Welding Inspector

Terms and Definitions

Section 2

Terms and Definitions

- Types of weld
- Types of joints (see BS EN ISO 15607)
- Features of the completed weld
- Weld preparation
- Size of butt welds
- Fillet weld
- Welding position, weld slope and weld rotation
- weaving

Welding Terminology & Definitions 2.1

What is a Weld?

- A union of pieces of metal made by welding. (BS499)

What is a Welding?

- An operation in which two or more parts are united by means of heat or pressure or both, in such a way that there is continuity in the nature of the metal between these parts. (BS499)

- A localised coalescence of metals or non-metals produced either by heating the materials to the welding temperature, with or without the application of pressure, or by the application of pressure alone and with or without the use of filler metal ” (AWS)

Welding Terminology & Definitions 2.1

What is a Brazing?

- A process of joining generally applied to metals in which, during or after heating, molten filler metal is drawn into or retained in the space between closely adjacent surfaces of the parts to be joined by capillary attraction. In general, the melting point of the filler metal is above 450°C but always below the melting temperature of the parent materials. (BS499)

What is a Braze welding?

- The joining of metal using a technique similar to fusion welding and a filler metal with a lower melting point than the parent metal, but neither using capillary action as in brazing nor intentionally melting the parent metal. (BS499)

Welding Terminology & Definitions 2.1

An Autogenous weld:

- A weld made without the use of a filler material and can only be made by TIG, Plasma, electron beam, laser or Oxy-Gas Welding.

What is a Joint?

- A connection where the individual components, suitably prepared and assemble, are joined by welding or brazing. (BS499)

- The junction of members or the edges of members that are to be joined or have been joined (AWS).

