Industrial instrumentation for Pressure and Temperature

# User Guide

## MGS37-41 PRESSURE GAUGES, ATEX VERSIONS 2G2-2D2-2D0, ZONES 1, 2, 21, 22

**MI-MGS37_41-2G2-2D2-2D0-ENG_6 03/2021**

## Index



### 1. Safety

- The safest ambient conditions for the instrument to operate properly depend on the correct selection and installation of it in the system, as well as on compliance with the maintenance procedures set out by the manufacturer. The user is entirely responsible for correct installation and maintenance.
- This manual is supplied with the instrument and should be properly kept. It is advisable to read it carefully before using this product.
- To specify the functional and constructive characteristics of the instruments, it is advisable to consult the most up-to-date version of the catalogue and data sheets which are available on the website www.nuovafima.com
- Improper use may damage the instrument and the operator or the whole plant.
- The managers responsible for the selection, installation and maintenance of the instrument should be aware of the environmental conditions that may negatively affect the instrument's operational activity and which may lead to its premature failure. Therefore, only technically qualified and trained staff should carry out the procedures called for in the plant regulations.

### 2. Directives

**The MGS37-41 pressure gauges conform to the essential Health and Safety Requirements laid down in European Directive 2014/34/EU for Group II, Category 2G or 2GD equipment in the T6…T1 temperature class.**

| VERSION | MARKING |
|---|---|
| **2G2** (gases) | CE Ex **II 2G Ex h IIC T6…T1 Gb -20°C ≤ Ta ≤ 60°C** |
| **2D2** (gases and dusts) | CE Ex **II 2G Ex h IIC T6…T1 Gb II 2D Ex h IIIC T85°C…T450°C Db -20°C ≤ Ta ≤ 60°C** |
| **2D0** (gases and dusts) | CE Ex **II 2G Ex h IIC T6…T1 Gb II 2D Ex h IIIC T85°C…T450°C Db 0°C ≤ Ta ≤ 60°C** |

**This instrument is NOT suitable for ZONES 0 and 20**

**EMC Directive 2014/30/EU** on electromagnetic compatibility does not apply to this product.
Under the terms of directive **2014/68/EU (P.E.D.)**, NUOVA FIMA pressure gauges are classified into 2 categories:
PS <=200 bar these instruments do not meet the essential safety requirements. They are designed and constructed by "Sound Engineering Practice" and are not required to bear the CE mark;
- PS > 200 bar these instruments should comply with the essential safety requirements prescribed by the PED, are classified as Category 1 and certified according to Form A. They must bear the CE mark.

### 3. Standards

NUOVA FIMA instruments are designed and manufactured to comply with the safety requirements required by the international regulations in force some of which are reported in this manual. To perform the installation and commissioning of the instruments, it is necessary to know and to comply fully with the following standards: **EN837-1, EN837-2, ASME B40.1, UNI CEI EN ISO 80079-36, UNI CEI EN ISO 80079-37, UNI EN 1127-1, UNI EN ISO 15156-3/MR0175.**
All instruments are subjected to calibration concerning national and/or international samples according to regulations established by the UNI EN ISO 9001:2015 quality management system.

### 4. Operating principle

The MGS37 and 41 models are composed of a Bourdon tube pressure gauge combined with a diaphragm seal. The internal volume between the diaphragm and the tube is filled up with silicon oil. According to the non-compressibility principle of liquids, the tube sensing element moves linearly according to the pressure applied on the diaphragm seal membrane. The rack on the indicator arm is keyed into the pinion so that pressure is indicated on a graduated scale appearing on the dial having a range ≥ 270°.

### 5. Materials

Components that come into contact with the process fluid are produced in Hastelloy C276. The housing is produced in AISI 304 or AISI 316 L stainless steel. The gaskets vent and filler caps are produced in EPDM or Viton. The window is in safety glass. The dial and the pointer are produced in aluminium.

### 6. Data sheet

Detailed information about the construction and operating characteristics, as well as drawings showing the overall dimensions are available on the catalogue sheets about MGS pressure gauges – 2G2 version for gas and 2D2, 2D0 version for gas and powders.

