

# AUSTRALIAN WELDER CERTIFICATION REGISTER (AWCR)



## USING AS/NZS ISO 9606-1 WITH **WeldQ**



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# OVERVIEW

The AWCR provides a national framework for qualifying and testing welders to standards such as AS/NZS ISO 9606-1 and AS/NZS 2980, and other welding standards where specified.

It:

- ✓ Allows qualified welders to be registered so as to be able to work on any site without further testing resulting in a significant cost saving to industry.
- ✓ Provides industry with easy access to a database of welders with up to date certification and details of their career history.
- ✓ Generates data for a skills gap analysis which will allow the development of a detailed suite of training initiatives to upskill the workforce.
- ✓ Runs on the **WeldQ** platform; a fully internet enabled cloud based system with a supporting mobile app.

# GETTING STARTED

This presentation provides basic information on AS/NZS ISO 9606-1 and how to apply it to Welder Qualification programs within **WeldQ**.

Topics covered include:

- ✓ History of ISO 9606-1
- ✓ Recognition of ISO 9606-1 in Australian and other standards
- ✓ An overview of AS/NZS ISO 9606-1 (including clarifications from ISO TC/44 SC11)
- ✓ Future considerations

**Note:** *It is recommended that AS/NZS ISO 9606-1 be read in conjunction with the information presented.*

# HISTORY OF ISO 9606-1

- ✓ Originally published as EN 287, cloned by ISO as ISO 9606-1 in 1994 to provide for standardisation of welder qualifications
- ✓ Revised by ISO –
  - Original revision draft in 2004 seen as too European centric
  - Pacific Rim Countries tend to follow North American practices, not European
  - Later drafts considered & incorporated comments by Australia, Canada, Japan and USA becoming more truly internationalised
  - Second edition published in 2012, usage growing

**Note:** *Australia considered the contents of the drafts and incorporated key items within the revision of AS 2980 in 2004, later updated in 2007 as AS/NZS 2980.*

# RECOGNITION OF ISO 9606-1

ISO 9606-1 was drafted to provide for the qualification of welders of both pressure equipment and non-pressure (e.g. structural, bridge, defence etc) applications

ISO 9606-1:2012 is recognised in:

- ✓ ASME IX
- ✓ AS/NZS 1554 series
- ✓ AS 1988
- ✓ AS/NZS 3992 (2015)
- ✓ AS 5100 series
- ✓ Accepted by Europe to replace EN 287
- ✓ AS/NZS 2980 revised to align with ISO 9606-1 requirements
- ✓ ISO 9606-1 has been adopted in Australia and New Zealand as AS/NZS ISO 9606-1
- ✓ Recognised and used by countries in the Asian Welding Federation

# OVERVIEW OF AS/NZS ISO 9606-1



Key aspects for consideration include:

1. Comparison with other standards
2. Terminology
3. Essential variables
4. Examination & testing
5. Acceptance criteria
6. Period of validity
7. Designation
8. Job knowledge (theory)

# OVERVIEW OF AS/NZS ISO 9606-1

## Comparison with other standards

### Approach:

- ✓ Uses methodology similar to many other standards
- ✓ Test methods similar to AS/NZS 2980, AS/NZS 3992, ASME IX
  - Welder is tested to a qualified WPS –
    - ❖ Option to utilise a draft WPS when being qualified at the same time
- ✓ Acceptance criteria for mechanical testing:
  - Similar to AS/NZS 3992 (AS 4037 Class 1) & AS 1796
  - A little more restrictive than AS/NZS 1554.1 and AWS D1.1
- ✓ Acceptance criteria for NDE
  - Uses methodology of ISO unless otherwise specified
  - More restrictive treatment of adjacent imperfections
- ✓ Alternative acceptance criteria acceptable when specified
- ✓ Welder qualification is transportable across employers but expires unless reconfirmed



# OVERVIEW OF AS/NZS ISO 9606-1

## Terminology



### AS/NZS ISO 9606-1:

- ✓ Defines all processes, consumables, terms and abbreviations within (Cl 4)
  - Process uses ISO 4063 reference numbers (all listed in Cl 4.2)
  - Symbols and abbreviations all ISO based
    - Note that Australia uses USA-aligned AS 1101.3
- ✓ Filler materials – includes both ISO type A (European) and ISO type B (Australian, North American) designations for flux covering or core.

