

# Gasunie Technical Standard

Material Specification Mechanical

MSW-04-E/3

**Flanges  $450 \leq DN \leq 1200$**

Version 5 *02-02-2024*

## FOREWORD

This specification supersedes the fourth version of MSW-04-E/3.

MSW-04-E is divided in the following parts:

- [MSW-04-E/1](#): "Pipe fittings  $450 \leq DN \leq 1200$ ";
- [MSW-04-E/2](#): "Pipe fittings  $15 \leq DN \leq 400$ ";
- MSW-04-E/3: "Flanges  $450 \leq DN \leq 1200$ ";
- [MSW-04-E/4](#): "Flanges  $15 \leq DN \leq 400$ ".

With respect to the former version the following has been changed:

- Clause 1: added Transport medium table.
- Added subclause 3.1 "Definition".
- Subclause 8.3.5: preparation grade has been changed to minimal P2.

Note:

The numbering and (sub)clauses in italics in this specification correspond to that in NEN-EN 14870-3.

Alterations are marked with a left margin line.

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**CLAUSE NUMBERS CORRESPOND TO CLAUSE NUMBERS IN EN 14870-3:**

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## 1. SCOPE AND APPLICATION

This specification contains the requirements for flanges for use in natural gas, hydrogen and nitrogen pipelines and piping systems (see documentation 1) with the following design criteria:

- nominal diameter :  $450 \leq DN \leq 1200$
- design pressure :  $0 \text{ bar (e)} < p_d \leq 80,0 \text{ bar (e)}$
- design temperature :  $-20 \text{ }^{\circ}\text{C} < T_d \leq + 50 \text{ }^{\circ}\text{C}$

This specification is based on NEN-EN 14870-3:2006 and serves as a supplement to that document. Therefore this specification shall be read in conjunction with NEN-EN 14870-3. Topics referred to as "by agreement" or "if specified" in NEN-EN 14870-3 do not apply when these topics are not specifically addressed in this document.

All flanges specified to be in accordance with this specification shall comply with the requirements of NEN-EN 14870-3, as amended and supplemented herein.

Transport medium <sup>1</sup>	Natural gas	Hydrogen	Carbon dioxide	Nitrogen	(Hot) water	Ammonia
	Applicable	Applicable	Not judged <sup>2</sup>	Applicable	Not judged <sup>2</sup>	Not judged <sup>2</sup>

1 The table is based on 100 % 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 Suitability shall be determined on the basis of an impact analysis. The requirements that do appear to be applicable shall be observed.

## 2. REFERENCES

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

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

### 2.1 Gasunie specifications

In this specification reference is made to the following Gasunie specifications:

<a href="#">MSA-25-E</a>	Transport, packing and marking.
<a href="#">MSA-32-E</a>	Requirements for inspection certificates of pressure parts.
<a href="#">MSW-01-E</a>	Pipe for gas lines; seamless and welded line pipe.

### 2.2 Standards

In this specification reference is made to the standards<sup>1</sup> mentioned in this subclause. Any supplements and errata notices are also applicable.

ASME B16.47	Large diameter steel flanges NPS 26 through NPS 60 metric/ inch standard.
NEN-EN 10222-4	Steel forgings for pressure purposes - Part 4: Weldable fine grain steels with high proof strength.
NEN-EN 14870-3 (March 2006)	Petroleum and natural gas industries - Induction bends, fittings and flanges for pipeline transportation systems; Part 3: Flanges.
NEN-EN-ISO 8501-3	Preparation of steel substrates before application of paints and related products - Visual assessment of surface cleanliness - Part 3: Preparation grades of welds, edges and other areas with surface imperfections.
NEN-EN-ISO 9712	Non-destructive testing - Qualification and certification of NDT personnel.
NEN-EN-ISO 10893-4	Non-destructive testing of steel tubes - Part 4: Liquid penetrant inspection of seamless and welded steel tubes for the detection of surface imperfections
NEN-EN-ISO 10893-5	Non-destructive testing of steel tubes - Part 5: Magnetic particle inspection of seamless and welded ferromagnetic steel tubes for the detection of surface imperfections
NEN-EN-ISO 10893-8	Non-destructive testing of steel tubes - Part 8: Automated ultrasonic testing of seamless and welded steel tubes for the detection of laminar imperfections

<sup>1</sup> Applicable for all NEN-EN standards: Depending on the country where the standard will be applied, DIN-EN or BS EN, for example, shall be chosen.

