




MECHANICAL WELDING STANDARD

Notes:

1. Only the Owner and/or the Approver are allowed to modify this document.
2. Comments and modification requests shall be forwarded to the Owner and/or the Approver.
3. Only signed pdf-format copies shall be used for project documentation.

| REV. | DATE | DESCRIPTION OF MODIFICATION | CREATED | CHECKED | APPROVED |
|------|-----------|--|---|--|--|
| 05 | | | | | |
| 04 | | | | | |
| 03 | 1-Oct-19 | GENERAL REVISION |  R. DIMITRIU |  A. HASELMAYER |  J. GRIPPELING |
| 02 | 05-Feb-18 | FORMAT CHANGED | G. FLAPPER | A. HASELMAYER | J. GRIPPELING |
| 01 | 18-May-17 | ADDED SECTION 11 WELD CLASS W4 TYPICAL WELD PLAN UPDATED SECTION NUMBERING AND REF.'S | G. FLAPPER | A. HASELMAYER | J. GRIPPELING |
| 00 | 01-Jan-17 | FIRST ISSUE | G. FLAPPER | A. HASELMAYER | J. GRIPPELING |

All rights reserved; confidential. This document is prepared by Danieli Corus BV entailing valuable know-how of Danieli Corus BV and is supplied only for the specific use as authorized by written agreement. This document shall not be disclosed, used or reproduced either wholly or in part except in connection with such authorized use and then only with the prior written consent of Danieli Corus BV. This document must not be used until signed as checked and approved by Danieli Corus BV.

© 2019 Danieli Corus BV

Location of Original:

[Danielicorus.sharepoint.com/sites/Departments/ENG_DCBV/Documents/Forms/Standards](https://danielicorus.sharepoint.com/sites/Departments/ENG_DCBV/Documents/Forms/Standards)

TABLE OF CONTENTS

| | | |
|-----|--|----|
| 1. | PURPOSE..... | 3 |
| 2. | ABBREVIATIONS | 3 |
| 3. | APPLICATION | 3 |
| 4. | DEFINITIONS | 3 |
| 5. | REFERENCES..... | 4 |
| 5.1 | International Standards | 4 |
| 5.2 | DC Standards | 6 |
| 6. | RESPONSIBILITIES | 7 |
| 7. | REQUIREMENTS | 7 |
| 7.1 | Code-Equipment..... | 7 |
| 7.2 | Classification of Welds | 7 |
| 7.3 | Documentation..... | 7 |
| 7.4 | Flame Straightening | 7 |
| 7.5 | Fe- contamination | 8 |
| 7.6 | Backing Strips | 8 |
| 7.7 | Welding Surface Preparation | 8 |
| 7.8 | Welding Consumables | 8 |
| 7.9 | Welding Conditions | 8 |
| 8. | NON-DESTRUCTIVE TESTS..... | 9 |
| 9. | NON CONFORMITY | 9 |
| | APPENDIX 1 – ISO/EN MATRIX WELDING CLASS REQUIREMENTS..... | 10 |
| | APPENDIX 2 – AWS/ASME MATRIX WELDING CLASS REQUIREMENTS..... | 14 |
| | APPENDIX 3 – DANIELI CORUS WELD PLAN – EXAMPLE | 18 |
| | APPENDIX 4 – DANIELI CORUS WELD MAP – EXAMPLE..... | 19 |

1. PURPOSE

This Standard defines DC requirements for welding, heat treatment and inspection for the fabrication of equipment.

The present Standard shall be used in conjunction international standards and DC drawings as referred to in the enquiry or PO documents.

2. ABBREVIATIONS

ABS – American Bureau for Shipping
ASME – American Society of Mechanical Engineers
ASTM – American Society for Testing and Materials
AWS – American Welding Society
BM – Base Metal
BV – Bureau Veritas
CRA – Corrosion Resistant Alloys
DC – Danieli Corus
EN – European Norm
IIW – International Institute of Welding
ISO – International Standardization Organization
ITP – Inspection and Test Plan
MT – Magnetic Testing
NDT – Non-destructive Testing
NOBO – Notified Body
PO – Purchase Order
PT – Penetrant Testing
PWHT – Post Weld Heat Treatment
RT – Radiographic Testing
TMCP – Thermo-mechanically Controlled Processed
TUV – Technischer Überwachungsverein
UT – Ultrasonic Testing
VDL – Vendor Document List
VT – Visual Testing
WPQ – Welding Personnel Qualification
WPQR – Welding Procedure Qualification Record
WPS – Welding Procedure Specification

3. APPLICATION

This Standard is applicable to welded structures and equipment designed, manufactured and tested for DC under the PO.

