Gasunie Technical Standard

Construction Specification Mechanical

CSW-01-E

Bilingual

Welding of pipes, fittings and structural sections

External

Version 12 *26-06-2018*

N.V. Nederlandse Gasunie

Gasunie Technical Standard

Construction Specification Mechanical
CSW-01-E

Welding of pipes, fittings and structural sections

This specification has been drawn up by the Gasunie department
"Veiligheid, Gezondheid en Milieu; VGM Advisering"
(Health, Safety and Environment; HSE - Advice)

This specification may be distributed to suppliers and contractors.

Issued by the Gasunie department "Document Management".

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FOREWORD

This specification is a translation of the twelfth version (dated 26-06-2018) of CSW-01-N.

This specification is a revised version of the eleventh version of CSW-01-E.

The following changes, among others, have been made in respect of the previous version:

- Clause 1: the text relating to the use of standardised Gasunie materials including the footnote has been deleted; from now on this will be stated in the tender documents.
- The term "Gasunie management" has been replaced by "client".
- A distinction is made between testing to be performed by the client and inspections by Gasunie department "VGM Inspectie" (HSE Inspection).
- NEN-EN-ISO 15614-1:2017 has been incorporated into annex A.
- The use of molybdenum alloy weld metal is no longer permitted for thermo-mechanically rolled steel.
- Requirements relating to pickling and passivating have been made more specific.
- The acceptance criteria for non-destructive testing, with the exception of visual inspection, have been moved to CSW-05-E. The acceptance criteria stated in CSW-01-E version 11 are still applicable until version 9 of CSW-05-E is published.
- The limits for supplementary requirements relating to the weld metal tensile test for WPQRs in steels with a yield strength ≥ 360 MPa have been clarified.
- Various small changes to the implementation requirements.

CONTENTS

1. SCOPE AND APPLICATION

This specification describes the quality requirements and the quality control for welded joints on the following components:
- pipes;
- fittings;
- structural sections;
- pipe sections.

This specification is applicable to new build, modification and repair work on gas transmission pipelines, stations and installations.

During performance of the work, the main contractor will be monitored by the client for compliance with this specification. Separate or additional inspections will be performed by Gasunie department "VGM Inspectie" (HSE Inspection) to check for compliance with this specification.

This specification complies with the standard NEN 3650-2.

In case of conflicting requirements or lack of clarity compared with the Dutch version, the Dutch version shall prevail.

1.1 Supplements and exceptions

The applicable temperature range within this specification is from −20° C to +50° C. This is the basis for the requirements on WPQRs.

This specification is not intended for welding on pipes containing gas.

Supplementary requirements for welds which are not tested hydrostatically are in CSW-20-E.

1.2 Warenwetbesluit Drukapparatuur (Pressure Equipment (Commodities Act) Decree)

This specification is **also** applicable to pipelines and/or installations that have to comply with the Warenwetbesluit Drukapparatuur (Pressure Equipment (Commodities Act) Decree).

2. REFERENCES

This specification is subject to the requirements of the documents mentioned in this clause.

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

2.1 Gasunie documents

Reference is made in this specification to the following Gasunie documents:

CSA-38-E	Safety, health and environmental management at construction sites (bilingual document).
CSW-05-E	Non-destructive testing.
CSW-19-N	Dichtheidsbeproeving en sterktebeproeving van leidingen en systemen (Testing of pipework for tightness and strength).
CSW-20-E	Welds that are not tested for density and strength (Bilingual) - English version.
GTS_REQ-001	Materiaalbestellijst GAB (Materials order list GAB).
GTS_W-011	Lasmethodebeschrijving (LMB) Welding Procedure Specification (WPS)).
GTS_W-015	Laswerkverslag (gastransport)leidingen leidingen en installaties. (Welding report for (gas transmission) pipes and installations).
GTS_W-017	Visual weld inspection report.
MSW-01-E	Pipe for natural gas lines. Seamless and welded line pipe.
MSW-01-E/2	Pipe for natural gas piping; Seamless pipe 15 ≤ DN ≤ 400
MSW-03-E/1	Ball and plug valves.
MSW-03-E/3	Pressure relieving devices (bevroren intern Gasunie-document).
MSW-03-E/4	Check valves of DN 50 and larger.
MSW-03-E/6	Control valves.
MSW-04-E/1	Pipe fittings 450 ≤ DN ≤ 1200.
MSW-04-E/2	Pipe fittings 15 ≤ DN ≤ 400.
MSW-04-E/4	Flanges 15 ≤ DN ≤ 400.
MSW-05-E	Induction bends DN 100 and larger.
MSW-06-E	Insulating pipe connections.
OSW-01-N	Leidingklassen voor buisleidingsystemen t.b.v. aardgastransport; Medium: aardgas en aardgascondensaat (Pipework classification for piping systems serving natural gas transportation. Medium: gas and gas condensate).

OSW-01-E/2	Pipework classification for piping systems; Medium: instrument air, utility air, natural gas and natural gas condensate, LNG and nitrogen, gaseous and liquefied. Material: stainless steel (316/316L).

2.2 Standards

Reference is made in this specification to the standards mentioned in this subclause. Any supplements and errata notices are also applicable. [1]

ASTM A 380/A 380M	Standard practice for cleaning, descaling, and passivation of stainless steel parts, equipment, and systems.
EN-ISO 13916	Welding - Guidance for the measurement of preheating temperature, interpass temperature and preheat maintenance temperature.
ISO/TR 15608	Welding - Guidelines for a metallic materials grouping system.
NEN 1059	Nederlandse editie op basis van NEN-EN 12186 en NEN-EN 12279 – Gasvoorzieningssystemen – Gasdrukregelstations voor transport en distributie (Dutch edition based on NEN-EN 12186 and NEN-EN 12279 – Gas supply systems – Gas pressure regulating stations for transmission and distribution).
NEN 3650-1 NEN 3650-2	Eisen voor buisleidingsystemen; Part 1: Algemene eisen; Part 2: Aanvullende eisen voor leidingen van staal (Requirements for pipeline systems; Part 1: General requirements Part 2: Additional specifications for steel pipelines).
NEN-EN 10204	Metallic products – types of inspection documents.
NEN-EN 12732	Gas infrastructure - Welding steel pipework - Functional requirements.
NEN-EN-ISO 3183	Petroleum and natural gas industries - Steel pipe for pipeline transportation systems.
NEN-EN-ISO 3834-1 NEN-EN-ISO 3834-2	Quality requirements for fusion welding of metallic materials - Part 1: Criteria for the selection of the appropriate level of quality requirements. Part 2: Comprehensive quality requirements.
NEN-EN-ISO 4063	Welding and allied processes - Nomenclature of processes and reference numbers.
NEN-EN-ISO 5173	Destructive tests on welds in metallic materials - Bend tests

[1] 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.

NEN-EN-ISO 5178	Destructive tests on welds in metallic materials - Longitudinal tensile test on weld metal in fusion welded joints.
NEN-EN-ISO 5817	Welding - Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) - Quality levels for imperfections.
NEN-EN-ISO 6947	Welding and allied processes – welding positions
NEN-EN-ISO 6520-1	Welding and allied processes - Classification of geometric imperfections in metallic materials; Part 1: Fusion welding
NEN-EN-ISO 9606-1 (September 2017)	Qualification testing of welders - Fusion welding - Part 1: Steels.
NEN-EN-ISO 14175	Welding consumables - Gases and gas mixtures for fusion welding and allied processes.
NEN-EN-ISO 14731	Welding coordination – Tasks and responsibilities.
NEN-EN-ISO 14732 (August 2013)	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 (July 2017)	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 17662	Welding – Calibration, verification and validation of equipment used for welding, including ancillary activities.
NEN-EN-ISO/IEC 17025	General requirements for the competence of testing and calibration laboratories.

2.3 European Directive

This specification refers to the following European Directive:

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.

2.4 Other references

Reference is made in this specification to the following document:

EPRG document "EPRG Tier 2 guidelines for the assessment of defects in transmission pipeline girth welds; R Denys, R M Andrews, M Zarea and G Knauf", publication of the European Pipeline Research Group: http://www.eprg.net/exchange/content/information/eprg_published

3. DEFINITIONS, ABBREVIATIONS AND SYMBOLS

3.1 Definitions

In this specification, the following definitions are applicable:

Contract concluded with contractor	Contract with the contractor in accordance with general contracting of work conditions.
Automatic welding process	Welding process where welding torch and welding filler material are moved mechanically without the operator having any direct control over the welding process.
Batch	Unique identification number of a product or a set of products belonging together.
Structural sections	Part of gas transmission pipelines, stations or installations such as valve stations, pressure vessels, storage tanks, scraper traps and suchlike that are connected into or onto the gas transmission pipeline, the station or the installation as a pre-assembled unit by means of an assembly weld.
Limited qualification	Welder qualification for fill and cap layers.
Gas transmission system	A system consisting of one or more pipelines and associated fittings and structural sections intended for the transmission of natural gas.
Gasunie department "VGM Inspectie" (HSE Inspection)	Part of the "**H**ealth **S**afety and **E**nvironment" department, which is responsible for the inspection of pressurised containers.
Mechanised welding	Welding process where the torch and the welding filler material are moved mechanically and the operator has direct control over the welding process.
Manual welding	Welding process where the torch and filler material are moved by hand.
Semi-mechanised welding	Welding process where the torch is moved by hand and the welding filler material is fed mechanically.
Main welding process	The welding processes used in more than 35 % of the total amount of production welds.
Fittings	Appurtenances, flanges, half shells and bends not bent from pipe in accordance with MSW-01-E, T-pieces, reducers, weldolets and transition pieces.
Installation	Constructions and facilities required for the extraction, production, chemical and/or physical treatment, storage or receipt of the gas to be transported.
Pipe section	A series of pipes connected by welds.

Assembly weld	A weld which is welded on the final destination, between: – pipe sections; – structural sections and pipe sections.
Client[2]	This depends on the contract form, i.e.: – Where the VIA procedure applies, this is Gasunie's project leader. – If the VIA procedure is not being applied, the person or persons responsible, on behalf of Gasunie, for construction management (management and construction supervision).
Main contractor[2]	Contractor or group of contractors who will perform the work on the instructions of the client.
Operator	A person who operates a mechanised welding machine.
Phased Array	Ultrasonic inspection system by means of which a weld is inspected with the use of two probes in a single circular movement with controlled pulse-echo signals.
"AUT" system	A mechanised ultrasonic system where the weld inspection is undertaken by angle and TOFD probes in a single rotary movement.
Repair	Every operation to restore a weld defect after the weld has been completed and is made available for visual inspection.
Repair percentage	$\frac{number\ of\ rejected\ welds}{number\ of\ tested\ welds} \times 100\ \%$
Valve station	An assembly of pipe sections, fittings and controls.
Station	A facility, including any housing, necessary for the operation of a transport pipeline.
Butt-welded joint	A joint between two work pieces, irrespective of the angle at which both work pieces are oriented towards each other, whereby these form a gap-free joint after welding.
Strip-end weld	The strip-end weld for spiral seam welded pipe ("skelp weld").
Tie-in welds	Welds that are not tested hydrostatically or pneumatically.
Time of flight diffraction	An automated two probe (transmitter and receiver) ultrasonic system whereby transit times of diffraction signals from indications form the basis of the weld inspection.

[2] These terms are different to the process specification, given that here the main issue is the lines of communication with regard to this specification.

Heat cycle	Period within which the welded joint is created without the temperature dropping below the minimum pre-heating level.
Work	Welding of or onto pipes, fittings and structural sections of gas transmission pipelines, stations and installations.

3.2 Abbreviations

In this specification, the following abbreviations are applicable:

AUT	Automatic Ultrasonic Testing
BSH	Beeldschermhoogte (screen height).
CTOD	Crack Tip Opening Displacement
EWP	European Welding Practitioner
EPRG	European Pipeline Research Group
FCAW	Flux Cored Arc Welding
GMAW	Gas Metal Arc Welding
GTS	Gasunie Technical Standard
HDM	The amount of hydrogen in deposited weld metal in mL/100 g
HiLo	High - Low (= alignment)
HSE	Health, Safety and Environment
IWE	International Welding Engineer
IWP	International Welding Practitioner
LK (WPQ)	Lasserskwalificatie [Welder Performance Qualification]
LMB (WPS)	Lasmethodebeschrijving [Welding Procedure Specification]
LMK (WPQR)	Lasmethodekwalificatie [Welding Procedure Qualification Record]
MT/MPI	Magnetic Testing/Magnetic Particle Inspection (Examination)
NDE (NDT)	Non-destructive Examination (Testing)
NIL	Netherlands Institute of Welding Technology
PA	Phased Array
PC	Welding position (see NEN-EN-ISO 6947)
PE	Pulse Echo
PED	Pressure Equipment Directive, Directive 2014/68/EU
PJ	Welding position (see NEN-EN-ISO 6947)
PH	Welding position (see NEN-EN-ISO 6947)
pWPS	Preliminary Welding Procedure Specification
QA	Quality Assurance
QC	Quality Control
QT	Quenched and Tempered material type
RT	Radiographic Testing (Radiografisch onderzoek)
SAW	Submerged Arc Welding
SMAW	Shielded Metal Arc Welding
TD	Tensile test, transverse on the weld
TIG	Tungsten Inert Gas
TL	Tensile test, longitudinal on the weld
ToFD	Time of flight diffraction
US	Ultasonic
UT	Ultrasonic Testing
WBZ	Heat Affected Zone (HAZ)

WWBD	Warenwetbesluit drukapparatuur (Pressure Equipment (Commodities Act) Decree)

3.3 Symbols

In this specification u/i annex E the following symbols are applicable:

Symbol	Description	Unit
b	Width of the inhomogeneity	mm
B_i	Root bend	1
B_u	Face bend	1
B_z	Side bend	1
CV	Charpy toughness	J
d	Wall thickness according to construction drawing or table of dimensions	mm
d_c	Defining thickness (the smallest of the values d_w of the weld or d of the attached parts)	mm
d_w	Weld thickness	mm
D	Pipe diameter	mm
D_e	External diameter	mm
d_r	Thickness to be X-rayed for radiographic testing	mm
$dvzb$	Thickness of side bend weld metal	mm
E	Arc voltage	V
h	Maximum height dimension of a weld indication in any direction, except for the longitudinal direction	mm
H	Echo height	%
HI	Heat input (warmte-inbreng)	kJ/mm
H_r	Comparison or reference echo height	%
I	Current strength	A
l	Length of the inhomogeneity	mm
$\bar{l}$	Acceptable length of the inhomogeneity	mm
l_{max}	Maximum permitted length of the weld indication in circumferential direction	mm
$\bar{l}_{tot}$	Total acceptable length of several inhomogeneities	mm
R	Radius of curvature	mm
R_e	Yield strength	MPa
$R_{e//}$	Yield strength of a bar TL	MPa
R_{eh}	Yield strength high	MPa
R_{eL}	Yield strength low	MPa
R_m	Tensile strength	MPa
$R_{m//}$	Tensile strength of a bar TL	MPa
$R_{m\perp}$	Tensile strength of a bar TD	MPa
R_{p02}	0,2 % yield strength	MPa
R_{t05}	Minimum specified yield strength	MPa
t	Wall thickness	mm
v	Speed of travel (the distance covered in longitudinal weld direction)	mm/s
x	Fit up opening	mm

4. GENERAL REQUIREMENTS

The welding and inspection work for transmission and station pipes is covered by the standards NEN 3650 and NEN 1059.

4.1 Organisation

The main contractor shall be certified in accordance with NEN-EN-ISO 3834 part 1 and 2.

4.2 Welding supervisors

The main contractor shall have within his organisation a welding specialist who is responsible for the quality control of all the welding work to be performed by the main contractor. This specialist shall possess the NIL qualification "Laspraktijkingenieur" or International Welding Engineer (IWE) – NEN-EN-ISO 14731.

The main contractor's organisation shall include an "International Welding Technologist" or an "International Welding Engineer", who is responsible for performing the welding work.

4.3 Welding teams

A welding team shall have sufficient equipment in order to be able to perform the work without interruption. The welding team shall also have the applicable WPS at hand and be able to show this immediately on first request of the client or Gasunie's "VGM" (HSE) department.

4.4 Welding equipment

The main contractor shall have welding equipment of sufficient quality and the capacity to perform the work under the given conditions. Furthermore, measures have to be taken to ensure that faulty equipment can be repaired or replaced quickly.

Machinery and tools shall be safe and suitable for the intended purpose.

Measuring equipment shall be calibrated, verified or validated in accordance with NEN-EN-ISO 17662, the most recent calibration, verification or validation shall be less than or equal to one year old.

