QUALITY CONTROL COUNCIL

RADIOGRAPHER'S WELD INTERPRETATION
REFERENCE GUIDE

Who is the QCC

The Quality Control Council of Canada (QCC) is a joint venture between the International Brotherhood of Boilermakers (IBB) and the United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry of the United States and Canada (UA), and is recognized as the designated Union to represent nondestructive testing and field heat treatment technicians across Canada.

The QCCC membership is growing rapidly with approximately 4,000 members across Canada. A large percentage are radiographers and are in very high demand. Our membership enjoys one of the highest premium health & welfare packages in the trades including Medical, Dental, Prescription Coverage, Pension, Post- Retirement Benefits. They also enjoy paid training and recertification costs and very favorable working conditions that are 10-30% higher contract compensations compared to non union. The QCCC has over one hundred signatory companies across Canada and are always looking for experienced technicians. If your interested in additional information, looking to unionize your company, or seeking employment opportunities, please feel free to contact us at **western@qcccanada.com / eastern@qcccanada.com.**

QCCC NATIONAL TRAINING SOCIETY

The QCCC National Training Society has opened three facilities in Edmonton AB, Hamilton ONT, and Saint John NB. The NTS is an NRCan Authorized Examinaton Center for recertification testing in all locations and also does written exams in the Edmonton location. The NTS is also a Recognized Training Organization and offers training in Materials & Processes, NDT Math, CEDO, RT, UT MPI, LPI, API certifications, National Board, Phased Array and TOFD advanced Ultrasonics with PCN Certification. All training and recertification costs for members are reimbursable through the National Training Fund. The facilities are open for anyone to book initial course training or recertification, please contact us at **nts@qcccanada.com**.

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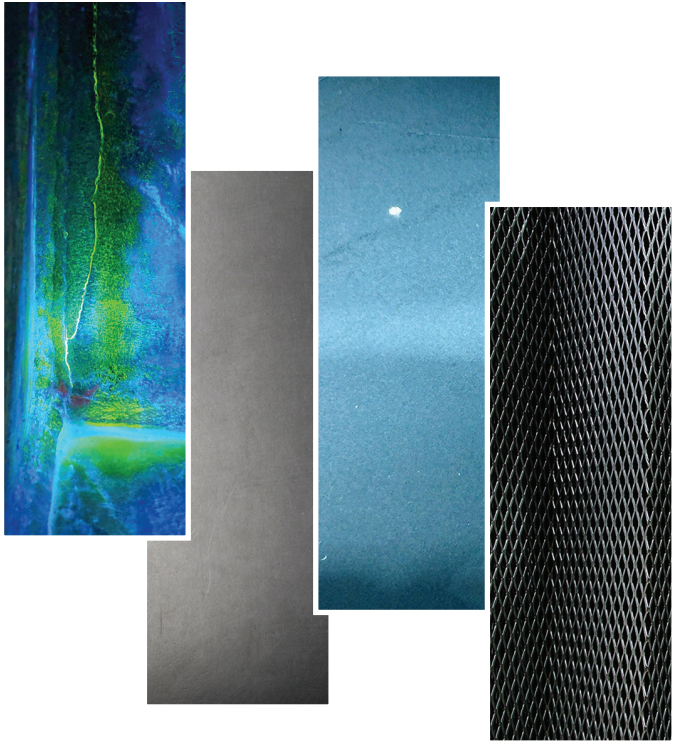
CONTENTS



6 Incomplete Penetration Single Edge

7 Lack of Fusion

8 Mismatch

9 Hollow Bead

10 Excessive Penetration

11 Concave Root

12 Concave Root Half Moon

13 Burn Through

14 Tungsten Inclusion

15 Internal Undercut

16 External Undercut

17 Longitudinal Crack & Rounded Slag

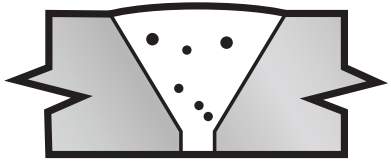
18 Sugared Root

19 Low Cover

20 Condensation

POROSITY

Flaw Type

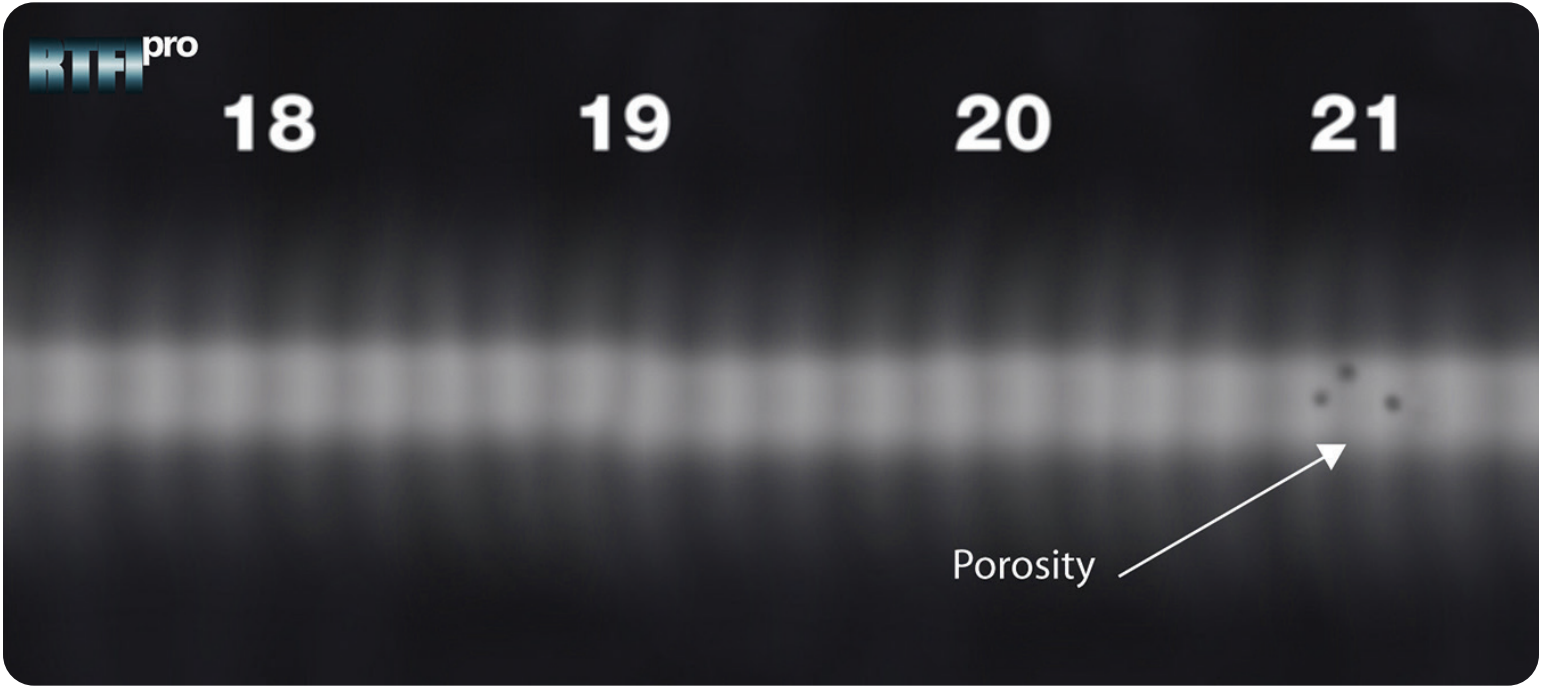


Description:

Porosity is the result of gas entrapment in the solidifying metal. It is a void in the weld metal and will have a darker radiographic density than the surrounding area. Porosity will frequently be found in radiographs but evaluation will determine if the weld requires repair.

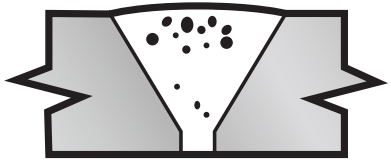
Porosity takes many shapes and forms on radiographs, but will often appear as dark, round or irregular circles, appearing by themselves or in clusters, or in a line. Sometimes, porosity is elongated and may appear to have a tail. This is the result of gas attempting to escape while the metal is still in a liquid state and is called wormhole porosity.

Radiograph Image:



CLUSTER

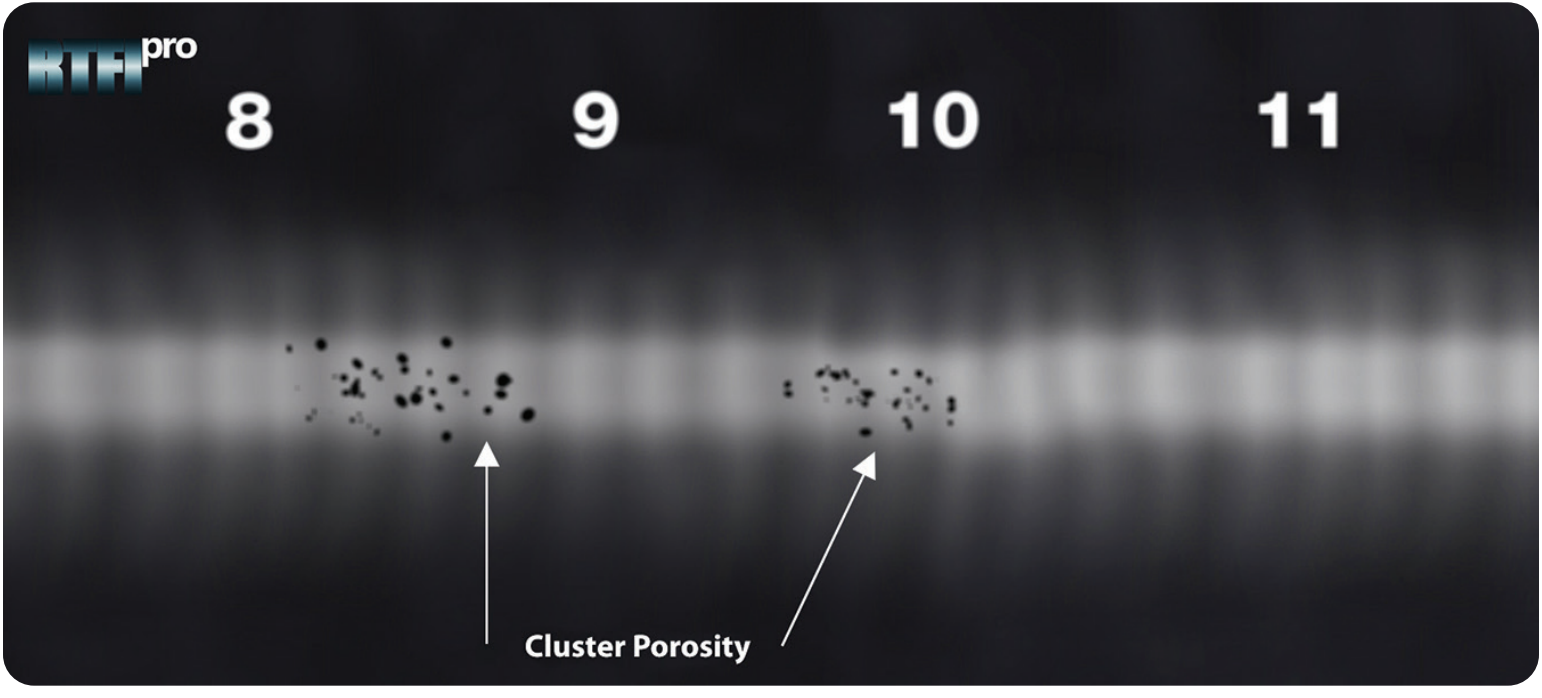
Flaw Type



Description:

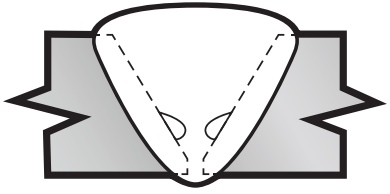
Cluster porosity is caused when flux coated electrodes are contaminated with moisture. The moisture turns into a gas when heated and becomes trapped in the weld during the welding process. Cluster porosity appears just like regular porosity in the radiograph but the indications will be grouped close together.

