

Gasunie Technical Standard

Material Specification Mechanical

MSW-04-E/1

Pipe fittings $450 \leq DN \leq 1200$

Version 10 *19-07-2024*

FOREWORD

This specification supersedes the ninth version of MSW-04-E/1.

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 version 8 and the former version the following has been changed:

- Added subclause 1.1 with table 1 Transport media.
- Added subclause 3.1 "Definition".
- Clause 1 (NEN-EN 14870-2): added first paragraph; transport media has been changed.
- Subclause 8.3.5 (NEN-EN 14870-2): preparation grade has been changed to minimal P2.
- Subclause 9.6: minimum bore DN 1050 has been changed in table 3 and 4.

Note:

The numbering and (sub)clauses in italics in this specification correspond to that in NEN-EN 14870-2.

Alterations are marked with a left margin line.

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CLAUSE NUMBERS CORRESPOND TO CLAUSE NUMBERS IN NEN-EN 14870-2:

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1. SCOPE AND APPLICATION

This specification contains the requirements for fittings for use in natural gas, hydrogen and nitrogen pipeline 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 14870-2:2005 (January 2005) and serves as a supplement to that document. Therefore this specification shall be read in conjunction with NEN-EN 14870-2. Topics referred to as "by agreement" or "if specified" in NEN-EN 14870-2 do not apply when these topics are not specifically addressed in this document.

All fittings specified to be in accordance with this specification shall comply with the requirements of NEN-EN 14870-2, as amended and supplemented herein.

1.1 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
	Applicable	Applicable	Not judged ²	Applicable	Not judged ²	Not judged ²

- 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 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

This specification refers to the following Gasunie specifications:

MSA-25-E	Transport, packing and marking.
MSA-32-E	Requirements for inspection certificates of pressure parts.
MSW-11-E	Shop coating of steel structures and pipeline elements.

2.2 Standards

This specification refers to the standards mentioned in this subclause. 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 14870-2 (January 2005)	Petroleum and natural gas industries - Induction bends, fittings and flanges for pipeline transportation systems; Part 2: Fittings.
NEN-EN-ISO 148-1	Metallic materials - Charpy pendulum impact test; Part 1: Test method.
NEN-EN-ISO 3183	Petroleum and natural gas industries - Steel pipe for pipeline transportation systems.
NEN-EN-ISO 3834-2	Quality requirements for fusion welding of metallic materials; Part 2: Comprehensive quality requirements.
NEN-EN-ISO 6507-1	Metallic materials - Vickers hardness test - Part 1: Test method.
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 9606-1	Qualification testing of welders - Fusion welding - Part 1: Steels.
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 10893-6	Non-destructive testing of steel tubes; Part 6: Radiographic testing of the weld seam of welded steel tubes for the detection of 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.
NEN-EN-ISO 11666	Non-destructive testing of welds - Ultrasonic testing - Acceptance levels.
NEN-EN-ISO 14731	Welding coordination - Tasks and responsibilities.
NEN-EN-ISO 14732	Welding personnel - Qualification testing of welding operators and weld setters for mechanized and automatic welding of metallic materials.
NEN-EN-ISO 15609-1	Specification and qualification of welding procedures for metallic materials - Welding procedure specification; Part 1: Arc welding.
NEN-EN-ISO 15614-1	Specification and qualification of welding procedures for metallic materials - Welding procedure test; Part 1: Arc and gas welding of steels and arc welding of nickel and nickel alloys.
NEN-EN-ISO 17640	Non-destructive testing of welds - Ultrasonic testing - Techniques, testing levels, and assessment.

3. DEFINITION, ABBREVIATIONS AND SYMBOLS

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

3.1 Definition

Transport medium ¹	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.

