



Exploration & Production

GENERAL SPECIFICATION

STRUCTURAL

GS STR 304

Fabrication of Welded Plate Girders (WPG)

02	10/04	§ 2, 4, 14.1, Figure 1 revised
01	10/03	§ 10.3, 10.5 revised – Change of Group name and logo
00	10/02	First issue
Rev.	Date	Notes

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1. Scope

This General Specification for fabrication of Welded Plate Girders (WPG) may be used in lieu of specification **GS STR 301** (for simplification purposes) by any party in case where a separate or isolated order (or sub-order) is placed for those items. Otherwise, the specification **GS STR 301** and related PPS shall be used instead. When needed, any additional clarifications shall be found in specification **GS STR 301**.

This specification defines the COMPANY's general requirements for the manufacture and inspection of WPG.

Where required, this specification shall be used in conjunction with a Project Particular Specification (PPS) detailing the additional tests and requirements or the possible modifications to the present specification, based on the particular design conditions or the local legislation of the structural project.

No deviations from the requirements stated in the present specification shall be permitted unless prior approval has been obtained from the COMPANY. Refer to Section 5 of this specification.

2. Reference documents

The reference documents listed below form an integral part of this General Specification. Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the EFFECTIVE DATE of the CONTRACT.

Applicable specifications and documents are listed hereafter in the present section.

The order of precedence of the applicable documents shall be:

- The Purchase Order
- The Project Particular Specification (PPS)
- The Present General Specification
- The Codes and Standards in reference.

Unless otherwise specifically indicated in writing, the CONTRACTOR shall work in accordance with the requirements specified herein and the applicable requirements of the latest editions at date of Contract award of the referenced codes and standards, whenever requested in the present specification.

The requirements of this specification shall take precedence over the referenced codes and standards. Where this specification states no overriding requirements the referenced codes and standards shall apply in full.

The CONTRACTOR shall equip himself with copies of all the reference specifications referred to in this specification and shall make them readily available to all his inspection personnel involved on the work.

Standards

Reference	Title
EN 473	Qualification and certification of non-destructive personnel
EN 1435	Radiographic inspection of welds
EN 10045-1	Charpy impact test on metallic materials
ISO 148	Charpy impact test (V-notch)
EN - ISO 6507	Hardness test - Vickers test - Part 1: HV5 to HV10
ISO 9001:2000	Quality management systems: Requirements
ISO 12096	Radiographic testing of weld seam for the detection of imperfections
ASTM A 370	Mechanical testing of steel products
ASTM A 578	Standard specification for straight-beam ultrasonic examination of plain and clad steel plates for special application
ASTM E 23	Notched bar impact testing of metallic materials
ASTM E 709	Wet Magnetic Particle Inspection
ASTM E 165	Liquid penetrant inspection

Professional Documents

Reference	Title
IIW/IIS doc. 62.60	Recommended practice concerning radiographic Image Quality Indicators (IQI)
CSWIP/PCN	Requirements for the certification of personnel engaged in NDT

Regulations

Reference	Title
Not applicable	

Codes

Reference	Title
AWS D 1.1	Structural welding code - Steel
ASME, Section V	Boiler and pressure vessel code: non-destructive examination

**Other documents**

Reference	Title
Not applicable	

Total General Specifications

Reference	Title
GS STR 201	Materials for offshore steel structures
GS STR 301	Fabrication of offshore steel structures

3. Definitions**a) Inspector**

Either the COMPANY's Inspector or the CONTRACTOR's Inspector, or both, shall be referred to herein as the "Inspector". The COMPANY and CONTRACTOR may respectively elect an independent inspection agency to act on their behalf in that purpose.

b) Site

The yards, workshops, laboratories or other locations where the fabrication, inspection and testing are to be performed complete or in part, shall be referred to herein as the "Site".

c) Contract documents

The drawings, equipment lists, bills of material, material specifications, etc., latest editions, issued by the COMPANY and attached to the Contract or the Purchase Order shall be referred to herein as the "Contract Documents".

d) Approval

Authorisation in writing given by the COMPANY to the CONTRACTOR on a procedure or to proceed with the performance of a specific part of the work without releasing in any way the CONTRACTOR from any of his obligations to conform with the technical specifications, requisitions, etc. The words "Approve", "Approved" and "Approval" shall be construed accordingly.

e) PPS

Used to designate the Project Particular Specification as defined in Section 1.

4. Quality Assurance/Quality Control

1. The CONTRACTOR shall operate a Quality Assurance system in accordance with [ISO 9001:2000](#) or equivalent, approved by a recognized authority. The Quality Assurance Manual shall be submitted to COMPANY and made available to the Inspector at all times.
2. Three weeks prior to commencement of any fabrication, the CONTRACTOR shall prepare and submit to COMPANY a written Quality Control Plan which describes the inspections to be performed during the said fabrication. The Quality Control Plan shall set forth "witness", "hold", "review" and "monitor" points.