### 3. DEFINITION, ABBREVIATIONS AND SYMBOLS

#### 3.1 Definition

In this specification the following definition is applicable:

Transport medium <sup>2</sup>	A gaseous or liquefied substance that is transported by and/or stored in a Gasunie transport network; limited to: <ul style="list-style-type: none"><li>– natural gas;</li><li>– hydrogen;</li><li>– carbon dioxide;</li><li>– nitrogen;</li><li>– (hot) water;</li><li>– ammonia.</li></ul>
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#### 3.2 Abbreviations

In this specification the following abbreviations are applicable:

DN	Nominal Diameter
ITP	Inspection and Test Plan
MT	Magnetic Testing
NDT	Non-Destructive Testing
PT	Penetrant Testing

#### 3.3 Symbols

In this specification the following symbols are applicable:

<u>Symbol</u>	<u>Description</u>	<u>Unit</u>
$D$	Diameter	mm
$D_i$	Internal diameter	mm
$ID$	Internal diameter / bore size	mm
$p_d$	Design pressure	bar (e)
$T_d$	Design temperature	°C
$T_{d,min}$	Minimum design temperature	°C
$t$	Specified wall thickness at the welding ends for flanges	mm
$t_{nom}$	Nominal wall thickness of pipe	mm

<sup>2</sup> Additives and other substances used in the medium or in the processes are therefore expressly outside the scope.

## 4. AMENDMENTS/SUPPLEMENTS TO NEN-EN 14870-3:2006

This chapter is presented in the form of amendments and supplements to NEN-EN 14870-3 and uses the same clause numbering as NEN-EN 14870-3.

If requirements of the mentioned codes and specifications conflict with this specification, this specification shall prevail.

### CLAUSE 1 SCOPE

Substitution *Substitute in the second paragraph of this clause the following:*  
"pipeline transportation systems for the petroleum and natural gas industries as defined in ISO 13623" with:

"natural gas, hydrogen and nitrogen pipelines and piping systems"

Substitution *Substitute the third paragraph of this clause with the following:*  
"This part of NEN-EN 14870-3 designates flanges to match MSW-01-E pipe."

Deletion *Delete in this clause the following:*  
The last paragraph.

### CLAUSE 5 DESIGNATION OF FLANGES

Substitution *Substitute this clause with the following:*  
"Flanges shall be designated as (L), non sour.  
Flanges shall demonstrate proven notch toughness in accordance with clause 9."

### CLAUSE 6 PRESSURE CLASS AND DESIGN

Deletion *Delete in this clause the following:*  
The fourth paragraph "For pipeline applications .. ISO 7005-1:1992, Annex F"

### CLAUSE 7 INFORMATION TO BE SUPPLIED BY THE PURCHASER

#### 7.1 Principal information

Addition *Add to item a the following:*  
"Flange designation, size and class shall be stated in the purchase order."

Addition *Add to item b the following:*  
"The quantity of flanges shall be stated in the purchase order."

Addition *Add to item c the following:*  
"The material grade shall be P355QH1 according to NEN-EN 10222-4, with minimum yield strength of 355 N/mm<sup>2</sup> and tensile strength of 470 N/mm<sup>2</sup>."

Addition *Add to item d the following:*  
"The wall thickness ( $t_{nom}$ ) and bore size (ID) of the matching pipe are stated in table 1 and 2 of this specification MSW-04-E/3. Welding end geometry shall be according figure 1."

Table 1: Welding end and bore details, design pressure 66,2 bar (e)

Nom. Diam.		Welding end		
DN	$D$ (mm)	$t_{nom}$ (mm)	$D_i \pm 1,0$ (mm)	$\alpha$
450	457,0	$7,0^{+1,4}_{-0,0}$	443,0	30°
500	508,0	$7,8^{+1,5}_{-0,0}$	492,4	30°
600	610,0	$9,3^{+1,8}_{-0,0}$	591,4	30°
750	762,0	$11,6^{+2,3}_{-0,0}$	738,8	30°
900	914,0	$13,9^{+2,8}_{-0,0}$	886,2	30°
1050	1067,0	$16,1^{+3,2}_{-0,0}$	1034,8	30°
1200	1219,0	$18,3^{+3,7}_{-0,0}$	1182,4	30°

Table 2: Welding end and bore details, design pressure 80 bar (e)

