WELD IMPERFECTIONS AND TROUBLESHOOTING

Cracks and Immediate Actions

A crack is an assessment issue. Stop and mark its position. Do not bury it under another run.

100 · Weld centreline



100 · HAZ indication



100 · Stepped tearing



104 · Crater crack



ISO 6520-1	What to Look For	First Investigation
100 · Crack	A sharp break in weld or parent metal. VT for visible indications, PT or MT for surface assessment.	Check location, orientation and when it appeared. Refer for assessment.
100 · Solidification	Often weld centreline. Opens during the last stage of solidification.	Review dilution, fit-up, bead shape and filler. Applies across fusion processes.
100 · Hydrogen	Can appear after cooling, in the HAZ or weld metal.	On ferritic steel, check hydrogen exposure, hardness, restraint and thermal history.
100 · Lamellar tearing	Stepped tearing in rolled plate beneath a restrained joint.	Review through-thickness strain and plate properties. UT may be appropriate.
104 · Crater crack	Short star or longitudinal crack at a stop.	Check crater fill, stop technique and termination tabs on applicable jobs.

Acceptance Example

ISO 5817:2023 Table 1 items 1.1 and 1.2 prohibit cracks and crater cracks at B, C and D in the listed thickness range of ≥0.5mm. A visible 2mm crater crack fails all three levels in that scope. The example length is illustrative.

ISO 5817:2023 · Table 1

TWI · Hydrogen cracking

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Porosity and Inclusions

Start with how the indication is distributed. Isolated pores, clusters and elongated cavities point to different checks.

2011 · Isolated pore



2013 · Pore cluster



2016 · Elongated cavity



2017 · Open pore



301 · Trapped slag



3041 · Tungsten



ISO 6520-1	Appearance / Detection	Likely Cause and First Check
2011 · Gas pore	Round internal cavity. RT can reveal volumetric pores.	On MIG/MAG or TIG, check shielding and contamination first.
2013 · Clustered porosity	Several pores concentrated in one area.	Look for a local oil patch, a leak or a change in torch coverage.
2016 · Wormhole	Elongated gas cavity. Examine RT pattern and preparation history.	Look for trapped gas from contamination, paint or moisture.
2017 · Surface pore	Round opening through face or root. VT, followed by a suitable surface method if needed.	Check draughts, nozzle condition and gas delivery before changing settings.
301 · Slag inclusion	Slag trapped inside a run or between runs. RT or UT as appropriate.	On MMA or slag-forming flux-core, clean each pass and inspect toe recesses.
3041 · Tungsten inclusion	Tungsten inside the deposit. RT may help identify the dense inclusion.	On TIG, check for tungsten contact with the pool or filler. Restore the tip.

Thin-Section Check

For a 2mm full-penetration butt weld, take weld thickness s = 2mm. For a single surface pore, Table 1 item 1.3 gives D: d ≤ 0.3s = 0.6mm. C and B prohibit it in the 0.5–3mm thickness band. Apply all other relevant criteria too.

ISO 5817:2023 · Table 1 item 1.3

TWI · Slag inclusions

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Fusion and Root Problems

Fusion is bonding at a boundary. Penetration is the depth reached. A tidy cap can hide either problem.

4011 · Sidewall



4012 · Inter-run



4013 · Root interface



4021 · Unfilled root



ISO 6520-1	Appearance / Detection	First Investigation
4011 · Sidewall	Planar line along a groove face. UT often useful when the joint permits.	Check arc access, angle and whether the pool is ahead of the arc.
4012 · Inter-run	Unfused boundary between runs.	Check bead placement, oxide or slag removal and access between beads.
4013 · Root fusion	Unfused interface at the root. Inspect accessible root or use specified NDT.	Check root face, root gap and arc aim. TIG can bridge a gap without fusing both sides.
4021 · Root penetration	Weld falls short of the root in a joint specified for full penetration.	Compare the section to the joint design. Verify gap, land and actual root-run settings.

Compare the Preparation

ISO 9692-1:2013 Table 1 example 1.5 for a broad-root-face V lists about 60°, a 1–4mm gap and a 2–4mm land for the listed processes and thickness range. These are joint preparation examples. Use the drawing for the actual root geometry.

Acceptance · ISO 5817:2023

Surface lack of fusion (1.5) fails B, C and D. Internal lack of fusion (2.12) fails B and C. At D, short indications in butt welds may be up to 0.4s high, capped at 4mm. For 4021 in single-sided full-penetration butt welds (1.6), B and C prohibit it. D permits short indications up to 0.2t, capped at 2mm. See clauses 3.2 and 3.3 for the length test.

Common Mistake

Turning up the current before measuring the groove. A restricted groove or offset root can still prevent the arc reaching the correct boundary.

ISO 9692-1:2013 · Table 1 row 1.5
TWI · Root fusion and penetration

ISO 5817:2023 · Items 1.5, 1.6 and 2.12

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WELD IMPERFECTIONS AND TROUBLESHOOTING

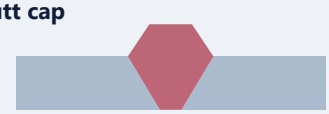
Face and Toe Imperfections

Use a clean surface, good lighting and the appropriate gauge. Record the worst point and the affected length.

