Testing & CQA Procedures

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CQA Solutions

CQA SOLUTIONS

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Introduction To Seaming

- The process of joining geomembrane panels is called seaming or welding. Both terms are often used interchangeably. Depending on the material type, there are specific methods that can be used to join (seam) the materials; these methods can be broken down into four main categories:

Thermal

Chemical

Adhesive

Tape

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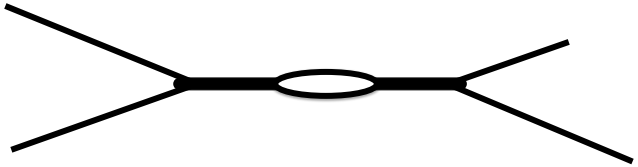
Thermal Welding

Single Fusion Weld

Double Fusion Weld



Extrusion Fillet Weld

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Considerations Prior To Welding

Proper Machine Set-up for the material. Thermal Fusion:

- Solid Wedge
- Dual Track Wedge
- Copper Wedge
- Stainless Steel Wedge
- Porcelain Wedge
- Stainless Steel Nip Rollers
- Rubber Nip Rollers

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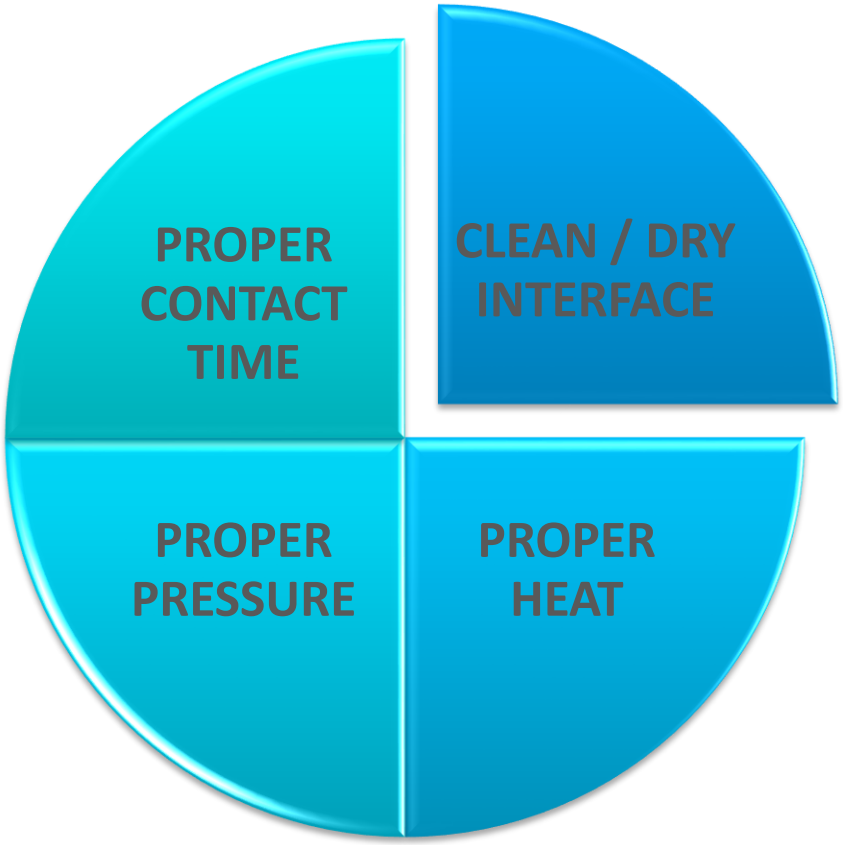
Core Welding Requirements



All CONDITIONS MUST BE MET TO ACHIEVE MAXIMUM WELD QUANTITY

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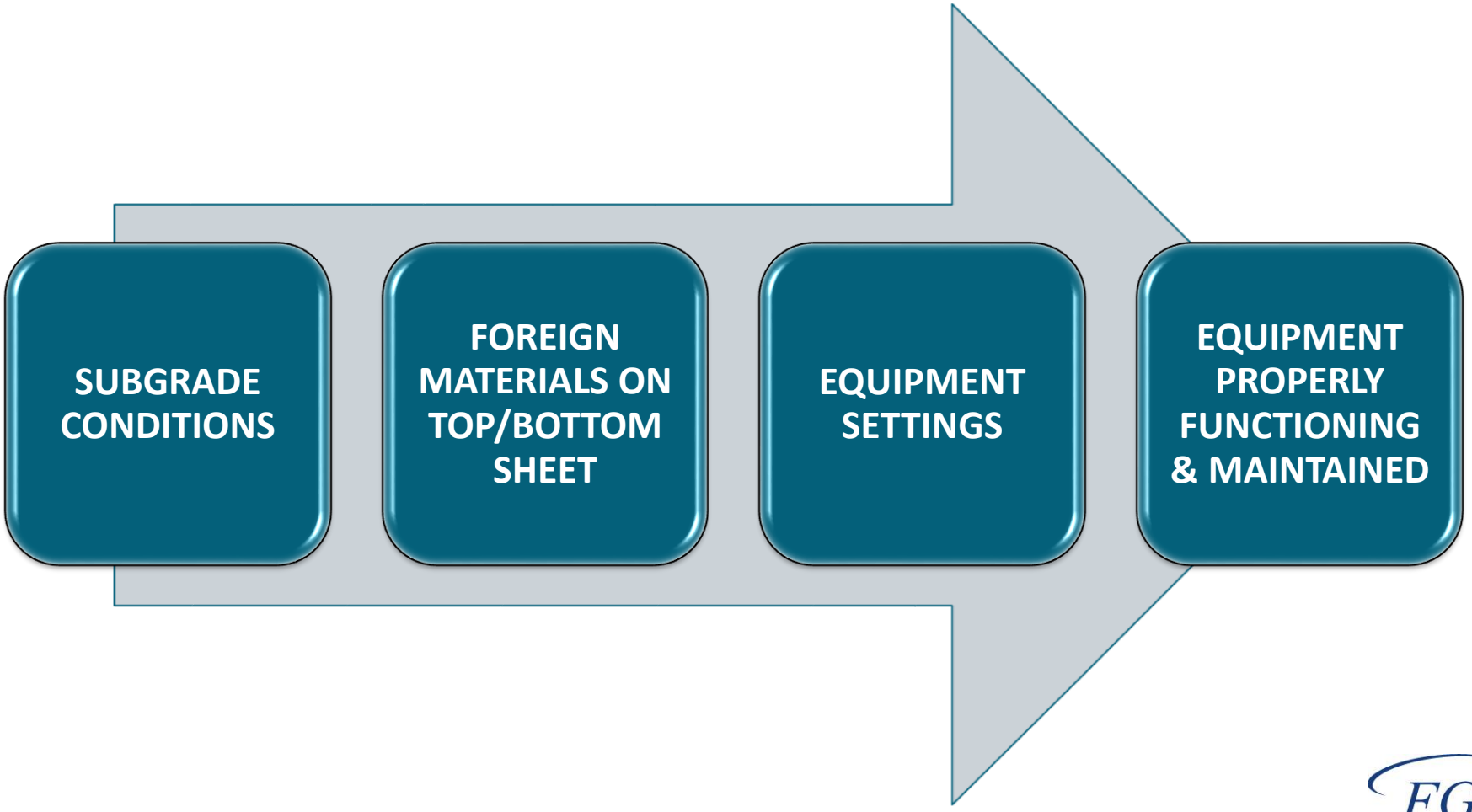
Seaming - Contact Time - Fusion