4.5 Sub-contracting and hiring services

The main contractor is permitted to sub-contract parts of the welding work on the condition that the requirements stipulated in the contract with the main contractor are complied with. The responsibilities and inspection activities according to NEN-EN-ISO 3834-2 remain in full force for the main contractor.

Hiring and sub-contracting includes:
- hiring or sub-contracting of a welder from an agency or from fellow contractors;
- employing or hiring from third parties welding foremen or welding specialists temporarily or for the duration of the work;
- weld testing by means of destructive or non-destructive testing by an NDT firm or a test laboratory.

4.6 Right of access

The right of access is regulated in the contract concluded with the contractor.

4.7 Liability

The testing and the acceptance by the client and/or Gasunie department "VGM" (HSE) do not release the main contractor from his liability for defects in the work that subsequently come to light.

The liability is regulated in the General Terms and Conditions of the contract concluded with the contractor.

4.8 Welding Quality Plan

The aim of a Welding Quality Plan is to record the specific quality requirements for the work and to have an overview of the welding and welding-related activities. This Plan makes it clear what activities will take place within a project as well as where and how they will be performed. Hence the scope of the Welding Quality Plan depends on the scope of the activities. The starting point for the Welding Quality Plan is the production planning and the inspection and testing overview required in NEN-EN-ISO 3834-2.

The welding work, including welding supervision, non-destructive testing or any (welding) work undertaken by third parties is to be recorded on the basis of a Welding Quality Plan for each project prior to the works commencing. A final Welding Quality Plan shall be submitted to the client no later than ten working days prior to commencement of the welding work for each project. Working with a standard Welding Quality Plan is permitted, where, for each project, the project-dependent issues, WPS/WPQR/planning schedules and the like are inserted as separate sheets. Work instructions mentioned in the Welding Quality Plan shall be made available to Gasunie for inspection.

During construction, changes to the Welding Quality Plan shall be incorporated within 2 days. The main contractor shall add outstanding certificates for weld filler materials and certificates of competency to the documentation during the project. The Welding Quality Plan shall be presented to Gasunie department "VGM Inspectie" (HSE Inspection).

The following points shall be included in the Welding Quality Plan:

a A planning schedule – start of welding and end of welding – for all welding. This includes the following tasks, if applicable:
   - pipe sections;
   - drillings;
   - assembly welding;
   - tie-in welds that are not to be hydrostatically tested (see CSW-20-E);
   - structural sections and fittings;
   - pre-production welding;
   - welding to be undertaken by third parties.

b Documents for the welding work referred to, such as:
   - welding procedure specifications, including repairs (WPSs);
   - registration forms for the WPQRs;
   - work on existing pipelines with regard to magnetic blow effect.

c Choice of non-destructive testing type, stating the inspection procedure numbers.

4.9 Weld repair percentage

The main contractor shall record the repair percentage once 40 welds have been performed and thereafter weekly.

$$\text{Repair percentage} = \frac{number\ of\ \ rejected\ \ welds}{number\ of\ \ tested\ \ welds} \times 100\,\%$$

5. MATERIALS

5.1 Material

The pipes, fittings and structural sections to be used shall comply with the Gasunie design and material specifications:

- OSW-01-N;
- OSW-01-E/2;
- MSW-01-E;
- MSW-01-E/2;
- MSW-03-E/1;
- MSW-03-E/3;
- MSW-03-E/4;
- MSW-03-E/6;
- MSW-04-E/1;
- MSW-04-E/2;
- MSW-04-E/4;
- MSW-05-E;
- MSW-06-E.

These materials are delivered by Gasunie. If this is not the case, or where non-standardised materials are being used, the latter shall be approved on a case-by-case basis by the Gasunie department "VGM" (HSE).

5.2 Batch testing for welding filler material

For classification of and requirements for the welding filler materials refer to NEN 3650-2 and NEN-EN 12732.

Welding filler material shall be given a 3.1 test report. The following tests shall, at least, be included in the report:

- Chemical analysis in accordance with the standard relating to the welding filler material;
- yield strength (R_{t05}) and tensile strength (R_m);
- elongation after fracture;
- Charpy toughness at a temperature of -20°C or lower.

The original 3.1 inspection certificate or certified copy of the original shall be available from the main contractor for verification.

When they are used in materials with a yield strength of 360 N per mm^2 or more, flux-cored wires shall be qualified , regardless of the welding process, per batch, by means of a WPQR.

5.3 Welding filler material (general)

An alternative qualification of welding filler materials shall be submitted to Gasunie department "VGM Inspectie" (HSE Inspection) for approval prior to commencing the project. The approval shall be completed prior to starting the project.

The powders for welding process 121 may only be of the basic or basic fluoride type.

The use of molybdenum alloyed welding filler material is not permitted for welding in thermo-mechanically rolled material, material group 2 (see ISO/TR 15608).

5.4 Welding filler material for mechanised welding (general)

Gasunie department "VGM" (HSE) shall perform a product audit prior to the use of any type or make of welding filler material for mechanised welding processes with "proces 13x" (process 13x). The audit shall be performed at the premises of the welding filler material manufacturer.

5.5 Tacking material

The following materials are permitted for tack-welding:
- core wire of the electrodes to be used;
- S-235JR or comparable (rod material);
- steel from the pipe in the current project.

The quality of the materials shall be demonstrated by:
- the order ticket, and
- the delivery document (2.2 inspection certificate according to NEN-EN 10204).

6. PREPARATION OF WELD BEVELS AND WALL THICKNESSES

6.1 Weld bevels

6.1.1 Standard weld bevels

The standard weld preparations as shown in figure 1 up to and including figure 7 are accepted.

6.1.2 Conditions for other weld bevels

The main contractor may apply other weld preparations following the approval of Gasunie department "VGM Inspectie" (HSE Inspection). The geometry of the weld preparation, including proof that the required NDE can be carried out, shall be submitted with the application.

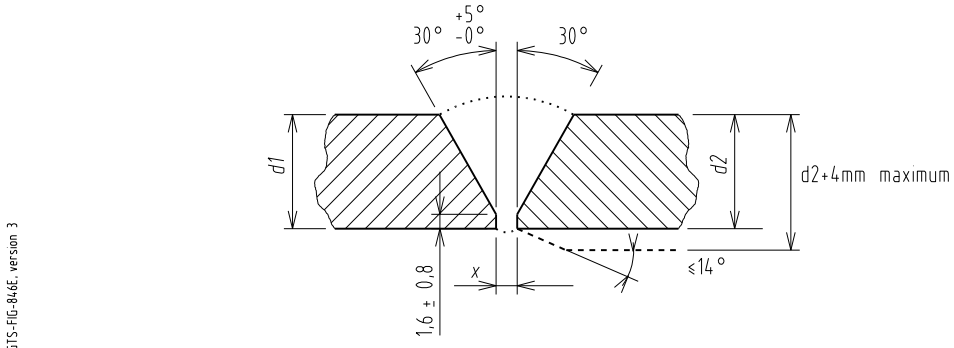


Figure 1: Pipe-to-pipe $d \leq 20$ mm
Comment: x) Depending on welding procedure

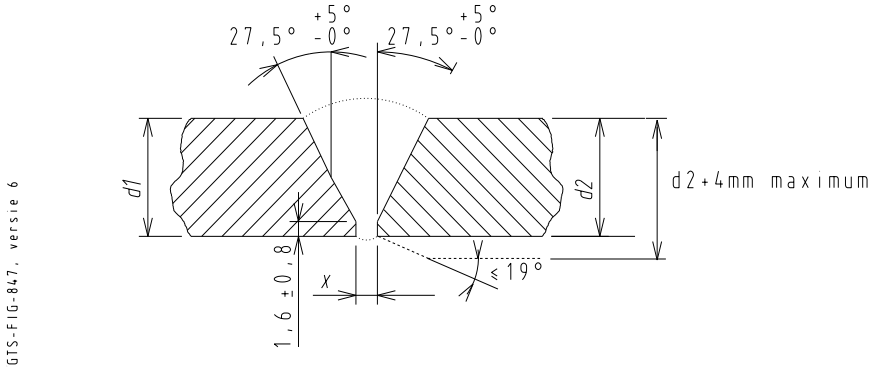
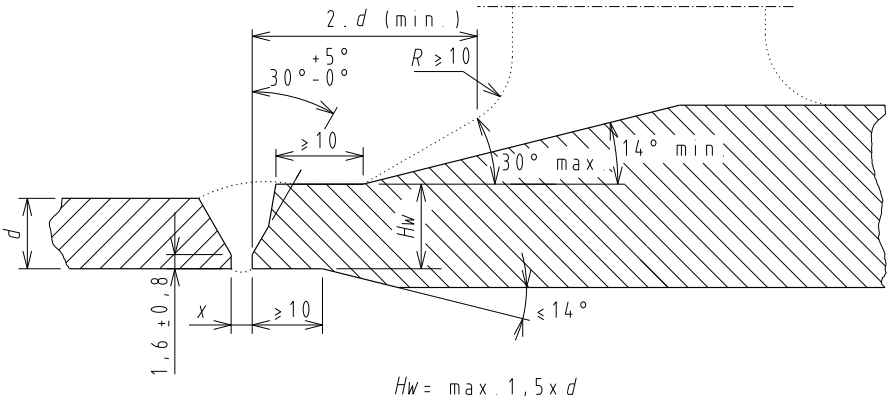
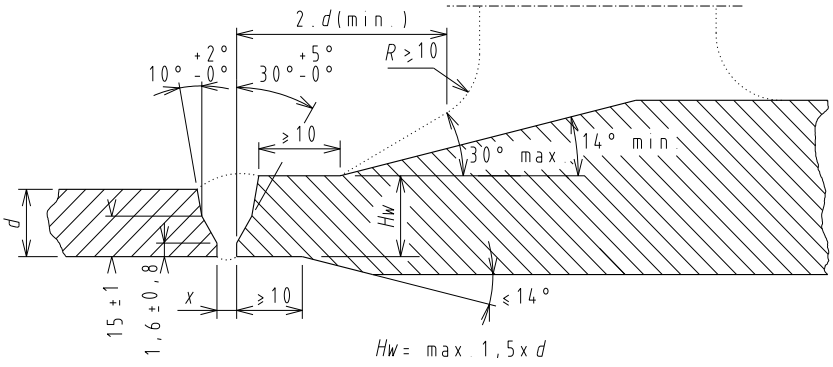


Figure 2: Pipe-to-pipe $d > 20$ mm.
Comment: x) Depending on welding procedure



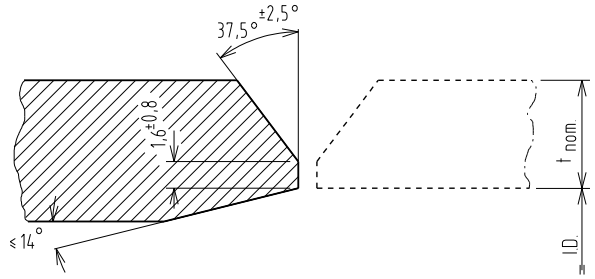
GTS-FIG-848, versie 4

Figure 3: Pipe to fitting or valve ≥ DN 450 $d \leq 20$ mm
Comment: *x*) Depending on welding procedure



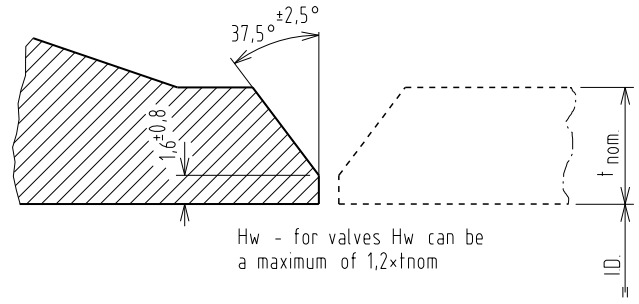
GTS-FIG-849, versie 4

Figure 4: Pipe to fitting or valve ≥ DN 450, $d > 20$ mm V-bevel according to figure 2 on the pipe side.
Comment: *x*) Depending on welding procedure



GTS-FIG-439 version 1

Figure 5: Pipe to fitting ≤ DN 400



GTS-FIG-440E version 2

Figure 6: Pipe to flange ≤ DN 400

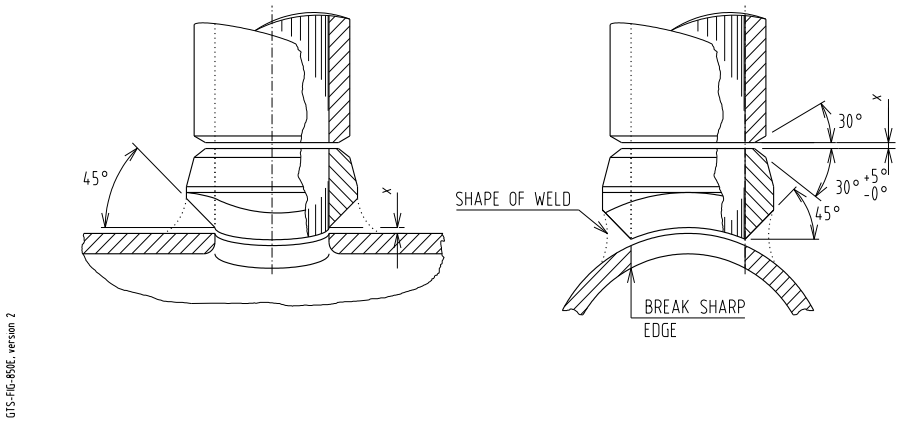


Figure 7: Weldolet
Comment: *x*) Depending on welding procedure

6.2 Differences in wall thickness

The ways in which differences in wall thickness are dealt with will vary according to the NDE inspection technique used. If Phased Array is used, subclause 6.2.2 shall be followed. For all other techniques, subclause 6.2.1 will be applicable.

6.2.1 Wall thickness difference where Phased Array is not used

In the case of pipes with the same strength, it is permitted, up to a measured wall thickness difference of 4 mm, for the thicker pipe to be renewed with an angle ≤ 19°(1:3). If the measured wall thickness difference is greater than 4 mm, a transition piece shall be used.

Instead of a transition piece, it is also permissible to rework the pipe with the larger wall thickness, with a maximum wall thickness difference of 10 mm, in the field. This work shall be carried out with a machine which follows the pipe wall. After the work has been completed, the final situation shall comply with figure 8.

In the case of pipes of different strengths, the following will apply:
- If the thinner pipe is of a higher strength class, Gasunie will supply a transition piece.
- If the thicker pipe is of a higher strength class, it can be reworked in accordance with this subclause.

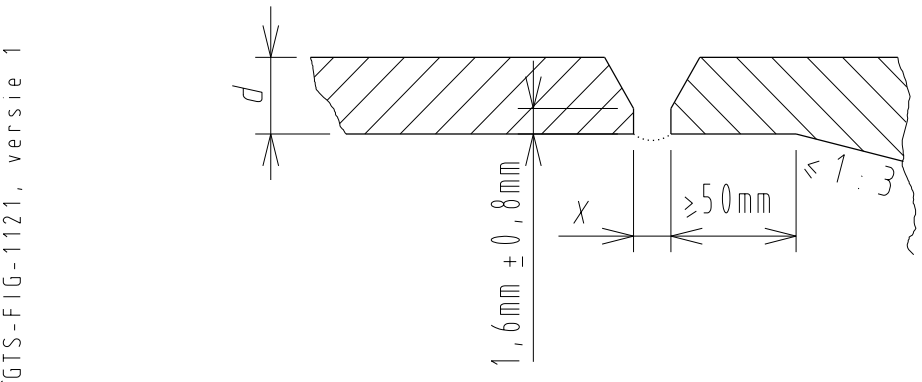


Figure 8: Reworking of wall thickness difference > 4 mm in the field

6.2.2 Wall thickness difference where Phased Array is used

Wall thickness differences where Phased Array inspections are used for pipe-to-pipe connections

Where Phased Array inspections are used, the wall thickness differences for pipe-to-pipe connections shall be dealt with in accordance with figure 9. The bevel shall be no greater than 1:3. If a less pronounced bevel is applied, this shall be no longer than 12 mm.