### 7. Function

This instrument works typically as a pressure transmitter of corrosive process fluids with H2S.
This instrument cannot cause fires when operating in normal conditions or when not in use, Operation within the operating limits is recommended. All misuse of the instrument should be prevented.

### 8. Intended use limits

**Maximum surface temperature –** It may be produced by the fluid temperature only. The temperature produced by the combination of the ambient temperature and the process fluid temperature must be below the one intended for the ATEX temperature class, and should not affect the instrument operating functioning.
The process fluid (Pt) temperature must therefore be kept within the limits indicated in the table below:

| *Class (Tmax)* | *Pt (°C)* | |
|---|---|---|
| | *Instrument case: Dry / Not fillable* | *Instrument case: Filled* |
| **T6** (85°C) | 70 | 65 |
| **T5** (100°C) | 85 | |
| **T4** (135°C) | 120 | |
| **T3** (200°C) | 150 | |
| **T2** (300°C) | | |
| **T1** (450°C) | | |

**Ambient temperature** – This instrument is designed to be used in safe conditions at the following ambient temperatures:
-20°C...60°C (2G2 and 2D2 version)
0°C…60°C (2D0 version)

**Model** – In compliance with standard EN837-1 In systems containing compressed gas, it is advisable to select an instrument equipped with an adequate safety device. In the event of an unexpected failure of the measuring element, the safety device allows the compressed gas to escape outside the case, thereby preventing the instrument from cracking. The safety patterns employed on MGS37 are designated type **S1** because it consists of a release valve which opens when the pressure inside the sealed case exceeds an established safety limit, putting it in communication with the outside. On the model MGS41 designated type **S3**, the safety consists of an entire blow-out back and there is an added baffle wall separating the measuring element from the clear solid front, providing further protection to the operator. An instrument with an adequate level of protection is recommended and should be chosen by consulting the following tables taken from standard EN837-2:

| *Measured fluid LIQUID* | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Case filling | Nothing | | | | Damping liquid | | | |
| DN | <100 | | ≥100 | | <100 | | ≥100 | |
| Range (bar) | ≤25 | >25 | ≤25 | >25 | ≤25 | >25 | ≤25 | >25 |
| Safety | 0 | 0 | 0 | 0 | **S1** | **S1** | **S1** | **S1** |

| *Measured fluid GAS or VAPOUR* | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Case filling | Nothing | | | | Damping liquid | | | |
| DN | <100 | | ≥100 | | <100 | | ≥100 | |
| Range (bar) | ≤25 | >25 | ≤25 | >25 | ≤25 | >25 | ≤25 | >25 |
| Safety | 0 | S2 | **S1** | **S3** | **S1** | S2 | S1 | **S3** |

0= gauges without blow-out device
**S1= gauges with blow-out device**
S2= safety pattern gauge without baffle wall
**S3= safety pattern gauge with baffle wall**

**Operating pressure** This instrument is designed to operate at a static pressure of up to 100% of the scale range. When dynamic or pulsating pressure is involved, the working pressure should not exceed 90% of the full-scale range.
**When gaseous fluids are involved it is advisable to use a nominal scale range that is double the operating range.**

**Chemical compatibility** – The degree of chemical compatibility between the process fluid and the wetted parts material, and between the atmosphere and the exposed parts material, should be checked. An IP65 protection level is recommended for better protection.
This procedure can be followed with process fluids that are compatible with Hastelloy C276.

**Over pressure limit:** 30% of FSV - 450 bar (max 12 hours).

**Overpressure** – Each model maximum overpressure values are shown in the table below:

| *Overpressure (bar)* | | | |
|---|---|---|---|
| *Range* | *≤16 bar* | *≤100 bar* | *≤400 bar* |
| MGS 37<br>MGS 41 | 60 | 250 | 450 |

**Ambient pressure** – This instrument is designed to work at an atmospheric pressure between 0,8 and 1,1 bar A.

**Maximum Permitted Pressure of an Assembly** - The maximum allowable pressure (PS) of an Assembly is determined by the PS of every component. To calculate the PS of an assembly, simply select the lowest value of the components. For safe operation, the PS of the assembly should not be exceeded.
To determine the maximum permitted pressure value for a standard product please see the data sheet available on the website www.nuovafima.com. For products not included in the NUOVA FIMA catalogue, please refer to the contractual documents.

