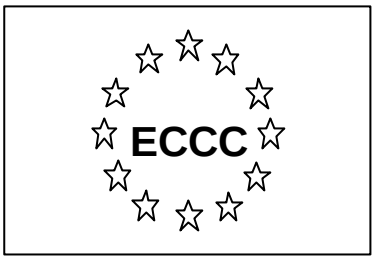

ECCC RECOMMENDATIONS - VOLUME 2 Part IIa [Issue 2]

TERMS AND TERMINOLOGY FOR WELDING PROCESSES AND WELD CONFIGURATIONS

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TERMS AND TERMINOLOGY FOR WELDING PROCESSES AND WELD CONFIGURATIONS

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ABSTRACT

ECCC Recommendations – Volume 2 Part IIa presents terms and terminology, with explanations where required, related to welding processes and the geometric description of the welded joint.

ECCC Recommendations Volume 2 Part IIa user feedback is encouraged and should be sent to:

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SECTION 1

FOREWORD

Section 2 deals with the geometric description of the welded joint and with the welding sequence. It is recognised that a weld may be performed by either several and different processes or a given process may be used with different filler metal (consumable types/sizes). In recognition of this a sequence has been defined to identify clearly the welding process(es) used for the different parts of the weld.

In Section 3 are included terms relating to the welding procedure (description of welding process, consumable, technique).

In Section 4 information about the final characterization of the weld are included.

Section 5 gives the units and symbols of the terms present in the list.

Section 6 is divided into 2 parts: the 1st part gives the definitions of terms present in the list, in the order in which they appear in the list; the 2nd part defines other terms which may be useful to describe the weld and they are given in alphabetical order.

At the end of the document there are tables for the description of weld, joint types, processes, techniques, positions, gases and thermal efficiency factors.

As far as possible the document refers to European Standard terminology and definitions. A list of the reference Standards used is given below:

EN 1792	Multilingual list of terms
EN 29692	Metal-arc welding with covered electrode, gas-shielded metal-arc welding and gas welding - Joint preparations for steel
EN 24063	Nomenclature of welding / brazing processes
EN ISO 6947	Welding positions
EN 1011	Recommendations for arc welding of ferritic steels
ISO 857-1	Welding and allied processes – vocabulary – Part 1: welding processes
EN 288	Specification and qualification of welding procedures for metallic materials
prEN ISO 15609-1	Specification and approval of welding procedures
EN 439	Classification of gases

EN 25817	Quality level of joints
EN 26520	Classification of the imperfections
EN 910	Destructive tests on welds in metallic materials - Bend tests
EN 895	Destructive tests on welds in metallic materials – Transverse tensile test
EN 1043	Destructive tests on welds in metallic materials - Hardness testing
EN 875	Destructive tests on welds in metallic materials - Impact tests – Test specimen location, notch orientation and examination

International Institute of Welding (IIW) - Multilingual collection of terms for welding and allied processes Part 1- General terms

SECTION 2

WELD GEOMETRY AND SEQUENCE

2.1 Joint type

Specify reference no. according to table 2.1

2.2 Joint preparation

According to the type of joint specify the parameters given in table 2.1

2.3 Backing material and type

If used specify the backing material (e.g. copper, ceramics, etc.) and the type (e.g. permanent, removable, etc.)

2.4 Method of preparation

Specify the method by which the chamfer has been obtained (e.g. machining, grinding, etc.)

2.5 Welding sequence

(i) process 0 - buttering
(ii) process 1 - root
(iii) process 2 - filling 1
(iv) process 3 - filling 2
(v) process 4 - back filling

This sequence associates a number of process (0,1,2,etc.) with a precise phase of welding:
- process 0 is associated with the initial buttering
- process 1 is associated with the welding process used for the root pass/es (e.g. TIG)
- process 2 is associated with the welding process used for the first part of filling (e.g. MMA)
- process 3 is associated with the welding process used for the 2nd part of filling (e.g. SA)
- process 4 is associated with the welding process used for the filling of the back side of the weld (e.g. SA)

SECTION 3

WELDING PROCEDURE

3.1 Welding process details

3.1.1 Welding process type - select from Table 3.1.1

3.1.2 Welding technique - select from Table 3.1.2

3.1.3 Welding position - see Table 3.1.3

Specify the position with which the weld has been performed by using the codes given in table 3.1.3 (reference standard EN ISO 6947)

3.2 Welding consumable

3.2.1 Alloy name *

Generic filler metal title (e.g. 9Cr1Mo, 3.5Ni, 25Cr20Ni, NiCrMo3)

3.2.2 Specification and Grade Name *

Refers to the specification to which the filler metal was produced, e.g. EN499 and its grade name, e.g. E 42 5 B 32 H5

3.2.3 Trade name *

3.2.4 Chemical analysis of welding wire *
(i) Typical, given by manufacturer
(ii) Batch

(i) composition of the filler metal given by the manufacturer, e.g. from the catalogue
(ii) composition of the batch from which the filler metal has been obtained

3.2.5 Consumable dimension

Diameter of the electrode / rod / wire

3.2.6 Chemical analysis of weld-metal deposit *
(i) Typical (given by the manufacturer)
(ii) Actual (performed on the actual weld to be tested)

