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WELDING ENGINEER FORUM

SUMMER 2021

July 13th, 2021



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AGENDA



- **Procedures Review Process and some recent statistics**
- **CSA W59 clause 3.2 – Unlisted base metal**
- **Complete Joint Preparation PQR to Support the Acceptance of Partial Joint Preparation and Fillet Weld**
- **Procedure Qualification Test - Limitations on Welding Parameters**
- **CWB Database of Previous Accumulated Test – Search and Acceptance Criteria**
- **Procedure Qualification Test Reports from Other Organization**
- **Sharing of Accepted Welding Procedures Between Fabricators**
- **Q & A**
- **Next Forum**

Procedures and Electrodes Department

Procedures and Electrodes Department



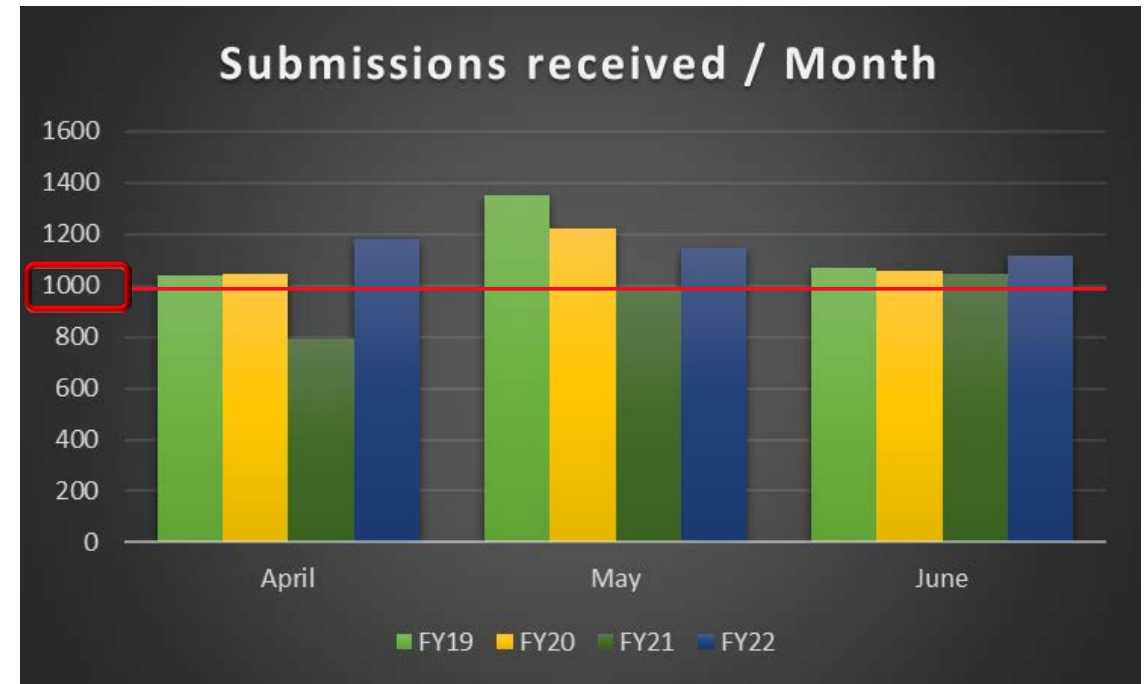
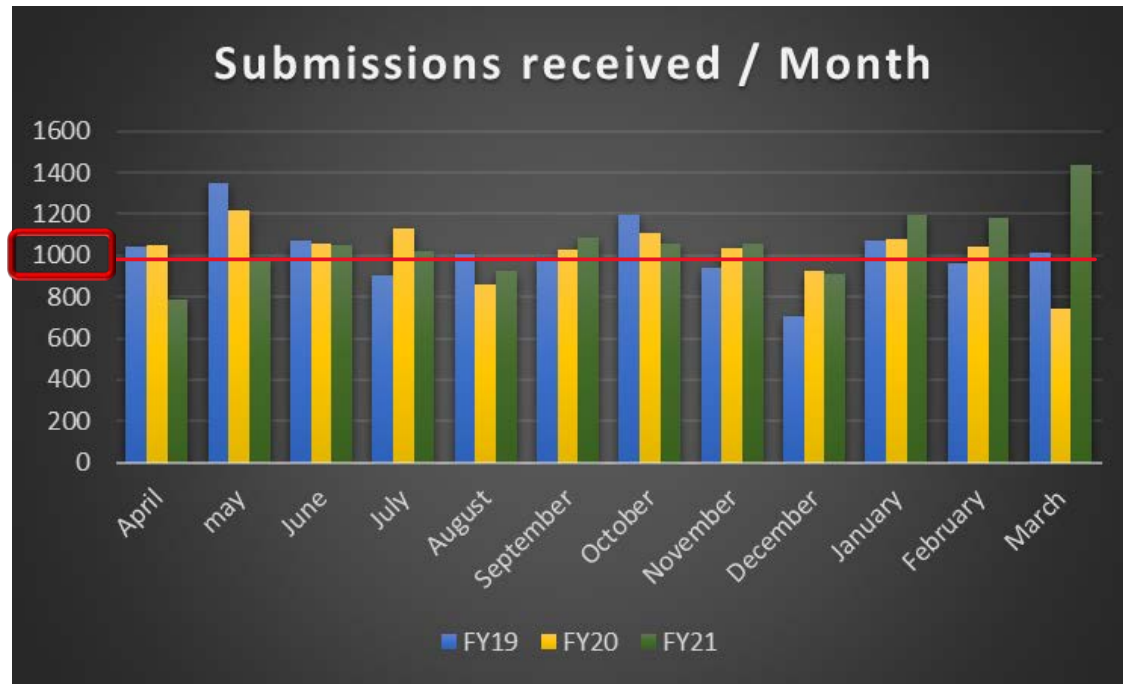
WHAT WE DO:

- **We review & accept welding procedures (WPS & WPDS) submitted on behalf of CWB certified or applicant companies**
- **We review welding procedure qualification reports (PQR)**
- **We support CWB certification team in the field**
- **We certify welding consumables and audit welding consumable manufacturers (POM) to CSA W48 as required by CSA W47.1/W59/W47.2/W59.2/W186**
- **A few numbers:**
 - **Review over 12,000 submissions (emails) every year, including over 40,000 WPDS and 2,800 PQR (daily these numbers represent 50 emails & 150 WPDS)**
 - **Number of Certified Welding Consumables: 2,450 (only 10% produced in Canada)**
 - **120 welding consumable POMs in 26 countries (only 6 POM located in Canada)**

WHO WE ARE:

- **We are a team of ten (10) welding professionals**

Procedures and Electrodes Department (cont.)



Procedures Review Process

Procedures Review Process



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A. Submission of welding procedures to CWB

All welding procedures are sent at procedures@cwbgroup.org

- a. You will get a reply confirming the reception of your email by CWB
- b. All welding procedures should be submitted in PDF and not secured

B. Response from CWB

A review letter will be sent when the review will be completed

a. There are three possible outcomes:

i. Welding procedures have been accepted (≈60%)

i. As prequalified

ii. Based on PQT

iii. Based on previous test accumulated by the CWB

ii. Welding procedures requires qualification (≈20%)

iii. Welding procedures requires revision (≈20%)

Procedures Review Process (cont.)