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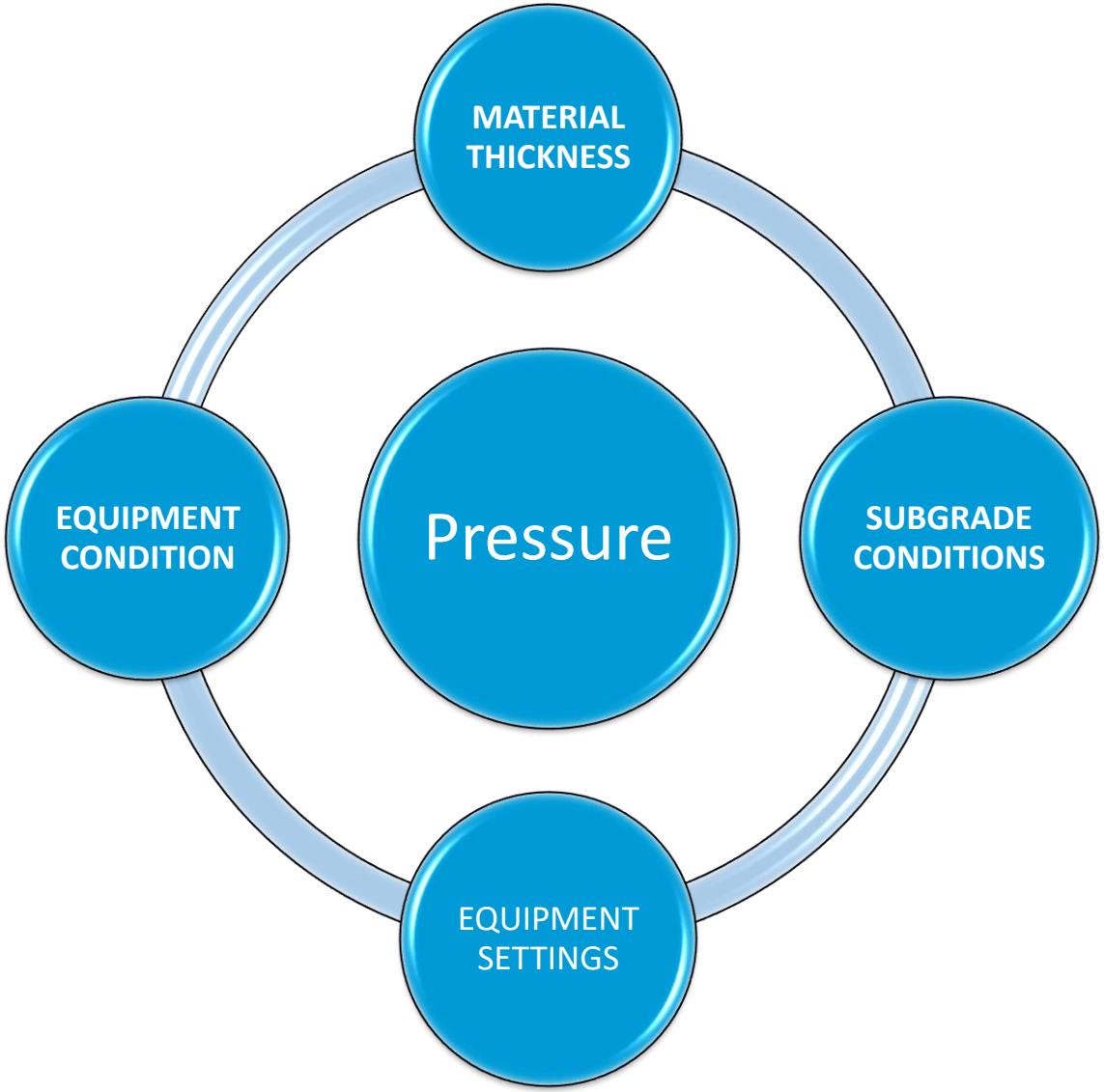
Seaming – Pressure - Fusion



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Seaming - Clean & Dry

Fusion Seam Preparation

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Questions

Does Cord Length Matter?

Does the Generator Matter?

