Technical Specification

VOLUME CONVERSION UNIT AND DATA TRANSMISSION (PTZ WITH INTEGRATED AMR)

ET 453

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Register of revisions

Revision number	Date	Motif
0	2015-05-04	Initial wording.
1	2019-07-01	Overhaul.
2	2021-10-28	Update §8.5.2.
3	2023-03-29	General revision carried out by IDOM Consulting, Engineering, Architecture, SAU

Information classification

Confidential	☐	Restricted	☐	Internal use	☐	Public	☒

Distribution of the document

External	Contractors ☐ Qualified for Allotments ☐ Internet ☒ Other ☐
Internal	CA ☐ AT ☒ ACR ☒
	AT-ED ☐ AT-EX ☐ AT-GE ☐ AT-MS ☐ ACR-DC ☐ ACR-GC ☐ ACR-RD ☐
Nominal	< name, function, position >

Caption:

CA: Board of Directors
AT: Technical Area
AT-ED: Technical Area - Engineering and Development
AT-EX: Technical Area - Exploration
AT-GE: Technical Area - Energy Management
AT-MS: Technical Area - Maintenance and Systems
ACR: Clients and Networks Area
ACR-DC: Clients and Networks Area - Commercial Development
ACR-GC: Clients and Networks Area - Large Consumption
ACR-RD: Clients and Networks Area - Networks

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The approval of this document formalised in this page, prevails over the totality of its contents.

Preamble

As part of the "H2 REN Programme" aimed at adapting technical specifications to prepare assets to receive hydrogen up to 100%, Portgás identified this regulation to be subject to assessment and consequent revision.

The revision now presented results from the work conducted by IDOM Consulting, Engineering, Architecture, SAU, who introduced the necessary changes to the specification in order to ensure that the "Gas volume conversion and data transmission electronic devices (PTZ with integrated AMR)" supplied under this specification are ready to receive hydrogen.

This revision of ET 453 cancels and replaces the previous revision dated 28 October 2021, and it is advisable to read this technical specification in full for a correct application of its provisions.

This technical specification should be given the status of a Portgás standard which establishes the rules to be followed to achieve the discriminated objective.

1. Objective

The purpose of this Technical Specification for Materials is to define the main construction, testing and operating characteristics of electronic devices for gas volume conversion and data transmission (PTZ with integrated AMR), as well as the technical requirements and conditions to be met with a view to approval of the model to be supplied to Portgás.

2. Scope

This technical specification applies to all Type 1 gas volume conversion devices (complete system according to EN 12405) that correct the gross meter volume for the base conditions according to pressure, temperature and considering the compression factor that compensates for deviation from the law of perfect gases (PTZ type) and that incorporate a modem that sends data to the Portgás central telemetering station via GSM/GPRS or NB-IoT. This specification is intended for units that can operate with a working pressure below 20 bar (rel).

3. References

All undated documents should be considered in their latest version.

3.1. External references

Directive 2014/32/EU

"Directive on the harmonisation of the laws of the Member States relating to the making available on the market of measuring instruments (recast)".

Directive 2014/34/EU

"Directive on the harmonisation of the laws of the Member States relating to equipment and protective systems intended for use in potentially explosive atmospheres (recast)".

EN 12405

"Gas meters - Conversion devices Part 1: Volume conversion".

"Gas meters - Conversion devices Part 3: Flow computer".

EN 12213

"Natural gas - Calculations of compression factor - Part 2: Calculation using molar-composition analysis (AGA8-92DC equation)".

"Natural gas - Calculation of compression factor - Part 3: Calculation using physical properties (SGERG-88 - virial equation)".

EN 1776

"Gas supply: Natural gas measuring stations - Functional requirements".

NP EN 60529

"Degrees of protection provided by enclosures (IP Code)"

3.2. Internal references

ET 405

"Equipment coding: Internal number and barcode definition"

4. Definitions / Abbreviations

Measurement Chain

A series of elements of a measuring system, which forms a single signal path from the sensor to the output element. The measurement chain consists of a meter and, where required, a DECVG, with its temperature and pressure measuring elements.