C. PQR reviews

- a. When PQR results are completed, a review letter confirming the test results will be sent**
- b. Corresponding welding procedures will then have to be revised as per the PQR and returned to the procedure department for final review/acceptance**

D. Turnaround time is three working days

- From reception of submission at CWB to return of review letter with corresponding welding procedures**

Unlisted base metal

CSA W59 clause 3.2 – Unlisted base metal



3.2 Base metal

3.2.1 General

Steel base metal to be welded under this Standard shall conform to the requirements of the CSA or ASTM Standards listed in Clauses 3.2.2 and 3.2.3 or other recognized specifications of equivalent welding quality as determined by the contractor's engineer and approved by the engineer. Equivalent welding quality shall be established on the basis of composition and carbon equivalent. Carbon equivalent shall be determined in accordance with the International Institute of Welding formula:

$$CE_{IWW} = C + Mn/6 + (Cr + Mo + V)/5 + (Ni + Cu)/15$$

In addition to the chemical composition, the non-listed steel shall have:

- **Similar mechanical properties**
- **Max Sulfur & Phosphorus content**
- **Same delivery condition (Q&T, TMCP, ...)**
- **Preheat to be specified on the WPDS (as the non-listed steel will not be included in table 5.3 of CSA W59)**

CJP PQR to Support the Acceptance of PJP and Fillet

CJP PQR to Support the Acceptance of PJP and Fillet



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- **A CJP PQR will qualify PJP and fillet weld within the range of essentials variables, if the joint configuration of the PJP and fillet weld size concur with associated clauses of CSA W59**

Examples:

- **A CJP PQR will not qualify an 8mm single pass fillet weld using 0.9mm GMAW electrode**

10.5.3.1

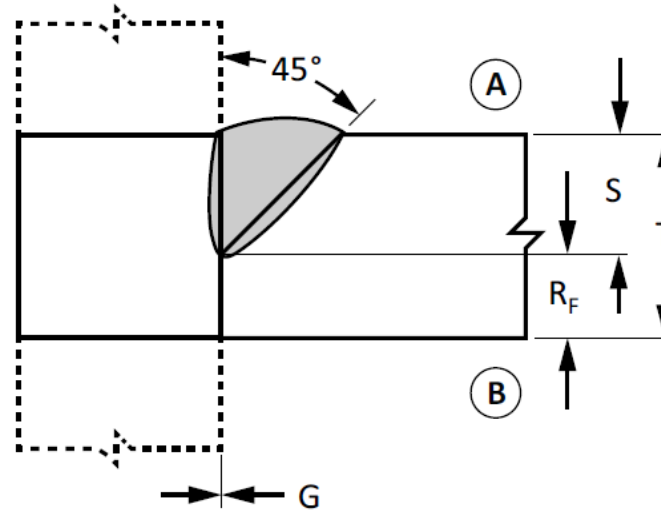
The maximum size of a fillet weld made in one pass in either the flat or the horizontal position, shall be

- a) 6 mm (1/4 in) for 0.9 mm (0.035 in) electrode wire diameter;

CJP PQR to Support the Acceptance of PJP and Fillet (cont.)

Examples:

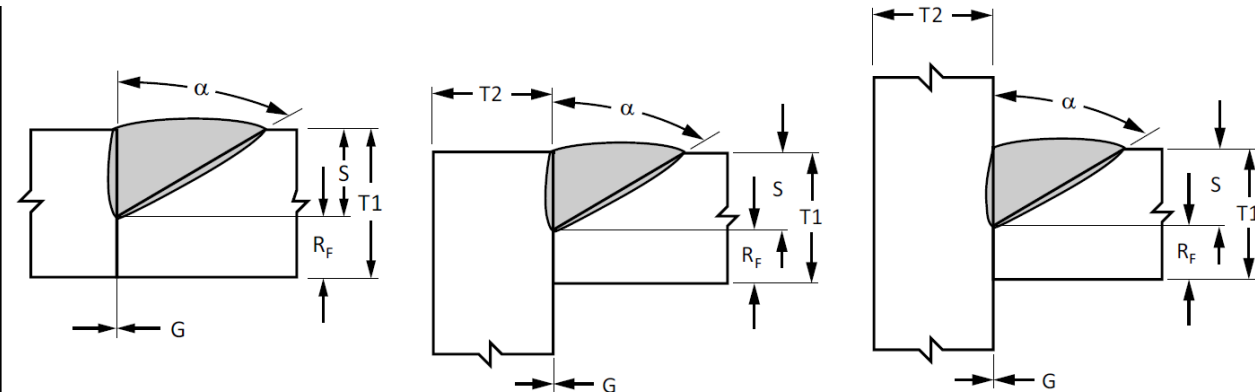
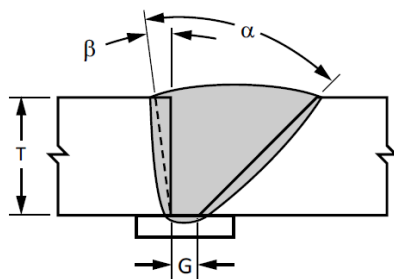
- A CJP PQR will not qualify PJP with $ETT=S$ when groove angle equal 45°



