

Gasunie Technical Standard

Material Specification Instrumentation

MSM-08-E

Valve actuators

CONFORMITY

Version 11L *04-08-2025*

FOREWORD

This specification supersedes the tenth version of MSM-08-E and has been completely revised.

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1. SCOPE AND APPLICATION

1.1 Scope

This specification contains the requirements for valve actuators for use with valves in Gasunie piping systems, in compliance with MSW-03-E/1.

1.2 Application

This specification is suitable for actuators at an ambient temperature range of -20 °C to +50 °C.

1.3 Transport media

Table 1 indicates the transport media for which this specification is applicable.

Table 1: Transport media

Transport-medium ¹	Natural gas	Hydrogen	Carbon dioxide	Nitrogen	(Hot) water	Ammonia
	Transport medium independent					

- 1 The table is based on suitability of the transport medium concerned.
The scope and media for which this specification is suitable are not automatically the same as the scope and media of underlying specifications. The scope and suitability for a medium are described for each specification.

2. REFERENCES

This specification makes prescriptive reference to the documents mentioned in this clause.

If the documents in this specification are mentioned with a date, this specific edition is applicable.

2.1 European legislation

This specification refers to the following European legislation:

2006/42/EU	Directive 2006/42/EU of the European Parliament and of the Council of 17 May 2006 on machinery, and amending Directive 95/16/EC.
2014/30/EU	Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to electromagnetic compatibility.
2014/34/EU	Directive 2014/34/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to equipment and protective systems intended for use in potentially explosive atmospheres (ATEX 114).
2014/35/EU	Directive 2014/35/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of electrical equipment designed for use within certain voltage limits.
2014/68/EU	Directive 2014/68/EU of the European Parliament and of the Council of 15 May 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of pressure equipment.

2.2 Gasunie specifications

This specification refers to the following Gasunie specifications:

MSA-25-E	Transport, packing and marking.
MSW-03-E/1	Ball, plug, axial piston, gate and check valves.

2.3 Standards

This specification refers to the following standards. Any supplements and errata notices are also applicable.

The following applies to all NEN-EN standards: Depending on the country where the standard will be applied, DIN-EN or BS EN, for example, shall be chosen.

NEN-EN 10204	Metallic products – Types of inspection documents.
NEN-EN 15714-3: 2022	Industrial valves - actuators; Part 3: Pneumatic part-turn actuators for industrial valves – Basic requirements.
NEN-EN 15714-4:2025	Industrial valves - Actuators - Part 4: Hydraulic part-turn actuators for industrial valves – Basic requirements.
NEN-EN-IEC 60079-7	Explosive atmospheres - Part 7: Equipment protection by increased safety "e".
NEN-EN-IEC 60529	Degrees of protection provided by enclosures (IP code).
NEN-EN-ISO 5640	Industrial valves - Mounting kits for part-turn valve actuator attachment.
NEN-EN-ISO 12944-2 ¹	Paints and varnishes - Corrosion protection of steel structures by protective paint systems - Part 2: Classification of environments
NEN-EN-ISO 22109:2020	Industrial valves - Gearbox for valves.
NEN-EN-ISO 22153:2021	Electric actuators for industrial valves - General requirements.
NEN-EN-ISO/IEC 17050-2	Conformity assessment - Supplier's declaration of conformity. Part 2: Supporting documentation.

¹ NEN-EN-ISO 12944-2 is only applicable for latest versions of coating standards.

3. DEFINITION, ABBREVIATIONS AND SYMBOLS

In this specification the following definitions, abbreviations and symbols are applicable.