3.2.7 Number of passes

Specify the number of passes associated with each welding process

3.2.8 Thickness of deposited weld metal

Specify the thickness of the weld metal deposited by each welding process

3.2.9 Type of covering (for covered electrodes) - see table 3.2.9

3.2.10 Wire - Flux classification (if applicable) **

Specify the reference standards (e.g. DIN 32522 / 8557) and the classification (e.g. UP Y38 30 S1 BAR 188)

3.2.11 Flux trade name (if applicable) **

* *At least one of these items of information shall be supplied to identify the filler metal.*
** *At least one of these items of information shall be supplied to identify the flux.*

3.3 Gas

3.3.1 Shielding gas

Specify the designation (group and identity No) of the shielding gas used according to table 3.3 (reference standard EN 439)

3.3.2 Backing

(i) Gas - select designation from table 3.3
(ii) Other type of backing shield

If applicable
(i) specify the designation (group and identity no.) of the gas used according to table 2.3
(ii) specify the type of backing shield if other than above

3.3.3 Plasma gas

If applicable specify the designation (group and identity No) of the gas used according to table 3.3

3.4 Preheat and interpass parameters

3.4.1 Answer yes/no if preheat and interpass heating used or not

3.4.2 Preheat temperature

Specify the temperature applied at the start of the welding process

3.4.3 Interpass temperature

Specify the minimum temperature reached immediately prior to the application of the next run

3.4.4 Post-heating for hydrogen release

(i) temperature
(ii) time

3.4.5 Lowest temperature achieved after welding and prior to PWHT

In some weld joints it may be necessary to maintain a certain temperature if PWHT is not performed shortly after welding

3.4.6 Heating method

e.g. by flame, by resistance, etc.

3.4.7 Temperature measurement method

e.g. thermocouple or thermocolour

3.5 Technique

3.5.1 Initial and interpass cleaning

Specify the method of cleaning, e.g. by grinding, by brushing, by pickling, etc.

3.5.2 Method of back gouging

For joints welded from both sides specify the method used (e.g. arc-air, grinding, etc.)

3.5.3 String or weave beads

3.5.4 Weaving details

where applicable specify the details of weaving as follows:
- for manual welding: maximum width of the run
- for mechanized welding: frequency, amplitude, dwell time of oscillation

3.6 Electrical characteristics

3.6.1 Heat input

Heat input is calculated as follows:

$Q = k \times (\text{voltage} \times \text{current} \times 10^{-3}) / \text{welding speed}$

in which k = thermal efficiency is given in table 2.6.1 for the different welding processes

3.6.2 Type of current and polarity

Specify the type of current and polarity as follows:
- AC if alternate current is used
- DCEP if direct current is used, with positive electrode
- DCEN if direct current is used, with negative electrode

3.6.3 Pulse welding details

if applicable specify the following parameters:
(i) base and peak current
(ii) frequency and pulse time

3.6.4 Current range

3.6.5 Arc voltage range

3.6.6 Welding speed range

3.6.7 Wire feed rate (if applicable)

3.6.8 Plasma current

If applicable (for plasma arc welding)

3.7 Intermediate heat treatment (after buttering)

3.7.1 Answer yes/no if intermediate heat treatment used or not

3.7.2 Soak temperature

3.7.3 Heating rate

3.7.4 Soak time

3.7.5 Cooling rate

3.7.6 Heating method

3.7.7 Temperature measurement method

3.8 Post weld heat treatment

3.8.1 Answer yes/no if post weld heat treatment used or not

3.8.2 Soak temperature range

3.8.3 Heating rate

3.8.4 Soak time range

3.8.5 Cooling rate

3.8.6 Heating method

3.8.7 Temperature measurement method

SECTION 4

CHARACTERISTICS OF THE WELDMENT

4.1 Weldment approved for (creep) testing

This clause indicates that the welded joint produced is either completely free from defects or existing defects are small, identified and locations are known so that weld creep testpieces can be selected from sound metal

4.2 Welding qualification standard used (e.g. EN XXX)

4.3 Non-destructive testing

4.3.1 Type of final non-destructive examination

Specify the non-destructive examination performed after welding (and PWHT if performed); use the following codes:
- VE for visual examination
- MT for magnetic particle inspection
- PT for liquid penetrant inspection
- UT for ultrasonic inspection
- RT for radiographic inspection

4.3.2 Defects / imperfections recorded (yes/no)

4.3.2.1 Type of imperfection

Specify the reference number of the imperfection according to EN 26520 (e.g. 5011 for undercut, 201 for gas cavity)

4.3.2.2 Quality level of the imperfection according to EN 25817

Specify D (low), C (medium) or B (high) if the imperfection has dimensions smaller than the limits specified for the respective quality level (e.g. for undercut imperfection, if the height “h” is smaller than 0,5 mm specify B, if 0,5mm < h ≤ 1mm specify C, if 1mm< h ≤ 1,5 mm specify D)