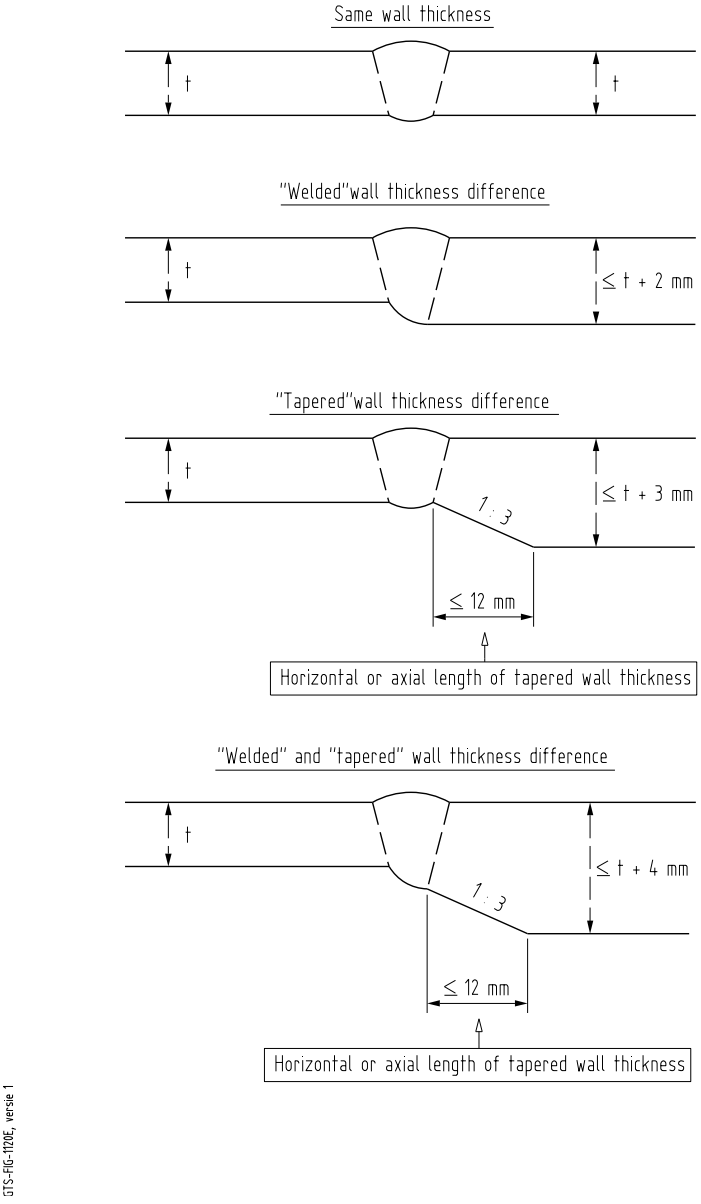


Figure 9: Wall thickness transition where Phased Array inspection is used.

7. WELDING PROCEDURE

7.1 Warenwetbesluit drukapparatuur (Pressure Equipment (Commodities Act) Decree)

Welding procedures to be used on pipelines covered by the WWBD shall also be approved by a Notified Body or Recognised Third Party organisation.

7.2 Welding Procedure Specification

The aim of the Welding Procedure Specification (WPS) is to provide a simple work instruction for the welder. The WPS shall be approved by the Gasunie department "VGM" (HSE).

The following conditions apply for the preparation of a WPS:

- The main language is Dutch.
- The specifications are produced with due regard for the variables contained in table 1, a sample WPS is shown in GTS_W-011.
- The validity of a WPS is determined on the basis of the validity of the underlying WPQR, apart from WPSs for welding materials below 360 MPa yield strength; these have unlimited validity. A transitional period to 1 July 2018 applies to already approved WPSs that do not comply with this condition.
- A WPS for material with a yield strength > 360 MPa where wall thicknesses are > 8 mm shall be based on a WPQR with all-weld tensile tests in accordance with this specification.
- The procedures for repair welds shall be specified; for details please refer to clause 11 and annex A.9.
  For the pre-heating temperature, please refer to subclause 9.9.2.
- A girth weld shall have at least two layers.
- The layer build-up and number of beads per layer shall correspond with the WPQR and be stated for each welding position and the thickness to be welded.
- Each WPS shall be supported by a WPQR approved by the Gasunie department "VGM" (HSE).
- A WPS for tack welding may be based on a WPQR for butt welds. The number, length and tacking distance shall be stated on the tacking WPS.

Table 1: Variables for the welding procedure specification

description	standard reference	On welding instruction (WPS):
Manufacturer	NEN-EN-ISO 15614-1	Main contractor
WPQR	NEN-EN-ISO 15614-1	Identification number
Parent metal		
Designation of material	Relevant material standard	L240/ A106 gr B L415MB and the like
Thickness	CSW-01-E	Thickness range, for example 5 mm -10 mm
Diameter	NEN-EN-ISO 15614-1	Diameter range, for example, > DN 200 or DN 50 / DN 100

description	standard reference	On welding instruction (WPS):
Place where pre-heating and interpass temperature is measured	NEN-EN-ISO 15614-1 NEN-EN-ISO 13916	measurement of pre-heating temperature at approx. 7 cm from the weld. Measurement of the interpass temperature in the weld joint at the place where welding started.
All welding procedures		
Welding process	NEN-EN-ISO 4063	141, 135, 121 and the like or GTAW, SMAW, SAW and the like.
Design joint	CSW-01-E	Layer/bead build-up specified in sketch for each 3 mm wall thickness
Welding position	NEN-EN-ISO 6947	Applicable positions
Weld preparation	CSW-01-E	Procedure, for example, grinding
Clamping/tacking	CSW-01-E	For example, internal clamp/ external clamp/tacking in weld joint
Welding technique		
Number of welders	CSW-01-E	Number of welders and/or use of manipulator
Weaving	NEN-EN-ISO 15614-1	Width, e.g. 3 times core diameter for SMAW or 20 mm for manual FCAW
Welding filler materials		
Designation of welding filler material	CSW-01-E	Make, type and diameter per weld section: root layer, fill layer and cap, in case of flux-cored wires, batch number
Electrical parameters		
Polarity	CSW-01-E	AC/DC +/-
Current Voltage		Amp range Voltage range For three areas in the weld; root layer, fill layer and cap. For SMAW-C the second layer shall also be specified separately.
Rate of travel	CSW-01-E	Current table – permitted minimum/maximum speed assuming average arc voltage. The minimum/maximum run out length is also permitted for SMAW.
Temperatures		
Pre-heating	CSW-01-E	Minimum; temperature as applied in the WPQR Maximum; interpass temperature as attained in the WPQR or lower
Interpass temperature	CSW-01-E	maximum interpass temperature as attained in the WPQR or lower
Supplementary variables for specific welding processes		
For mechanised/automated processes		
Programme indication/code in welder's control panel		
Software program and revision		
Submerged arc welding 121		
Electrodes	NEN-EN-ISO 15614-1	Number/configuration
Distance between contact tube and workpiece	NEN-EN-ISO 15609-1	mm

description	standard reference	On welding instruction (WPS):
powder	CSW-01-E	name, type
Gas metal arc welding 13x		
Gas flow rate	NEN-EN-ISO 15609-1	L/min
Diameter of gas nozzle		mm
Type of gas	NEN-EN-ISO 15614-1	Brand and type or composition
Pulsed welding/material transfer method	NEN-EN-ISO 15614-1	Welding machine brand, type and settings
Tungsten inert gas welding 14x		
Tungsten electrode	NEN-EN-ISO 15609-1	Diameter/type
Gas flow rate		L/min
Diameter of gas nozzle		mm (where several diameters apply, also give gas flow rate per diameter)
Type of gas	NEN-EN-ISO 15614-1	Brand and type or composition

7.3 Welding Procedure Qualification Record (WPQR)

The Welding Procedure Qualification Record (WPQR) shall be carried out in accordance with NEN-EN-ISO 15614-1 and annex A of this specification and shall be attended by the Gasunie department "VGM" (HSE).

WPQRs, with the exception of WPQRs for stainless steel, are recorded on a registration form as shown in annex A.
The following reports shall be submitted before the registration form is signed:

- report of the parameters as stated in annex C of this specification recorded during performance of the welding test, and
- a report of the NDT, and
- a report of the mechanical tests.

These tests and reports are to be attended and approved by the Gasunie department "VGM" (HSE). The reports shall be stored by the main contractor and may be requested by the Gasunie department "VGM" (HSE).

7.4 Period of validity of the WPQR

For a WPQR in material with a yield strength of ≥ 360 MPa, the WPQR is valid for three years. If a WPQR supports a material with a yield strength < 360 MPa, the restriction to the period of validity is not applicable. A WPQR in a material ≥ 360 MPa can be extended for one additional period of three years on the basis of the results of an approved production weld. The date of the test report will be authoritative for the new period of validity.

For an WPQR with a yield strength < 360 MPa, the WPQR will be valid for an unlimited period of time.

7.5 Special conditions relating to the use of welding processes and welding procedures

7.5.1 Manual and semi-mechanised welding processes

The following welding processes are permitted for girth welding:

Process	Description
111	welding using coated electrode, basic, rutile and cellulosic.
114	welding with self-shielding flux-cored wire.
135-P, -G, -S*	Welding with solid wire
136-P, -G, -S	Welding with flux-cored wire
138-P, -G, -S	Metal powder cored arc welding
121	Submerged arc welding
141	TIG welding

* An electronically or mechanically controlled process 13X-D is permitted for the root layer. For example, Lincoln STT, Fronius CMT or EWM Coldarc.

The following restrictions apply to cellulosic welding:
Cellulosic welding is only permitted in a downhill direction for girth welds of:
- pipe-pipe;
- pipe-cold bend;
- pipe-induction bend;
- for transition pieces made of pipe material, pipe-transition piece;
- hot-formed bends of pipe material in accordance with NEN-EN-ISO 3183.

All welds performed using the cellulosic welding process shall be tested hydrostatically.

7.5.2 Mechanised welding processes

The following mechanised welding processes are permitted for girth welds:

Type of welding process	Procedure no. in accordance with NEN-EN-ISO 4063
Tungsten Inert Gas	141
Gas Metal Arc Welding	135-P, -G, -S*
Flux-Cored Arc Welding	136-P, -G, -S
Metal powder cored arc welding	138-P, -G, -S

* An electronically or mechanically controlled process 13X-D is permitted for the root layer. For example, Lincoln STT, Fronius CMT or EWM Coldarc.

Copper back-up strips are not permitted.

Other mechanised or automated welding processes may be applied following the approval of Gasunie department "VGM Inspectie" (HSE Inspection).

8. WELDER COMPETENCY REQUIREMENTS

8.1 Warenwetbesluit drukapparatuur (Pressure Equipment (Commodities Act) Decree)

Welder's qualifications that are to be applied to pipes covered by the WWBD shall be approved by a Notified Body or a recognized third party organisation.

8.2 Welder's Performance Qualification

Welders shall be qualified in accordance with NEN-3650-2, i.e. in accordance with NEN-EN 12732 annex A and NEN-EN-ISO 9606-1, and an "operator" in accordance with NEN-EN 12732 annex A and NEN-EN-ISO 14732). These standards shall be clearly shown on the qualification. This qualification shall be issued by a Notified Body recognised for the purpose or a recognised third party organisation.

In addition, for qualifications in accordance with NEN-EN-ISO 9606-1, in the case of controlled short-circuit arc processes in the root layer, concerning the make and type of welding machine (for example: Lincoln STT,EWM Coldarc or Vermaat VIP), the qualification shall apply solely to that make and type of welding machine. For these processes, this shall be shown on the welder qualification.

In addition, for qualifications in accordance with NEN-EN-ISO 14732, solely qualifications in accordance with subclause 4.1 a) (operator has welded the WPQR) or subclause 4.1 c) (weld test in accordance with NEN-EN-ISO 9606-1) are permitted. The qualification shall apply solely to that make and type of welding machine, and remote control used for the qualification, this shall be shown on the certificate.

The extension of the welders' qualification in accordance with NEN-EN-ISO 9606-1 is only allowed in accordance with subclause 9.3 point a (every 3 years, full qualification) or b (after two years, extension by NoBo or a recognised third party organisation). WPQs issued or extended prior to 31 December 2015 will remain valid until the next extension. After 31 December 2015, for all qualifications, the extension shall be performed in accordance with subclause 9.3 point a or b of NEN-EN-ISO 9606-1.

The extension of the welders' qualification in accordance with NEN-EN-ISO 14732 can only be performed in accordance with subclause 5.3 point [sic] a (every 3 years, full qualification) or b (after two years, extension by NoBo or third party organisation). WPQs issued or extended prior to 31 December 2015 will remain valid until the next extension. After 31 December 2015, the extension shall be performed in accordance with subclause 5.3 point a or b of NEN-EN-ISO 14732.

8.3 Testing welder competency

Every welder who starts welding on a project shall be assessed as to their competency by means of a non-destructive inspection in accordance with this specification (CSW-01-E). If these criteria are not met, the welder in question will be excluded from welding work on the project concerned.

A welder shall produce at least seven acceptable welds out of their first ten welds.

If these criteria are not met, the welder in question will be excluded from welding work on the project concerned.

8.4 Welder's identification and list of welder's qualifications

During the welding work, the welder shall be able to show the following documents immediately:
- the welder's identification, and
- the list of valid qualifications (with dates).

The original welder's qualification certificate shall be able to be produced within 24 hours.

The Gasunie department "VGM" (HSE) can require the welding of test pieces if:
- the authenticity of the documents is insufficient, or
- the competency of the welder is in doubt.

8.5 Welding competency of fitters

Fitters making tack welds shall possess a fillet welding certificate in accordance with NEN-EN-ISO 9606-1, issued by a Notified Body or a recognised third party organisation. The tack weld certificates issued by the Gasunie department "VGM" (HSE) remain valid until the first three-yearly extension.

9. EXECUTION OF WORK

9.1 Weld bevels

The weld bevel and a strip of 10 mm wide on the internal and external surface of the pipe adjoining the fusion edge shall be cleaned to bare metal before start of welding The pipe shall be free from coating, paint, grease, moisture and dirt over a width of 50 mm from the weld bevel.

Permitted tools/resources are:
- rotary brush(es);
- flap disk;
- rotary grinding stone, cutter;
- degreasing agent.

9.2 Damaged weld bevels

Damage to the weld bevel that may have a negative effect on the welding process shall be recorded in a non-conformity form, as used by the main contractor performing the work.

Damage shall not, under any circumstances, be repaired by welding.

If a repair is not feasible, subclause 9.3 shall be applied.

9.3 Reworking weld bevels

Pipe ends with damage that cannot be repaired by filing or grinding shall be cut off by the main contractor over the damaged length plus 10 mm and a new weld bevel shall be created in accordance with the applicable WPS.

9.4 Pipe/plate cutting

Pipes/plates can only be cut if the material identification concerned has been re-stamped and the Gasunie hard stamp has been placed. Another stamp is permitted if this agreed with the client and the Gasunie department "VGM Inspectie" (HSE Inspection) (based on a remarking qualification issued by a third party accepted by Gasunie department "VGM Inspectie" (HSE Inspection).

When re-marking, at least the following information shall be included:
- the batch number for all seamless pipe ≥ DN 50 and ≤ DN 400;
- the BB number and pipe number for all other pipes;
- the identifications of the type of steel, if present (for all dimensions).

The material identification on plate shall be re-stamped in the same direction as the original.

Where materials are supplied by the contractor, identification is monitored by using material certificates. Where materials are supplied by Gasunie, the material certificates have already been assessed by Gasunie. Identification is monitored by using the "Materials order list GAB" (GTS REQ-001) and the drawings.

Additional requirements are set in annex D for re-stamping RVS.

When cutting pre-1975 pipe material the following conditions shall be met:
- prior to cutting the pipe, ultrasonic inspection shall be performed for doublings in accordance with CSW-05-E, and
- the cut pipe ends shall be ground clean, and
- the newly created weld bevels shall be inspected using the magnetic method in accordance with CSW-05-E.

9.5 Minimum distances between welds

The minimum distance between girth welds in transmission pipelines of pipe pieces is 1,5·*D*, with a minimum of 1000 mm. As an exception to this, at stations, the following minimum distances between welds shall be adhered to:
- 150 mm for pipe diameters ≤ DN 400;
- 300 mm for pipe diameters > DN 400.

The minimum distance between a weldolet or threadolet and the edge of every other weld is:
- 150 mm for underground use;
- 5·*d* with a minimum of 25 mm for use above ground.

Deviations from stated minimum weld distances are only allowed after approval by Gasunie department "VGM Inspectie" (HSE Inspection).

9.6 Storage and handling of weld filler material

Storage and handling shall be in accordance with the manufacturer's instructions for the relevant weld filler material.

