

WELDING DISCONTINUITIES

Types of Discontinuities:

- ▲ **EXTERNAL :** Can be identified by a visual inspection method
eg: Dye Penetrant and Magnetic Particle testing.
- ▲ **INTERNAL :** Require a Non-Destructive testing (NDT) method
eg: X-Ray or Ultrasonic testing.

(i) Main Causes:

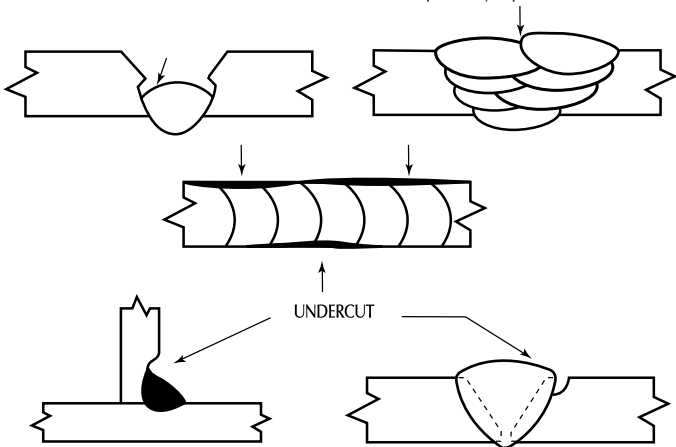
- ▲ Welding operators carelessness or lack of skill.
- ▲ Adverse working conditions (Hot - Cold).
- ▲ Poor Design or lack of preparation.

(ii) Main Defects:

- ▲ **Undercut.**
- ▲ **Slag inclusions.**
- ▲ **Porosity.**
- ▲ **Overlap or over-roll.**
- ▲ **Lack of fusion.**
- ▲ **Incomplete penetration.**
- ▲ **Weld cracking.**
- ▲ **Joint Misalignment.**

Undercut:

- ▲ **Definition:** A groove at the toe or root of a weld either on the weld face or in previously deposited weld metal.



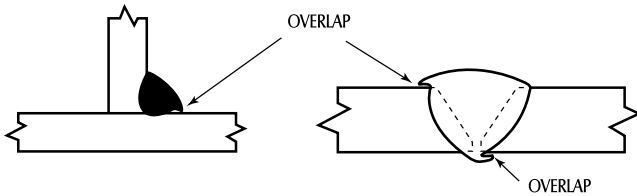
- Causes:**
- Excessive amperage.
 - Too long an arc length .
 - Excessive weaving of the electrode.
 - Too fast a rate of travel.
 - Angle of electrode too inclined to the joint face.

Result: A stress concentration site and a potential site for fatigue crack initiation.

Overlap or over-roll:

▲ Definition:

An imperfection at the toe or root of a weld caused by metal flowing onto the surface of the parent metal without fusing to it.



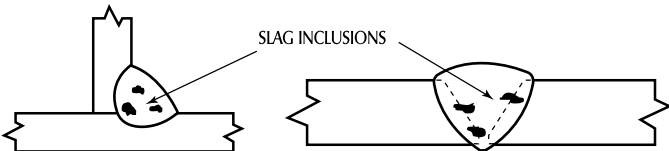
- Causes:
- Incorrect rate of travel.
 - Incorrect "angle of approach".
 - Too large an electrode size.
 - Too low an amperage.

Result: Has a similar effect as undercut and produces a stress concentration site due to the unfused weld metal.

Slag Inclusions:

▲ Definition:

Refers to any non-metallic material in a completed weld joint. These inclusions can create a weak point in the weld deposit.



- Causes:
- Failure to remove slag from previous runs.
 - Insufficient amperage.
 - Incorrect electrode angle or size.
 - Faulty preparation.

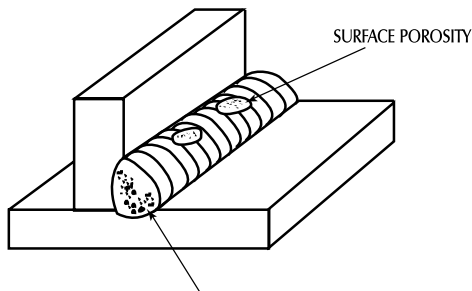
Result: Slag inclusions reduce the cross sectional area strength of the weld and serve as a potential site for cracking.

Porosity:

▲ Definition:

A hole or cavity found internally or externally in the weld. Porosity can originate from wet electrodes, electrode flux breaking down or from impurities on the surface of the parent metal.

Also known as "Piping", "Blow or Worm Holes"



INTERNAL POROSITY AND START-OF-RUN POROSITY ARE VERY COMMON

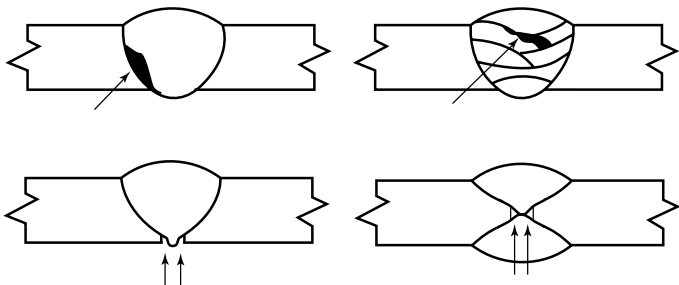
Other Causes: - Unclean parent metal surface i.e. oil, dust, dirt or rust contamination.
- Incorrect electrode for parent metal.
- Inadequate gas shielding of the arc.
- Parent metals with a high percentage of sulphur and phosphorus.