Radiograph Image:



ELONGATED SLAG

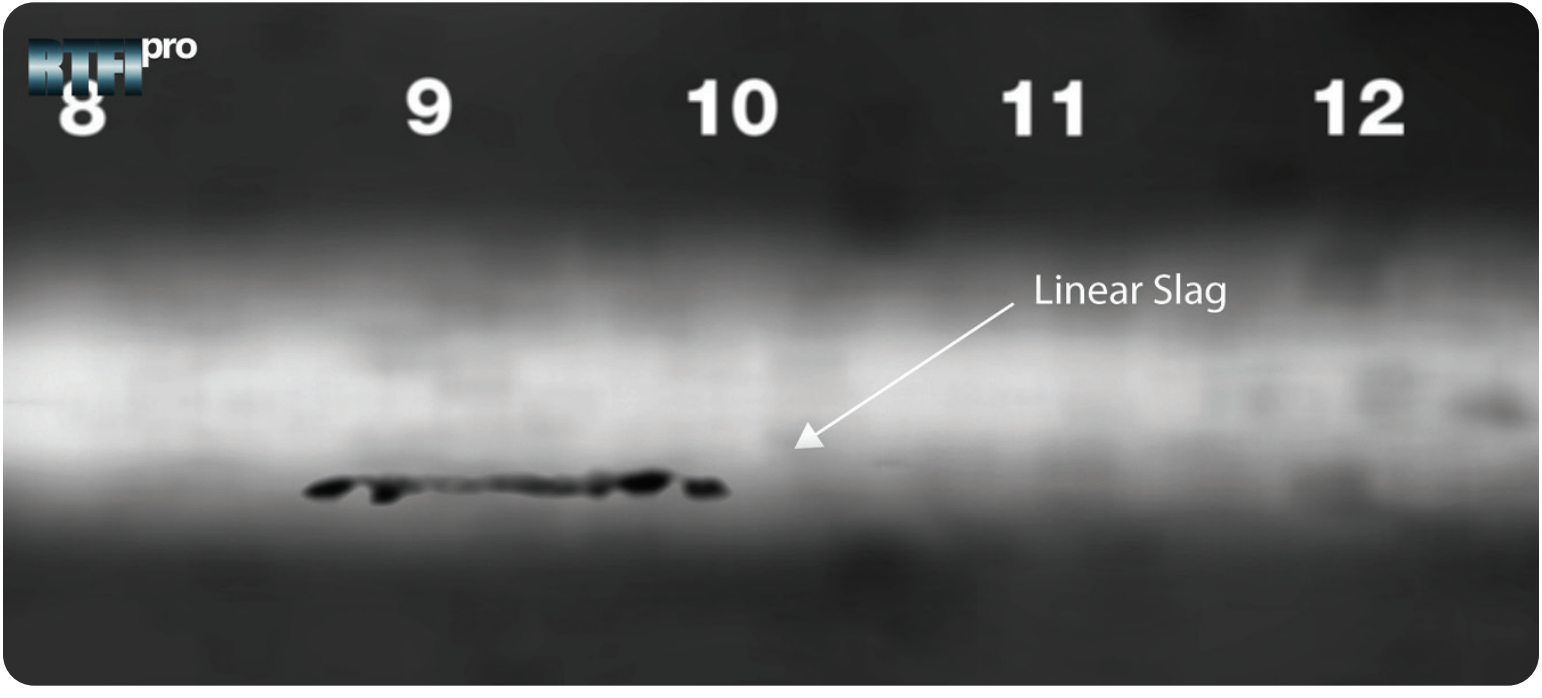
Flaw Type



Description:

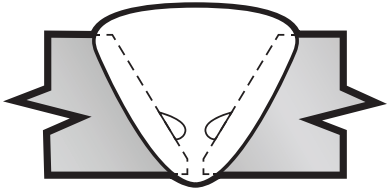
Elongated slag (or Slag Line) is non-metallic linear slag lines in the weld. The slag line is irregular and with variable width. It is often found in any area above the root, occurring between passes due to inadequate cleaning.

Radiograph Image:



WAGON TRACK LINEAR SLAG LINES

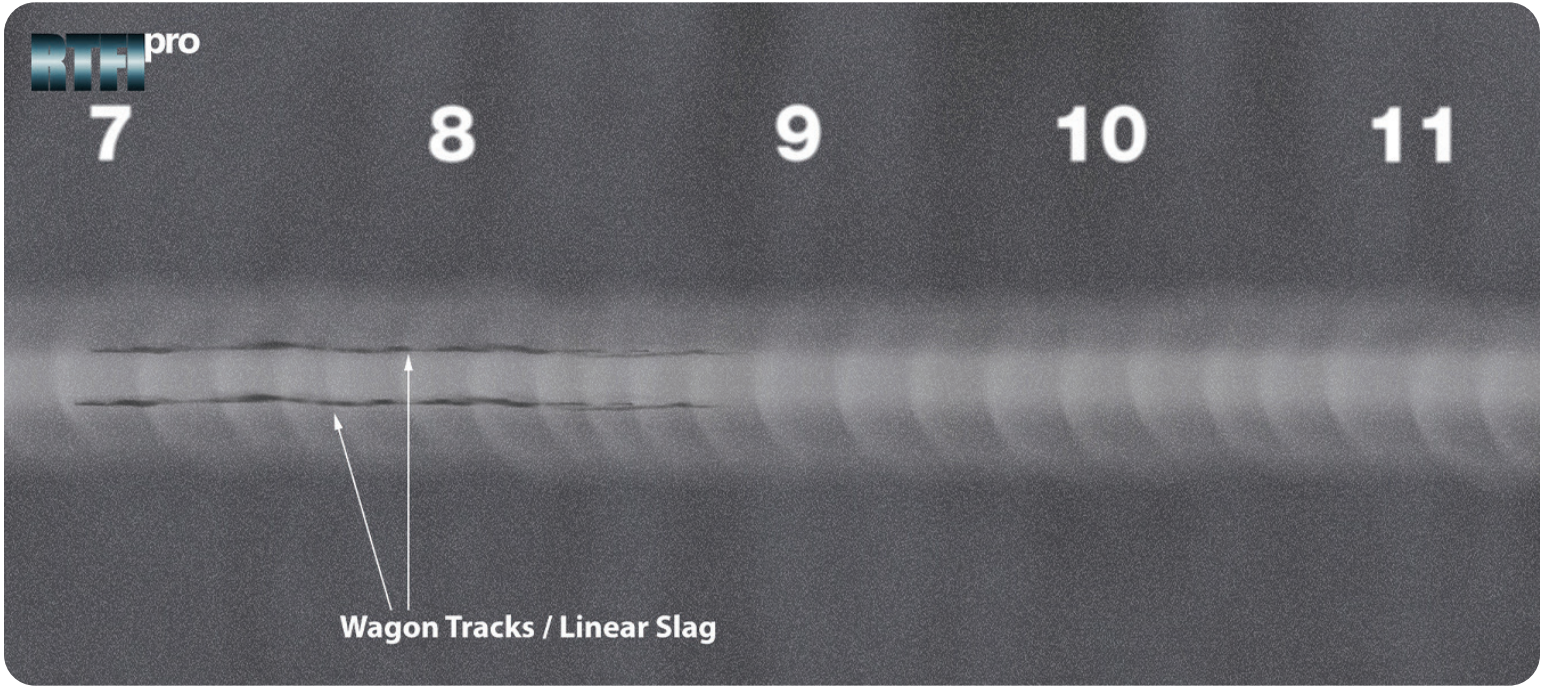
Flaw Type



Description:

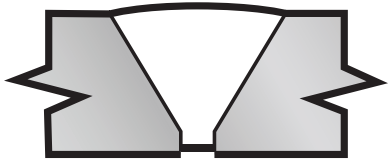
Also referred to as non-metallic inclusions, these inclusions are caused by non-metallic materials which become trapped in the weld passes or between the weld metal and the base metal due to insufficient cleaning or buffing. These inclusions are linear in appearance and found parallel to each other running in the direction of the weld metal due to insufficient cleaning. Slag lines can often be confused with LOF as in some cases they are very similar in appearance. A key point to remember with this indication is the density and the direction. Slag lines in most cases with be a lighter density than LOF and will be irregular in linear length as LOF will be straight.