3.1 Definition

Client	The person or persons who is/are responsible, on behalf of Gasunie, for supervising the fulfilment of the contract in general and the execution of the work in particular.
Prescribed validation	Validation prescribed by the Client in accordance with which the Service provider can only continue the work, on the relevant subject, following formal "acceptance" by the Client.
Service provider (Supplier)	The party with whom the contract is or will be concluded.
Transport medium	A gaseous or liquefied substance that is transported by and/or stored in a Gasunie transport network; limited to: – natural gas; – hydrogen; – carbon dioxide; – nitrogen; – (hot) water; – ammonia. Additives and other substances used in the medium or in the processes are therefore expressly outside the scope.
Validation	The alignment of expectations demonstrating that the intended purpose will be achieved within the defined set of requirements with the process and/or product in question. A validation is, by definition, initiated by the Service Provider, except for validation prescribed by the Client "prescribed validation".
Verification	Demonstrating, by means of evidence, that the product or the action corresponds to the requirements set (has the product been made correctly/has the action been carried out correctly). Verification is initiated and/or carried out by the Service Provider.
Safety factor	The ratio between "torque produced by an actuator" to "torque required by a valve to actuate when changing position" (close to open or vice versa).

3.2 Abbreviations

ATEX	Atmosphères Explosibles
BAT	Break Away Torque
DoC	Declaration of Conformity
EMC	Electro Magnetic Compatibility
ESD	Emergency shutdown
ITP	Inspection and Test Plan
MAST	Maximum Allowable Stem Torque
RED	Required engineering documents

3.3 Symbols

<u>Symbol</u>	<u>Description</u>	<u>Unit</u>
d	Diameter of radial dowel pins	mm
D_b	Diameter of bolt holes	mm
d_c	Diameter of close-fitting bolts	mm
d_d	Diameter of dowel pins	mm
D_h	Diameter hand-wheel	mm
F	Actuating force	N
L_w	Length of wrench	mm
ΔP	Differential pressure	bar

4. REQUIREMENTS

4.1 General requirements

Actuator and gearbox shall comply with the requirements as stated in the following European directives (if relevant):

- Machinery directive (2006/42/EU), Actuator and gearbox
 - EMC directive (2014/30/EU), (hydro)electric actuators
 - ATEX (2014/34/EU)
 - Low voltage directive (2014/35/EU)
 - PED 2014/68/EU, for pneumatic and hydraulic operated actuators
- The manufacturer shall remain responsible for the manufacturing procedures and the suitability of the equipment for its intended use.

The complete actuator shall be suitable for outdoor installation.

Actuators shall meet the requirements of IP68 as a minimum in accordance with NEN-EN-IEC 60529.

The construction of actuators shall be such that galvanic corrosion under all circumstances is excluded.

Drive systems acceptable to Gasunie are:

- manual operated (by hand-wheel and gearbox);
- electro-mechanical (electric motor driving gear system with optional a spring return system for ESD functions);
- electro-hydraulic (electrical motor double acting or spring-return piston-hydraulic cylinder system);
- hydraulic (double acting or spring-return piston- hydraulic cylinder system);
- pneumatic (double acting or spring-return piston-cylinder system).

4.2 Actuator sizing

4.2.1 Manual operation

All hand-operated valves for above and surface box operation shall be provided with a locking device for blocking in open or close position suitable for a Ø 12 mm padlock.

Sizing of gearboxes shall be based on the following criteria:

- The maximum output torque of the gearbox shall be equal to at least 1,3 times the BAT of the valve at the specified design pressure, but shall not exceed the MAST of the valve.
- The actuating force (F see annex A) on the hand-wheel of the gearbox shall not exceed 360 N at 1,3 times the BAT of the valve.
- If possible the hand-wheel shall be equipped with a hexagonal nut (wrench width 50 mm) on the centreline of the drive shaft, see annex A for illustration).
- The operation time (number of turns) shall be kept as low as possible.

4.2.2 By external energy

For actuators powered by air, electricity or hydraulics this clause applies.

The safety factor between valve and actuation applied to the torque shall be:

- For liquid or dense media at least 1,3;
- For gaseous media at least 2.

The torque shall not exceed the maximum allowable stem torque of the valve. In the event that the maximum allowable stem torque is less than the required safety factor, then the effective output torque of the actuator will be reduced accordingly.

For gaseous media:

The overall time required to open or close a valve shall be between 0,5 seconds and 4 seconds per inch nominal valve diameter at the applied minimal safety factor on the torque of the valve at a given maximum ΔP . For ESD valves the time for the safety function shall be between 0,5 seconds and 2 seconds for the safety function and may be up to 8 seconds per inch for the other direction if the safety function is realised with a spring.