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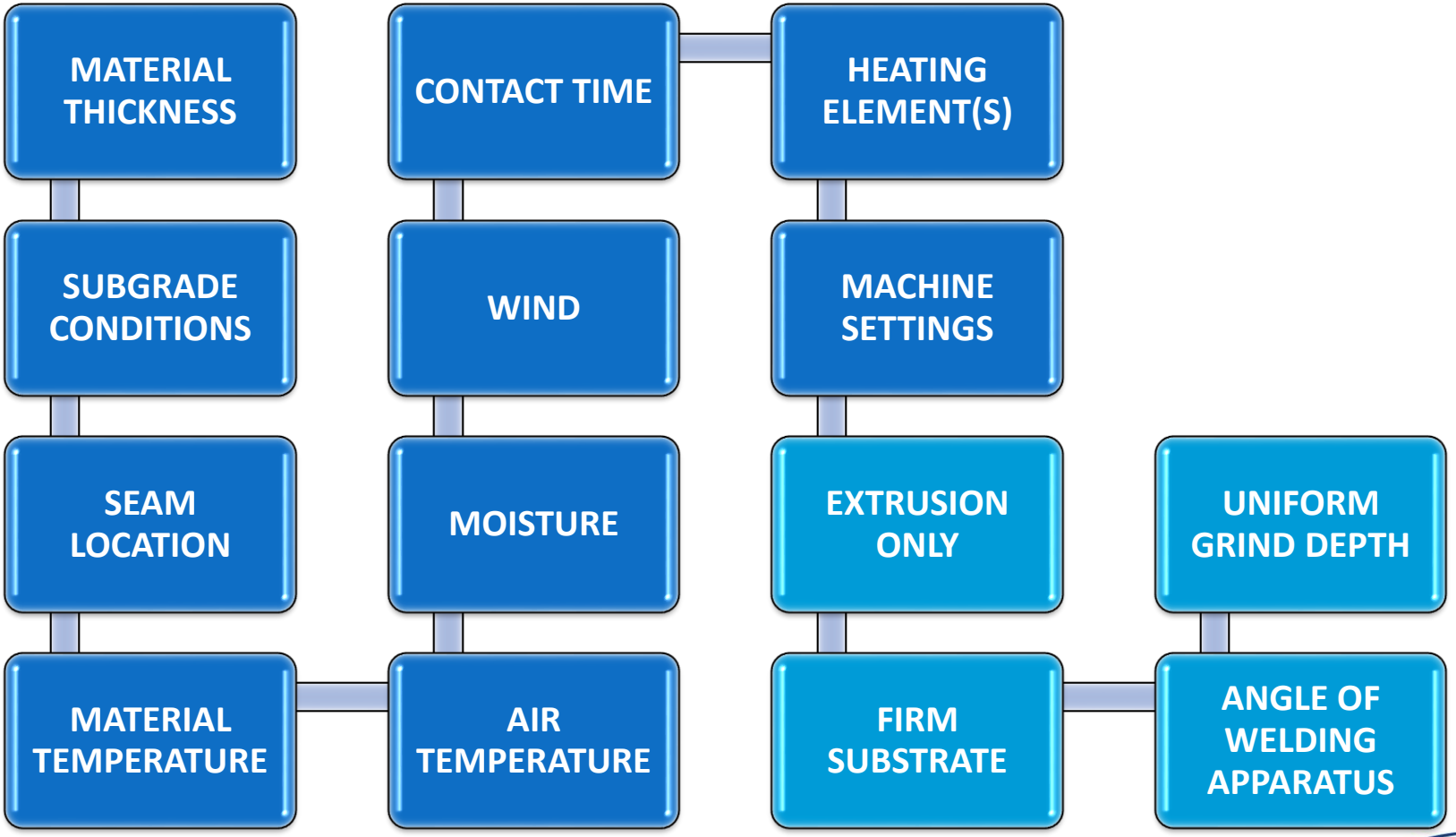
Seaming - Heat



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Seaming - Contact Time - Extrusion

- Subgrade/underlying foundation
- Angle of weld
- Operator Speed
- Location of Weld

Making a vertical weld on a pipe boot. Gravity will impact contact time and pressure.

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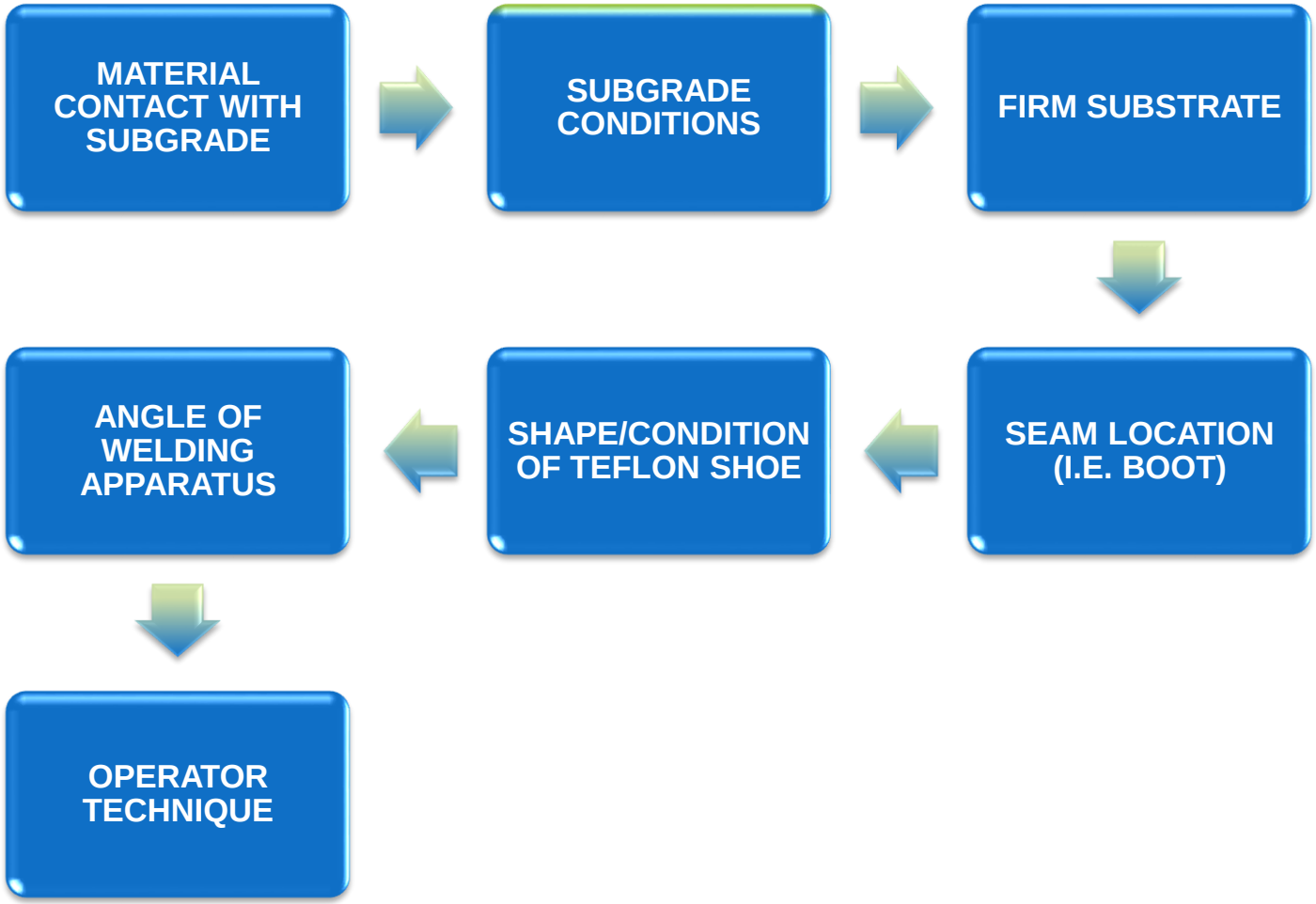
Seaming – Pressure - Extrusion



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Extrusion Fillet - Pressure

Extrusion fillet welding a pipe penetration: Note Angle

Each step must be properly done to achieve a solid, watertight weld.

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Seaming - Clean & Dry

Leave Your Sunscreen At Home!