| Welding Process | Joint Type | Base Metal Thickness "T" | Root Opening "G" | Root Face "Rf" | Groove Angle " θ " | Weld Size "E" | Position |
|-----------------|--------------|---|------------------|---------------------------------------|---------------------------|---------------------------------------|---------------|
| SMAW | Tee / Corner | $8 \text{ mm } (5/16 \text{ in}) \leq T \leq 10 \text{ mm } (3/8 \text{ in})$ | 0 | $= 3 \text{ mm } (1/8 \text{ in})$ | 45° | $S - 2 \text{ mm } (1/16 \text{ in})$ | F / H / V / O |
| | | $T > 10 \text{ mm } (3/8 \text{ in})$ | | $\geq 3 \text{ mm } (1/8 \text{ in})$ | | $S - 3 \text{ mm } (1/8 \text{ in})$ | F / H / V / O |
| FCAW | Tee / Corner | $8 \text{ mm } (5/16 \text{ in}) \leq T \leq 10 \text{ mm } (3/8 \text{ in})$ | 0 | $= 3 \text{ mm } (1/8 \text{ in})$ | 45° | $S - 2 \text{ mm } (1/16 \text{ in})$ | F / H / V / O |
| | | $T > 10 \text{ mm } (3/8 \text{ in})$ | | $\geq 3 \text{ mm } (1/8 \text{ in})$ | | $S - 3 \text{ mm } (1/8 \text{ in})$ | |

CJP PQR to Support the Acceptance of PJP and Fillet (cont.)

- For aluminum, as per clause 10.6.1.3 of CSA W47.2 a CJP will qualify a PJP within the range of essentials variables. Please be aware that a change in specified joint geometry is an essential variable as per CSA W47.2 table 3



| Joint Number | Joint Designation | Base Metal Thickness | Groove Preparation | | | Recommended Welding Positions | Weld Size (E) |
|---------------------------------|-------------------|----------------------|--------------------|----------------|-----------------------------------|-------------------------------|---------------|
| | | T | Root Opening (G) | Root Face (Rf) | Groove angle ($\alpha + \beta$) | | |
| All dimensions in "millimetres" | | | | | | | |
| G4-2 | B-U4-G | ≤ 25 | 0-2 | 2-3 | 60° | H | T |
| | | > 25 | | 3 T1 | | | |

| Joint Number | Joint Designation | Base Metal Thickness | | Groove Preparation | | | Recommended Welding Positions | Weld Size (E) |
|---------------------------------|-------------------|----------------------|----|--------------------|----------------|---------------------------|-------------------------------|---------------|
| | | T1 | T2 | Root Opening (G) | Root Face (Rf) | Groove angle (α) | | |
| All dimensions in "millimetres" | | | | | | | | |
| G4-1P | B-P4-G | 6 to U | - | 0-2 | Min 2 | 60° | All | S |
| G4-1P | C-P4-G | 6 to U | U | 0-2 | Min 2 | 60° | All | S |
| G4-1P | T-P4-G | 6 to U | U | 0-2 | Min 2 | 60° | All | S |

CJP PQR to Support the Acceptance of PJP and Fillet (cont.)