This Standard is not applicable to welded structures and equipment designed, manufactured and tested according to EN 1090, EN 13445-2 or PD 5500. In this case the requirements of EN 1090, EN 13445-4, -5 respectively PD 5500 shall be applied in full.

4. DEFINITIONS

Terms with initial capital as used in this document shall have the meanings and interpretations assigned to them in the General Purchase Conditions Danieli Corus B.V. (IJmuiden, September 2015).

Standard - a set of technical definitions and guidelines that functions as instructions for the supplier;

Shall - indicates the necessity of following the indicated action;

May - indicates the advice of following the indicated action;

Can - indicates the possibility of following the indicated action:

5. REFERENCES

5.1 International Standards¹

| | |
|-------------------|---|
| ASME Section V | Boiler and Pressure Vessel Code – Section V – Non-destructive Examination |
| ASME Section VIII | Boiler and Pressure Vessel Code – Section VIII – Rules for Construction of Pressure Vessels – Division 1 |
| ASME Section IX | Boiler and Pressure Vessel Code - Section IX – Welding, Brazing and Fusing Qualifications |
| ASME B31.1 | Power Piping |
| ASTM E1316 | Standard Terminology for Nondestructive Examinations |
| AWS A5.1 | Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding |
| AWS A5.18 | Specification for Carbon Steel Electrodes and Rods for Gas Shielded Arc Welding |
| AWS B1.10 | Guide for Nondestructive Examination of Welds |
| AWS B2.1 | Specification for Welding Procedure and Performance Qualification |
| AWS D1.1 | Structural Welding Code – Steel |
| EN 1011-1 | Welding – Recommendations for Welding of Metallic Materials – General Guidance for Arc Welding |
| EN 1090-1 | Execution of Steel Structures and Aluminum Structures – Requirements for Conformity Assessment of Structural Components |
| EN 1090-2 | Execution of Steel Structures and Aluminum Structures – Technical Requirements for Steel Structures |
| EN 10160 | Ultrasonic Testing of Steel Flat Product of Thickness Equal or Greater than 6mm (Reflection Method) |
| EN 10204 | Metallic Products – Types of Inspection Documents |
| EN 13445-3 | Unfired Pressure Vessels – Design |
| EN 13445-4 | Unfired Pressure Vessels – Fabrication |
| EN 13445-5 | Unfired Pressure Vessels – Inspection and Testing |
| EN 13479 | Welding Consumables – General Product Standard for Filler Metals and Fluxes for Fusion Welding of Metallic Materials |
| ISO 2553 | Welding and Allied Processes – Symbolic Representation on Drawings – Welded Joints |
| ISO 3452-1 | Non-destructive Testing – Penetrant Testing – Part 1: General Principles |
| ISO 3452-2 | Non-destructive Testing – Penetrant Testing – Part 2: Testing of Penetrant Materials |
| ISO 3452-3 | Non-destructive Testing – Penetrant Testing – Part 3: Reference Test Blocks |
| ISO 3452-4 | Non-destructive Testing – Penetrant Testing – Part 4: Equipment |
| ISO 3834-1 | Quality Requirements for Fusion Welding of Metallic Materials – Part 1: Criteria for the Selection of the Appropriate Level of Quality Requirements |