9.7 Alignment

9.7.1 General conditions

When aligning pipes and fittings for gas transmission pipes, stations and/or installations, the main contractor shall take the following points into account:
- Adjustment work shall be carried out in such a way that stress-free welding can be performed.
- For the permitted alignment, refer to annex B of this specification.
- The differences in wall thickness and centre line between the weld bevels shall be equally spread across the circumference during alignment. If bevels are created by grinding or machining, these shall be recorded in the NDT request (see subclause 10.1.2 of this specification).
- The longitudinal joints of the pipes and fittings to be welded shall be aligned between the 10 o'clock and 2 o'clock positions where possible.
- Longitudinal joints shall be aligned with a minimum of 1 hour position difference (30°). Furthermore, there shall be no strip-end-weld within 200 mm of the girth joint.
- The maximum segmental cut per weld bevel is 1,5°, this means that a deviation of 3° can occur over a weld.

- The opening in the pipe onto which a weldolet is to be welded shall be smoothly finished and be chamfered on the inside (see figure 7).
- Only tools that cannot damage the pipe shall be used during the alignment work.
- External clamps may only be removed after a minimum of 60 % of the first layer has been applied evenly spread over the circumference. For diameters less than DN 300, performing tack welds and then removing the external clamp is permitted in accordance with subclause 9.7.3.

9.7.2 Supplementary conditions for aligning in the field

In the trench, only assembly welds can be made between the pipeline sections.

At the location of the weld there shall be sufficient free space in the trench around and along the pipe for ensuring, amongst other things, the welder's safety. The minimum required distances are:
- between the pipe and the bottom of the trench, 0,7 m, and
- between the pipe and the trench wall 0,7 m, and
- the free length along the pipe shall be a minimum of 1,5 m.

Conditions for using welding clamps in field runs:
- Welds in a pipe diameter greater than DN 400 shall be conducted using an internal clamp, unless this is not possible in technical terms.
- Assembly welds between pipe sections and pipe sections to structural sections shall be welded as pipe-pipe joints with equal wall thickness.

Downhill welding using cellulose electrodes:
- Internal alignment clamps may only be removed after the first two layers have been completed.
- For DN 1050 and greater, a minimum of three layers shall be present before the internal clamp is removed.
- When using external clamps, as a minimum the length of the half circumference shall be welded with the second weld layer evenly spread over the circumference.

Other welding processes:
- Internal clamps may only be removed after the first two layers have been completed or when a minimum of 25 % of the wall thickness is present.

Different thicknesses affecting removal of internal clamp:
- In the event of different minimum layer thicknesses affecting the removal of clamps, a qualification test ("drop test") shall be performed in the presence of the Gasunie department "VGM" (HSE).

The "drop test" consists of performing a hoisting motion on the diameter/wall thickness to be qualified. Two full-length pipes at the weld layer thickness to be tested shall, without a clamp, be hoisted to a height of 3 metres. Then these pipes shall be allowed to drop quickly and to come down onto the support. The "drop test" simulates "rough" handling during the construction of the pipeline. After this test, a magnetic inspection shall be performed in accordance with CSW-05-E.

9.7.3 Tacking

Tack welding may only be used on valve locations and stations if the use of alignment clamps is not possible. This is on the following conditions:

- For diameters of greater than DN 300, Gasunie department "VGM" (HSE) shall grant permission per individual project.
- For every type of tack weld an approved WPS shall be present.
- Only basic electrodes and TIG welding processes are permitted.
- The maximum distance between tack welds is 30 cm, with a minimum three tack welds per weld fit up.
- The tack welds shall be distributed evenly around the circumference.
- The length of the tack weld shall be at least 25 mm.
- The tack weld may not touch the outer surface of the pipe.
- Tack welded joints may not be moved.

Where prefab work is performed in a workshop, pieces in the tacked welded state may be hoisted. The working procedure and scale of the pieces shall be recorded in the weld plan in such cases.

9.8 Welding

Only steel earth terminals may be used. After removal of the earth terminal, the main contractor shall inspect the pipe surface for defects.

The arc may only be struck in the welded joint on the previous layer or against the weld bevel; under no circumstances on the pipe surface next to the weld.

At the locations where work is being undertaken, the main contractor shall use tents and insulation blankets in order to protect the welder and the weld. During and after welding work, the pipe ends shall be protected by covers against draughts, penetrating damp and dirt.

Before and during welding and grinding, the factory coating shall be protected against the burner flame, welding spatters and grinding spatters by using heat-resistant mats.

While work is being performed, the client or Gasunie department "VGM Inspectie" (HSE Inspection) may ask the main contractor to measure and record the welding parameters. This reporting shall be included in the quality administration.

Welding beads shall be staggered so start and end points of beads above and next to each other do not occur together within a distance of 15 mm.

Assembly welds shall be completed without interruption.

At the end of each working day, welded joints in diameters < DN 300 shall be finished. For diameters ≥ DN 300 the joint shall be filled to a thickness of at least 0,4 times the greatest wall thickness. Welds which are not completely finished shall be finished within 7 calendar days.

After completion of the weld, the surface of the weld and the adjacent pipe surface shall have slag residues and weld spatters removed over a width of $7 \cdot d$ with a minimum van 75 mm. Permitted cleaning methods are:
- by means of brushing;
- by means of a flap disk.

Inspections may only be carried out after cleaning.

Cleaning using a scaling hammer is not permitted.

9.8.1 Downhill welding using cellulose electrodes

The following conditions are applicable for the main contractor when welding downhill using cellulose electrodes:
- the first two layers shall be applied immediately after each other, the second weld layer having to be welded with raised heat input; only short interruptions for grinding and brushing shall be permitted.

9.8.2 Mechanised welding

Equipment used for production welds shall be the same as the equipment used during qualification.

The main contractor provides for the registration of the essential weld parameters in accordance with annex C. These parameters shall be measured by the main contractor for at least one weld in every 50 . After changing or adapting the welding program, the parameters from one complete weld shall be measured and monitored to ensure that welding is taking place within the permitted range of variables of the WPQR. These reports shall be appended to the quality administration.

9.8.3 Number of welders per girth joint

Reference is made to table 2 for the minimum number of welders for cellulosic welds and to table 3 for the other welding processes.

Table 2: Number of welders for downhill welding with cellulose electrodes

Nominal pipe diameter	number of welders	
	for first and second layer	filling and final layer
< DN 300	1	1
≥ DN 300	2 or more at the same time	2 or more at the same time

Table 3: Number of welders for other welding processes

nom. pipe diameter (D)	no. of welders
$D \leq 150$	max. 1
$150 < D <$ DN 400	1 or 2
$D \geq$ DN 400	2 or more at the same time

If the weld is carried out by roll-welding or with a weld manipulator, one welder is allowed to weld the full circumference of the weld.

9.9 Pre-heating and heat treatments

Pre-heating and heat treatments shall be carried out in accordance with the WPS.

9.9.1 Temperature measurements

The temperature measurements shall be carried out using an electronic contact thermometer.

After pre-heating, (check) temperature measurements shall be carried out over the entire circumference of the pipe and fittings at around 5 – 7 cm from the weld joint at the moment that the welder indicates that welding is about to start. The interpass temperature shall be measured in the joint, at the location where the welder starts the welding. Welding may only be started when the temperature of the parts to be welded is between the pre-heating temperature and the interpass temperature.

When working with welding stations or on sites where several welds are being made at the same time, temperature indicating sticks may be used under the following conditions. For each welder/team of welders the following shall be present:
- one temperature indicating stick for the minimum pre-heating temperature, and
- one temperature indicating stick for the maximum interpass temperature.

At least one electronic contact thermometer shall be present in the welding station or on the site.

The pre-heating and interpass temperature shall be measured regularly by the welder or fitter in order to be certain that there is compliance with the requirements of the WPS.

9.9.2 Pre-heating the weld joint

The weld joint shall be preheated to the temperatures stated in table 4. Pre-heating over the interpass temperature as stated on the WPS is not permitted. Heating can be carried out with suitable gas burners or electric heating.

When carrying out heat treatments, including pre-heating and maintaining the temperature of the weld, it shall be ensured that the temperature of the nearest coating stays continually under 110 °C. The coating shall be protected from damage and grinding and/or welding spatters.

Table 4: Pre-heating temperature

welding process	material class	wall thickness	pre-heating temperature
111-C	L245, L415, L450, L485	6	≥ 90 °C
		8	≥ 100 °C
		10	≥ 110 °C
		12	≥ 120 °C
		14	≥ 130 °C
		16	≥ 140 °C
		≥18	≥ 150 °C
111-B/-R 121 13X 141	L245, A106 gr. B, A333 gr. 6, A420 WPL6	each	"lukewarm"
	L415, L450, L485, P420Q, P460Q, P460N, S420NL	≤ 10 mm	HDM > 5 mL/100 g ≥ 50 °C HDM ≤ 5 mL/100 g lukewarm
		> 10 mm	HDM > 5 mL/100 g ≥ 100 °C HDM ≤ 5 mL/100 g ≥ 50 °C
Valves and isolation couplings: maximum pre-heating temperature 80 °C, maximum interpass temperature 125 °C.			
Other material classes or welding processes are in accordance with the approved WPS.			

9.9.3 Maintaining the temperature of the weld

The following requirements shall be observed in respect of maintaining the temperature of the weld:

- All welds shall be covered with an insulation blanket.
- The type of blanket shall be suitable for the season.
- If the temperature of the weld falls below 50 °C, the blankets can be removed.

9.9.4 Heat treatment after welding

The following is applicable if a heat treatment is necessary after welding:

- the procedure for this shall be approved by Gasunie department "VGM" (HSE) prior to commencement of the work;
- the heat treatment shall be specified on the relevant WPS;
- the heat treatment shall take place before NDT;
- the heat treatment shall be undertaken in accordance with NEN 3650-2.

9.10 Coding of welded joints

The main contractor shall mark every completed weld with the weld number. This shall be applied next to the weld on the coating using paint or crayon. Other methods are permitted provided they have been approved by the Gasunie department "VGM" (HSE).

Note:
*It is **forbidden** to stamp marks in or next to the weld using letter and/or number punches.*

Gasunie has two types of weld numbering, the composition depends on application, gas transmission pipes or stations and installations.

For **gas transmission pipes** the weld number is composed as shown below:

- For welded joints in pipe sections
  The weld number consists, successively, of:
  - the letter A up to and including H for permanent welds, or
    the letter Z for temporary welds, and
  - the serial number (three figures): 001 up to and including 999.
- For welded joints under workshop conditions (prefab work)
  The weld number consists, successively, of:
  - The letter J up to and inducing M or P up to and including S for permanent welds, or
    the letter Z for temporary welds, or
    the letter N for weldolets, and
  - The serial number (three figures): 001 up to and including 999.
- For assembly welds
  The weld number consists, successively, of:
  - the letter U up to and including W, or
    the letter N for weldolets, and
  - the serial number (three figures): 001 up to and including 999.

Comment:
- The letter H is reserved for girth welds of drillings.
- The letter T is reserved for girth welded joints that cannot be hydrostatically/ pneumatically tested (see CSW-20-E). For weldolets this is Tn.

For **stations and installations** the weld number is composed in the way stated in the instruction on the isometric drawing for the welding work report see annex E.

9.11 Reporting welding and NDT

The welding work shall be recorded on/in:
- the designated form GTS_W-015, or
- a form containing at least the same information, or
- an automated system containing specific clearances by persons with responsibility for such clearances. At completion a final record in print shall be supplied for quality administration.

For stations this shall be in conjunction with an (isometric) drawing.

The NDT report shall contain the welder's identifications in connection with:
- being able to verify the work performed, and
- extending the welder's certificates.

Visual inspection (form GTS_W-017):
- A = agreed, if:
  - the weld preparation is in accordance with this specification, and
  - the weld appearance meets the acceptability requirements;
- NA = not agreed, if the above-mentioned criteria are not met.

9.11.1 NDT reporting

The welds shall be coded as stated below:
- on the isometric drawing (see annex E), and
- in the weld report, and

where necessary, followed by the weld status.

For gas transmission pipes the pipe number shall be added.

The **weld status** is indicated as follows (after the weld number):
- no addition for the original weld;
- A : for a repaired weld;
- X : for a new weld after cut-out;
- XA : for a repaired weld after cut-out;
- H : for re-imaging[1)];
- C : for check imaging;
- C/O : for welds that are not eligible for repair, only on the NDT report.

1) re-shoots only need to be performed at the location where the radiographic image does not comply with the quality requirements. The exception to this is RT on welded joints < DN 100, in such cases the whole weld shall be re-tested.

9.11.2 Packaging of NDT media

The NDT firm supplies the media in labelled boxes; the labels shall state the following items:
1. pipe/inst. number;
2. project name;
3. project number of the Gasunie department "VGM" (HSE);
4. investment number;
5. route map/iso number;
6. date;
7. order numbers of NDT firm;
8. the code numbers stating the contents of the box.

Where radiographic images are involved, a copy of the report shall be enclosed with the films. Where digital media are involved, the reports may be enclosed in digital form.

Roll pack films shall be delivered in compartment boxes. Each box shall be provided with a label containing the information described above.

10. INSPECTION AND TESTING

The scope and the type of weld inspection is described in this clause. Deviation from the scope or the type is only possible following written approval from the Gasunie department "VGM Inspectie" (HSE Inspection).

10.1 Scope and type of weld inspection

Unless a different percentage is indicated in the referencing GTS specification, all butt welds shall be 100% volumetrically inspected, with the exception of fillet and weldolet welds.

The NDT type, depending on the type of material and project scope, is shown in table 5. There are alternative requirements for the inspection of repaired welds, for more detail see clause 11 of this specification. The inspection procedures and inspectors shall comply with the requirements according to CSW-05-E.

10.1.1 Visual weld inspection

In accordance with annex B of this specification, every weld shall be visually inspected by a member of the main contractor's staff trained[1)] in this area.

1) A person shall have at least one of the following qualifications in order to be able to conduct a visual inspection: VT-w level 1 or higher, IWI-B, IWI-S, IWI-C, IWP, IWS, IWT or IWE.

The result of this inspection shall be recorded on form GTS_W-017.

Identified deviations shall be repaired in accordance with subclause B of this specification.

Welds that have passed visual examination can be given clearance for further non-destructive inspections.

10.1.2 NDT application

Following approval for visual inspection, the main contractor shall submit an request to the NDT contractor for non-destructive testing to be performed.

This request shall contain at least the following details:
- welds to be inspected;
- type of NDT;
- specific information as requested in the NDT procedure concerned.

These requests shall be available for inspection by the client and the Gasunie department "VGM Inspectie" (HSE Inspection).

10.1.3 Non-destructive weld testing

Table 5 gives an overview of NDT techniques. Different fixed NDT combinations are prescribed, depending on the type of weld, the number and the wall thickness.

Table 5: Instruction for NDT techniques.

NDT technique in accordance with CSW-05-E	Wall thickness			Weldolets, welded on parts	Weld bevels
	≥ 6,0 mm		< 8,0 mm		
	No. of welds				
	≥ 50	< 50 or station			
Visual inspection	V	V	V	V	V
AUT	V[4)]				
ToFD + MT + manual PE (D)	A[1)]	V[1)]			
X-ray[3)]	A	A	A		
PA + MT[2)]			V		
MT				V	

Key:
V: Instruction.
A: Alternative, possible following permission from the Gasunie department "VGM" (HSE).
D: UT solely on transverse imperfections.

Comments:
1) If the transition angle due to wall thickness differences by design and/or construction is over 20°, ToFD inspection shall be replaced by radiographic inspection. The use of isotope is allowed only, if for technical reasons the use of X-ray is not possible.
2) PA inspection shall be used instead of X-ray inspection if the following requirements are met:
   - material type with Re ≤ 245 MPa;
   - pipe/pipe joints DN ≥ 50 with wall thicknesses 4.5 mm up to 8 mm and wall thickness differences ≤ 2 mm and/or tapering, whereby the axial distance is 12 mm at the most; for the precise execution, reference is made to subclause 6.2;
   - the weld cap shall not be removed.
3) If process 135-D is used without electronically or mechanically controlled short-circuit, the choice of inspection technique is limited to combinations which include ultrasonic testing, regardless of the material type.
4) AUT is applicable where wall thicknesses are ≥ 8 mm. For wall thicknesses below this, PA + MT or ToFD + MT + manual PE shall be applied.

Application of AUT applies only for girth welds between pipes of the same wall thickness. For other girth weld connections, for example, welding of pipes to fittings, or hot-formed bends or pipes with a different wall thickness, inspection shall be by ToFD and manual PE+MT.