5. Technical Queries/Non-Conformance Reports

1. Any CONTRACTOR's requests for clarifications or deviations to COMPANY specifications shall be submitted to COMPANY only through Technical Queries (TQ), the format of which shall have prior approval of the COMPANY.
2. A deviation to specifications shall not be considered as accepted if it has not been submitted to and accepted by COMPANY through a Technical Query.
3. Approval given by the COMPANY to any CONTRACTOR's work procedures, specifications, equipment, etc, shall not release in any way the CONTRACTOR from his obligation to meet the COMPANY's specifications.
4. Any work performance or test result which is found, at a later date, not in conformance with COMPANY specifications or agreed procedure shall be subject to a Non-Conformance Report (NCR) to be issued by the CONTRACTOR for submission to COMPANY. NCR report shall indicate the corrective action intended by the CONTRACTOR.

6. Approval of documents and procedures

The following shall be submitted to COMPANY for approval at least three weeks before fabrication is scheduled to start.

1. Fabrication or shop drawings showing weld arrangement, location of welding at prefabrication and fabrication stages, and weld details.
2. List of proposed welding consumables with their data sheets.
3. Consumables handling, drying, storing, flux recycling and traceability procedure.
4. Sequence of fabrication, assembly and welding. Fit-up of flanges to web, including equipment used and precautions to avoid distortion and warpage.
5. Weld Register together with all Welding Procedure Specifications (WPS) and Welding Procedure Qualification Records (WPQR), including for repair welding.
6. List of welders and welding operators, with certificates.
7. Mill certificates of CONTRACTOR's supplied materials.
8. Identification, control and traceability procedures for materials.
9. Key plans showing member identification and weld marking schemes.
10. Inspection and Non-Destructive Testing procedures.
11. Procedures to monitor dimensions and control the tolerances during fabrication.
12. List of Non-Destructive Testing personnel, with certificates.

7. Drawings

1. Fabrication Drawings, Shop Drawings and As-built Drawings shall be in accordance with provisions of [API RP 2A](#).
2. Designation of steels on drawings shall fully comply with para. 5.3 and 5.4 of specification [GS STR 201](#).
3. The web to flange connections of WPG subject to cyclic load or high localized static loads (e.g. at nodes) shall be made with full penetration welds.

4. The requisition or PPS will state whether it is necessary or not necessary to let the web to flange connection unwelded over a distance of 500 mm at each end of WPG, in order to allow for a proper fit-up at the splices and nodes at erection site.
5. All shop drawings and cutting plans shall be submitted to COMPANY for approval three weeks prior to starting any plate cutting.
6. Approval or review of Shop Drawings by the COMPANY does not relieve the CONTRACTOR of his responsibility to complete the work in accordance with the Contract Documents, the COMPANY approved Fabrication Drawings and specifications.
7. No fabrication shall be performed until relevant Shop Drawings have been checked and approved by the COMPANY, unless otherwise agreed.
8. As-built drawings shall incorporate all pertinent information regarding actual material supply and fabrication, and shall be submitted to the COMPANY within two weeks upon the WPG delivery. Drawings shall be available at erection site prior to erection.

8. Materials

All materials to be used shall fully conform to the general specification GS STR 201, taking into account the classification of steel members defined herein. The use of wide flats is prohibited.

Steel qualities shall be subject to COMPANY's prior approval and shall fully conform to specification **GS STR 201**.

9. Fabrication

9.1 General

Unless otherwise indicated in this specification, fabrication and welding of Welded Plate Girders (WPG), also called built-up sections, shall be in accordance with provisions of ANSI/AWS D1.1 code.

A Manufacturing Procedure Specification (MPS), including fabrication sequence, welding and inspection shall be submitted by CONTRACTOR to COMPANY approval.

9.2 Splices

As far as possible, WPG shall be designed so as to have no splices. Where splices are deemed necessary, the following shall apply.

- Splices shall not be located closer together than twice the depth of the WPG or one metre, whichever is smaller.
- Splices in **beams** shall not be within $L/8$ of the supports (where L is the distance between supports) or the central $L/4$. Where the beam is cantilevered, any splice shall be closer to the free end than to the support.

9.3 End preparation

Unless otherwise specified in the requisition, WPG shall be supplied without bevelled ends.

9.4 Web stiffeners

Where requested, web stiffeners shall be welded on WPG as specified on drawing. No rat-holes shall be permitted on these stiffeners. Correct weld sequencing and sniped corner on the stiffener plates shall be used to give a close fit-up of stiffeners with web and flange. Sniped corners shall be continuously welded. Corners shall be sniped by trimming and bevelling as appropriate.

9.5 Temporary attachments and welds

- A temporary attachment is defined as an element introduced for some specific and temporary function on the structure (e.g. lifting lugs, fit-up aids, etc.).
- Temporary attachments and welds shall be minimized.
- The location of such welded attachments shall be selected so as to avoid interference with the principal weld seams of the structure. Minimum acceptable clearance between welds shall be two (2) times the thickness of the structure with minimum of 100 mm.
- When temporary welding is deemed necessary, welding shall be carried out according to the same procedures that govern the permanent structural part in question (i.e. same care, consumables, preheating, etc., as required for the structural part).

The temporary welds shall subsequently be removed and ground flush with the base material. On High and Extra High Strength Steels (i.e. specified YS above 300 Mpa) the grindings shall then be inspected by MPI or LPI.