Calculator

Electronic device that receives the signals emitted by the meter and pressure and temperature transducers and carries out the calculations.

Basic conditions

The following reference conditions are considered: 0 °C temperature, 1.01325 bar absolute pressure and 25 °C initial combustion temperature.

Flow conditions

Pressure and temperature conditions of the gas in the measurement chain.

Correction

Method used to convert gas volume at flow conditions to base conditions.

Electronic Gas Volume Conversion Device (DECVG)

Equipment designed to convert the volume of gas measured in a meter by the effect of temperature, pressure and compressibility factor in relation to the base conditions of pressure and temperature.

Gas volume conversion device type 1 (complete system)

Conversion device with specific types of transducers for pressure and temperature or only for temperature.

Conversion factor

Factor equal to the volume at base conditions divided by the volume at measured conditions.

Operating pressure

Difference between gas pressure at the meter inlet and atmospheric pressure.

Count data transmission unit (AMR - Automatic Meter Reading)

Equipment designed to collect data, store it and transmit it via GSM (*Global System for Mobile Communications*) / GPRS (*General Packet Radio Service*) to the Portgás telemetering centre.

5. Regulatory compliance

The electronic gas volume conversion devices associated with meters shall comply with the requirements and tests for construction, operation, safety and compliance of standard EN 12405-1 and with the specificities referred to in this document.

European directives must also be fully complied with:

- Directive 2014/32/EU - "Directive on the harmonisation of the laws of the Member States relating to the making available on the market of measuring instruments (recast)"

- Directive 2014/34/EU - "Directive on the harmonisation of the laws of the Member States relating to equipment and protective systems intended for use in potentially explosive atmospheres (recast)"

6. Rated operating conditions

6.1. Ambient temperature range

The units must withstand an ambient temperature of at least - 25 °C and a maximum of + 55 °C.

6.2. Humidity range

The equipment shall be designed for condensing humidity, meeting the requirements of test A.5 of EN 12405-1.

6.3. Mechanical environment class

The equipment must be of mechanical class M2 (according to standard EN 12405-1), i.e. it can be used in locations with high or significant levels of vibration and shock.

6.4. Electromagnetic environment class

The equipment shall be of electromagnetic environmental class E2 (according to EN 12405-1), i.e. it may be used in locations with electromagnetic disturbances corresponding to those that may be found in industrial buildings.

7. Construction and metrological performance requirements

7.1. Essay

The construction and metrological performance requirements are guaranteed by compliance with the tests for conformity to standard EN 12405-1.

List of applicable tests:

- Accuracy
- Ambient temperature
- Damp heat, continuous test
- Damp heat cyclic
- Power supply variation
- Reduction of short-term consumption
- Electric discharges
- Electromagnetic immunity

- Electrostatic discharges
- Pressure overload
- Vibration
- Shocks
- Pressure overload (mechanical)
- Durability
- Alarm operations
- Repeatability
- Short variations in DC current
- Overvoltage's on supply or signal lines
- Magnetic field at mains frequency

The requirements and procedures of each test should be consulted in the standard.

7.2. Maximum permissible errors

The maximum permissible errors according to EN 12405-1 for type 1 conversion devices are as follows:

Reference conditions	Rated operating conditions
0,5 %	1 %

Table 1

8. Design requirements

8.1. Security

The conversion device must be approved according to Directive 2014/34/EU and comply with the ATEX certificate of verification.

The equipment must be capable of operating in potentially explosive atmospheres with a minimum equipment category of 2.

The equipment, in an integrated form (including batteries), must be constructed and approved as being intrinsically safe.

The protection index suitable for outdoor installation must be at least IP65 in accordance with EN 60529.

8.2. Gas temperature measurement

The equipment must be fitted with an integrated Pt100, Pt500 or Pt1000 temperature probe, class AA in accordance with IEC 60751, connected to a HART temperature transducer.