For liquid or dense media:

The time required to open or close a valve shall be dependent on the opening angle of the valve to prevent fluid hammer:

- 20 - 100% open between 4 to 8 seconds per inch nominal valve diameter;
- 0 - 20% open between 8 to 16 seconds.

The travel time shall be adjustable at the actuator on site.

The connection between the actuator and the valve, gearbox or extension shall be in accordance with NEN-EN-ISO 5640 and:

- secured by means of dowel pins or close-fitting bolts as shown in MSW-03-E/1, to ensure the positioning of each item with respect to the other and consequently to avoid incorrect installation;
- sealed by means of a gasket or O-ring.

The output shaft of the actuator or the gearbox shall be constructed in such a way to allow installation of the actuator or the gearbox on the valve in line or in perpendicular position.

In order to prevent pressure build-up in the housing of the actuator or the gearbox due to leakage of the valve stem seal, the actuator, the gearbox or the adapter between the valve and the actuator shall be provided with an atmospheric breather plug. An open construction to the atmosphere of the adapter is not allowed.

The actuator or the gearbox shall drive the valve through the entire length of the key.

A mechanical position indicator on the actuator or the gearbox shall clearly show the valve position.

Actuators and gearboxes shall be suitable for installation on a vertical (upward) or horizontal valve stem.

Actuators and gearboxes placed on plug valves with a central sealing system, shall have a safe and suitable design for this purpose.

The adjustment of the actuator shall be such, that the ball or plug can be positioned with an accuracy of 0,5 degrees at each end of travel.

4.2.3 *Electric actuator*

4.2.3.1 *Power supply*

Actuators for control valves with a rated power less than 1,5 kW power supply shall be single phase 230 V a.c. 50 Hz, otherwise power supply shall be three phase 400 V a.c. 50 Hz.

4.2.3.2 *Control signals*

For remote control of the actuator following signals are required.

Control signals 24V d.c. max 0,5 A:

- open;
- close;
- stop;
- ESD.

Note: for replacement of an existing actuator 24 V a.c. can be required (not for ESD actuators).

Indicating signals, potential free contacts suitable for 24 V d.c. 0,5 A – 5 A:

- open;
- close;
- fault;
- 4 freely programmable contacts.

Additional for control valves:

- 4 mA - 20 mA passive, position setpoint;
- 4 mA - 20 mA passive, position indication.

If the supply power fails, the fault contact shall be set (fail open) and the open and close contacts shall signal the correct position.

In case the ESD function is realised by a spring loss of supply power may not trigger the ESD function. The only reason to trigger the ESD function is a low signal to the ESD control signal.

5. GEARBOX, AMENDMENTS/SUPPLEMENTS TO NEN-EN-ISO 22109 (2020)

5.1 General requirements

If not specifically stated otherwise, the amended sections are replacements of the appropriate section of NEN-EN-ISO 22109. Sections not mentioned remain unaltered.

Additional requirements, which are not stated NEN-EN-ISO 22109 are indicated with "addition" in the left margin.

Sections of NEN-EN-ISO 22109 which are not valid, are indicated with "deletion" in the left margin.

Requirements which are stated in NEN-EN-ISO 22109 that need to be replaced, are indicated with "substitution" in the left margin.

Client choices are indicated as "choice".

Section numbers in italics correspond with section numbers of NEN-EN-ISO 22109.

5.2 Modifications and supplements to NEN-EN-ISO 22109 (2020)

SECTION 5 *Design requirements*

5.5 Environmental conditions

Substitution *5.5.1 General*

Substitute the entire subsection with the following text:

"The gearbox shall be capable of operation at an ambient temperature range between -33 °C and +60 °C with relative humidity up to 100 %.

For temperatures between -20 °C and -33 °C it is permitted that instruments, equipment and materials will not function in accordance with their specification."