¹ Latest revision of the standard is applicable unless otherwise stated

| | |
|-------------|---|
| ISO 3834-2 | Quality Requirements for Fusion Welding of Metallic Materials – Part 2: Comprehensive Quality Requirements |
| ISO 3834-3 | Quality Requirements for Fusion Welding of Metallic Materials – Part 3: Standard Quality Requirements |
| ISO 3834-4 | Quality Requirements for Fusion Welding of Metallic Materials – Part 4: Elementary Quality Requirements |
| ISO 4063 | Welding and Allied Processes – Nomenclature of Processes and Reference Numbers |
| ISO 5576 | Non-destructive Testing – Industrial X-Ray and Gamma Ray Radiology - Vocabulary |
| ISO 5577 | Non-destructive Testing – Ultrasonic Testing – Vocabulary |
| ISO 5817 | Welding – Fusion - Welded Joints in Steel, Nickel, Titanium and their Alloys (Beam Welding Excluded) – Quality Levels for Imperfections |
| ISO 6520-1 | Welding and Allied Processes – Classification of Geometric Imperfections in Metallic Materials – Part 1: Fusion Welding |
| ISO 6947 | Welding and Allied Processes – Welding Positions |
| ISO 9001 | Quality Management Systems – Requirements |
| ISO 9013 | Thermal Cutting – Classification of Thermal Cuts – Geometrical Product Specification and Quality Tolerances |
| ISO 9606-1 | Qualification Test of Welders – Fusion Welding – Part 1: Steels |
| ISO 9606-3 | Approval Testing of Welders – Fusion Welding – Part 3: Copper and Copper Alloys |
| ISO 9606-4 | Approval Testing of Welders – Fusion Welding – Part 4: Nickel and Nickel Alloys |
| ISO 9606-5 | Approval Testing of Welders – Fusion Welding – Part 5: Titanium and Titanium Alloys, Zirconium and Zirconium Alloys |
| ISO 9692-1 | Welding and Allied Processes – Types of Joint Preparation – Part 1: Manual Metal Arc Welding, Gas Shield Metal Arc Welding, Gas Welding, TIG Welding and Beam Welding of Steels |
| ISO 9692-2 | Welding and Allied Processes – Types of Joint Preparation – Part 2: Submerged Arc Welding of Steels |
| ISO 9712 | Non-destructive Testing – Qualification and Certification of NDT Personnel |
| ISO 10675-1 | Non-destructive Testing of Welds – Acceptance Levels for Radiographic Testing – Part 1: Steel, Nickel, Titanium and Their Alloys |
| ISO 10863 | Non-destructive Testing of Welds – Ultrasonic Testing – Use of Time-of-Flight Diffraction Technique (TOFD) |
| ISO 11666 | Non-destructive Testing of Welds – Ultrasonic Testing – Acceptance Levels |
| ISO 12706 | Non-destructive Testing – Penetrant Testing – Vocabulary |
| ISO 12707 | Non-destructive Testing – Magnetic Particle Testing – Vocabulary |
| ISO 13916 | Welding – Measurement of Preheating Temperature, Interpass Temperature and Preheat maintenance Temperature |
| ISO 14731 | Welding Coordination – Tasks and Responsibilities |
| ISO 14732 | Welding Personnel – Qualification Testing of Welding Operators and Weld Setters for Mechanized and Automatic Welding Of Metallic Materials |
| ISO 15626 | Non-destructive Testing of Welds – Time-of-Flight Diffraction Technique (TOFD) – Acceptance Levels |
| ISO 15607 | Specification and Qualification of Welding Procedures for Metallic Materials – General Rules |
| ISO 15608 | Welding – Guidelines for Metallic Materials Grouping System |

| | |
|-------------|---|
| ISO 15609-1 | Specification and Qualification of Welding Procedures for Metallic Materials – Welding Procedure Specification – Part 1: Arc welding |
| ISO 15614-1 | Specification and Qualification of Welding Procedures for Metallic Materials – Welding Procedure Test – Part 1: Arc and Gas Welding of Steels and Arc Welding of Nickel and Nickel Alloys |
| ISO 15609-1 | Specification and Qualification of Welding Procedures for Metallic Materials – Welding Procedure Specification – Part 1: Arc welding |
| ISO 15613 | Specification and Qualification of Welding Procedures for Metallic Materials – Qualification based on Pre-production Welding Test |
| ISO 17020 | Conformity Assessment – Requirements for the Operation of Various Types of Bodies Performing Inspection |
| ISO 17635 | Non-destructive Testing of Welds – General Rules for Metallic Materials |
| ISO 17636-1 | Non-destructive Testing of Welds – Radiographic Testing – Part 1: X- and Gamma-ray Techniques with Film |
| ISO 17636-2 | Non-destructive Testing of Welds – Radiographic Testing – Part 2: X- and Gamma-ray Techniques with Digital Detectors |
| ISO 17637 | Non-destructive Testing of Welds – Visual Testing of Fusion-Welded Joints |
| ISO 17663 | Welding – Quality Requirements for Heat Treatment in Connection with Welding and Allied Processes |
| ISO 17671-2 | Welding – Recommendations for Welding of Metallic Materials – Part2: Arc Welding of Ferritic Steels |
| ISO 17638 | Non-destructive Testing of Welds – Magnetic Particle Testing |
| ISO 17640 | Non-destructive Testing of Welds – Ultrasonic Testing – Techniques, Testing Levels, and Assessment |
| ISO 23277 | Non-destructive Testing of Welds – Penetrant Testing – Acceptance Levels |
| ISO 23278 | Non-destructive Testing of Welds – Magnetic Particle Testing – Acceptance Levels |
| ISO 25901-3 | Welding and Allied Processes – Vocabulary – Part 3: Welding Processes |

5.2 DC Standards

No DC standards are relevant to the present standard

5.3 Nomenclature

DC / SUPPLIER / MANUFACTURER: Party who is in charge with the supply of a welded structure.