9.6 Web to flange fit-up

A tight contact shall be obtained between web and flanges using appropriate restraining frame and pressure prior to tacking and welding.

9.7 Correction of steel members

Distorted members or WPG shall be straightened as directed by clause 5.26.2 of [AWS D1.1: 2000](#). The temperature of heated areas as measured by approved methods shall not exceed:

- 550°C for controlled rolled steels
- 590°C or tempering temperature minus 50°C (the lowest temperature) for quenched and tempered steels, and normalized and tempered steels
- 650°C for normalized steels and other C-steels and C-Mn steels.

The CONTRACTOR shall establish and submit a detailed procedure for correction of distortions. The procedure shall include details of the methods used for heating and controlling the temperature.

For steel grades with a minimum specified yield strength of 300 Mpa and above, a qualification of the procedure shall be carried out. The qualification test shall include tensile test, impact test, hardness test and micrographic test.

At production stage, hardness test may be required on heated surfaces (for comparison purposes with the results obtained at qualification test). Also, if welds are located too close to the heated areas they shall be re-checked by NDT.

Cold straightening may be used provided that distortion is less than 5%.

10. Welding

10.1 Code

All welding shall comply with **AWS D1.1** Code, unless otherwise modified hereafter.

10.2 Welding processes

Only manual Shielded Metal Arc Welding (SMAW) and Submerged Arc Welding (SAW) process shall be used.

Flux Cored Arc Welding process without shielding gas (i.e. FCAW-SS) may be approved for fillet welds provided that the CONTRACTOR gives evidence of long successful practice of the process in previous similar jobs to the satisfaction of the COMPANY.

Only Low Hydrogen processes shall be used for welding and tack welding.

10.3 Welding consumables

- a) Consumables shall conform to ANSI/**AWS D1.1** code and shall have been approved by an international recognized certification body (e.g. DNV, LLOYD's, etc.).
- b) For SMAW process, coated electrodes shall have a minimum diameter of 3.15 mm.
- c) The number of different consumables shall be minimized.
- d) Each heat, lot or batch of consumables shall be subject to inspection and approval by the Inspector. 3.1.B Mill test certificates from consumables' manufacturers showing test results actually obtained for chemical and mechanical properties of the said batches shall be submitted to the Inspector.
- e) The permissible atmospheric exposure of low hydrogen electrodes shall be two hours max., unless a shorter time is required in **AWS D1.1**.
- f) The CONTRACTOR's consumable procedure for storing, handling, drying, flux recycling and traceability shall be approved by the Inspector before fabrication commences.
- g) When SAW process is applied to full penetration tee-butt welds WPG, the provision of specification **GS STR 301** §8.5.2 shall apply to welding flux.

10.4 Weld types

- a) Unless otherwise stated, the web to flange connections of WPG shall be made with fillet welds according to Figure 1a of present spec., except for the skid beams of Wellhead Platforms and at structural nodes where full penetration welds are required (see Figure 1b). Only automatic SAW process shall be used for web to flange welds.
- b) Web to flange connections shall have a concave profile and transition smoothly into flange and web.
- c) In the event that flange splices and webs splices are deemed necessary, butt welds shall be full penetration double V-, J- or K- welds (i.e. double sided welds). Splices shall be made to produce a straightness similar to that of the uncut members. All spliced joints shall be 100% RT and MPI prior to fit-up.
- d) All fillet welds shall be continuous welds.

10.5 Qualification of welding procedures

a) Qualification tests shall include impact tests (for butt welds and tee-butt welds) and a macro-section (for butt welds, fillet welds and tee-butt welds). On the macro-section a VICKERS hardness survey shall be made (for steel grade S 355 and above) as per Figure 2 using a 5 kg load. The maximum hardness shall not exceed 325 HV5. CHARPY V-notch impact tests shall be made as per Figure 3 for butt welds and as per Figure 4 for tee-butt welds.

b) Base materials :

1 – Material grades with SMYS greater than 355 MPa

Any steel with a minimum specified YS in excess of 355 MPa, i.e. S420, S460 and S500 steel grades as defined by GS STR 201 shall require separate welding procedure qualification test on the production material:

- per delivering mill
- per as-delivery condition
- per each steel grade
- per each steel quality (impact test requirements)

The validity of such a welding procedure qualification is moreover limited to materials of the same grade as defined above considering the further restriction:

- Carbon, Carbon Equivalent and Pcm of the test material is not less than 0.02%, 0.03% and 0.02% respectively, in comparison with the materials of the order.
- Welding consumables are considered as still acceptable in COMPANY's opinion.

2 – Material grades with SMYS less than or equal to 355 MPa

Welding procedure qualification tests is required for steels corresponding to group I as defined by AWS D1.1, or any steels group II as defined by AWS D1.1, with SMYS less or equal to 355MPa, or any steel combination as defined by AWS D1.1.