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Seaming – Field Inspection

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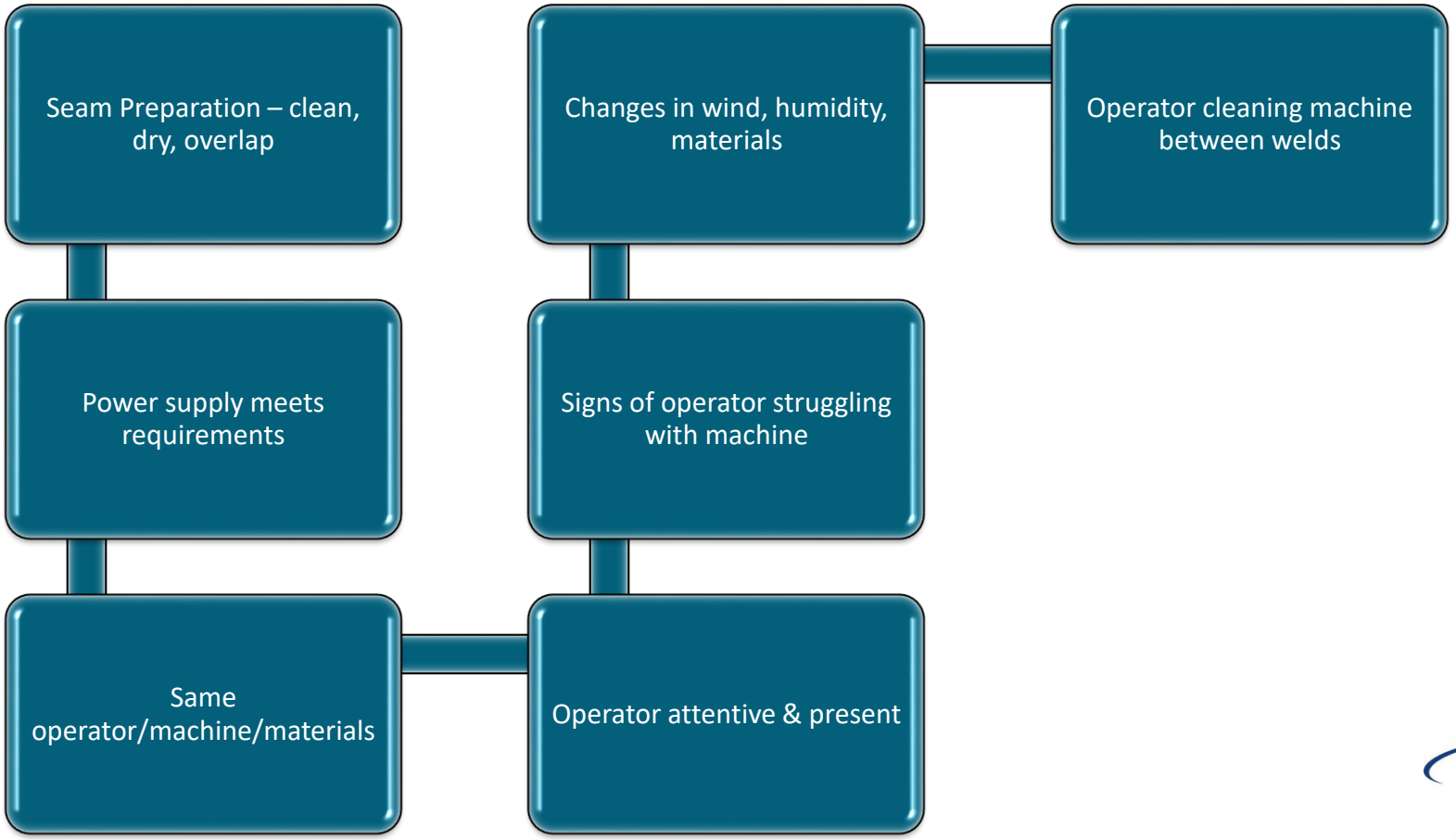
Fusion Seaming In Progress

What To Look For:



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Fusion Seaming – After Completion

- Inconsistencies: Wheel Tracks
- Wheel Spins
- Creases/Crimps
- Burnouts
- Frequent Non-Destructive Test Breaks

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Suspect Areas

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Wheel Spin

Difference in tracks – wheel spin on far side

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Wheel Spin

Severe wheel
spin
resulted in break
in seam continuity

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Nip Roller Pressure

Improper nip roller pressure caused cutting along edge of seam

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Bubble & Lost Overlap

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Wheel Spin

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Extrusion

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Extrusion Seaming – Field Inspection

What To Look For – During Seaming

- Seam Preparation – clean, dry, overlap, bevel, heat tack sound, proper grind
- Power supply meets requirements
- Same operator(s)
  Same machine
  Same materials
- Signs of operator fatigue
- Changes in wind, humidity, materials
- Purging extrudate
- Timeliness in covering grind

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Extrusion Seaming – Field Inspection

What To Look For – After Seaming

Top:

- Excessive or uncovered grind
- Any non-uniform areas or inconsistencies in extrudate.
- Repeated passes
- Sunken areas
- Indicators for lack of firm substrate (i.e. wrinkles)

Bottom (Trials, Extrusion Destructs):

- Heat Penetration
- Lack of Heat
- Excessive Heat/Burn Thru

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Suspect Areas

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Extrusion Seaming

Consider:

- Overlaps of multiple extrusion welds should be avoided

- Limiting the amount of reheating along an extrusion weld (i.e. additional beads to cover excess grind, leaks, etc.

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Extrusion

Extrusion grinding and welding without light!