Radiograph Image:



INCOMPLETE PENETRATION

Flaw Type

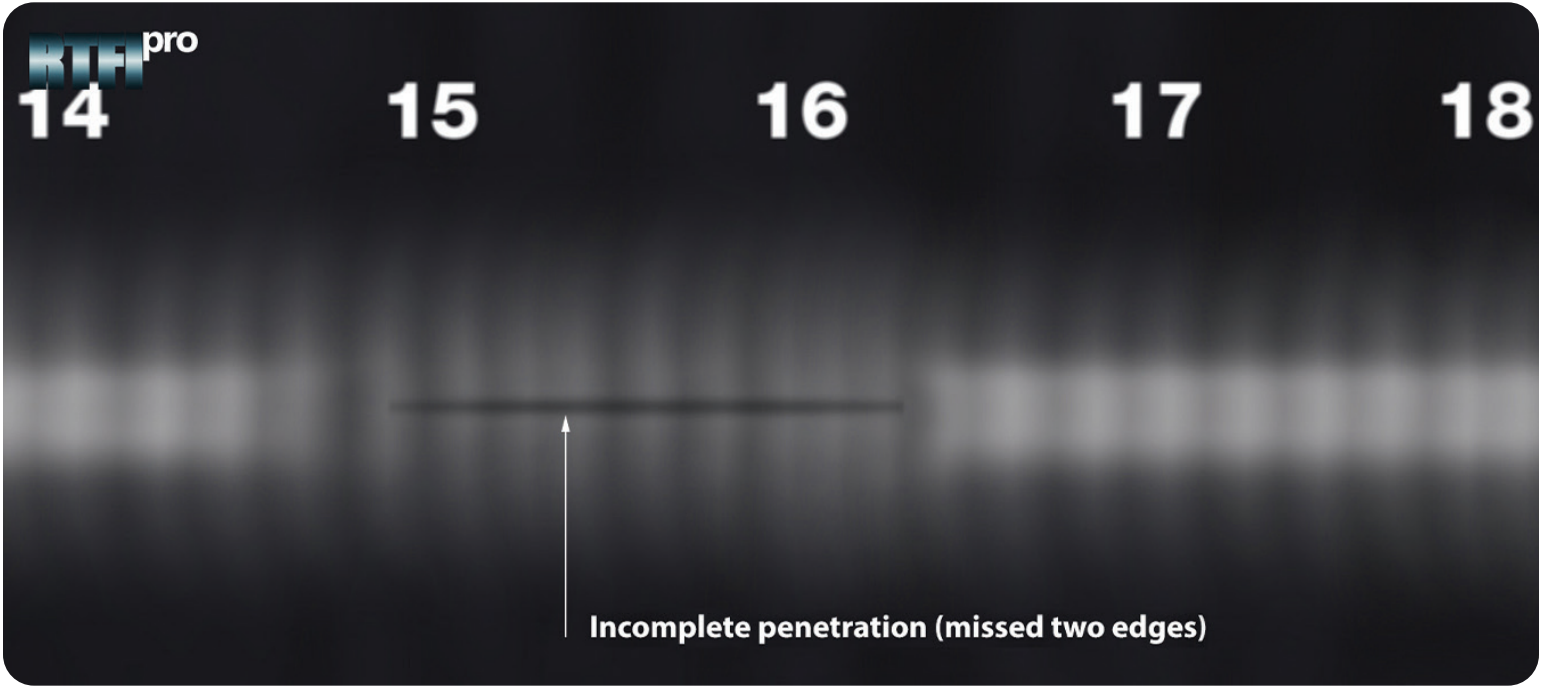


Description:

Also known as Lack of Penetration or Inadequate Penetration. It is the region of incomplete filling of the weld root area, depicted by one or both sides of the weld joint lacking unity at the toe or toes of the root.

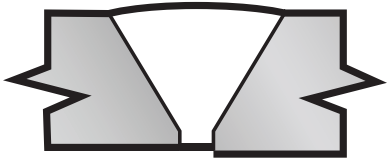
The incomplete penetration is cause by inadequate heat while the root pass is being deposited. It may also be caused by faulty joint design, improper electrode size or poor operator technique. Incomplete penetration usually has a very straight and defined location in the root.

Radiograph Image:



INCOMPLETE PENETRATION SINGLE EDGE

Flaw Type

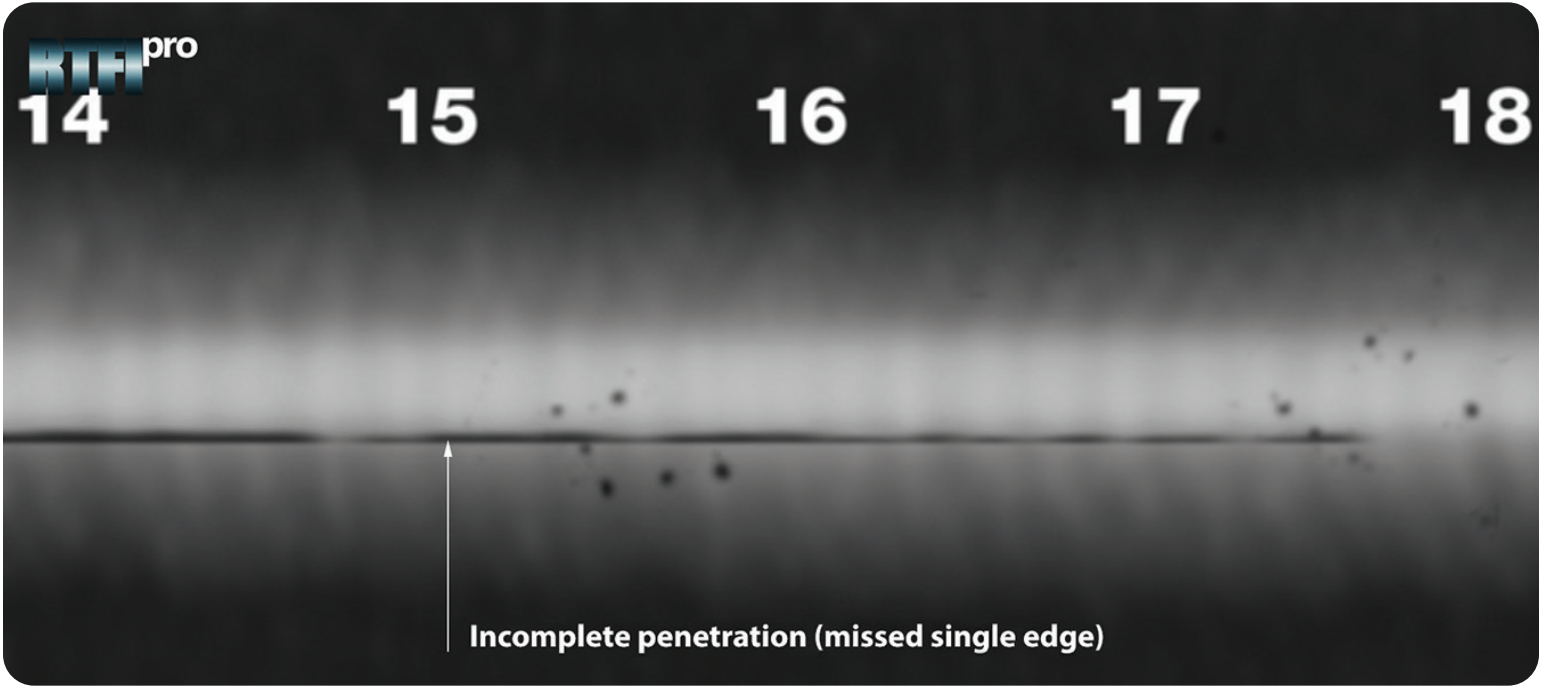


Description:

Also known as Lack of Penetration or Inadequate penetration, it is the region of incomplete filling of the weld root area on one side due to misalignment or no misalignment as in accordance with ASME enquiry 18-895. This Hi-lo version is classified inadequate penetration due to Hi-Lo for API 1104.

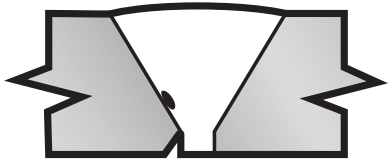
Classified Incomplete penetration for ASME in accordance to ASME Enquiry 18-895, however for CSA Z662 it is considered Lack of fusion

Radiograph Image:



LACK OF FUSION

Flaw Type



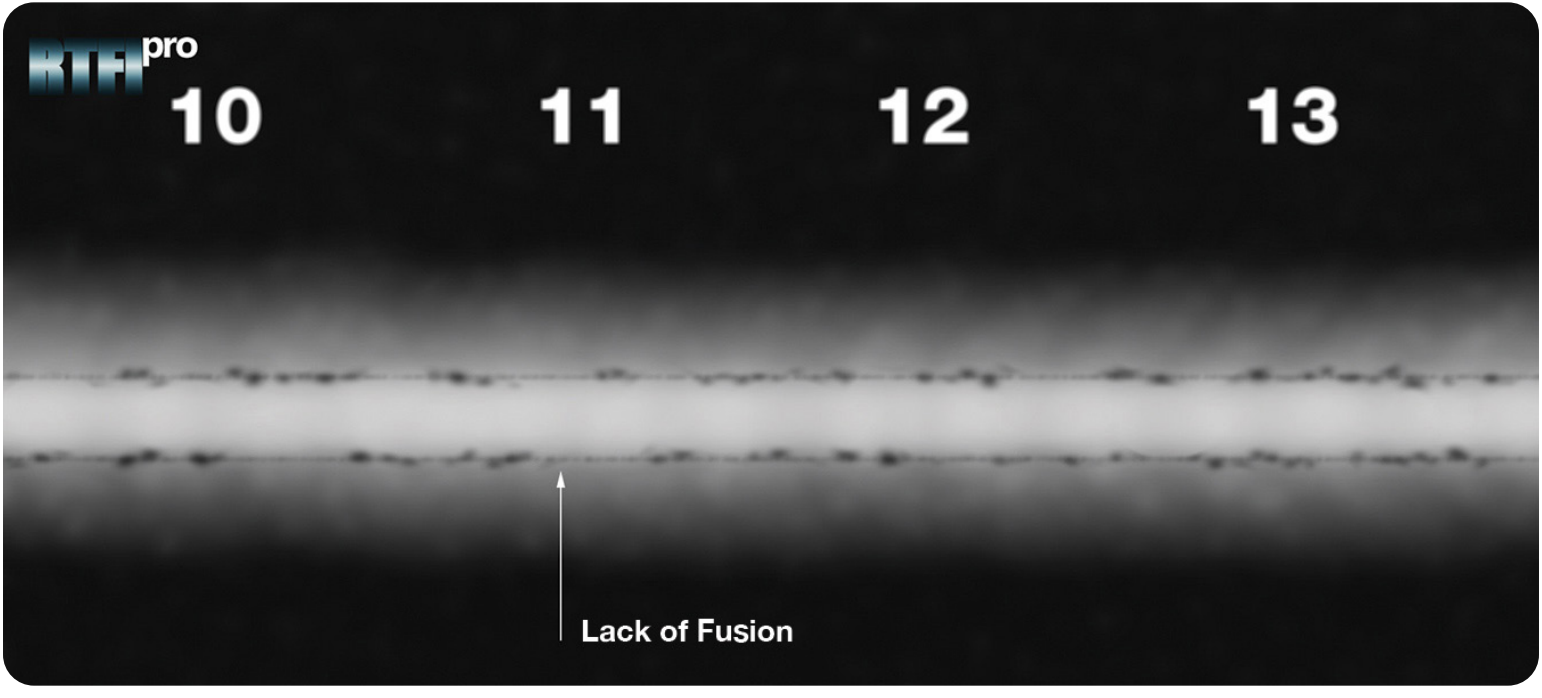
Description:

Lack of fusion is an area of lack of bonding between successive weld passes or between a weld pass and the side wall of the base material. The indication for lack of fusion is relatively straight and in some cases, angularly oriented, which creates the potential for the discontinuity to be undetectable by radiography

When viewed, it may not be clearly defined but will have a linear alignment, running in the same direction that the weld is deposited. In a lack of side wall fusion, small circular shapes may appear as if they were protruding from the linear indication. It is easy to confuse LOF and slag lines, but the key point to remember is the straighter and sharper definition appearance of LOF, as well as the circular “blips” that may protrude from it.