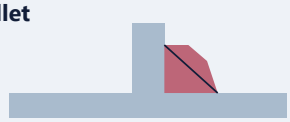
5011 · Toe groove



502 · High butt cap



503 · Convex fillet



506 · Unfused lip



511 · Face underfill



ISO 6520-1	What You See	Likely Cause and First Check
5011 · Undercut	A groove at a weld toe. VT and depth gauge.	Review speed, arc length, current and work angle within the procedure.
502 · Excess weld metal	Butt weld cap too high. VT and bridge gauge.	Compare deposition with travel speed and the available groove volume.
503 · Excessive convexity	Fillet face projects too far beyond the line between toes.	Check fillet shape and wire feed or travel speed.
506 · Overlap	Weld metal rolls past the toe without fusion.	Check arc aim and deposition rate. Confirm whether the visible lip is fused.
511 · Incompletely filled groove	Face below adjacent parent metal.	Check pass count, deposition and local starts or stops.

Worked Check · Excess Cap

For a butt cap 10mm wide, Table 1 item 1.9 gives a maximum height of 2.0mm at B, 2.5mm at C and 3.5mm at D, subject to the smooth-transition criterion. A 2.8mm cap fails B and C on height and meets D on height alone.

Undercut and Overlap

For t > 3mm and a smooth transition, item 1.7 limits undercut depth to 0.05t (max. 0.5mm) at B, 0.1t (max. 0.5mm) at C and 0.2t (max. 1mm) at D. Item 1.13 prohibits overlap at B and C. At D, h ≤ 0.2b.

ISO 5817:2023 · Table 1 items 1.9, 1.13

TWI · Geometric shape imperfections

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Root Profile and Alignment

Inspect the root before access is lost. Treat weld shape, component alignment and arc damage as separate checks.

504 · Root projection



510 · Through-hole



515 · Concave root



5071 · Plate offset



601 · Arc strike



602 · Droplets



508 · Angular mismatch



ISO 6520-1	Appearance / Detection	First Investigation
504 · Excess penetration	Too much root reinforcement. Root VT, borescope or specified NDT.	Review gap, root face, root current and travel.
510 · Burn-through	Hole through the joint. VT from either side if accessible.	Check local gap, speed and heat on thin edges.
515 · Root concavity	Recess in the root surface. VT or borescope.	Check root fit, travel, pool control and purge pressure.
5071 · Plate mismatch	One edge sits higher than the other. Use bridge gauge or straightedge.	Check fit-up, tack sequence and clamp release.
601 · Arc strike	Local mark outside the intended weld. VT, then specified surface examination.	Check holder handling, return contact and arc starts. Refer for assessment.
602 · Spatter	Droplets on adjoining material. VT.	Check arc stability, return connection, feed and gas.
508 · Angular mismatch	Parts deviate from intended angle. Check against the datum.	Review shrinkage, restraint, pre-set and weld order.

Plate Example

For 8mm plate with a longitudinal weld, ISO 5817:2023 Table 1 item 3.1 gives maximum linear offset of 0.8mm at B, 1.2mm at C and 2.0mm at D. Measure relative to the intended position.

ISO 5817:2023 · Table 1 item 3.1

TWI · Distortion types and causes

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Troubleshooting at the Machine

Start with a repeatable test and record the actual values. Change one variable at a time within the authorised range.

Symptom	First Check	Sourced Comparison
MAG · unstable transfer	Check polarity, contact tip, wire feed and gas before tuning voltage or inductance. Measure CTWD from tip to work.	One stainless short-arc example uses 0.9mm wire, DC+, 13mm CTWD, 3.0m/min, 20–21V and about 60A with 90% He / 7.5% Ar / 2.5% CO_2.
TIG · dark deposit	Check for leaks, tungsten contamination and excessive stick-out relative to shielding coverage.	CK troubleshooting cites 7–12L/min in its relevant shielding check. One example uses 4–6L/min on stainless with a #5 or #6 cup and 1.6mm tungsten.
MMA · stubbing	Read the exact electrode data. Check polarity, current, arc length and coating condition.	E6013 example, 2.5 × 350mm: 60–100A. This range applies to that electrode.
Flux-core · trapped slag	Clean each run and check the toe profile before depositing the next run.	Check the wire's gas and positional approval before changing setup.

Inspection and Repair Record

Record weld ID, location, extent, process, parameters and inspection method. VT means visual testing, PT penetrant, MT magnetic particle, UT ultrasonic and RT radiographic testing. The contract or inspection plan sets acceptance. Have an authorised person approve removal, repair and reinspection. Repeated thermal cycles can change the joint and introduce fresh distortion.

Fume and UV

Capture fume at source indoors and use suitable RPE when the assessment calls for it. Protect others from arc radiation with screens.

For help with recurring faults, send the process, joint section, consumable, settings and inspection result. Call 023 8033 9443 or email sales@rhdaveywelding.co.uk.

Jasic TIG Range Guide
Parweld XTM
Parweld Filler Wires
Weld Star TIG
Kjellberg MMA Electrodes

HSE · Welding controls
CK · TIG troubleshooting

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