**Protection level** – CEI EN 60529 standard. These refer to hermetically sealed ring conditions, with built-in caps located properly. Values are shown in the table below:

| *Version* | IP rating *(instrument case)* |
|---|---|
| **2G2** | IP 55 *(Dry)* *(Not fillable PN ≤ 6 bar)* |
| **2D2** | IP 65/67 *(Filled)* *(Not fillable PN > 6 bar)* |
| **2D0** | IP 65/67 *(Filled)* |

**Liquid-filled Cases –** The dampening liquid is generally used to prevent vibrations of the parts in motion caused by vibrations and/or pulsations. Instruments are manufactured and shipped as a sealed execution to prevent the liquid inside the case from leaking. The filling liquid type should be selected very attentively taking into account the use limits according to the ambient temperature.

| *Filling liquids* | *Ambient temperature* |
|---|---|
| Glycerine 98% | 0°C...60°C |
| Silicon oil | -20°C...60°C |
| Fluorurate fluid | -20°C...60°C |

### 9. Wrong uses

The following applications may be potentially dangerous:
- Systems containing compressed gas **(6)**
- Systems containing corrosive, liquid or gaseous fluids **(7)**
- Systems subjected to dynamic or cyclical pressures **(2)**
- Systems containing toxic fluids **(1)**
- Systems containing combustible/inflammable fluids **(5)**
- Systems producing mechanical vibrations **(3) (4)**
- thermal incompatibility between the filling liquid and the process fluid **(6)**

**Explosion Failure (1) –** When thermal energy is released violently because of a chemical reaction between the separating oil and the oxidant agent in the process and the diaphragm seal is seriously damaged, an explosion may occur. It is generally accepted that this event is unpredictable. If the sensing element situated in the case is affected by the chemical reaction, it may explode and fragments of the case may be projected in all directions. Silicon oil should not be used when highly oxidant agents are involved. In this case, fluorurate fluids are recommended.

**Fatigue Failure (2)** - When pressure causes mechanical stress a small crack from the inside to the outside, generally along an edge of the instrument, is produced. Such a failure is more dangerous when the medium is a compressed gas rather than a liquid. Fatigue failures release the fluid gradually, and therefore the case pressure increase is indicated by the opening of the relief valve. When measuring high pressures, the process operating pressure is close to the maximum permissible stress limit and an explosion may occur.

**Vibration Failure (3)** – The most common vibrations may wear the movement components out because of high cyclic loading resulting in a gradual loss of accuracy and, eventually, in a failure of the pointer in indicating a pressure change.

**Crack Failure (5) –** When the instrument is used improperly or the sensing element is cracked or broken, when the process fluid is combustible or inflammable and the instrument shouldn't operate because an explosive atmosphere may be generated inside and around the instrument case. In cases like these, the worn-out parts of the instrument must be replaced preventing the fluid from leaking.

**Temperature (6)** – The temperature inside and on the surface of the instrument may increase significantly because of rapid compression of the gas in the process or of an impact wave in the process liquid. Internal overheating caused by adiabatic compression or by an impact wave can lead to spontaneous combustion of the fluids measured or ignition of explosive atmospheric conditions outside the case. The surface temperature should not exceed the correct limit set for the temperature class required in the area in which the instrument is operating.

**High temperatures (6) – High-temperature levels exceeding the permitted one, may provoke the expansion of the** filling liquid. Consequently, the membrane may blow up damaging the instrument permanently. The filling liquid may also decompose producing gas. At this point, the assembly is completely out of order.