### WeldQ:

- ✓ Uses ISO terminology
- ✓ Includes definition of ISO reference numbers and terms in its drop-down list of options accessed by examiners



# OVERVIEW OF AS/NZS ISO 9606-1

## Essential variables

Eight essential variables (Cl 5.1):

- ✓ Welding process (Cl 5.2)
- ✓ Product type (Cl 5.3)
- ✓ Type of weld (Cl 5.4)
- ✓ Filler material group (Cl 5.5)
- ✓ Filler material type (Cl 5.6)
- ✓ Dimensions (Cl 5.7)
- ✓ Welding position (Cl 5.8)
- ✓ Weld details (Cl 5.9)

**Note:** Parent materials (see ISO/TR 15608) are not an essential variable

# OVERVIEW OF AS/NZS ISO 9606-1

## Essential variables (1)

### Key points:

- ✓ Welding process (CI 5.2)
  - Each test typically qualifies only one process other than:
    - ❖ Where there are limited process similarities (CI 5.2)
    - ❖ Multiple processes can be qualified within the same joint (Table 1)  
e.g. GTAW root, MMAW fill & cap (Diag.1)
      - *ISO TC44/SC11 clarification: Multi-process joints can also be qualified by each process being qualified separately then used in combination.*  
*e.g. MMAW qualified as ss,mb (Diag.3) or ss,nb (Diag.4) for fill & cap with GTAW root (ss,nb)*
  - Use of Dip (short-circuit) transfer qualifies the welder for globular & spray mode but not the reverse.
- ✓ Product type (CI 5.3)
  - Plate – also covers rotating pipe if OD  $\geq 75$ mm, and fixed pipe if OD  $\geq 500$ mm
  - Pipe – also covers larger diameter pipe and plate if OD  $\geq 25$ mm

# OVERVIEW OF AS/NZS ISO 9606-1

## Essential variables (2)

Key points:

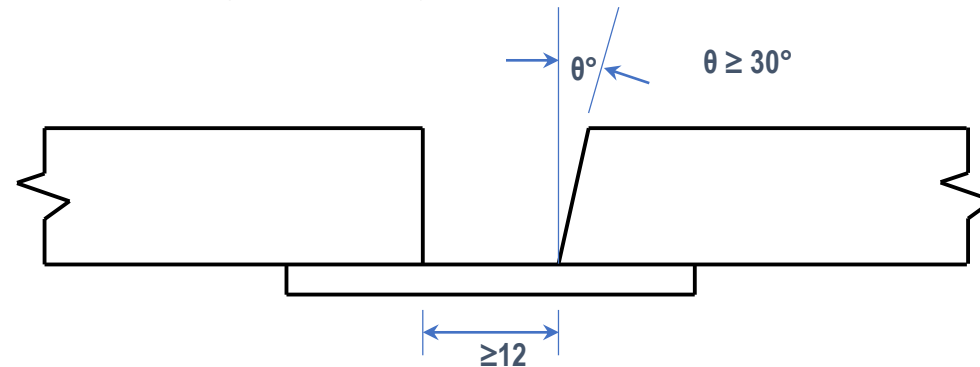
✓ Type of weld (Cl 5.4)

➤ Butt welds do not qualify welders to weld fillet welds

➤ Fillet welds may be qualified in combination with a butt weld – two options:

❖ Single bevel butt joint with backing – ss,mb ( see Cl. 5.4 (b), Annex C & below)

*Note: Fillet (single or multipass) must be welded and visually assessed before butt weld is completed.*



❖ Single pass supplementary fillet test to be welded in HV position (see Cl. 5.4(e))

➤ Special test piece may be used if butt, fillet or branch joint not suitable

# OVERVIEW OF AS/NZS ISO 9606-1

## Essential variables (3)

Filler material key points:

- ✓ Filler material grouping ( Cl 5.5, Table 3)
  - Six groups FM1 to FM6
    - ❖ FM1 – non-alloy and fine grained steels
    - ❖ FM2 – high strength steels
    - ❖ FM3, FM4 – creep-resisting steels
    - ❖ FM5 – stainless & heat-resisting steels
    - ❖ FM6 – nickel & nickel alloys
  - Range of qualification based on filler metal group used in the test
- ✓ Filler material type (Cl 5.6, Tables 4 & 5)
  - Cellulosic covering only qualifies cellulosic
  - Basic covering or core qualifies all covering or core types other than cellulosic
  - Rutile & other covering or core qualifies all other than basic or cellulosic
  - Solid wire & metal core qualifies solid wire and metal core only

# OVERVIEW OF AS/NZS ISO 9606-1

## Essential variables (4)

### Key points:

#### ✓ Dimensions

- Butt welds – qualification based on deposited metal thickness.
- Butt welds in pipes – qualification also based on pipe diameter  $D$  (Table 7).