Substitution *5.5.3 Enclosure protection*

Substitute the entire subsection with the following text:

All Gearboxes shall comply with protection class IP68 in accordance with NEN-EN-IEC 60529 against the effects of continuous immersion in water to a depth of 0,5 m above the top of the gearbox.

Choice *5.5.4 Corrosion protection*

Coating shall be corrosion category C5 or better.

SECTION 6 *Optional equipment*

Addition

The following equipment shall be mounted on the gearbox:

- a position indicator to show the open/closed position of the valve.
- If the gearbox is mounted directly on the valve, the gearbox shall be provided with an atmospheric air vent to prevent pressure build-up in the gearbox housing in the event of leakage through the valve stem seal.

SECTION 8 Marking

8.1 Mandatory markings

Addition

Add the following item:

- i) Gasunie purchase order number, item number and Gasunie article number.

6. ELECTRIC ACTUATORS, AMENDMENTS/SUPPLEMENTS TO NEN-EN-ISO 22153 (2021)

6.1 General requirements

If not specifically stated otherwise, the amended sections are replacements of the appropriate section of NEN-EN-ISO 22153. Sections not mentioned remain unaltered.

Additional requirements, which are not stated NEN-EN-ISO 22153 are indicated with "addition" in the left margin.

Sections of NEN-EN-ISO 22153 which are not valid, are indicated with "deletion" in the left margin.

Requirements which are stated in NEN-EN-ISO 22153 that need to be replaced, are indicated with "substitution" in the left margin.

Client choices are indicated as "choice".

Section numbers in italics correspond with section numbers of NEN-EN-ISO 22153.

6.2 Modifications and supplements to NEN-EN-ISO 22153 (2021)

SECTION 5 *Design requirements*

5.2 Environmental conditions

Substitution *5.2.2 Ambient temperature and humidity*
Substitute the entire subsection with the following text:
"The actuator shall be capable of operation at an ambient temperature range between -33 °C and +60 °C with relative humidity up to 100 %.

For temperatures between -20 °C and -33 °C it is permitted that instruments, equipment and materials will not function in accordance with their specification."

Substitution *5.2.4 Enclosure protection*
Substitute the entire subsection with the following text:
"Electric actuators shall have at least enclosure protection type IP68 in accordance with NEN-EN-IEC 60529."

Choice *5.2.5 External corrosion protection*
Coating shall be corrosion category C5 or better.

5.5 Fail-safe direction

Addition
An additional warning pictogram for spring energy shall be placed on the spring casing.

5.6 Electrical connections — Cable entries

Addition
If explosion protection is required, the terminal compartment shall be of enhanced safety according NEN-EN-IEC 60079-7.

5.8 Performance

5.8.3 Operating time and speed

Addition Actuators shall have variable speed.

5.9 Basic design requirements

5.9.4 Travel limitation

Addition Travel position indicating and limiting devices may not use batteries to store the position.

SECTION 6 Optional equipment

6.9 Gasunie requirements (additional subsection)

Addition The actuator shall be electrically isolated from gearbox or valve.
The local controls shall be protected by a vandal cover; the cover shall be lockable by an 8 mm padlock (supplied by Gasunie).
The manual operation shall be lockable by an 12 mm padlock (supplied by Gasunie).

SECTION 8 Marking

8.2 Mandatory markings

Addition Add the following item:
m) Gasunie purchase order number, item number and Gasunie article number.

7. PNEUMATIC ACTUATORS, AMENDMENTS/SUPPLEMENTS TO NEN-EN 15714-3 (2022)

7.1 General requirements

If not specifically stated otherwise, the amended sections are replacements of the appropriate section of NEN-EN 15714-3. Sections not mentioned remain unaltered.

Additional requirements, which are not stated NEN-EN 15714-3 are indicated with "addition" in the left margin.

Sections of NEN-EN 15714-3 which are not valid, are indicated with "deletion" in the left margin.

Requirements which are stated in NEN-EN 15714-3 that need to be replaced are indicated with "substitution" in the left margin.

Client choices are indicated as "choice".

Section numbers in italics correspond with section numbers of NEN-EN 15714-3.