**Corrosion failure (7)** -
This condition may develop when the sensing element materials are subject to a chemical attack by the substances composing the fluid to be measured or by the atmosphere surrounding the pressure system.
When this kind of failure occurs, fluid starts leaking locally in spots or a fatigue crack starts developing because of the material weakening. The sensing element is usually quite thin hence it is subject to a strong mechanical stress. Therefore, it should be chemically compatible with the media to measure. None of the most common materials is immune from a chemical attack whose power can be influenced by concentration, temperature and the type of mix of chemical substances

### 10. Transport

The characteristics of the instruments may be affected during transport, despite adequate packaging, and must be checked before use. If a calibration check is required the instrument should be isolated from the process using a shut-off valve and the pointer should return to the zero mark correctly (unless the temperature is far from 20°C). If the pointer doesn't return to zero it means that the instrument is seriously damaged and must be repaired.




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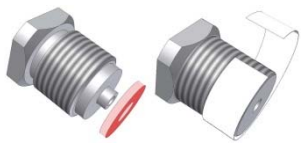
## 11. Storage

Instruments should stay packaged in their original standard box until installation and stored in dry, indoor spaces. If instruments are supplied with special packaging (in wooden boxes lined with tar paper or in barrier bags), it is always best to keep them indoors, and always protected from the atmospheric agents. The condition of the packaging materials must be checked every 3-4 months, especially if the boxes are exposed to the weather. The storage area temperature should range between –20°C and 65 °C, except if otherwise specified in the catalogue data sheets.

## 12. Installation

**2G2, 2D2 and 2D0 versions of MGS37-41 pressure gauges must be installed in compliance with European Standard EN 837-2, and special care must be taken to avoid any loose mechanical connections.**
**The instrument should be installed far from magnetic and electromagnetic induction, ionising radiation, ultrasound and exposure to sunlight to prevent the instrument's surface temperature increase.**
It is advisable to install a shut-off valve between the pressure gauge and the plant to make the instrument removal for maintenance easier. The pressure connection must be watertight. If the pressure connection is provided with a cylindrical thread, tightness is produced using an O-ring clamped between the two flat sealing surfaces, one on the pressure connection and the other on the instrument's process connection. If the pressure connection has a tapered thread, the tightness is performed by simply screwing the connection onto the coupling, through the mating of the threads. It is common practice to wrap PTFE tape around the male thread before coupling (see Fig).



In both cases, the torque must be applied using two hexagonal spanners, one on the flat faces of the instrument/process coupling and the other on the pressure connection.
**Do not force the case to tighten as this may damage the instrument.**
When pressurising the system for the first time, check the tightness of the connection seal. All instruments must be mounted in a vertical position so that the dial stays vertical unless otherwise indicated on the dial itself. When the instrument includes a safety device, this must be at least 20 mm from any other object. - For wall or panel mount instruments, make sure that the pipe conveying the pressurised fluid is connected to the instrument coupling without exerting torsion or force.
**Effect of liquid columns** - The user should be aware that, if the instrument is loaded by a liquid column, calibration is required to compensate for this effect. This may be the case when the instrument is fitted above or below the pressure connection. When gas or steam are involved, this condition is not produced but installing the instrument above the pressure connection is advisable.
**Ventilation** – The case must be ventilated as indicated in the instructions shown on the sticker supplied with the instrument.
**Temperature** – Verify that the process fluid temperature is ≤ to the permitted one.
**Mechanical stress** - Pressure gauges should not receive mechanical stress.

**Equipotentiality – The instrument is equipotent with the plant when it is mounted on using an Ohmic contact between the threaded process connection and the pressure connection**

## 13. Use

**The user must be aware of the risks related to the chemical and physical characteristics of the gases, vapours, and/or powders in the system, and carry out a thorough preliminary check before putting them into service.**
**Putting into service** - The instrument should always be put into service very carefully to prevent pressure surges or sudden temperature changes. **Therefore, the interception valves should be closed extremely slowly.**

**Adjustment of Zero –** The filling liquid volume may be modified by a variation of the ambient or of process temperature. The internal system temperature may also change causing a zero error on the instrument.
Wait until the instrument and the diaphragm seal reach the working temperature and adjust the instrument to zero. In some cases, this procedure is not necessary because the instrument calibration temperature has already been established at the workshop.

