

**SPECIFICATION FOR UNDERGROUND
PRESSURE VESSEL TYPE
DISTRIBUTION STATIONS**

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1. Introduction

This specification is referred to pressure vessel type underground gas regulating stations where the housing is a (partly) pressurized vessel, containing all necessary components for pressure control and ancillaries.

This type of underground gas pressure regulating stations is installed below ground level as a module between the inlet and outlet pipe work. The components for pressure control (pressure regulating and pressure safety) are integrated in a single insert §4.3.6. In particular cases it may be required by EDA Attiki the station to be equipped with a meter device installed in a separate underground watertight vessel.

2. Scope

This specification contains the relevant minimum functional requirements for buried pressure vessel type underground gas pressure regulating stations, which form a part of gas distribution systems and have a maximum upstream operating pressure which does not exceed 19 bar (Class 150#) and have a design temperature of -15 to 50 °C.

This standard is applicable to the design, materials, construction, and testing thereof specific requirements for individual components (valves, regulators, safety devices etc.) are contained in the appropriate international standards.

3. Design

3.1 General

We distinguish two cases:

1. Distribution stations where:

6 The inlet operating pressure (P_i) will be: $6 \leq P \leq 19$ barg. The outlet operating pressure (P_a) will be: $1 \leq P_a < 5$ barg.

The typical inlet and outlet dimensions are 4" and 6" accordingly. However, in certain cases EDA Attiki may require for different inlet and outlet pipe diameters, which will be specified at the time of the order. The regulator shall be provided with springs proper for the outlet pressure P_a adjustment between 1 to 5 barg. The typical capacity of abovementioned stations is 5000 m³/h. However stations with capacity of 8000 m³/h may be required in particular cases. The calculations for the sizing of the station shall be performed at $P_i = 6$ barg and $P_o = 2$ barg. In addition, the maximum capacity and the maximum permissible velocity 25 m/sec (regulator exit is excluded) (with due care of the equipments of the station) shall be taken into account at the design stage.

The manufacturer of the station shall provide to EDA Attiki the relevant documentation in order to verify that the aforementioned parameters (P_i , P_a , maximum velocity, maximum capacity) were taken into account for the sizing of the station.

2. Distribution stations where:

The inlet operating pressure (P_i) will be: $1 \leq P_i \leq 4$ barg

The outlet operating pressure (P_a) will be: $25 \leq P_a < 75$ mbarg.

The typical capacities of the aforementioned stations are 500, 1000, 2000 Nm³/h.

The calculations for the sizing of the station shall be performed at $P_i = 1$ barg and $P_a = 0.025$ barg. In addition, the maximum (with due care of the equipment of the station) shall be taken into account at the design stage.

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6 The manufacturer of the station shall provide to EDA Attiki the relevant documentation in order to verify that the aforementioned parameters (P_i , P_a , maximum capacity) were taken into account for the sizing of the station. Inlet is $\Phi 125$ and outlet is $\Phi 225$ (unless other specified at the order).

Underground gas pressure regulating stations shall be designed, constructed, located, and operated taking into consideration the safety and environmental requirements.

The pressurized part of the station must conform to PED 97/23.

6 The station shall be rejected if it is not designed in such a manner that un-authorized or un-intended operation of the in- and outlet valves and pressure control components is prevented. All parts of the station shall be adequately protected against corrosion. The design of the station and the components used (for example safety devices) shall be such that there will be no continuous discharge of gas into the atmosphere. The regulator and slam shut device, as well as the monitor (if any), shall have an integral strength design.

All pressure containing parts, including those parts that become pressure containing in case of the rupture of a diaphragm shall have a design pressure not less than 19 bar (Class 150#) and a design temperature of -15 to 50 °C.

Sealing have to be designed and located in the station in such a manner that damaging and accumulation of dirt etc. during maintenance etc. is prevented. All materials that are exposed to the gas, especially sealings and filter elements, shall be resistant to condensate and substances normally used for odorization and conditioning of gases. They shall be resistant to the permissible impurities in the gas. Furthermore, they shall be resistant to rapid depressurization.

3.2 Components

The 19-4 bar underground pressure regulating station shall consist of two identical, with capacity 5000(8000) Nm^3/h pressure regulating units (the operating and the stand by one) connected in such a way that enables the interchange between the main unit and the stand by one to be possible only by adjusting the pressure set points. The 4-0.025 bar underground pressure regulating station shall be single stream unless otherwise required by EDA Attiki at the particular order.