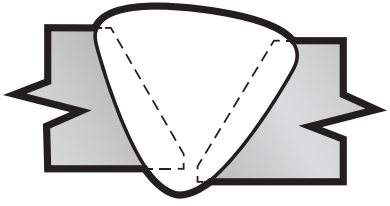
The ability to detect LOF is dependent on the orientation of the defect with respect to the radiation beam. LOF with the parent material will appear as a fine dark straight line which may be continuous or intermittent. When the LOF is occurring on cap side, it will be visible.

Radiograph Image:



MISMATCH

Flaw Type

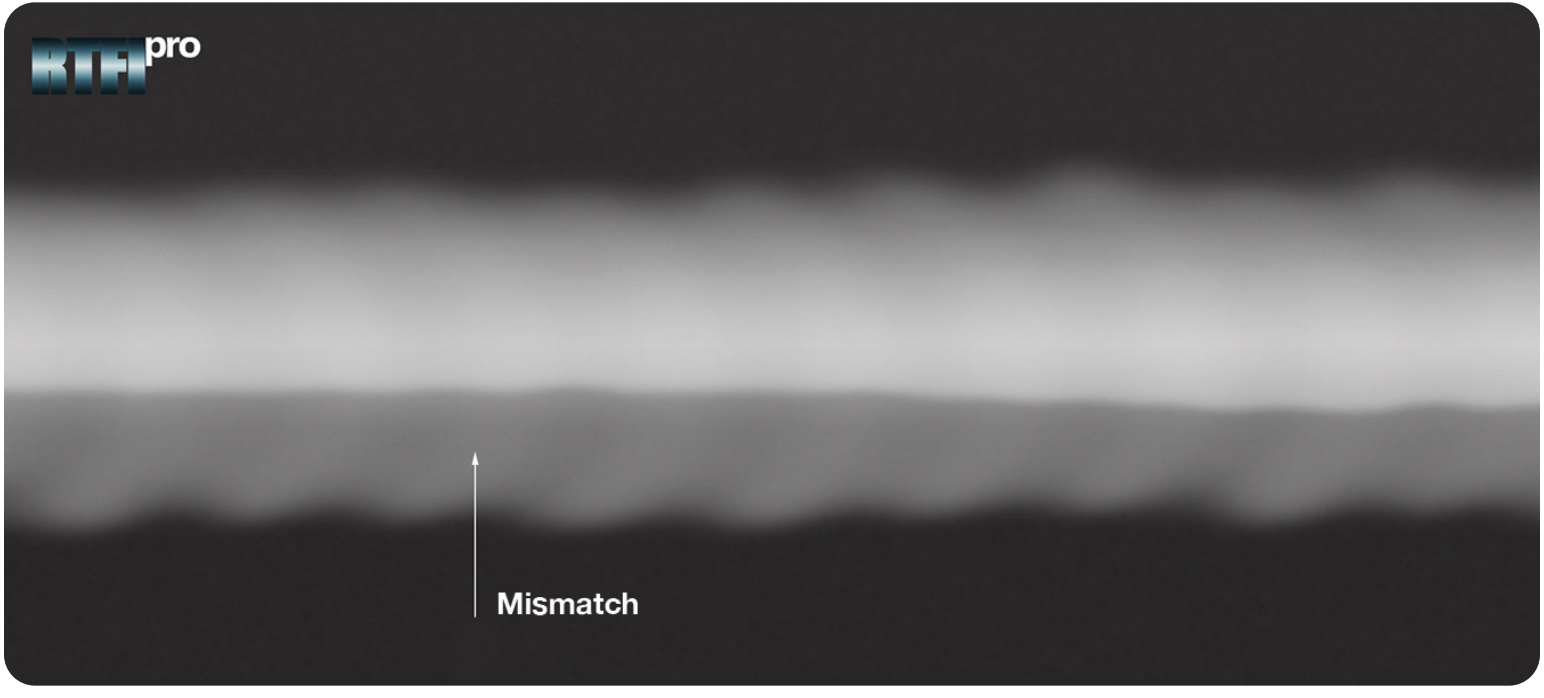


Description:

Mismatch (Hi-Lo or Off-Set) is the condition where two pipes are welded together and they are not properly aligned and/or of different thickness. The radiograph shows a difference in density between the two sides.

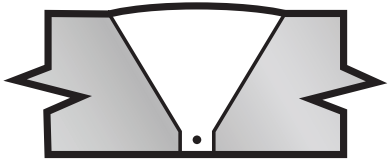
In some occurrences, the appearance of a dark straight line is present, which is the failure of the weld metal to bond with the pipe root edge (land), known as incomplete penetration due to Hi-Lo (ASME Code). The radiograph shows the density difference due to misalignment of both pipes.

Radiograph Image:



HOLLOW BEAD

Flaw Type

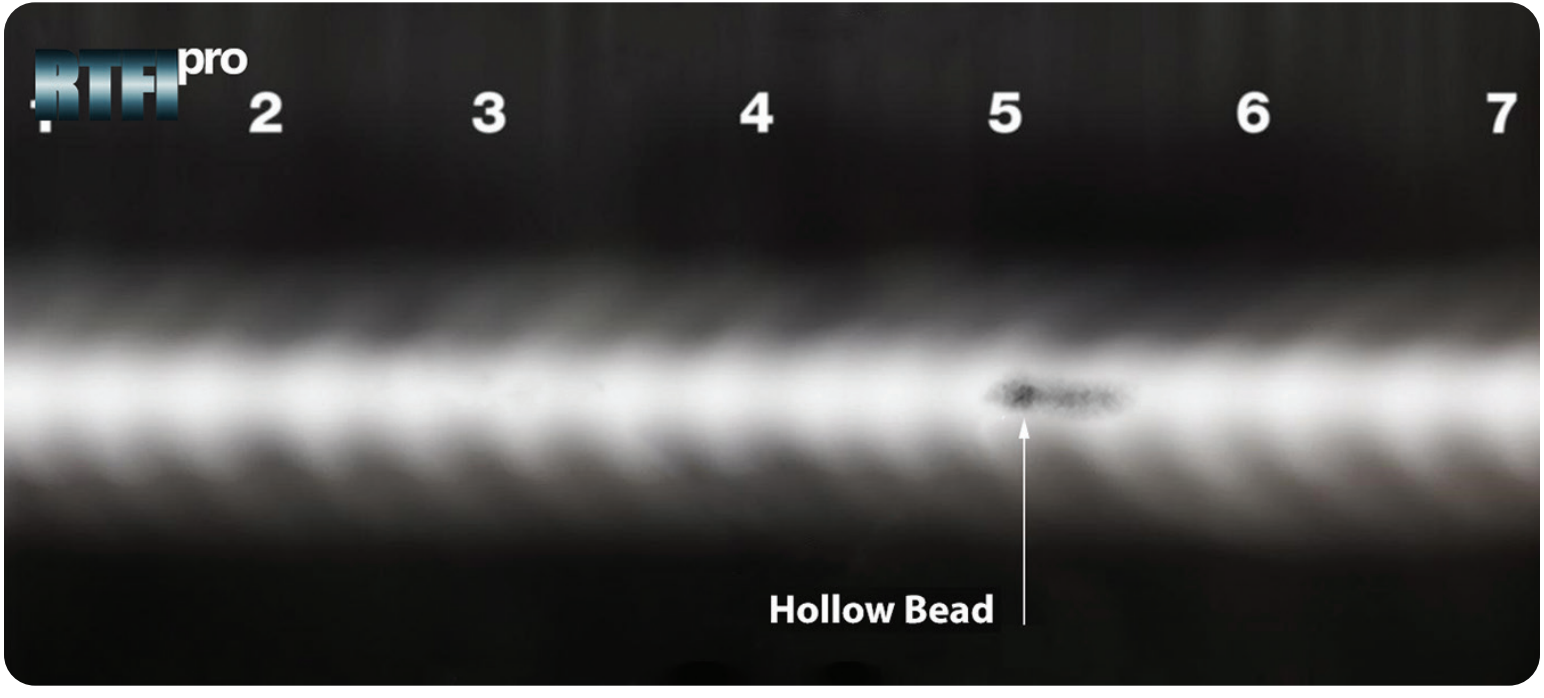


Description:

Hollow bead is elongated gas entrapped in the weld root area. Problems with hollow beads begin in the root pass when the primary causes are very high welding currents and fast welding speed used.

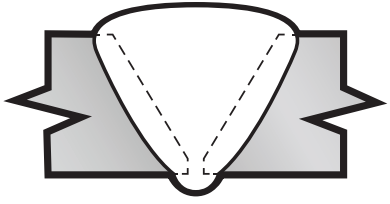
Hollow bead is found in the root and will have a linear appearance. If there are no acceptance criteria mentioned for hollow bead, it shall be evaluated as elongated indication (if satisfying the requirements of an elongated indication).