FABRICATOR / VENDOR: Parties which are touching the material (forming, cutting, welding, heat treatment, etc.) such as workshop of the fabricator or sub-suppliers, including also supplier of material (plates, forgings, casting, welding additives, etc.) as well as groups or companies for pre-assembly-, erection- or maintenance, etc.

6. RESPONSIBILITIES

Fabricator/Vendor of the welded structures and equipment is responsible that all relevant standards as well as this standard are applied and executed. Fabricator shall not subcontract any activities for a welded structure without prior written authorization from DC.

DC project specific requirements as detailed on project drawings take precedence over the general requirements in this Standard

DC shall be informed in writing;

- In cases the requirements of this document cannot meet by the Fabricator/Vendor.
- If conflicts between this Standard and referenced documents are found.

Any deviation and alteration from this document requires written authorization from DC to proceed.

7. REQUIREMENTS

7.1 Code-Equipment

Equipment that is subjected to a design code such as pressure vessels and heat exchangers require welding in accordance to stringent standards and to local, national or international codes, rules and law requirements.

If design is conducted as per EN/ISO or ASME/AWS-standards conduct welding and inspection have to be in line with EN/ISO or ASME/AWS.

However, mixing of standards is not allowed.

7.2 Classification of Welds

DC has classified the welding, inspection and testing in three weld classes, this has been done to help Suppliers and clarify DC requirements.

The welds are divided in 3 quality classes, each with their own requirements:

- Class W-1 (highest quality class), see Appendix 1 or Appendix 2;
- Class W-2 (middle quality class), see Appendix 1 or Appendix 2;
- Class W-3 (workmanship quality class), see Appendix 1 or Appendix 2;

The required quality classes for the different group of welds are indicated in the relevant drawings and specifications.

7.3 Documentation

Prior to commencing any welding activity, submit for DC's review and approval the required welding documentation, as per applicable weld class and VDL.

After welding is completed the welding record (as-run) shall be submitted to DC.

Supplier shall use welding symbols in accordance to an International Organization e.g. ISO 2553, IIW or AWS standards.

7.4 Flame Straightening

Flame straightening can be used after welding. Supplier shall submit for DC review and approval the flame straightening procedure, which shall include as a minimum the temperature application and control.

It is not allowed to use flame straightening on TMCP materials unless their manufacturing (material) certificates shows simulated PWHT has been conducted and they have been tested in this condition.

7.5 Fe- contamination

Supplier shall have stainless steel and CRA material segregated (including use of separate labeled tools) from C-Mn steel in order to avoid Fe contamination. For stainless steel and CRA welding monitoring temperature (pre-heat and interpass) it is recommended to use contact thermocouples and not use surface temperature indicator crayons.

7.6 Backing Strips

- Supplier shall make use of the same type of material for permanent backing strips (ceramic backing strips are always allowed), -rings, -spacer blocks and run off tabs as the parent materials.
- Copper backing strips are only allowed after written confirmation from DC has been obtained

7.7 Welding Surface Preparation

- The welding surface shall be free from oxides, paint, oil, grease, fat, zinc, dust or other contamination.
- Weld bevels shall be inspected by VT and PT/MT (acceptance criteria as per Appendix 1 or 2) prior to the welding operation.
- The welding surface shall be free from pits, pores, cracks, flaws, laminations, burrs, etc. due to material imperfections or resulting from the manufacturing processes or caused by slitting, punching, nibbling, thermal cutting, etc.

Tack Welding

- Tack welds shall be positioned in the melting zone of the first weld bead layer (the root layer)
- Tack welds shall be cleaned, grinded or totally removed before the actual welding.

7.8 Welding Consumables

- Supplier shall use the noblest type of metal for welds joining dissimilar metals.
- Supplier shall determine the flushing requirements and the required amount of inert gas for the backing in relation to the type of weld seam, the position and the type of materials under concern. For stainless steel and CRA welding the purging method and extent shall be **approved** by DC prior to use.

7.9 Welding Conditions

All work (including welding) shall be executed as much as possible in a workshop which has heating facilities. In case that work has to be performed outside in the open air Supplier shall obtain approval from the DC with respect to the conditions.

Work outside shall not take place if climatic and ambient weather conditions are forecasted such as:

- Condensation, rain or snow are present on the base material;

- Dust and fallout is present on the base material;
- Wind speed at weld location is greater than 38km/h (10.7m/s);
- Temperature outside at weld location is below -5 °C (23 °F);
- Any other condition that would have a negative effect on the quality of the weld;

Whenever work is conducted outside weather-suitable protection shall be used to ensure that the welding work performed can meet the requirements. The weather-protection is subject to approval by the DC.