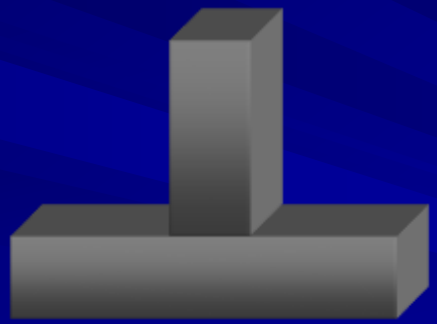
Joint Terminology 2.2

Edge

Open & Closed Corner

Lap

Cruciform

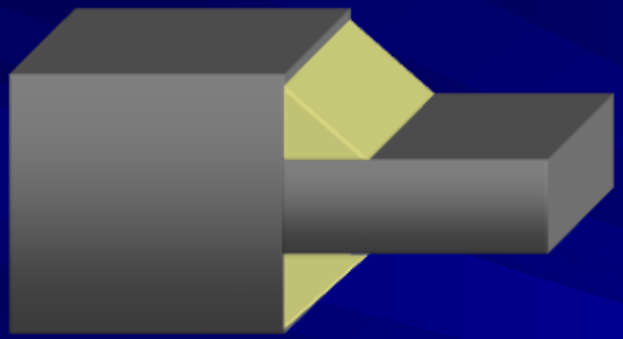


Tee

Butt

Welded Butt Joints 2.2

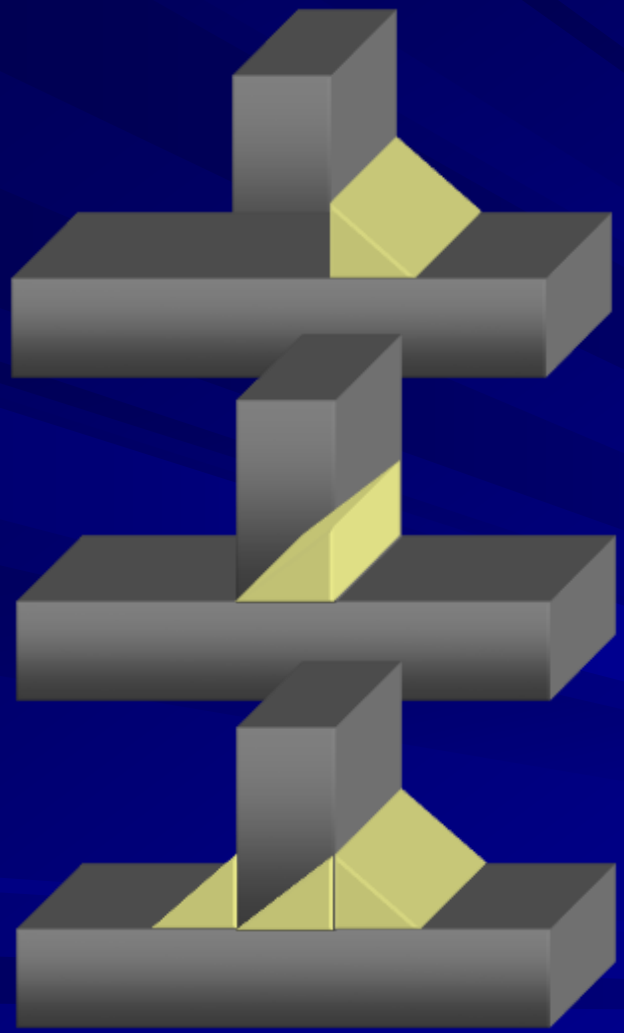
A Butt Welded butt joint



A Fillet Welded butt joint

A Compound Welded butt joint

Welded Tee Joints 2.2



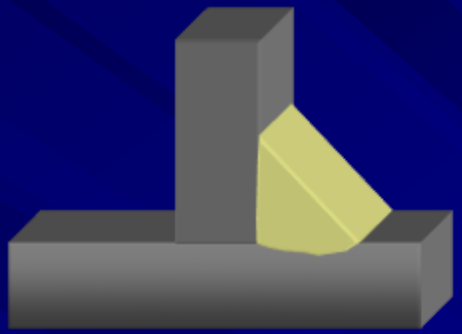
A Fillet Welded T joint

A Butt Welded T joint

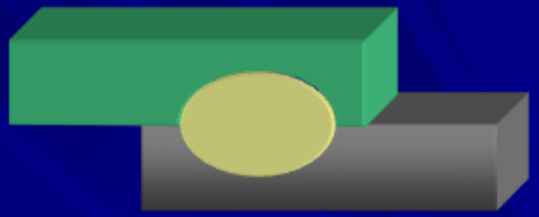
A Compound Welded T joint

Weld Terminology 2.3

Butt weld



Fillet weld



Spot weld

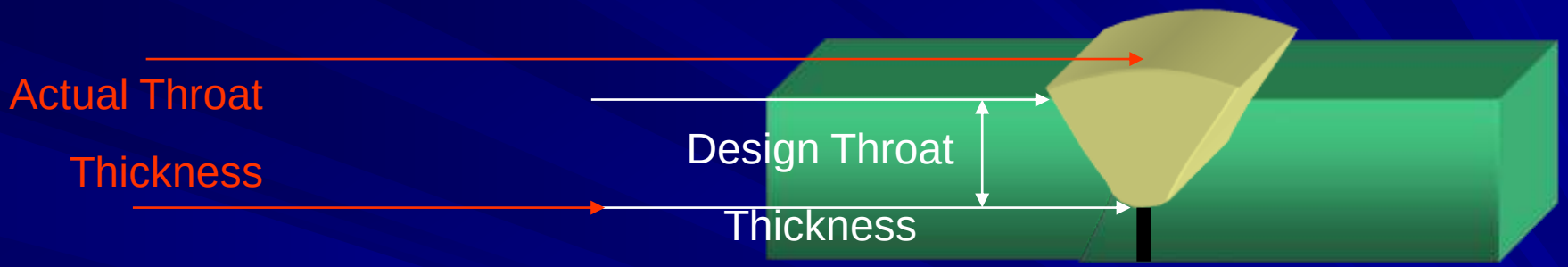
Edge weld

Plug weld

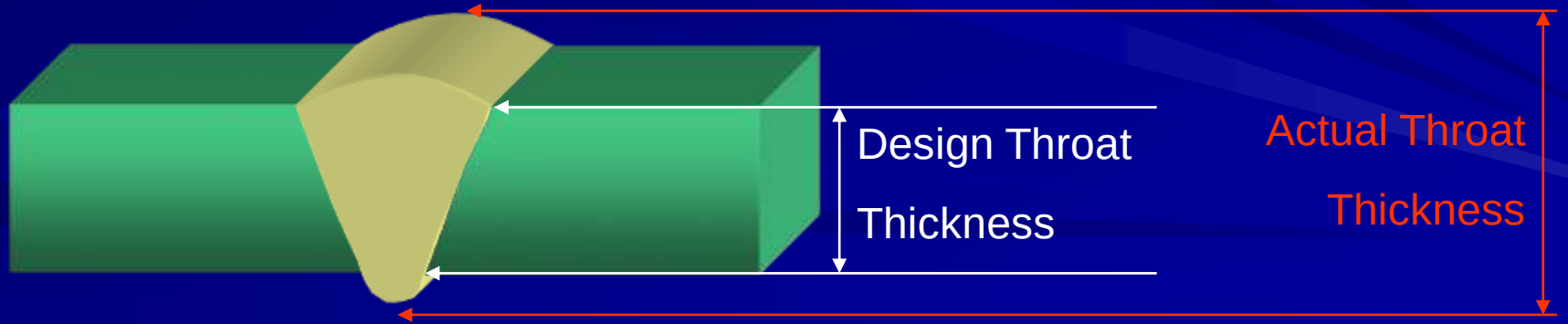
Compound weld

Butt Preparations – Sizes 2.4

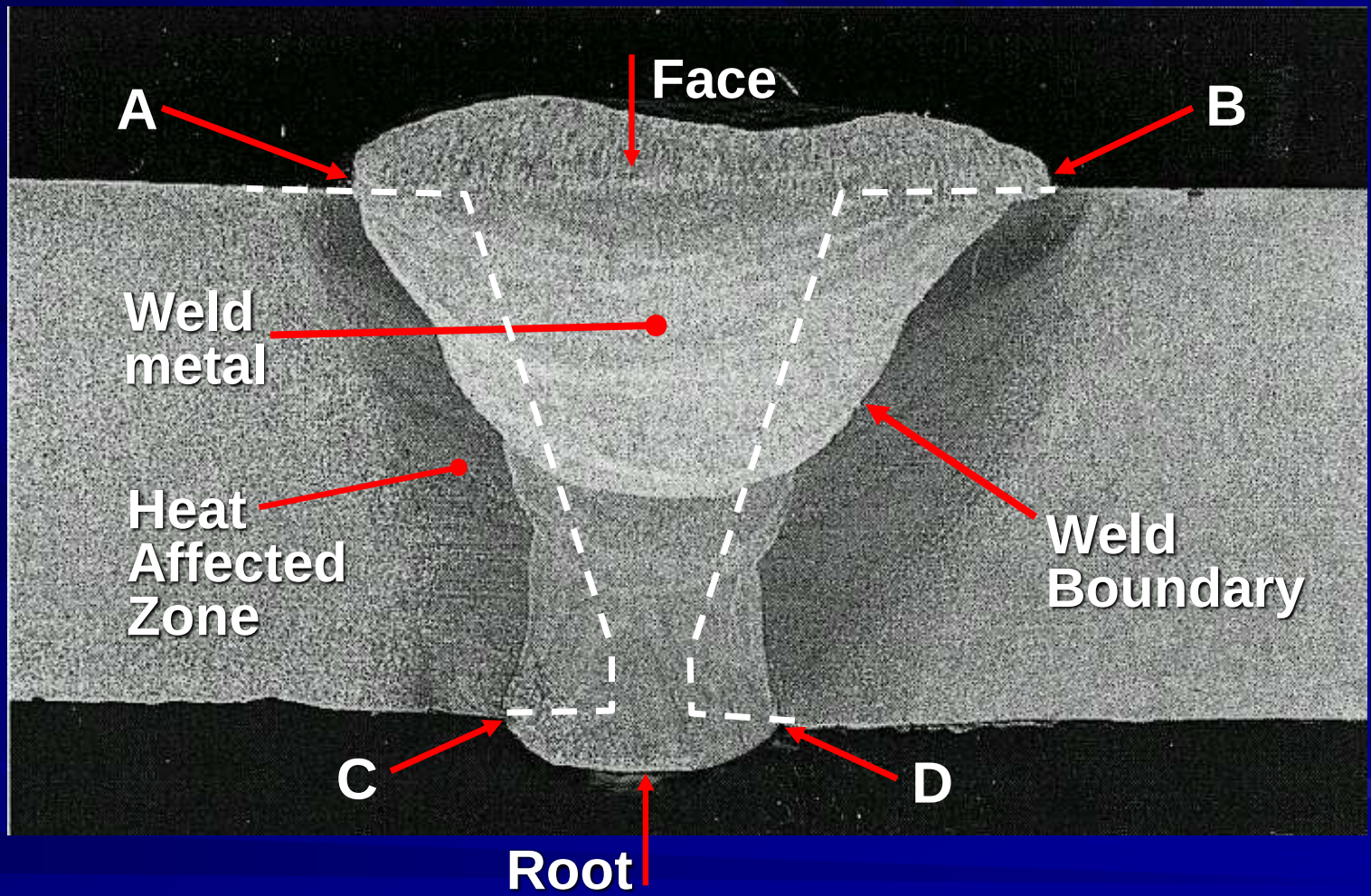
Partial Penetration Butt Weld



Full Penetration Butt Weld

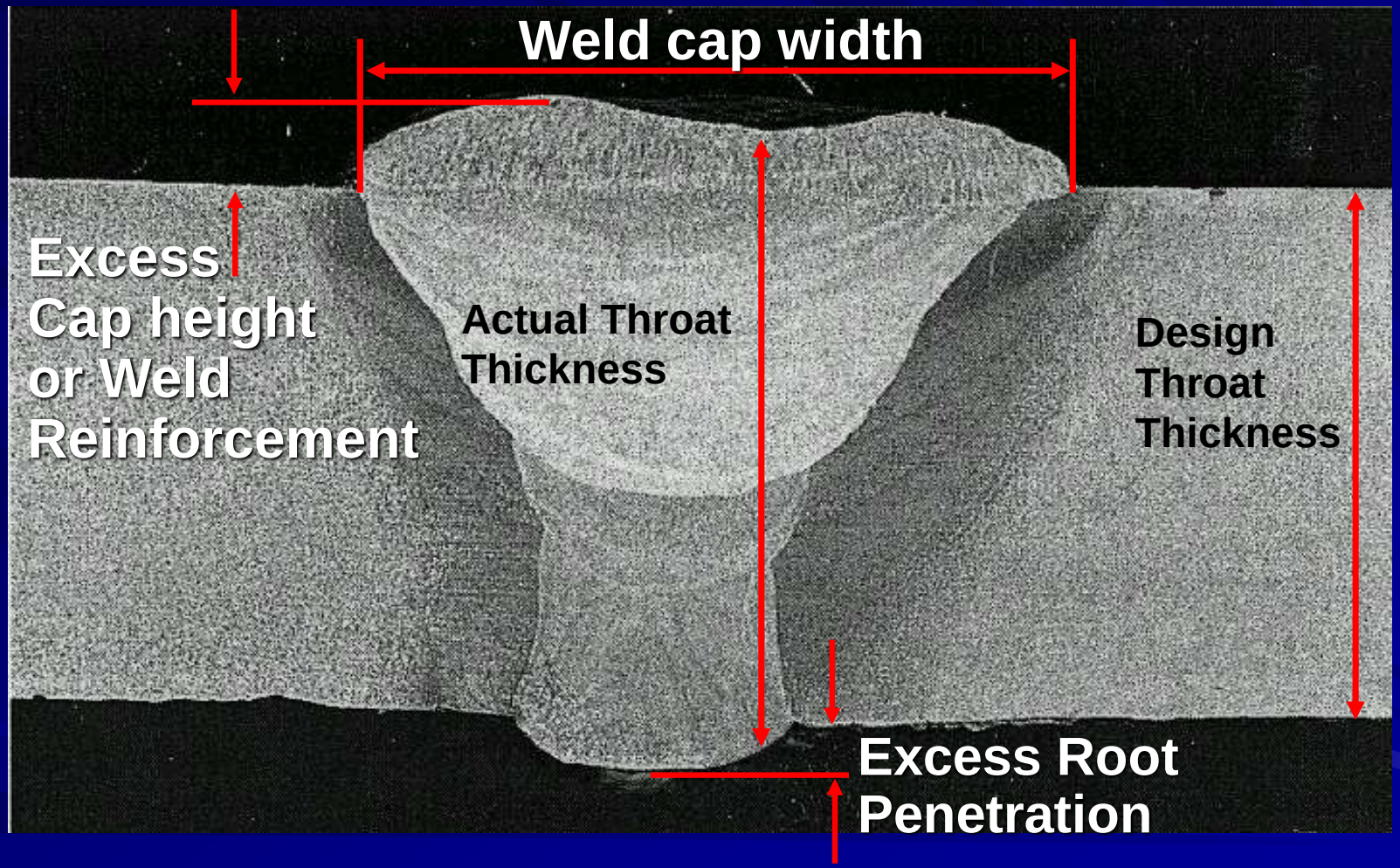


Weld Zone Terminology 2.5