The validity of such a welding procedure qualification is limited to materials of the same group or steel group combination as defined above, considering the further restriction:

- per delivering mill (group II only)
- per as-delivery condition (group II only)
- per each steel quality (impact test requirements)

In addition, any welding procedure qualified as per above, will cover materials of the said group provided that:

- Minimum Specified YS does not exceed the Minimum Specified YS of the qualified material by more than 60 Mpa
- Carbon Content, Carbon Equivalent and Pcm of the test material is not less than 0.02%, 0.03% and 0.02% respectively, in comparison with the materials of the order.
- Welding consumables are considered as still acceptable in COMPANY's opinion.

c) At COMPANY's option, qualified welding procedures from previous orders may be accepted without further qualification tests, provided that the following conditions are satisfied:

- The qualification records proposed by CONTRACTOR are fully documented as regard to the requirements of present specification (for example, brand name and designation of consumables shall be clearly indicated in WPS and WPQR, and Mill certificate of base material used for qualification tests shall be included in WPQR).
- The Carbon Equivalent (ladle), Pcm (ladle) and Carbon content (ladle), whichever the greater, of the job do not exceed those of the test piece (as shown on WPQR) by no more than 0.02%.
- The WPS/WPQR has been qualified by an internationally recognized inspection agency.

All the above conditions shall always be subject to prior acceptance of the COMPANY.

10.6 Weld production tests

Web to flange connections carried out with full penetration weld require production tests using extension pieces attached to the seams during production welding. Production tests shall be one test in every 20 welds produced and shall include the impact tests and hardness survey carried out at qualification tests (refer to para. 10.5). When no qualification test has been granted by COMPANY, one production test shall be made on the first WPG produced.

11. Welding repairs (base material and weld)

No welding repairs shall be carried out without prior approval of the Inspector. Removal of defects, qualification of welding procedure and repair welding shall be witnessed and approved by the Inspector.

Unacceptable defects shall be removed by grinding, machining or Arc-Air gouging. Where Arc-Air gouging is used, all carbon, copper and other debris, including carburized metal, shall be removed by grinding or by other mechanical methods approved by the Inspector.

The repair grooves shall be examined by dye penetrant or magnetic particle method in the presence of the Inspector to ensure that all defects are removed, prior to rewelding.

Qualified welders shall carry out welding repairs using an approved qualified welding procedure. All procedures for welding repairs on base material and weld shall be qualified. Preheating at an approved temperature shall be applied for steels with Yield Strength (YS) above 262 MPa (38,000 psi) or wall thickness above 25.4 mm (1").

Only low hydrogen electrodes shall be used for SMAW.

Repair of welds containing cracks shall not be permitted until the cause of cracking is clarified and remedial action is established by Manufacturer, to the satisfaction of the Inspector.

The external surface of the repair weld shall be subject to suitable grinding in order to obtain a uniform appearance and to merge smoothly into the original Weld Metal and/or into the adjacent Base Metal. In such cases, full MPi shall be applied.

Repairs at a same location shall be limited to 3 maximum.

Each weld repair area shall be 100% re-inspected non-destructively according to approved UT or RT procedures. Additionally, 100% magnetic particle inspection or liquid penetrant inspection shall be carried out.

12. Inspections

12.1 Dimensional inspection

Dimensional tolerances of WPG shall conform to Table 1.

12.2 Visual and Non-Destructive Testing

- All welds shall be 100% visually inspected prior to commencement of NDT and/or PWHT.
- All butt welds shall be 100% inspected by RT for $WT \leq 40$ mm and UT for $WT > 40$ mm.
- All tee-butt welds (if any) shall be 100% inspected by UT.
- All fillet welds, butt welds and tee-butt welds (if any) shall be subject to 100% MPi where S 355 steel grade (or a higher steel grade) is involved in the weldment, and 20% MPi for a lower steel grade.
- All plate areas with $WT > 25$ mm that will be heavily stressed in the through thickness direction by the welding operation (e.g. tee-butt welds) shall be ultrasonically tested for lamellar tearing prior to fit-up and welding.
- All NDT procedures shall be submitted to Inspector's approval.
- Standards of acceptance shall be as per Table 2. Weld connecting members of different categories of importance shall be subject to the inspection requirements of the most stringent category in question.

13. Handling and transportation of WPG

All materials and WPG shall be handled and transported by suitable and COMPANY approved procedures that do not induce deformations or excessive stresses.

Temporary lifting lugs, if needed in the absence of any other appropriate means, shall be welded to the top flanges as per requirements of para. 9.5 of this specification.

During on and off-loading, transport, storage and handling, all WPG shall be treated in a manner such that they do not suffer damage, overload or deformation.

14. Documentation

The following minimum documentation shall be supplied by the CONTRACTOR.

14.1 When the bids are submitted

- Name of WPG manufacturer.
- A simplified Manufacturing Procedure Specification (MPS) and a Quality Control Plan as per Sections 4, 6 and 9 of this specification. The MPS shall detail the equipment and procedure to fit-up properly the flanges to web of WPG.
- Deviations to present specification, if any. Any material substitution shall be fully detailed.
- Quality Assurance certification (ISO 9001:2000 etc.) of manufacturer.