**Intermittent measuring** - It is advisable to perform the measuring by opening the shut-off valve slowly and then closing it again once the reading has been noticed. This procedure ensures a long lifespan of the instrument and safety during operation.
It is not advisable to use the instruments for measuring pressures near zero, as in that range, the accuracy tolerance may represent a significant percentage of the applied pressure. For this reason, these instruments should not to be used for measuring residual pressures inside huge containers such as tanks, surge tanks, and the like. In fact, such containers may retain pressures that could be dangerous for the operator, even when the instrument indicates a zero pressure. The installation of a ventilation device on tanks is recommended to achieve pressure zero before removing covers or connections or performing similar tasks.
It is not advisable to install new instruments on systems with different operating media, to prevent chemical reactions that may cause explosion because of contamination of the wetted parts.
**Caps – The filling and vent caps must not be removed during the operation of the system.**

## 14. Possible malfunctions

Indication failure (pointer to zero): filling up system empty.
Indication steady on the same value: Pressure pipes clogged. The initial valve closed.
Indication steady outside the graduated scale: Excess pressure – temporary or permanent reading error.
Indication error exceeds that stated for the instrument. Calibration altered.
Pointer oscillating rapidly: Harmful pulsations in the process fluid. Harmful mechanical vibrations.
Ejection of the safety cap: Excess Temperature: Breaking or cracking of the sensitive element probable.

## 15. Maintenance

A specific maintenance programme should be drawn up to perform proper maintenance of the instrument and of its original features condition. Mechanical components must be maintained and protected from high temperatures and the risk of fire and explosion due to any malfunction should be prevented.
**General check** – The window should be intact, without cracks. The filling plug and blow-out vent should be placed in the right position. The pointer should be within the graduated scale.

**Removal** – The instruments should be isolated from the system by closing the initial valve, and the pressure inside the instrument must be reduced to zero by opening the vent in the system. The process fluid left in the instrument process connection must not be disposed of in the environment so, as not to cause pollution or harm people. Dangerous and toxic fluids must be handled with care.
**Routine check** - Instruments employed on plants operating in severe working conditions (vibrations, pulsating pressures, corrosive or combustible and inflammable fluids) should be replaced according to the maintenance programme. The state of the sensing element should be checked every 3/6 months, as well as the indication accuracy, the degree of corrosion on the sensing element (for fluid diaphragm) the seal on the gaskets, and the presence of condensate inside the case. If the instrument does not operate properly, an extra check is advisable.

The sensing element corrosion level cannot be verified in detail because the sensing element cannot be inspected: it is necessary to consider rough values concerning a membrane 0,06 mm thick.
**Dust deposits on the instrument should not be thicker than 5mm otherwise they must be removed and the instrument cleaned using a cloth soaked in a water and soap solution.**

**Detailed check** – The test fluid should be compatible with the process fluid to be measured. To check the integrity of the sensing element, fit the instrument on a pressure generator, with a shut-off valve between the two devices. Submit the instrument to the maximum pressure allowed and disconnect it from the pressure source by closing the shut-off valve. If there are any leaks on the sensing element, the pointer will slowly return to zero. To check the accuracy of the indication, a stable pressure should be generated in the laboratory and applied to the instrument which is being checked and to a laboratory pressure gauge or primary pressure gauge. The accuracy of the latter must be 4 times higher than the nominal accuracy for the instrument being checked. The values indicated by the two instruments during the pressure rise and fall allow us to establish the non-linearity, the hysteresis, and the repeatability of the instrument under test.
**Check the condition of the gaskets and the IP protection level.**

**Recalibration** – If the calibration check produces measured values that are different from the nominal values shown in the catalogue, the instrument should be recalibrated. It is advisable to return the instrument to NUOVA FIMA for recalibration through the service **Product Return**.

**NUOVA FIMA does not accept any responsibility for the misuse of the instruments or for instruments operating in non-authorised working conditions. In this case, the CE Declaration of Conformity and Contractual Guarantee is null and void.**

## 16. Disposal

Before disposal, the instrument and the diaphragm seal should be disassembled and the filling circuit should be empty. Window and vents should be disposed of as aluminium and stainless steel. The fluid remaining inside the instrument may be harmful and toxic.



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