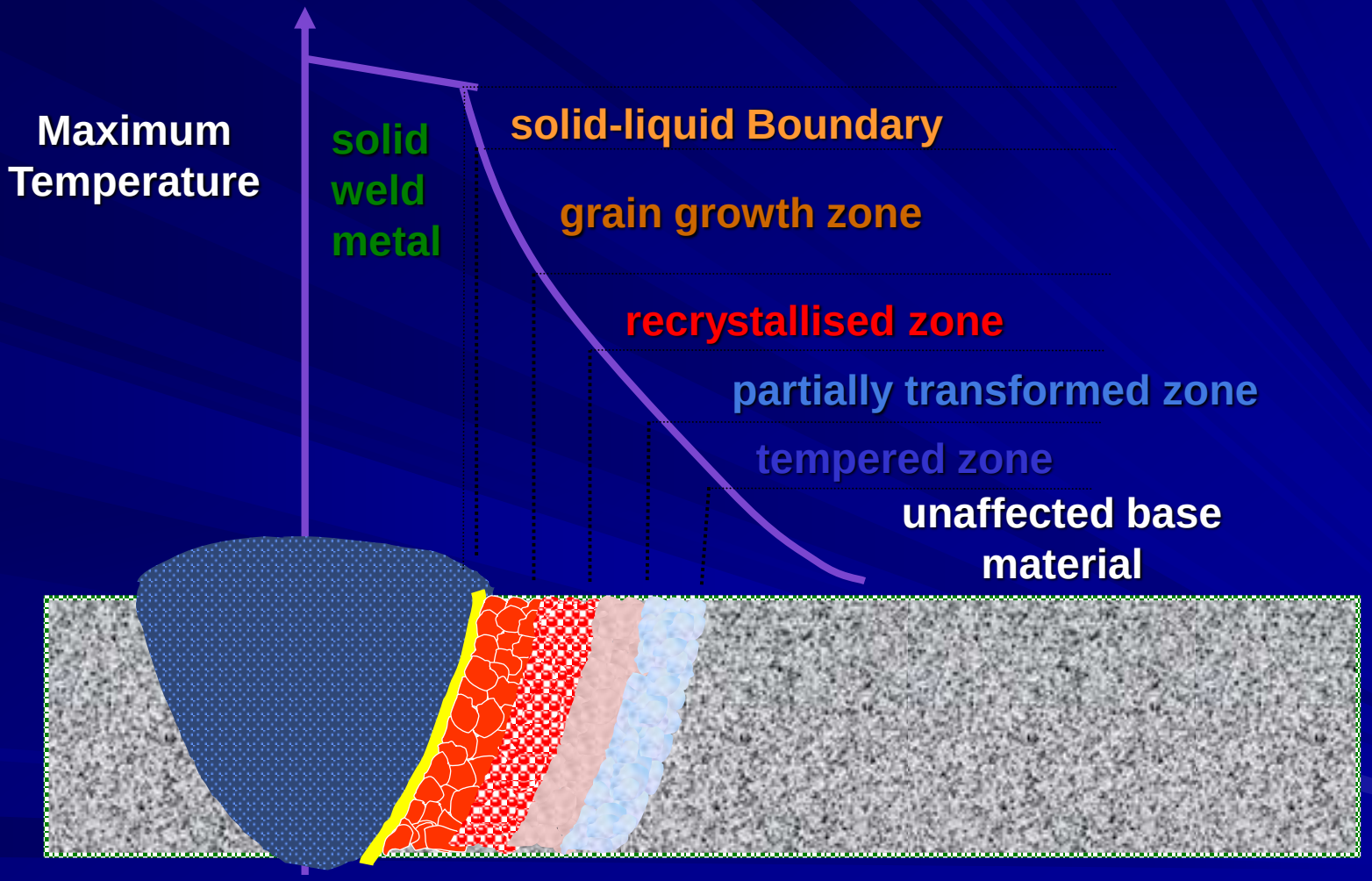


A, B, C & D = Weld Toes

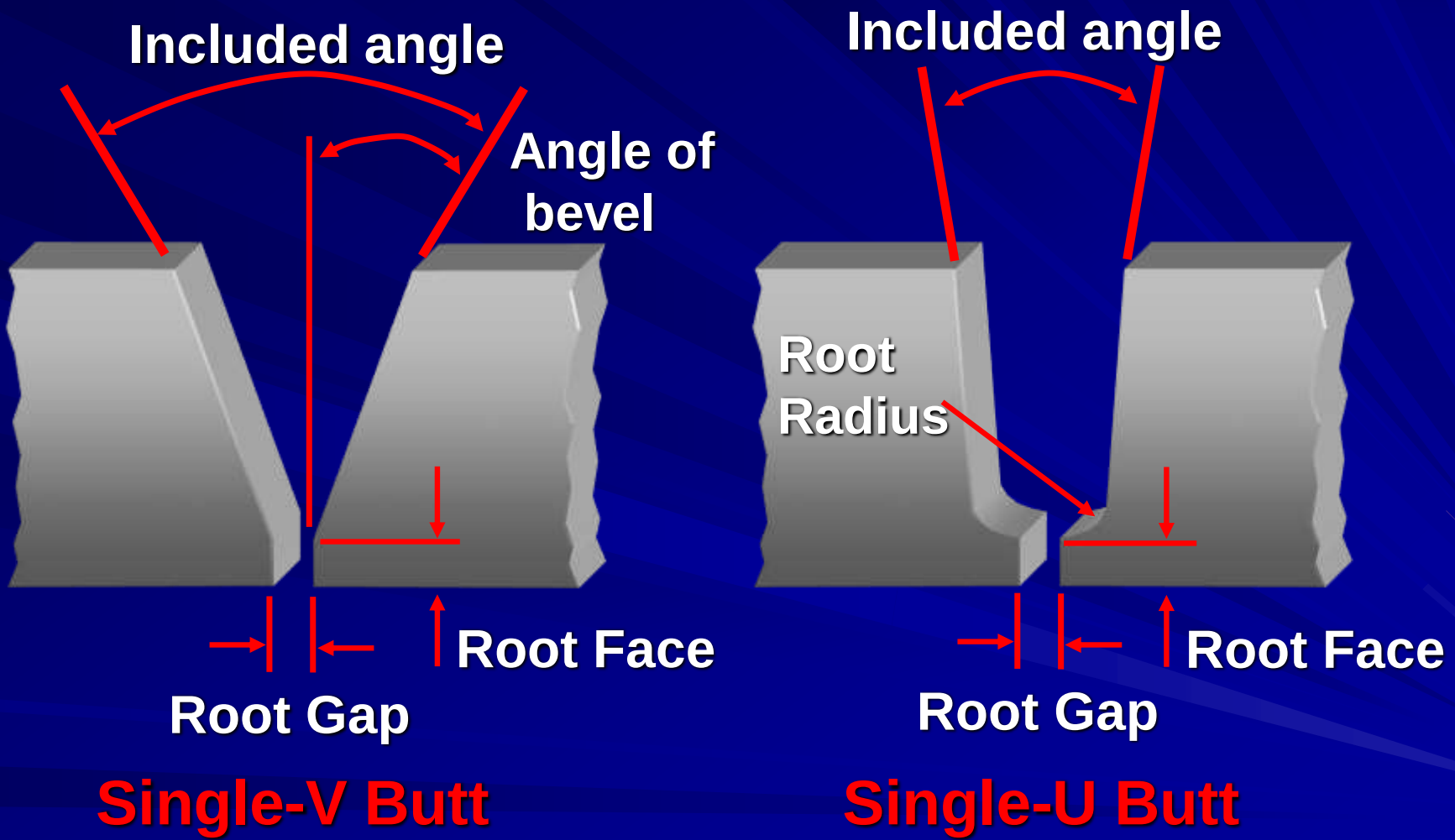
Weld Zone Terminology 2.5



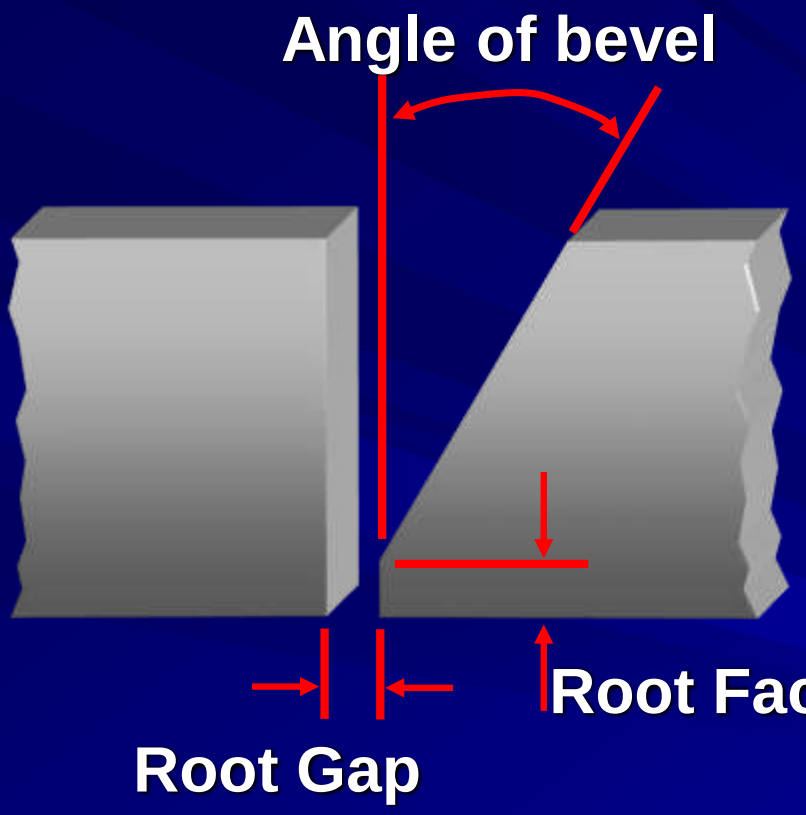
Heat Affected Zone (HAZ) 2.5



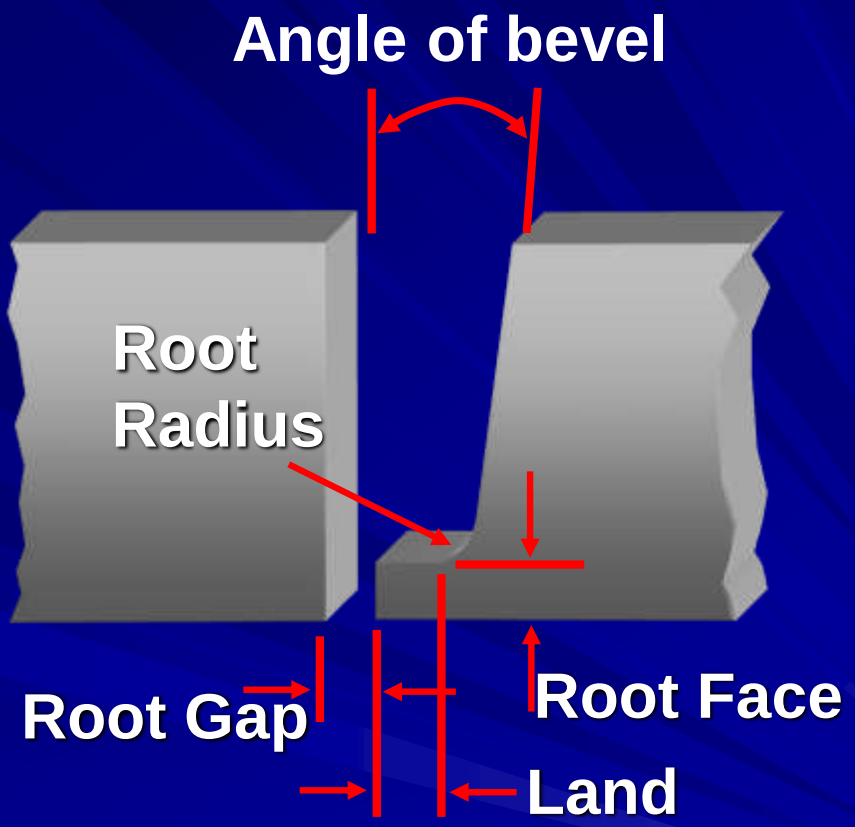
Joint Preparation Terminology 2.7



Joint Preparation Terminology 2.8 & 2.9



Single Bevel Butt



Single-J Butt

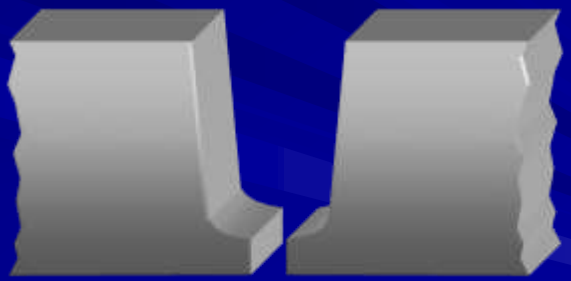
Single Sided Butt Preparations 2.10

Single sided preparations are normally made on thinner materials, or when access form both sides is restricted

Single Bevel

Single Vee

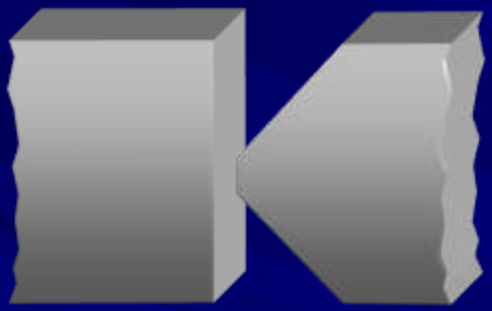
Single-J



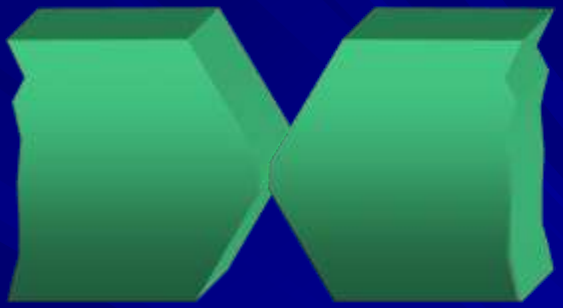
Single-U

Double Sided Butt Preparations 2.11

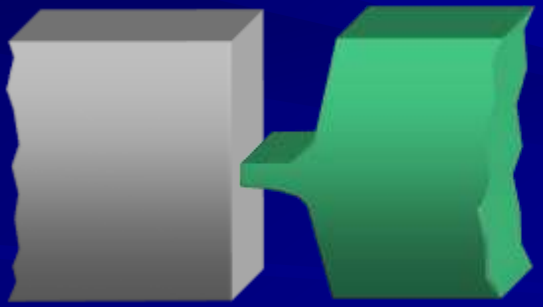
Double sided preparations are normally made on thicker materials, or when access form both sides is unrestricted