14.2 Upon completion of WPG production

1. The CONTRACTOR shall supply a close-out production report. It shall include, but not limited to, the information and documents stated hereafter:
 - Release Certificate of the Inspector
 - Manufacturing Procedure Specification (finalized)
 - Mill certificates of materials and welding consumables
 - Welding Procedure Specifications, WPQ Records and production test reports
 - NDT reports, welders qualifications, NDT operator certifications
 - Dimensional inspection reports/As-built drawings
 - Quality Control Plan
 - Compilation of concession/deviations, if any, granted by the COMPANY.
2. The PPS shall state the number of originals and copies of the production report which is to be supplied to the COMPANY.
3. The Inspector (whatever it acts on behalf of the CONTRACTOR or the COMPANY) shall stamp (rubber-stamp), date and sign these documents for the acceptance of WPG meeting all the requirements of this specification.

14.3 Schedule

1. WPG shall be dispatched only after a Release Certificate has been issued by the Inspector.
2. The full production report as stated above in para. 14.2.1 shall be transmitted to the COMPANY without delay after completion of WPG production. The latest date of submission of this report shall be two weeks max. after WPG dispatch. Whenever possible, the production report will be supplied on a CD ROM, as well.

Table 1 - Tolerances for Welded Plate Girders (WPG)
(see the figures on next page)

Designation	Tolerances (mm)	Figure 14...
H = total height	$\pm 0.003 H$ (max. ± 4)	4
h = web height	$\pm 0.003 h$ (max. ± 4)	4
(Height measurements are made at web location)		
Width "b"	± 3 max.	4
Flange rotation "t"	$t \leq 0.010 b$	5
Symmetry error $s = \frac{b1 - b2}{2}$	$s \leq 0.010 b$ (max. 5)	6
Inclination of web "i"	$i \leq 0.004 H$	6
Flange deflection "c"	$c \leq 0.010 \frac{b}{2}$	7
Out-of-straightness normal to web (Web buckles) "p"	$p \leq 0.010 h$	7
Final length L of fabricated WPG	- 0 ; + 0.0010 L with 12 mm max.	8
Squareness at ends "v"	$v \leq 0.004 H$	9
Straightness error "q", or counter deflection tolerance (Deflection q is measured on web plane)	$q \leq 0.0010 L$ with 12 mm max.	10
General deflection measured on each flange (sweep) "u"	$u \leq 0.0010 L$ with 12 mm max.	11
Weight tolerances on each WPG calculated with respect to theoretical linear weight, welds included	+ 6% - 2%	-

Figures of Table 1

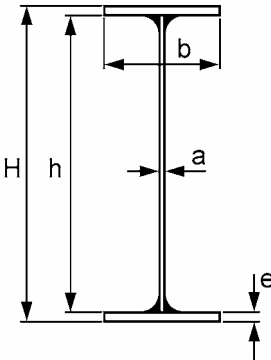
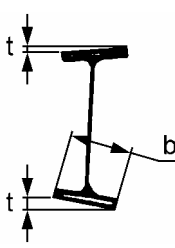
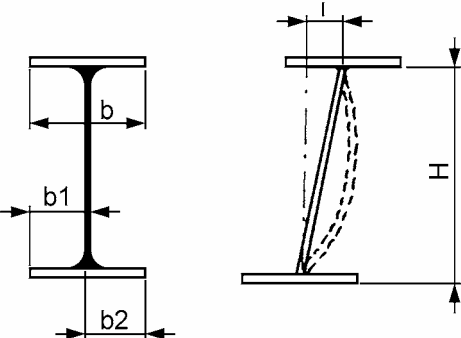
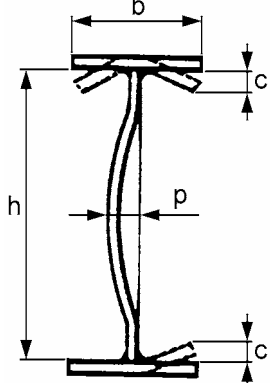
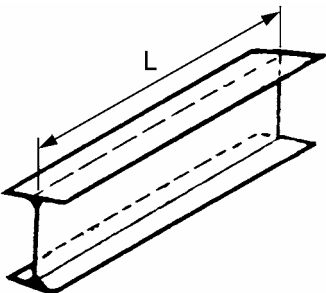
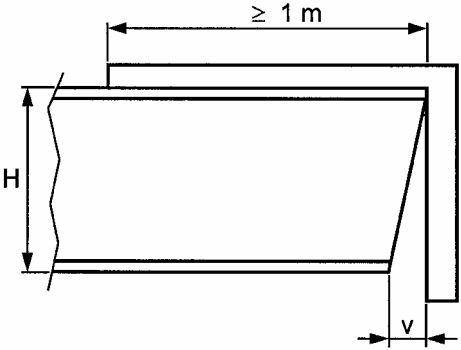
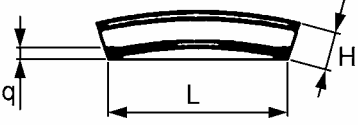
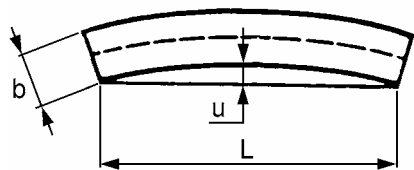
 Figure 14.4	 Figure 14.5
 Figure 14.6	 Figure 14.7
 Figure 14.8	 Figure 14.9
 Figure 14.10	 Figure 14.11

