

INDIAN METAL BUILDING FORUM

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Technical Knowledge Series

FABRICATION GUIDANCE SERIES

Welding Requirements: Frequently Asked Questions

Shop and site welding of PEB and structural steel | Based on AWS D1.1 practice

Qualify the Procedure

Qualify the Welder

Inspect the Weld

DOCUMENT NO:	IMBF-FAB-002
SERIES:	Series C: Fabrication (IMBF-FAB)
COMPANION TO:	IMBF-FAB-001 Welding Requirements
REFERENCE CODE:	AWS D1.1 Structural Welding Code: Steel
USE:	Quick answers for fabricators, QA/QC and inspectors

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Rev 00 | 05 October 2026 | Educational / Technical Reference (Draft for technical review)
A quick-reference FAQ. The contract specification and the applicable code edition always govern.

About this FAQ. Answers summarise common requirements for statically loaded steel building structures welded to AWS D1.1 practice. Values were written from code practice as commonly applied and are not checked against a specific edition. The contract specification, the approved WPS and the code edition named in the contract govern. Status: draft for IMBF technical review.

1 DOCUMENTS AND QUALIFICATION

Q1. What is the difference between a WPS, a PQR and a WPQ?

The WPS is the written instruction to the welder. The PQR is the test record proving that the WPS gives sound welds. The WPQ is the test record proving that a named welder can make sound welds with that process and position.

Q2. Does every WPS need a PQR?

No. A WPS that meets all the code rules for a prequalified procedure needs no qualification test. Any WPS outside those rules must be qualified by test and backed by a PQR.

Q3. When must a WPS be revised or requalified?

When an essential variable changes beyond the code limit: for example the process, filler classification, welding position, or a large change in current, voltage or travel speed.

Q4. How long does a welder's qualification last?

It stays valid while the welder keeps using the process. Requalify if the welder has not used the process for more than six months, or if there is specific reason to question ability.

Q5. Do tack welders need to be qualified?

Yes. Tack welds become part of the joint, so they must be made by qualified tack welders or welders, to a WPS, and to the same quality as the final weld.

Q6. Who may inspect welds?

A qualified welding inspector, for example an AWS Certified Welding Inspector or a person accepted by the engineer as equivalent. NDT is done by personnel certified to SNT-TC-1A or equivalent, with results interpreted by Level II or III.

Q7. What must a WPS contain?

Process, joint design, base metal and thickness range, filler metal and shielding, position, electrical characteristics, travel speed, technique, and preheat and interpass temperature. It should be signed as approved.

Q8. Where should the WPS be kept?

At the welding station, where the welder and the inspector can read it. A WPS that stays in the office does not control the weld.

2 MATERIALS AND CONSUMABLES

Q9. Which filler metal should be used?

The one named in the WPS, matching the strength of the base metal. Typical for A36, A572 Gr 50 and IS 2062 E250 / E350: E7018 for SMAW, ER70S-6 for GMAW, E71T-1 for FCAW and F7A2-EM12K for SAW.

Q10. How should low-hydrogen electrodes be stored?

Buy them in sealed containers. Once opened, keep them in a holding oven at 120 deg C minimum and issue only what will be used in the permitted time.

Q11. How long can E7018 electrodes stay out of the oven?

Four hours at most. Electrodes exposed longer must be re-dried at 260 to 430 deg C for at least two hours, and may be re-dried once only. Electrodes that have been wet are discarded.

Q12. Is a mill test certificate needed for every plate?

Yes. Each plate and section should be traceable to a mill test certificate by heat number, and the grade must match the drawing.

Q13. Can rusty wire or damp flux be used?

No. Wire must be clean and free of rust. SAW flux must be dry and clean; flux that has been wet is not reused.

Q14. Can another brand of the same electrode classification be used?

Generally yes, if the classification and the WPS limits are unchanged and the batch certificate is on file. Check the contract: some specifications approve consumables by brand.

3 BEFORE AND DURING WELDING

Q15. How clean must the joint be?

Free of loose scale, rust, grease, paint, moisture and cutting slag. Tight mill scale that survives wire brushing may remain unless the code or WPS says it must be removed.

Q16. What root gap is acceptable in a fillet joint?

Parts should be in close contact. A gap up to 5 mm may be accepted, but where it exceeds 1.6 mm the fillet leg is increased by the amount of the gap.

Q17. When is preheat required?

For A36 and A572 Gr 50 with low-hydrogen processes: 10 deg C minimum up to 38 mm thick, 65 deg C over 38 to 64 mm, and 110 deg C over 64 mm. Higher-strength steels and restrained joints need more. Always follow the WPS.

Q18. What if the steel is very cold?

If the steel is below 0 deg C, warm it to at least 20 deg C and keep it there during welding. Do not weld when the ambient temperature is below minus 20 deg C.

Q19. Can we weld in rain or wind?

Not on wet surfaces or in rain. Gas-shielded processes need a wind shield when wind speed at the weld is over about 8 km/h, because the gas is blown away and the weld becomes porous.

Q20. What must be recorded during welding?