4.4 Destructive testing

4.4.1 Cross weld room temperature tensile test
(i) Testpiece size
(ii) Tensile strength
(iii) Location of fracture

(i) Testpiece size – to state if full weld thickness or section within weld thickness used for tensile test
(iii) Location of fracture - use the following codes:
PM = fracture in parent metal
HAZ = fracture in heat affected zone
WM = fracture in weld metal

4.4.2 Impact test
(i) Testpiece dimensions
(ii) Notch type / location / direction
(iii) Test temperature
(iv) Individual test results
(v) Average energy absorbed (J) at test temperature(s)
(v) Average energy absorbed / unit area at test temperature(s)

(ii) notch type / location / direction - refer to the method of denomination of EN 875

4.4.3 Bend test
(i) Type
(ii) Bend angle

(iii) Diameter of former
(iv) Result (satisfactory, not satisfactory)

(i) Type - use the following codes:
- FB = face bend test
- RB = root bend test
- SB = Transverse side bend test

4.4.4 Macro examination

(i) Reference number of imperfections (if any) according to EN 26520
(ii) Weld zone width
(iii) HAZ width
(iv) For buttering: width on face side and on root side

(ii) weld zone width - record the minimum and maximum dimensions of the weld zone
(iii) HAZ width - record the minimum and maximum dimensions of the heat affected zone (from fusion line to unaffected parent metal)

Note: unaffected parent metal means "untransformed" for materials subjected to solid state transformation (e.g. carbon and low alloy steels) and "with unchanged grain size" for materials like austenitic and ferritic stainless steels, nickel base alloys, etc

4.4.5 Hardness test

(i) Location
(ii) Hardness

(i) location - specify the location with respect to the distance from the surfaces and the location among the different zones of the weld (PM = parent metal / HAZ = heat affected zone / WM = weld metal)
(ii) Hardness - state hardness test type and value; for multiple values in the same location specify the individual values and/or range

SECTION 5

STANDARD TERMS AND SYMBOLS

NAME	UNIT(S)	SYMBOL
5.1 Weld Geometry and Sequence (Section 2)		
Joint preparation (2.2) see Table 2.1 for graphical explanation		
Thickness	mm	t_Q
Gap	mm	b
Angles of bevel	degree (°)	α, α_1, α_2
Thickness of root face	mm	c
Depth of preparation	mm	h
Angle	degree (°)	β
Radius	mm	R
5.2 Welding Procedure (Section 3)		
Welding consumable (3.2)		
Thickness of deposited weld metal by process number	mm	t_D
Preheat and interpass (3.4)		
Temperature	degree Celsius (°C)	T
Time	Hours (h)	t
Technique (3.5)		
Weaving details:		
- maximum width of the run	mm	WR
- frequency	Hz	ν
- amplitude	mm	A
- dwell time of oscillation	s	dt
Electrical characteristics (3.6)		
Heat input	KJ/mm	Q
Thermal efficiency	-	*k*
Voltage	volt (V)	U
Current	ampere (A)	I
Welding speed	mm/s	v

NAME	UNIT(S)	SYMBOL
Pulsed welding details:		
- base current	ampere (A)	I_b
- peak current	ampere (A)	I_p
- frequency	Hz	ν_p
- pulse time	s	t_p
Current range	ampere (A)	ΔI
Arc voltage range	volt (V)	ΔU
Welding speed range	mm/s	Δv
Wire feed rate	mm/s	w_f
Plasma current	ampere	IP
Heat treatment (3.7 and 3.8)		
Temperature	degree Celsius (°C)	T
Heating rate / Cooling rate	°C/h	
Time	Hours (h)	t

5.3 Characteristics of the weldment (Section 4)

Cross weld room temperature tensile test (4.4.1)		
Testpiece size	mm	
Tensile strength	N/mm^2	R_m
Impact test (4.4.2)		
Testpiece dimensions	mm	
Test temperature	degree Celsius (°C)	
Energy absorbed	J	C_V
Energy/unit area	J/mm^2	A_v

NAME	UNIT(S)	SYMBOL
Bend test (4.4.3)		
Bend angle	degree (°)	α_B
Diameter of Former	mm	D_F
Macro examination (4.4.4)		
Weld zone width (minimum value)	mm	WZ_{min}
Weld zone width (maximum value)	mm	WZ_{max}
HAZ width (minimum value)	mm	H_{min}
HAZ width (maximum value)	mm	H_{max}
Width of buttering (on face side)	mm	WB_f
Width of buttering (on root side)	mm	WB_r
Hardness test (4.4.5)		
Hardness type		
- Vickers	Hardness number and load used	eg HV30
- Brinell	Hardness number	HBS (steel ball) HBW (WC ball)

SECTION 6

In general definitions are taken from European Standards; the definitions written in italic are taken from the IIW "Multilingual collection of terms for welding and allied processes".

