“The Code is a large document and it is sometimes very difficult to understand. Even for many of us who work with it every day. In my opinion there is no one person who could be termed as a ‘Code Expert’. There are many people who are knowledgeable about one or more sections, and there may even be some who are experts on some Code sections, but there is no one who is expert on the whole ASME Code.”

M. F. Sullivan
Materials and Welding

Dr. Sandor Somogyi
ASME Certification 360 Workshop
Bergamo, Italy September 26-27, 2016
Materials

1) Procurement of Materials
2) Certification
3) Identification and Traceability
4) Delivery Condition - Heat Treatment
5) Piping Components Machined from Bar
Procurement of Materials

- Materials permitted by the Construction Code shall be purchased to ASME Section II (SA, SB, SFA) specifications
- The 'Ordering Information' of the specification (even if it is not mandatory), should be used to prepare a P/O
- Requirements of the applicable 'General Specification' shall be considered.

SA-182 par. 4.1 *It is the purchaser’s responsibility to specify in the purchase order information necessary to purchase the needed material.*
# General Specifications

<table>
<thead>
<tr>
<th>Piping component Specification</th>
<th>General Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>SA-105</td>
<td>SA-961 SPECIFICATION FOR COMMON REQUIREMENTS FOR STEEL FLANGES, FORGED FITTINGS, VALVES, AND PARTS FOR PIPING APPLICATIONS</td>
</tr>
<tr>
<td>SA-181</td>
<td></td>
</tr>
<tr>
<td>SA-182</td>
<td></td>
</tr>
<tr>
<td>SA-350</td>
<td></td>
</tr>
<tr>
<td>SA-234</td>
<td>SA-960 SPECIFICATION FOR COMMON REQUIREMENTS FOR WROUGHT STEEL PIPING FITTINGS</td>
</tr>
<tr>
<td>SA-403</td>
<td></td>
</tr>
<tr>
<td>SA-420</td>
<td></td>
</tr>
</tbody>
</table>
Procurement of Materials

4. Ordering Information (SA-20)

4.1 Orders **should** include the following information, as necessary, to adequately describe the desired product.

4.1.1 Quantity (weight [mass] or number of plates),

4.1.2 Dimensions,

4.1.3 Name of product (for example, plates, carbon steel; plates, alloy steel),

4.1.4 Specification designation (including type, class, and grade as applicable) and **year-date**, 

4.1.5 Condition (as-rolled, normalized, quenched and tempered, etc. If heat treatment of plate is to be performed by the fabricator, this is to be stated. Also, if purchaser specifies a heat-treatment cycle, this is to be stated),
Procurement of Materials

4.1.6 Impact test requirements, if any (see Section 12). (For Charpy V-notch test, include test specimen orientation, testing temperature, and acceptance criteria. For drop-weight test, give testing temperature),

4.1.7 Exclusion of either plates produced from coil or plates produced from plate-as-rolled, if applicable. (See 5.4 and Appendix X1.)

4.1.8 Limits for grain refining elements other than aluminum, if applicable (see 8.3.2),

4.1.9 Paint marking (see 13.2.1),

4.1.10 Supplementary requirements, if any (test specimen heat treatment, special impact test requirements, etc.), and

4.1.11 Additional requirements, if any. (Certification?)
Certificate of Compliance and Material Test Report.

3.2.6.1(a) The Manufacturer shall ensure all requirements of the material specification, and all special requirements of Part 3 of this Division, that are to be fulfilled by the materials manufacturer have been complied with. The Manufacturer shall accomplish this by obtaining Certificates of Compliance or Material Test Reports.

Certified Material Test Report (CMTR) - is it mandatory?

NO. Some material product or general specifications do require a separate certification statement. For those materials, the MTR would have to be a CMTR to be in compliance with that specification.

SA-20 par.19.5 CoC
SA-530 par. 21.1 Certified Test Report
Certification

SA-20 19.1 The manufacturer or processor shall report the results of all tests required by the applicable product specification, the applicable supplementary requirements, and the purchase order.

SA-105 12.2 When test reports are required...

SA-106 24.1 When test reports are requested...

SA-182 18.1 In addition to the certification requirements of Specification A961/A961M, test reports shall be furnished to the purchaser or his representative.

