WHOLESALE MARKET METERING PROCEDURES (VICTORIA)

Incorporating:

- Metering Uncertainty Limits and Calibration Requirements Procedures
- Energy Calculation Procedures
- Metering Communications Procedures
- Installation Database Procedures
- Metering Register Procedures
- Data Validation Procedures

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Version	Effective Date	Summary of Changes
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Wholesale Market Metering Register Procedures (Victoria)

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Wholesale Market Data Validation Procedures (Victoria)

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1.0	Oct 2004	New Procedure
NGR 1.0	1 July 2010	Reviewed and rebranded for NGR

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CHAPTER 1. INTRODUCTION

1.1 Purpose

These are the Wholesale Market Metering Procedures (Victoria) (**Procedures**) made under rules 297, 303(6), 308(4), 309(3), 311(4), 314(2) of the National Gas Rules (**NGR**). These Procedures replace the following procedures:

- Wholesale Market Metering Uncertainty Limits and Calibration Requirements Procedures (Victoria) made under rule 297 of the NGR.
- Wholesale Market Energy Calculation Procedures (Victoria) made under rule 303 (6) of the NGR.
- Wholesale Market Metering Communications Procedures (Victoria) made under rule 308 (4) of the NGR.
- Wholesale Market Installation Database Procedures (Victoria) made under rule 309 (3) of the NGR.
- Wholesale Market Metering Register Procedures (Victoria) made under rule 311 (4) of the NGR.
- Wholesale Market Data Validation Procedures (Victoria) made under rule 314 (2) of the NGR.

These Procedures have effect only for the purposes set out in the National Gas Rules (**NGR**). The NGR and the National Gas Law (**NGL**) prevail over these Procedures to the extent of any inconsistency.

1.2 Definitions and Interpretation

1.2.1 Glossary

The words, phrases and abbreviations set out below have the meanings set out opposite them when used in these Procedures.

Terms defined in the NGL or the NGR have the same meanings in these Procedures unless otherwise specified in this clause. Those terms are intended to be identified in these Procedures by italicising them, but failure to italicise a defined term does not affect its meaning.

Term	Definition
Actual flow	The volume flow at the pressure and temperature existing in the meter (sometimes referred to as the uncorrected flow)
Connection Point	A delivery point, a transfer point or a receipt point
Corrected Flow	The volume flow as it would be at the reference or base pressure and temperature (101.325 kPa and 15°C).
CTM	Custody Transfer Metering (CTM) facility that includes the metering equipment, RTU, and associated field data processing systems. Specifically in the context of this document it is a *metering installation* at a transmission delivery point, a transfer point or a receipt point
DDN	Digital Data Network (Leased line)
Distribution Delivery Point	A point on a distribution pipeline at which gas is delivered to a Customer or injected into a storage facility
DM	Daily Meter (volume or energy data logger). Specifically in the context of this document, it is a *metering installation* at a *distribution delivery point* as required for market settlement.
DTS	The declared transmission system, also referred to as the gas transmission system.
DWGM	Declared Wholesale Gas Market in Victoria

Term	Definition
Gas Chromatograph (GC)	Instrument used for measuring gas composition and calculating gas heating value.
GCD	Gas Composition Data.
HV	Heating Value (the Higher Volume HV is used for CTM calculations)
Maximum Physical Capacity	The maximum energy or volume flow that can physically flow through a meter with the available pressure and without damage to the meter.
Maximum Valid Capacity	The maximum energy or volume flow through a meter that can be considered to be a real (valid) reading.
MCE	Market Clearing Engine
MDA	Metering Data Agent – An agent appointed by AEMO to create, maintain and administer the *metering database* according to rule 310 (2)
MDA application	Meter Data application – The AEMO software that handles the automatic validation, substitution and application of CTM and Heating Value data.
Metering Database	The *metering database* kept by AEMO pursuant to rule 310 of the NGR
Metering Installation	The meter and associated equipment and installations installed as required under Part 19 Division 3 Subdivision 4 of the NGR for *connection points*
MIBB	AEMO's Market Information Bulletin Board.
NGR (Rules)	National Gas Rules
Poll Frequency	The frequency at which the SCADA host requests information
PSTN	Public Switched Telephone Network
Responsible Person	The person or organisation responsible for providing the *metering installation* under the NGR (see rule 292).
RTU	Remote Terminal/Telemetry Unit. (Usually, when associated with a *metering installation*, where the greater part of flow and energy calculations are carried out)
SCADA	Supervisory Control And Data Acquisition – the systems used (among other things) to collect data from GCs and CTMs and send data to CTMs
Settlement	The determination of trading imbalances, trading amounts and settlement amounts in respect of Market Participants who trade in the market, as defined in the NGR.
System Injection Point	A *connection point* on the declared transmission system designed to permit gas to flow through a single pipe into the declared transmission system, which may also be, in the case of a transfer point, a *system withdrawal point*.
System Withdrawal Point	A *connection point* on the declared transmission system designed to permit gas to flow through a single pipe out of the declared transmission system, which may also be, in the case of a transfer point, a *system injection point*.
Uncorrected flow	See "Actual flow"
Uncertainty	A number that quantifies the precision of a measurement, the smaller the uncertainty the more precise the measurement.