PART 1 - DEFINITIONS OF TERMS USED

6.1 Weld geometry and sequence

Joint preparation	:	*The preparation for making a connection where the individual components have been suitably prepared and assembled to be joined by welding*
Backing	:	Piece of suitable material used to prevent a molten pool collapse during welding; it may also be used to assist formation of the root run
Permanent backing	:	Backing designed to remain permanently joined to the workpiece after welding
Temporary backing	:	Backing designed to be removed from the workpiece after welding
Buttering	:	*A surfacing operation in which one or more layers of weld metal are deposited on the groove face of one or both members to be joined. Buttering provides a metallurgically compatible weld metal for subsequent completion of the weld*
Root pass	:	The first run deposited in the root of a multirun weld

6.2 Welding procedure

Metal-arc welding with covered electrode	:	Manually operated metal-arc welding using a covered electrode
Flux-cored wire metal-arc welding without gas shield	:	Metal-arc welding using a tubular-cored electrode without external shielding gas
Submerged arc welding with wire electrode	:	Metal-arc welding in which one or more bare or cored wire(s), or strip electrode(s) are used. The arc(s) is (are) completely enveloped by molten slag which fuses from the granular flux that is deposited loosely

Metal-arc inert gas welding (MIG welding)	:	Gas-shielded metal-arc welding in which the shielding is provided by an inert gas, e.g. argon or helium
Metal-arc active gas welding (MAG welding)	:	Gas-shielded metal-arc welding in which the shielding is provided by a chemically active gas
Flux-cored wire metal-arc welding with active / inert gas shield	:	Metal-arc active / inert gas welding using a tubular-cored electrode
Tungsten inert gas arc welding (TIG welding)	:	Gas shielded arc welding using a non-consumable, pure or activated tungsten electrode in which the arc and the weld zone are protected by a shroud of inert gas; filler metal may be added
Plasma arc welding	:	Arc welding using the plasma of a constricted arc. Shielding may be supplemented by an auxiliary gas. Filler metal may or may not be added
Laser beam welding	:	Fusion welding using a coherent beam of monochromatic light
Electron beam welding	:	Fusion welding using a focused beam of electrons
Manual welding	:	Welding where the electrode holder, welding hand gun, torch or blowpipe are manipulated by hand
Partly mechanized welding	:	Manual welding where the wire feed is mechanized
Fully mechanized welding	:	Welding where all main operations (excluding the handling of the workpiece) are mechanized. Manual adjustment of welding variables during welding is possible
Automatic welding	:	Welding where all operations are mechanized. Manual adjustment of welding variables during welding is possible
Robotic welding	:	Automatic welding using a manipulator that can be pre-programmed to different welding directions and fabrication geometries

Welding position	:	Position determined by the location of the weld in space and by the working direction (see table 2.1.3 for a list of positions and their graphical explanation)
Welding consumables	:	Materials consumed in the making of a weld, including filler metals, fluxes and gases
Filler metal	:	*Metal added during welding, braze welding, brazing or surfacing*
Weld metal	:	*All metal melted during the making of a weld and retained in the weld*
Pass / Run	:	*The metal melted or deposited during one passage of an electrode, torch or blowpipe, electron or laser beam, etc.*
Gas backing	:	Auxiliary material (e.g. forming gas) used to prevent oxidation of the opposite side of the weld, and also to reduce the risk of a molten pool collapse
Preheat temperature	:	Temperature of the workpiece in the weld zone immediately prior to any welding operation. It is normally expressed as a minimum and is usually equal to the minimum interpass temperature
Interpass temperature	:	Temperature in a multi-run weld and adjacent parent metal immediately prior to the application of the next run. It is normally expressed as a maximum temperature.
Post-heating for hydrogen release	:	*The application of heat to an assembly after welding*
String bead	:	Bead that is produced with no weaving motion of the filler rod or welding tool
Weave bead	:	Bead that is produced with a weaving motion of the filler rod or welding tool
Weaving	:	A welding technique where the run is produced by oscillating the torch transverse to the direction of welding
Heat input	:	Energy introduced into the weld region during welding per unit run length

Thermal efficiency	:	Ratio of heat energy introduced into the weld to the electrical energy consumed by the arc
Current	:	Current passing through the electrode
Arc voltage	:	Electrical potential between contact tip or electrode holder and workpiece
Welding speed	:	Travel speed of the weld pool / Rate at which the welding operation progresses in the direction of welding
Wire feed rate	:	Length of wire consumed per unit time
Post weld heat treatment	:	Any heat treatment subsequent to welding

6.3 Non destructive testing

Non destructive testing	:	*Testing to detect internal, surface and concealed defects in materials using techniques that do not damage or destroy the items being tested*
Visual examination	:	*Visual judgment of the condition of the surface, shape and position of weld*
Magnetic particle inspection	:	*A method of inspection which facilitates the detection of superficial defects on a piece of ferrous metal subjected to a magnetic field. Where they occur, these defects cause magnetic disturbances which are revealed by the indicating media put into contact with the surface of the test piece.*
Liquid penetrant inspection	:	*A method of inspection employing a coloured or fluorescent penetrating fluid which allows the detection of faults issuing at the surface of the piece under examination*
Ultrasonic inspection	:	*A method of inspection to discover interior faults by projecting ultrasonic waves into the test piece and the observation of their reflected paths within it; ultrasonic inspection permits to determine the importance of faults as well as to locate their position.*
Radiographic inspection	:	*A method of inspection which employs X or gamma (g) rays or neutrons, which are able to penetrate a piece of metal to produce an image of a fault within*

		this piece of metal upon a sensitive screen or a radiograph
Defect / imperfection	:	A discontinuity in the weld or a deviation from the intended geometry. Imperfections include e.g. cracks, lack of penetration, porosity, slag inclusions