8. NON-DESTRUCTIVE TESTS

NDT shall be carried out after final heat treatment (e.g. PWHT if required) and before any painting or coating application. The time for NDT after final heat treatment is depending on the material but shall not be less than 24 hours. It is recommended to apply NDT also before PWHT in order to avoid additional heat treatment in case of repair.

NDT testing shall be conducted as per Appendix 1 or Appendix 2. NDT testing shall be either MT or PT (not both techniques). NDT testing shall be either UT or RT (not both techniques).

NDT testing is detailed in Appendix 1 or Appendix 2 however requirements detailed in drawing will always take precedence and should be followed above this specification.

9. NON CONFORMITY

Repairs of defects is allowed in conformance with the applicable welding codes according to which the main WPS is made (ISO, EN, AWS, ASME). If weld repairs are required DC shall be informed immediately. The welding record (as-run) shall be submitted also for repairs.

If PWHT is required by the WPS and a repair is conducted after PWHT, then a new PWHT shall be conducted. The WPQR shall be made simulating the intended number of re-repairs and PWHT allowed. Supplier shall completely finish all welding prior any PWHT

APPENDIX 1 – ISO/EN MATRIX WELDING CLASS REQUIREMENTS

The welding requirements per Welding Class, W-1, W-2 and W-3 are indicated in the following Matrix in the four Sections;

1. Welding Quality Control
2. Welding Procedures
3. Weld Personnel
4. Weld Inspection and Testing

The international ISO/EN Standards are used as basis for the quality assessment of the different weld classes.

| | General Standards | Weld Class W1 | Weld Class W2 | Weld Class W3 |
|----------|---|--|--|-----------------------------------|
| 1 | Quality Control | | | |
| 1.1 | Company Quality System including Subcontractors | ISO 9001 | QA/QC System in accordance with ISO 9001 | |
| 1.2 | Quality Requirements for Welding | ISO 3834 series | ISO 3834-2 | ISO 3834-4 |
| 1.3 | Competence of NDT - External organization | ISO 17020 | Certificate required | N/A |
| | Competence of NDT - Internal organization | ISO 3834 | Only allowed if NDT Department is independent of Production Department | N/A |
| 1.4 | Welding Plan and Weld Map | | Required | N/A |
| 1.5 | Welding Coordination | ISO 3834 series | ISO 3834-2 | N/A |
| 1.6 | Parent Materials - Certificate | EN 10204 | 3.1 Certificate | 2.1 Declaration |
| | Parent Materials - Inspection for lamination and/or segregations | EN 10160 | S3 body E4 for edge | N/A |
| | Parent Materials - Weld edge requirements after beveling | EN 10160 | E4 | E3 |
| | Parent Materials - Storage, Identification, Traceability | ISO 3834 series | ISO 3834-2 | N/A |
| 1.7 | Welding Consumables | EN13479 | Type and grade used required approval by NOBO e.g. TUV, ABS, BV, etc | |
| | Welding Consumables - Certificate | EN 10204 | 2.2 Test Report | |
| | Welding Consumables - Storage and handling | ISO 3834 series | ISO 3834-2 + As per manufacturer's instruction | As per manufacturer's instruction |
| 1.8 | ITP | | Required to be approved by DC before welding starts | Only if required by VDL |
| 2 | Welding Procedures | | | |
| 2.1 | Indication of weld process & general standards | ISO 25901-3 ISO 4063 ISO 6947 EN 1011-1 | Applicable – for vocabulary Applicable – for nomenclature and reference numbers Applicable – for welding positions Recommended – general guidance | N/A |
| 2.2 | Specification and qualification of welding procedures – General rules | ISO 15607 ISO 15608 | Applicable | N/A |
| 2.3 | WPS | ISO 15609-1 | Required | |
| 2.4 | WPQR | ISO 15614-1 ISO 15613 | Required | N/A |
| 2.5 | Joint design and preparation - General | ISO 9692-1 ISO 9692-2 | Applicable | |
| | Joint design and preparation – Thermal cutting | ISO 9013 | Applicable | |
| | Joint design and preparation – Surface roughness | | Maximum 500 microns | |