3.2 Abbreviations

DN	Nominal Diameter
EWf	European Welding Federation
HV	Hardness Vickers
IIW	International Institute of Welding
ITP	Inspection and Test Plan
LOR	Lock-O-Ring
MT	Magnetic Testing
NDT	Non-Destructive Testing
OES	Optical Emission Spectroscopy
PT	Penetrant Testing
QA	Quality Assurance
QC	Quality Control
RED	Required Engineering Documents
RT	Radiographic Testing
UT	Ultrasonic Testing
WPAR	Welding Procedure Approval Record
WPQ	Welding Procedure Qualification
WPQR	Welding Procedure Qualification Report
WPS	Welding Procedure Specification

3.3 Symbols

<u>Symbol</u>	<u>Description</u>	<u>Unit</u>
A_f	Elongation	%
a	Throat thickness	mm
C_{branch}	Thickness of the branch	mm
C_{cr}	Thickness of the crotch	mm
CE	Carbon equivalent	%
C_{header}	Thickness of the header	mm
d	Width of specimen	mm
$D_{branch\ outside}$	Outside diameter of the branch	mm
h	Height (two scraper-guides)	mm

¹ Additives and other substances used in the medium or in the processes are therefore expressly outside the scope.

<u>Symbol</u>	<u>Description</u>	<u>Unit</u>
h_1	Height (three scraper-guides)	mm
h_2	Height (three scraper-guides)	mm
P_{cm}	Crack measurement parameter	%
p_d	Design pressure	bar (e)
R	Rounding radius	mm
R_m	Tensile strength	MPa
$R_{t0,5}$	Yield strength for 0,5 % total elongation	MPa
T_d	Design temperature	°C
$T_{d,min}$	Minimum design temperature	°C
t	Specified wall thickness at the welding ends for pipe fittings	mm

4. AMENDMENTS/SUPPLEMENTS TO NEN-EN 14870-2

This chapter is presented in the form of amendments and supplements to NEN-EN 14870-2 and uses the same clause numbering as NEN-EN 14870-2.

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

CLAUSE 1 SCOPE

- | | |
|--------------|---|
| Substitution | <p><i>Substitute in the first paragraph:</i>
 "pipeline transportation systems for the petroleum and natural gas industries as defined in EN 14161" with:
 "natural gas, hydrogen and nitrogen pipelines and piping systems."</p> |
| Substitution | <p><i>Substitute the second paragraph with the following:</i>
 "This document is applicable to welding-end fittings such as elbows, caps, tees, reducers and transition pieces made from unalloyed or low-alloy steels."</p> |
| Deletion | <p><i>Delete in this clause the following:</i></p> <ul style="list-style-type: none"> – the third paragraph; – table 1; – the fourth paragraph; – the sixth paragraph. |

CLAUSE 6 PRESSURE RATING AND DESIGN

6.1 General

- | | |
|--------------|--|
| Substitution | <p><i>Substitute this subclause with the following:</i>
 "All fittings shall be in accordance with the applicable drawings mentioned in the purchase order."</p> |
|--------------|--|

6.2 Tees and headers

- | | |
|--------------|---|
| Substitution | <p><i>Substitute the first paragraph with the following:</i>
 "Outlet branches in tees and headers manufactured from seam-welded pipe shall be positioned in accordance with the applicable drawing mentioned in the purchase order."</p> |
| Substitution | <p><i>Substitute the second paragraph with the following:</i>
 "The design and welding for the attachment of guide bars of barred tees shall be in accordance with the applicable drawing mentioned in the purchase order."</p> |

CLAUSE 7 INFORMATION TO BE SUPPLIED BY THE PURCHASER**7.1 Principal information**

Substitution *Substitute item b in this subclause with the following:*
 "Fitting dimensions shall be in accordance with the applicable drawings mentioned in the purchase order and subclause 9.6 of this specification (MSW-04-E/1).

Manufacturer is responsible for design for internal pressure within the specifications of MSW-04-E/1 and applicable drawings as mentioned in the purchase order.

Addition *Add to item c the following:*
 "End-preparations shall be in accordance with subclause 9.6 of this specification (MSW-04-E/1).

Substitution *Substitute item d in this subclause with the following:*
 "No fitting shall be manufactured without the approval of the ITP by the purchaser, prior to commencement of manufacturing."