Each pressure-regulating unit consists of the following basic components:

- Housing
- Filter
- Pressure regulator (active and monitor for the 19-4 barg station)
- 6 · Pressure safety system (at least slam shut valve and relief valve)
- Inlet and outlet maintenance and depressurization valves
- Pressure indicators

The whole station shall be equipped with street cover (made to withstand a 25 tons load) which could be the main cover of the vessel or a distinctive surface cover.

Each unit shall be equipped with a relief valve. The same vent pipe will be shared by the relief valve of each unit.

Regarding 4-0.025 barg underground pressure regulating station, inlet and outlet transition fittings (PE - steel) according to ΔΕΠΑ-PEMS 09 must be delivered if required by EDA order. However, monitor regulator is not considered obligatory. Inlet and

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outlet PE pipe must have a free length of about 50 cm for welding purposes, must be PE 80, SDR11, EN 1555.

Regarding 19-4 barg underground pressure regulating station it will be determined at the order whether insulating joints (according to EDA MR 001) are required to be included at the delivery. Inlet and outlet steel pipe must have a free length of about 50 cm for welding purposes and must be according to EN 10208/ISO 3183.

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Both station types must be delivered with proper support mechanism in the inlet and the outlet.

4. Requirements

4.1 Housing

4.1.1 General

The housing shall contain all components necessary for filtering, pressure regulating, and the pressure safety system.

It shall be an integral part of the gas distribution system and shall be placed totally below ground level with the exception of ventilation posts. It shall be partly pressurized with the gas from the upstream/downstream. Pilots, controllers for the pressure safety system, relief valves and pressure indicators shall be located in the non-pressurized compartment of the housing.

The housing up to and including the maintenance outlet valve as well as the inlet valve shall have a design pressure of at least 19bar (Class 150#) and a design temperature of -15 to 50 o C. For the strength calculation, manufacturing, quality control and testing, proper international design codes have to be applied The housing shall be capable of withstanding possible external loads that may occur during installation and operation.

All pressure containing parts of the housing shall be gastight.

The manufacturer shall provide covers for the pressure parts of the housing, designed in such a way that it is not possible to open them before the gas pressure has been released.

4.1.2 Strength

The housing shall be fabricated from rolled-forged or cast low carbon steel or other type of steel with equivalent or superior characteristics and quality.

The supplier shall prove the equivalent or superior quality of the proposed type of steel submitting proper documentation (test results). Regarding the 4-0.025 bar station, although steel is strongly suggested; cast iron is also an acceptable material for the housing of the station.

The safety factor (S) used in the strength calculation at the design pressure and the type of steel selected shall be defined and the manufacturer shall guarantee that the housing can withstand all internal and external forces without any permanent deformation.

4.1.3 Non- pressurized compartment

The non-pressurized compartment has to have vent connections that are sufficient to prevent disturbing quantities of condensate.

The non-pressurized compartment must have a watertight sealing that is independent from the street cover. The water tightness can be tested by covering the complete underground pressure regulating station without and with an opened street cover with at least 500 mm water. After 10minutes, no water shall have penetrated into the non-

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pressurized compartment. The manufacturer however, is free to apply alternative methods to check the water tightness, providing to EDA Attikis proper documentation for results.

Alternatively, in case that the non-pressurized compartment is not watertight a proper draining path shall be designed.

4.1.4 Corrosion protection

- 6 The housing shall have a proper corrosion protection coating (polyurethane base). Bolting that can come into contact with the soil shall be manufactured from a corrosion resistant material. When the coating is tested with a holiday detector at 15 kV and no pores are detected, the coating shall be considered accepted.

4.2 Filter

Each vessel shall be equipped with a filter to remove contamination that the gas may have picked-up in the pipeline upstream the station.

The filter element used shall at least remove 98% of all solid particles of at least 5 micrometer or bigger under all operating conditions.

The maximum pressure drop with a clean filter element shall not exceed 50 mbar.

Filter elements shall be able to withstand a pressure differential of 1 barg without deformation. The gas velocity at design conditions shall not exceed 0.3 m/s, based on the net filter surface and the gas flow expressed as actual m³/h. EDA Attikis requires for a differential manometer or another equivalent mechanism which will indicate the need for filter maintenance, to be installed. The filter element and the separated contamination must be easily removable from the housing.

The design shall be such that separated contamination cannot fall in the part of the housing downstream the filter element or on the inlet valve during maintenance.

4.3 Pressure control system

4.3.1 General

The pressure control system must consist of a pressure regulator and a pressure safety system.