Note ISO TC44/SC11 clarification that:

$D \leq 25$  mm qualifies the welder over the range  $D$  to  $2D$

$D > 25$ mm to  $D \leq 50$  mm qualifies the welder for  $D \geq 25$ mm

$D \geq 50$ mm qualifies the welder  $\geq 0.5D$

- Fillet welds – qualification based on material thickness (Table 8)

#### ✓ Positions

- More challenging positions qualify for easier positions (consistent with Australian standards and ASME IX).

Note that for welding two pipes (Cl 5.8) – PH + PC qualifies H-L045, and , PJ + PC qualifies J-L045

- Range of positions qualified varies between joints in plate or pipe, and butt or fillet

# OVERVIEW OF AS/NZS ISO 9606-1

## Essential variables (5)

Key points (Cl 5.9):

- ✓ Weld details – backing materials
  - Six options – more challenging options also qualify for easier options
    - ❖ No backing (ss,nb)
    - ❖ Material backing (ss, mb)
    - ❖ Welded from both sides (bs)
    - ❖ Gas backing (ss,gb)
    - ❖ Consumable inserts (ci)
    - ❖ Flux backing (ss,fb)
- ✓ Weld details – layer technique for fillet welds
  - Multi-layer qualifies both multi-layer and single-layer
  - Single-layer qualifies single-layer

**Note:** Parent materials (see ISO/TR 15608) are not an essential variable

# OVERVIEW OF AS/NZS ISO 9606-1



## Examination & testing (1)

### Key points:

- ✓ Examination
  - All test piece welding to be witnessed by the examiner or examining body
    - ❖ Weld Australia and **WeldQ** requires examiners be suitably qualified (and registered)
  - Minimum test piece length 200mm with an examination length of 150mm
  - For small dia pipes, multiple test pieces may be required to get the minimum examination length
  - Stop-starts required in root and capping runs
- ✓ Welding
  - Requires a qualified WPS (draft WPS OK but must be qualified as part of the test)  
*WPS may be qualified to any standard but items specified in ISO 15609-1 must be recorded*
- ✓ Testing
  - All welds must be visually examined
  - All welds are then tested volumetrically e.g. UT, RT, fracture tests, bend tests, macros



# OVERVIEW OF AS/NZS ISO 9606-1

## Examination & testing (2)

### Test options:

- ✓ Butt welds:
  - ❖ VT + RT; or,  
Note: *If RT used with GMAW, FCAW (metal core only) or oxy-acetylene processes, additional bend or fracture tests required (Cl 6.5.2.4).*
  - ❖ VT + UT ( $\geq 8\text{mm}$  ferritic steel only); or,
  - ❖ VT + bend tests; or,
  - ❖ VT + fracture tests; or,
  - ❖ VT + notched tensile test (pipe with OD  $\leq 25\text{mm}$  only).
  
- ✓ Fillet and branch welds:
  - ❖ VT + fracture tests; or,
  - ❖ VT + macros; or,
  - ❖ VT + RT (pipe only).

# OVERVIEW OF AS/NZS ISO 9606-1



## Test method & acceptance criteria

### Test methods:

- ✓ Visual examination – use AS/NZS ISO 17637
- ✓ Fracture test – use AS/NZS 2205.4.1 (ISO 9017)
- ✓ Macro test – use AS/NZS 2205.5.1 (ISO 17639)
- ✓ Bend test – AS 2205.3.1 is similar to ISO 5173
- ✓ NDT (RT and UT) must use the test methods consistent with specified acceptance criteria and WPS.