6.4 Destructive testing

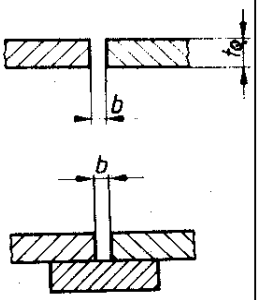
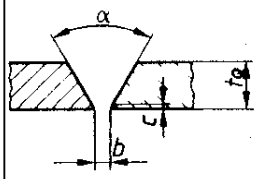
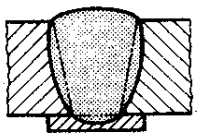
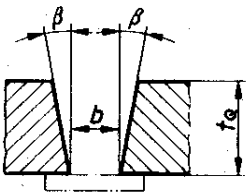
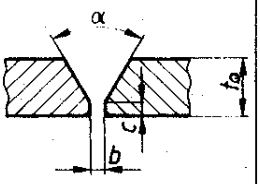
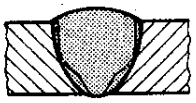
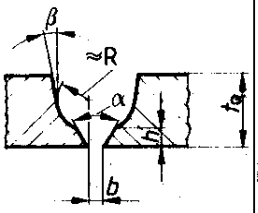
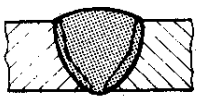
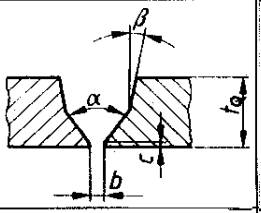
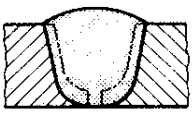
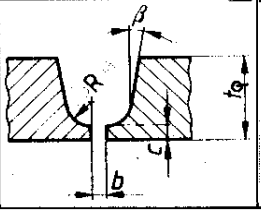
Destructive testing	:	*Testing to detect internal or external defects, or assess mechanical or metallurgical properties by mechanical means, which generally result in the destruction of the material*
Face bend test	:	Test made on a specimen for which the surface in tension is the side which contains the larger width of the weld or the side from which the welding arc was first applied.
Root bend test	:	Test made on a specimen for which the surface in tension is the side opposite to the face bend test specimen.
Transverse side bend test	:	Test made on a specimen for which the surface in tension is a cross section of the weld.

PART 2 - DEFINITIONS OF OTHER GENERAL WELDING TERMS

Arc welding	:	Fusion welding processes using an electric arc
Bevel / Chamfer	:	*An opening or channel in the surface of a part or between two components, which provides space to contain a weld*
Metal-arc welding	:	Arc welding processes using a consumable electrode
Deposited metal	:	*Filler metal after it becomes part of a weld or joint*
Direction of welding	:	Direction in which welding is carried out
Heat affected zone - HAZ	:	*That part of the parent metal which is metallurgically affected by the heat of welding, but not melted*
Multi-run welding	:	Welding in which the weld is made or layer deposited in more than two runs

Parent metal	:	*Metal to be joined, or surfaced, by welding, braze welding or brazing*
Stress relieving heat treatment	:	*Heating to a suitable temperature and holding it long enough to reduce residual stresses and then cooling slowly enough to minimise the development of new residual stresses without appreciably altering the structure.*
Weld zone	:	*The zone containing the weld metal and the heat-affected zone*
Welding operation	:	Operation in which workpieces are joined by welding
Weld	:	*The results of the welding operation*
Welding	:	*The union of two or more parts by heat or pressure or a combination of both such that the materials form a continuum. A filler material with a melting point similar to that of the parent material may be used*

Table 2.1 Part 1: Joint preparation for butt welds welded from one side

Ref. No. (*)	Designation	Illustration	Cross section	Parameters to be specified	Remarks
1.2	Square butt weld			Gap (b) Thickness (t_Q)	 With backing strip
1.3	Single-V butt weld			Angle of bevel (α) Gap (b) Thickness of root face (c) Thickness (t_Q)	$c \leq 2$ mm
1.14	Steep-flanked single-V butt weld			Angle (β) Gap (b) Thickness (t_Q)	With backing strip
1.5	Single-V butt weld with broad root face			Angle of bevel (α) Gap (b) Thickness of root face (c) Thickness (t_Q)	$c > 2$ mm
1.3.7	Single-U butt weld with V root			Angle of bevel (α) Angle (β) Gap (b) Depth of preparation (h) Radius (R) Thickness (t_Q)	
1.3.3	Single-V butt weld with V root			Angle of bevel (α) Angle (β) Gap (b) Thickness of root face (c) Thickness (t_Q)	
1.7	Single-U butt weld			Angle (β) Gap (b) Thickness of root face (c) Radius (R) Thickness (t_Q)	

(*) the reference number is in accordance with EN 29692

Table 2.1 Part 1: Joint preparation for butt welds welded from one side *(continue)*