Result: Severely reduces the strength of the welded joint.
Surface porosity can allow a corrosive atmosphere to attack the weld metal which may cause failure.

Lack of Fusion:

▲ Definition:

A lack of bonding between the weld metal and the parent metal or between weld metal passes.

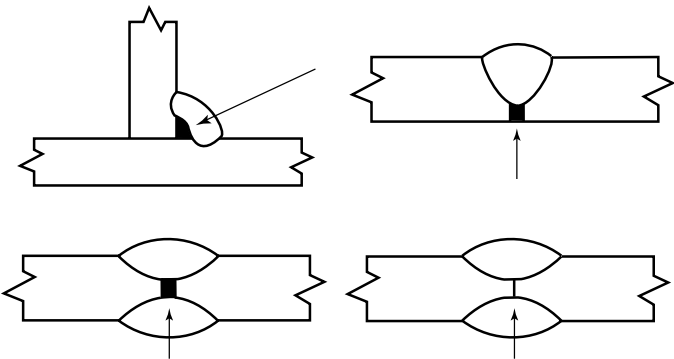


Lack of Fusion cont.:

- Causes:
- Small electrodes used on cold and thick steel.
 - Insufficient amperage.
 - Incorrect electrode angle and manipulation.
 - Rate of travel too fast, not allowing proper fusion.
 - Unclean surface (mill scale, dirt, grease etc).
- Result: Weakens the welded joint and becomes a potential fatigue initiation site.

Incomplete Penetration:

- ▲ Definition: A failure of the weld metal to penetrate into the root of the joint.



- Causes:
- Current too low.
 - Insufficient root gap.
 - Too large an electrode size.

- Result: Weakens the welded joint and becomes a potential fatigue initiation site.

Weld cracking:

- ▲ Definition: Planar (Two Dimensional) discontinuities produced by the tearing of parent or weld metal. Weld metal cracking can occur in either the plastic condition (hot shortness) or by fracturing when cold (cold shortness). There are many types of cracks that can occur in the base metal or weld metal of welded joints.

Weld cracking cont.:

Some common types of cracking include:

Crater Cracking: Hot cracking mainly caused by a failure to fill up the crater depression at the end of a weld pass. Shrinkage stresses and inadequate weld metal in the crater causes crater cracking.

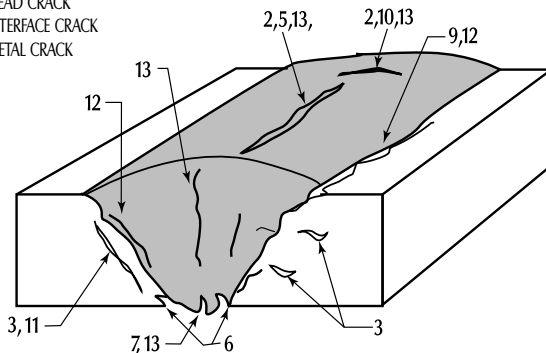
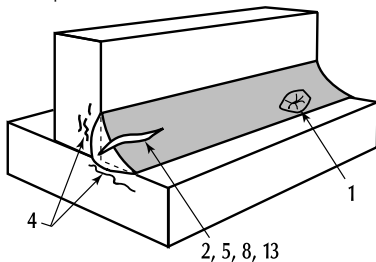
Underbead Cracks: Cold cracking that is usually in the Heat-affected zone (HAZ) of the parent metal.

Longitudinal Crack: Usually a hot cracking phenomenon. Cracking runs along the length of the weld.

- Main Causes:
- Incorrect welding procedures and techniques. (eg. Wrong consumable or welding current, inadequate preheat etc.)
 - Weld size may be too small for the parts being welded.
 - Base metal may contain a high carbon content (over 0.45%).
 - Metals which contain high percentages of sulphur or phosphorus tend to crack easily, so Hydrogen controlled electrodes are recommended.
 - Electrodes may be wet or damp.

CRACK TYPES:

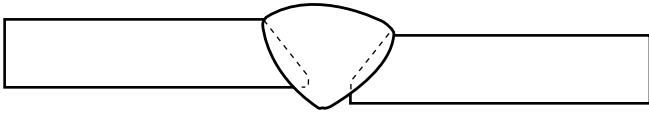
1. CRATER CRACK
2. FACE CRACK
3. HEAT-AFFECTED ZONE CRACK
4. LAMELLAR TEAR
5. LONGITUDINAL CRACK
6. ROOT CRACK
7. ROOT SURFACE CRACK
8. THROAT CRACK
9. TOE CRACK
10. TRANSVERSE CRACK
11. UNDERBEAD CRACK
12. WELD INTERFACE CRACK
13. WELD METAL CRACK



Misalignment:

- ▲ Definition: Normally defined as an unnecessary or unintentional variation in the alignment of the parts being welded.

Misalignment is a common fault in prepared butt welds, and is produced when the root faces of the parent plate (or joint) are not placed in their correct position for welding.



- Causes:
- Poor assembly of the parts to be welded.
 - Inadequate tack welds that break or insufficient clamping that results in movement.
- Result: Misalignment is a serious defect since failure to melt both edges of the root will result in stress concentration sites which in service may lead to premature fatigue failure of the joint.