Table 2 - Standards of acceptance for weld defects
a) Internal defects (Radiographic Testing)

Type of defect	Member Category		
	Special Category	First Category	Second Category
Cracks	Not acceptable	Not acceptable	Not acceptable
Lack of fusion or Incomplete penetration	- Length $\leq \frac{t}{3}$, max. 12 mm	- Length $\leq \frac{2t}{3}$, max. 25 mm	- Length $\leq 1.5 t$, max. 50 mm
Slag inclusions	- Length $\leq \frac{2t}{3}$, max. 50 mm - Width $\leq \frac{t}{6}$, max. 4 mm	- Length $\leq 1.5 t$, max. 75 mm - Width $\leq \frac{t}{4}$, max. 5 mm	- Length $\leq 3 t$, max. 100 mm - Width $\leq \frac{t}{3}$, max. 6 mm
Porosities: • Isolated: max. pore diameter • Cluster: max. pore diameter • Scattered: max. accumulated pore diameters in any 10 x150 mm area of weld	t/5, max. 3.5 mm 2 mm 10 mm	t/4, max. 3.5 mm 2 mm 15 mm	t/3, max. 4.0 mm 3 mm 20 mm

b) Surface defects (Visual Inspection, MPI, LPI)

Type of defect	Member Category		
	Special Category	First Category	Second Category
Cracks	Not acceptable	Not acceptable	Not acceptable
Undercuts	- Static loads = Depth $\leq$ 0.4 mm Length $\leq$ 25 mm - Cyclic loads = Not acceptable	- Static loads = Depth $\leq$ 0.8 mm Length $\leq$ 25 mm - Cyclic loads = Not acceptable	Depth $\leq$ 0.8 mm Length $\leq$ 50 mm
Lack of fusion or Incomplete penetration	Not acceptable	Not acceptable	Length $\leq$ t/2, max. 10 mm
Porosities	Not acceptable	Size $\leq$ t/4, max. 3.5 mm	Size $\leq$ t/3, max. 4.0 mm

Notes on Table 2:

- (1) Any form of crack or suspected crack shall be considered unacceptable regardless of its size or location.

Occurrence of cracks will initiate more extensive NDT and revision of the welding procedure.

- (2) If separate elongated defects are situated on line and the distance between them is less than the length of the longest indication, the defects are to be evaluated as one continuous defect.
- (3) Summation of imperfections: any accumulation of lack of fusion, incomplete penetration, undercuts and slag inclusions shall not exceed 50 mm in Special and 1st Category member and 100 mm in 2nd Category member in any 300 mm of continuous weld.

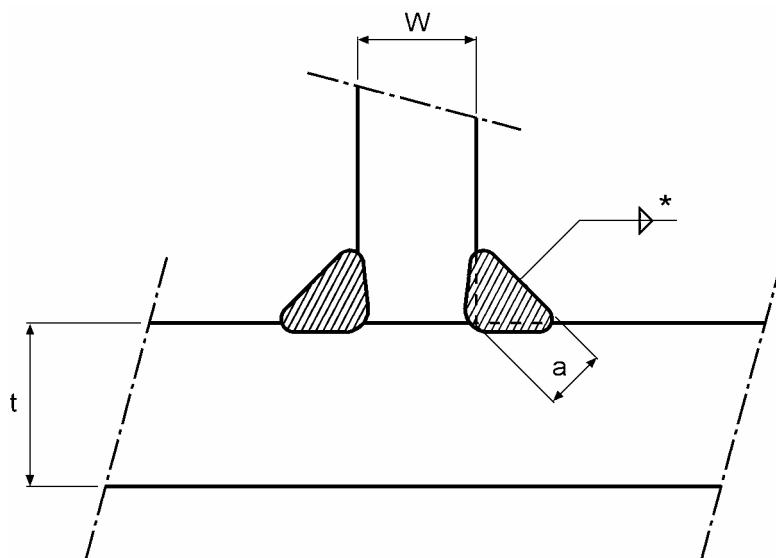
Figure 1 - Web to flanges welds

a) Fillet welds

a = well throat

$a = w/2$

* unless otherwise noted in drawings



b) Full penetration tee-butt welds (typical)