Nom. Diam.		Welding end		
DN	$D$ (mm)	$t_{nom}$ (mm)	$D_i \pm 1,0$ (mm)	$\alpha$
450	457,0	$8,3^{+1,7}_{-0,0}$	440,4	30°
500	508,0	$9,2^{+1,8}_{-0,0}$	489,6	30°
600	610,0	$11,1^{+2,2}_{-0,0}$	587,8	30°
750	762,0	$13,8^{+2,8}_{-0,0}$	734,4	30°
900	914,0	$16,4^{+3,4}_{-0,0}$	881,2	30°
1050	1067,0	$19,1^{+3,9}_{-0,0}$	1028,8	30°
1200	1219,0	$21,7^{+4,4}_{-0,0}$	1175,6	27,5°

GTS-FIG-1174, version 1

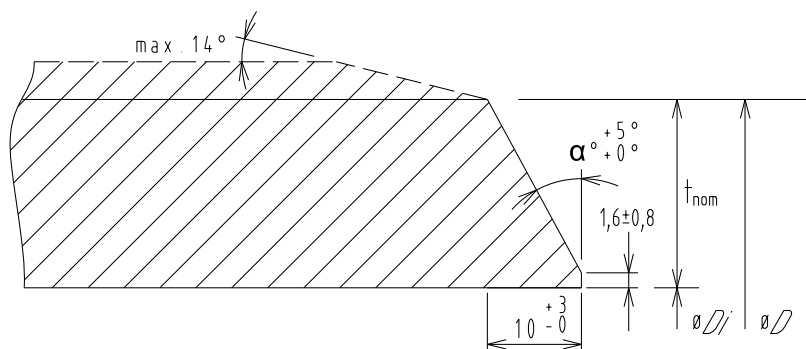


Figure 1: Welding end detail for flanges"

Addition

*Add to item e the following:*

"The flange facing shall be raised face with a serrated surface finish from 3,2  $\mu\text{m}$  to 6,3  $\mu\text{m}$ ."



## 7.2 Supplementary information

- Addition      *Add to item i the following:*  
 "Flanges shall be packed and shipped in accordance with MSA-25-E."
- Addition      *Add item k:*  
 "Type of coating shall be in accordance with MSW-11-E code A."

## CLAUSE 8      **MANUFACTURING**

### **8.1 Manufacturing procedure specification**

- Substitution      *Substitute this subclause with the following:*

#### **"8.1 Inspection and Test Plan**

The manufacturer shall draw up an Inspection and Test plan (ITP) covering all verification activities and indicating all tests/inspections to be witnessed by Gasunie or an authorised inspection agency. The ITP shall be approved by Gasunie, prior to commencement of manufacturing. In principle, 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.

The following information shall be provided on each activity:

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

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).

The following documents shall be included:

- manufacturer's written material specifications;
- non-destructive testing (NDT) procedures;
- mechanical testing procedures;
- final testing procedures;
- painting procedures;
- marking procedures;
- shipping procedures.

The NDT procedures shall be submitted to Gasunie for approval.

#### Note:

The inspectors of Gasunie are authorised to carry out two types of inspection, either in the context of a Gasunie Quality Inspection and/or – if stated in the purchase order – as a User Inspectorate.

An update of the ITP and approval by Gasunie is required either every 3 years or by any change in the manufacturer's production procedures or by a new revision of this specification (MSW-04-E/3)."

Intern/Internal

**8.2 Starting material**

Deletion *Delete in this subclause the second paragraph.*

Addition **8.3.5 Surface treatment (additional subclause)**

Surface preparation shall be minimal P2, according to NEN-EN-ISO 8501-3. Additional weld porosity and welding spatters shall be dressed out. Bolt holes shall be prepared on both sides.

**8.4 Heat treatment**

Deletion *Delete in the second paragraph of this subclause the following:  
", if specified"*

**CLAUSE 9 TESTING AND INSPECTION****9.2 Extent of testing and inspection**

Substitution *Substitute Table 3 of this subclause with table 3 of this specification (MSW-04-E/3):*

Table 3: Number of tests for destructive physical testing

Type of test	Number and frequency of testing
chemical composition	one per heat after final heat treatment according subclause 9.3.
tensile – base metal	one per heat after final heat treatment
impact – base metal	one set per heat after final heat treatment
surface hardness	one set per heat after final heat treatment

**9.3 Chemical composition**

Substitution *Substitute this subclause with the following:*

"The product analysis shall be taken after final heat treatment and shall be in accordance with MSA-32-E".