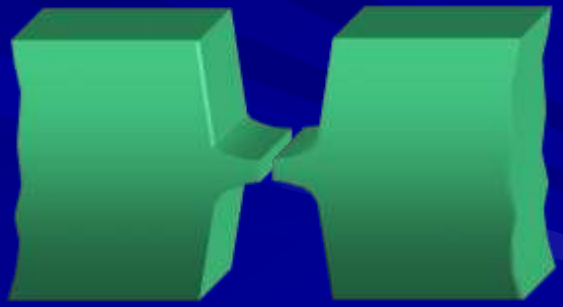
Double-Bevel



Double-Vee



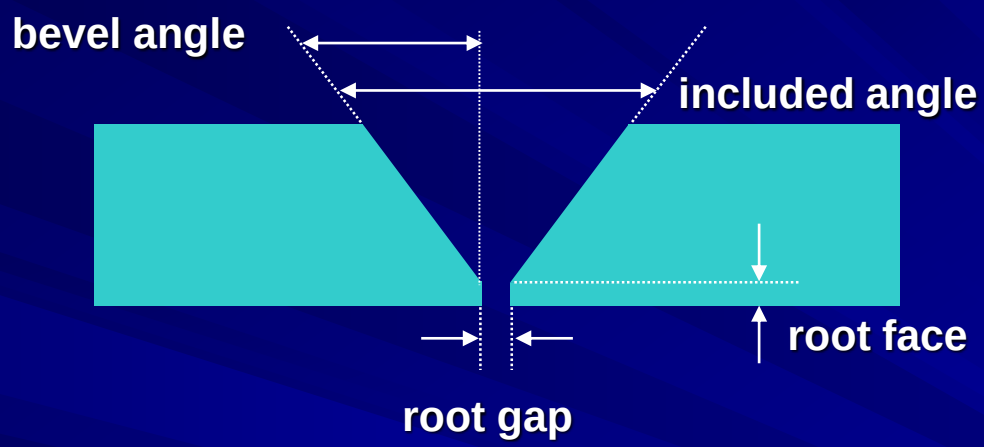
Double- J



Double- U

Weld Preparation

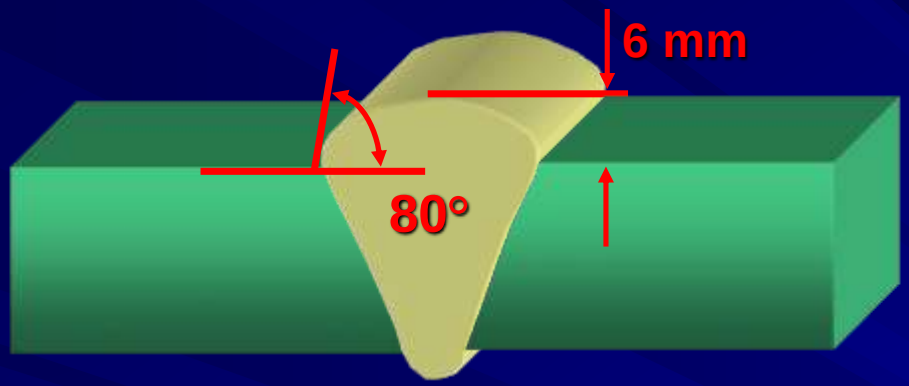
Terminology & Typical Dimensions: V-Joints



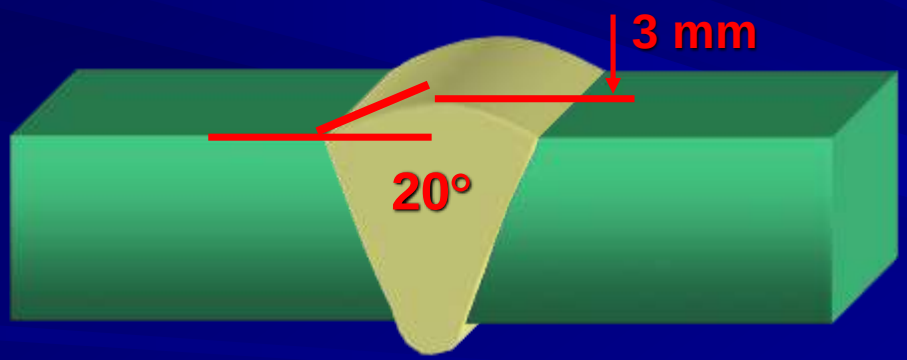
Typical Dimensions

bevel angle	25 ° to 30°
root face	~1 to ~2 mm
root gap	~1 to ~4 mm

Butt Weld - Toe Blend



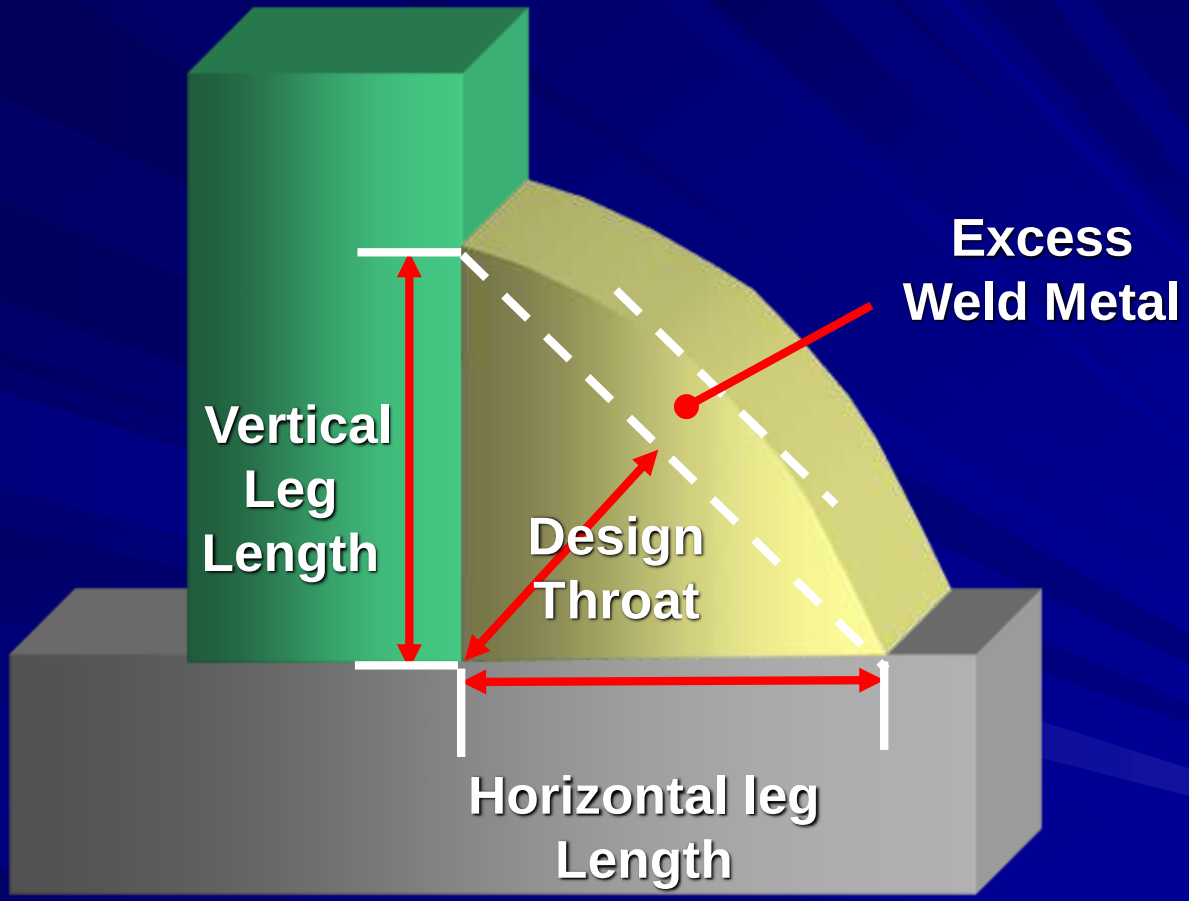
Poor Weld Toe Blend Angle



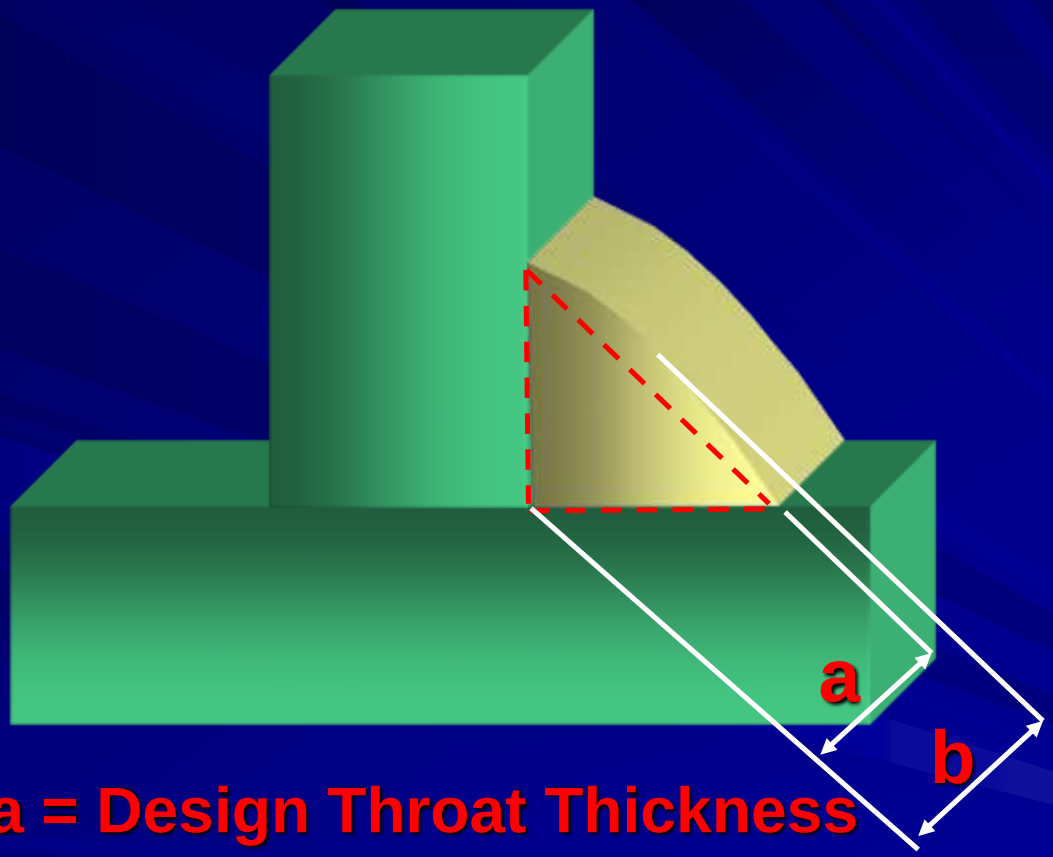
Improved Weld Toe Blend Angle

- Most codes quote the weld toes shall blend smoothly
- This statement is not quantitative and therefore open to individual interpretation
- The higher the toe blend angle the greater the amount of stress concentration
- The toe blend angle ideally should be between 20°-30°