### Acceptance criteria:

- ✓ Acceptance requirements to be assessed in accordance with AS/NZS ISO 5817 unless otherwise specified
- ✓ Alternative acceptance criteria can be applied when specified

# OVERVIEW OF AS/NZS ISO 9606-1



## Period of validity (Cl 9)

### Requirements:

- ✓ Qualification valid from date of testing
- ✓ Validity of all qualifications must be confirmed every 6 months by person responsible for welding or an examiner. Welder must weld within the limits of qualification
- ✓ Three options for period of validity:
  1. Welder to be retested after 3 years
  2. Every 2 years two welds made in previous 6 months to be assessed (note Cl 5.8). If OK, qualification is revalidated for a further 2 years
  3. No expiry but qualifications must be confirmed, welder must be employed by same manufacturer and manufacturer must have a validated ISO 3834 quality program
    - **WeldQ** currently only caters for 3 year and 2 year validity methods
    - Qualification can be revoked where doubt exists as to the welders ability

# OVERVIEW OF AS/NZS ISO 9606-1



## Validation *cont'd*

### Requirements:

- ✓ Two welds made in the 6 months prior to revalidation to be examined by RT, UT or destructive tests.
  - If welder initially qualified in H-L045 or J-L045 (6G) position, testing in the PC position and either the PH or PJ position (as relevant) revalidates the welder in the H-L045 or J-L045 (6G) position (see clause 5.8).
- ✓ Validation conducted by an examiner.
  - Qualification can be revoked where doubt exists as to the welders ability

*Note: It may be more cost effective or practical to qualify welders for initial 3 year period (clause 9.3(a)) and repeat qualification tests after 3 years.*

# OVERVIEW OF AS/NZS ISO 9606-1



## Designation (1)

At the top of the welder's qualification test certificate, a *Designation* or summary of the items of test are printed. Format of the designation is:

STANDARD NNN PP WW FF ff s t (D) pp dd II

Where:

1. STANDARD = AS/NZS ISO 9606-1
2. NNN = Welding process number
3. PP = Product type (plate – P or pipe – T)
4. WW = Type of weld (BW or FW)
5. FF = Filler metal group or parent material group
6. ff = Filler material type
7. s t (D) = test piece dimensions e.g. deposit thickness (s), material thickness (t) or pipe OD
8. pp = Welding position
9. dd II = Weld details e.g. backing materials, layer details (fillet welds)

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## Designation (2)



Examples of *Designation*:

AS/NZS ISO 9606-1 135 P FW FM1 S s 12 t 12 D - PB - ml

Represents:

- ❖ Fillet weld qualified to AS/NZS ISO 9606-1, welded with process 135 (GMAW or MAG) on plate using a solid wire low strength (FM1) filler. Weld size was 12mm fillet (multi-layer) on 12mm thick plate in the PB (HV or 2F) position.

AS/NZS ISO 9606-1 141 T BW FM3 S s 7 t 7 D 63 H-L045 ss,nb

Represents:

- ❖ Butt weld qualified to AS/NZS ISO 9606-1, welded with process 141 (GTAW) on pipe using a solid wire creep resistant (FM3) filler. Weld size was 7mm within a pipe (tube) with a 7mm wall thickness and 63mm outside diameter in the 6G (H-L045) direction. It is welded from one side without backing (ss,nb).

# OVERVIEW OF AS/NZS ISO 9606-1

## Job knowledge (Theory)



Key points re Job Knowledge:

- ✓ Test is optional
- ✓ Can be examined by suitable methods such as
  - Written (multiple choice tests)
  - Oral questions
  - Computer test
  - Demonstration/observation following set criteria
- ✓ Syllabus consistent with AS 1796 theory component for welding process being tested
  - AS1796 qualified welders able to claim “Acceptable” knowledge
- ✓ **WeldQ** recognises and allows for theory component as “Acceptable” or “Not tested”.



# FUTURE CONSIDERATIONS

## Summary:

- ✓ ISO 9606-1 is gaining importance and traction throughout the world
- ✓ ISO 9606-1 has been adopted in Australia as AS/NZS ISO 9606-1
- ✓ In Australia, it is referenced in AS/NZS 3992 and the AS/NZS 1554 series of standards
- ✓ Defence industry and road authorities are now referencing AS/NZS ISO 9606-1 as the basis for welder qualifications
- ✓ Welder qualifications to AS/NZS ISO 9606-1 are transportable between companies
- ✓ **WeldQ** is set up to manage welder qualifications to AS/NZS ISO 9606-1 and is searchable

## In the future:

- ✓ **WeldQ** is being further developed to better align with AS/NZS ISO 9606-1
- ✓ It is anticipated that AS/NZS 2980 will be withdrawn in the medium term future
- ✓ It is anticipated that ISO 9606-1 will be amended to better align with Australian industry requirements

# QUESTIONS

If you have any questions please use the Contact Form on the AWCR website.

<http://awcr.org.au>