7.2 Supplementary information

Substitution *Substitute item l with the following:*
 "Type of coating is specified on the applicable drawing and shall be in accordance with MSW-11-E."

Substitution *Substitute item n with the following:*
 "Fittings shall be packed and shipped in accordance with MSA-25-E."

Substitution *Substitute in item p the following:*
 "ISO 10474" with "NEN-EN 10204"

Addition *Add to this subclause:*
 "w) additional test ring requirements for welding operations. Test rings shall be in a similar manufactured condition and specification as the fittings they represent."

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 covering all verification activities and indicating all tests/inspections to be witnessed by Gasunie or an authorised inspection agency. 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).

Reference to the following documents shall be included:

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

The welding, NDT and painting 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/1)."

8.2 Starting material

Addition

Add to this subclause the following paragraph:

"The chemical composition of the starting material shall be in accordance with column "**Classes B and C**" of table 4.

8.3.2 Welding

Substitution

Substitute the first paragraph of this subclause with the following:

"The company that performs welding shall be certified in accordance with NEN-EN-ISO 3834-2 by an authorised Notified Body. This Notified Body shall be recognised by the European Welding Federation (EWF) or International Institute of Welding (IIW). The company shall have a qualified welding engineer available. This welding engineer shall be certified by the EWF or the IIW in accordance with NEN-EN-ISO 14731 as an International Welding Engineer.

Within the company a welding technologist shall be employed who is responsible for the actual welding activities of the company. This welding technologist shall be certified by the EWF or the IIW in accordance with NEN-EN-ISO 14731."

- Substitution *Substitute the second paragraph of this subclause with the following:*
 "The following documents shall be prepared for welds and weld repairs and shall be part of the ITP which shall be submitted to Gasunie for approval, prior to commencement of manufacturing:
- Welding Procedure Specification (WPS), in accordance with NEN-EN-ISO 15609-1, within the limits of NEN-EN-ISO 15614-1 and the applicable construction code if this is more restrictive than NEN-EN-ISO 15614-1. The WPS shall be prepared and signed by the welding engineer of the company. Alternatively, the WPS can be prepared and signed by the welding technologist, but the welding engineer will remain responsible for the completeness and compliance of the documents.
 - Welding Procedure Approval Record (WPAR), in accordance with NEN-EN-ISO 15614-1. The WPAR shall be issued by Gasunie or a Gasunie representative recognised third party organisation for permanent joining.

Welders and welding operators shall be qualified in accordance with NEN-EN-ISO 9606-1 or NEN-EN-ISO 14732. The welding procedure qualification (WPQ) shall be issued by Gasunie or a Gasunie representative recognised third party organisation for permanent joining. The applicable WPS shall be available to the welder at the location where and when welding is performed."

- Addition *Add to the sixth paragraph of this subclause the following:*
 ", unless specified on the applicable drawing mentioned in the purchase order."

- Addition *Add to this subclause the following paragraphs:*
 Tee, elbow or reducer made from plate shells shall contain a maximum of two longitudinal welds, which shall be placed diametrically opposite to each other and not in the area of an outlet.

Repair of base material by welding is not allowed.

- 8.3.3 Heat treatment*
 Substitution *Substitute the second paragraph of this subclause with the following:*
 "A record shall be maintained of each heat treatment batch either by a yearly calibrated oven/furnace or by a sufficient number of thermocouples attached adequately to the material surface. The heat treatment record shall be included in the inspection document."

- 8.3.5 Surface treatment (additional subclause)*
 Addition "Surface preparation shall be minimal P2, according to NEN-EN-ISO 8501-3. Additional weld porosity and welding spatters shall be dressed out."