| | General Standards | Weld Class W1 | Weld Class W2 | Weld Class W3 |
|--|---|--|---|--|
| 2.6 | Pre-heating weld zones - General | ISO 17671-2 | Applicable | |
| | Pre-heating weld zones – Measurement of pre-heat and interpass temperatures | ISO 13916 | Applicable | |
| 2.7 | PWHT | ISO 3834 | ISO 3834-2 | ISO 3834-4 |
| | | ISO 17663 | Applicable | Applicable |
| 3 | Weld Personnel | | | |
| 3.1 | WPQ | ISO 9606 | Required – Mechanical testing to be performed by NOBO | |
| 3.2 | Weld operator qualification | ISO 14732 | Required – Mechanical testing to be performed by NOBO | |
| 3.3 | Weld coordination personnel | ISO 14731 | Required | |
| 4 | Welding Inspection and Testing | | | |
| 4.1 | General Rules NDT – Selection of NDT methods | ISO 17635 | Applicable | |
| | General Rules NDT – Terminology | ISO 5817 | Applicable – for VT | |
| | | ISO 5577 | Applicable – for UT | |
| | | ISO 5576 | Applicable – for X-ray | |
| | | ISO 12706 | Applicable – for PT | |
| | | ISO 12707 | Applicable – for MT | |
| | | ISO 6520-1 | Applicable | |
| | General Rules NDT – Classification of imperfections | | | |
| | NDT Procedures | | Required to be submitted for DC's review/approval | |
| | 4.2 | Qualification of NDT personnel - General | ISO 9712 | Required |
| Qualification of NDT personnel executing inspection and signing report | | ISO 9712 | Level 2 | |
| Qualification of NDT personnel approving procedures | | ISO 9712 | Level 3 | |
| 4.3 | VT - General | ISO 17637 | Required | |
| | VT – Acceptance criteria | ISO 5817 | Quality Class B | Quality Class D |
| | VT – Extent of examination | | 100% of all welds | |
| | VT – Test Report | | Required | Only if required by VDL |
| | | | Required | N/A |
| 4.4 | PT - General | ISO 3452-1 | Required | N/A |
| | PT – Acceptance criteria | ISO 23277 | Level 2X | N/A |
| | PT – Extent of examination | | 100% of all finished welds | 25% ² of all finished welds |
| | PT – Test Report | | Required | N/A |
| 4.5 | MT - General | ISO 17638 | Required | N/A |
| | MT – Acceptance criteria | ISO 23278 | Level 2X | N/A |
| | MT – Extent of examination | | 100% of all finished welds | 25% ² of all finished welds |
| | MT – Test Report | | Required | N/A |

| | General Standards | Weld Class W1 | Weld Class W2 | Weld Class W3 |
|-----|----------------------------|----------------------------|--|---------------|
| 4.6 | UT - General | Testing Level C | Testing Level B | N/A |
| | UT - Acceptance criteria | Level 1 | Level 2 | N/A |
| | UT - Extent of examination | 100% of all finished welds | 25% ² of all finished welds | N/A |
| | UT - Test Report | Required | | N/A |
| 4.7 | RT - General | Test Class B | | N/A |
| | RT - Acceptance criteria | Level 1 | Level 2 | N/A |
| | RT - Extent of examination | 100% of all finished welds | 25% ³ of all finished welds | N/A |
| | RT - Test Report | Required | | N/A |

² If written agreement is obtained from DC, UT can also be done as per ISO 10863 test level C for weld class W1, test level B for weld class W2 with acceptance criteria as per ISO 15626 level 1 for weld class W1 and level 2 for weld class W2.

³ NDT shall be increased by 25% (to 50%) if ≤20% of the examined welds are rejected.

NDT shall be increased to 100% if >20% of the examined welds are rejected.

DC has the right to indicate which welds shall be inspected comprising the 25%.

All welders and weld types shall be inspected with the 25%

APPENDIX 2 – AWS/ASME MATRIX WELDING CLASS REQUIREMENTS

The welding requirements per Welding Class, W-1, W-2 and W-3 are indicated in the following Matrix in the four Sections;

5. Welding Quality Control
6. Welding Procedures
7. Weld Personnel
8. Weld Inspection and Testing

The AWS/ASME Standards are used as basis for the quality assessment of the different weld classes.