1.2.2 Interpretation

The following principles of interpretation apply to these Procedures unless otherwise expressly indicated:

(a) These Procedures are subject to the principles of interpretation set out in Schedule 2 of the National Gas Law.

(b) References to time are references to Australian Eastern Standard Time.

(c) Rounding is carried out in accordance with AS 2706 – 2003.

1.3 Related Documents

Reference	Title	Location
NX-19	Manual for the Determination of Supercompressibility Factors for Natural Gas	Online, published by the American Gas Association
AS 2706	Numerical Values – Rounding and interpretation of limiting values	Online, published by Standards Australia
	Gas Metering - CTM Data Requirements	AEMO website
	Gas Metering – DM Data Requirements	AEMO website
	Gas Quality Standard and Monitoring Guidelines (DTS)	AEMO website
	National Gas Rules	AEMC website

CHAPTER 2. METERING UNCERTAINTY LIMITS AND CALIBRATION REQUIREMENTS

2.1 Introduction

Under rule 299(2) each *metering installation* must be calibrated in accordance with the requirements in these procedures. The uncertainty limits are consistent with limits in literature and were chosen to ensure that commercially available meters are capable of meeting them if they are calibrated at the intervals set out in section 2.4.

2.2 Scope

The procedures in this chapter are made under rule 297 of the NGR. They apply to all *metering installations* where gas is injected into or withdrawn from the DTS and apply to *responsible persons* in the DWGM.

2.3 Uncertainty Limits for Measuring Volume

The table below sets out the uncertainty limits required to be met by the *responsible person* for *metering installations* for *transfer points* on the DTS.

Category	Flow rate range (standard cubic metres per hour)	Uncertainty limits (volume)
A	>300,000	±0.7%
B	>40,000 and ≤ 300,000	±1.0%
C	>4,000 and ≤40,000	±1.5%
D	≤4,000	±2.5%

2.4 Calibration Requirements

The table below sets out the frequency with which the calibration must be carried out by the *responsible person*. Each time a calibration on a DWGM CTM is conducted, the results must be sent to AEMO.

Category	A	B	C	D
Peak flow rate (standard cubic metres per hour)	>300,000	>40,000 ≤300,000	>4,000 ≤40,000	≤4,000
Minimum pressure and temperature transmitter calibration frequency	Quarterly	Six-monthly	Annually	Annually or as otherwise agreed with AEMO
Remote meter fault detection surveillance frequency	Daily by exception	Daily by exception	Daily by exception	Daily by exception
In situ meter proving frequency	Annually Note: for ultrasonic meters by electronic means	Annually Note: for ultrasonic meters by electronic means	Annually or as otherwise agreed with AEMO Note: for ultrasonic meters by electronic means	Annually or as otherwise agreed with AEMO

2.5 Uncertainty Limits for Energy Calculations

The table below sets out the uncertainty limits required to be achieved in calculating energy values at transfer points on the DTS. These limits have been developed to be apply to the energy quantity measured across a gas day.

Category	Flow rate range (standard cubic metres per hour)	Uncertainty limits (energy)
A	>300,000	±1.0%
B	>40,000 and ≤ 300,000	±1.5%
C	>4,000 and ≤ 40,000	±2.0%
D	≤4,000	±3.0%

CHAPTER 3. ENERGY CALCULATION PROCEDURES

3.1 Introduction

Consumer meters measure gas volume flow at the prevailing pressure and temperature of the gas flowing through the meter. This measured volume flow is converted to the volume the gas would occupy at standard (sometimes called reference or base) conditions (101.325 kPa absolute and 15°C).