CLAUSE 9 TESTING AND INSPECTION

9.2 Extent of testing and inspection

- Substitution *Substitute in the first paragraph of this subclause the following:*
 "for each fitting class." with
 "Only requirements of fitting class B shall be used for testing and inspection."
- Substitution *Substitute in Table 2 of this subclause the following:*
 Surface hardness "O" with "M"
 Fitting body (UT or MT) "O" with "M"

Substitution *Substitute the footnote of Table 2 of this subclause as follows:*
 "d May be carried out on starting material by agreement." with
 "d Only after final heat treatment."

Substitution *Substitute in Table 3 of this subclause the following:*
 Surface hardness "By agreement" with "One per test unit"

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 column "**Classes B and C**" of table 4;
 – shall be in accordance with MSA-32-E"

Substitution *Substitute for element CE in table 4 the following:*
 "0,43" with "0,48"

9.4.2.3 Requirements

Substitution *Substitute this paragraph with the following:*
 "The mechanical properties shall meet the requirements stated in table 2 of this specification (MSW-04-E/1).

Table 2: Mechanical properties

Grade	Yield strength		Tensile strength		Ratio	Elongation
	$R_{t0,5}$ MPa		R_m MPa		$R_{t0,5}/R_m$	A_f %
	minimum	maximum	minimum	maximum	maximum	minimum
415	415	535	550	760	0,85	18
450	450	570	535	760	0,90	18
485	485	605	570	760	0,90	18

The CE limits apply if $C > 0,12 \%$, and
 the P_{cm} limits apply if $C \leq 0,12 \%$.

9.4.3.1 Test pieces

Substitution *Substitute in the first paragraph of this subclause the following:*
 "ISO 148, ISO 148-2 and ISO 148-3" with "NEN-EN-ISO 148-1"

Substitution *Substitute the last paragraph of this subclause with the following:*
 "Test pieces for welds shall be taken from the weld centreline as well as from the fusion line, whereas the notch location shall be as shown in Figure 2 of NEN-EN 14870-2."

9.4.3.2 Test method

Substitution *Substitute the second paragraph of this subclause with the following:*
 "Charpy V-notch impact testing shall be in accordance with NEN-EN-ISO 148-1 with a striker radius of 2 mm."

Substitution *Substitute table 5 as follows:*

Table 5 (NEN-EN 14870-2) – Maximum Charpy V-notch test temperature

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

9.4.5 Surface hardness testing

Substitution *Substitute this subclause with the following:*

"9.4.5 Surface hardness testing

9.4.5.1 Test method

Surface hardness testing shall be performed using the Vickers method in accordance with NEN-EN-ISO 6507-1, method HV 10.

9.4.5.2 Acceptance criteria

No hardness reading shall exceed 300 HV 10."

9.4.10 Guided weld bend testing

9.4.10.1 Test pieces

Substitution *Substitute in the first paragraph in this subclause the following.*

"EN ISO 7438" with "NEN-EN-ISO 3183"

9.4.10.3 Acceptance criteria

Deletion *Delete the last paragraph in this subclause.*

9.5.1 NDT procedures and personnel

Substitution *Substitute this subclause with the following:*

"The manufacturer shall have at least an NDT expert 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 technique they use.

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."

9.5.3.3 Treatment of dressable surface defects

Substitution *Substitute in the first paragraph in this subclause the following:*

"9.6" with "the minimal wall thickness as mentioned on the applicable drawings".

9.5.4 Fitting ends

Substitution

Substitute in first paragraph the first sentence with:

"The complete end preparation shall be subjected to MT in accordance with NEN-EN-ISO 10893-5, or PT in accordance with NEN-EN-ISO 10893-4".

Substitute in third paragraph the first sentence with:

"For class B and C fittings, a 50 mm wide band at each end shall be inspected for laminar imperfections by UT in accordance with NEN-EN-ISO 10893-8".

9.5.5 Weld seams

Substitution

Substitute this subclause with the following:

"Weld seams shall be subjected to radiographic testing in accordance with NEN-EN-ISO 10893-6. The image quality class shall be R1. The acceptance criteria shall be in accordance with NEN-EN-ISO 10893-6.