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Moisture in Seam

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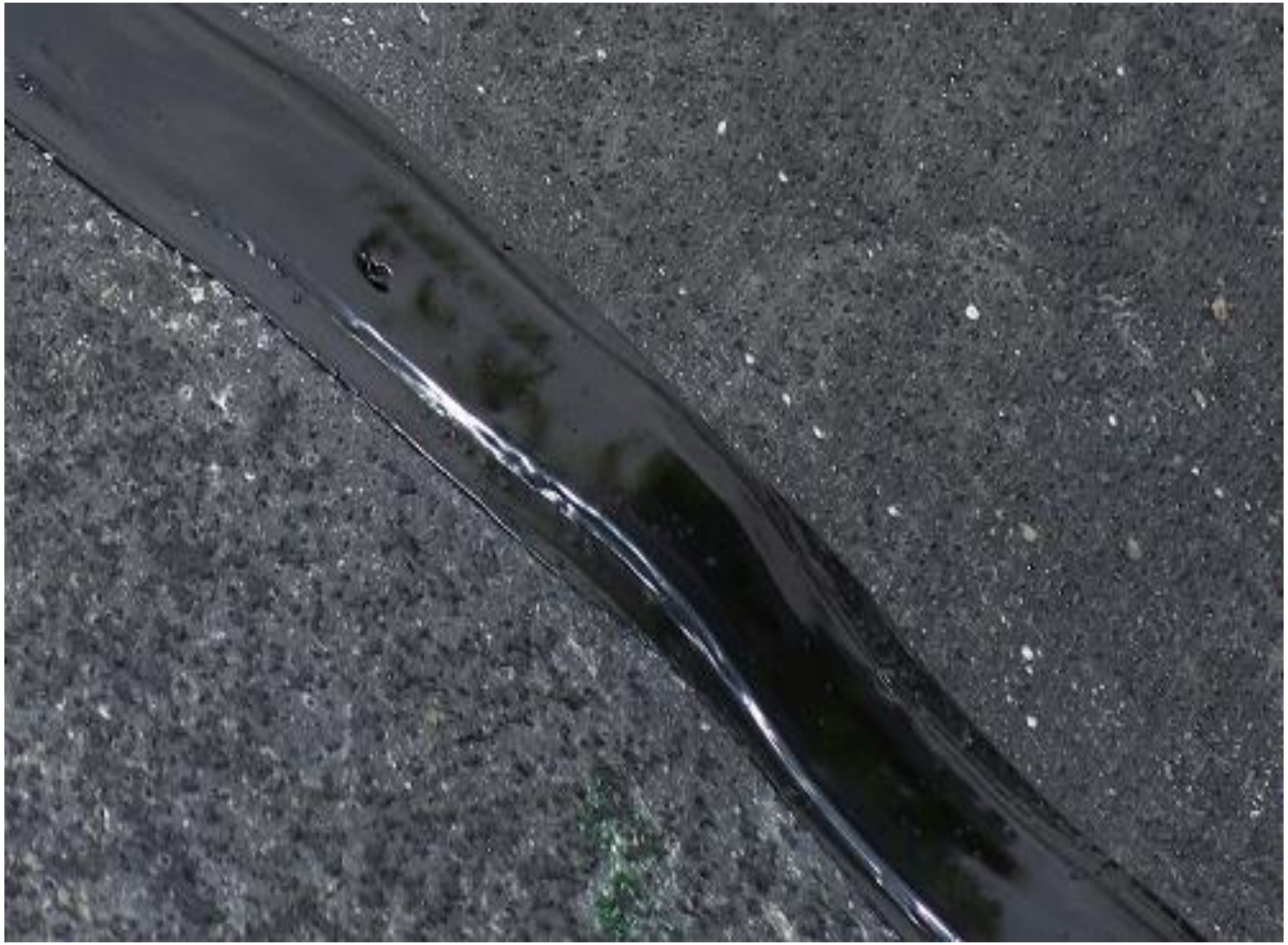
Sweat



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No Grind

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Bad Grind

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Termination

Raised point on extrusion from improper termination technique. Sloppy!

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Trial Seams

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Trial Seams

- Trial seams are non-production welds produced on the same materials under the same conditions as the actual welding that will be taking places, as a way to pre-qualify that the seaming personnel and welding equipment can successfully weld that material combination.

Chemical Trial Seam

Extrusion Trial Seam

Fusion Trial Seam

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Extrusion

Extrusion Trial Seam

Testing of Trial Seams

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Qualifications

Typically only looking for three things:

- Peel Strength
- Peel Adhesion (on some materials does not matter if strength met)
- Shear Strength (elongation usually not monitored closely in the field)

Extrusion does not account for teams of personnel performing the tasks

- Beveling (when applicable)
- Heat tacking
- Grinding (when applicable as certain materials do not require grinding)
- Person performing the welding

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Who Passes?

Specified Shear Strength is 120 PPI, and the following results are obtained:

- Welder A: 130 PPI, Coupon Width 1.1”
- Welder B: 110 PPI, Coupon Width 0.9”
- Welder C: 119.5 PPI, Coupon Width 1.0”

- Welder A: Actual PPI = 130/1.1 = 118.2 FAIL
- Welder B: Actual PPI = 110/0.9 = 122.2 PASS
- Welder C: Actual PPI is 119.5. 119.5 < 120.0 so FAIL

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Beyond Peel & Shear

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Trial Welds – Beyond Peel and Shear

Importance and value often overlooked – The key to ensuring a quality seam begins with Trial Welds and the information discerned from them.

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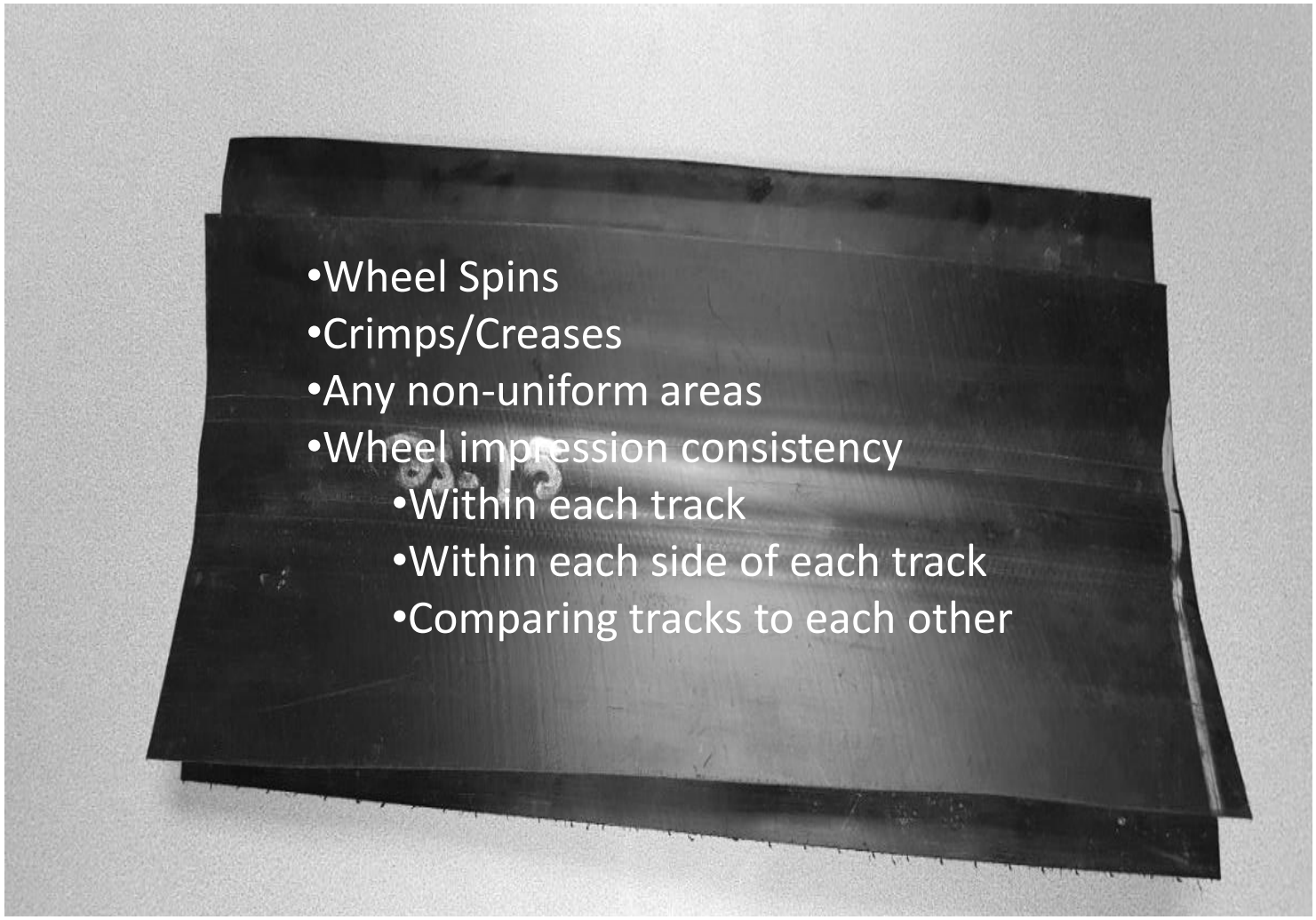
Take Note…