7.2 Modifications and supplements to NEN-EN 15714-3 (2022)

SECTION 5 *Motive energy*

5.1 Operating medium

Substitution Substitute the entire subsection with the following text:

"The operating medium can be air, natural gas or nitrogen."

Note: Natural gas is only allowed if it is a replacement and no other options are available.

5.3 Pressure

Substitution Substitute in item b: "0,8 MPa (8 bar)" with "1,2 MPa (12 bar)".

SECTION 7 *Basic design requirements*

7.6 Environmental conditions

Substitution *7.6.1 Ambient temperature*

Substitute the entire subsection with the following text:

"The actuator shall be capable of operation at an ambient temperature range between -33 °C and +60 °C with relative humidity up to 100 %.

For temperatures between -20 °C and -33 °C it is permitted that instruments, equipment and materials will not function in accordance with their specification."

7.6.2 Enclosure protection

Substitution Substitute "IP 65" with "IP68".

7.6.3 Corrosion protection

Choice Coating shall be corrosion category C5 or better.

7.7 Pressure connections*7.7.2 Remotely mounted pilot valves and 7.7.3 Direct mounted pilot valves*

Choice Table 4 and 5, all pressure connections shall be NPT type thread.

SECTION 8 Optional equipment**8.1 Ancillaries**

Addition Actuators for open/close use should be provided with a valve position monitor make Imtex, type DQ25S5SR-GU005.

SECTION 10 Marking*10.1 Basic requirements on marking*

Addition Add the following item:

i) Gasunie purchase order number, item number and Gasunie article number.

8. (ELECTRO) HYDRAULIC ACTUATORS, AMENDMENTS/SUPPLEMENTS TO NEN-EN 15714-4 (2025)

As there is not yet a standard for electrohydraulic actuators reference is made to the standard for electric actuators see clause 6 and the standard for hydraulic actuators in this clause. The system design principles should be according to EN ISO-4413. The reservoir containing the oil shall be pressurized and an alarm contact shall be set if the pressure in the reservoir is declining. Piping shall be minimised and no piping work on site required. It should be possible to mount the actuator in any position.

8.1 General requirements

If not specifically stated otherwise, the amended sections are replacements of the appropriate section of NEN-EN 15714-4. Sections not mentioned remain unaltered.

Additional requirements, which are not stated NEN-EN 15714-4 are indicated with "addition" in the left margin.

Sections of NEN-EN 15714-4 which are not valid, are indicated with "deletion" in the left margin.

Requirements which are stated in NEN-EN 15714-4 that need to be replaced are indicated with "substitution" in the left margin.

Client choices are indicated as "choice".

Section numbers in italics correspond with section numbers of NEN-EN 15714-4.

8.2 Modifications and supplements to NEN-EN 15714-4 (2025)

SECTION 7 *Basic design requirements*

7.6 Environmental conditions

Substitution

7.6.1 *Ambient temperature*

Substitute the entire subsection with the following text:

"The actuator shall be capable of operation at an ambient temperature range between -33 °C and +60 °C with relative humidity up to 100 %.

For temperatures between -20 °C and -33 °C it is permitted that instruments, equipment and materials will not function in accordance with their specification."

7.6.2 *Enclosure protection*

Substitution

Substitute "IP 65" with "IP68".

7.6.3 *Corrosion protection*

Choice

Coating shall be corrosion category C5 or better.

7.7 Pressure connections

7.7.2 *Remotely mounted pilot valves*

Choice

Table 5, all pressure connections shall be NPT type thread.

SECTION 10 Marking

10.1 Mandatory marking

Addition

Add the following item:

- k) Gasunie purchase order number, item number and Gasunie article number.

9. INSPECTION AND TESTING

9.1 Inspection

Each actuator shall be visually inspected to assure the conformity with the approved design drawings and the requirements of this specification. The inspection shall be in accordance with the approved ITP and shall include the following items as a minimum:

- dimensional check;
- surface quality;
- paint quality;
- markings and identification plates;
- shipping requirements.