| | General Standards | Weld Class W1 | Weld Class W2 | Weld Class W3 |
|----------|---|---|--|-----------------------------------|
| 1 | Quality Control | | | |
| 1.1 | Company Quality System including Subcontractors | ISO 9001 | QA/QC System in accordance with ISO 9001 | |
| 1.2 | Quality Requirements for Welding | ISO 3834 series | ISO 3834-2 | ISO 3834-4 |
| 1.3 | Competence of NDT - External organization | ISO 17020 | Certificate required | N/A |
| | Competence of NDT - Internal organization | ISO 3834 | Only allowed if NDT Department is independent of Production Department | N/A |
| 1.4 | Welding Plan and Weld Map | | Required | N/A |
| 1.5 | Welding Coordination | ISO 3834 series | ISO 3834-2 | N/A |
| 1.6 | Parent Materials – Mill Certificate | ASME II part A | Required | |
| | Parent Materials - Inspection for lamination and/or segregations | ASME II part A | Required - SA 20 section 9 | |
| | Parent Materials - Weld edge requirements after beveling | | See sections 4.4 or 4.5 below | |
| | Parent Materials - Storage, Identification, Traceability | ISO 3834 series | ISO 3834-2 | N/A |
| 1.7 | Welding Consumables | AWS A5.1 AWS A5.18 ASME II part C | Type and grade used required approval by NOBO e.g. TUV, ABS, BV, etc | |
| | Welding Consumables - Certificate | EN 10204 | 2.2 Test Report | |
| | Welding Consumables - Storage and handling | ISO 3834 series | ISO 3834-2 + As per manufacturer's instruction | As per manufacturer's instruction |
| 1.8 | ITP | | Required to be approved by DC before welding starts | Only if required by VDL |
| 2 | Welding Procedures | | | |
| 2.1 | Indication of weld process & general standards | ASME IX AWS D1.1 | Applicable | |
| 2.2 | Specification and qualification of welding procedures – General rules | ASME IX AWS D1.1 | Applicable | N/A |
| 2.3 | WPS | ASME IX AWS D1.1 | Required | |
| 2.4 | WPQR | ASME IX AWS B2.1 | Required | N/A |
| 2.5 | Joint design and preparation – Surface roughness | | Maximum 500 microns | |
| 2.6 | Pre-heating weld zones – Measurement of pre-heat and interpass temperatures | | Required | |

| | General Standards | Weld Class | Weld Class | Weld Class |
|----------|--|---------------------------------------|---|--|
| | | W1 | W2 | W3 |
| 2.7 | PWHT | ISO 3834-2 UW-40 | ISO 3834-3 | ISO 3834-4 |
| 3 | Weld Personnel | | | |
| 3.1 | WPQ | ASME IX AWS D1.1 | Required – Mechanical testing to be performed by NOBO | |
| 3.2 | Weld operator qualification | ASME IX AWS D1.1 | Required – Mechanical testing to be performed by NOBO | |
| 3.3 | Weld coordination personnel | ASME IX AWS D1.1 | Required | |
| 4 | Welding Inspection and Testing | | | |
| | General Rules NDT – Selection of NDT methods | ASME V AWS B1.10 | Applicable | |
| | General Rules NDT – Terminology | ASTM E 1316 | Applicable | |
| | NDT Procedures | | Required to be submitted for DC's review/approval | |
| 4.2 | Qualification of NDT personnel - General | SNT-TC-1A | Required | |
| | Qualification of NDT personnel executing inspection and signing report | SNT-TC-1A | Level 2 | |
| | Qualification of NDT personnel approving procedures | SNT-TC-1A | Level 3 | |
| 4.3 | VT - General | ASME V art 9 AWD D1.1 chapter 6 | Required | |
| | VT – Acceptance criteria | AWS D1.1 chapter 6 | Cyclically loaded nontubular connections (Table 6.1) | Statically loaded nontubular connections (Table 6.1) |
| | VT – Extent of examination | ISO 5814 | Quality Class B 100% of all welds | Quality Class C Quality Class D |
| | VT – Test Report | | Required | Only if required by VDL |
| 4.4 | PT - General | ASME V art 6 | Required | N/A |
| | PT – Acceptance criteria | ASME VIII | Appendix 8 | N/A |
| | PT – Extent of examination | | 100% of all finished welds | N/A |
| | PT – Test Report | | Required | N/A |
| 4.5 | MT - General | ASME V art 7 | Required | N/A |
| | MT – Acceptance criteria | ASME VIII | Appendix 6 | N/A |
| | MT – Extent of examination | | 100% of all finished welds | N/A |
| | MT – Test Report | | Required | N/A |
| 4.6 | UT - General | ASME V AWS D1.1 | Article 4 Chapter 6 | N/A |

| | General Standards | Weld Class W1 | Weld Class W2 | Weld Class W3 |
|-----|-----------------------------|----------------------------|--|---------------|
| 4.7 | UT -- Acceptance criteria | Appendix 12 | | W3 |
| | UT -- Extent of examination | Class B (Table 6.3) | Class B (Table 6.2) | N/A |
| | UT -- Test Report | 100% of all finished welds | 25% ³ of all finished welds | N/A |
| | RT - General | Required | | N/A |
| | RT -- Acceptance criteria | Article 2 | | N/A |
| | RT -- Extent of examination | UW 51 | UW 52 | N/A |
| | RT -- Test Report | 100% of all finished welds | 25% ⁴ of all finished welds | N/A |
| | | Required | | N/A |