When choosing radiography, single-wall X-ray inspection is obligatory for diameters ≥ DN 200. If the inspection method is RT, for projects of more than 50 welds in the same diameter, an X-ray crawler shall be used.

Approval from Gasunie department "VGM Inspectie" (HSE Inspection) shall be obtained in advance for the use of isotope instead of RT.

10.1.4 Destructive testing of production welds

The Gasunie department "VGM Inspectie" (HSE Inspection) shall designate production welds for each main welding process (35 % of the welds having the same WPS) in the field runs. The number of welds to be destructively tested is in accordance with table 6. These welds shall be tested destructively.

If Gasunie has the impression there are possible deviations from the WPS, the relevant weld can be cut out if the client or the Gasunie department "VGM" (HSE) indicates this. This cut-out weld shall be destructively tested at the expense of the main contractor.

Please refer to subclause 10.2.2 for the required tests on the production welds.

Table 6: Number of production welds for field runs

Length of pipe in km	No. of production welds for each main welding process
1 < length ≤ 10	1
10 < length ≤ 50	2
length > 50	2 and 1 weld for every extra 50 km

10.1.5 Other NDT techniques and/or re-testing

If necessary, the client or the Gasunie department "VGM" (HSE) may prescribe for the main contractor:
- other additional NDT techniques, and/or
- ask for a certain type of test to be repeated.

10.2 Testing the inspections

10.2.1 Non-destructive testing

Following clearance by the welding expert from the main contractor's firm or its delegated representative, the client and/or Gasunie department "VGM Inspectie" (HSE Inspection) shall review the inspection results against the requirements contained in this specification; this will take place at least on a random inspection basis.

Where there is a combination of inspection techniques, the matching criteria shall apply for each technique, irrespective of the results of the other techniques applied.

10.2.2 Destructive testing of cut-out production welds

Only NDT acceptable welds may be indicated by the Gasunie department "VGM Inspectie" (HSE Inspection) as being production welds. The main contractor shall have the cut-out production welds tested in accordance with annex A. The production weld shall be cut out including 150 mm of pipe material on both sides of the welded joint.

Within five days of being instructed by Gasunie department "VGM Inspectie" (HSE Inspection), the main contractor shall get the cut-out production welds tested in an NEN-EN-ISO/IEC 17025 accredited laboratory in the Netherlands, or, following written approval from Gasunie department "VGM Inspectie" (HSE Inspection), in another NEN-EN-ISO/IEC 17025 accredited laboratory abroad.

The required associated documentation is:
- WPS and WPQR registration form;
- NDT reports approved by Gasunie management;
- BB number(s) and pipe number(s) of the pipe(s).

The time and location of testing shall be communicated to the Gasunie department "VGM Inspectie" (HSE Inspection) by the main contractor two days in advance.

If a destructively tested production weld is rejected, the main contractor shall, on the instructions of Gasunie department "VGM Inspectie" (HSE Inspection), cut out two welds produced with the same WPS. These shall be tested in accordance with annex A. Both welds shall comply with the requirements stipulated. If this is not the case, there shall be further consultation between the client, Gasunie department "VGM Inspectie" (HSE Inspection) and the main contractor.

10.3 Release prior to hydrostatic/pneumatic testing

Only pipelines that have been completely inspected and meet the requirements may be tested in accordance with CSW-19-N, where the following requirements are applicable:

a Unless otherwise agreed, the main contractor shall provide the client with the complete welding and pipe book no less than 72 hours prior to the test.

b The results of the destructive tests of the production welds are evaluated and accepted by the Gasunie department "VGM" (HSE).

11. HANDLING WELD DEFECTS

Repaired or completely replaced welds shall be fully inspected, approved and accepted in accordance with clause 10.

11.1 Conditions

The main contractor is allowed to repair weld defects, with due consideration for the following aspects:

- The repair is recorded in the pipe and weld log with reference to the repair WPS.
- Cracks will not be repaired.
- The weld shall not be repaired over more than 20% of the circumference.
- The weld has not been previously repaired.
- The repair shall be carried out on the basis of a repair WPS approved by the Gasunie department "VGM" (HSE).
- Internal welding is a repair method for which safety shall be guaranteed in accordance with CSA-38-E.
- The entire weld defect or group of weld defects shall be removed.

Rejected welds with defects in the root layer or the second layer in materials with an R_e of 360 MPa and above may not be repaired using process 111-C.

11.2 Repair of visually observed weld defects

Repair work by means of grinding shall be visually inspected again in accordance with clause 10. Surfaces damaged by arc strikes shall be magnetically tested in accordance with clause 10 after grinding. This repair work by means of grinding is not deemed to be a repair as mentioned in subclause 11.1, but shall be recorded on form GTS W-017.

Repairs by means of welding shall be carried out in accordance with subclause 11.1.

11.3 Re-inspection after repair

Following a repair, the whole weld shall be inspected. The same inspection technique used for the repair shall be used for this inspection.

11.4 Weld defects that cannot be repaired

If it is not possible to comply with the requirements set out above in subclause 11.1 then the following applies, following Gasunie department "VGM" (HSE) consultations:

a The welded joint shall be cut out completely, including 150 mm of the pipe ring on both sides of the weld, and made available to Gasunie department "VGM" (HSE) immediately. If Gasunie department "VGM" (HSE) decides on further inspection then, on the instructions of Gasunie department "VGM (HSE), the main contractor shall deliver the welded joint with an accompanying form to a laboratory appointed by Gasunie department "VGM" (HSE), with the following documentation as a minimum:
   1. Copy of the WPS and, if applicable, the repair WPS.
   2. Name of the main contractor's (welding) supervisor/quality controller involved.
   3. Certified NDT report(s).
   4. Certified copies of the applicable scans or X-ray films.

   Prior to cutting out, the weld shall be stamped by Gasunie department "VGM" (HSE)using a steel punch.

b Welds with cracks shall be cut out completely, including a 150 mm pipe ring on both sides of the weld.
   Note: an exception to this is fittings for which only 15 mm of the fitting side needs to be cut out.

The welded joint with the defect shall be delivered by the main contractor to the designated laboratory within two working days.

12. TACK WELDING NUTS TO FLANGES IN SURFACE BOXES

The main contractor shall be aware of the following conditions for the tack welding of nuts to flanges in surface boxes:

- use welding filler material AWS E309L or equivalent depending on the welding process selected;
- submit WPS for evaluation and approval to the Gasunie department "VGM" (HSE);
- tack two sides per nut over the full length;
- perform quality control: visual and a tap with a 1 kg copper hammer on the stud provided with a nut.

ANNEXES

A. WELDING PROCEDURE QUALIFICATION

Welding procedure qualifications shall comply with the requirements of NEN-EN-ISO 15614-1 level 2 and the deviating and supplementary conditions in this annex.

Where reference is made in this annex to "clause", the relevant clause in NEN-EN-ISO 15614-1 (2017) is meant.

A.1. General requirements WPQR

General requirements with regard to the welding procedure qualification report are:
- The welding test shall be carried out in a workshop or at a field location.
- The test welding shall be carried out at a location decided upon by mutual consultation.
- The main contractor shall produce sufficient weld length in the weld test for all the tests as well as any retesting.
- The selected materials and welding filler materials shall, unless agreed otherwise, comply with the requirements stipulated in clause 5 of this specification.
- Gasunie will provide test material for qualifications in delivery condition "Quenched Tempered" (QT).

Gasunie department "VGM" (HSE) retains the right, in specific cases, to deviate from the above and to demand supplementary tests. Some examples of special cases that can give rise to alternative testing are:
- welding processes met (extremely) high or low heat input;
- welding processes in non-standard Gasunie materials.

A.2. Procedure

If a test has to be performed for qualifying a welding procedure, the procedure is as follows:
1) The main contractor prepares a pWPS with all the required variables in accordance with annex C and NEN-EN-ISO 15614-1 and submits this to Gasunie department "VGM" (HSE) for acceptance evaluation.
2) Gasunie department "VGM" (HSE) shall be notified, in writing, a minimum of five working days in advance in respect of where and when the qualification weld is to be performed.
3) Gasunie department "VGM" (HSE) shall be present at the qualification welding and, after the welding is completed, stamps the test piece on both sides of the finished weld.
4) The main contractor will have the test piece inspected.
5) Gasunie department "VGM" (HSE) shall be notified, in writing, a minimum of five working days in advance in respect of where and when the destructive test is to be performed so that they can attend the test.
6) Gasunie department "VGM" (HSE) reviews whether the requirements set have been met and signs the qualification test documents and qualification form.

A.3. Test piece

The following applies as a supplement to **clause 6.2.3**:
For pipe-pipe connections it applies that two pipe sections, each with a length of at least once the pipe diameter and a minimum of 300 mm, are to be welded together. A sample is taken from this section with 150 mm base material on both sides of the weld.

The following applies as a supplement to **clause 6.3**:
Where material with $R_e \geq 360$ MPa is being repaired, a separate WPQR is required for repairs or counter welds.

The main contractor shall record the welding parameters and the heat input by using an electronic system. Temperature measurement may be carried out using contact thermometers, the values shall be recorded on the WPQR. This record list, after it has been signed, shall be submitted by the main contractor to the Gasunie department "VGM" (HSE) welding inspection for evaluation and approval. This list shall be added to the WPQR.

The test piece shall be marked with:
- the number of the pWPS;
- the name/names of the welder(s) and/or their identification(s);
- the date of welding;
- the identification of the Gasunie inspector who attended the test weld (letter/number punch).

A.4. Inspection of the test piece

A.4.1. Non-destructive testing of the test piece

The following applies as a supplement to **clause 7.1 "**Scope of the tests" and to table 2 of NEN-EN-ISO 15614-1:
The scope of the testing of the butt-welded joint is shown in table 7.

For NDT of repair and counter weld qualifications, the same NDT scope as for a full butt weld according to table 7 applies.

A.4.2. Destructive testing of the test piece

Only test pieces that are NDT acceptable are to be subjected to destructive testing.

Destructive testing is carried out in an accredited laboratory within the territory of the Netherlands, or at a different location decided upon by mutual consultation.

The scope of testing for a weld qualification is in accordance with table 7.

Table 7: Supplement to table 2 of NEN-EN-ISO 15614-1

Test weld	Thickness and/ormaterial	Scope of the testing	Comments
Radiographic or PA	d < 8,0 mm	100 %	
ToFD	d ≥ 8,0 mm	100 %	
Tensile test, weld metal	Material R_e > 360 MPa	2x	*
Bend tests	If d > 21 mm side bend bars permitted	2x over the root layer 2x over the final layer	For welding processes with HI ≤ 0,6 kJ/mm, double the amount of tests
Side bend tests, weld metal	Cellulosic welding in DN ≥ 600 and ≥ L415	2x side bend bars, weld metal	
Impact tests	d > 5,0 mm		
Supplementary impact tests	d >20,0 mm	root layer: centre weld (3x), fusion line (3x)	
Hardness test		1x 3 hours 1x 6 hours	
Macro assessment		1x 3 hours 1x 6 hours	

* In order to perform this test properly, account shall be taken of the wall thickness/diameter ratio of the test piece. This test can be implemented properly with a wall thickness of 9 mm and above and a diameter of DN 600 or more.

The specimens for tensile and bend testing from a test piece produced using cellulosic electrodes shall be heat treated prior to the destructive test to remove hydrogen in accordance with table 8.

Table 8: Hydrogen-free annealing temperature and time

wall thickness	annealing temperature	annealing time
≤ 17 mm	250 °C	4 hours
> 17 mm	250 °C	6 hours

For weldolet qualification destructive tests, please refer to subclause A.8.

A.5. Dimensions and removal of the test bars

In deviation from figure 6 in **clause 7.2 "**Location and removal of test bars":

The test bars for downhill and uphill welding processes, or a combination of downhill and uphill welding processes of complete qualifications, shall be removed in accordance with figures 10, 11 and 12. The position for CTOD tests, if this is specified as a supplementary requirement when stated in the job instructions by the client or the Gasunie department "VGM Advisering" (HSE Advice).