Fillet Weld Features 2.13



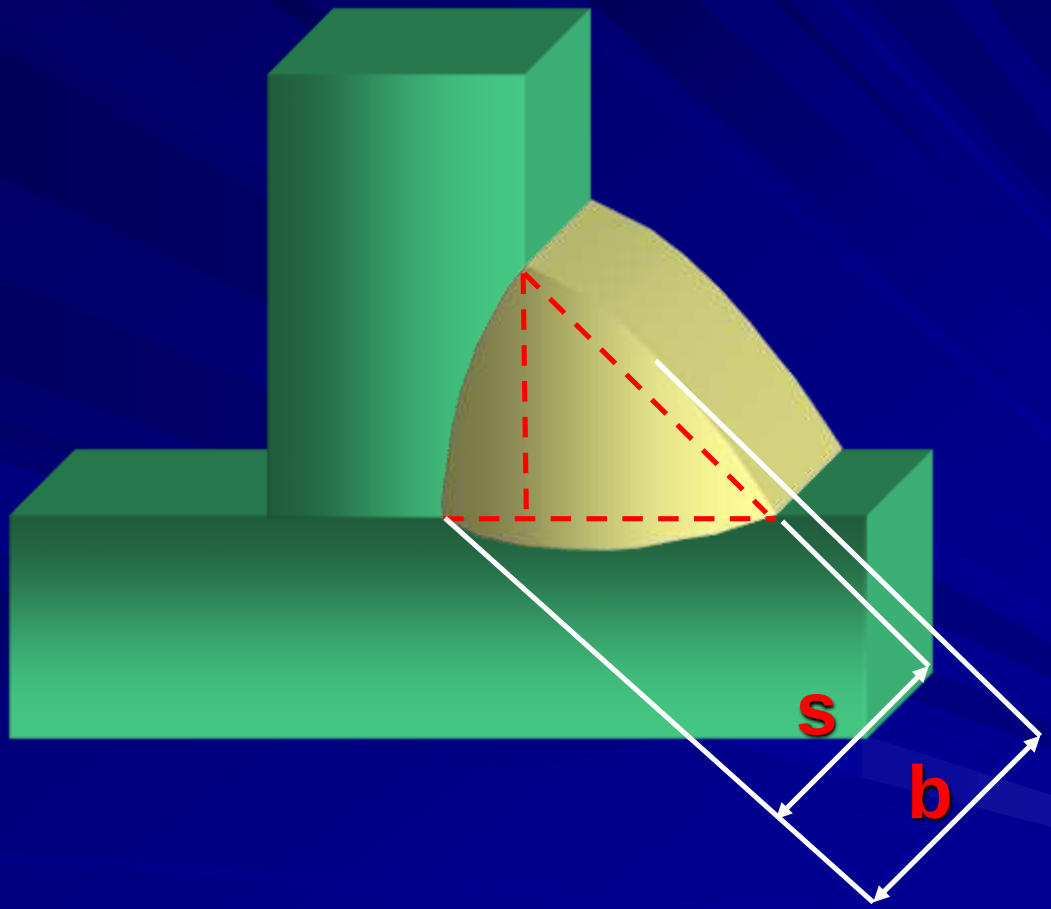
Fillet Weld Throat Thickness 2.13



a = Design Throat Thickness

b = Actual Throat Thickness

Deep Penetration Fillet Weld Features 2.13



s = Design Throat Thickness
(Deep penetration Fillet weld)

b = Actual Throat Thickness

Fillet Weld Sizes 2.14

Calculating Throat Thickness from a known Leg Length:

Design Throat Thickness = Leg Length x 0.7

Question: The Leg length is 14mm.

What is the Design Throat?

Answer: 14mm x 0.7 = 10mm Throat Thickness

Fillet Weld Sizes 2.14

Calculating Leg Length from a known Design Throat Thickness:

Leg Length = Design Throat Thickness x 1.4

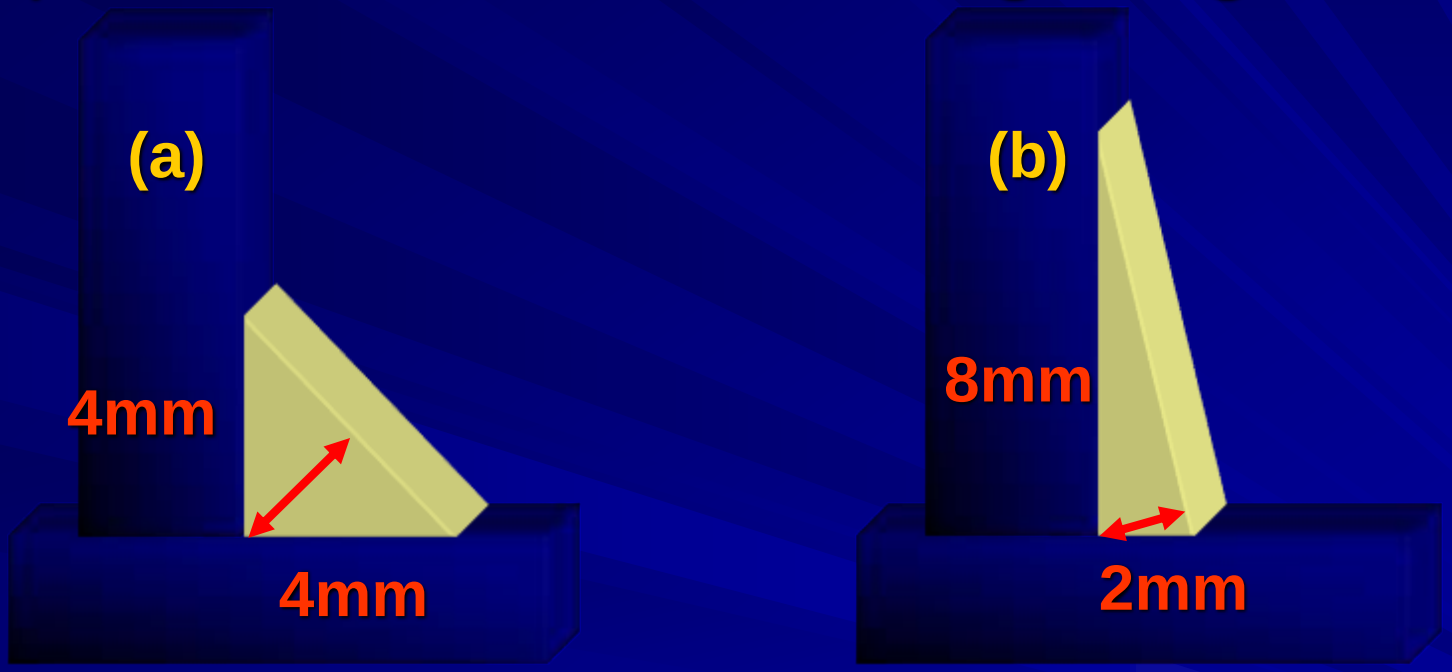
Question: The Design Throat is 10mm.

What is the Leg length?

Answer: 10mm x 1.4 = 14mm Leg Length

Features to Consider 2

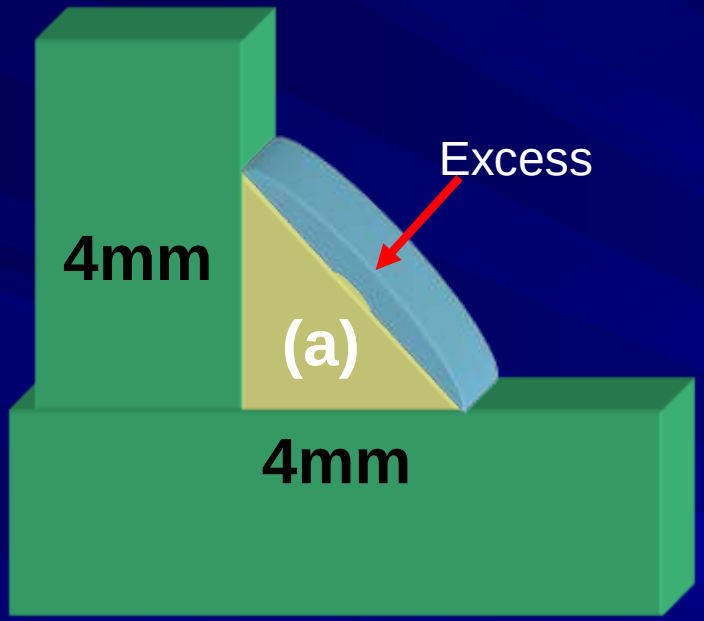
Importance of Fillet Weld Leg Length Size

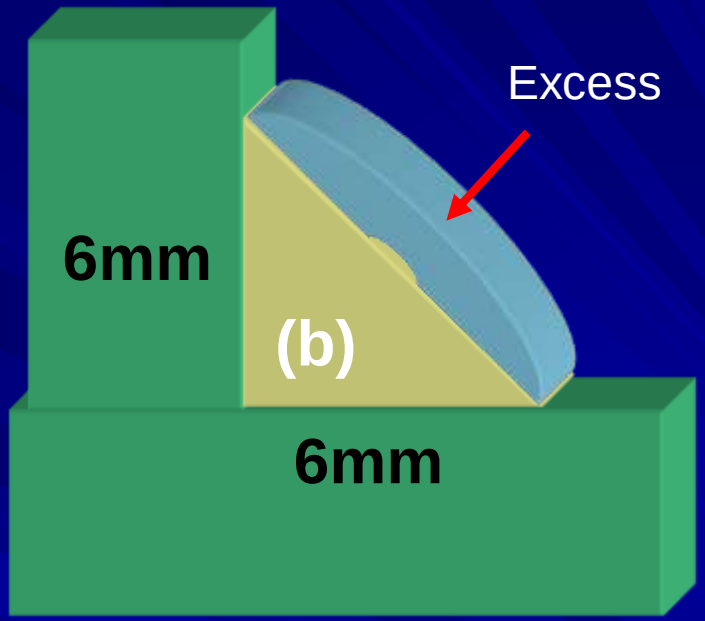


Approximately the same weld volume in both Fillet Welds, but the effective throat thickness has been altered, reducing considerably the strength of weld B