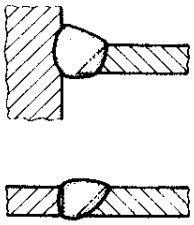
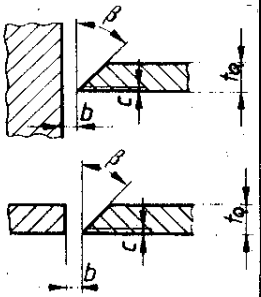
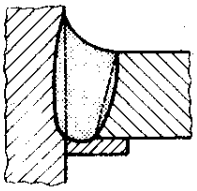
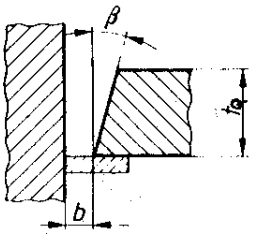
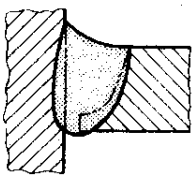
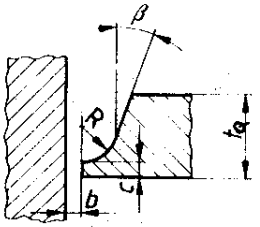
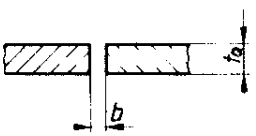
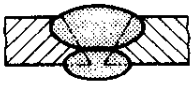
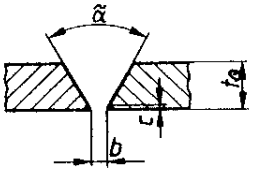
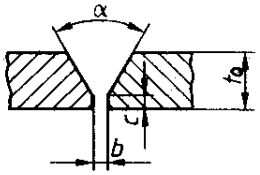
Ref. No. (*)	Designation	Illustration	Cross section	Parameters to be specified	Remarks
1.4	Single-bevel butt weld			Angle (β) Gap (b) Thickness of root face (c) Thickness (t_Q)	
1.15	Steep-flanked single-bevel butt weld			Angle (β) Gap (b) Thickness (t_Q)	With backing strip
1.8	Single-J butt weld			Angle (β) Gap (b) Thickness of root face (c) Radius (R) Thickness (t_Q)	With backing strip

Table 2.1 Part 2: Joint preparation for butt welds welded from both sides

Ref. No. (*)	Designation	Illustration	Cross section	Parameters to be specified	Remarks
2.2	Square butt weld			Gap (b) Thickness (t_Q)	
2.3.9	Single-V butt weld with run sealing			Angle of bevel (α) Gap (b) Thickness of root face (c) Thickness (t_Q)	c ≤ 2 mm
2.5.9	Single-V butt weld with root face and sealing run			Angle (β) Gap (b) Thickness of root face (c) Thickness (t_Q)	c > 2 mm

(*) the reference number is in accordance with EN 29692

Table 2.1 Part 2: Joint preparation for butt welds welded from both sides

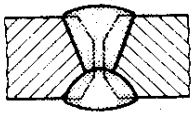
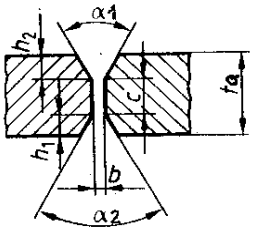
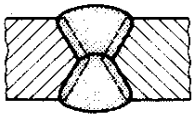
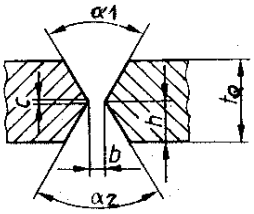
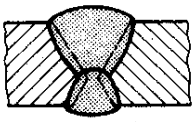
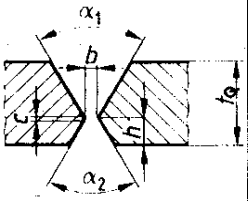
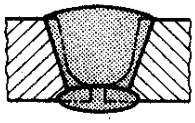
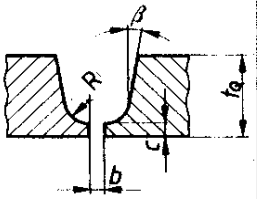
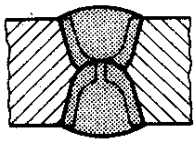
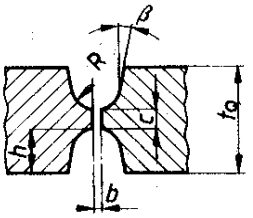
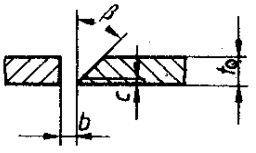
Ref. No. (*)	Designation	Illustration	Cross section	Parameters to be specified	Remarks
2.5.5	Double-V butt weld with broad root face			Angle of bevel (α_1, α_2) Gap (b) Thickness of root face (c) Depth of preparation (h_1, h_2) Thickness (t_Q)	
2.3.3	Double-V butt weld			Angle of bevel (α_1, α_2) Gap (b) Thickness of root face (c) Depth of preparation (h) Thickness (t_Q)	h = t/2
2.3.3 A	Asymmetrical double-V butt weld			Angle of bevel (α_1, α_2) Gap (b) Thickness of root face (c) Depth of preparation (h) Thickness (t_Q)	
2.7.9	Single-U butt weld with sealing run			Angle (β) Gap (b) Thickness of root face (c) Radius (R) Thickness (t_Q)	
2.7.7	Double-U butt weld			Angle (β) Gap (b) Thickness of root face (c) Depth of preparation (h) Radius (R) Thickness (t_Q)	It can also be asymmetrical
2.4.9	Single bevel butt weld with sealing run			Angle (β) Gap (b) Thickness of root face (c) Thickness (t_Q)	