Additional features of the pressure control system are:

- 6
- a relief device,
 - a pressure warning system (a pressure supervising system-SCADA system)

The pressure control system shall maintain the pressure in the downstream system within the required limits and shall ensure that this pressure does not exceed the permitted level. (The downstream system includes all the pipe work up to the next pressure boundary)

Under normal operating conditions the pressure regulator shall maintain the pressure in the downstream system within the band that is described by its accuracy class or lock-up pressure class if there is no gas flow. If a failure of the regulator occurs that results in an increase of the pressure in the downstream system, the pressure safety system shall assume control of the pressure at a higher set value, independent from the pressure regulating system.

In selecting the set points for the pressure safety system, the allowable set point deviations shall be taken into account.

Regarding 19/ 4 barg station, the pressure safety system shall consist of a monitor regulator plus a slam shut device. The station will be equipped with a relief device.

4.3.2 Pressure regulator

The regulator shall be leak tight when there is no gas flow

The regulator shall be pilot operated and have at least the following accuracy-(RG) and lock-up pressure classes (SG):

in case of 19-4 barg station the following are the boundary conditions :

RG = 2.5; SG = 10

in case of 4-0.025 barg station the following are the boundary conditions :

RG = 10; SG = 10

4.3.3 Slam shut device

The slam shut device stays in the open position under normal operating conditions and quickly, automatically and completely shuts off the gas flow when the pressure downstream the regulator has exceeded the preset value.

After the slam shut device has closed, it shall only be possible to open it manually and locally.

When the slam shut device has been actuated, it shall be leak tight.

Especially for 4-0.025 stations it is not required the slam shut valve to be triggered at minimum pressure.

The slam shut device shall have at least the following accuracy (AG):

AG=2.5

4.3.4 Monitor regulator

The monitor regulator shall be pilot operated and leak tight when there is no gas flow.

The monitor regulator shall have an accuracy class (AG) better than 2.5 and a lock-up pressure class (SG) better than 10. In case of 4-0.025 station monitor is not considered obligatory.

4.3.5 Relief device

6 A relief device shall be fitted. The function of the relief device is to protect against pressure rises in excess of acceptable limits or unnecessary action of the slam shut valve due to minor leakage of a regulator, etc. The relief device shall be integrated in the housing of the underground pressure regulating station. The maximum set point shall be chosen in such a way that also with the maximum allowable positive deviation from its set point the acceptable limit of the pressure for the part it is protecting will not be exceeded. The outlet of the relief device shall be connected to a separate depressurization line.

4.3.6 Instrumentation pipe work and sensing points

Instrument lines are a part of the underground pressure reducing installation. All instrument lines, including flexible ones, if used, shall be made of stainless steel and all parts shall be suitable for the design pressure of the station.

The sensing points for the regulator, monitor regulator and slam shut off valve shall be connected upstream the outlet valve of the underground pressure regulating installation.

The sensing points shall be reasonably free from turbulence and any effect resulting from changes in the gas velocity or from high velocities in the station, such that a representative pressure is measured.

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There shall be no valves installed in sensing lines that can isolate the sensing element from the sensing point, except for test valves which are open under normal operating conditions (if they have not been manually actuated).

Dedicated vent and depressurization lines shall not be combined in a manifold nor shall they be combined with breather lines.

The terminal of vent and depressurization lines shall be designed to suit local conditions. The height of the vent pipe shall be 2.5m (above ground part). Suitable precautions shall be taken to prevent blockage of the outlet of vent lines and to protect them against the ingress of foreign material.

4.3.7 Turbine meter

In particular cases it may be required by EDA Attikis the station to be equipped with a turbine meter device. The meter shall be installed in a separate underground watertight vessel that will be connected by the site contractor with the regulating devices of the station. The meter shall be a short body type one, flanged ends and shall be equipped with a LF and a HF1 pulse generator. A pressure transmitter shall be installed at the meter body.

A thermowell shall be installed at the proper distance after the meter but inside the watertight vessel. The meter vessel shall be equipped with a strong street cover (proper to withstand 25 tons load) so that it can be placed in footways, pedestrian areas and carriageways. The cover shall show no excessive permanent deformation after a test load of 400 KN has been applied in accordance with EN 124.

On the cover, the following information will be moulded:
"ΑΕΠΙΟ" or "GAS".

6 A meter by-pass shall also be installed.

4.3.8 Remote monitoring infrastructure

The 19-4bar station shall be equipped with a (remote) warning system to ensure that a malfunction of the station is noticed immediately. As a minimum requirement, the following functions shall be monitored:

- Position of the slam shut valve
- Position of the inlet and outlet valves
- Differential pressure at the filter
- 6 position of the vessel cover of each pressure regulating (underground) unit (open, close)
- Inlet and outlet pressure

We distinguish the following cases:

When the station is equipped with a meter device the outlet pressure shall be monitored with means of a pressure transmitter installed at the meter body.