Fillet Weld Sizes 2.14

Importance of Fillet weld leg length Size





Area = (4 x 4)/2

= 8 mm^2

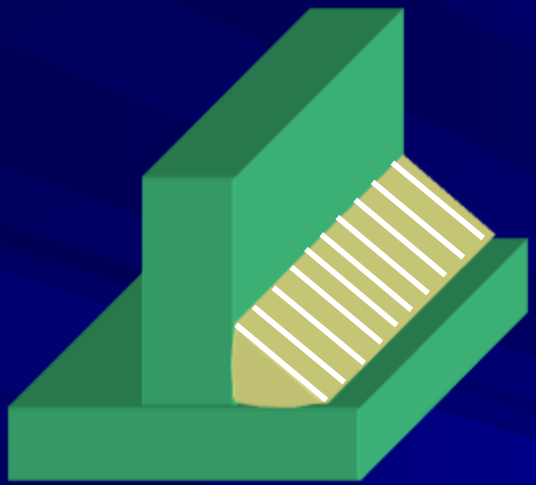
Area = (6 x 6)/2

= 18 mm^2

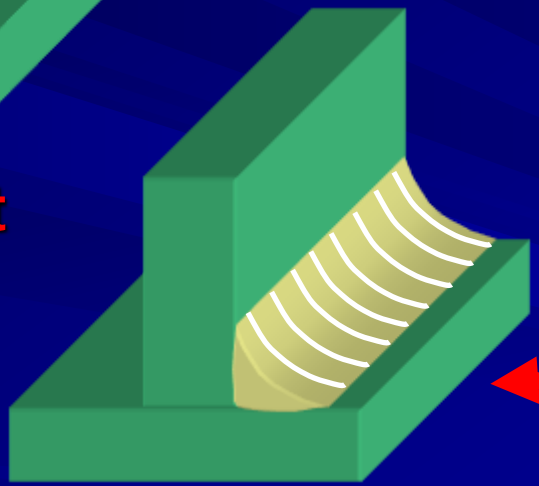
The c.s.a. of (b) is over double the area of (a) without the extra excess weld metal being added

Fillet Weld Profiles 2.15

Fillet welds - Shape



Mitre Fillet



Concave Fillet

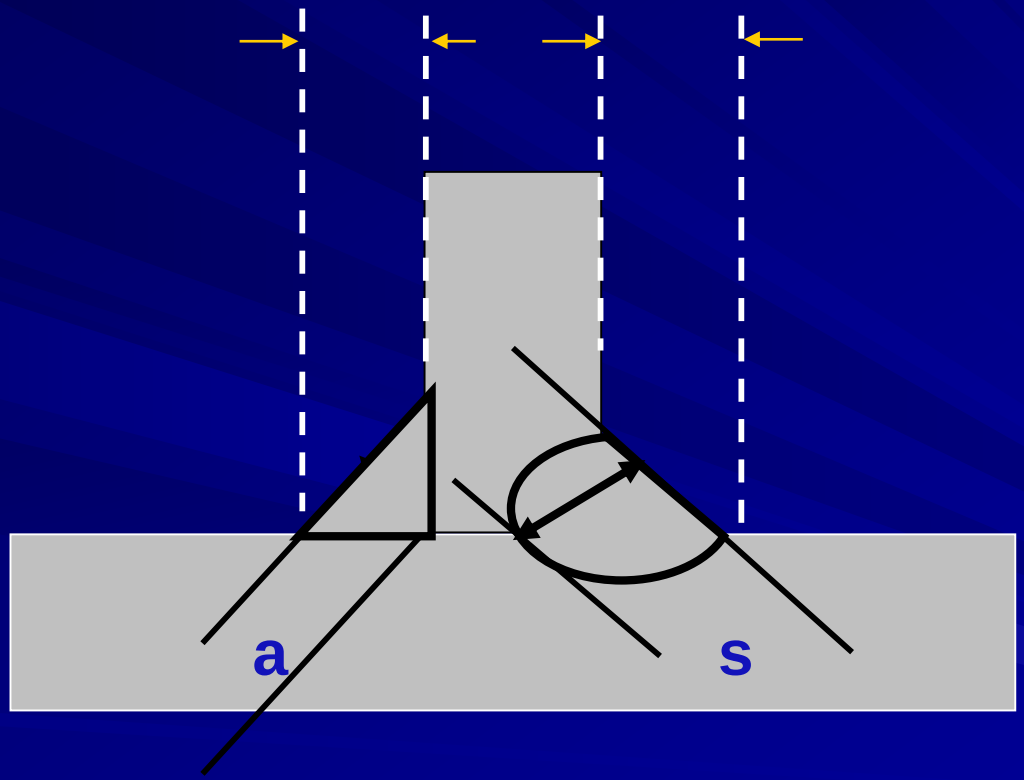
Convex Fillet

A concave profile is preferred for joints subjected to fatigue loading

Fillet Features to Consider 2.15

EFFECTIVE THROAT THICKNESS

“a” = Nominal throat thickness **“s” = Effective throat thickness**



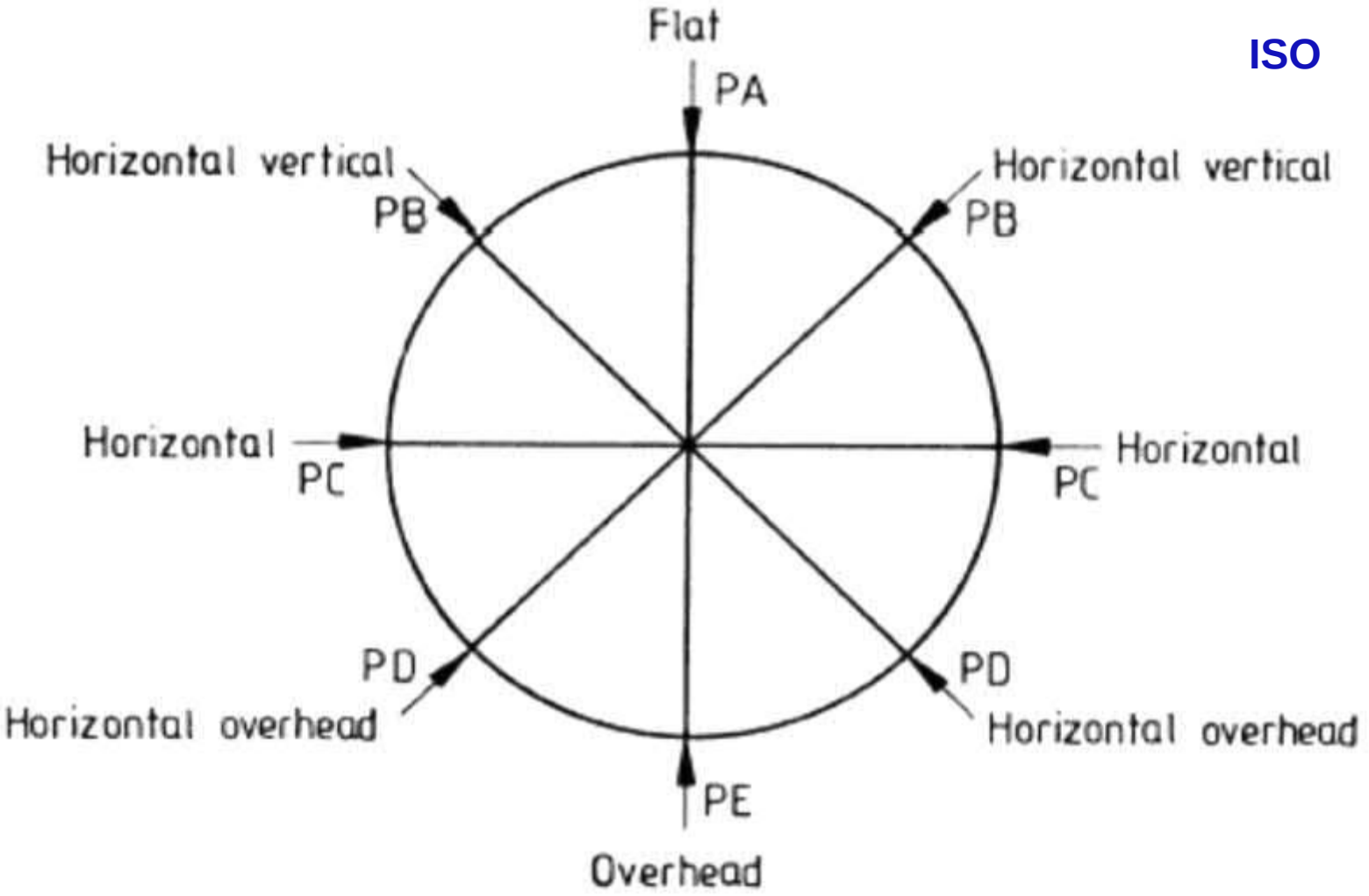
Deep penetration fillet welds from high heat input welding process MAG, FCAW & SAW etc