The sensors shall be designed for an extended measuring range for gas temperature (-20 °C to +50 °C).

The probe cable should be a minimum of 2 metres long.

8.3. Gas pressure measurement

An absolute pressure transducer shall be used. The pressure transducer for hydrogen distribution shall be compatible with the appropriate material in order to prevent permeation and corrosion.

The pressure transducer shall be calibrated in a specific range by the manufacturer, which shall be at least:

$$\frac{p_{max}}{p_{min}} > 2$$

Portgás suggests the following pressure ranges (indicative values):

0 - 10 bar (abs): Range covering most customers

4 - 20 bar (abs): Range covering customers supplied at exceptional pressures

The equipment must make it possible to connect a second pressure transducer to monitor the pressure upstream of the pressure regulator.

8.4. Compression factor

The compression factor shall be calculated according to the SGERG-88 method.

Note: For distribution of gas with 100% H2, it is feasible to use the ideal gases law. On the other hand, for mixtures, it will be the supplier's responsibility to calculate the correct compressibility factor.

8.5. Food

8.5.1. Battery

One or more replaceable lithium thionyl chloride batteries (or equivalent), type D, with a voltage of 3.6 V and a nominal capacity of at least 17 Ah must be used to supply the volume equipment. Regarding back-up time (minimum 5 years), the EN 12405-1 standard must be complied with.

For the data transmission unit, battery *packs* are admitted, provided that a minimum autonomy of 5 years is guaranteed, considering a daily communication for data sending and a weekly maintenance window of 10 minutes. The battery *packs* should preferably be composed of the same type of batteries that supply the volume conversion unit.

8.5.2. External power supply

The equipment must be equipped so that it can be powered from an external source.

8.5.3. *Back-up* battery

In case of battery replacement, due to end of life of the main battery or failure of the external power supply there must be a *back-up* battery that ensures the operation of the equipment until the fault is corrected in accordance with EN 12450-1.

8.6. Display

The display, in addition to meeting the requirements of EN 12405-1, shall be back-lit so that it can be read in low light conditions.

9. Data transmission

9.1. Firmware

The conversion device shall allow remote *firmware* upgrade.

9.2. Entries

The units must have at least two configurable digital inputs for inputting signals from the volumes measured by the counting units. The two inputs must allow the connection of counting pulses of the LF type (low frequency of the REED *Switch* or *Wiengang* type) up to 4 Hz. These inputs must allow the connection of *encoder-equipped* counters.

9.3. Outputs

The conversion device must have:

- At least 4 independent and configurable outputs, for volume and alarm transmission (*opto-coupler* type, open *collector*).
- Local interface for connection to other systems - RS232 / RS485
- Standardised optical interface for connection to a portable system for the configuration, consultation and downloading of stored information.
- Modbus RTU communication protocols. The communication and address protocol must be configurable in the field by the user.
- Configuration and reading software compatible with Microsoft Windows® environments.

The supplier must guarantee data integration in Portgás' current telemetering system.

9.4. Modem

9.4.1. General

The modem must be able to send the local logs and files (*logging*) to the telemetering central office via GSM/GPRS or NB-IoT.

In addition to communications, the unit must allow the creation of communication windows for remote maintenance. The system must allow the parameterisation of communication to and from the centre to be independent (and therefore potentially distinct).

The periodicity of communications to the central telemetering system must be configurable between 1 minute and 1 month.

9.4.2. Antenna

The device shall be supplied together with the antenna. The antenna shall be external and replaceable.

9.5. Wi-Fi

As an option, Portgás may request a Wi-Fi module that allows data transmission using the customer's internet connection.

10. Memory

The equipment must be able to make local records and files (*logging*) with counting-relevant information that must be accessible on site and transferred to a portable (PC-type) system for later viewing and processing.