SA-961 19.1 Marking of the specification number and manufacturer’s name or trademark on the parts, and printing of the same on test reports, shall be certification that the parts have been furnished in accordance with the requirements of the specification.
EN 10204 Metallic products - **Types** of inspection documents

3.1 Inspection Certificate

Statement of compliance with the order, with indication of results of specific inspection.

Does it satisfy the ASME material certification requirements? Yes, provided the provisions of the applicable Code Section are met (UG-93(a)(1) or 3.2.6.1 etc.)

The required content/information of the Material Test Report shall be specified in the procurement documents.

- EN 10204 type 3.1 certificate complying with SA-182 par. 18 and SA-961 par. 19
- Certified Test Report per SA-106 par. 24.1 and SA-530 par. 21 (EN 10204 type 3.1 acceptable?)
Identification and Traceability

UG-77(a) The pressure vessel Manufacturer shall maintain traceability of the material to the original identification markings by one or more of the following methods:

• accurate transfer of the original identification markings
• identification by a coded marking traceable to the original required marking
• recording the required markings using methods such as material tabulations or as-built sketches that ensure identification of each piece of material

Questions:

1) What is considered to be original/required marking?
2) How to ensure that the original/required marking is obtained from and provided by the supplier?
Identification and Traceability

Plates SA-20 13.1 Required Markings:

13.1.1 Except as allowed by 13.4, plates shall be legibly marked with the following information: applicable ASTM designation (see 1.1) (year of issue not required); “G” or “MT” if applicable (see 13.1.2); applicable grade, type, and class; heat number; plate identifier; and name, brand, or trademark of the manufacturer (for plates produced in discrete cut lengths of flat product) or the processor (for plates produced from coil and for subdivided plates (see 13.4)).
Identification and Traceability

13.4 Subdivided Plates:
13.4.1 By agreement between the purchaser and the manufacturer or processor, each subdivided plate (a plate separated from a master plate) shall be legibly marked with the name, brand, or trademark of the organization that subdivided the plate plus a code traceable to the required markings, provided that the information required in 13.1, cross referenced to that code, is furnished with the plates.
Delivery Condition - Heat Treatment

Fig. UCS-66 Note (a)(3) Fig. 3.7 Note (d)(3)
Normalized rolling condition is not considered as being equivalent to normalizing.
SA/EN 10028-2 par. 1.1
SA/EN 10028-3 par. 1.1
Plates for which normalizing has been replaced by normalizing rolling as permitted by para. 8.2.2 shall be marked “+NR” instead of “+N.”
SA/CSA-G40.211.2 par. 1.2 Controlled rolling shall not be used as a normalizing procedure.
SA/EN 10028-3 par. 8.2.2 Normalizing may, at the discretion of the manufacturer, be replaced with normalizing rolling for the steel grades P275NH, P275NL1, P275NL2, P355N, P355NH, P355NL1 and P355NL2 (see 3.1 in EN 10028-1:2000 + A1:2002). In this case, tests on simulated normalized samples with an agreed frequency of testing may be agreed at the time of enquiry and order to verify that the specified properties are complied with.

Note: P275NH permitted for Sec. VIII Div.1 only, and has assigned P No. 1 Gr. No. 1
Delivery Condition - Heat Treatment

SA-841 Standard Specification for Steel Plates for Pressure Vessels, Produced by Thermo-Mechanical Control Process (TMCP)

![Diagram showing the delivery condition and heat treatment processes.]

**FIG. X1.1 Schematic Diagrams of Thermo-Mechanical Control and Conventional Process of Steel Plate as may be Applied to Grades A through F**

NOTE:
- TMR: Thermo-Mechanical Rolling
- N: Normalized
- DQ: Direct Quenching
- AC: Accelerated Cooling Process
- CR: Controlled Rolling
- AR: As Rolled
- R: Reduction
- T: Tempered
Delivery Condition - Heat Treatment

*normalizing* – a heat treating process in which a steel plate is reheated to a uniform temperature above the upper critical temperature and then cooled in air to bellow the transformation range (former SA-20 and current SA-6)

*normalizing, n*—heating a steel object to a suitable temperature above the transformation range and then cooling it in air to a temperature substantially below the transformation range.