Current, voltage, travel speed and gas flow against the WPS, normally in a daily welding parameter log, together with the welder identification for each member.

Q21. How should preheat be measured?

With temperature-indicating crayons or a contact thermometer, on the base metal about 75 mm from the joint, just before welding starts and between passes.

Q22. What is interpass temperature?

The temperature of the weld area just before the next pass is laid. It must not fall below the minimum preheat, and the WPS may also set a maximum.

Q23. Why does welding sequence matter?

Weld shrinkage distorts members, especially end plates and thin webs. A balanced sequence, presetting and restraint keep the member within fabrication tolerance and avoid heat straightening later.

Q24. Are arc strikes outside the weld a defect?

They should be avoided. An arc strike leaves a small hard spot that can crack. Grind it smooth and check the area for soundness.

4 WELD SIZE AND DETAILING

Q25. What is the minimum fillet weld size?

For low-hydrogen processes, by the thinner part joined: 3 mm up to 6 mm thick; 5 mm over 6 to 12 mm; 6 mm over 12 to 20 mm; 8 mm over 20 mm. The drawing size governs when it is larger.

Q26. Is there a maximum fillet size along a plate edge?

Yes. The plate thickness for plates under 6 mm, and 2 mm less than the thickness for plates of 6 mm and over, unless the drawing calls for build-up to full thickness.

Q27. Is single-side web-to-flange welding allowed in PEB members?

Often, yes: it is common metal building practice with automatic SAW. It is acceptable only where the design and the contract allow it. Some projects require welding on both sides.

Q28. Can the shop change weld size or use intermittent welds instead of continuous?

No. Size, length and type come from the shop drawing and weld map. Any change is a design change and needs the engineer's written approval.

Q29. What is the throat of a fillet weld?

The shortest distance from the root to the face. For an equal-leg fillet it is 0.707 times the leg size, and it is the dimension that carries the load.

Q30. What is the minimum length of a fillet weld?

Four times its size. A shorter weld is counted at a reduced size, so short stitch welds should follow the drawing exactly.

5 INSPECTION AND ACCEPTANCE

Q31. How much visual inspection is required?

All welds, over their full length, after cooling and cleaning. Visual inspection comes before any NDT.

Q32. Is any crack acceptable?

No. Cracks are rejected whatever their size or location.

Q33. How much undercut is allowed?

For statically loaded structures: 1 mm for material under 25 mm thick, with 2 mm allowed for a total of 50 mm in any 300 mm; and 2 mm for material of 25 mm and over.

Q34. Can a fillet weld be slightly undersize?

Within limits, for not more than 10 % of the weld length: up to 2 mm under for fillets of 5 mm or less, 2.5 mm for 6 mm fillets and 3 mm for fillets of 8 mm and larger.

Q35. How much porosity is allowed in a fillet weld?

The sum of visible piping porosity of 1 mm and larger must not exceed 10 mm in any 25 mm of weld, nor 20 mm in any 300 mm. Groove welds in tension should show none.

Q36. Which welds need UT, MT or PT?

The contract and the approved Quality Assurance Plan decide. Typically UT for full-penetration butt welds of 8 mm and over, and MT or PT for fillet and partial-penetration welds at end plates and base plates.

Q37. What does a visual inspector need?

The drawing and weld map, the WPS, fillet and undercut gauges, a rule or tape, adequate light, and a marker to identify defects on the member.

Q38. What lighting is needed for MT and PT?

At least 1000 lux at the test surface for visible methods.

Q39. Must all spatter be removed?

Slag must be removed from every pass and from the finished weld. Tightly adhering spatter may remain unless it interferes with painting or NDT, or the contract requires removal.

6 REPAIR AND RECORDS

Q40. How is a cracked weld repaired?

Find the extent by MT or PT, remove the crack and 50 mm of sound metal beyond each end, re-weld to an approved procedure with a qualified welder, and retest by the same method.

Q41. How are undersize welds and undercut corrected?

By cleaning and adding weld metal to the WPS. Overlap and excess convexity are corrected by removing the excess metal.

Q42. Is heat straightening allowed?

Yes, with control. For ordinary structural steels the steel temperature must not exceed 650 deg C, checked with temperature crayons, and the member is re-inspected afterwards.

Q43. When can a repaired weld be painted?

Only after the repair has been re-inspected and accepted.

Q44. How is defective weld metal removed?

By grinding, chipping or air-carbon-arc gouging, without nicking the base metal. Gouged surfaces are cleaned to bright metal before re-welding.

Q45. When is a non-conformance report raised?

When a weld or member does not meet the drawing, WPS or acceptance criteria and cannot be corrected by routine rework. The NCR records the defect, the approved repair and the re-inspection result.

Q46. Which welding records should be kept?

WPS, PQR and welder qualification records; material and consumable certificates; fit-up and welding inspection reports; parameter logs; NDT reports; repair and non-conformance records; calibration records.

Final disclaimer. This IMBF publication is an educational quick reference. It is not a substitute for the applicable welding code, the contract specification, an approved WPS, qualified inspection or professional advice. See IMBF-FAB-001 for the full guide and its basis.