- For aluminum, CJP will not qualify a fillet weld
- For stainless steel, as per note 2) of table K.5 of CSA W47.1 and clause 6.7.1 of AWS D1.6, a CJP PQR will qualify PJP, plug/slot weld and fillet weld within the range of essentials variables
 - Same logic as CSA W47.1 will be followed, the corresponding PJP and fillet weld size should be as per the prequalification limitations

Maximum criteria for prequalified joints using the shielded metal arc welding process (SMAW)

| | | |
|--------------------------------|-------------------|-------------------------------------|
| Maximum one-pass fillet | 10 mm (3/8 in) | In the flat position |
| | 8 mm (5/16 in) | In horizontal or overhead positions |
| | 12 mm (1/2 in) | In the vertical position |

Procedure Qualification Test - Limitations on Welding Parameters

Procedure Qualification Test - Limitations on Welding Parameters

- **CSA W47.2 has qualification range specified for welding parameters in Table 3 (Essential variables for GMAW, GTAW, and PAW).**
 - **Welding current : $\pm 15\%$**
 - **Arc voltage: $\pm 10\%$**
 - **Arc travel speed: $\pm 25\%$**
- **CSA W47.1 does not specify any such range, but it should be coherent and not too far from the welding parameters used during PQT; we recommend the following :**
 - **Welding Current and Wire Feed Speed: $\pm 10\%$**
 - **Arc Voltage: $\pm 7\%$ or ± 2 Volts**
 - **Arc Travel Speed: $\pm 15\%$**
- **When impact testing conducted:**
 - **Maximum heat input must be considered**



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Previous Accumulated Test Search and Acceptance Criteria

CWB Database of Previous Accumulated Test – Search and Acceptance Criteria

As allowed by clause 11.2.2 of CSA W47.1, non-prequalified WPDS can be accepted based on previous tests accumulated by the CWB (WeldEye)

Limitations:

1. Database in WeldEye has not been updated lately
2. Two similar PQR required (Reliability Concerns / Human Error)
3. Similar Welding Parameters as those on the WPDS are required to support the acceptance
4. Searching can be subjective between CWB engineers

WeldEye search ... example for an FCAW stainless steel fillet weld between SS and CS

- E309LT1-1 / 1.2mm wire diameter
- 100%CO₂
- In horizontal

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- Procedures
 - Search
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- ArcQ / QC
- Tools
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Procedure Search

| Standard | Extended | Advanced |
|--|---|---|
| Procedure no.: | <input type="text"/> | Filler metal <input type="text"/> |
| Project | <input type="text"/> | F No. <input type="text"/> |
| Produced by | <input type="text"/> | Brand name 1: <input type="text"/> |
| Location: | <input type="text"/> | 2: <input type="text"/> |
| Job no. | <input type="text"/> | 3: <input type="text"/> |
| Rep. no. | <input type="text"/> | Classification 1: <input type="text" value="E309LT-1"/> |
| Standard | <input type="text"/> | 2: <input type="text"/> |
| Specification | <input type="text"/> | 3: <input type="text"/> |
| Revision | <input type="text" value="All revisions"/> | Flux brand name <input type="text"/> |
| Procedure type | <input type="text" value="Any"/> | Shielding gas <input type="text"/> |
| Joining method | <input type="text"/> | Shielding gas type 1: <input type="text" value="100% CO2"/> |
| Stat. sign | <input type="text"/> | 2: <input type="text"/> |
| Stat. doc. | <input type="text"/> | 3: <input type="text"/> |
| Index no. | <input type="text"/> - <input type="text"/> | Purging gas <input type="text"/> |
| Layout | <input type="text"/> | Parameters |
| Client | <input type="text"/> | Electrode diam. <input type="text" value="1.2"/> - <input type="text" value="1.2"/> mm |
| Ref. | <input type="text"/> | Current <input type="text"/> - <input type="text"/> / <input type="text"/> - <input type="text"/> A |
| Parent metal <input type="text"/> | | Volt <input type="text"/> - <input type="text"/> / <input type="text"/> - <input type="text"/> V |
| Name/Grade 1: <input type="text"/> | | Wire feed speed <input type="text"/> - <input type="text"/> / <input type="text"/> - <input type="text"/> m/min |
| 2: <input type="text"/> | | Welding speed <input type="text"/> - <input type="text"/> / <input type="text"/> - <input type="text"/> mm/min |