(Current SA-941)
SA-516 5.2 Plates over 1.50 in. [40 mm] in thickness shall be normalized.

5.4 If approved by the purchaser, cooling rates faster than those obtained by cooling in air are permissible for improvement of the toughness, provided the plates are subsequently tempered in the temperature range 1100 to 1300°F [595 to 705°C].

Questions:
1) What type of heat treatment is this?
2) What testing requirements apply?
3) What is the required marking?
Interpretation: II-A-10-07

Subject: Number of Test Coupons for Tension Test as Per SA-20/SA-20M (2007 Edition Through 2009 Addenda)

Date Issued: February 7, 2011

File Number: 10-560

Question: Are plates that are accelerated cooled from the austenitizing temperature and tempered considered to be quenched and therefore subject to the test rules described in the second sentence of SA-20/SA-20M, para. 11.1.1?

(Two tension test coupons shall be taken from each quenched and tempered plate, as heat treated.)

Reply: Yes.

Marking: MT or QT?
Piping Components Machined from Bar

UG-14 (b)

Except for flanges of all types, hollow cylindrically shaped parts [up to and including NPS 4 (DN 100)] may be machined from rod or bar, provided that the axial length of the part is approximately parallel to the metal flow lines of the stock. Other parts, such as heads or caps [up to and including NPS 4 (DN 100)], not including flanges, may be machined from rod or bar. Elbows, return bends, tees, and header tees shall not be machined directly from rod or bar.
Piping Components Machined from Bar

SA-105 and SA-350 par. 1.1

Although this specification covers some piping components machined from rolled bar and seamless tubular materials (see…), it does not cover raw material produced in these product forms.

SA-182 par. 5.4

The material shall be forged as close as practicable to the specified shape and size. Except for flanges of any type, forged or rolled bar may be used without additional hot working for small cylindrically shaped parts…
Piping Components Machined from Bar

Case 2156-1 Use of Rod and Bar for Hollow Cylindrical-Shaped Parts Larger Than NPS 4
Section VIII, Division 1

Inquiry: In addition to the pressure parts listed in UG-14, may rod and bar material be used for hollow cylindrical-shaped parts larger than NPS 4 constructed under Section VIII, Division 1?

Reply: It is the opinion of the Committee that, in addition to the pressure parts listed in UG-14, rod and bar material may be used for hollow cylindrical-shaped parts larger than NPS 4, such as shells and nozzles, but excluding flanges of all types except as permitted by Appendix 2, constructed under Section VIII, Division 1, provided the following additional requirements are met: (see (a) through (f)
1) Question: Can rolled bar be certified to meet SA-182/SA-182M?
Reply: No. SA-182/SA-182M is a specification for piping components, see section 1.1. (of SA-182)

2) Question: Does SA-182/SA-182M permit cylindrically shaped parts larger than NPS 4 machined directly from rolled bar without additional hot working to be certified to SA-182/SA-182M?
Reply: No. See size limitations in SA-234/SA-234M & SA-403/SA-403M as referenced in section 5.4 of SA-182/182M.

3) Question: Do the piping components covered by SA-182/SA-182M include valves and valve parts?
Reply: Yes. See section 1.1 (of SA-182/182M)
Welding

1) Welding Procedure Qualification
2) Welder Performance Qualification
3) Section IX Nonmandatory Appendix L

Welders and Welding Operators Qualified under ISO 9606-1:2012 and ISO 14732-2013
Welding Procedure Qualification

A properly prepared and qualified WPS shall:

• provide sufficient information, and useful, clear and definitive instructions to the welder to satisfy Code requirements while making production welds

• be supported by correctly selected and referenced PQR(s) properly certified by the manufacturer

• specify variables that can be controlled, checked, measured and verified during welding

• accommodate client and jurisdictional requirements, if any
Welding Procedure Qualification

QW-200.1(a) A WPS is a written qualified welding procedure prepared to provide direction for making production welds to Code requirements.

QW-200.2(b) All variables, if recorded, shall be the actual variables (including ranges) used during the welding of the test coupon. If variables are not monitored during welding, they shall not be recorded.