- Wheel Spins
- Crimps/Creases
- Any non-uniform areas
- Wheel impression consistency
  - Within each track
  - Within each side of each track
  - Comparing tracks to each other

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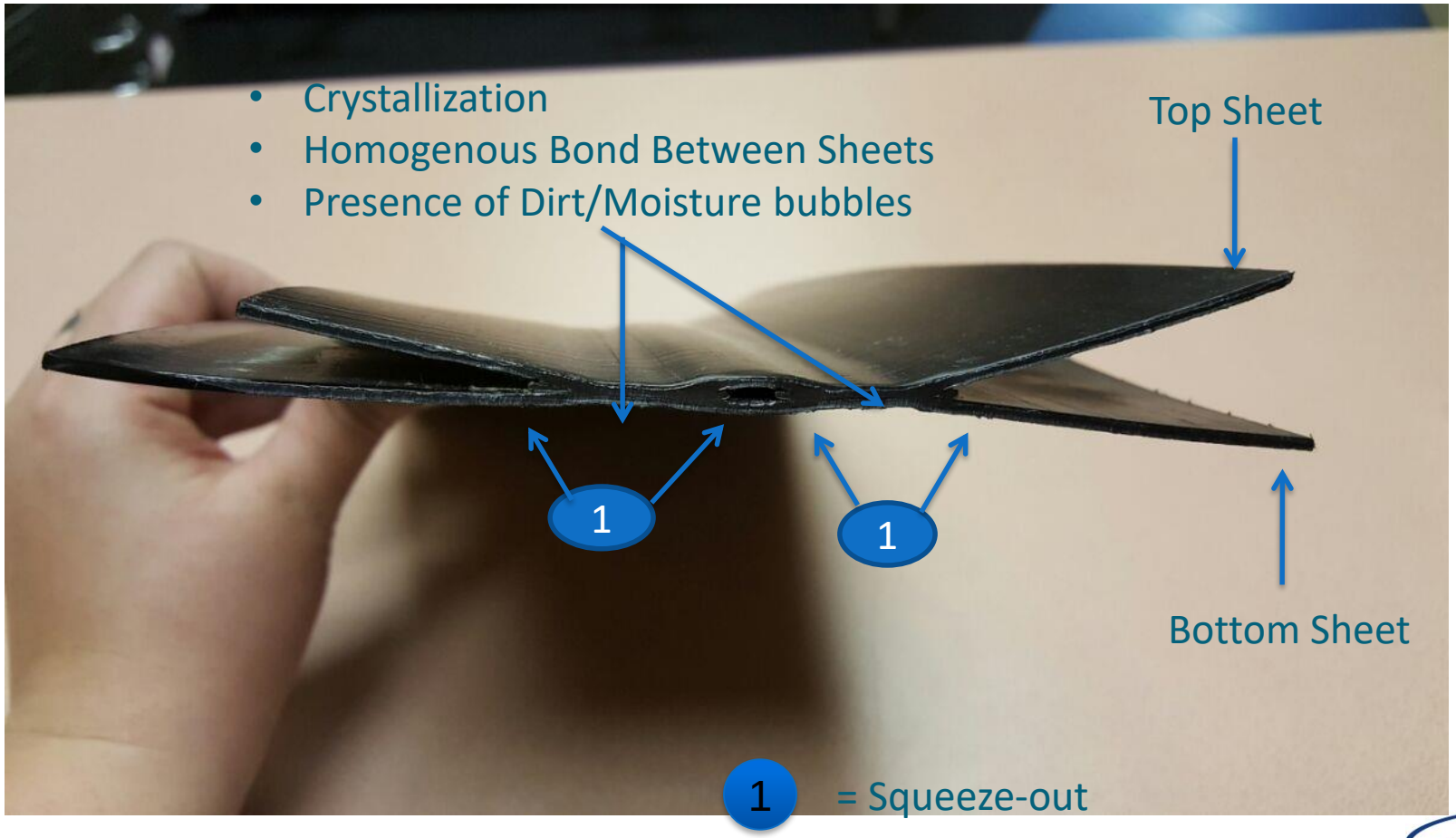
Fusion: What To Look For…