Choose project

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- Procedures
 - Search
 - New
 - Lists
- ArcQ / QC
- Tools
- Administration
- Logout
- Help

| | | | |
|-----------------------|--------|----------------------|--------------------------|
| Joint type | | Min average FL/BM | |
| Joint design | | Max. hardness | |
| 1/2 sided | | CTOD Performed | All |
| Referenced WP | | CTOD test temp. | |
| Single/multi-pass | SINGLE | Corrosion test temp. | |
| Equipment: | | Weight loss | |
| Included angle 1: min | | Ferrite % min | |
| 2: min | | Ferrite % max | |
| max | | FN Min | |
| Weld size/ETT min | | FN Max | |
| max | | Used in project | |
| Process 1: | | PED Appr. | |
| Type: | | Appr. | |
| Process 2: | | Discipline | |
| Process 3: | | Active | Yes |
| Positions | 2F | Order by | Proc. no. |
| Preheating | | Max lines in survey: | 200 |
| Interpass temp. | | Survey | Heading |
| Soaking | | Force survey | <input type="checkbox"/> |
| PWHT min | | | |
| max | | | |
| PWHT | | | |

User Attributes

Add

Found: 33

Produced by WeldEye®




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 - Search
 - New
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- ArcQ / QC
- Tools
- Administration
- Logout
- Help

Procedure Survey

Heading | Document | **Miscellaneous** | Sketch

| <input type="checkbox"/> | PROCEDURE NO: ^ (NAT.) | REV: | PDF | PROCESSES | PARENT METAL GRADE A / B | CE A / B | THICKNESS RANGE A/B[mm] | PIPE DIAM. RANGE A/B[mm] | POSITIONS | SINGLE/DOUBLE, FILLET SIZE | JOINT TYPE/JOINT DESIGN | CHARPY-V TEST TEMP. |
|--------------------------|------------------------|------|---|-----------|-------------------------------|----------|-------------------------|--------------------------|-----------|----------------------------|-------------------------|---------------------|
| <input type="checkbox"/> | P 000941 | 0 |  | FCAW | A240 TYPE 304 300W | | 13.00 - 25.00 | - | 2F | ONE 6.00 - | TEE FILLET | |
| <input type="checkbox"/> | P 001168 | |  | FCAW | A240 TYPE 316L A36 | | 38.00 - 50.00 | - | 2F | ONE 8.00 - | TEE FILLET | |
| <input type="checkbox"/> | P 002188 | 0 |  | FCAW | A240 TYPE 304L 350W | | 10.00 - 15.00 | - | 2F | ONE 6.00 - | TEE FILLET | |
| <input type="checkbox"/> | P 002188 | 0 |  | FCAW | A240 TYPE 304L A240 TYPE 304L | | 10.00 - 15.00 | - | 2F | ONE 6.00 - | TEE FILLET | |
| <input type="checkbox"/> | P 004125 | 0 |  | FCAW | A240 TYPE 409 A36 | | 6.00 - 10.00 | - | 2F | ONE 6.00 - | LAP FILLET | |
| <input type="checkbox"/> | P 007070 | 0 |  | FCAW | 304L 350W | | 6.00 - 19.00 | - | 2F | ONE 6.00 - | TEE FILLET | |
| <input type="checkbox"/> | P 007072 | 0 |  | FCAW | 316L 350W | | 6.00 - 19.00 | - | 2F | ONE 6.00 - | TEE FILLET | |

Edit **Delete** **Add**

WELDING PROCEDURE QUALIFICATION RECORD (WPQR)

WPQR No: P 000941

Ref.:

Date: 05.12.94

Rev: 0

 Prod. by: **Canadian Welding Bureau**

 Client: **APEXM1**

 Ref. stand: **W47.1/W59**

Project:

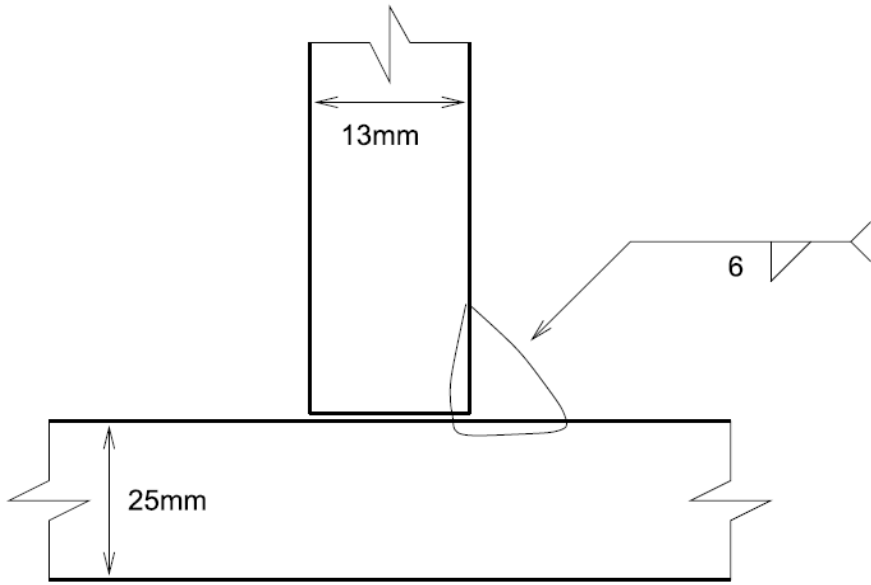
 Ref. spec.: **2&7**

 Exam. body: **W.WIENER**

Location:

 Ref. Proc.: **F7-2-2**

| | | | |
|--------------------|-------------------|----------|----------|
| Welding process | FCAW | | |
| Shielding gas type | 1 100% CO2 | 2 | 3 |
| Weaving (yes/no) | max: mm | max: mm | max: mm |
| Purging gas type | l/min | | |
| Welding positions | 2F | | |
| Joint type | TEE | | |
| Joint preparation | | | |
| Cleaning method | | | |
| Backing | N/A | | |
| Single/Double | ONE | | |
| Back gouging | N/A | | |
| Flux designation | N/A | | |
| Flux handling | | | |
| Tungsten electrode | N/A | mm | |
| Torch angle | ° | | |
| Stand off distance | 19 | mm | |
| Nozzle diameter(s) | mm | | |
| Tack welding proc. | Rev: | | |



Identification of parent metal

I: CE:

C:

PCM:

II: CE:

C:

PCM:

| Part | Name/Grade | Standard | Group | Delivery cond. | Heat no. | Thickness [mm] | Diameter [mm] |
|------|----------------------|-------------------------|----------|----------------|----------|----------------|---------------|
| I | A240 TYPE 304 | ASTM | | | | 13.00 | |
| II | 300W | CAN/CSA-G40.21-M | B | | | 25.00 | |

Identification of filler metal

| Index | Trade name | Classification | Group | Filler handling |
|-------|----------------|----------------|-------|-----------------|
| 1 | SANDVIK CANADA | E309LT-1 | | |
| 2 | | | | |
| 3 | | | | |

Welding Parameters

Equipment:

| Pass no. | Index | Dia. [mm] | Welding process | Wire feed speed [m/min] | Current [A] | Voltage [V] | Current / Polarity | Welding speed [mm/min] | Run Out Length [mm] | Gas [l/min] | Heat input [kJ/mm] |
|----------|-------|--------------|-----------------|----------------------------|----------------|----------------|--------------------|---------------------------|------------------------|----------------|-----------------------|
| 1 | A | 1.20 | 1 | 9.90 - | 190 - | 28.0 - | DC+ | 538 - 538 | N/A | 18.9 | 0.6 - |
| | | | | - | - | - | | - | | | - |
| | | | | - | - | - | | - | | | - |
| | | | | - | - | - | | - | | | - |
| | | | | - | - | - | | - | | | - |
| | | | | - | - | - | | - | | | - |
| | | | | - | - | - | | - | | | - |
| | | | | - | - | - | | - | | | - |
| | | | | - | - | - | | - | | | - |