The approximate thickness of weld metal deposited shall be recorded for each set of essential and, when required, supplementary essential variables. Weld metal deposited using each set of variables shall be included in the tension, bend, notch toughness, and other mechanical test specimens that are required.
# Welding Procedure Qualification

<table>
<thead>
<tr>
<th>BASE METALS (QW-403)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Material Spec.</td>
<td>SA-106</td>
</tr>
<tr>
<td>Type/Grade, or UNS Number</td>
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</tr>
<tr>
<td>P-No. 1 Group No. 1 to P-No. 1 Group No. 1</td>
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<tr>
<td>Thickness of Test Coupon</td>
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<tr>
<td>Diameter of Test Coupon</td>
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<tr>
<td>Maximum Pass Thickness</td>
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<td>Other</td>
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<thead>
<tr>
<th>FILLER METALS (QW-404)</th>
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<tbody>
<tr>
<td>SFA Specification</td>
<td>E70S-3</td>
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<tr>
<td>AWS Classification</td>
<td>E7018</td>
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<tr>
<td>Filler Metal F-No.</td>
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<tr>
<td>Weld Metal Analysis A-No.</td>
<td>1</td>
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<tr>
<td>Size of Filler Metal</td>
<td>2.4 mm 2.5 mm</td>
</tr>
<tr>
<td>Filler Metal Product Form</td>
<td>SOLID NA</td>
</tr>
<tr>
<td>Supplemental Filler Metal</td>
<td>NA NA</td>
</tr>
<tr>
<td>Electrode Flux Classification</td>
<td>NA NA</td>
</tr>
<tr>
<td>Flux Type</td>
<td>NA NA</td>
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<tr>
<td>Flux Trade Name</td>
<td>NA NA</td>
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<tr>
<td>Weld Metal Thickness</td>
<td>3 mm 5.74 mm</td>
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<tr>
<td>Other</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>FILLER METALS (QW-404)</th>
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<tr>
<td>Spec. No. (SFA)</td>
<td>5.18 5.1</td>
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<td>AWS No. Class</td>
<td>E70S-5 E7018</td>
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<tr>
<td>F-No.</td>
<td>5 4</td>
</tr>
<tr>
<td>A-No.</td>
<td>1 1</td>
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<tr>
<td>Size of Filler Metal</td>
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<td>Filler Metal Product Form</td>
<td>SOLID NA</td>
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<tr>
<td>Supplemental Filler Metal</td>
<td>NA NA</td>
</tr>
<tr>
<td>Weld Metal</td>
<td></td>
</tr>
<tr>
<td>Deposited Thickness</td>
<td>max 6 mm max 11.48 mm</td>
</tr>
</tbody>
</table>
Welder Performance Qualification

QW-351 The limits of weld metal thickness for which he will be qualified are dependent upon the approximate thickness of the weld metal he deposits with each welding process, exclusive of any weld reinforcement, this thickness shall be considered the test coupon thickness as given in QW-452.

Consider: to think about (something or someone) carefully especially in order to make a choice or decision
Considered: resulting from careful thought
Source: Merriam-Webster's Learner's Dictionary
# Welder Performance Qualification

<table>
<thead>
<tr>
<th>Welder’s name</th>
<th>Identification no.</th>
</tr>
</thead>
</table>

## Test Description

<table>
<thead>
<tr>
<th>Identification of WPS followed</th>
<th>Specification and type/grade or UNS Number of base metal(s)</th>
<th>Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SA-106 B</td>
<td>8.74 mm</td>
</tr>
</tbody>
</table>

## Testing Variables and Qualification Limits

### Welding Variables (QW-350)

- **Welding process(es):**
- **Type (i.e., manual, semi-automatic) used:**
- **Backing (with/without):**
- **Plate / Pipe (enter diameter if pipe or tube):**
- **Base metal P-Number to P-Number:**
- **Filler metal or electrode specification(s) (SFA) (info. only):**
- **Filler metal or electrode classification(s) (info. only):**
- **Filler metal F-Number(s):**
- **Consumable insert (GTAW or PAW):**
- **Filler Metal Product Form (solid/metal or flux cored/powder) (GTAW or PAW):**
- **Deposit thickness for each process:**
  - **Process 1** GTAW 3 layers minimum / No
  - **Process 2** SMAW 3 layers minimum / No
- **Position(s):**
- **Vertical progression (uphill or downhill):**
- **Type of fuel gas (OFW):**
- **Inert gas backing (GTAW, PAW, GMAW):**
- **Transfer mode (spray/globular or pulse to short circuit: GMAW):**
- **GTAW current type/polarity (AC, DCEP, DCEN):**