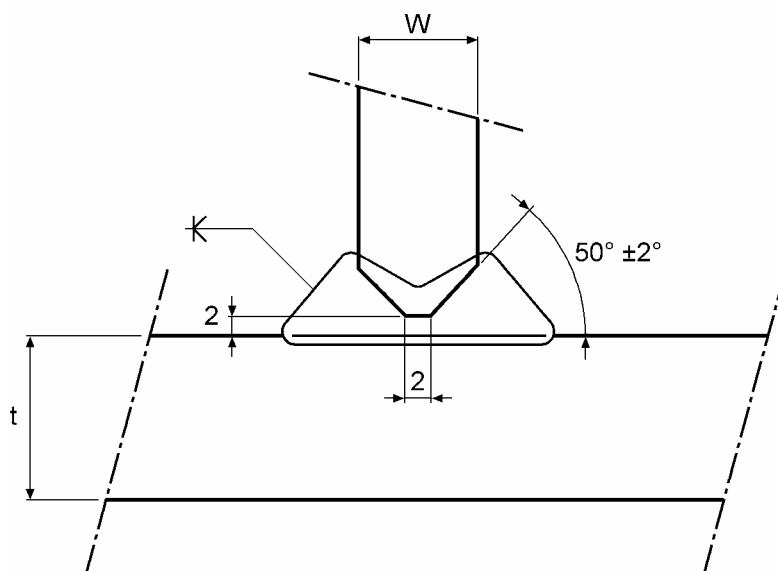
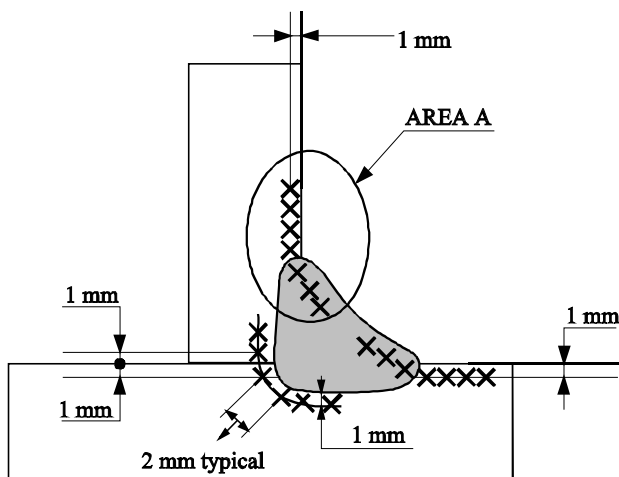
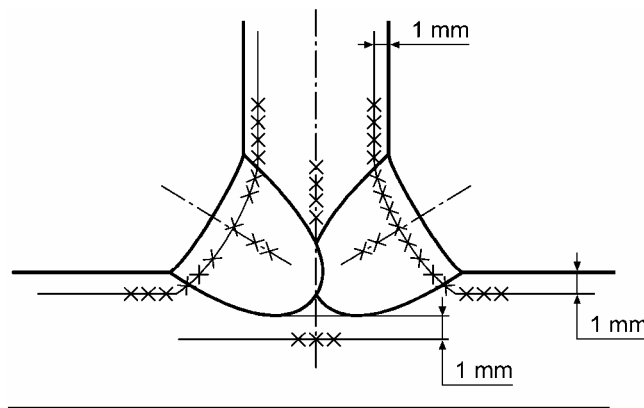


Figure 2 - VICKERS hardness survey (5 kg load)

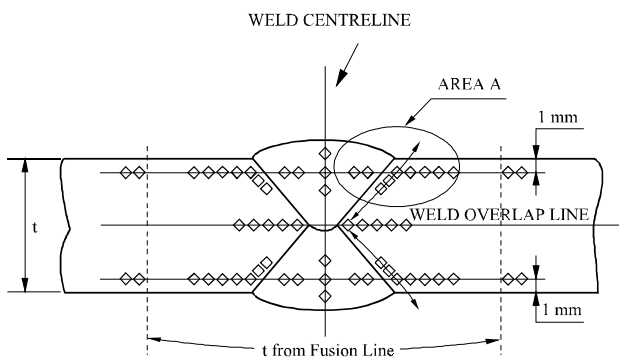


Fillet weld



Full penetration tee-butt weld

Enlargement of area A (typical)