Welding Positions 2.17

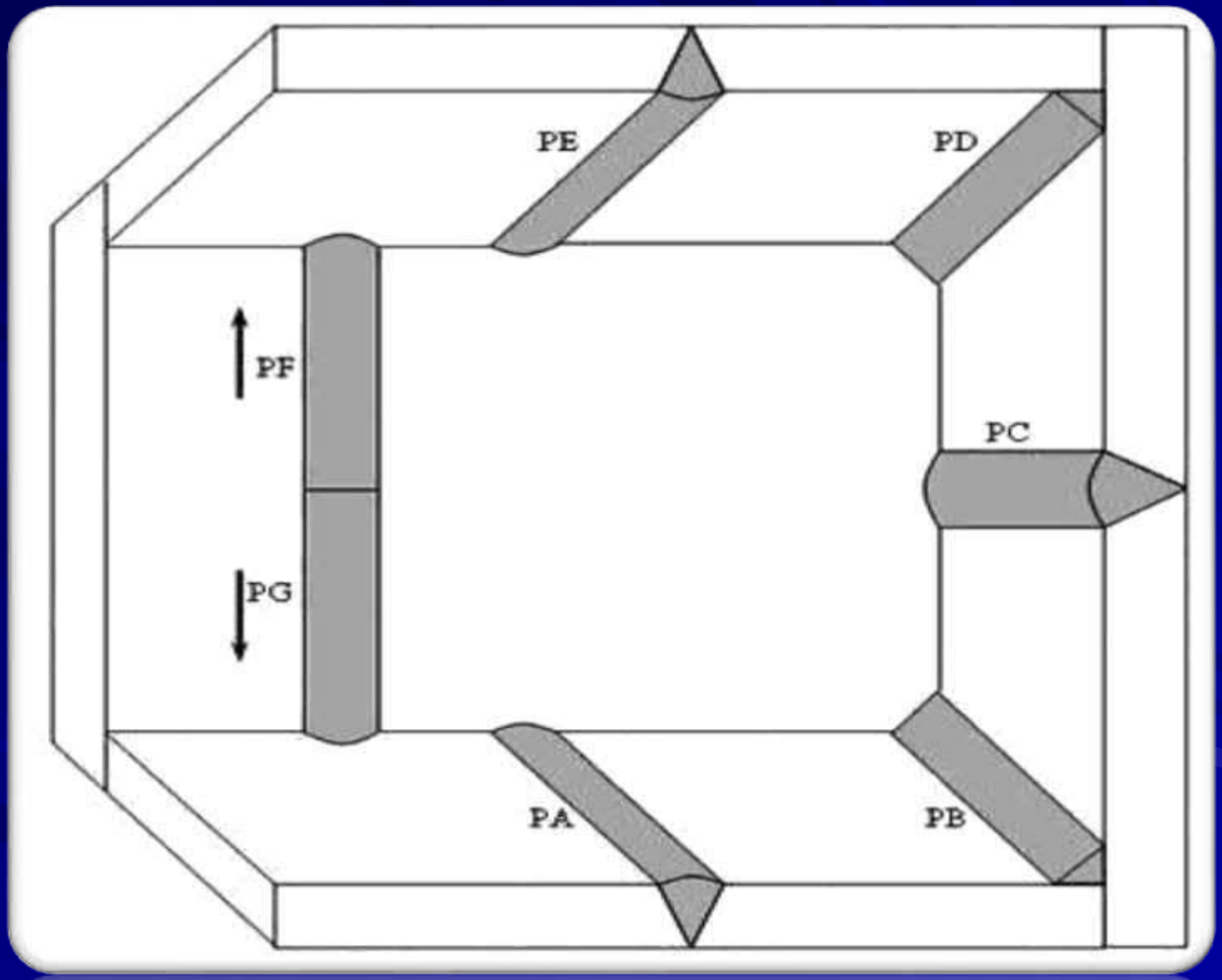
PA	1G / 1F	Flat / Downhand
PB	2F	Horizontal-Vertical
PC	2G	Horizontal
PD	4F	Horizontal-Vertical (Overhead)
PE	4G	Overhead
PF	3G / 5G	Vertical-Up
PG	3G / 5G	Vertical-Down
H-L045	6G	Inclined Pipe (Upwards)
J-L045	6G	Inclined Pipe (Downwards)

Welding Positions 2.17

ISO

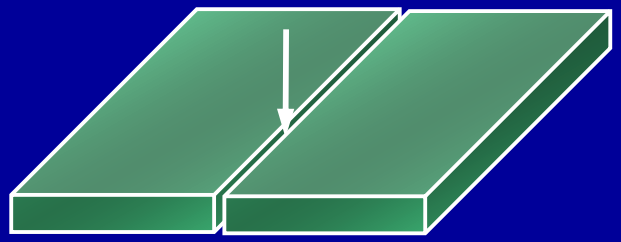


Welding Positions 2.17

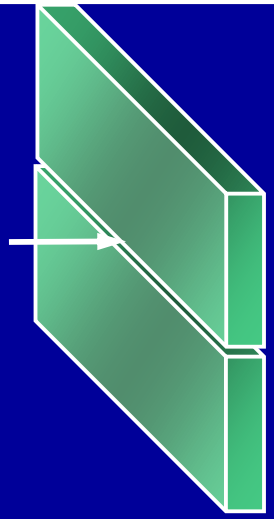


Welding position designation 2.17

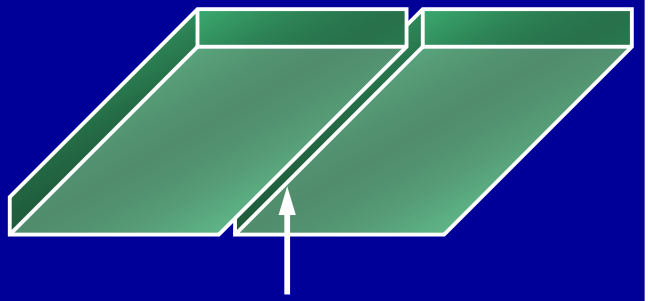
Butt welds in plate (see ISO 6947)



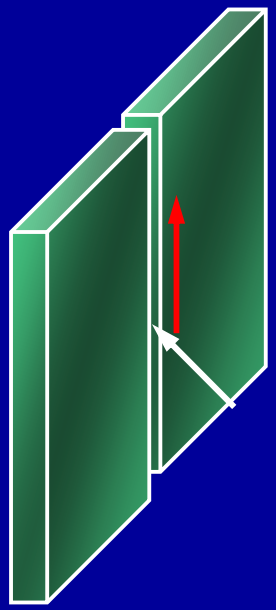
Flat - PA



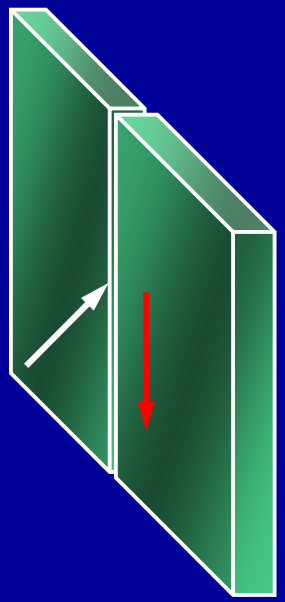
Horizontal - PC



Overhead - PE



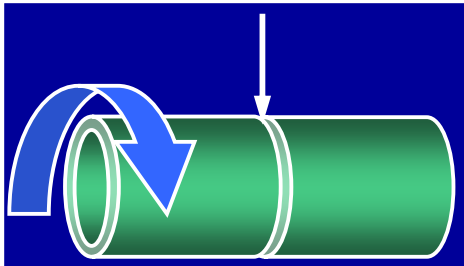
Vertical up - PF



Vertical down - PG

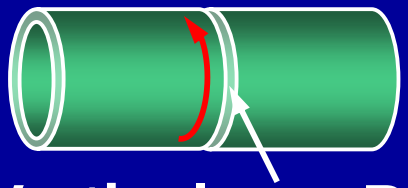
Welding position designation 2.17

Butt welds in pipe (see ISO 6947)