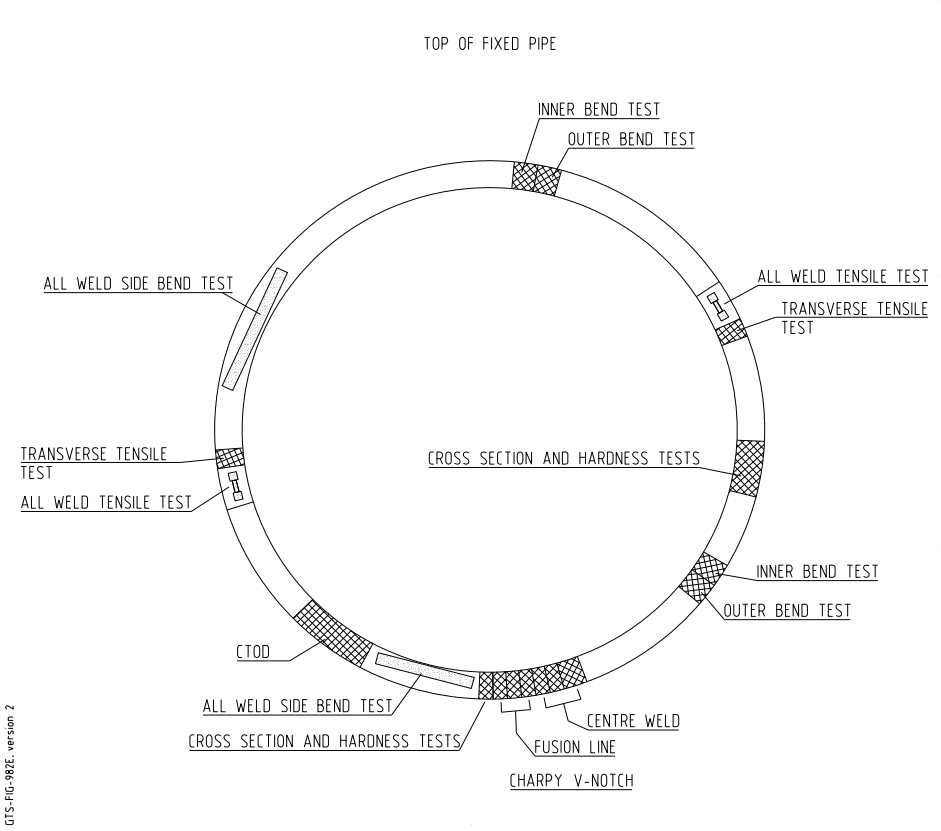


Figure 10: Position of test bars for downhill welds

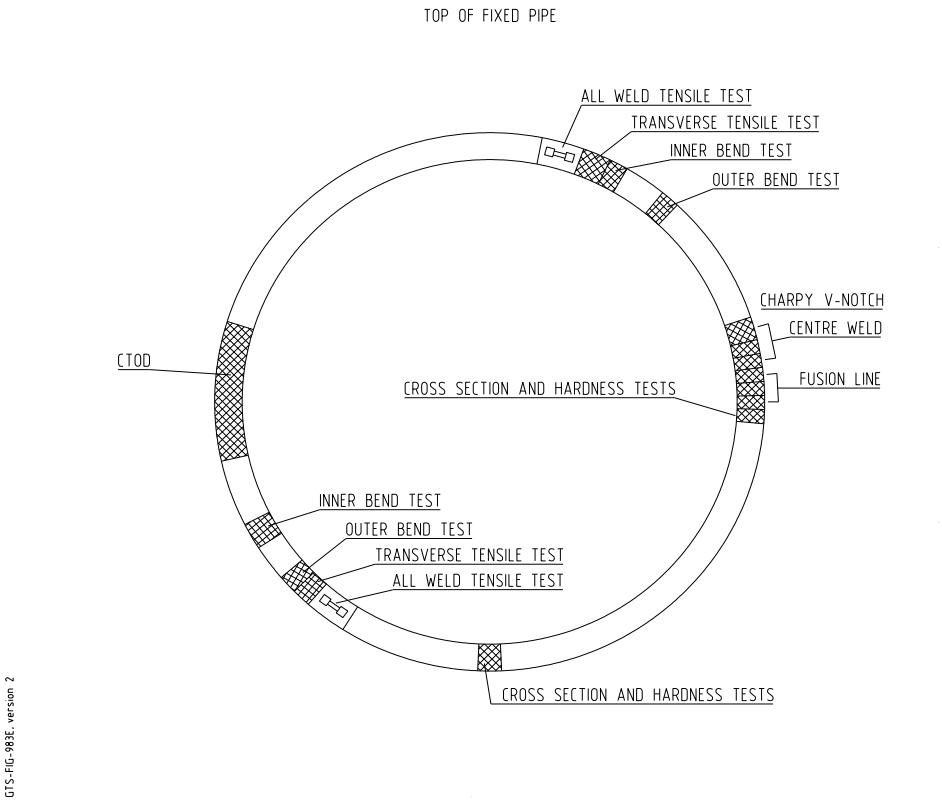


Figure 11: Position of test bars for uphill welds

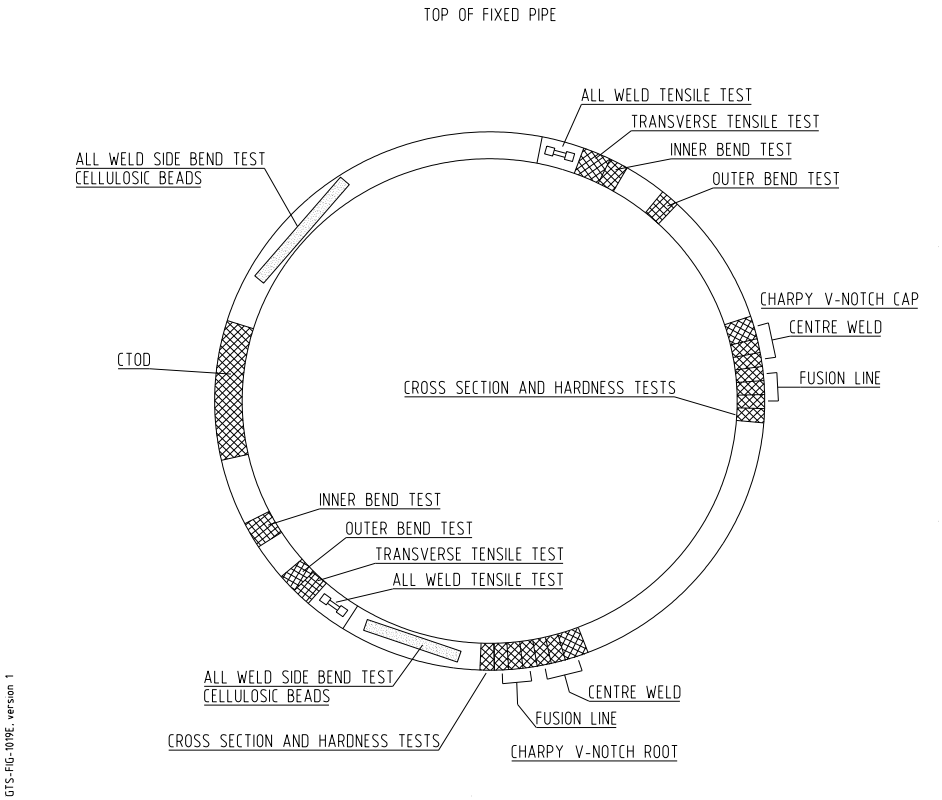


Figure 12: Test bars for first layers downhill and filling and final layers uphill.

A.6. Inspection and testing

A.6.1. Tensile tests on weld metal

For materials with R_e > 360 MPa, two lateral all-weld test bars (TL), are to be removed immediately next to the cross weld test bars (TD). The test standard is NEN-EN-ISO 5178.

The fracture surface shall be free from base material. If the all-weld test bar originates from a pipe diameter of < DN 900, a check for any presence of base material shall be made by means of etching.

Where weld joints with a bevel angle smaller than 10° are being tested, a right-angled bar shall be removed which shall have the greatest possible height.

Please refer to table 9 for the requirements for girth weld joints.

Table 9: Supplementary requirements for girth weld joints

Base material specification	All weld requirement or fracture in the weld for the cross tensile test*	Fracture requirement in base material for cross weld tensile test	Elongation requirement for weld metal minimum (%)
R_{t05} < 360 MPa	$R_{m\perp}$ and $R_{m//} \geq R_m$, base material	$R_m \geq R_m$, base material	n/a
L415	$R_{m\perp}$ and $R_{m//}$ ≥ 572 MPa $R_{t05//}$ ≥ 469 MPa		18
L450	$R_{m\perp}$ and $R_{m//}$ ≥ 590 MPa $R_{t05//}$ ≥ 510 MPa		18
L485/L480	$R_{m\perp}$ and $R_{m//}$ ≥ 627 MPa $R_{t05//}$ ≥ 543 MPa		17

* The requirements for yield strength and tensile strength are based on NEN-EN-ISO 3183.

In accordance with NEN 3650-2, the requirements are 13 % overmatching on the yield strength of the base material, and 10 % overmatching on the tensile strength of the base material. These values apply to the materials that are not mentioned in table 9. For weld metal, the elongation upon fracture shall be a minimum of 18 % for R_e < 485 MPa and a minimum of 17 % for R_e ≥ 485 MPa.

A.6.2. Inspection and testing of butt-welded joint

The execution and testing of the inspection are to be carried out in accordance with the relevant clauses stated in NEN-EN-ISO 15614-1.

Clause 7.3 "Non-destructive testing".
Method and testing
Implementation and acceptance of the NDT in accordance with this specification (CSW-01-E).

A waiting time of at least 12 hours for the NDT is applicable to cellulosic welding process qualifications.

Clause 7.4.1 "cross weld tensile test".
Deviating stipulations:
If there is a fracture in the weld metal, the tensile strength shall be tested against table 9.

Clause 7.4.2 "Bend test".
Deviating stipulations:
a Two weld metal side bends.
For welds made by the cellulosic process in material class L415 and higher and diameter ≥ DN 600, two side bend tests for the weld metal are to be performed for each qualification. These shall be removed from the position shown in figures 10 and 12. See figure 13 for the exact shape and dimensions. These test bars shall be made hydrogen-free by annealing for 16 hours at 250 °C. The required mandrel diameter is 180 mm. For the bending arrangement, the distance between the rollers may not exceed 22 mm in accordance with NEN-EN-ISO 5173.

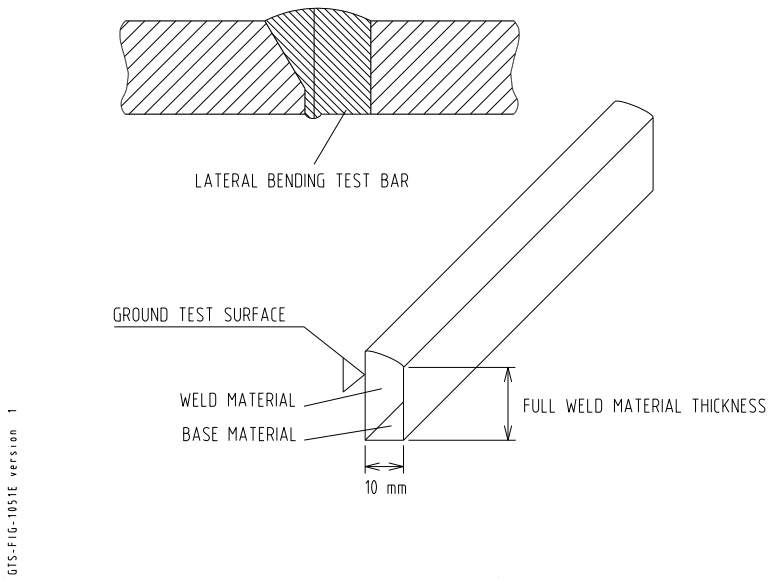


Figure 13: Removal and dimensions of test bar

The bar shall be drawn over the mandrel entirely. The required minimum bending angle is 150°.

The surface shall be free from cracks or cracklike indications when testing welding procedure qualifications.

Testing production welds, cracks or cracklike indications are permitted provided:

- these meet the requirements of clause 7.4.2 of NEN-EN-ISO 15614-1;
- the amount is less than 10 per test bar;
- The indications are only visible in one single layer of the weld.

Clause 7.4.4 "impact tests". Deviating stipulations:
A minimum average value of 40 J and a minimum individual value of 30 J is applicable for minimum impact energy when using 10 mm x 10 mm samples.

Depending on the material class and wall thickness, the impact test shall be performed at a temperature in accordance with table 10.

All test results shall be reported.

Table 10: Testing temperature for impact test

Material class	d_c in mm	Test temperature
L 240	≤ 16	0 °C
L 360, L 415, P460 and L 480	≤ 30	-20 °C
L 240	> 16	consult Gasunie "VGM" (HSE) department
L 360, L 415 and L 480	> 30	
other	all	

Clause 7.4.5 "Hardness test".
Table 2 of NEN-EN-ISO 15614-1 is replaced by table 11.

Table 11: Hardnesses

Medium/welding process	Location			
	Weld metal HV/10		HAZ HV/10	
	root layer	final layer	root layer	final layer
Non-sour gas/ cellulosic welding process	300	300	275	320
Non-sour gas/Other welding processes	325	325	350	350
Hydrogen/other welding processes	248	325	248	325

Clause 7.5 "acceptance levels"
Deviating stipulation
In accordance with this specification (CSW-01-E).

A.7. Validity of welding procedure qualification

A.7.1. Range of validity

The range of the WPQR is based on the relevant points in NEN-EN-ISO 15614-1 with the following requirements:

Clause 8.3.2 "Material thickness and pipe centre line":
Deviating stipulation
If an impact test is not performed the range is limited to 5 mm wall thickness.

The following supplement applies to table 7 of NEN-EN-ISO 15614-1:
If the test piece has been welded in a material with R_e > 360 MPa, the maximum qualified base material and/or the weld metal thickness is 1,25 times the welded thickness.

If the test piece has been welded in a material with R_e > 360 MPa, an all-weld test piece shall be removed if the qualification range of the WPQR is 8 mm or more.

Please refer to subclause A.8 for the weldolet qualification ranges.

A.7.2. Applicable for all welding procedures

The following applies in supplement to **clause 8.4.2** "welding positions":
For mechanised welding with a bevel angle of 10° and over, a change of more than 6° from the horizontal position of the pipe requires re-qualification.

The following applies in supplement to **clause 8.4.3** "Type of welded joint":
The range is ±3° with regard to the qualified bevel angle for bevel angles less than 10°. For bevel angles of 10° and over, the qualified bevel angle is all angles of 10° and above.

Layer build-up: This shall be based on the WPQR. The application of less layers than are qualified in the WPQR, in relation to the thickness to be welded, is not permitted. During execution however, one or two more layers/beads may be applied than specified in the WPS.

The following applies in supplement to **clause 8.4.4** "Filler material, manufacture (manufacturer and trade name)":
- For all filler materials: change in manufacturer and/or trade name requires a new qualification.
- For flux-cored wires if used in material with R_e > 360 MPa: a change of batch requires a new qualification.

The following applies in supplement to **clause 8.4.7** "Heat input":
A change in weld direction requires re-qualification.

The following layers are defined with regard to heat input:
root layer, 2nd layer, fill layers are deemed to be one layer, cap layers are deemed to be one layer.

For manual or semi-mechanised welding:
A change of ±15 % with regard to the maximum and minimal heat input per layer.

For mechanised welding:
A change of ±10 % with regard to the maximum and minimum heat input per layer.
The following changes also require re-qualification:
- application or non-application of a weave;
- change of > 2 mm to the width of the weave;
- change to dwell time by more than 0,1 s;
- change in weave frequency>7 % for fill layers;
- change in weave frequency >12 % for final layers.

The following applies in deviation to **clause 8.4.8** "Pre-heating temperature":
A reduction in the pre-heating temperature requires re-qualification.

The following applies in supplement to **clause 8.4.9** "Interpass temperature":
An increase in the interpass temperature requires re-qualification.

A.7.2.1 Cellulosic welds which are not fully welded within one heat cycle

When cellulosic welds are not finished in one single heat cycle, this shall be qualified by cooling off the desired number of layers, with a minimum of two layers, to below 50 °C (see subclause 9.7.2), after which the weld shall be pre-heated and the welding be completed.

A.7.3. Validity period

The validity of WPQRs in materials with a yield strength ≥ 360 MPa is limited to 3 years. Please refer to subclause 7.4. for extending the period of validity.

Validity is limited to three years for repair WPQRs in material with R_e > 360 MPa. This can be extended by welding a new repair WPQR. As an alternative, when extending a repair WPQR, a WPQR or a production weld report can be submitted in which the identical welding filler material is applied within the range of validity of the welding parameters in accordance with subclause A.7 of this specification.

A.8. Welding procedure qualification for weldolets and welded on parts

The following applies in supplement to NEN-EN-ISO 15614-1:

The WPS for a weldolet weld or for a welded on part shall be based on the WPQR of a girth weld in the same base material as the pipe to which the weldolet is being welded. The minimum diameter in accordance with 8.3.2.3 is not applicable for this WPS.

The validity of this qualification is restricted to:
- a pipe wall thickness of up to 30 mm;
- material group 2.2 and lower if qualified to material group 2;
- material group 3 and lower if qualified to material group 3;
- weldolets ≤ DN 150.

A.9. Qualification procedure for repair welds

The following applies in supplement to NEN-EN-ISO 15614-1 that, for material with R_e > 360 MPa, repair procedures and/or counter weld procedures shall be made and tested in accordance with NEN-EN-ISO-15614-1 and this specification.

A.9.1. Repair WPQR

The repair WPQR shall be welded in a weld where a full "through thickness" repair shall be carried out. It is not permitted to remove more than 1/3 part of the girth weld in one piece for a repair qualification. If necessary, this can be removed from several girth welds.
A repair WPQR shall be performed around the 3 o' clock position.

The scope of testing for the qualification of a repair qualification is in accordance with table 12.

Table 12: Scope of repair qualification

Type of inspection	Thickness and/or material	Scope of the inspection	Comments
Radiographic or PA	d < 8,0 mm	100 %	
ToFD	d ≥ 8,0 mm	100 %	
MT	All	Accessible surface	
Tensile test, transverse	All	1x	
Tensile test, weld metal	Material R_e > 360 MPa	1x	*
Bend tests	If d > 21 mm side bend bars permitted	2x over the root layer 2x over the cap layer	For welding processes with HI ≤ 0,6 kJ/mm, double the amount of tests
Side bend tests	Cellulosic welding in DN ≥ 600 and ≥ L415	2x side bend bars, weld metal	
Impact tests	d > 5,0 mm	centre weld (3x), fusion line (3x)	

Type of inspection	Thickness and/or material	Scope of the inspection	Comments
Supplementary impact tests	*d* >20,0 mm	root layer: centre weld (3x), fusion line (3x)	
Hardness test	All	1x 3 hours	
Macro assessment	All	1x 3 hours	

* In order to perform this test properly, account shall be taken of the wall thickness/ diameter ratio of the test piece. This test can be implemented properly with a wall thickness of 9 mm and above and a diameter of DN 600 or more.

A.9.2. Counter weld WPQR

An internal weld WPQR shall be performed at the 6 o'clock position.
The scope of testing for the qualification of an counter weld qualification is in accordance with table 13.

Table 13: Inspection of counter weld qualification

Type of inspection	Thickness and/or material	Scope of the inspection	Comments
Radiographic	*d* < 8,0 mm	100 %	
ToFD	*d* ≥ 8,0 mm	100 %	
MT		100 %	
Bend tests	If *d* > 21 mm side bend bars permitted	2x over the root layer 2x over the cap layer	For welding processes with *HI* ≤ 0,6 kJ/mm, double the amountof tests
Side bend tests	All	2x side bend bars, weld metal	
Impact tests	*d* > 5,0 mm		
Hardness test	All	1x 3 hours	
Macro assessment	All	1x 3 hours	

A.10. WPQR registration form

The results of the WPQR are recorded on a WPQR registration form which contains all the relevant values and tests.

This form shall state:
- the relevant characteristics in accordance with NEN-EN-ISO 15614-1 and this specification regarding the validity range;
- identification of the NDT reports;
- identification of the laboratory report;
- test welds report;
- registered weld parameters report;
- the mechanical values relating to values of all-weld metal tensile tests and impact tests.

These reports certified by the Gasunie department "VGM" (HSE) are, together with the WPQR registration form, submitted to the welding specialist within the Gasunie department "VGM" (HSE). If the WPQR meets the requirements, the WPQR registration form shall be certified.

B. ACCEPTANCE REQUIREMENTS FOR WELDS

This annex describes the acceptability requirements of welds as determined by means of:
- visual inspection, and
- non-destructive testing.