Table 2.1 Part 2: Joint preparation for butt welds welded from both sides *(continue)*

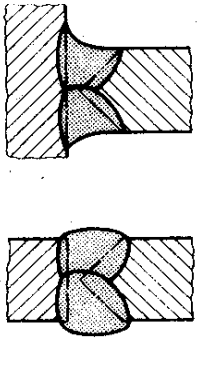
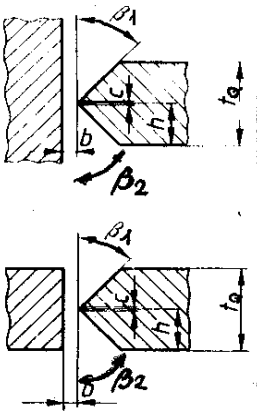
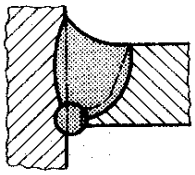
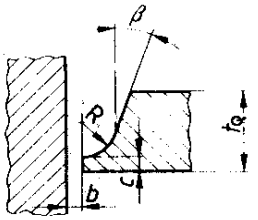
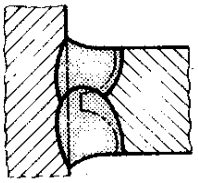
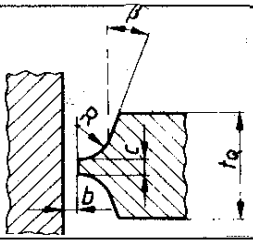
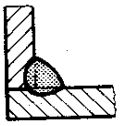
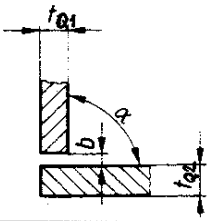
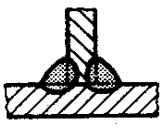
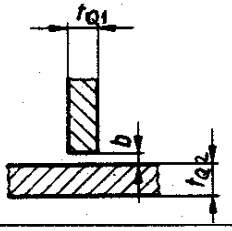
Ref. No. (*)	Designation	Illustration	Cross section	Parameters to be specified	Remarks
2.4.4	Double bevel butt weld			Angle (β_1, β_2) Gap (b) Thickness of root face (c) Depth of preparation (h) Thickness (t_Q)	It can also be asymmetrical
2.8.9	Single-J butt weld with sealing run			Angle (β) Gap (b) Thickness of root face (c) Radius (R) Thickness (t_Q)	
2.8.8	Double-J butt weld			Angle (β) Gap (b) Thickness of root face (c) Radius (R) Thickness (t_Q)	It can also be asymmetrical

Table 2.1 Part 3: Joint preparation for fillet welds

Ref. No. (*)	Designation	Illustration	Cross section	Parameters to be specified	Remarks
3.10A	Fillet weld, T-joint			Angle (α) Gap (b) Thicknesses (t_{Q1}, t_{Q2})	
4.10.10 C	Double fillet weld,			Gap (b) Thicknesses (t_{Q1}, t_{Q2})	

(*) the reference number is in accordance with EN 29692

Table 3.1.1

Welding process type

Numerical Designation	Full designation	Abbreviation
111	Metal-arc welding with covered electrode	MMA
114	Flux-cored wire metal-arc welding without gas shield	FCAW-NG
121	Submerged arc welding with wire electrode	SA
131	Metal-arc inert gas welding	MIG
135	Metal-arc active gas welding	MAG
136	Flux-cored wire metal-arc welding with active gas shield	FCAW-AG
137	Flux-cored wire metal-arc welding with inert gas shield	FCAW-IG
141	Tungsten inert gas arc welding	TIG
151	Plasma arc welding	PAW
751	Laser beam welding	LBW
76	Electron beam welding	EBW
Other(*)		
Not Known		

(*) take number and designation from EN 24063 (ISO 4063)

Table 3.1.2

Welding technique

MW - Manual welding

PMW - Partly mechanized welding

FMW - Fully mechanized welding

AW - Automatic welding

RW - Robotic welding

Table 3.1.3

Welding position

PA - flat position

PB - horizontal vertical position

PC - horizontal position

PD - horizontal overhead position

PE - overhead position

PF - vertical up position

PG - vertical down position

Inclined position: - for plates specify slope S and rotation R according to EN ISO 6947

- for pipes specify the welding direction (H, J or K) and the angle of inclination L of the pipes according to EN ISO 6947

see sketch on next page (taken from EN ISO 6947)