<table>
<thead>
<tr>
<th>Values</th>
<th>Actual Values</th>
<th>Range Qualified</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GTAW</strong></td>
<td>Manual</td>
<td><strong>GTAW</strong></td>
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<tr>
<td><strong>SMAW</strong></td>
<td>Manual</td>
<td><strong>SMAW</strong></td>
</tr>
<tr>
<td><strong>Manual</strong></td>
<td>WO/W</td>
<td><strong>Manual</strong></td>
</tr>
<tr>
<td><strong>6.05 mm</strong></td>
<td>1 to 1</td>
<td><strong>6.05 mm</strong></td>
</tr>
<tr>
<td><strong>5.18/5.1</strong></td>
<td>ER70S5-E7018</td>
<td><strong>ER70S5-E7018</strong></td>
</tr>
<tr>
<td><strong>6.4</strong></td>
<td>NO</td>
<td><strong>6.4</strong></td>
</tr>
<tr>
<td><strong>SOLID</strong></td>
<td>NO</td>
<td><strong>SOLID</strong></td>
</tr>
<tr>
<td><strong>5 mm</strong></td>
<td>1G</td>
<td><strong>5.74 mm</strong></td>
</tr>
<tr>
<td><strong>1G</strong></td>
<td>NA</td>
<td><strong>1G</strong></td>
</tr>
<tr>
<td><strong>FLAT</strong></td>
<td>NA</td>
<td><strong>FLAT</strong></td>
</tr>
<tr>
<td><strong>W</strong></td>
<td>NA</td>
<td><strong>W</strong></td>
</tr>
<tr>
<td><strong>WO + W</strong></td>
<td>NA</td>
<td><strong>WO + W</strong></td>
</tr>
<tr>
<td><strong>DCFN</strong></td>
<td>DCFN</td>
<td><strong>DCFN</strong></td>
</tr>
</tbody>
</table>

### Notes

- **ASME**
- **Setting the Standard**

---

Dr. Sandor Somogyi
Welding Procedure Qualification

PQR # supporting a WPS used on the repair welding ... was made with a 11 mm deep groove weld on a 38 mm test coupon using tensile tests with dimensions of approx. 32 mm x 19 mm; thus not conform to Figure QW-462.1(a) and testing in fact more the base metal than deposited weld metal.
Welding Procedure Qualification

ASME SURVEY / AUDIT
CORRECTIVE ACTION REPORT (CAR)

1. Company Name: 

2. QD N°: 1508-1

3. Address: 

4. Company Identification N°: 

5. Quote Reference and Criteria (include Document identification and paragraph number):

NB-2549 Repair by Welding: Repair by welding shall be in accordance with NB-2539, except that ....

NB-2539.2 Qualification of Welding Procedures and Welders. The welding procedure and welders or welding operators shall be qualified in accordance with Article NB-4000 and Section IX

NCA-3857.3 Welding: When welding is required in the repair of material or source material, it shall be performed in acc. with procedures and by welders or welding operators qualified in accordance with this Section and Section IX.

QG-102 The purpose of qualifying the procedure specification is to demonstrate that the joining process proposed for construction is capable of producing joints having the required mechanical properties for the intended application.

QW-141.1 Tension Tests. Tension tests as described in QW-150 are used to determine the ultimate strength of groove-weld joints.

QW-151 Tension test specimens shall conform to one of the types illustrated in Figures QW-462.1(a) through QW-462.1(e) (The expectation is that the weldment (weld metal, HAZ and base metal) will be tested, not the unwelded base metal be included in the tension specimens)

QW-202.3 Weld Repair and Buildup. WPS qualified on groove welds shall be applicable for weld repairs to groove and fillet welds and for weld buildup under the following provisions: ...

Quality Manual FEQM 102, par. 6.2.4.1: Any repair welding required on a forging to supplied under the requirements of this programme shall be carried out using qualified procedures.