Radiograph Image:



EXCESSIVE PENETRATION

Flaw Type

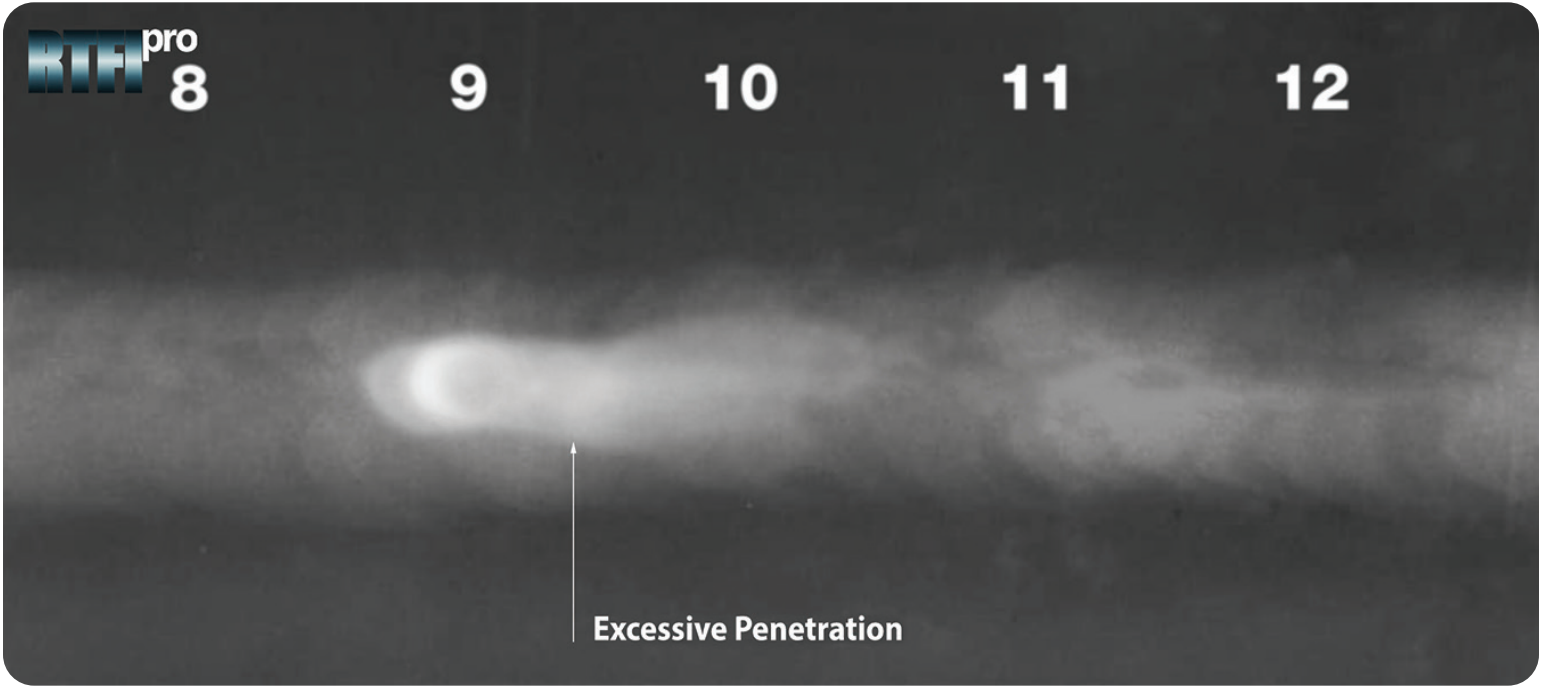


Description:

Excessive Penetration results from excessive heat input while the root is being created. The reinforcement of the root becomes excessive and appears as a denser white colour.

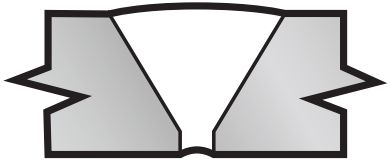
When Excessive Penetration occurs in short or intermittent droplets, it may be referred to as icicles and it can be sometimes accompanied by a burn through. Excessive Penetration cannot be measured (DWESWV) when internal access is not available and therefore, the hight of the penetration cannot be measured. Icicles give the technician a height to work with.

Radiograph Image:



CONCAVE ROOT

Flaw Type

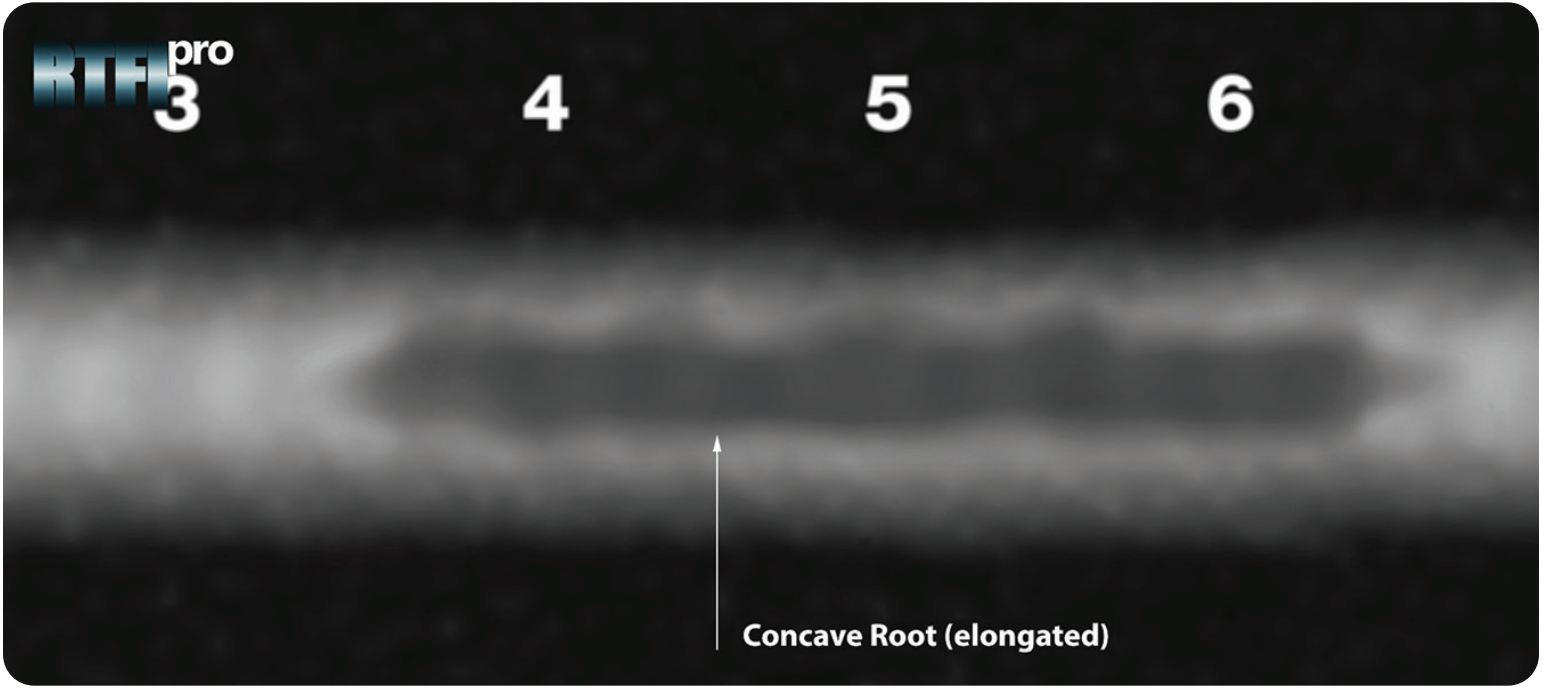


Description:

Concave (Internal Concavity) is a concave condition in the root pass that results from insufficient heat input while depositing the root pass. It is sometimes referred to as “suck back”.

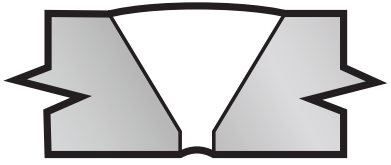
Unlike incomplete penetration, the root bead is fused to both surfaces and the center of the root pass is slightly concaved within. Unlike incomplete penetration the root is fused with internal concavity. With most codes the density must not be darker than the thinnest base metal.

Radiograph Image:



CONCAVE ROOT HALF MOON

Flaw Type



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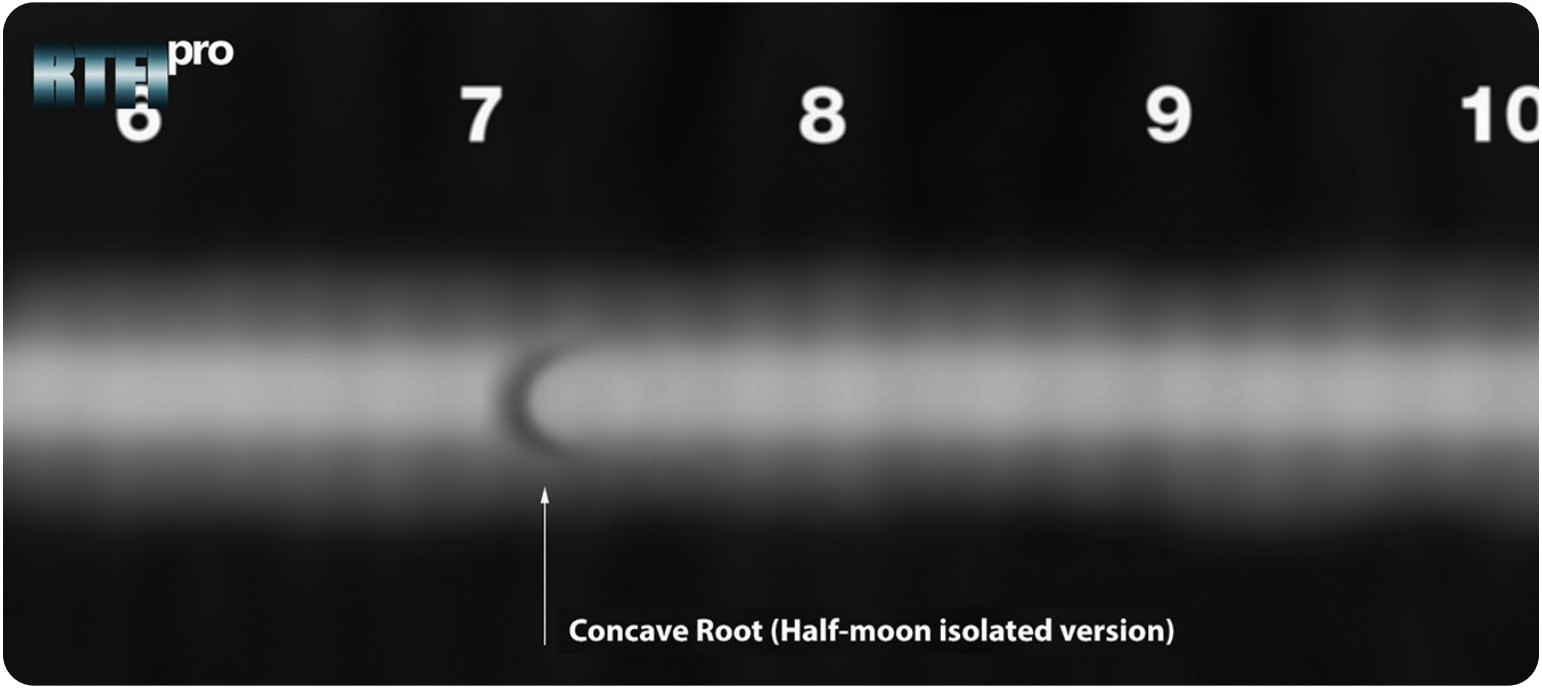
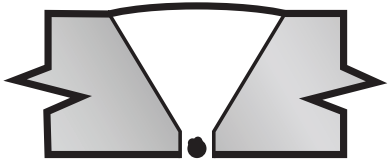
Radiograph Image:



