (**DWT**)
3) Mercury In Glass Thermometer
4) Resistance Decade Box
5) Certified RTD

Some other equipment may also be used.

The equipment is periodically checked and its accuracy verified by NATA accredited laboratories. Appropriate calibration certificates will be obtained and stored in Jemena's Enterprise Content Management System (**ECMS**) after the verification process.

The frequency of re-calibration shall be as detailed in Table 8 Calibration Period of Validation Instruments.

**Table 8 Calibration Period of Validation Instruments**

| Validation Instrument | Examples of Instruments Used | | Re-Calibration Period Required |
|---|---|---|---|
| | Brand Name | Catalogue No | |
| Multifunction Calibrator | Beamex Advanced Calibrator | MC6 | Every 12 months |
| NitroPak Calibrator | Ralston | NPAK | 12 Months |
| Digital Test Gauge | Crystal | XP2i | 12 Months |
| Hydraulic Dead Weight Tester | Ametek | PK II | Every 36 months |
| Function Generator | | TG550 | Every 12 months |
| Crystal Digital Test Gauge | | 3KPSIXP2 | Every 12 months |
| Mercury in Glass Thermometer | AMA | | Every 5 years |
| PT100 Simulator | Beamex | RTS24 | 12 Months |
| PT100 RTD | WIKA | TR40 | 12 Months |
| Delta Ohm Digital Thermometer | | HD9215 | Every 12 months |
| Time Electronic Decade Box | | | Every 12 months |
| Digital Multimeter | Fluke | 45 | Every 12 months |
| Certified RTD | | | Every 12 months |

## 2.11 METER SECURITY

### 2.11.1 PHYSICAL SECURITY

All Jemena’s remote and un-manned facilities are fenced and under regular remote surveillance by Jemena personnel or external security company. Site security system alarms are configured in the SCADA system. This ensures that any unauthorised access to site is immediately alarmed in the Melbourne Control Centre.

External contractor access to these facilities are controlled by induction processes and permit to work system.

### 2.11.2 SOFTWARE SECURITY

Flow meters used for custody transfer application(s) are protected by a password and only accessible through special software. Additionally, a parameter write lock in the Signal Processing Unit (**SPU**) of the meter prevents unauthorised changes to the meter configuration.

Temperature and pressure transmitters are not password protected but the risk of unauthorised alteration is minimised by adherence to Jemena’s standard permit to work system.

### 2.11.3 TRANSPORT AND STORAGE

Transport and storage of all metering equipment shall be in accordance with manufacturer’s instruction and Jemena’s transportation requirements as defined by the project.

Meters shall be firmly secured during transport and measures shall be taken to avoid mechanical damage. A detailed inspection of the meter shall be performed by Jemena personnel or Jemena authorised external contractor prior to installation of the meter. Site Acceptance Testing (**SAT**) will be performed to ensure that meter performance has not been degraded due to the transportation process.

## 2.12 ESTIMATED METER READING & METERING CORRECTIONS

If the PCCS custody transfer measurement system is out of service or registering inaccurately so that the quantity of gas delivered during a period cannot be ascertained or computed from the readings from the facility, the gas delivered during such period will be determined upon a basis of the best data available, using any one of the following methods:

- By correcting the error if the percentage of error is ascertained by calibration, test or mathematical calculations; or
- By estimating the quantity of deliveries during the preceding periods of demand under similar conditions when the metering facilities were registering accurately.

## 2.13 PROCEDURES ON METER FAILURE, INCORRECT OPERATION AND METER BYPASS

If the event of a meter failure or incorrect operation or if a meter is bypassed for maintenance purposes, an estimation of meter reading as per Section 2.12 Estimated Meter Reading & Metering Corrections will be performed, if a standby meter is unavailable.

The failed meter will be repaired and re-instated in service. A validation will be performed on the re-instated meter to ensure the meter performance is within acceptable tolerance of errors. On successful validation, the meter will be placed in operation.

## 2.14 TRAINING AND COMPETENCY REQUIREMENT

The field technicians performing meter validations will be suitably trained to perform the activities required to complete validations following the facility appropriate procedures. The staff will have to demonstrate competency in the required validation procedures, applicable equipment, and understanding of hazards before they are allowed to perform validations.