Instead of RT, ultrasonic testing may be used by agreement. UT shall be in accordance with NEN-EN-ISO 17640 and acceptance criteria in accordance with NEN-EN-ISO 11666 level 2.

In addition the inner and outer weld seam surface shall be subjected to MT in accordance with NEN-EN-ISO 10893-5, with acceptance criteria level M2 (table 3)."

9.5.6 Guide bar attachment welds

Substitution

Substitute in this subclause the following:

"ASTM E 709" with "NEN-EN-ISO 10893-5"

Addition

Acceptance criteria shall be according NEN-EN-ISO 10893-5, level M2 table 3. PT in accordance with NEN-EN-ISO 10893-4. Acceptance criteria in accordance with NEN-EN-ISO 10893-4 level P2 table 3.

9.5.7 Fitting body

Addition

All accessible surfaces shall be MT examined in accordance with NEN-EN-ISO 10893-5, with acceptance criteria in accordance with NEN-EN-ISO 10893-5, level M2 table 2.

Accessible is defined as all outside surfaces, and inside surfaces for a distance of one diameter from the fitting ends.

Irregularities shall not be in the crotch area of a tee.

9.6 Dimensions

Substitution

Substitute this subclause with the following:

Dimensions and tolerances shall be in accordance with the applicable drawing mentioned in the purchase order.

The inside diameter of each non-reducing fitting shall permit the passage of a drift mandrel consisting of two parallel circular metal disks of the minimum bore size, each at least 6 mm thick; rigidly connected and separated by a distance of one nominal pipe diameter.

Welding-end dimensions and minimum bore requirements shall be in accordance with table 3 and 4 of this specification (MSW-04-E/1). Welding-end geometry shall be according to figure 1.

Table 3: Welding-end and bore details, design pressure 66,2 bar (e)

Nom. Diam.		Welding end			minimum bore
DN	D (mm)	t_{nom} (mm)	$D_i \pm 1,0$ (mm)	α	$0,95 \cdot ID_{\text{pipe}}$ (mm)
200	219,1	$8,2^{+1,0}_{-1,0}$	202,7	$37,5^{+2,5}_{-2,5}$	192,6
250	273,0	$9,3^{+1,2}_{-1,2}$	254,5	$37,5^{+2,5}_{-2,5}$	241,8
300	323,9	$11,0^{+1,4}_{-1,4}$	301,9	$37,5^{+2,5}_{-2,5}$	286,8
400	406,4	$14,2^{+1,6}_{-1,6}$	378,0	$37,5^{+2,5}_{-2,5}$	359,1
450	457,0	$7,0^{+1,4}_{-0,0}$	443,0	30^{+5}_{-0}	420,9
500	508,0	$7,8^{+1,5}_{-0,0}$	492,4	30^{+5}_{-0}	467,8
600	610,0	$9,3^{+1,8}_{-0,0}$	591,4	30^{+5}_{-0}	561,8
750	762,0	$11,6^{+2,3}_{-0,0}$	738,8	30^{+5}_{-0}	701,9
900	914,0	$13,9^{+2,8}_{-0,0}$	886,2	30^{+5}_{-0}	841,9
1050	1067,0	$16,1^{+3,2}_{-0,0}$	1034,8	30^{+5}_{-0}	983,1
1200	1219,0	$18,3^{+3,7}_{-0,0}$	1182,4	30^{+5}_{-0}	1123,3

Table 4: Welding-end and bore details, design pressure 80 bar (e)