This corrected volume is then multiplied by the heating value of the gas (energy per unit standard volume) to obtain the energy content. Meters with higher flowrates or pressures require more sophisticated energy calculation methods and since consumer meter installations cover a wide range of flow rates and pressures, a number of different techniques are used. These procedures contain the energy calculation methodology for the three meter types used at *distribution delivery points*.

3.2 Scope

The procedures in this chapter are made under rule 303(6) of the NGR and relate to the calculation of natural gas energy at *distribution delivery points*. These procedures do not cover *metering installations* directly connected to the AEMO-operated gas transmission system, as the "Gas Metering – CTM Data Requirements" document, covers these meters. Unless there is an agreement to the contrary, this procedure does not apply to either of the following:

- meters in areas that have derogations under Part D of the Gas Distribution System Code
- meters in areas that are not supplied from the AEMO-operated declared transmission system.

3.3 Energy Calculation Methodology

3.3.1 Flow Corrector Meter Energy Calculation

For *metering installations* with data logger flow-correctors where the corrected volume is calculated from metered volume readings, pressure and temperature measurements and gas composition data the following applies:

At the *metering installation*:

The volume of gas (in standard cubic meters) flowing through a meter each hour is calculated by the flow corrector according to the following formula each hour:

$$V_h = \sum_{i}^{h} [(Umeas_i \times Pmeas_i \times Tbase_i \times Zbase_i) \div (Pbase_i \times Tmeas_i \times Zmeas_i)]$$

Note: Individual measurements are usually converted to an hourly average value.

Energy calculation:

The hourly energy flow (in GJ) is calculated according to the following formula for each hour.

$$Q_h = HV_h \times V_h \div 1000$$

The total quantity of gas (in GJ) for the metered period is calculated according to the following formula:

$$Q = \sum_{h}^{TotalHours} Q_h$$

Where:

$\sum_{i}^{h} x_i$	The summation of x over each interval (i) until all intervals in the hour (h) have been summed together.

$\sum_{h}^{TotalHours} x_h$	The summation of x over each hour (h) until all hours (h) in the metering period (TotalHours) have been summed together.
Q	The total energy value of a quantity of gas (in GJ).
Q_h	The hourly quantity of gas measured in energy (GJ)
X_i	An individual measurement of parameter X made by the meter within the hour.
V_h	The hourly–corrected volume flow in standard cubic metres.
HV_h	The hourly zonal heating value of gas (in MJ per standard cubic metre) as published by AEMO for the appropriate heating value zone.
U_{meas}	The uncorrected flow (in cubic metres) measured by the meter.
P_{meas}	The measured gas pressure (in kPa absolute) being the gauge pressure plus 101.325kPa.
T_{meas}	The measured gas temperature (in Kelvin), being °Celsius temperature plus 273.15.
Z_{meas}	The compressibility at the measured pressure and temperature, as per NX-19.
P_{base}	The base pressure (in kPa absolute), being 101.325 kPa.
T_{base}	The base temperature (in Kelvin), being 288.15 Kelvin.
Z_{base}	The compressibility at base pressure and temperature, as per NX-19.
$TotalHours$	The Total number of hours for the metered period.

Where the installation is such that a temperature probe has not been installed, the temperature will be deemed to be 15°C and this figure will be used in calculations.

AEMO will publish the gas composition data (relative density, nitrogen and carbon dioxide concentration) to be applied in the NX-19 algorithm.

3.3.2 Data Logger Meters – PCF Energy Calculation

For *metering installations* fitted with data loggers that record only the hourly meter readings in cubic metres and do not determine the corrected volume of gas, the following applies:

At the *metering installation*:

The data logger records the hourly meter readings, U_h

Energy calculation:

The calculation of the hourly–corrected volume of gas (in standard cubic meters) is according to the following formula each hour:

$$V_h = U_h \times PCF$$

The calculation of the hourly quantity of gas (in GJ) is according to the following formula for each hour:

$$Q_h = V_h \times HV_h \div 1000$$

The total quantity of gas (in GJ) for the metered period is calculated according to the following formula: $Q = \sum_{h}^{TotalHours} Q_h$

Where:

Q	The total energy value of a quantity of gas (in GJ).
Q_h	The hourly quantity of gas measured in energy (GJ).
$\sum_{h}^{TotalHours} x_h$	The summation of x over each hour (h) until all hours (h) in the metering period (TotalHours) have been summed together.
U_h	The hourly actual flow (in cubic metres) measured by the meter for each hour of the billing period.