The validations are performed by a field technician and witnessed and checked by another field technician. This is recorded in the validation spreadsheets as shown in the Figure 2 Validation Witness Record. This process ensures that new field technicians will be trained by performing validations with experienced field technicians. This also provides an opportunity to perform site specific knowledge transfer and assess the competency of the field technicians before they are allowed to train other field technicians.

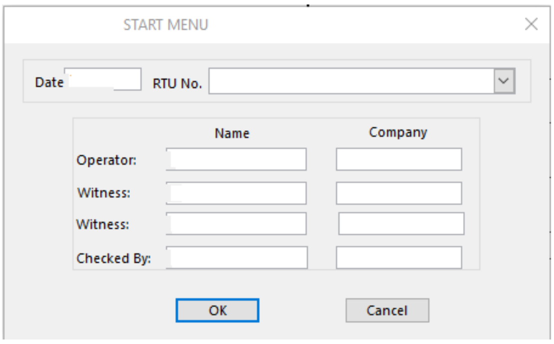


**Figure 2 Validation Witness Record**

In addition to the above, the field technicians will perform additional formal training sessions for e.g. Workplace inductions, Site specific induction, Manual handling etc.

Training covering the new meter installation shall be included after commissioning of any new meters. This training should be provided by the commissioning team, project engineers or meter vendors and attended by field technicians working on the facility. A copy of the training records will be stored in ECMS.

## 2.15 RECORD KEEPING

All validation documents will be kept as records in ECMS. Anomalies and complaints will be recorded in the validation documents as much as possible to ensure that consolidated records are maintained. If anomalies and complaints are present in other documents for e.g. email, they will also be kept as records.

All records will be kept for a minimum 5 years from the date of creation.

# 3 GAS QUALITY MEASUREMENT

Gas entering the inlet of PCCS must meet the specifications as defined in Section 1 of Schedule 3 of the Nitrogen Removal Services Agreement (**NRSA**).

Gas exiting the residue compressors must meet alternate gas quality specifications specified in Section 2 of Schedule 3 of the NRSA.

Live monitoring of the gas quality is enabled via the SCADA system. Output from the on-site measurement equipment is linked to the Melbourne Control Centre. Alarms are triggered should the measured or calculated gas properties approach the limits specified.

## 3.1 ON SITE ANALYSIS

GCs sample line gas and separate the inert and hydrocarbon components to C6+ and are used to analyse the gas stream. Gas composition, specific gravity, heating value and Wobbe Index of the gas are determined.

Moisture analysers are used to continuously sample the gas stream to establish its water dew point.

### 3.1.1 CHROMATOGRAPHS

A small gas sample is retrieved from the pipeline at nominal intervals of 3 – 6 minutes. The sample is separated into its basic components and is analysed by the C6+ gas chromatograph, returning the following:

- Hexane Plus (C6+)
- Propane (C3)
- I-Butane (I-C4)
- N-Butane (N-C4)
- Neo-Pentane (Neo-C5)
- I-Pentane (I-C5)
- N-Pentane (N-C5)
- Nitrogen (N2)
- Methane (C1)
- Carbon Dioxide (CO2)
- Ethane (C2)

The C9+ chromatograph system analyses for the following components:

- Hexane (C6)
- Propane (C3)
- I-Butane (I-C4)
- N-Butane (N-C4)
- Neo-Pentane (Neo-C5)
- I-Pentane (I-C5)
- N-Pentane (N-C5)
- Nitrogen (N2)
- Methane (C1)
- Carbon Dioxide (CO2)

- Ethane (C2)
- Nonane+ (C9)
- Octanes (C8)
- Heptanes (C7)

A microprocessor calculates the gas composition concentrations, Specific Gravity (real), Compressibility Factor, Higher Heating Value (real; dry basis), and the Wobbe Index. The basis of these calculations is GPA 2172 or ISO 6976. These figures are supplied to the flow computers for correcting the meter data to standard volume conditions and calculating energy.