BURN THROUGH

Flaw Type

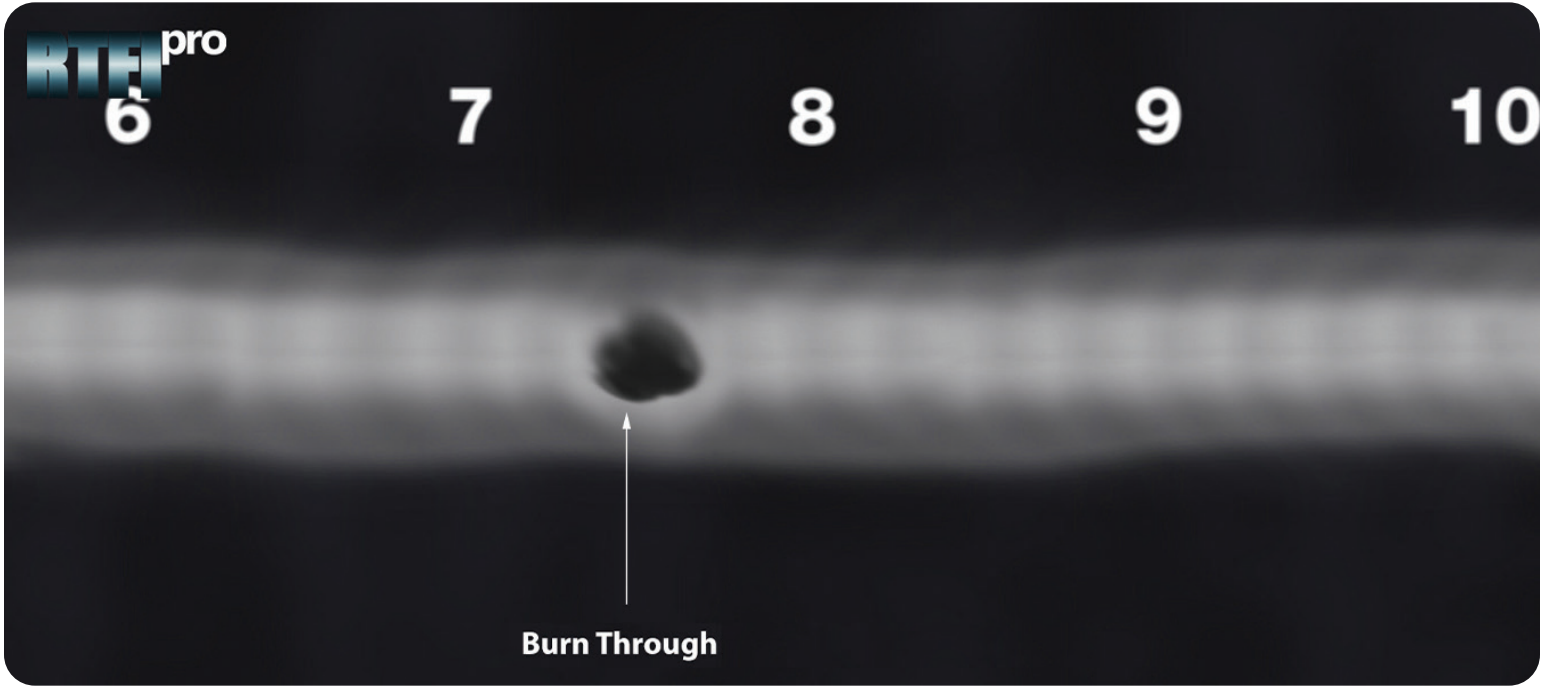


Description:

A Burn Through is when the welder burns through the root. This indication is located in the root and will be easily distinguished with a dark density. The burn through area can spread past the root area.

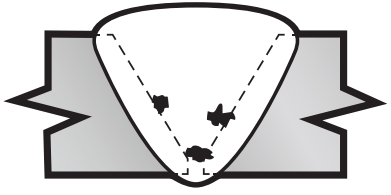
The burn through area is usually and irregular circle shape. Burn through is regularly seen with excessive penetration. With some burn through it may appear as halfmoon shape with the visibility of internal undercut present with the burn through area.

Radiograph Image:



TUNGSTEN INCLUSION

Flaw Type

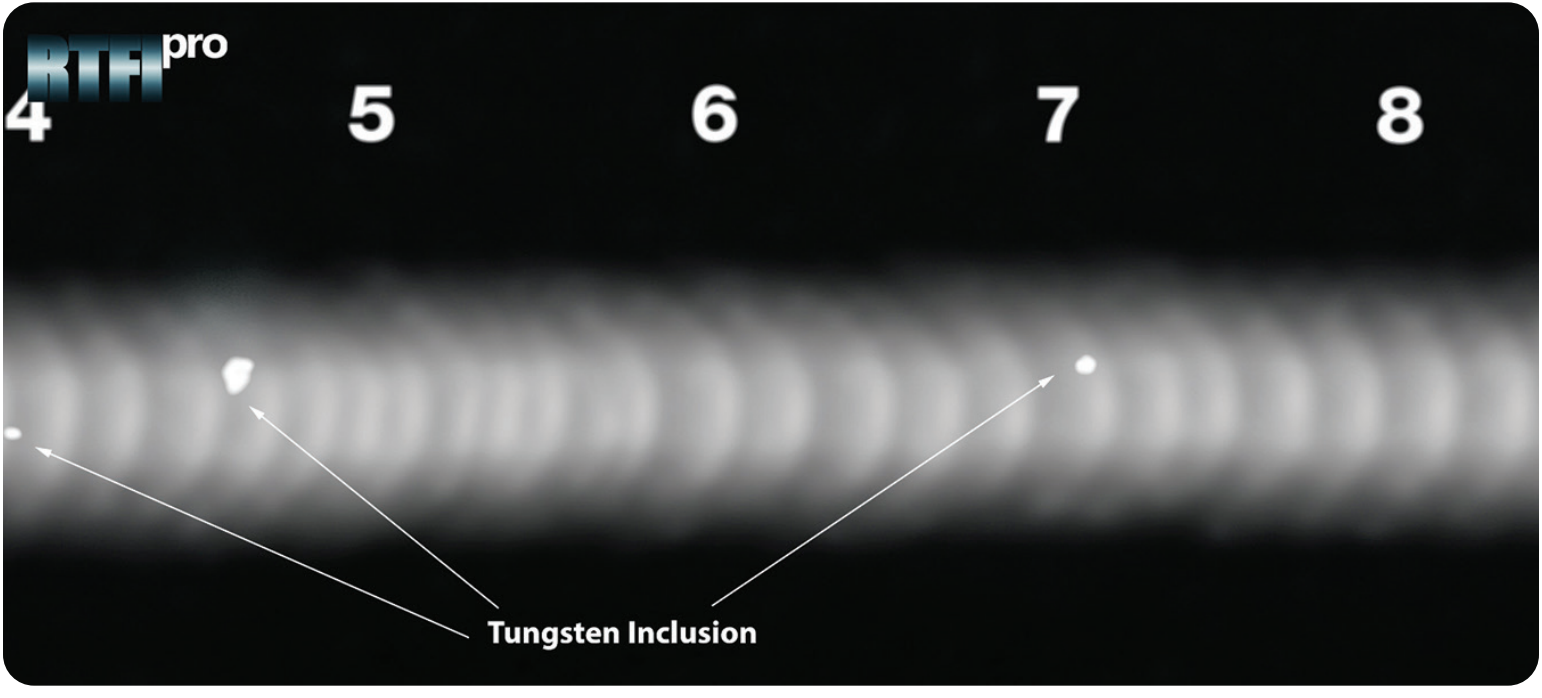


Description:

Tungsten inclusion are pieces of TIG iron from welding trapped in the weld metal, most likely from mistakes during manual welding.

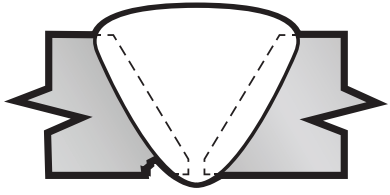
Such tungsten inclusions are caused by tungsten dipping in the weld puddle, breaking off after sticking in the puddle, or spraying in the puddle from using too large an electrode. The appearance will be a deep white colour usually circular or irregular appearance.

Radiograph Image:



INTERNAL UNDERCUT

Flaw Type

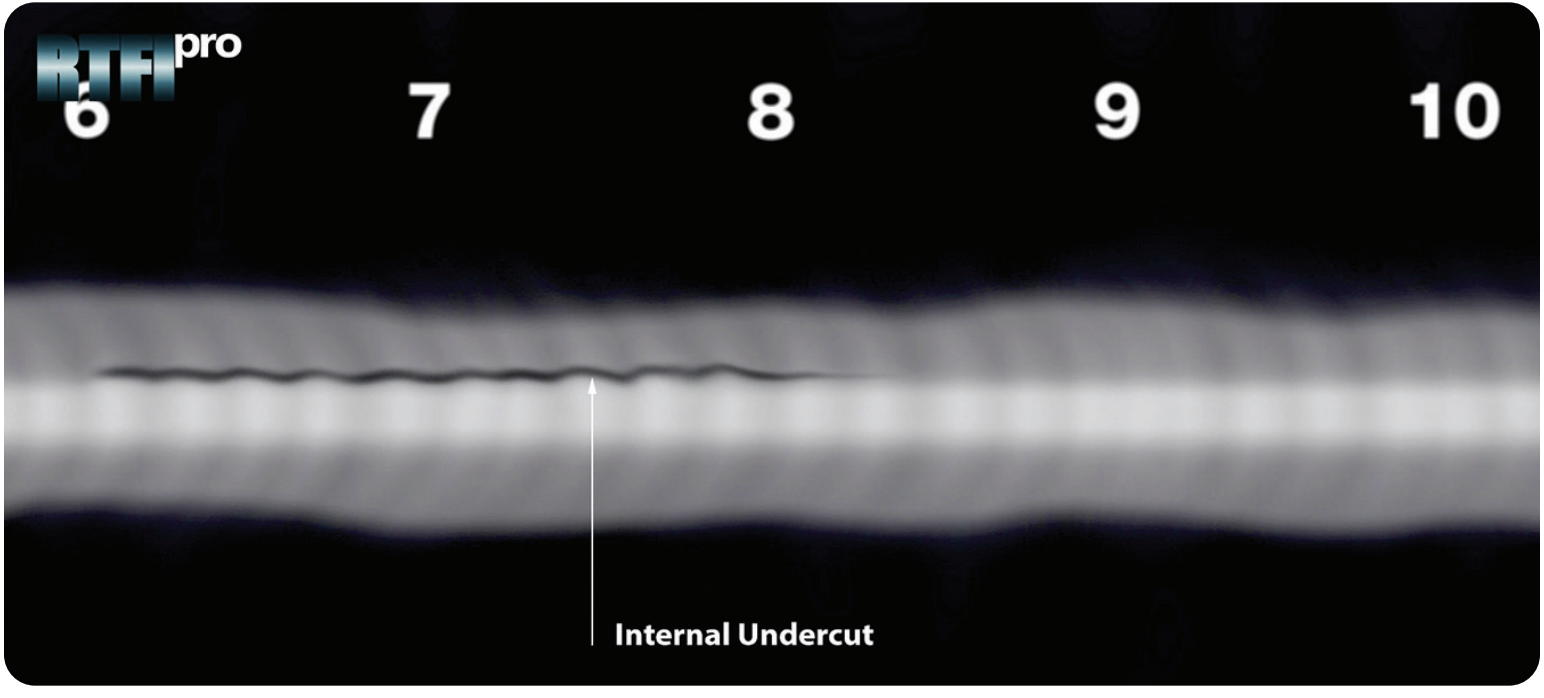


Description:

Undercut is described as the melting of the base metal, which occurs at the root or toe of the weld (internally or externally).