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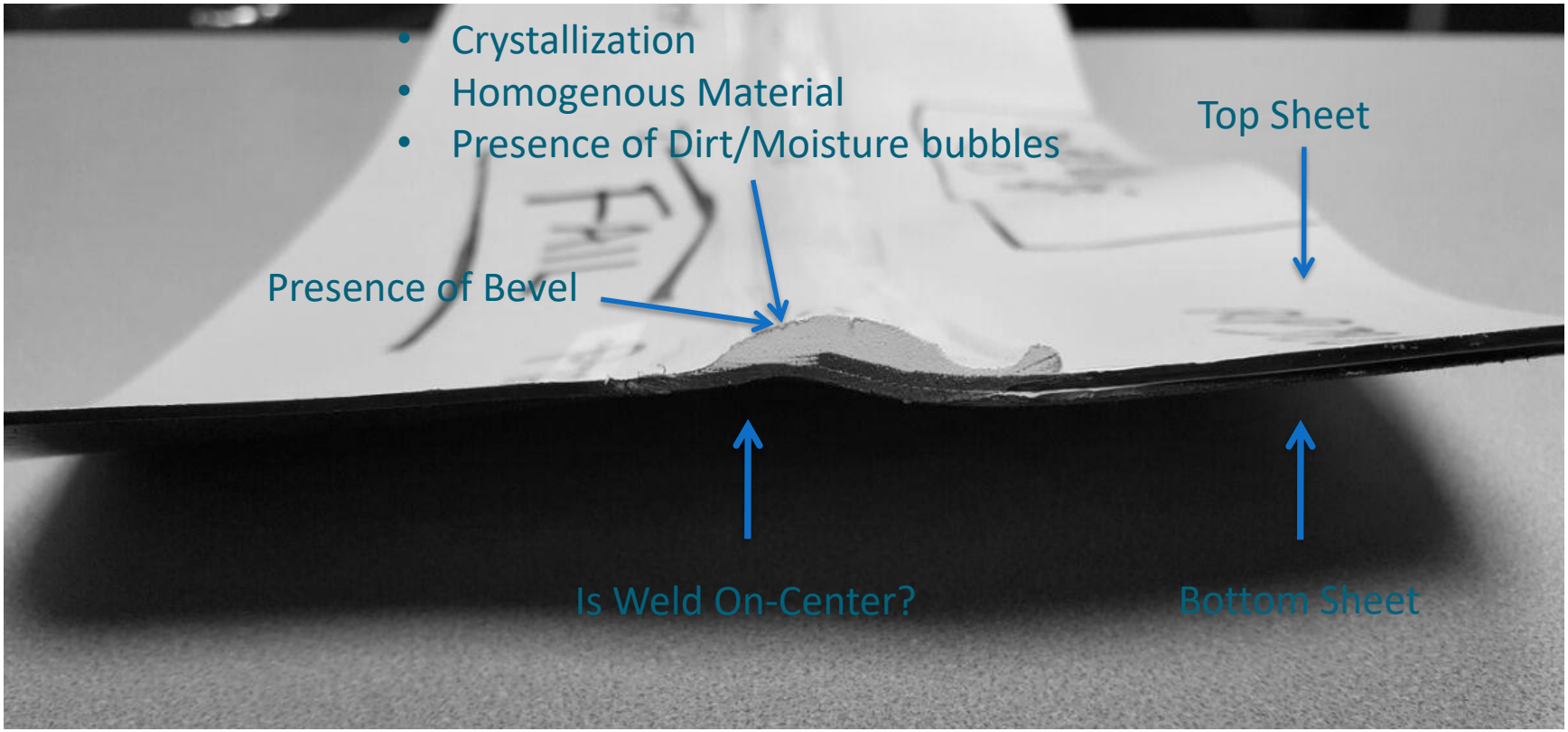
Extrusion: What to look for…



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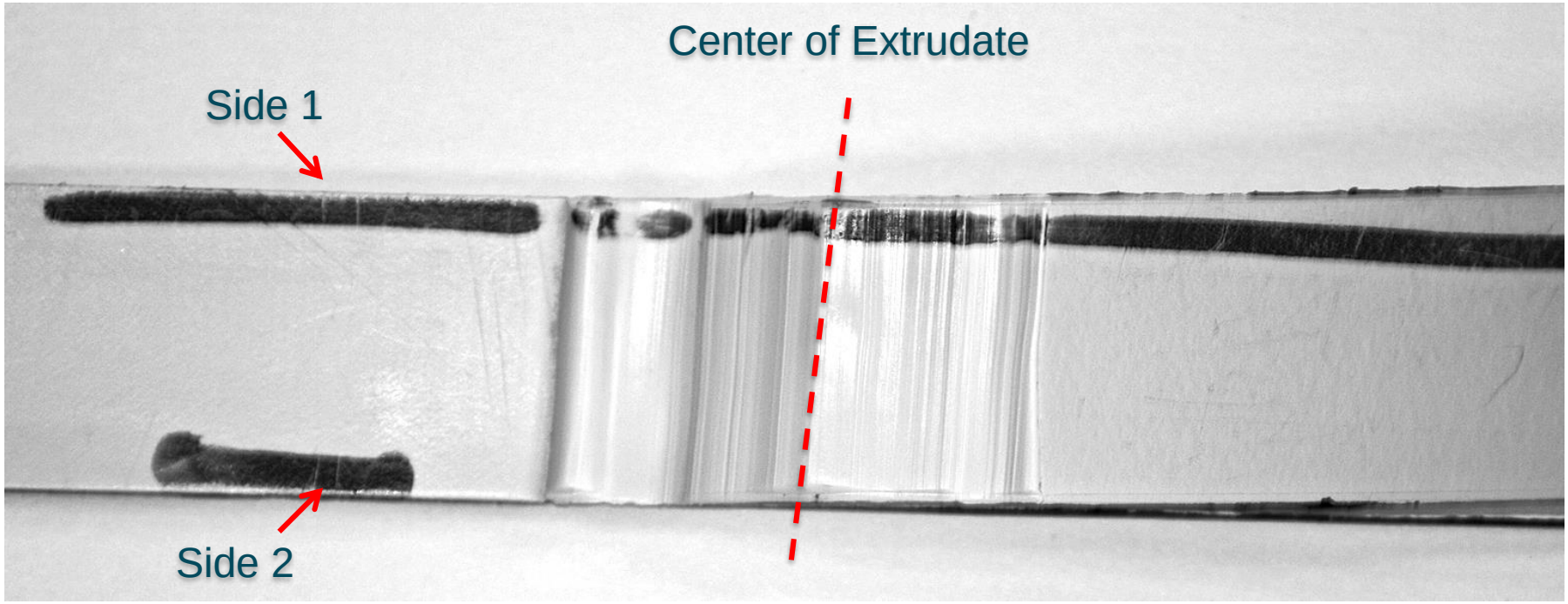
The Tip of the Iceberg