B.1. Visual inspection

B.1.1. Symbols

Symbol	Description	Unit
D_e	External diameter	mm
d_c	defining thickness (the smallest of the values d_w of the weld thickness or d of the joined parts)	mm

B.1.2. Nature of the visual weld inspection

General characteristics and conditions for visual weld inspection are:
- The main contractor shall conduct the surface treatment (remove slag residues, coating and weld spatters) in order to make a surface inspection possible.
- Imperfections and transitions between weld and base material are permitted provided that they do not hinder the observations.
- It has a qualitative character.
- The quantitative requirements and limits stated in this specification are intended as a guideline for the inspector and as reasonable limits: they should not be taken as absolute standards.
- It is performed by a suitably qualified person on the instructions of the main contractor.
- The client or the Gasunie department "VGM" (HSE) can verify the results.
- It is carried out on the completed weld, with the naked eye or using a simple, maximum 5x magnification magnifying glass.
- The weld surface to be inspected shall:
  - be clearly illuminated, and
  - it shall be free from grease, dirt, slag residues and/or
  - any protective layer.
- In some cases, extending the inspection to cover the weld bevels prior to welding is recommended.

The requirements for visual inspections are set out in F.

B.1.3. Alignment requirements

The alignment (see figure 14) shall not exceed that which is stated in table 14, for external alignment, or table 15, for internal alignment.

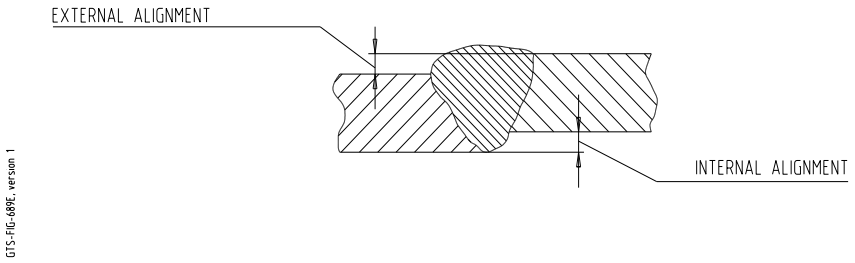


Figure 14: Alignment

Table 14: Permitted external alignment

Pipe wall thickness	Permitted external alignment
$d \leq 10$ mm	$0{,}3 \cdot d$
10 mm $< d \leq 24$ mm	3 mm
$d > 24$ mm	$0{,}125 \cdot d$

Table 15: Permitted internal alignment

welding process	
Downhill cellulosic welding	Other welding processes
1 mm over the entire circumference (per longitudinal joint 2 mm over a length of ≤ 150 mm)	1 mm over the entire circumference 2 mm over the length van D_e 2,5 mm over the length of $\frac{1}{3} \cdot D_e$

As an alternative a bevel may be applied to the inside of the pipe in accordance with table 16. When using this method, a maximum alignment van 1 mm is permitted after welding, irrespective of the welding process. Any bevel will only be considered as such if the gradient amounts to a maximum of 19° (1:3). The length of this bevel shall be stated in the NDT request.

Table 16: Permitted lengths for bevelling of internal alignment

Pipe wall thickness (mm)	Cellulosic welding		Other welding processes	
	Maximum circumference length with maximum wall thickness reduction			
	Entire circumference	Up to 1/3 *D* with a maximum of 300 mm	Entire circumference	Up to 1/3 *D* with a maximum of 300 mm
$5 < d \leq 7$	1,0	1,5	1,0	1,5
$7 < d \leq 10$	1,0	1,5	1,0	2,0
$10 < d \leq 15$	1,0	2,0	1,0	2,5
$15 < d \leq 17,5$	1,0	2,0	1,0	3,0
$17,5 < d \leq 30$	1,0	2,5	1,0	3,0

A bevel can be effected through mechanical processing with due regard for subclause 9.2.

C. REQUIRED VARIABLES FOR PERFORMING WPQR

The variables mentioned below shall always be shown on the WPQR unless they are not required for the process

description	standard reference	variable
Manufacturer/main contractor	NEN-EN-ISO 15614-1	Manufacturer/main contractor
Parent metal		
Material designation	Relevant material standard	Material type
Material group	ISO/TR15608	group number
Thickness	CSW-01-E	thickness
Diameter	NEN-EN-ISO 15614-1	diameter
All welding procedures		
Welding process	NEN-EN-ISO 6947	process number
Design joint	CSW-01-E	bevel angle
		layer build-up
Welding position	NEN-EN-ISO 6947	indication of position
Weld preparation	CSW-01-E	method
Clamping/tacking	CSW-01-E	clamping/tacking
Welding technique		
Manual weaving	NEN-EN-ISO 15614-1	width
Automatic weaving	CSW-01-E	application of weave width
		weave width used
		weave frequency
		Dwell time
Counter weld processing		
Method	CSW-01-E	processing method
Shape		opening angle
Welding filler materials		
Designation of manufacturer	CSW-01-E	Brand and type, batch

description	standard reference	variable
Electric parameters		
Power type/polarity	CSW-01-E	AC/DC +/-
Power Voltage		Amperes Volt
Pulsed welding		welding machine settings

description	standard reference	variable
Mechanised and automated welding		
Program		Software program and revision
Rate of travel	CSW-01-E	mm/min
Weave width		mm
Weave rate		mm/min
Dwell time		seconds
Run identification		Programme indication/code in welder's control panel
Wire feed range		m/s
Temperatures		
Pre-heating	CSW-01-E	°C
Interpass temperature	NEN-EN-ISO 15614-1	°C
Subsequent heating H2		°C
Heat treatment		Temperature/time
Variables specific to each welding process		
Manual metal arc welding 111		
Electrode diameter	NEN-EN-ISO 15614-1	mm
Rate of travel Run out length		mm/s mm
Submerged arc welding 121		
Electrodes	NEN-EN-ISO 15614-1	Number/configuration
Contact tube-workpiece distance	NEN-EN-ISO 15609-1	mm
Powder	CSW-01-E	name, type
Gas metal arc welding electrode 13x		
Electrodes	NEN-EN-ISO 15614-1	Number/configuration
Inert gas flow rate	NEN-EN-ISO 15609-1	L/min
Diameter of gas nozzle		mm
Contact tube-workpiece distance	NEN-EN-ISO 15609-1	mm
Type of backing gas	NEN-EN-ISO 15614-1	Sort, brand. type NEN-EN-ISO 14175
Type of gas		Sort, brand. type NEN-EN-ISO 14175
Mode of material transfer if used, specific pulse process		-P,-G, -S CMT/VIP/STT and the like
Tungsten inert gas welding electrode 14x		
Tungsten electrode	NEN-EN-ISO 15609-1	Diameter/type
Gas flow rate		L/min
Diameter of gas nozzle		mm
Type of gas	NEN-EN-ISO 15614-1	Sort, brand. type NEN-EN-ISO 14175
Type backing gas		Sort, brand. type NEN-EN-ISO 14175
Filler wire		Yes/no

D. HANDLING AND WELDING STAINLESS STEEL

D.1. Scope

This annex applies to the handling and welding of LNG process pipes to a minimum design temperature of -104 °C and pipework in accordance with OSW-01-N/2 and joints between these materials and carbon steel at stations. The following paragraphs contain the requirements that are applicable to this.

D.2. General requirements

The Welding Quality Plan shall specifically describe the work for the handling and welding of stainless steel. This consists of the following aspects:
- keeping stainless steel pipes and fittings apart and working on them separately;
- the use of tools and resources;
- backing gas procedure;
- pickling and passivating.

D.3. Materials

The welding filler material does not need to comply with the classification and requirements of NEN-EN 12732.

Welding shall be performed with filler materials possessing at least the same mechanical and corrosion features as the base material.

The following materials are permitted for tacking:
- materials having the same composition as the base material.

D.4. Supplementary requirements for the Welding Procedure Qualification Record and Welding Procedure Specification

WPQRs shall be qualified in accordance with NEN-EN-ISO 15614-1 with the following supplementary requirements:
- The WPQRs shall meet the requirements of the PED.
- The pre-heating and interpass temperature shall not exceed 150 °C.
- The oxygen content in the backing gas may not exceed 0,05 %.
- Where stainless steel is being joined to carbon steel , the ferrite percentage at the 12 o'clock and 6 o'clock positions shall be a minimum of 3 %.

The welding of the PWQR and laboratory tests do not need to be witnessed by the Gasunie department "VGM" (HSE).

In addition to the standard requirements set in this specification, the welding procedure specification shall describe how backing gas is implemented.

D.5. Execution

The following requirements shall be taken into consideration for handling stainless steel:

- stainless steel shall be handled and stored separately from other materials.
- Chloride-free pens or materials shall be used for marking the pipe.
- In deviation from subclause 9.4, traceability of the materials shall be performed by engraving the pipe sections. The pipe will not be stamped by Gasunie.
- In order to protect against, for example, spatter and grinding sparks, there shall be proper separation of stainless steel from other materials.
- Brushes shall be made of stainless steel and only be or have been used for stainless steel.
- If grinding discs are used for working with stainless steel, they shall only be used for stainless steel; grinding discs that have already been used for other sorts of material may not be used for stainless steel.
- Stainless steel earth terminals shall be used.
- No zinc contamination may occur; for example when applying paint, galvanised bolts or zinc constructions.
- After welding, the welds shall be pickled and passivated. The procedure shall comply with the guidelines of ASTM A380. Pickling shall be carried out by using a "chemical descaling" method, as mentioned in ASTM A380. Passivation shall take place after pickling. The methods chosen shall be suitable for the type of material.

Subclause 9.9.2 of this specification does not apply.

D.6. Inspection and testing

As regards the inspection procedure to be performed, only the following inspections may be applied:

- radiographic inspection;
- penetrant inspection.

If there are any possible deviations from the WPS, the weld concerned may be cut out at the request of the client or Gasunie department "VGM" (HSE). This cut-out weld shall be tested destructively at the expense of the main contractor.

E. SAMPLE OF ISOMETRIC DRAWING

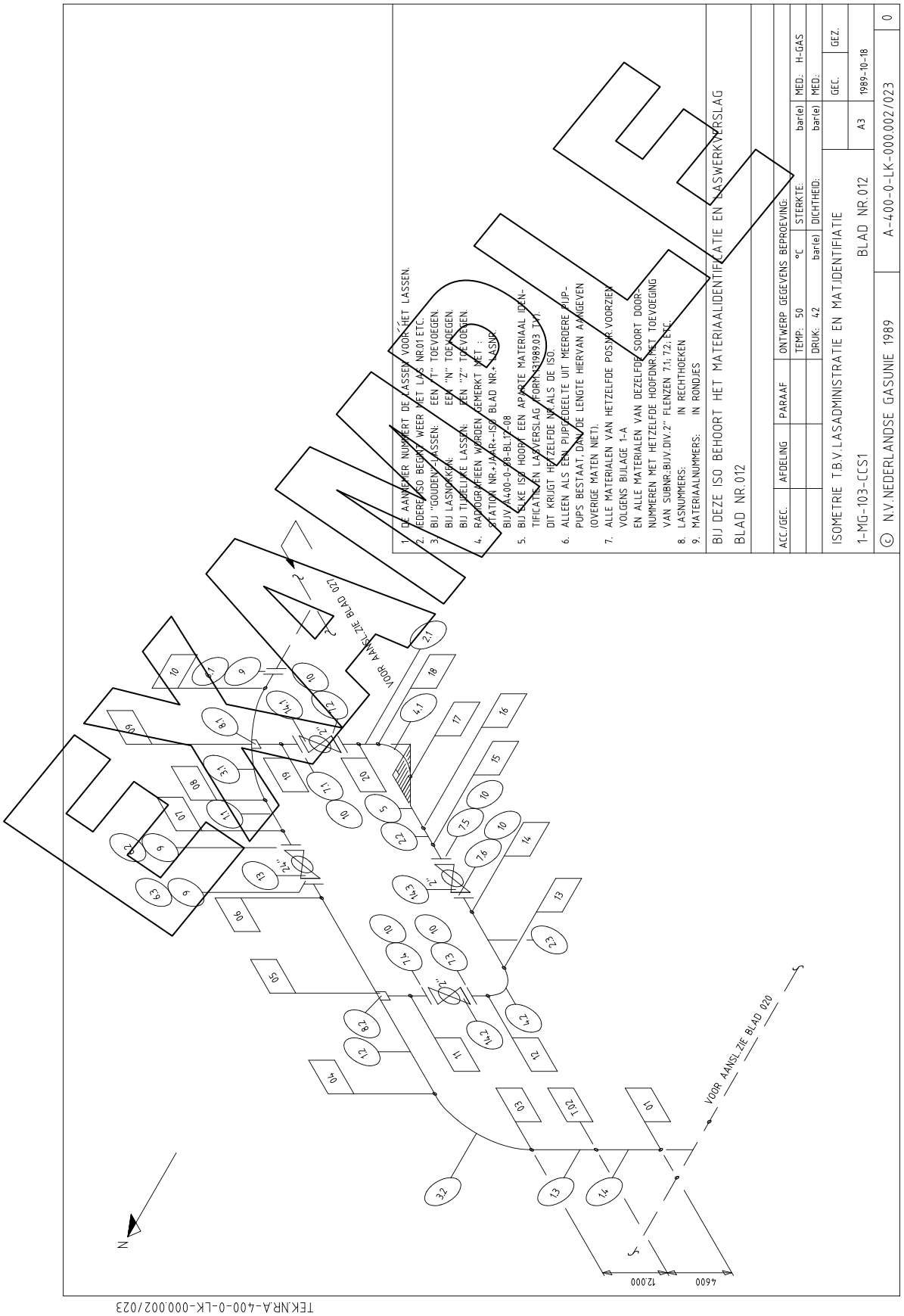


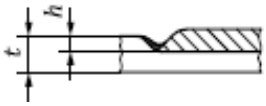
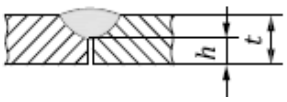
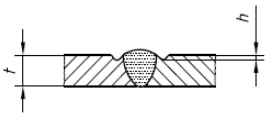
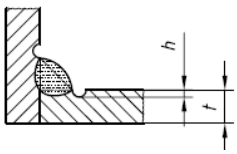
Figure 15: Sample of isometric drawing

F. VISUAL INSPECTION NEN-EN-ISO 5817 & NEN-EN 12732 (TABLE G1 IN THE STANDARD)

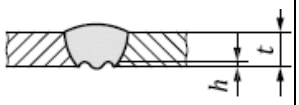
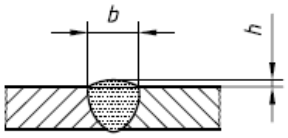
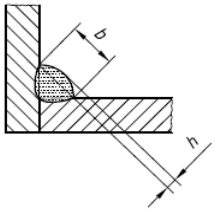
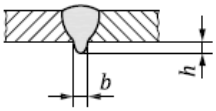
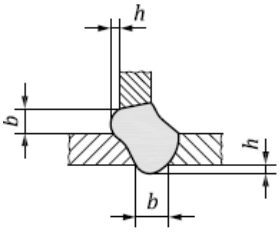
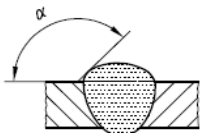
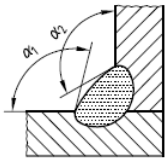
The symbols shown in this annex are taken from the standard, NEN-EN-ISO 5817, and may differ from the symbols shown in subclause 3.3.