The chromatograph automatically calibrates itself every 24 hours using a reference gas custom-blended to be similar to the gas being transported. This reference gas is supplied with a certification of analysis. The certified mole% of each gas is entered into the chromatograph to allow self-adjustment on calibration. The chromatograph is checked as part of routine validations of metering equipment.

Hydrocarbon Dew Point is calculated in the C9+ Gas chromatograph. The calculations are based on two empirically derived equations of state (Redlich Kong Soave and Peng Robinson) to predict the hydrocarbon dewpoint from the gas composition. The algorithms return the hydrocarbon dew point maximum temperature (cricondentherm) and the temperature at four other pressures.

All gas chromatographs are factory tested and calibrated with use of the gravimetric methods in accordance to Australian legal units of measurement.

#### 3.1.2 MOISTURE ANALYSER

The Moisture Analyser draws a continuous sample stream from the gas flow and provides an indication of water content. An analogue output signal and alarm is provided.

The analysers covers the overall range from 0 to 100ºC (32ºF to 212ºF); analyser performance is immune to changes in sample gas, sensibility of 0.1 ppmv or 1% of reading, whichever is greater.

The analogue output of the analyser is connected to the SCADA system and is alarmed and monitored.

The moisture analyser(s) are calibrated as part of routine verifications of gas analysis and Energy Accounting equipment.

# 4 REFERENCE AND LOCAL CONDITIONS

## 4.1 REFERENCE CONDITIONS

The standard reference conditions utilised by Jemena for the gas measurement is as below. These standards are Industry accepted reference conditions within Australia.

| | |
|---|---|
| Measurement Reference Temperature | 15°C (288.15K) |
| Measurement Reference Pressure | 101.325 kPa (abs) |
| Standard Gravitational Acceleration (gs) at sea level and 45 latitude | 9.80665 m/s |

| | |
|---|---|
| Density of Air at standard temperature and pressure | 1.2255 kg/m3 |

## 4.2 LOCAL CONDITIONS

The local gravitational acceleration and atmospheric pressure at each site varies. A universal strategy must be established for determination of the local conditions to allow conversion to “Standard Conditions”.

### 4.2.1 LOCAL GRAVITATIONAL ACCELERATION

Local gravitational acceleration at each site is calculated in accordance with equation 3-A-10 of AGA3-1992. The local gravity is dependent on the latitude and elevation of the site.

### 4.2.2 LOCAL ATMOSPHERIC PRESSURE

Local atmospheric pressure is also calculated for each site. It is calculated using the following equation and is dependent on the elevation only.

$$P_{local} = 101.325 - \frac{h * density\ air * gs}{1000}$$

| | | |
|---|---|---|
| H | = | elevation (m) |
| density air | = | 1.2255 kg/m$^3$ |
| Gs | = | 9.80665 m/s$^2$ |

# 5 ABBREVIATIONS AND DEFINITIONS

| Term / Abbreviation | Definition |
|---|---|
| AGA | American Gas Association |
| AGP | American Gas Association |
| AS | Australian Standard |
| Bq/sm3 | Becquerels per Standard Cubic Meter |
| ºC | Degrees Celsius |
| Calibration | To determine the accuracy of a measurement instrument |
| Control | A function of Jemena in monitoring the Pipeline via the SCADA system and in executing the necessary actions and directives to ensure the effective receipt, transportation and delivery of gas to the Purchasers. |
| Custody Transfer | The transfer of responsibility for the care and keeping of the gas. |
| Delivered | Gas having left the pipeline at the Delivery Point/s specified in the relevant contract as the point of transfer of custody of the gas from Jemena to the relevant Shipper. |
| Delivery Point | A defined location for gas to leave the pipeline |
| DWT | Dead Weight Tester |
| E&I | Electrical and Instrumentation |
| ECMS | Enterprise Content Management System |
| Energy | The volume of gas in standard cubic meters multiplied by the Gross Heating Value (GHV). Standard units are Gigajoules (GJ). |
| Energy Accounting | The determination of all quantities of gas added to or subtracted from and remaining in the Jemena Pipeline system each Gas Day and the determination of the energy content of all such quantities of gas. |
| ºF | Degrees Fahrenheit |
| FAT | Factory Acceptance Test |