When the station is not equipped with a meter device, the outlet pressure shall be monitored by means of a pressure transmitter installed at the outlet of each regulating vessel.

- In case of installation of a meter device, the indication of the meter as well as the indications of the pressure and temperature transmitters shall be monitored remotely.

All the materials for the remote monitoring infrastructure should be according to EDA-MR-003/0 specification.

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4.4 In-, outlet maintenance and depressurization valves

The underground pressure regulating station shall be equipped with in- and outlet valves for maintenance purposes of the station. The inlet shall be a ball valve. The outlet shall be a ball or a butterfly valve. The valves can be an integral part of the housing. In case that the inlet and the outlet valve is incorporated in to the housing, a security lock shall block opening of these maintenance valves if a cover of the housing is opened.

The underground pressure regulating station shall be equipped with sufficient depressurization valves or alternatives to enable to depressurize all compartments.

4.5 Indicators

6 Pressure indicators and filter differential pressure indicator, shall be installed on the station showing at least in- and outlet pressure and filter differential pressure. In case a monitor regulator is installed, a pressure indicator could be installed showing the pressure between the monitor regulator and the regulator.

Pressure indicators for the inlet operating pressure shall provide readings between 0 to 20 bar and for the outlet operating pressure between 0 to 6 bar. The accuracy of the selected pressure indicators shall be 1,6% F.S or better. The slam shut device shall be equipped with a visual indicator to show the open or closed condition.

6 The size of the indicators must be at least DN 63.

4.6 Vessel cover

The street cover must be protected against unauthorized opening and should be provided with a lock.

6 The street cover could be the cover of the vessel or a distinctive surface cover.

6 The street cover must withstand a 25 tons load. The street cover shall be according to EN 124.

On the vessel cover, the inscription "AEPIO or "GAS" will be moulded.

4.7 Electrical components

Electrical components used in the non-pressurized compartment shall be suitable for a hazardous area zone 0 according to EDA MR 003/0. Intrinsically safe electrical components will be used.

4.8 Elastomeric materials

4.8.1 General requirements

Elastomeric materials used for non-reinforced diaphragms static and dynamic seals, shall be free from porosity, inclusion, blisters, and surface imperfections visible to the naked eye.

4.8.2 Test methods for elastomeric materials

4.8.2.1 General conditions of testing

Unless otherwise specified, tests are carried out at a temperature of (23 ± 2) °C.

4.8.2.2 Hardness

The hardness is measured by IRHD, preferably according to the micro-test method specified in ISO 48. Any other test method conforming to applicable international standards shall be considered.

4.8.2.3 Tensile strength and elongation at break

Tensile strength and elongation at break are measured according to ISO 37 and expressed in MPa and percentage respectively. The test is performed preferably on dumb bell test pieces of type 2. Any other test method conforming to applicable international standards shall be considered.

4.8.2.4 Compression set

Tests are carried out according to ISO 815 (type B test piece)
Any other test method conforming to applicable international standards shall be considered.

4.8.2.5 Resistance to ageing

Changes in hardness, tensile strength, and elongation at break are measured in accordance to ISO 188.

Any other test method conforming to applicable international standards shall be considered.

4.8.2.6 Resistance to gas

Resistance to gas is measured according to the test method given in ISO 1817.
Any other test method conforming to applicable international standards shall be considered.

4.8.2.6 Resistance to lubricants

6 Resistance to lubricants is measured according to the test method given in ISO 1817.
Any other test method conforming to applicable international standards shall be considered.

Requirement for connections.

All flanged connections shall be welded neck type and not slip-on ones. Deviations shall be clearly noticed at the technical offer.

5. Testing

5.1 Strength test

6 Underground pressure regulating station shall be strength tested.
The test shall be carried out with water or a non-corrosive liquid at ambient temperature and at a pressure of 1.5 times the design pressure for a time of at least 15 minutes. Alternatively, a combined strength and external tightness test may be performed with air or nitrogen at the same pressure.

The result of the test is satisfactory if the following 2 conditions are met: No leakage shall be detected with an acceptable test method. No permanent deformations will be permitted.

Alternative test methods are acceptable provided that equivalent results are succeeded and proved by proper test documentation.

The inlet and the outlet maintenance valve shall be tested according to the relevant standards.

5.2 External tightness test

All pressure components up to including the inlet and the outlet maintenance valve of the underground pressure regulating station shall be tested for external tightness.