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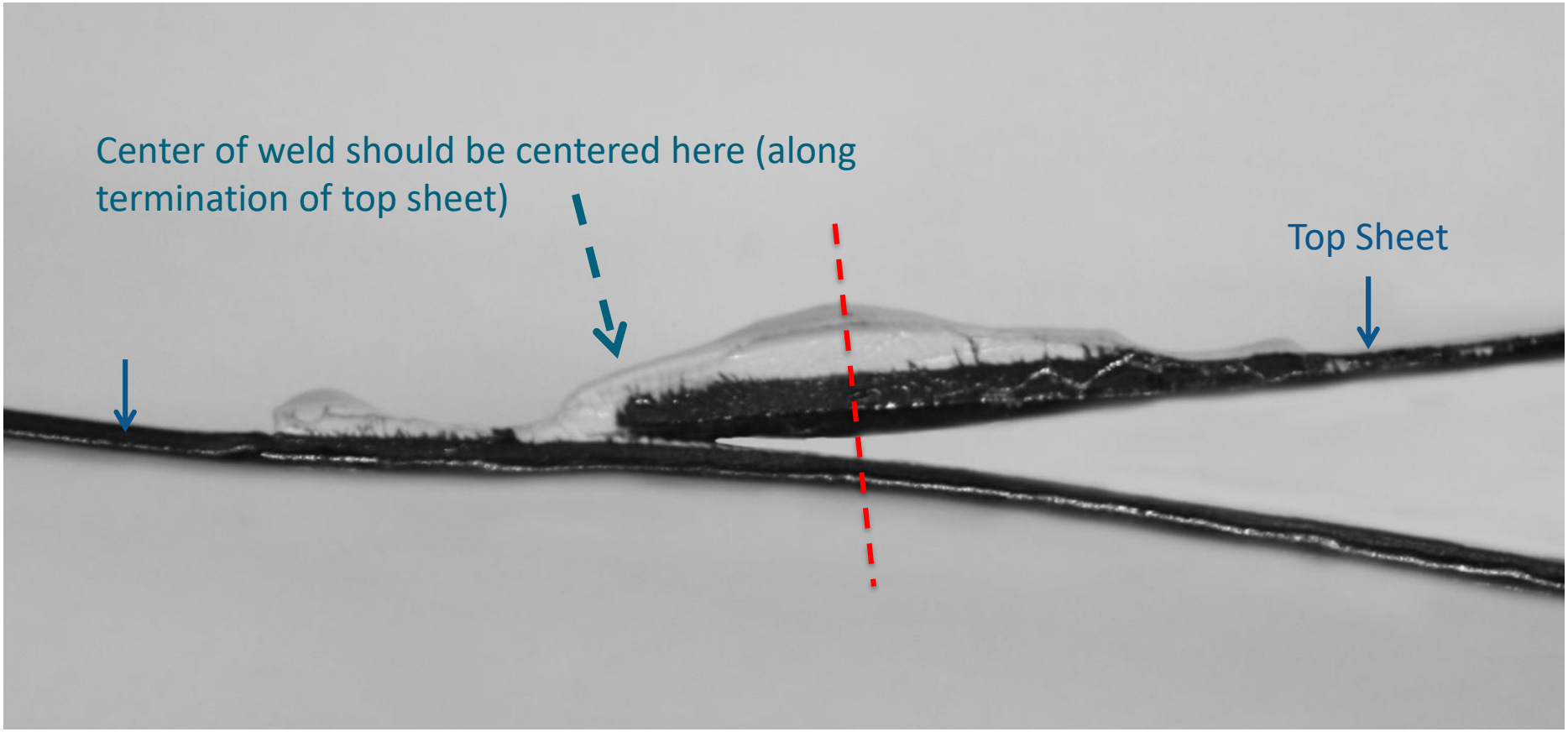
What Looks Good On Top…Sometimes Isn't



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It takes a team

Changes in support personnel, particularly the grinder operator should be considered as basis for new trial seams.

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Non-Destructive Testing

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Non-Destructive Seam Testing

Vacuum Testing an Extrusion Welded Repair

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Non-Destructive Seam Testing

Non-Destructive Testing (Continuity) ≠ Destructive Testing(Integrity)

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Non-Destructive Seam Testing

Air Pressure Test, Vacuum Test, Air Lance

Failure procedures should be clear

Tests should be monitored by QA

Individuals performing tests need to know what a failure is!

Failures can help identify potentially suspect seams

Testing should be performed as seaming progresses

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Testing Methods

- Once a seam has been welded and cured (if applicable) it will be non-destructively tested
  - As the term indicates, this is a test where the seam is left intact and tested for leaks
- There are various methods of non-destructive testing a seam
  - Air lance
  - Air pressure test
  - Vacuum test
  - Spark test
  - Ultrasonic

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Contractor Workflow

- Air Lance Test

1. A source of compressed air is required.
2. Attach an air compressor hose that has a 3/16” diameter discharge nozzle.
3. Discharge air through nozzle at a minimum rate of 50PSI.
4. Discharge nozzle should be held no further than 2.0” from the outer edge of the seam.
5. Air discharge must be aimed perpendicularly at the edge of the seam.

6. The Installer will walk with the air discharge at the above requirements for the entire length of the seam.
7. Failures will be marked for repair.

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Contractor Workflow

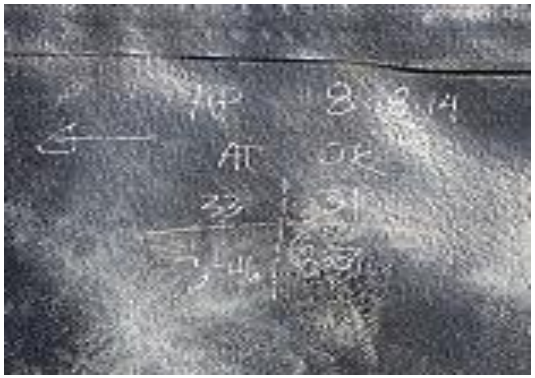
Air Pressure Test

Seal both ends of Seam

Insert Needle in the Channel

Pressurize Seam

Steam Stabilization



Begin Seam Test

End Seam Test

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Contractor Workflow

Vacuum Box Test

1. Seam edge should be cleaned of excessive dirt and debris.
2. Seam should be allowed to cool before testing occurs.
3. Vacuum box observation window should be cleaned of dirt and debris.
4. Soapy solution should be applied to the seam directly ahead of vacuum testing.
5. Vacuum box is placed over the seam.
6. Vacuum is created by opening the control valve on the vacuum box.

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Contractor Workflow

Vacuum Box Test

1. Perimeter of box should be inspected for a good seal.
2. Observe that minimum specified pressure is obtained.
3. Vacuum box should remain in position through the required dwell time.
4. During dwell time, seam should be inspected through observation window on vacuum box for signs of bubbles.
5. Any locations of leaks indicated by bubbles should be marked for repair and recorded.
6. Process is repeated along the entire seam length.

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Contractor Workflow

Holiday Spark Test

1. Prior to welding, confirm conductive medium is properly located and secured.
2. Confirm that the apparatus is working properly.
3. Once the weld is completed, power up the spark test apparatus and pass over the entire length of the seam.
4. Defective areas will be indicated by a visible spark or the sound of a spark (a sound similar to a bug zapper).
5. Mark defective areas for repair.
6. Upon completion of initial testing, the wire protruding from the weld should be cut off flush with the seam.

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THANK YOU FOR YOUR ATTENTION

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