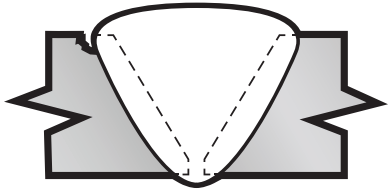
Undercut on the cap will be visible, otherwise internal access is necessary to measure internal undercut. Comparator shims are to be used to measure the depth of the undercut, as well as to compare the density of the undercut to the density of the groove on the undercut shim.

Radiograph Image:



EXTERNAL UNDERCUT

Flaw Type

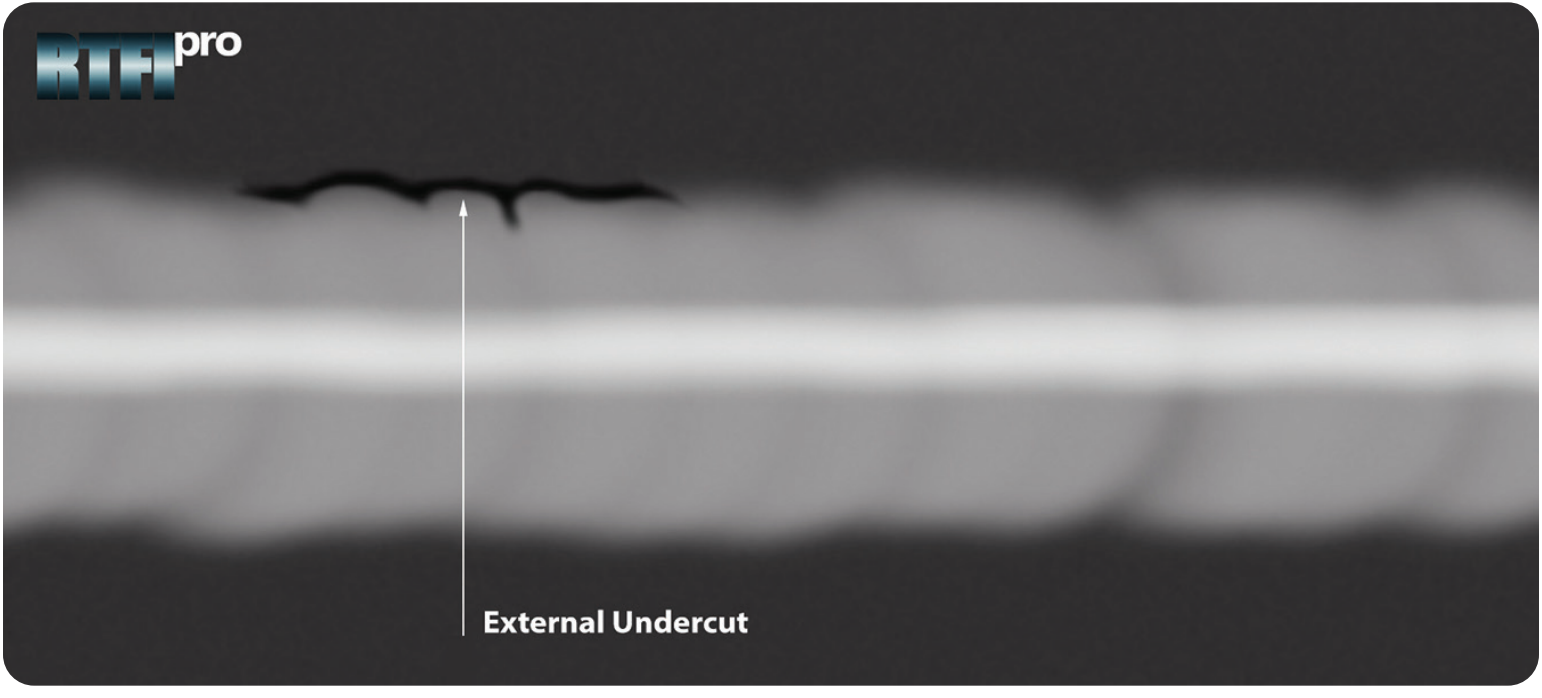


Description:

Undercut is described as the melting of the base metal, which occurs at the root or toe of the weld (internally or externally).

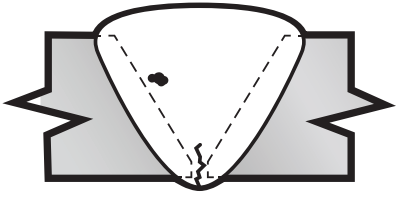
Comparator shims are to be used to measure the depth of the undercut, as well as to compare the density of the undercut to the density of the groove on the undercut shim. A measuring gauge can be used to measure the depth.

Radiograph Image:



LONGITUDINAL CRACK AND ROUNDED SLAG

Flaw Type

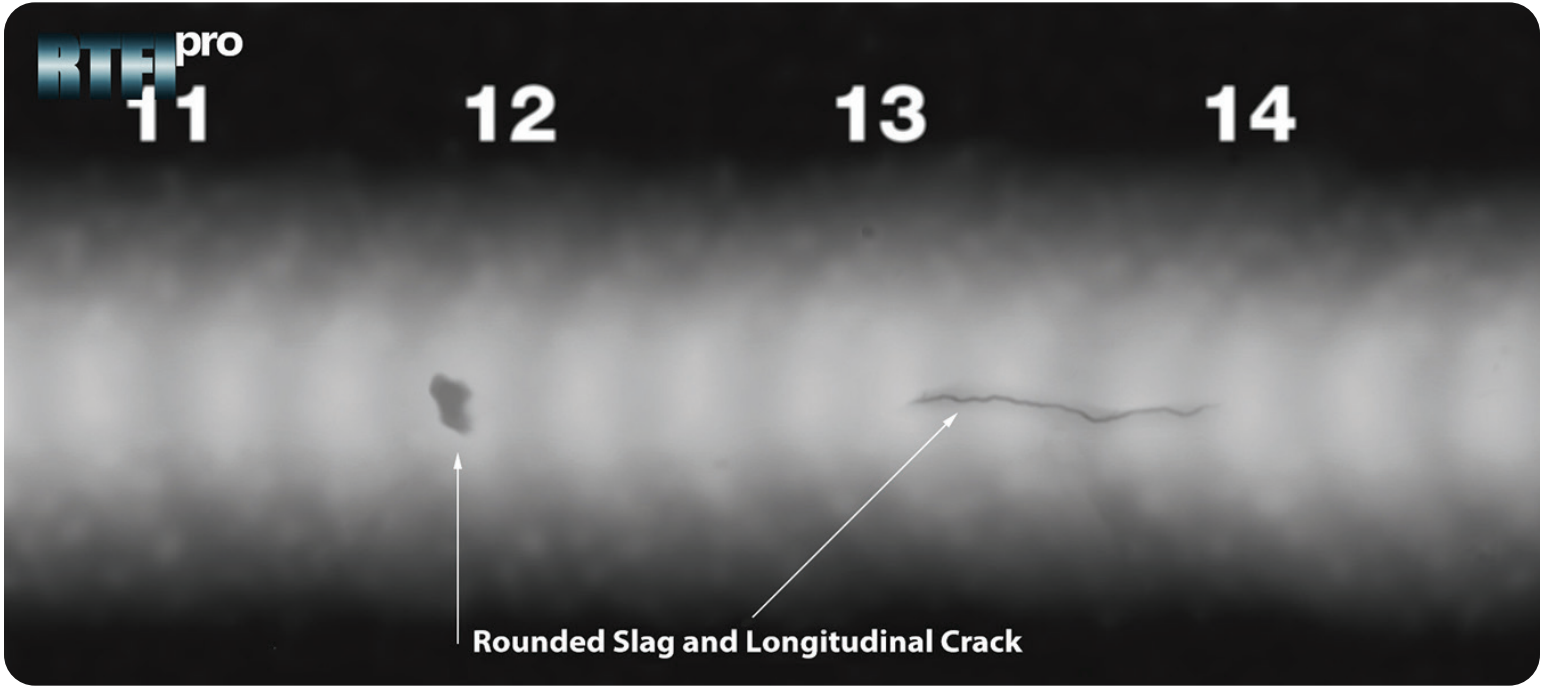


Description:

Longitudinal Crack is a crack that runs in the direction of the weld axis, and caused by rapid preheating or cooling.

Rounded Slag is a non-metallic piece of material found in the weld material caused from insufficient cleaning. They can be circular or elongated.

Radiograph Image:



SUGARED ROOT

Flaw Type

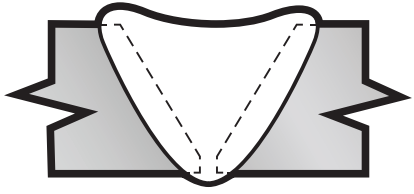
Description:

Sugared Root (or Sugaring) is the oxidation of stainless-steel welds caused due to the inadequate (or loss) of purging gas. It is also known as granulation due to its appearance as granular sugar. It is evaluated (and even rejected depending on the severity) on the basis of weld metal not flowing smoothly into the base metal.