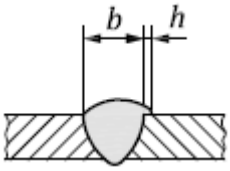
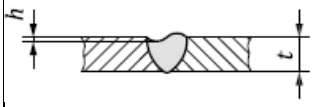
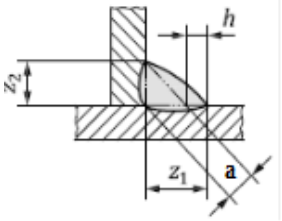
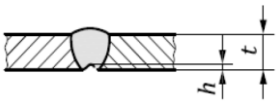
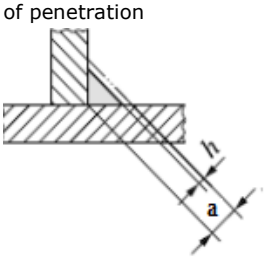
Symbol	Description	Unit
a	Nominal throat thickness of the fillet weld	mm
A	Area surrounding the gas pores	1
b	Width of weld reinforcement	mm
d	Diameter of a gas pore	mm
d_A	Diameter of the area surrounding the gas pores	mm
h	Height or width of an imperfection	mm
l	length of imperfection in longitudinal direction of the weld	mm
l_p	Length of a projected or cross-sectional area	mm
s	Wall thickness t + 1 mm	mm
t	Wall or plate thickness (nominal size)	mm
w_p	Width of the weld or width or height of the cross sectional area	mm
z	Leg length of a fillet weld	mm
α	Angle of weld toe	°
β	Angle of angular misalignment	°

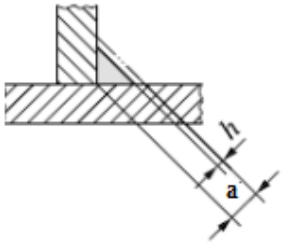
F.1. Imperfections appearing on the surface (1)[3]

No.3	Reference NEN-EN-ISO 6520-1	Imperfection indication	Comments	*t* (mm)	Limits imperfections NEN-EN-ISO 5817 & NEN-EN 12732 table G1 in the standard
1.1	100	Crack	---	≥ 0,5	Not permitted
1.2	104	Crater crack	---	≥ 0,5	Not permitted
1.3	2017	Surface pore	Maximum dimension of a single pore in: — Butt welds; — Fillet welds.	0,5 to 3	Not permitted
			Maximum dimension of a single pore in: — Butt welds; — Fillet welds.	> 3	$d \leq 0,4 \times t$, no greater than 4,0 mm
1.4	2025	End crater pipe		0,5 to 3 > 3	Not permitted Not permitted
1.5	401	Lack of fusion (incomplete fusion)	---	≥ 0,5	Not permitted
		Micro lack of fusion	Can only be detected via microscopic inspection	≥ 0,5	Not permitted
1.6	4021	Incomplete root penetration	Only for single side butt welds 	≥ 0,5	Not permitted
1.7	5011 5012	Continuous undercut Intermittent undercut	Smooth transition is required. This is not regarded as a systematic imperfection  	0,5 to 3 > 3 ≥ 0,5	- Butt welds: Not permitted $h \leq 0,05\ t$, but max. 0,5 mm - Fillet welds: $h \leq 0,1 \cdot t$, but not more than 1,5 mm and a length of 50 mm

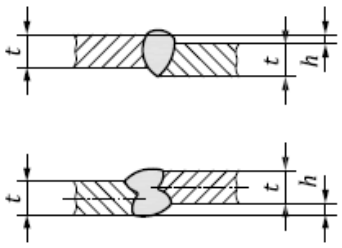
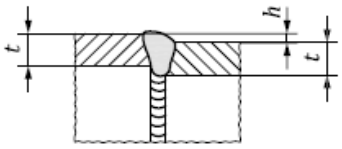
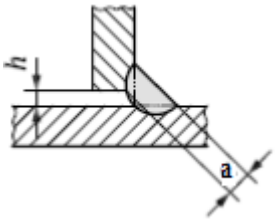
[3] The numbering shown concurs with the numbering used in NEN-EN-ISO 5817.

No.3	Reference NEN-EN-ISO 6520-1	Imperfection indication	Comments	*t* (mm)	Limits imperfections NEN-EN-ISO 5817 & NEN-EN 12732 table G1 in the standard
1.8	5013	Shrinkage groove	Smooth transition is required 	0,5 to 3 > 3	Not permitted Short imperfections: $h \leq 0{,}05\ t$, but max. 0,5 mm
1.9	502	Excess weld metal (butt weld)	Smooth transition is required 	≥ 0,5	$h \leq 1$ mm + $0{,}15 \cdot b$ but max. 3 mm
1.10	503	Excexcessive convexity (fillet weld)		≥ 0,5	$h \leq 1$ mm + $0{,}1 \cdot b$, but max. 3 mm
1.11	504	Excess penetration	 	0,5 to 3 > 3	$h \leq 1$ mm + $0{,}1 \cdot b$, h ≤ 1 mm + $0{,}4 \cdot b$, maximum 3 mm average, localised, up to 4 mm permitted.
1.12	505	Incorrect weld toe	- Butt welds 	≥ 0,5	α ≥ 120°
			- Fillet welds  $\alpha_1 \geq \alpha$ and $\alpha_2 \geq \alpha$	≥ 0,5	α ≥ 110°

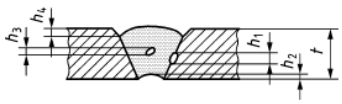
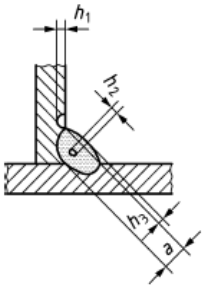
No.3	Reference NEN-EN-ISO 6520-1	Imperfection indication	Comments	*t* (mm)	Limits imperfections NEN-EN-ISO 5817 & NEN-EN 12732 table G1 in the standard
1.13	506	Overlap		≥ 0,5	Not permitted
1.14	509 511	Sagging Incompletely filled groove	Smooth transition is required 	0,5 to 3 >3,0	Not permitted Short imperfections: $h \leq 0{,}05\ t$, but max. 0,5 mm
1.15	510	Burn through	---	≥ 0,5	Not permitted
1.16	512	Excessive asymmetry of fillet weld (excessive unequal leg)	In cases in which an asymmetrical fillet weld has not been prescribed 	≥ 0,5	$h \leq 1{,}5$ mm + 0,15·a
1.17	515	Root concavity	Smooth transition is required 	0,5 to 3 > 3,0	Not permitted Short imperfections: $h \leq 0{,}1 \cdot t$, but max. 1 mm
1.18	516	Root porosity	Spongy formation at the root of a weld due to bubbling of the weld metal at the moment of solidification (e.g. lack of gas backing)	≥ 0,5	Not permitted
1.19	517	Poor restart	---	≥ 0,5	Not permitted
1.20	5213	Insufficient throat thickness	Not applicable to processes with proof of greater depth of penetration 	0,5 to 3 > 3	Not permitted Not permitted

No.3	**Reference NEN-EN-ISO 6520-1**	**Imperfection indication**	**Comments**	***t* (mm)**	**Limits imperfections NEN-EN-ISO 5817 & NEN-EN 12732 table G1 in the standard**
1.21	5214	Excessive throat thickness	The actual throat thickness of the fillet weld is too large 	≥ 0,5	$h \leq 1$ mm + 0,15·a, but max. 3 mm
1.22	601	Stray arc	---	≥ 0,5	See subclause 9.8
1.23	602	Spatters	---	≥ 0,5	Not permitted
1.24	610	Temper colour (Discolouration)	---	≥ 0,5	Not applicable

F.2. Imperfections in the geometry of the joint (3)

No.	Reference NEN-EN-ISO 6520-1	Imperfection indication	Comments	*t* (mm)	Limits imperfections NEN-EN-ISO 5817 and NEN-EN 12732 table G1 in the in the standard
3.1	5071	Linear alignment between plates	 Plates and longitudinal welds	0,5 to 3 > 3	$h \leq 0{,}2$ mm + $0{,}1 \cdot t$ $h \leq 0{,}1 \cdot t$, but max. 3 mm
	5072	Transversal girth welds on pipes	 Girth welds	≥ 0,5	See annex B of this specification (CSW-01-E)
3.2	617	Incorrect root gap for fillet welds	Gap between the parts to be joined. Gaps exceeding the appropriate limit may, in certain cases, be compensated for by a corresponding increase in the throat thickness. 	0,5 to 3 > 3	$h \leq 0{,}2$ mm + $0{,}1 \cdot a$ $h \leq 0{,}5$ mm + $0{,}1 \cdot a$, but max. 2 mm

F.3. Multiple imperfections (4)

No.	Reference NEN-EN-ISO 6520-1	Imperfection indication	Comments	*t* (mm)	Limits imperfections NEN-EN-ISO 5817 & NEN-EN 12732 table G1 in the standard
4.1	None	Multiple imperfections in any transverse cross section	 $h1 + h2 + h3 + h4 = \sum h$  $h1 + h2 + h3 = \sum h$	0,5 to 3 > 3	Not permitted *Maximum total height of imperfections* $\sum h \leq 0{,}2 \cdot t$ or $\sum h \leq 0{,}15 \cdot a$

Gasunie Technical Standard

Construction Specification Mechanical

CSW-01-E
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Bilingual

Welding of pipes, fittings and structural sections

External

Version 2 *22-12-2022*

N.V. Nederlandse Gasunie

Gasunie Technical Standard

Construction Specification Mechanical
CSW-01-E
Addendum to version 12

Welding of pipes, fittings and structural sections

This specification has been drawn up by the Gasunie department
"Veiligheid, Gezondheid en Milieu; VGM Advisering"
(Health, Safety and Environment; HSE - Advice)

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FOREWORD

This addendum is an addition/modification to the twelfth version of CSW-01-E (dated 26-06-2018) and replaces version 1 (dated 16-04-2019) of the addendum to the twelfth version of CSW-01-E.

Changes compared with the previous version are indicated by a vertical line in the left margin.

2. REFERENCES

2.1 Gasunie documents

The reference to GTS_W-011 "Lasmethodebeschrijving (LMB) (Welding Procedure Specification (WPS))" no longer applies.

5 MATERIALS

5.2 Batch testing for welding filler material

Replace last paragraph with:

"When used in materials with a yield strength of > 360 MPa, flux-cored wires shall, regardless of the welding process, be qualified, per batch, by means of a WPQR."

5.3 Welding filler material (general)

Replace last paragraph with:

"The use of molybdenum alloyed solid welding filler material, when welding according to process 141, is not permitting for welding in thermo-mechanically rolled material, material group 2 (see ISO/TR 15608).

Explanation:
When welding with process 141 in a TM steel, the chemical composition of TM steel in combination with the Mo from the welding wire may result in a structure with very detrimental effect on the notch toughness."

7 WELDING PROCEDURE

7.1 Warenwetbesluit drukapparatuur (Pressure Equipment (Commodities Act) Decree)

Replace the text with the text below:
"Welding method qualifications to be used on pipelines covered by the WWBD shall also have the approval of a Notified Body or Recognised Third Party organisation."

7.2 Welding Procedure Specification

Replace the second indent with:
"The descriptions are made taking account of the variables shown in table 1."

Replace the third indent with:
"The validity of a WPS is determined on the basis of the validity of the underlying WPQR, apart from WPSs for welding materials ≤ 360 MPa yield strength; these have unlimited validity."

In table 1 "Variables for the welding procedure specification":
replace "L240" with "L245".

7.4 Period of validity of the WPQR

Replace entire section with:

For a WPQR in material with a yield strength > 360 Mpa, the WPQR is valid for three years. If a WPQR supports a material with a yield strength ≤ 360 Mpa, the restriction to the period of validity is not applicable. A WPQR in a material > 360 MPa can be extended for one additional period of three years on the basis of the results of an approved production weld. The date of the test report will be authoritative for the new period of validity.

For a WPQR with a yield strength ≤ 360 Mpa, the WPQR will be valid for an unlimited period of time.

7.5 Special conditions relating to the use of welding processes and welding procedures

7.5.1 Manual and semi-mechanised welding processes

Change the list as follows:

The following restrictions apply to cellulosic welding:

- Cellulosic welding is permitted in a downwards direction for circumferential welding of:
  - pipe-pipe;
  - pipe-cold-formed bend;
  - pipe-induction-formed bend;
  - for transition pieces made of pipe material, pipe-transition piece;
  - hot-bent bend of pipe material according to NEN-EN-ISO 3183.

- Cellulosic welding is *not* permitted for:
  - material with yield strength > 360 MPa with a wall thickness < 9,5 mm.

9 EXECUTION OF WORK

9.8 Welding

9.8.3 Number of welders per girth joint

Replace the whole subclause with the text below:

Reference is made to table 2 for the minimum number of welders per girth joint.

Table 2: Number of welders per girth joint

nom. pipe diameter (*D*)	no. of welders
D ≤ DN 150	1
DN 150 < *D* < DN 400	1 or 2
D ≥ DN 400	2 or more simultaneously

If the weld is carried out using a rolling tower or welding manipulator, one welder will suffice.

10 INSPECTION AND TESTING

10.1 Scope and type of weld testing

10.1.3 Non-destructive weld testing

Replace entire section with:

"Table 5 gives an overview of NDT techniques. Different fixed NDT combinations are prescribed, depending on the type of weld, the number and the wall thickness.

Table 5: Instruction for NDT techniques

NDT technique in accordance with CSW-05-E	Weld test	Weldolets, welded on parts	Weld bevels
Visual inspection	V	V	V
ToFD + MT + manual PE (D^4)	V[1)]		
PA + MT + manual PE (D^4)	V[2)]		
AUT	V[3)]		
Radiographic	A		
MT		V	V[5)]

Key:
V: Instruction.
A: Alternative, possible following permission from the Gasunie department "VGM" [HSE].
D: Manual PE only on transverse indications

Comments:
1) ToFD testing may be carried out under the following conditions:
   - Welded joints DN ≥ 100 with wall thickness 6,0 mm ≤ t ≤ 30,0 mm. If the transition angle due to wall thickness differences by design and construction is over 20°, ToFD inspection shall be replaced by radiographic inspection.
   - In the case of welded joints, the free space on both sides of the welds shall be sufficient to allow scanner equipment to be installed. If this is not possible, the ToFD inspection shall be replaced by a radiographic inspection.

2) PA inspection may be carried out if the following conditions are met:
   - material type with R_e ≤ 245 MPa;
   - pipe/pipe joints DN ≥ 50 with wall thicknesses 4,5 mm up to 8 mm and wall thickness differences ≤ 2 mm and/or tapering, where the axial distance is 12 mm at the most; for the precise execution, reference is made to subclause 6.2;
   - the weld cap shall not be removed.

3) AUT inspection may* be carried out under the following conditions:
   - Pipe/pipe joints with equal wall thickness 8,0 mm ≤ t ≤ 30,0 mm.
   - Reference block shall be made of project-specific pipe material.
   - Pipe/fitting combinations shall be inspected by means of ToFD + MT + manual PE (D^4).

   * AUT is compulsory for projects with a length of 2 km or more in the same diameter-wall thickness.

4) Manual PE inspection on transverse indications from welds with a diameter ≥ DN 100.

5) Only weld bevels relating to tie-in welds."

11 HANDLING WELD DEFECTS

11.1 Conditions

Replace the last paragraph with:

"Rejected welds with defects in the root layer or the second layer in materials with an R_e > 360 MPa may not be repaired using process 111-C."

ANNEXES

A WELDING PROCEDURE QUALIFICATION

A.3 Test piece

Replace the second paragraph with:

"The following applies as a supplement to **clause 6.3**:
Where material with Re > 360 MPa is being repaired, a separate WPQR is required for repairs or counter welds."

A.6 Inspection and testing

A.6.1 Tensile tests on weld metal

Replace table 9 with:

Table 9: Supplementary requirements for girth weld joints

Base material specification	All weld requirement or fracture in the weld for the cross tensile test *	Fracture requirement in base material for cross weld tensile test	Elongation requirement for weld metal minimum (%)
$R_{t05} \leq 360$ MPa	$R_{m\perp}$ and $R_{m//} \geq R_m$, base material	$R_m \geq R_m$, base material	n.a.
L415	$R_{m\perp}$ and $R_{m//} \geq 572$ MPa $R_{t05//} \geq 469$ MPa		18
L450	$R_{m\perp}$ and $R_{m//} \geq 590$ MPa $R_{t05//} \geq 510$ MPa		18
L485	$R_{m\perp}$ and $R_{m//} \geq 630$ MPa $R_{t05//} \geq 540$ MPa		17

* The requirements for yield strength and tensile strength are based on NEN-EN-ISO 3183.

A.6.2 Inspection and testing of butt-welded joint

Replace table 10 with the table below:

Table 10: Test temperature for impact test

Material class	d_c in mm	Test temperature
L245	≤ 16	0 °C
L360, L415, P460 and L485	≤ 30	-20 °C
L245	> 16	Consult Gasunie department "HSE"
L360, L415 and L485	> 30	
other	all	

Replace table 11 "Hardnesses" with the table below:

Table 11: Hardnesses

Medium/welding process	Location			
	Weld metal HV/10		HAZ HV/10	
	root layer	final layer	root layer	final layer
Non-acidic gas/ cellulosic welding	300	300	275	320
Non-acidic gas/other welding processes	325	325	350	350
Hydrogen/other welding processes	300	325	275	325

A.7 Validity of welding procedure qualification

A.7.3 Validity period

Replace entire section with:

"The validity of WPQRs in materials with a yield strength > 360 MPa is limited to 3 years. For extending the period of validity, see section 7.4.

Validity is limited to three years for repair WPQRs in material with R_e > 360 MPa. This can be extended by welding a new repair WPQR. As an alternative, when extending a repair WPQR, a WPQR or a production weld report can be submitted in which the identical welding filler material is applied within the range of validity of the welding parameters in accordance with section A.7 of this specification."