In addition to overall visual inspection the following specific items will be inspected by Gasunie management:

- data as specified in material specification (data sheet and inspection);
- explosion proof material and certificates;
- documents as stated in the RED.

9.2 Testing

9.2.1 Testing actuators for valves smaller than DN 400

Gasunie requires no additional testing, other than manufacturer's standard, for actuators placed on valves smaller than DN 400.

Manufacturer's standard will be specified and approved by Gasunie management in the ITP.

For actuators placed on valves smaller than DN 400, the manufacturer shall submit a "EU declaration of conformity". This "EU declaration of conformity" according to NEN-EN-ISO/IEC 17050-2 shall at least state that the actuator meets the manufacturer's specifications and theoretical torque figures.

9.2.2 Testing actuators for valves of DN 400 and larger

Each actuator placed on valves of DN 400 and larger shall be subject to a performance shop-test. All tests may be witnessed by the client. The test results shall be in accordance with the manufacturer's data as specified in the quotation.

The following tests will be carried out for pneumatic actuators:

- Tests to determine:
 - the supply pressure to produce the maximum allowable stem torque of the valve;
 - the supply pressure to produce two times the in-shop breakaway torque of the valve;
 - the supply pressure to operate the actuator without load (input characteristics);
 - the output torque at manufacturer's maximum allowable supply pressure.
- Electrical equipment test.

The following tests will be carried out for electric actuators:

- Tests to determine the required setting at:
 - two times the in-shop breakaway torque of the valve;
 - the output torque at 100 % setting.
- Electrical equipment test.

10. REQUIREMENTS FOR DOCUMENTS

10.1 General requirements

All documents required by Gasunie will be stated in the RED, which will be part of the material specification.

The original documents shall be retained by the manufacturer for a minimum of ten years from the date of manufacture.

The documents shall be legible, identifiable, retrievable and in a digital form.

The documents should preferably be prepared in Dutch. However, English is also acceptable.

10.2 Certificates

The required explosion proof (ATEX) certificates, inspection certificates and EMC reports shall be supplied to Gasunie management conform the RED form.

An EU Declaration of Conformity (DoC) is legally mandatory to declare the products meet all applicable European Directives. Gasunie however requires a DoC which includes the evidence (like the test report number of the test report and the applied standards) on which the declaration is based. It is the normal route to comply with the requirements of the harmonic standards, the (NEN-)EN-standards.

Actuators require an inspection certificate 2.2 (according to NEN-EN 10204) as a minimum.

11. PACKING AND SHIPPING

Each actuator, or batch of actuators, shall be handled in accordance with MSA-25-E.

12. VALIDATION AND VERIFICATION REQUIREMENTS

12.1 Validation

The manufacturer shall draw up an Inspection and Test Plan covering all verification activities and indicating all tests/inspections to be witnessed by Gasunie or an authorised inspection agency (Notified Body). This ITP shall be approved by Gasunie. Manufacturers may use their own procedure and format for the ITP, provided the minimum requirements are included.

All verification activities shall be grouped in a logical sequence in line with the production plan.

At least the following information shall be provided for each activity:

- activity number;
- description;
- controlling document;
- acceptance criteria;
- type of record or document to be provided;
- verification action (witness, hold-point or review of documents);
- party (manufacturer/Gasunie).

The relevant work instruction/procedures shall be indicated in the controlling document column. The acceptance criteria column shall identify the specific clause/subclause of the applicable documents (codes, standards, requisitions, specifications and the like).

Critical documents referred to in the ITP shall be considered part of this plan and shall be subject to approval by Gasunie. At least the following procedures shall be submitted to Gasunie for approval:

- functional test procedures;
- final testing procedures;
- painting procedures;
- marking procedures;
- shipping procedures.

Gasunie has made a distinction in requirements for testing actuators placed on valves smaller than DN 400 and for actuators placed on valves of DN 400 and larger.

12.2 Verification

Each actuator shall be visually inspected to assure the conformity with the approved design drawings and the requirements of this specification. The inspection shall be in accordance with subclause 9.1.

Testing is to be done as described in subclause 9.2, with a paragraph depending on the valve diameter.