Periodic files, programmable between 1 min and 60 min, for the following data:

- Total uncorrected volume (m3);
- Total corrected volume (Nm3);
- Total volume with PTZ in alarm (m3);
- Total volume corrected with PTZ in alarm (Nm3)
- Uncorrected hourly flow rate (m3/h);
- Corrected hourly flow rate (Nm3/h);
- Correction factor;
- Compression factor;
- Average temperature;
- Medium pressure;
- Battery level.

Daily files

- Total uncorrected volume (m3);
- Total corrected volume (Nm3);
- Total volume with PTZ in alarm (m3);
- Total volume corrected with PTZ in alarm (Nm3)
- Uncorrected hourly flow rate (m3/h);
- Corrected hourly flow rate (Nm3/h);
- Correction factor;
- Compression factor;
- Average temperature;
- Medium pressure.

Maximum and minimum files

- Uncorrected hourly flow rate (m3/h);
- Corrected hourly flow rate (Nm3/h);
- Correction factor;
- Compression factor;
- Average temperature;
- Medium pressure;

Monthly files

The memory capacity of the broker should allow the recording of the above listed files for a minimum period of 12 months, for a data archiving periodicity of 60/60 min.

11. Alarms

The device must be able to detect:

- If any of the measured or calculated values are outside the specified value range;
- If the instrument operates outside the input range of the calculator;
- If any electrical signal is outside the input range of the calculator;

Under these conditions, volumes corrected with unmeasured temperature and/or pressure data (due to sensor malfunction, for example) should be saved in an alarm and duly marked.

12. Marking

12.1. Type plate

Each unit must have a rating plate bearing the following information:

a) Affixing the CE marking and the supplementary metrology marking as defined by Directive 2014/32/EC;
b) type approval mark or number;
c) logo and/or name of the manufacturer;
d) instrument serial number and year of manufacture;
e) risk area classification of the volume conversion device;
f) MPE under reference conditions;
g) bar code;
h) Portgás logo;

All markings must be indelible, legible, easily visible under normal operating conditions of the equipment.

12.2. Bar code

Individually, the electronic gas volume conversion and data transmission devices shall be provided with a bar code, placed in an easily readable location on the same face of the display, in accordance with the Portgás - ET 405 technical specification.

13. Sealing

All equipment must be provided with sealing points that can easily reveal any foreign intervention tending to alter its operation. One of these points is reserved for the exclusive use of the manufacturer or repairer.

14. Transport and packaging

During transport and storage, the unit's connections must be protected with suitable covers to prevent any accidental ingress of foreign bodies.

The packaging should be prepared to minimise damage to the equipment during transportation and steps should be taken to ensure stable transportation.

15. Materials Qualification System

The materials supplied under this technical specification must be subject to an assessment of conformity and quality against the requirements listed.

The assessment guarantees support for Portgás' standardisation system as a quality mechanism for the supply of materials/products for the gas infrastructure.

Portgás is responsible for the approval process.

The suppliers shall share the documentation foreseen in this document, as well as other elements they consider relevant for the evaluation of the application process, culminating in the production of an Approval form to be shared with the supplier.

15.1. Modification of an approved model

If the supplier modifies a previously approved template, it will be removed from the list of approved materials and the supplier must submit a new request for approval according to the Material Qualification System.

16. Provision of technical documentation

The supplier must deliver the following documentation, in digital format:

- Technical documentation of the equipment:
  - Description, characteristics and its components;
  - Operation and maintenance manual for the equipment;
  - List and characteristics of the materials used;
  - Detailed design;
  - Declaration that indicates that the model was designed and built according to the regulations and standards in force, citing them. The declaration must also state that the equipment is manufactured in accordance with the standards and requirements officially approved in this technical specification.
  - Life cycle analysis descriptive document, according to ISO 14040 (Environmental management - Life cycle assessment - Principles and framework).
  - Document describing the compatibility analysis with hydrogen at ratios of up to 20% hydrogen of the gas volume
- Certificates of conformity issued by the manufacturer, in accordance with the standards used.