Substitution *Substitute value for Maximum permitted element concentration of element N in Table 4 column "Non-sour service (designations N and L)":  
"0,010 to 0,030" with "0,030".*

**9.4.3.1 Test pieces**

Substitution *Substitute table 5 with the following:*

Table 5 – Maximum Charpy V-notch test temperature

Specified wall thickness at the welding end for flanges (mm)	Test temperature (°C)
$t \leq 22$	$T_{d,min}$
$22 < t \leq 25$	$\leq -30$
$25 < t \leq 27,5$	$\leq -40$
$27,5 < t \leq 30$	$\leq -50$

**9.5.1 NDT personnel and procedures**

Substitution *Substitute this subclause with the following:*

The manufacturer shall have at least NDT experts available for the NDT methods employed. This NDT expert shall be certified according to NEN-EN-ISO 9712 level 3 in the method employed by the manufacturer. The personnel performing the examinations shall have at least NEN-EN-ISO 9712 level 2 for the used technique.

**Documentation**

For each test method used, a procedure shall be written and approved by the level 3 expert for the relevant method. This NDT procedure shall fulfil the requirements of the relevant EN, ISO or ASME standards. All relevant information for performing the test, interpretation, evaluation of results and reporting shall be included in the procedure as a minimum.

The written procedures for each method employed in production shall be submitted to Gasunie for approval before start manufacturing. A sketch or document showing the location of the NDT and the repairs shall be made for the manufacturing report.

**9.5.4 MT/PT inspection****9.5.4.1 Method**

Substitution Substitute in first paragraph the first sentence with:  
"The weld-end of flanges shall be inspected by MT in accordance with NEN-EN-ISO 10893-5 for the presence of laminar imperfections."

Substitute in second paragraph the last sentence with:  
"Each flange shall be inspected by magnetic particle testing in accordance with NEN-EN-ISO 10893-5 or by liquid penetrant testing in accordance with NEN-EN-ISO 10893-4."

Addition By agreement, PT in accordance with NEN-EN-ISO 10893-4 may be carried out instead of MT.

**9.5.4.2 Requirements**

Substitution *Substitute this subclause with the following:*  
"100 % of the flanges shall be tested."

**9.5.5 UT inspection****9.5.5.1 Method**

Substitution Substitute in first paragraph the first sentence with:  
"The final 50 mm of each end of the flange shall be UT-inspected for the detection of laminar imperfections in accordance with NEN-EN-ISO 10893-8."

**9.5.5.2 Requirements**

Substitution *Substitute this subclause with the following:*  
"10 % of the batch shall be tested. If any unacceptable imperfection is found on the test sample, the test shall be extended to 100 % of the batch."

**9.6 Dimensions****9.6.1 Flange dimensions**

Substitution *Substitute in the first paragraph:*  
"B16.47" with "ASME B16.47 series A"

Deletion In the first paragraph "B16.36" and delete the second, third and fourth paragraph.

**CLAUSE 10 DOCUMENTATION**

Substitution *Substitute this clause with the following:*

"The flange shall be certified in accordance with MSA-32-E. The required inspection certificate shall be in accordance with MSA-32-E route 10.

The following documents shall be supplied:

- finished product inspection certificates including results of dimensional check, destructive tests, non destructive tests, heat treatment time and temperature.

**CLAUSE 11 MARKING**

Addition *Add to the second paragraph of this clause the following:*

"Die stamp position shall be located with a distance of 5 mm from the weld bevel or at the rim of the flange."

Addition *Add to the seventh enumeration in this clause the following:*

"The manufacturer's name or trademark shall be clearly made with a specific stamp or engraved and not a combination of standard characters."

Substitution *Substitute the ninth enumeration with:*

"- design pressure and class"

Addition *Add to this clause the following:*

Depending on the applicable heat treatment, flanges shall be marked with:

- "N" in case of normalised or normalised and tempered heat treatment;
- "QT" in case of quenched and tempered heat treatment.

## **5. DOCUMENTATION**

In this specification the following informational documentation applies:

- 1 N.V. Nederlandse Gasunie, memorandum [OTW 22.1045](#),  
"GTS MSW-04-E/3 en -E/4 Flanges wijzigen voor de toepassing voor  
waterstof en stikstof", d.d. 31-05-2022.