Radiograph Image:

LOW COVER

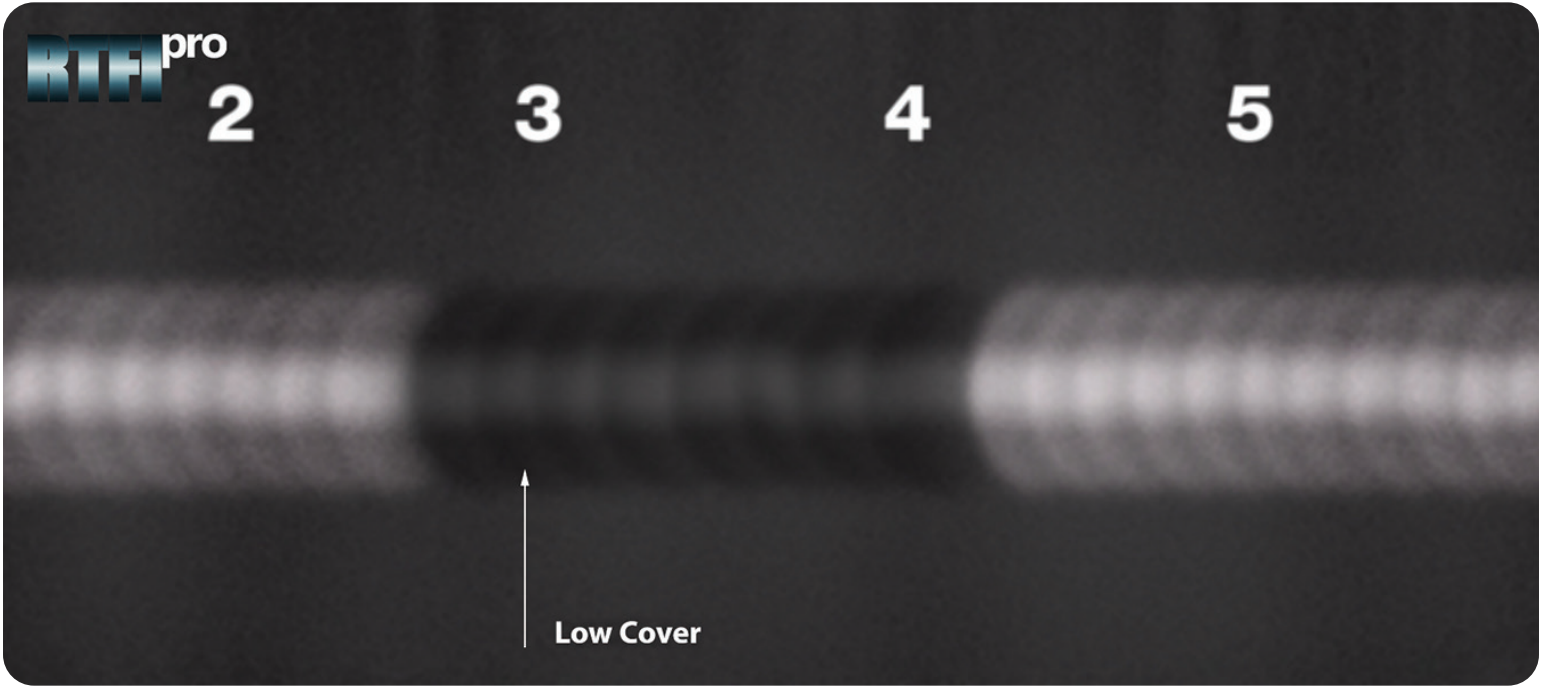
Flaw Type



Description:

Low Cover is when the weld metal at the cap is not completely filled and as a result the base metal exceeds the height of the weld cap or close proximity to it. This condition is seen on a radiograph by an increase in the density of the weld area; this can be visually measured and determined.

Radiograph Image:



CONDENSATION

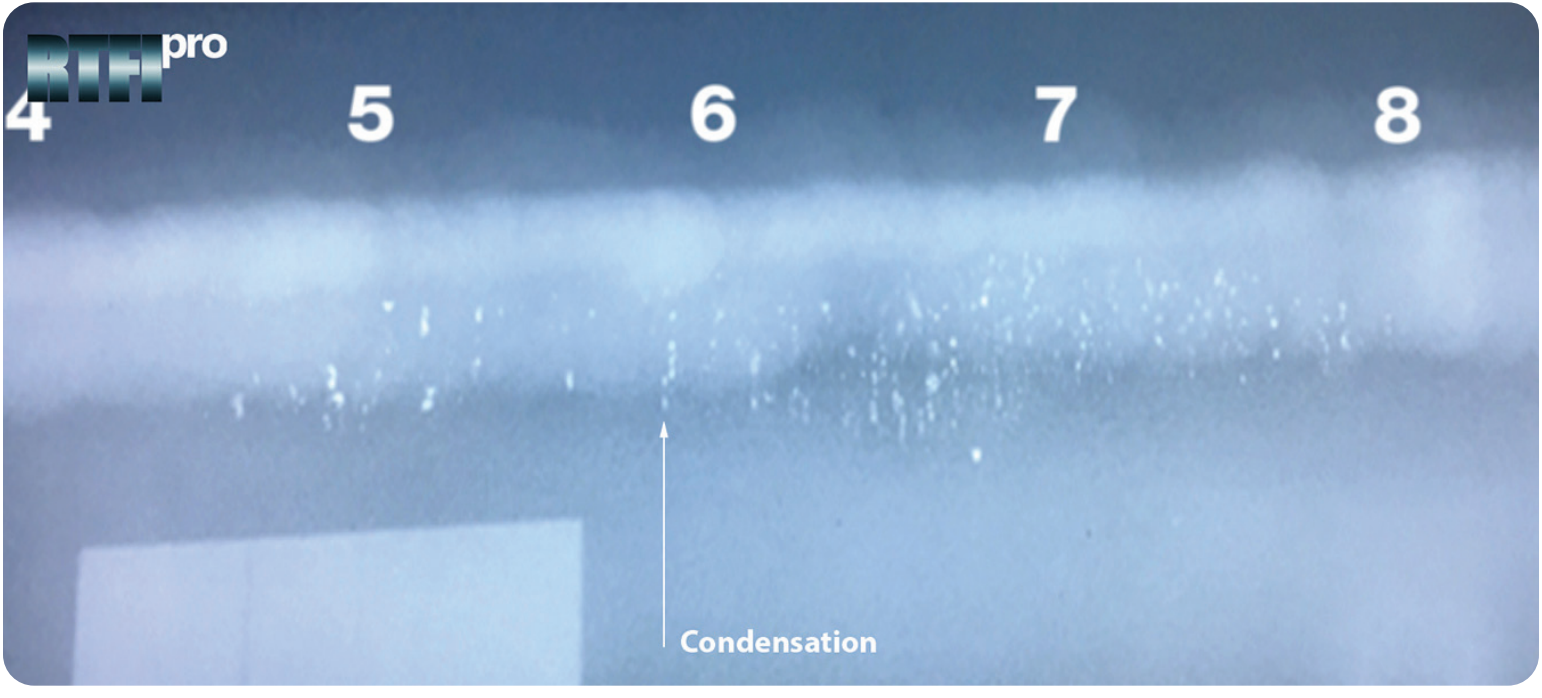
Flaw Type

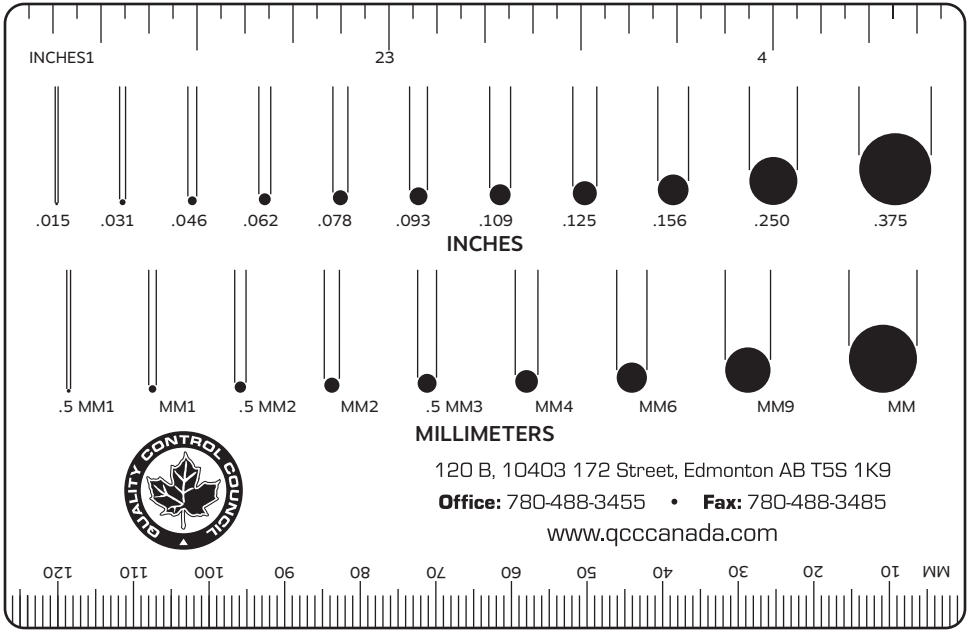
Description:

Condensation is the appearance of white deposits on a radiograph. It occurs during cold temperatures while using lead screens. When the film is left outside in cold weather, after a period of time, the condensation is developed on the radiograph.

The amount of condensation is dependent upon the length of time, the film cassette remained in the cold. The longer the time the film (on the lead cassette) is exposed to cold temperatures, the more severe the condensation is.

Radiograph Image:

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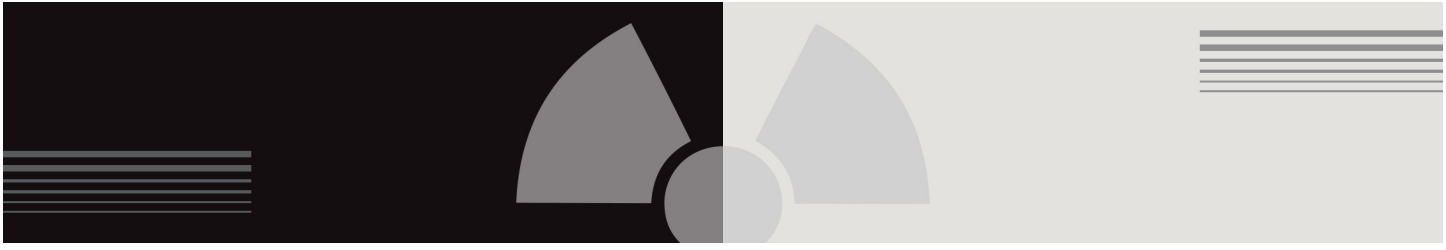

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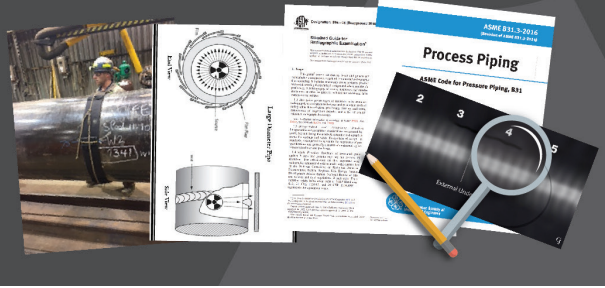

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