



SAFETY TRAINING LEAFLET 15 GAS PRESSURE

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SAFETY TRAINING LEAFLET 15

GAS PRESSURE

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1 Introduction

1.1 Safety leaflets

Safety training leaflets summarise the basic operational safety knowledge which needs to be known by employees working in the gas industry.

Refer to EIGA Doc 23 *Safety Training of Employees* for the various combinations of leaflets which define the scope of safety training for a variety of specific jobs.

Each leaflet addresses a specific topic as identified in the title.

1.2 Comprehension tests

There is a comprehension test for each leaflet, included in **Appendix 1**.

Each test comprises a number of questions. To pass the test it is suggested that the employee should score 75% at the first attempt. Incorrect answers should be discussed to confirm understanding.

Appendix 2 includes the list of correct answers.

2 About gas pressure

Pressure (symbol: p or P) is the force exerted on a surface area.

Gas is stored in pressure vessels or flows through pipelines. Gas molecules move randomly and undergo collisions with gas vessel or pipeline walls. Collisions of gas molecules exert a force on the vessel or pipeline walls which results in a pressure inside the vessel or pipeline.

Pressure increases with gas temperature (as the gas molecules then move faster) and amount of gas (more molecules exert more force) and decreases with volume (higher volume means a longer distance between walls and so fewer molecules colliding with walls). As such, Pressure is a fundamental property of gases.

The international standard (SI) unit for pressure is the “pascal” – Pa [N/m²], however, in the gas industry the units more commonly used for pressure are “MPa” or “bar”. For conversion between common pressure units see the table below. Values are approximate.

	Pascal	bar	Pounds per square inch	Other pressure units
1 MPa	10 ⁶	10	145.03	mm H ₂ O mm Hg
1 bar	10 ⁵	1	14.50	
1 psi	6 894.75	0.07	1	

Pressure is indicated on pressure gauges (manometers) which should be clearly marked with the units and may also be marked with the maximum pressure allowed in the gas vessel or pipeline. If the gauge is used with oxygen, the marking “Clean for oxygen use” (or similar statement or a symbol) shall appear on the gauge.

Pressure gauges display so-called gauge pressure - the difference between the absolute pressure and atmospheric pressure.

To avoid confusion “g” for gauge and “a” for absolute pressure are appended to the units or directly to the acronym for the unit measured. For example:

- for gauge pressure: p = 100 barg or p_g = 100 bar
- for absolute pressure p = 100 bara or p_a = 100 bar

$$p_a \text{ (absolute pressure)} = p_g \text{ (gauge pressure)} + p_{\text{atm}} \text{ (atmospheric pressure)}$$

3 Generating pressure

Pressure can be generated in many ways, the most common being:

- by mechanical means, such as a pump or compressor,
- by heating vessels or piping, either deliberately or accidentally e.g. gas cylinders exposed to fire,
- by the vaporization of cryogenic liquids in confined spaces e.g. in a pipeline between two closed valves,
- by chemical reaction e.g. explosion of a hydrogen–oxygen/air mixture.

4 Pressure safety

Pipelines and vessels are often referred to as “high pressure”, “medium pressure” or “low pressure”. These terms do not have any exact definition and should not be interpreted as having any real significance. Any pipeline or vessel containing gas or liquid under pressure constitutes a potential hazard and must be protected against overpressure.

Pressure and force should not be confused. Even a low pressure acting on a large surface area such as a manway or cover, can create a large force and energy hazard when released. For example, a pressure of 2 bar acting on a cover of 1 m² will produce a force equivalent to the weight force of 20 tonnes. Pressurised systems store significant amounts of energy and must be handled with caution.

Always use a pressure gauge to know whether a system is pressurised or not. Mind that the gauge could be broken if indicating zero pressure. Also mind the difference between barg and bara as described further up.

Pressure vessels have the maximum allowable working pressure (MAWP), service pressure and test pressures marked on the nameplate. Compare the pressure indicated on the gauge with the MAWP.

Assume that all pipes and vessels contain gas or liquid under pressure unless you can positively prove otherwise.

If the pointer of a pressure gauge is stationary or reads zero:

- tap the gauge lightly to ensure the pointer is free and is not stuck, except when the pressure gauge is fitted with electrical switches;

if there is a valve between the system and the gauge, ensure it is open.

Report leaks from systems under pressure immediately.

Use a permit to work system for all maintenance works. Always relieve the pressure in a vessel or system before commencing repairs. Never repair a leak while the system is under pressure. If in doubt, check with your supervisor.

Never disconnect a pipe or flexible hose when it contains pressure; it may straighten or “whip” and could cause severe injury.

Cryogenic liquids must never be trapped between two valves or closed ends. Ensure that there is a relief valve to protect any part of the system where this could occur and always operate valves in the correct sequence.

Pressure systems must be tested periodically. This must always be done by trained personnel. Personal Protection Equipment (PPE) must be worn during this operation and, when appropriate, operators must be protected or shielded from the pipe or vessel being tested.

Appendix 1 – Gas Pressure – Test Questions

Tick the correct answer (s) or write in the blank spaces as requested.

1. What is the definition of pressure?
A. Force exerted on one point
B. Temperature change
C. Weight supported by an object
D. Force exerted on a surface area
2. Handling a low-pressure container involves no risk.
A. True
B. False
3. Tick the causes that could lead to an outburst due to excess pressure:
A. Cryogenic liquids becoming trapped in pipes
B. Failure of a pump's automatic trip (stop) system
C. Vacuum in a fill hose
D. Chemical reactions during acetylene decomposition
4. Name two safety devices used to protect facilities or receptacles from over pressure.

5. How should cylinder valves be opened?
A. Quickly
B. By your right hand
C. Slowly
D. By mechanical tools
6. Identify at least two items that must be included on the nameplate of a pressure vessel
A. maximum allowable working pressure
B. atmospheric pressure
C. service (operating) pressures
D. test pressure
7. A pressure of 1 bar acting on a flange area of 200 cm² will exert a force of:
A. 200 kg
B. 1 kg
C. 2 kg
D. 1000 kg
8. A flexible hose will “whip” and could cause severe injury if disconnected under pressure or in event of rupture.
A. True
B. False
9. What information should be displayed on a pressure gauge on a receptacle in oxygen service?
A. Pressure units
B. Difference between maximum gas pressure in the vessel and vessel test pressure
C. Gauge intended for oxygen service
D. Difference between absolute gas pressure in the vessel and atmospheric pressure
10. A work permit shall be issued before any maintenance work on a pressurised system.
A. True
B. False

Appendix 2 - Gas Pressure – Test Answers

1. D
2. B
3. A, B and D
4. * Safety valve
* Rupture disc
* Pressure limiter
5. C
6. A, C or D
7. A
8. A
9. A, C,D
10. A