V_h	The hourly-corrected volume flow in standard cubic metres.
HV_h	The hourly zonal heating value of gas (in MJ per standard cubic metre) as published by AEMO for the appropriate heating value zone.
$TotalHours$	The total number of hours for the metered period.
PCF	The pressure correction factor applied to convert the metered volume of gas to standard cubic metres.

3.3.3 Basic Meter Energy Calculation

For *metering installations* not fitted with data loggers read at the start and end of each measurement period, the following applies:

At the *metering installation*:

The meter index is read at the start and end of the metering period. The difference between the readings (in cubic metres) indicates the volume of gas passed by the meter.

Energy Calculation:

The total corrected volume in standard cubic meters for the metered period is calculated according the following formula:

$$V = U \times PCF$$

The quantity of gas (in MJ) for the metered period is calculated according to the following formula:

$$Q = V \times HV_{ave}$$

Where:

Q	the quantity of gas (in MJ) for the metered period
U	the flow (in cubic metres) measured by the meter for the metered period
V	the volume, in standard cubic metres, for the metered period
PCF	the pressure correction factor applied to convert the metered volume of gas into the same pressure and temperature as the base pressure and base temperature used for heating value
$HVave$	the average heating value of gas for the measurement period (in MJ per standard cubic metre) calculated as described in the AEMO Retail Market Procedures (Victoria). Where the meter is in an area that has derogation under Part D of the Gas Distribution System Code or is not supplied from the AEMO operated transmission system but there is an agreement that this procedure applies, an appropriate heating value will be used.

3.4 Imperial Meters

Where the meter at any type of installation is calibrated in imperial units, the volume flow must be converted to metric units.

3.5 Pressure Correction Factor

Pressure correction factors are only acceptable for volume conversion up to metering pressures of 450 kPa gauge. Above this pressure, the changes in gas compressibility with changes in pressure and temperature become significant and must be taken into account by use of flow-correctors. A table of pressure correction factors is published by AEMO.

AEMO will only change the basis on which pressure correction factors are calculated after consultation with participants. The implementation date of any changed pressure correction factors will be set after consultation with participants. Pressure correction factors for additional pressures within the pressure range of the existing table may be calculated on the same basis as the existing table and published by AEMO without consultation.

CHAPTER 4. METERING COMMUNICATIONS PROCEDURES

4.1 Introduction

Under rule 308(1) of the NGR, AEMO must collect metering data from all *metering installations* from which metering data is required for settlement purposes. The *responsible person* for each *metering installation* must ensure that the metering data is capable of being transmitted, or otherwise collected, from their *metering installation* and delivered to the *metering database*.

4.2 Scope

The procedures in this chapter are made under rule 308(4) of the NGR. These procedures:

- describe AEMO's communications and data requirements;
- set out the communication interfaces and associated parameters between the *metering installation* (maintained by the *responsible person*), and the *metering database* (maintained by AEMO or its appointed Metering Data Agent (MDA));
- cover both Custody Transfer Meters (CTMs) and Daily Meters (DMs);
- define the communications requirements for the transfer of Gas Composition Data (GCD), relative density and Heating Value (HV) from gas quality monitoring systems to the *metering database* and from there to other *metering installations*; and
- defines the interface requirements between the AEMO SCADA host and third party Management and SCADA systems.

4.3 Requirements

4.3.1 Performance

Where a third party telecommunications network (e.g. public switched telephone network (PSTN), packet switched radio or digital radio network) is used to communicate between the MDA and each *metering installation*, or between the MDA and a Market Participant, the Market Participant shall use their reasonable endeavours, working together with the MDA, to ensure the network continues to meet functional, performance and capacity requirements.

Custody Transfer Meters

The CTM RTU shall have provision for hourly electronic transfer of data between the *metering installation* and the MDA systems unless otherwise agreed.

Daily Meters

The DMs data logger shall provide transfer of data between the *metering installation* and the MDA's systems either electronically daily or via manual collection of data twice a month or as approved by AEMO.