Nom. Diam.		Welding end			minimum bore
DN	D (mm)	t_{nom} (mm)	$D_i \pm 1,0$ (mm)	α	$0,95 \cdot ID_{\text{pipe}}$ (mm)
200	219,1	$8,2^{+1,0}_{-1,0}$	202,7	$37,5^{+2,5}_{-2,5}$	192,6
250	273,0	$9,3^{+1,2}_{-1,2}$	254,5	$37,5^{+2,5}_{-2,5}$	241,8
300	323,9	$11,0^{+1,4}_{-1,4}$	301,9	$37,5^{+2,5}_{-2,5}$	286,8
400	406,4	$14,2^{+1,6}_{-1,6}$	378,0	$37,5^{+2,5}_{-2,5}$	359,1
450	457,0	$8,3^{+1,7}_{-0,0}$	440,4	30^{+5}_{-0}	418,4
500	508,0	$9,2^{+1,8}_{-0,0}$	489,6	30^{+5}_{-0}	465,1
600	610,0	$11,1^{+2,2}_{-0,0}$	587,8	30^{+5}_{-0}	558,4
750	762,0	$13,8^{+2,8}_{-0,0}$	734,4	30^{+5}_{-0}	697,7
900	914,0	$16,4^{+3,4}_{-0,0}$	881,2	30^{+5}_{-0}	837,1
1050	1067,0	$19,1^{+3,9}_{-0,0}$	1028,8	30^{+5}_{-0}	977,4
1200	1219,0	$21,7^{+4,4}_{-0,0}$	1175,6	$27,5^{+5}_{-0}$	1116,8

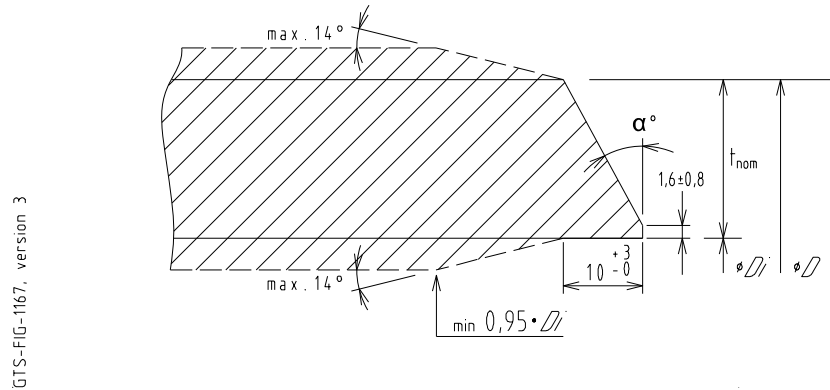


Figure 1: Welding-end detail for fittings

For tees:

- the tapering shall not be located inside the reinforcement length as included in the calculation;
- the outside crotch radius shall be $R > 0,05 \cdot D_{\text{branch outside}}$;
- the crotch thickness shall be $C_{\text{Cr}} > 0,5 \cdot (C_{\text{header}} + C_{\text{branch}})$;
- The branch material shall be according table 2 of this specification (MSW-04-E/1), a welded ring can be used if the weld is located outside the crotch area.

CLAUSE 10 INSPECTION DOCUMENT

Substitution *Substitute this clause with the following:*

"The fitting 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:

- Applicable drawings as mentioned in the purchase order, concession requests if applicable, calculations, finished product inspection certificates including results of dimensional check, destructive tests, non destructive tests, heat treatment time and temperature.

CLAUSE 11 MARKING

Substitution *Substitute this subclause with the following:*

"Fittings shall be hard stamped and marked with paint:

Hard stamp:

Fittings shall be marked as specified on the applicable drawings. Method of applying marking shall be by stamping on the external surface with low stress die stamps or interrupted dot stamps.

Each fitting shall be clearly marked by a unique identification number, which corresponds with the documents mentioned in clause 10.

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

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

Paint marking:

The fittings shall be marked with paint on the outside with the following items:

- purchase order number;
- diameter;
- wall thickness;
- material grade;
- heat treatment condition.

In case of QT, the fittings shall be marked with paint on each cutback in the 12, 4 and 8 clock position with the text "QT steel".

5. DOCUMENTATION

In this specification the following informational documentation applies:

- 1 N.V. Nederlandse Gasunie, memorandum [OTW-L 22.0610](#),
"GTS_MSW-04-E/1 en -E/2 Pipe fittings voor de toepassing voor
waterstof en stikstof en voor overgangsstukken", d.d. 24-03-2022.