Butt weld

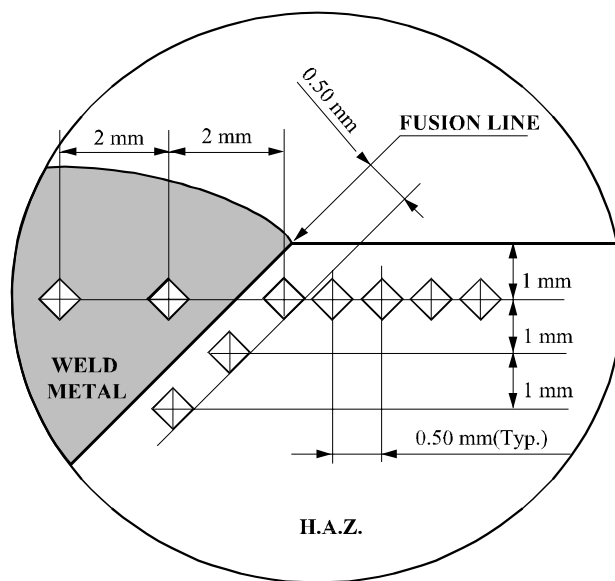
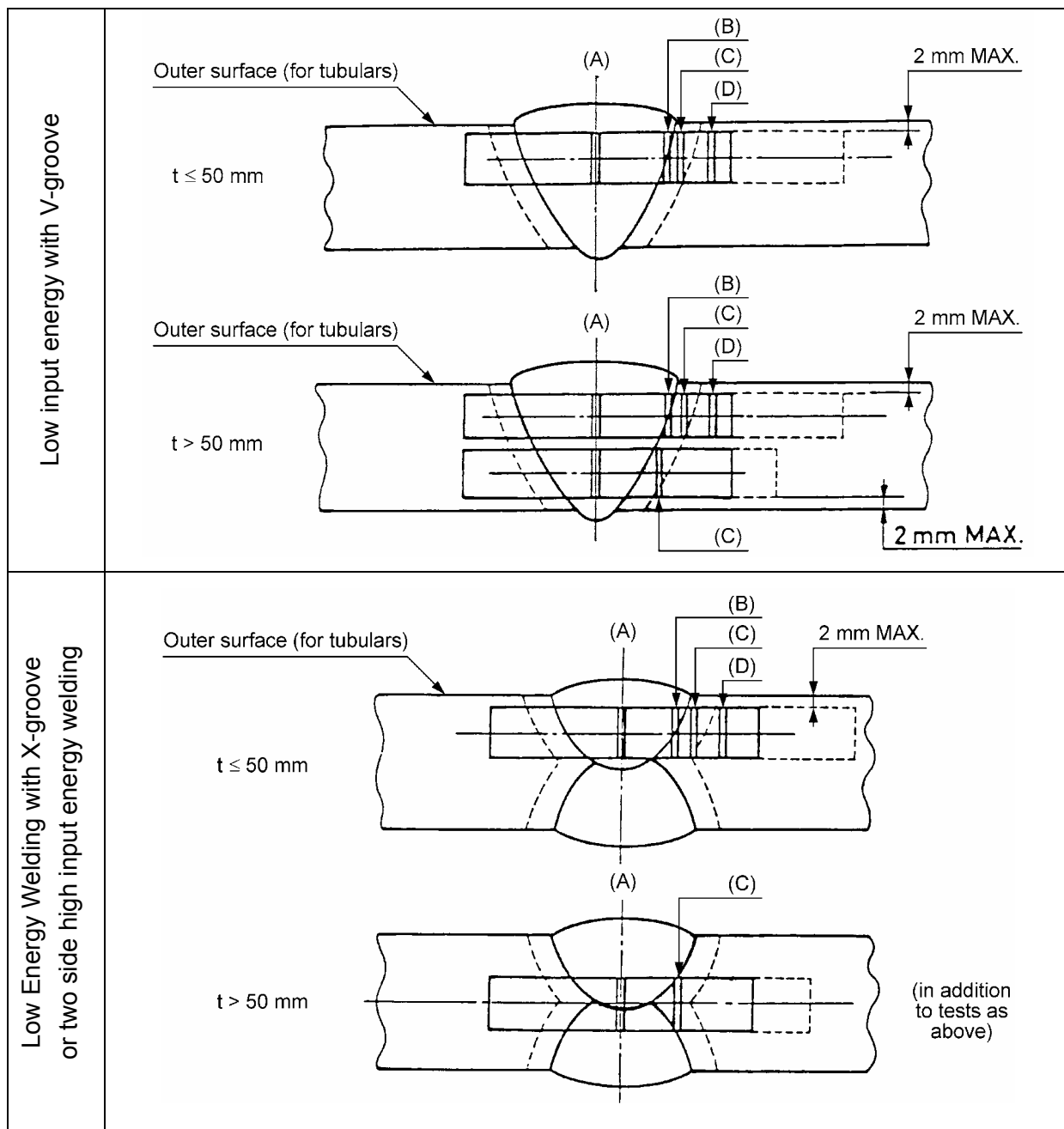
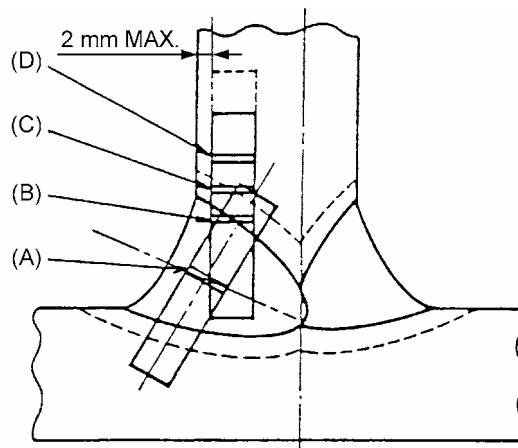


Figure 3 - CHARPY V impact tests/Butt welds

Notch Specimen Location:

- (A) Notch at centreline of Weld Metal
- (B) Centre of notch located at Fusion Line
- (C) Centre of notch located 2 mm from Fusion Line
- (D) Centre of notch located 5 mm from Fusion Line
- (1) For 2nd category members or WPG in Warm Sea constructions, test with notch location (D) is not required
- (2) Impact testing to be made on steeper bevel side of weld (when materials are similar)

Figure 4 - CHARPY V impact test/Tee-Butt Welds



Notch Specimen Location:

- (A) Notch at centreline of Weld Metal
- (B) Centre of notch located at Fusion Line
- (C) Centre of notch located 2 mm from Fusion Line
- (D) Centre of notch located 5 mm from Fusion Line

(1) For 2nd category members or WPG in Warm Sea constructions, test with notch location (D) is not required.