4.3.2 Timing

Both CTM and DM clocks are to be referenced to Australian Eastern Standard Time with an accuracy of ± 5 secs.

All data transferred shall be time and date stamped as detailed in:

- Gas Metering – CTM Data Requirements
- Gas Metering – DM Data Requirements
- Gas Quality Standard and Monitoring Guidelines

4.3.3 Reliability

Communication links for both CTMs and DMs must be of a reliable design so that at least 95% of the time data is downloaded or uploaded from the *metering installation* on the first attempt.

4.3.4 Availability

Metering data in hourly intervals shall be available for communication from both DM and CTM *metering installations* for the total of the stored data.

The communications link shall be available for transfer of data between the *metering installation* and the *metering database* for at least 95% of the year and within the time required for settlement as stated in the Division 2 Subdivision 6 of the NGR or as otherwise agreed between AEMO and the *responsible person*.

4.3.5 Security and Confidentiality

Metering data shall be secure from either local or remote unauthorised access by suitable electronic access controls. Affected Participants shall have, where practical, read only access.

Metering data and passwords are confidential and each Participant must ensure they are treated as confidential information.

Refer to NGR for further details regarding security of *metering installation*s.

Metering installations will also need to meet relevant legislative security requirements.

4.3.6 Communication Protocol

The communications protocol required to read metering data shall be network independent and be supportable by AEMO or the MDA.

Custody Transfer Meters

AEMO's SCADA system currently supports communication to Bristol 3305, 3310, 3330 and ControlWave RTUs as widely used at current CTM *metering installation*s. This system makes use of the BSAP (Bristol Standard Asynchronous Protocol) communications protocol. Other communication protocols and RTUs will be considered provided the *responsible person* covers development and implementation costs.

Daily Meters

A configuration file detailing how the site is polled and any other information that may be required to read the meter must be supplied to the MDA.

4.3.7 Polling Frequency

Custody Transfer Meters

AEMO's SCADA system polls all metering sites at least once every 30 minutes.

Daily Meters

Refer to section 4.3.1.

4.3.8 Data Requirements

For CTM data requirements refer to “Gas Metering – CTM Data Requirements”.

For DM data requirements refer to “Gas Metering – DM Data Requirements”.

For gas quality requirements refer to “Gas Quality Standard and Monitoring Guidelines (Declared Transmission System) “.

CHAPTER 5. INSTALLATION DATABASE PROCEDURES

5.1 Introduction

The procedures in this chapter are made under rule 309 of the NGR. The Rules specify that each *responsible person* must maintain a database with information about their *metering installations*. The purpose of these procedures is to set out the information that is to be contained in installation databases for the DWGM in accordance with Part 19 of the Rules.

5.2 Requirements

Each installation database must contain the following information and such other information related to a *metering installation* as specified by AEMO:

1. Metering point reference details, including:
    a. Locations and reference details (e.g. drawing numbers).
    b. Site identification names.
    c. Details of affected Participants associated with the system point.
    d. The *responsible person*.
    e. Metering installation registration number (MIRN).
    f. Base load.
    g. Temperature sensitivity factor.
    h. Customer characterisation.
2. The identity and characteristics of metering equipment including:
    a. Serial numbers.
    b. Metering installation identification name.
    c. Metering installation types and models.
    d. Current test and calibration programme details, test results and references to test certificates.
    e. Calibration tables, where applied to achieve *metering installation* accuracy; and data register coding details.
3. Data communication details, including:
    a. Telephone number(s) (or frequency details in the case of telemetric equipment) for access to data.
    b. Communication equipment type and serial numbers; communication protocol details or references.
    c. Data conversion details.
    d. User identifications and access rights.
    e. “Write” password (to be contained in a hidden or protected field).

CHAPTER 6. METERING REGISTER PROCEDURES

6.1 Introduction

The procedures in this Chapter are made under rule 311 of the NGR.. The Rules specify that AEMO must maintain a register of all *metering installations* that provide data used for settlement purposes. The purpose of these procedures is to set out the metering information that is to be contained in the metering register for the DWGM in accordance with Part 19 of the Rules.

6.2 General

1. The metering register forms part of the *metering database* and holds metering information relating to *metering installations*.
2. The purpose of the metering register is to facilitate:
   (d) Registration of system points, *distribution delivery points*, metering points and affected Participants.

   (e) Verification of compliance with the Rules.

   (f) Audit of changes to registered information.