| Term / Abbreviation | Definition |
|---|---|
| FC | Flow Computer |
| FUG | Facility Use Gas |
| Gas | Any naturally occurring mixture of one or more hydrocarbons in a gaseous state, and zero or more of the gases hydrogen sulphide, nitrogen, helium and carbon dioxide, and the residue gas resulting from the treating or processing of the natural gas. |
| Gas Day | Is the Gas day starting at 6am AEST and ending 24 consecutive hours later at 6am AEST. |
| GC | Gas Chromatograph |
| GEA | Gas Engine Alternator |
| Gigajoule (GJ) | $10^9$ Joules |
| GPA | Gas Processors Association |
| Gross Heating Value(GHV) | Higher Heating Value (HHV) shall mean the energy produced by the complete combustion of one cubic meter of gas with air, at a temperature of 15 degrees Celsius and at an absolute pressure of 101.325 kPa, with the gas free of all water vapour, and the products of combustion cooled to 15 degrees Celsius, the water vapour formed by combustion condensed to the liquid state, expressed in MJ per standard cubic meter (MJ/scm). |
| gs | Standard gravitational acceleration |
| GTA | Gas Transportation Agreement |
| GTE | Gas Treatment Equipment |
| Melbourne Control Centre | The place where gas transmission control occurs. |
| ml/TJ | Millilitre per Terajoule |
| ISO | International Organisation for Standardisation |
| Joule (J) | The energy expended or the work done when a force of one Newton moves the point of application a distance of one meter in the direction of that force. |
| K | Kelvin |

| Term / Abbreviation | Definition |
|---|---|
| Kilopascal(kPa) | One thousand pascals and is by definition a measure of absolute pressure.<br>It is sometimes convenient for instrument calibration to use the term "kilopascal gauge" (kPag). This means that the gauge reads zero at atmospheric pressure. |
| kg | Kilogram |
| kg/m3 | Kilogram per cubic meter |
| MICS | Mount Isa Compressor Station |
| mg/sm3 | Milligram per Standard Cubic Meter |
| MJ/m3 | Megajoule per Cubic Meter |
| Megajoule(MJ) | $10^6$ Joules |
| ml | millilitre |
| Month | A period extending from the beginning of the first day in a calendar month to the beginning of the first day in the next calendar month. |
| m/s | Meter per Second |
| NATA | National Association of Testing Authorities |
| NGP | Northern Gas Pipeline |
| NRSA | Nitrogen Removal Service Agreement |
| NRU | Nitrogen Removal Unit |
| NT | Northern Territory |
| PCCS | Phillip Creek Compressor Station |
| Petajoule(PJ) | $10^{15}$ joules |
| Pipeline | The pipeline licensed under Pipeline Licence No. pursuant to the Petroleum Act |
| PPL | Petroleum Pipeline Licence |
| ppm | Parts per Million |

| Term / Abbreviation | Definition |
|---|---|
| ppmv | Parts per million volume |
| QLD | Queensland |
| Qmax | highest flow rate at which the meter can still maintain an accuracy |
| Qmin | lowest flow rate at which the meter can still maintain an accuracy |
| Qt | Transitional Flowrate |
| Quantity | The quantity of gas measured in terms of its energy content. |
| Received | Gas having entered the pipeline at the inlet receipt point specified in the relevant contract as the point of custody transfer from the supplier to the Shipper. |
| RTD | Resistance Temperature Detector |
| SAT | Site Acceptance Test |
| SCADA | Supervisory Control and Data Acquisition and refers to the electronic means of receiving remote data and of sending remote control signals and data to pipeline facilities from the Melbourne Control Centre. |
| SCS | Station Control System |
| Shipper | An entity receiving transportation service on the pipeline pursuant to an effective Transportation Service Agreement (also known as the “facility user” or, in certain circumstances, “access provider” under the Pipeline Access Principles). |
| SI | International System of Units |
| SPU | Signal Processing Unit |
| SUG | System Use Gas |
| Terajoule(TJ) | $10^{12}$ joules |
| USM | Ultra-Sonic Meter |