Heat treatment

Method:

Preheat min: °C Interpass temp. max: °C Heat treatment proc.: Temp. control:
 PWHT min: °C max: °C Soaking: min/mm min Heating rate: °C/h Cooling rate: °C/h

| | | | |
|----------|----------------|-------|--|
| Remarks: | Name of welder | Stamp | Additional info enclosed (Yes/No): no Date/Signature: 05.12.94 DBD Dragici, Dan B. Approved: |
| | R. CARMIER | | |
| | | | |
| | | | |

CWB Database of Previous Accumulated Test – Search and Acceptance Criteria (cont.)

Going forward:

1. New PQR to be uploaded in database
2. Search criteria are under review
3. Improvement of the search guideline for CWB engineers

PQR from Other Organization

Procedure Qualification Test Reports from Other Organization



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Clause 11.2.3 of CSA W47.1....

Provided that all requirements outlined in this Standard for the applicable welding process have been met, a WPDS that has been qualified by an authority acceptable to the CWB to another recognized code or standard shall be acceptable.

For the PQR to be accepted, the following conditions must be met:

- The qualification system and test requirements must be similar to and meet or exceed the requirements of W47.1 and be accepted by the Bureau.
- A qualification record providing evidence satisfactory to the Bureau that previous qualification tests were successfully completed and **duly witnessed by a qualified independent third party**

Procedure Qualification Test Reports from Other Organization (cont.)



Acceptance based on Clause 11.2.3 of CSA Standard W47.1:2019 can be on a case-by-case basis. Generally, a certification task completed by a well-recognized certification body while matching or exceeding our certification requirements are acceptable to CWB.

- **All welding witnessed**
- **All mechanical tests witnessed**
- **All PQR signed by the certification body**
- **Confirmation of the extent of witnessing could be required**

Sharing Welding Procedures Between Fabricators

Sharing of Accepted Welding Procedures Between Fabricators



- **A fabricator (subcontracted) can use the CWB accepted WPDS from the fabricator who subcontracted them**
- **Sharing welding procedures among multi-plant companies is acceptable**

Questions & Answers:

Questions & Answers:

Use of AWS D9.1 for stainless steel application with thickness less than 3mm:

- AWS D9.1 is a non-structural code, but if needed it can be referred on WPDS and use for qualifying non-structural stainless steel sheet application

Welding procedures resource/example for aluminum:

- Annex A of CSA W59.2-2018 includes recommended joint geometries for aluminum

Seal welds:

5.4.10 Seal welds (CSA W59)

When seal welds are specified, the minimum preheat requirements of this Standard shall apply. Seal welds shall meet the workmanship and quality provisions of this Standard, but shall not require approved welding procedures.

Questions & Answers (cont.):

Possible improvement for submitting welding procedure to CWB for review:

- We are currently implementing a new ERP for CWB certification, the welding procedure review process is part of that project. The intent is to provide more accessibility to CWB clients to their certification documentation including welding procedures and PQR.

What stainless steel alloy are considered prequalified?

- The austenitic alloy listed in table 5.2 of AWS D1.6 are considered prequalified. The correspondence between the base metal and filler metal are not correct in the table K.1 of CSA W47.1, but the alloy listed are considered prequalified (same as those listed in table 5.2 of AWS D1.6)

Closing Words & Next Forum

Next Forum



- All your questions will be reviewed, our answers will be posted in the FAQ section of the webpage
- The next welding engineer forum will be held early December this year
- Please visit the welding engineer webpage at <https://www.cwbgroup.org/certification-and-qualification/welding-engineers>
- The video of today's presentation and the PDF copy of the presentation will be available on the welding engineer webpage