6.3 Metering Register Information

Metering information to be contained in the metering register should include such information as AEMO considers reasonably necessary and by way of example, may include the following:

1. Meter identification:
   (a) Metering installation registration number (MIRN).

   (b) Logical meter identification - if a logical meter.

   (c) Logical meter algorithm - if a logical meter.
2. Location in market:
   (a) Custody Transfer Meter group identification custody transfer meter is defined in the Retail Market Procedures (Victoria).

   (b) Heating value zone. Heating value zone is defined in the Retail Market Procedures (Victoria).

   (c) Unaccounted for gas (UAFG) zone. See Attachment 6 of the Retail Market Procedures (Victoria).

   (d) *System withdrawal zone*.

   (e) *System injection point*.

   (f) Transmission zone (TUoS zone).

   (g) Hub identification.

   (h) Hub flow direction.

   (i) Transmission or distribution *connection point* identification.

   (j) Base load; Base load is defined in the Retail Market Procedures (Victoria).

   (k) Temperature sensitivity factor.
3. Parties identification:
   (a) Metering data agency identification.

   (b) *responsible person* identification.

   (c) Market Participant settling account identification.

(d) Declared host Retailer identification.

(e) Supplying Retailer identification.

(f) Distributor identification.

(g) Identification of the energy values provider[1].

(h) Supplier of last resort identification[2].

4. Data validation and substitution processes agreed between affected Participants, including:

   (a) Algorithms.

   (b) Data comparison techniques.

   (c) Processing and alarms.

   (d) Alternate data sources.

5. Meter information:

   (a) Meter type.

   (b) Meter size.

   (c) Meter maximum capacity.

[1] Being the party who has either a contractual or regulatory obligation to provide AEMO with data to support settlement.
[2] See Clause 6.1.3 of the Retail Market Procedures (Victoria) and section 51D of the Gas Industry Act 2001 (Vic)

CHAPTER 7. DATA VALIDATION PROCEDURES

7.1 Introduction

Before metering data is sent to the AEMO's settlements system, it undergoes two separate stages of data cleaning. The first is a set of automatic checks (validation) that identify either missing data or data that has a value outside its expected range. The second is a set of manual checks and data substitution.

7.2 Scope

The procedures in this chapter are made under rule 314(2) of the NGR. They cover the automated validation and substitution parameters to be applied to CTMs, DMs and Gas Chromatographs for which AEMO is the MDA.

7.3 Policy

The validation and substitution parameters are chosen to ensure that only valid data passes through the Metering Data Application (MDA application) and that invalid or missing data is substituted in a manner that gives the greatest probability of being representative of the actual flows. Note that all data points that have failed validation receive an automatic substitution and are also reviewed manually on a monthly basis.

7.4 Procedure

7.4.1 Choice of Validation Parameters

The validation rules currently used in the MDA application are:

Rule	Description
Missing Record	Check for missing data
High Low	Check for data outside specified (upper and lower) limits

No parameters are required for the "Missing Record" validation rule.

The "High Low" validation rule requires the setting of both a low and a high limit. The low limit should always be set to zero. All meters can show valid zero flow albeit during abnormal transmission system operation.

The high limit should be set to represent the maximum valid capacity of the metering site. The maximum valid capacity will be the lower of the maximum physical capacity of the site and the maximum gas consumption that the metering site feeds. In determining the maximum valid capacity, the calibrated range of the metering device also needs to be taken into account.

The determination of the maximum physical capacity will depend on the nature of the site:

- Turbine meters are usually fitted with a critical flow nozzle ("sonic nozzle") down-stream, which limits the maximum actual volume flow through the meter to less than 120% of the design capacity of the meter. The maximum valid capacity can thus be calculated from the maximum actual flow through the meter/nozzle combination at the maximum expected supply pressure.
- Rotary meters will have a nominated maximum actual design capacity (and may be fitted with a critical nozzle). The maximum valid capacity can thus be calculated from the maximum actual flow through the meter at the maximum expected supply pressure.
- Coriolis meters do not have a sharply defined physical limit on flow capacity. They are capable of measuring flows even when the pressure drop becomes unacceptably high from a supply perspective. The maximum valid capacity is more closely aligned to the calibrated range and could be set at values up to twice the calibrated range, as the change in meter factor is small at high flows.