13. RATIONALE (EXPLANATIONS OF REQUIREMENTS)

This clause contains substantiation of requirements and other additional information and is intended for Client use only.

13.1 Design considerations for selecting an actuator

To comply with the 2024 European directive to reduce methane emissions (EU 2024/1787) a pneumatic actuator powered with natural gas is not an option anymore. For the gas transmission pipelines the decision is taken to switch to electric actuators, this because failure of electric power mostly disables remote steering and stay put is the desired action.

For ESD valves standard electric actuators are not an option as the requirements for emergency power require enormous investments and still the electric power can fail. An electric actuator with an additional spring return function is an option.

13.1.1 *Pneumatic actuators supplied with instrument air*

A standard double acting pneumatic actuator is allowed by the current Gasunie standards if it is sized according to subclause 4.2.2 and a maximum working pressure of 5 bar (e). This leads to big actuators (Ø 1,5 m for a DN 1200 valve) with big air supply demand. The instrument air system shall be designed to be able to supply all ESD valves at the same time.

For single acting actuators, the same applies but by staggering the valve sequence to get in production the capacity of the instrument air supply can be lower.

13.1.2 *(Electro) hydraulic actuators*

Hydraulic actuators are normally smaller than pneumatic actuators because the hydraulic pressure is higher than instrument air. The required hydraulic pressure can be generated by a handpump or an electric driven pump.

For manual operation, a gearbox with hand-wheel is the cheaper option, for remote steered actuators without an ESD function a standard electric actuator will be cheaper.

For ESD functions an electrohydraulic actuator shall be single acting. For the design of the electrical installation, it is wise to stagger the valve sequence to get in production.

13.2 Types of ESD valves

For the emergency shut down actuator the fact that no natural gas can be used has an impact on the possible options and require in some cases a radical new design. In the next paragraphs a summing of the requirements of the function and possible design options.

13.2.1 *Standard fail to open or close*

The fail open or close actuators are the industry standard versions and are available in a wide range of implementations.

The best implementation for the function depends on the availability of power sources.

- Instrument air (see §13.1.1)
- Electricity (see §13.1 and §13.1.2)

13.2.2 *Compressor station bypass valve*

This type of valve is a normal fail to open with the restriction that it only may do so if the differential pressure over the valve is below 1,5 bar.

13.2.3 *High pressure shut down valve*

A high-pressure shutdown valve is fail-close when the downstream pressure exceeds a setpoint. The measurement can be done by an electric transmitter or a solenoid switch.

13.2.4 *Manifold blowdown valve*

A natural gas-powered manifold blowdown valve (as currently installed) is not a fail-safe actuator for the blowdown action. The valve shall close before all pressure in the manifold is gone to prevent air entering the manifold. In the current standard this is realized by feeding the pilot operated solenoid with the gas pressure from the manifold. For new stations, this design needs to be reconsidered to prevent methane emission.

13.3 *Historical data*

13.3.1 *Reason for safety factor of 2*

After the terroristic attack at the compressor in Ravenstein in 1972 it was not possible to close the valve to stop the gas flow. The reason was the high gas flow, a ball valve and a scotch yoke actuator. A ball valve in 45° position with high gas flows requires more torque and a symmetrical scotch yoke delivers less torque in this position. The safety factor for this reason changed from 1.3 to 2 in 1974.

13.3.2 *Actuator selection in the history of Gasunie*

As natural gas is mostly present in the pipeline, natural gas was a requirement to power actuators. A requirement was that actuators shall be manually operated when there was no gas pressure. That's why the early actuators are mostly hydraulic operated with a gas expansion engine to power the hydraulic pump and have a backup hand pump.

When scotch yoke pneumatic actuators were introduced in the pipeline grid they were fitted with a backup pressure tank to make it possible for manual operation (3 times). The backup tanks are now removed when the decision was made that when the pipeline is pressure less there is no need for manual operation. Now backup tanks are only required for manifold blow-down valves.