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The test shall be carried out with air or nitrogen at ambient temperature and at a pressure of 6 bars for a time of at least 30 minutes, covering the inspected parts with a foaming liquid.

The result of the test is satisfactory if the following condition is met:

Bubble tight for the duration of the test

Alternative test methods are acceptable provided that equivalent results are succeeded and proved by proper test documentation.

5.3 Internal sealing test

The regulator, slam shut device, the monitor and the relief device, in the assembled underground pressure regulating station shall be pneumatically tested to assess the compliance of the sealing with the requirements.

The test shall be carried out at ambient temperature with air or gas at a low pressure of 0.5 to 1 bar, followed by:

a test at 1.1 times the design pressure for at least 5 minutes regarding the 4-0.025 station or

a test at 6 bar for at least 5 minutes regarding the 19-4 station.

To check for leakages a flexible hose is connected to the relevant part of the station and immersed in a tank of water or by applicable methods.

The result of the test is satisfactory if the following condition is met:

Bubble tight for at least 2 minutes

Alternative test methods are acceptable provided that equivalent results are succeeded and proved by proper test documentation.

5.4 Welding Approval

All weldings shall be (100%) approved using radiographic method. If radiographic method is not applied, an other acceptable method (magnetic, penetrating fluids etc) according to applied European standards shall be used. Documentation for the successful execution of the abovementioned checks shall be provided to EDA ATTIKIS at the delivery of the product.

5.5 Functional test

5.5.1 Functional test of regulators and monitors

The regulator/monitor shall be pneumatically tested to assess compliance with requirements.

The test shall be carried out at ambient temperature with air or gas at the settings specified in the relevant EDA order.

As part of the internal sealing test, the sealing of the regulator/monitor in its closed position has been verified.

The result of the functional test is satisfactory if the following 6 conditions are met:

- the regulator/monitor opens when air is supplied to the motorization chamber
- the regulator/monitor closes when air is released from the motorization chamber
- the air output from the pilot closes at pressures higher than the required set pressure
- the air output from the pilot opens at pressures lower than the required set pressure
- the pilot can be adjusted between the minimum and maximum settings

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- a minimum of 5 operation cycles has been carried out for both pilot and valve
- In case of specific requirement in the order specification or relevant product standard, the valve shall be subsequently tested likewise with a pressurized housing of the underground pressure regulating station at Pmax.
- Pmax: The highest operating pressure at which any component of the underground pressure regulating station will continuously operate within the specification
- Any other test method conforming to applicable international standards shall be considered.

5.5.2 Functional test of the slam shut device (SSD)

The SSD shall be pneumatically tested to assess compliance with requirements. The test shall be carried out at ambient temperature with air or gas at the settings specified in the relevant EDA order.

As part of the internal sealing test, the sealing of the SSD in its closed position has been verified. During verification of the triggering performance of the SSD the housing of the underground pressure regulating station is not pressurized.

The result of the test is satisfactory if the following 5 conditions are met:

- the response time is no higher than 2 seconds
- the SSD is triggered at the required set minimum pressure (if applicable)
- the SSD is triggered at the required set maximum pressure
- the SSD can be relatched at pressures between the minimum and maximum settings
- a minimum of 5 triggering operations has been carried out for each of the required settings

The SSD shall be subsequently tested likewise with a pressurized housing of the underground pressure regulating station at design pressure (19bar).

6. Identification

The underground pressure reducing station shall be equipped with a type plate with at least the following identification:

- Manufacturer name and/or logo and/or registered trademark
- Type, including downstream pressure type
- Design pressure, 19 bar
- Year of fabrication
- Serial number
- Diameter of regulator valve and flow coefficient
- Set range and specific set range of regulator and slam shut device
- Set range and specific set range of monitor and/or relief device
- Registration number and organization if type tested

6 The plate must be readable after installation of the station

7. Certification

6 The manufacturer shall issue a test certificate according to EN 10204 3.1. Additionally, 3.1 certificate is required for the regulator, the inlet and outlet valve, the transmitters and the meter (if applicable). In addition, CE marking is required for the pressure vessel type station (PED 97/23).

8. Delivery

The packaging for delivery shall be designed so as to avoid any deterioration during handling, transporting and storing. In addition a maintenance and operation manual in English language must be delivered for the described station.

6 At the inlet and the outlet, must be installed proper caps and vent devices (at the outlet) for test purpose.

6 Also there must be a provision for electrical grounding of the station.
 Inlet and outlet of the station may be arranged according to the indicative arrangements described in Annex 1 (EDA can determine the selected arrangement for each station)

6 **Annex 1**
 Indicative inlet and outlet arrangements
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