6. Description of Deficiency:

Contrary to the above mentioned Section IX requirements, the PQR # 338 supporting WPS 413 Iss. 1 used on the repair welding of Seal Housing S/N 2412081-1 was made with a 11 mm deep groove weld on a 38 mm weld coupon using tensile tests with dimensions of appr. 32.6 mm x 19 mm; thus not conform to Figure QW-462.1(a) and testing in fact more the base metal than the deposited weld metal.
**Welding Procedure Qualification**

QG-102 The purpose of qualifying the procedure specification is to demonstrate that the joining process proposed for construction is capable of producing joints having the required mechanical properties for the intended application.

QW-141.1 Tension Tests. Tension tests as described in QW-150 are used to determine the ultimate strength of groove-weld joints.

QW-151 Tension test specimens shall conform to one of the types illustrated in Figures QW-462.1(a) through QW-462.1(e)

The expectation is that the weldment (weld metal, HAZ and base metal) will be tested, not having the unwelded base metal included in the tension specimens.
## Welding Procedure Qualification

<table>
<thead>
<tr>
<th>Process</th>
<th>Deposited WM (mm)</th>
<th>BM Qualified (mm)</th>
<th>WM Qualified (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GTAW</td>
<td>$t_1 + t_2 = 20$</td>
<td>5 - 200</td>
<td>200 max</td>
</tr>
<tr>
<td>GMAW</td>
<td>$t_3 + t_4 = 10 + 10$</td>
<td>5 - 200</td>
<td>20 or 200 max ?</td>
</tr>
<tr>
<td>SAW</td>
<td>$t_5 + t_6 = 10 + 10$</td>
<td>5 - 200</td>
<td>20 or 200 max ?</td>
</tr>
</tbody>
</table>

*NOTE: T = 60 mm*
Interpretation: IX-10-17
QW-322.1(a)

Background: A welder successfully completes a performance qualification test. During the next 6 month, the welder used the welding process multiple times during the first 4 month, but did not use the welding process in the fifth or sixth month.

Question: When maintaining the welder's qualification, is the welder continuity based on the last date the welder used the welding process?

Reply: Yes.
Welder Performance Qualification

Section IX Nonmandatory Appendix L
Welders and Welding Operators Qualified under
ISO 9606-1:2012 and ISO 14732-2013

Rule No. 1 This is not a „post facto” approval

• Welding of the test coupon must be done under the full supervision and control of the employer
• A WPS qualified to Section IX must be followed
• Testing of test coupon may be performed by others, but the employer remains responsible for Code compliance
• WPQ or WOPQ must be certified by the employer
Technical Requirements

- WPQ must record the essential variables and list the ranges qualified. (While the “actual values” recorded on the test record will be the same as for ISO the ranges qualified will be different according to Section IX).
- The test coupon material must have a P-Number and filler metals must have assigned F-Numbers.
- The forms may be in any format as long as the actual values, ranges qualified, and test results are recorded.
- A record showing the ranges qualified under both ISO and ASME may be on separate forms or they may be on one form.
Testing Requirements

• Mechanical testing according to ISO acceptable
• RT and UT technique and personnel requirements satisfying the ISO satisfy the requirements of Section IX?
• QW-191.2.1(b) Ultrasonic examinations shall be performed using a written procedure in compliance with Section V, Article 1, T-150 and the requirements of Section V, Article 4 for methods, procedures, and qualifications.
• RT and UT acceptance criteria – restriction on linear slag inclusions length
• the UT test coupon must be at least 1/2 in. (13 mm) thick
• fracture test according to ISO 9017 do not satisfy the requirements of Section IX.
QW-191.2.2 Personnel Qualifications and Certifications.

(a) All personnel performing ultrasonic examinations for welder and welding operator qualifications shall be qualified and certified in accordance with their employer’s written practice.

(b) The employer’s written practice for qualification and certification of examination personnel shall meet all applicable requirements of SNT-TC-1A for the examination method and technique.

(c) Alternatively, the ASNT Central Certification Program (ACCP) or CP-1891 may be used to fulfil the examination and demonstration requirements of SNT-TC-1A and the employer’s written practice. *(ISO 9712 not included)*