Table 3.2.9

Type of covering

A - Acid covering

B - Basic covering

C - Cellulosic covering

R - Rutile covering

RA - Rutile-acid covering

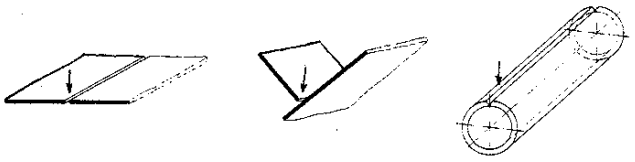
RB - Rutile-basic covering

RC - Rutile-cellulosic covering

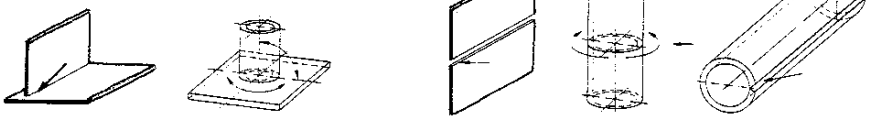
RR - Rutile thick covering

S - Other

N - Not known

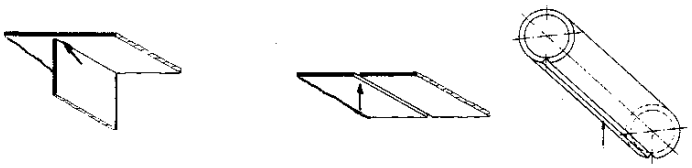


a) PA: flat position



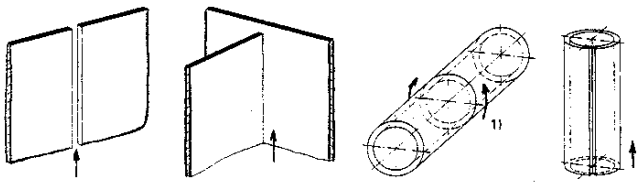
b) PB: horizontal vertical position

c) PC: horizontal position

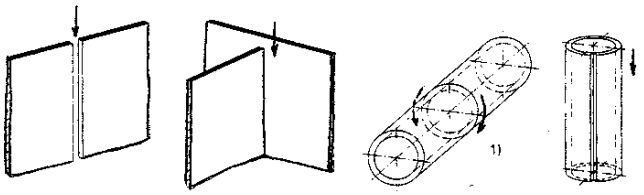


d) PD: horizontal overhead position

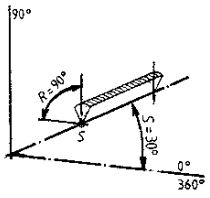
e) PE: overhead position



f) PF: vertical up position[1)]



g) PG: vertical down position[1)]



Inclined position for plates

Examples of welding position (from EN ISO 6947)

Table 3.3

Classification of shielding Gases

(table taken from EN 439)

1) Designation		Constituents in percent volume						Typical Applications	Remarks
Group	Identity No	Oxidizing		Inert	Reducing		Unreactive		
		CO_2	O_2	Ar	He	H_2	N_2		
R	1 2			Balance [2)] Balance [2)]		> 0 to 15 > 15 to 35		TIG, PAW, PAC, Back Shielding	Reducing
I	1 2 3			100 Balance	 100 > 0 to 95			MIG, TIG, PAW, Back Shielding	Inert
M1	1 2 3 4	> 0 to 5 > 0 to 5 > 0 to 5	 > 0 to 3 > 0 to 3	Balance [2)] Balance [2)] Balance [2)] Balance [2)]		> 0 to 5		MAG	Slightly oxidizing
M2	1 2 3 4	> 5 to 25 > 0 to 5 > 5 to 25	 > 3 to 10 > 3 to 10 > 0 to 8	Balance [2)] Balance [2)] Balance [2)] Balance [2)]					
M3	1 2 3	> 25 to 50 > 5 to 50	 > 10 to 15 > 8 to 15	Balance [2)] Balance [2)] Balance [2)]					More pronounced oxidation
C	1 2	100 Balance	 > 0 to 30						
F	1 2					 > 0 to 50	100 Balance	PAC. Back Shielding	Unreactive Reducing

1) Where components not listed are added to one of the groups in this table, the mixture is designated as special gas mixture and carries the prefix S followed by the base gas or mixture symbol as in the above table followed by the percent concentration by volume and chemical formula of the additional gases.

2) Argon may be replaced by up to 95% helium. The helium content is designated by an additional identification number added in brackets as a suffix as indicated below:

Identification number	Helium content in volume %
(1)	> 0 to 33
(2)	> 33 to 66
(3)	> 66 to 95

Table 3.6.1

Thermal efficiency factor *k* of welding process

(table taken from EN 1011-1)

Process No	Process	Factor *k*
121	Submerged arc welding with wire electrode	1.0
111	Metal-arc welding with covered electrode	0.8
131	Metal-arc inert gas welding	0.8
135	Metal-arc active gas welding	0.8
114	Flux-cored wire metal-arc welding without gas shield	0.8
136	Flux-cored wire metal-arc welding with active gas shield	0.8
137	Flux-cored wire metal-arc welding with inert gas shield	0.8
138	Metal-cored wire metal-arc welding with active gas shield	0.8
139	Metal-cored wire metal-arc welding with inert gas shield	0.8
141	Tungsten inert gas arc welding	0.6
15	Plasma arc welding	0.6