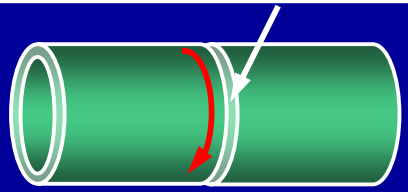
Flat - PA

axis: horizontal
pipe: rotated



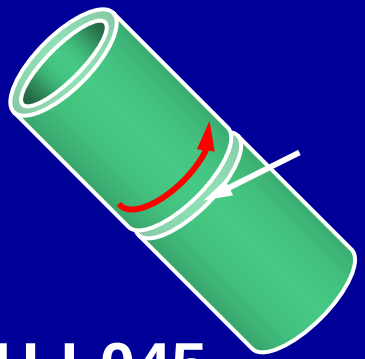
Vertical up - PF

axis: horizontal
pipe: fixed



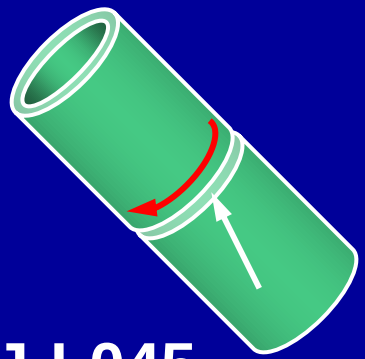
Vertical down - PG

axis: horizontal
pipe: fixed



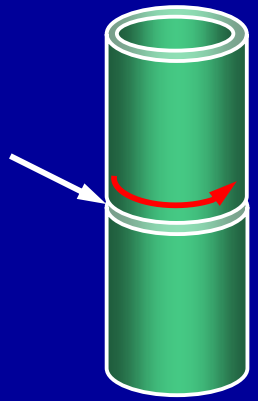
H-L045

axis: inclined at 45°
pipe: fixed



J-L045

axis: inclined at 45°
pipe: fixed

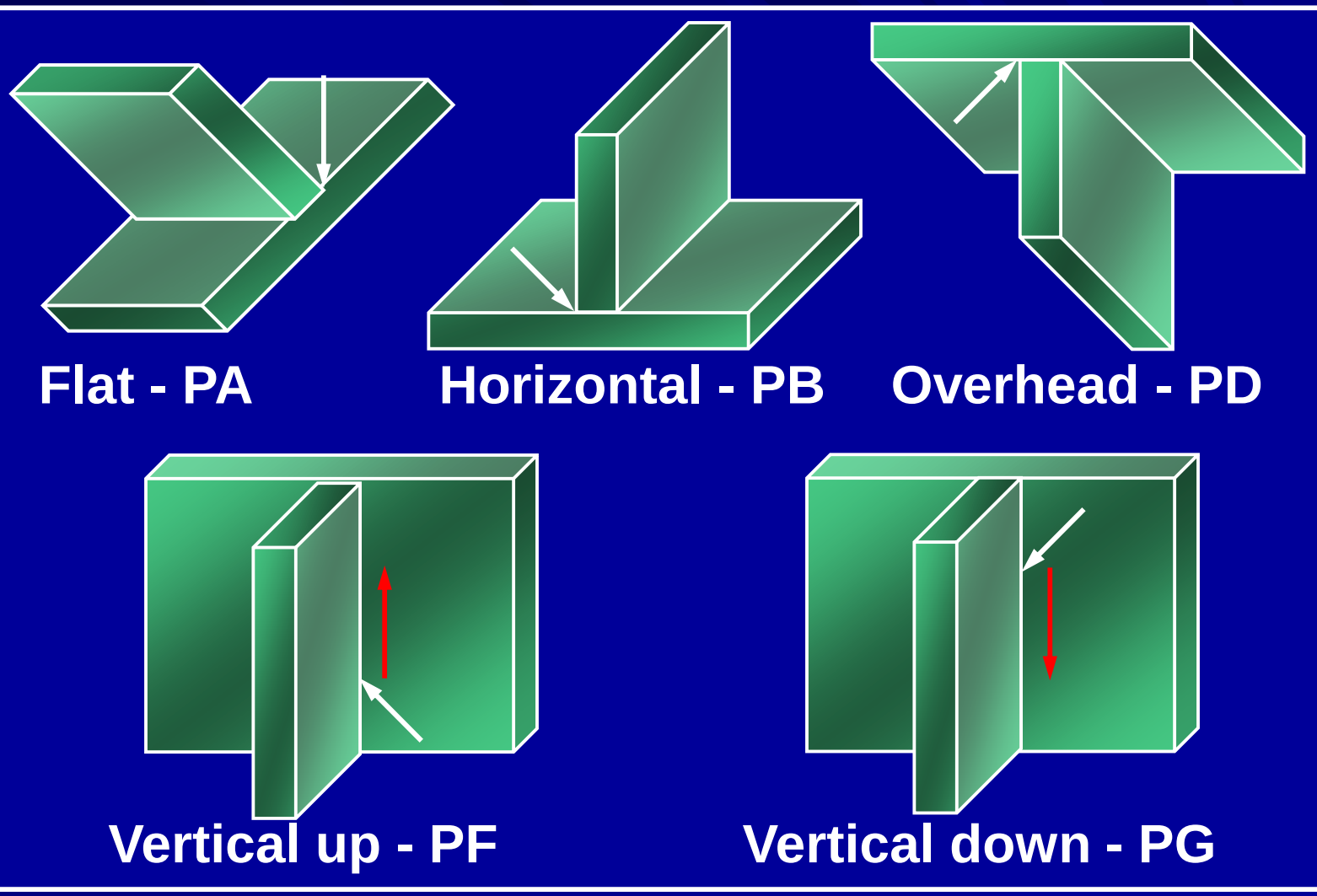


Horizontal - PC

axis: vertical
pipe: fixed

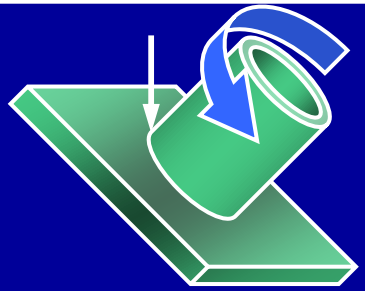
Welding position designation 2.17

Fillet welds on plate (see ISO 6947)

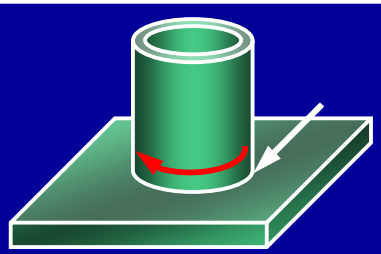


Welding position designation 2.17

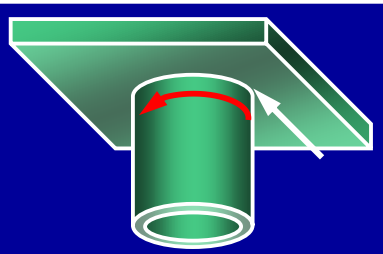
Fillet welds on pipe (see ISO 6947)



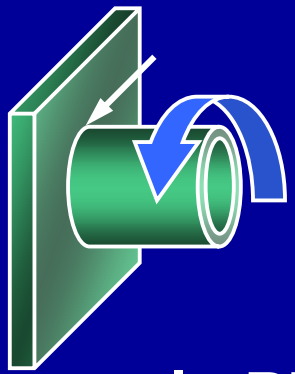
Flat - PA
axis: inclined at 45°
pipe: rotated



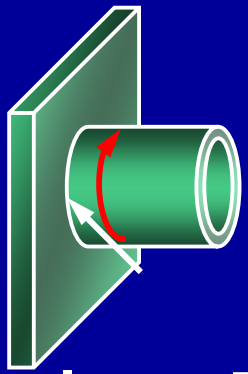
Horizontal - PB
axis: vertical
pipe: fixed



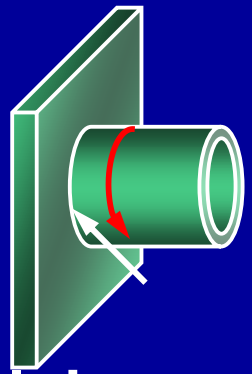
Overhead - PD
axis: vertical
pipe: fixed



Horizontal - PB
axis: horizontal
pipe: rotated

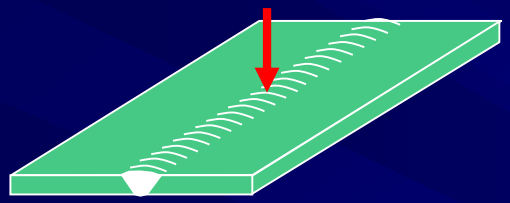


Vertical up - PF
axis: horizontal
pipe: fixed



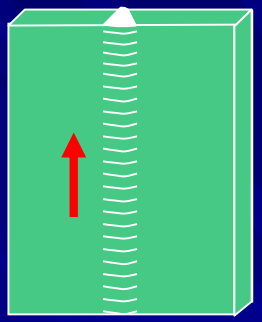
Vertical down - PG
axis: horizontal
pipe: fixed

Plate/Fillet Weld Positions 2.17

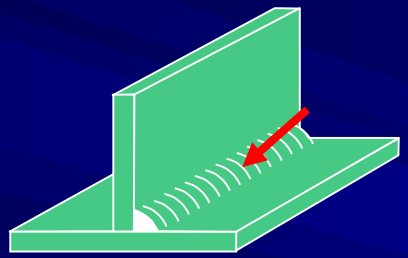


PA / 1G

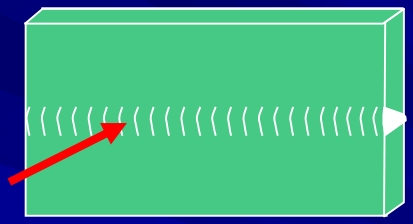
PA / 1F



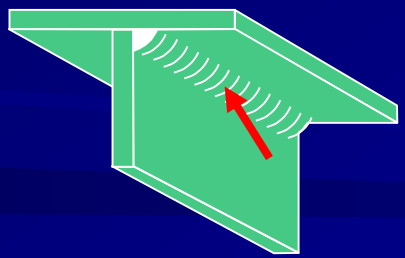
PF / 3G



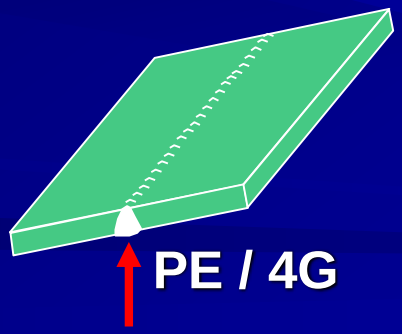
PB / 2F



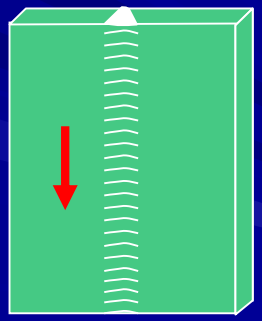
PC / 2G



PD / 4F

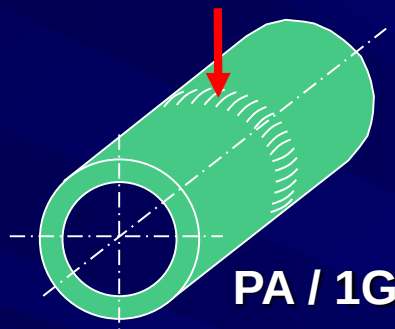


PE / 4G



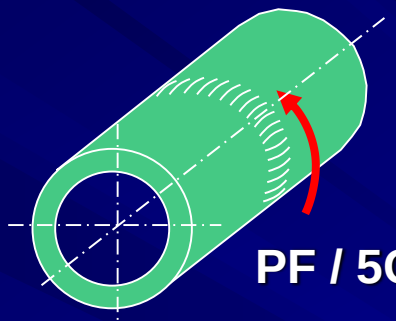
PG / 3G

Pipe Welding Positions 2.17



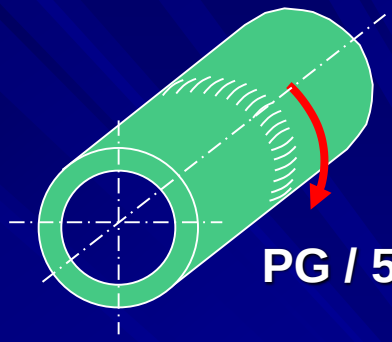
PA / 1G

Weld: Flat
Pipe: rotated
Axis: Horizontal



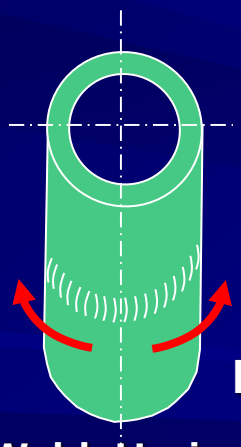
PF / 5G

Weld: Vertical upwards
Pipe: Fixed
Axis: Horizontal



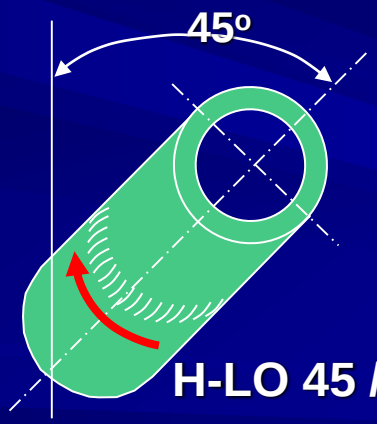
PG / 5G

Weld: Vertical Downwards
Pipe: Fixed
Axis: Horizontal



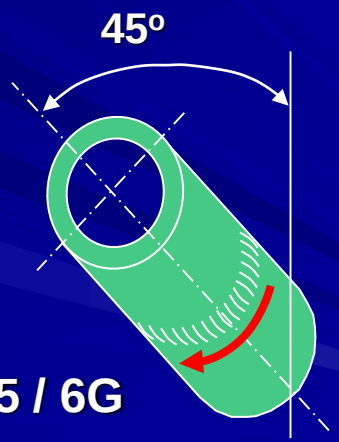
PC / 2G

Weld: Horizontal
Pipe: Fixed
Axis: Vertical



H-LO 45 / 6G

Weld: Upwards
Pipe: Fixed
Axis: Inclined



J-LO 45 / 6G

Weld: Downwards
Pipe: Fixed
Axis: Inclined

Travel Speed Measurement 2.18

Definition: the rate of weld progression

- measured in case of mechanised and automatic welding processes
- in case of MMA can be determined using ROL and arc time