⁴ NDT shall be increased by 25% (to 50%) if 20% of the examined welds are rejected.
 NDT shall be increased to 100% if more than 20% of the examined welds are rejected.
 DC has the right to choose which welds shall be inspected to form the 25%.
 All welders and weld types shall be inspected in the 25%



APPENDIX 3 – DANIELI CORUS WELD PLAN – EXAMPLE

| WELD PLAN | | | | | | | | | | | | | | DANIELI CORUS | | | | | | | | SUPPLIER | |
|--|------------|-------------------|------------|------------|-------------|-------------|-------------|------------------|----|-----|-----------|-------|-----------|------------------------------------|------|-----------|------|---------------|-------------|---------|-----------|------------------------------------|--|
| Project: [Insert Project Name and Number] | | | | | | | | | | | | | | Purchaser: Danielli Corus | | | | | | | | Ref. No: [Insert Supplier ref. No] | |
| Doc NO / Rev: [Insert Weld Plan Doc No] | | | | | | | | | | | | | | Manufact. Spec.: [Insert Doc. No.] | | | | | | | | | |
| Issue Date: [Insert Date] | | | | | | | | | | | | | | Welding Spec.: [Insert Doc. No.] | | | | | | | | | |
| Part Name: [Insert Part Name] | | | | | | | | | | | | | | Drawing No: [Insert Doc. No.] | | | | | | | | Ref. No: [Insert PO Number] | |
| Weld ID No | Joint Type | Part (D1/ID2) Ref | Weld class | WPS Doc No | WPQR Doc No | W/PQ ID Ref | Fit-Up A/NA | Intended NDT [%] | | | VT [100%] | PT/MT | | UT/RT | A/NA | Report No | A/NA | Pre-HT [degC] | PWHT [degC] | Remarks | | | |
| | | | | | | | | PT | MT | UT | | RT | Report No | | | | | | | | Report No | | |
| 1 | FW | Ref | W1 | Ref | Ref | Ref | A | 100 | | 100 | | Ref | A | A | Ref | A | 150 | - | | | | | |
| 2 | FW | Ref | W3 | Ref | Ref | Ref | A | - | | - | | Ref | A | - | - | - | 30 | - | | | | | |
| 3 | FW | Ref | W2 | Ref | Ref | Ref | A | 25 | | 25 | | Ref | A | A | Ref | A | 100 | - | | | | | |
| 4 | CJP | Ref | W1 | Ref | Ref | Ref | A | 100 | | 100 | | Ref | A | A | Ref | A | 100 | 450 | | | | | |
| 4-R | CJP | Ref | W1 | Ref | Ref | Ref | A | 100 | | 100 | | Ref | A | A | Ref | A | 100 | 450 | | | | | |
| 5 | PJP | Ref | W1 | Ref | Ref | Ref | A | 100 | | 100 | | Ref | A | A | Ref | A | 100 | 450 | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | |
| Supplemental Instructions: | | | | | | | | | | | | | | Created | | | | | | | | Checked | |
| 1. Bring related drawings in zones indicating unique Weld ID No and examination area for partial NDT regarding weld class W2 | | | | | | | | | | | | | | Supplier | | | | | | | | Approved | |
| 2. Repeat Weld ID No extended with "R" for lagging repair weld | | | | | | | | | | | | | | Danielli Corus | | | | | | | | | |
| 3. Indicate joint type (acc. AWS A5.1 - R (Root), FW (Fillet Weld), CJP (Complete Joint Penetration), CJP (Complete Joint Penetration) | | | | | | | | | | | | | | Client | | | | | | | | | |
| 4. Indicate Part ID No according to drawing / Bill of material | | | | | | | | | | | | | | Inspector | | | | | | | | | |
| 5. Fit-up check includes surface quality and geometry of weld preparation including root opening | | | | | | | | | | | | | | | | | | | | | | | |
| 6. Indicate achieved examination status through A (Accepted) or NA (not accepted) | | | | | | | | | | | | | | | | | | | | | | | |
| 7. 100% VT is mandatory to all finished welds | | | | | | | | | | | | | | | | | | | | | | | |
| 8. Indicate intended NDT initially through "extent %" in respective columns | | | | | | | | | | | | | | | | | | | | | | | |