- Ultrasonic meters are usually limited by a maximum gas velocity, which equates to a maximum actual volume flow through the meter. The maximum valid capacity can thus be calculated from the maximum actual flow through the meter at the maximum expected supply pressure.
- Orifice meters are usually limited by the maximum range of associated differential pressure transducers. The maximum actual volume flow rate is determined by the meter design.

The determination of the maximum gas consumption at a metering site depends on the facilities downstream of the *metering installation*.

For some sites, the maximum flow may be much smaller than the design capacity of the site. For these sites an upper limit between the design capacity of the site and normal maximum flows would be appropriate.

7.4.2 Choice of Substitution Parameters

The automated substitution rules currently used in the MDA application are:

Rule	Description – Replace invalid (or missing) data as indicated
Default	Fixed site specific figure
Prev. Valid	Use last previous valid data (for set number of hours)
Like site	Use data from similar site (with appropriate scaling)
Prev. Week	Use data from a similar day of the week (at same time of day)
Prev. Next	Not used for automated validation
Energy	Not used for automated validation
Like Day	Not used for automated validation
Week Average	Use the average of data from a week of valid data
Month Average	Use the average of data from a month of valid data

The choice of which of the above rules are used and the order in which they are used depends on the nature of gas flows through the *metering installation*. It is best to consider the likely flow behaviour (load) of the site over a full year in determining the substitution parameters for any particular site. Note that each rule can be applied only once and that no rule after the “Default” rule will be applied.

The general scheme is to use “Prev. Valid” for a number of hours depending on the hour-to-hour volatility of the load. If the load is likely to undergo significant changes between consecutive hours (for example gas fired power generation or predominantly domestic loads), then one or two hours would probably be the most appropriate. The shorter period would be used for sites that change more rapidly. If the load is relatively constant (for example chemical plants using gas as a feedstock) then four () hours would probably be the most appropriate. The length of time that “Prev. Valid” should be used depends on judgement and past experience, and longer times may be appropriate.

The next rule is based on the yearly flow behaviour. This could be a “Default” value for a site with a near constant load or could be “Prev. Week” for sites that show a weekly cycle and which probably also show a season-to-season cycle. AEMO has found that some sites show similar weekly and season-to-season cycles, only differing from each other in the scale of the flows. For these sites, the “Like Site” substitution can be used, where substitution is based on a site with similar flow behaviour and an appropriate scaling factor. These sites are often sites with significant (temperature dependant) domestic load and similar percentages of industrial (temperature independent) base-load.

The “Week Average” rule used in situations where the load may be erratic and show no regular weekly cyclic behaviour and “Month Average” rules is used in situations where the site may show significant week-to-week variations.

The final rule applied is usually the “Default” rule to capture the remote possibility of system fault where previous rules cannot be applied. The default value for sites that show season-to-season variations should be based on the midpoint between the summer and winter flows.

7.4.3 Special Cases

During field commissioning and testing of new metering sites, it would be usual to set the validation rules to zero to force a substitution and set the substitution to default zero so that any spurious test signals are replaced by zero in the market systems. The more appropriate validation and substitution rules are then implemented when the field commissioning is completed.

Heating Values from Gas Chromatographs generally have a similar set of validation and substitution rules unless specific situations require particular rules. The validation rules are “Missing Record” and then “High Low” with upper and lower parameters 44.2 and 34.9 (MJ/m^3) respectively. The substitution rules are previous valid (typically for 24 hours) and then “Default” with a reading of 38.66 (MJ/m^3).

Where a meter or gas chromatograph is known to be likely to be giving false readings, substitutions can be forced to occur by setting the validation limits to fail all readings, for example by setting the upper parameter to the same as the lower parameter.

7.4.4 Recording Parameter Approval and Changes

Validation and substitution parameters are recorded in AEMO’s MDA application. When changes are made to these parameters, they are reviewed, recorded as part of a change process and in the MDA application, and published on the MIBB.

7.4.5 Review of Validation and Substitution Parameters

Validation and substitution parameters are reviewed as necessary when installations are brought on-line or significantly modified. Ad hoc reviews are conducted when inappropriate validations or substitutions are detected during the review of meter substitutions carried out each month. Complete review of substitutions parameters at all sites should be carried out at 5 yearly intervals. Validation limits should be reviewed when meters are up-graded or replaced and whenever validation limits are breeched during abnormal periods of high flow.