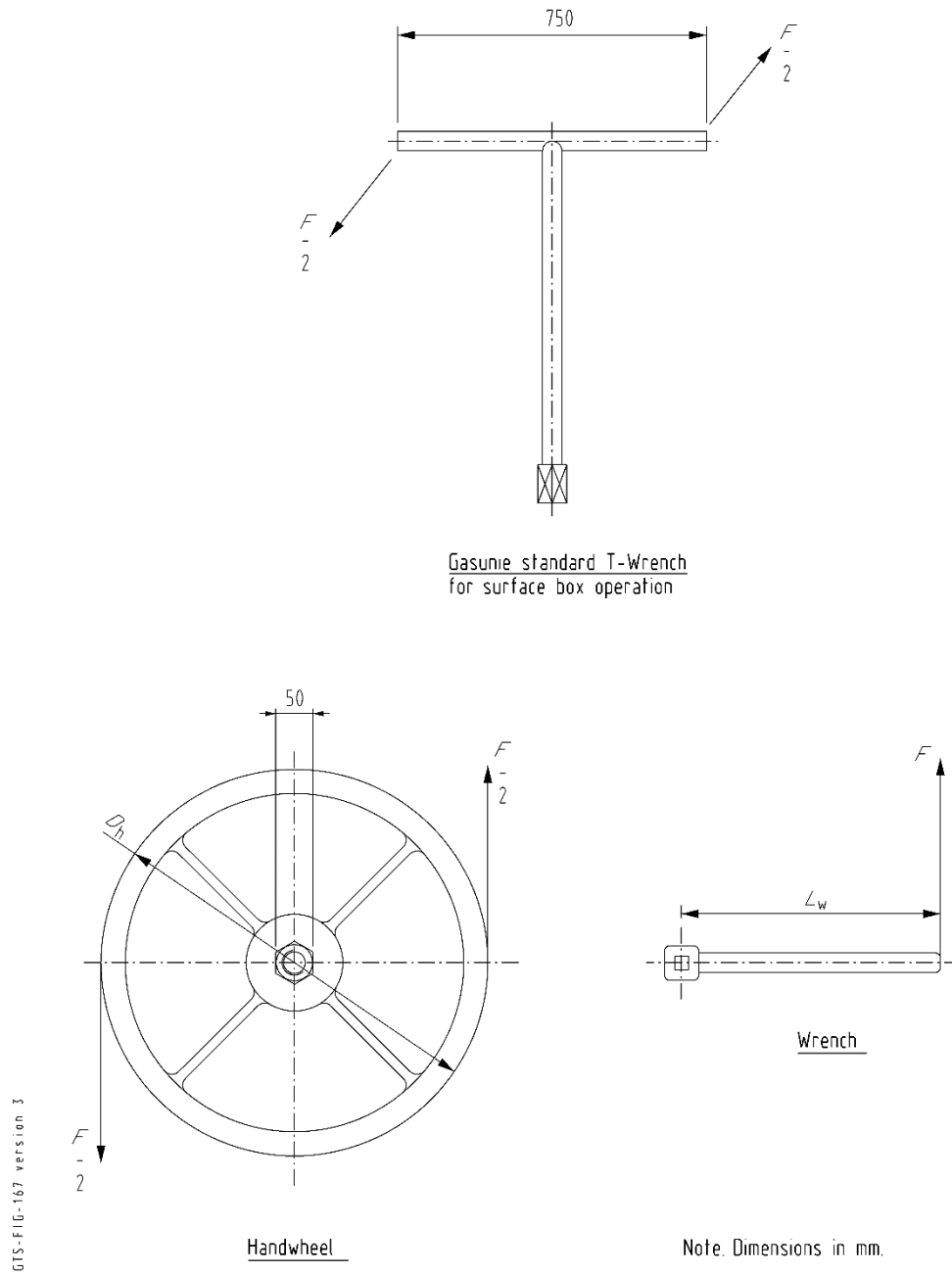
ANNEX**A ACTUATING FORCE FOR HAND-WHEEL AND WRENCH-OPERATED VALVES (NORMATIVE)**

Figure 1: Actuating force for hand-wheel-operated and wrench-operated valves
GTS-FIG-167