



NDT Images

AN OVERVIEW

Your guide to proper
processing and interpretation
of radiography films for
Non-Destructive Testing (NDT)

Carestream
ndt.carestream.com

INTRODUCTION

This guide addresses common artifacts that result from poor film handling and shows how you can avoid them.

The guide is designed to help you identify and understand a wide variety of casting and welding defects that appear on images obtained during Non-Destructive Testing (NDT).

FILM HANDLING ARTIFACTS

While many factors can affect image quality, macroscopic defects known as artifacts are sometimes produced during film handling and processing. These artifacts degrade film images. If images are seriously degraded, interpretations and analyses derived from those images will be compromised. Often, those analyses will be completely unsatisfactory.

To make sure you achieve the highest quality images — and operate cost effectively — it is critical to minimize the number and types of artifacts that appear on processed films. The solution is simple. **Proper film handling practices will prevent nearly all artifacts that compromise NDT films.**

Section I of this guide defines the most common film handling artifacts and describes what causes them. Detailed troubleshooting procedures are offered to help you prevent similar artifacts from forming in the future.

Section II offers general procedures you can follow to prevent the formation of artifacts.

WELD AND CASTING DEFECTS

It's critical that your NDT programs produce the best possible data. This guide will help you identify the wide variety of artifacts and NDT defects, from crimps to streaks, from micro-fissures to gas voids.

Section III addresses defects typically found in images of Castings.

Section IV helps identify defects found in images of Welds.

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PRESSURE MARKS

WHAT DO THEY LOOK LIKE?

A pressure mark exhibits a significantly lower density compared to adjacent areas.

WHAT CAUSES THEM?

A severe localized application of pressure to an area of the film before exposure.

WHEN CAN THESE OCCUR?

The major cause of pressure marks is poor film handling during the preparation of cassettes. Film may be pinched in the cassette at some point in the handling process. An object dropped on the cassette can also cause pressure marks.

HOW DO I TEST FOR PRESSURE MARKS?

Carefully prepare another cassette of film directly from the same box. Expose and process the film. If you don't see defects like you saw the first time, what you saw the first time is likely a pressure mark.

HOW CAN I PREVENT THEM?

Always handle film with care. Avoid any type of pressure on the film.



CRIMP MARKS (AFTER EXPOSURE)

WHAT DO THEY LOOK LIKE?

Crimp marks appear as crescent-shaped defects that are darker (higher density) than adjacent film areas.

WHAT CAUSES THEM?

Any sharp bending of the film after exposure and just before or during processing will crimp the film.

WHEN CAN THESE OCCUR?

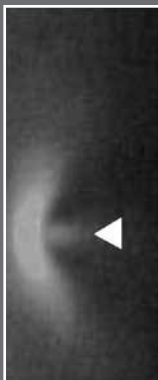
This usually happens when film is handled improperly when cassettes or hangers are being unloaded.

HOW DO I TEST FOR POST-EXPOSURE CRIMP MARKS?

Expose some film and then intentionally crimp or kink it. Process the film and examine the film with reflected light. Chances are you'll see one or more crescent-shaped defects.

HOW CAN I PREVENT THEM?

Handle the film with care. To carry a single sheet, gently bend the film in half and hold it in a "3-point grip", that is, grasp it with your thumb and middle finger and place your index finger in between to keep the film surfaces separated. It's easier if you keep the long dimension parallel to the floor.



CRIMP MARKS (BEFORE EXPOSURE)

WHAT DO THEY LOOK LIKE?

Crimp marks appear as crescent-shaped defects that are lighter (lower density) than adjacent film areas.

WHAT CAUSES THEM?

Sharp, abrupt bending of the film before exposure causes crimp marks of this type.

WHEN CAN THESE OCCUR?

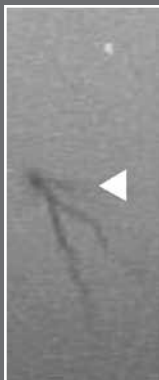
This usually happens when film is handled poorly when removing a sheet from a box or loading a cassette prior to exposure.

HOW DO I TEST FOR PRE-EXPOSURE CRIMP MARKS?

Intentionally crimp or kink some film, expose it, then process normally. Examine the film and you'll probably see lighter crimp marks where you mishandled the film.

HOW CAN I PREVENT THEM?

Handle the film with care. To carry a single sheet, gently bend the film in half and hold it in a "3-point grip", that is, grasp it with your thumb and middle finger and place your index finger in between to keep the film surfaces separated. It's easier if you keep the long dimension parallel to the floor.



STATIC MARKS

WHAT DO THEY LOOK LIKE?

Static marks appear as either jagged, branching dark lines or irregular and intense dark spots. Static marks are similar to certain casting irregularities.

WHAT CAUSES THEM?

The dissipation of static electricity causes static marks.

WHEN CAN THESE OCCUR?

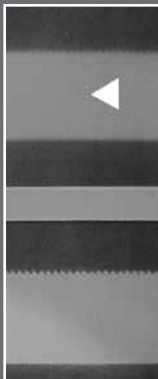
Removing film quickly from its box when the relative humidity is low (a bad hair day) is the most common cause of static marks.

HOW DO I TEST FOR STATIC MARKS?

Shuffle your feet or rub your hair before handling film. Sometimes you'll see or hear the static discharge. After processing, if you see jagged lines or dark spots, chances are good you've got static marks.

HOW CAN I PREVENT THEM?

Keep film at a relative humidity that's greater than 40%. Avoid sliding the films or moving fast when removing film from its box.



POOR DEFINITION

WHAT DOES IT LOOK LIKE?

Poor definition is simply a term to describe images that are not sharp.

WHAT CAUSES IT?

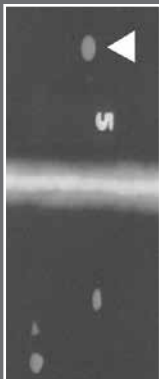
In most cases, poor definition is caused by a lack of contact between the screen and the film.

WHEN CAN THIS OCCUR?

Any time there's not enough, or poor, contact between lead or fluorescent screens and the film you can get "unsharp" images.

HOW CAN I PREVENT IT?

Simple. Just make sure your screen and film path are adjusted to correct tolerances and properly aligned.



SPOTS (FIXER)

WHAT DO THEY LOOK LIKE?

Spots from fixer will appear as small spots of a lower density than the surrounding film area.

WHAT CAUSES THEM?

Before development, a splash of fixer, even in trace amounts, will cause spots.

WHEN CAN THESE OCCUR?

Any time there's chemical contamination you can have a problem. In this case, it's usually due to a poor darkroom layout or careless processing techniques.

HOW CAN I PREVENT THEM?

Don't splash fixer, of course. And in general, keep film loading areas completely dry.



SPOTS (DEVELOPER)

WHAT DO THEY LOOK LIKE?

Spots from developer will appear as small spots of a high density compared to the surrounding area of the film.

WHAT CAUSES THEM?

A touch or splash of developer prior to developing the film will cause this type of spot.

WHEN CAN THESE OCCUR?

Poor processing techniques or a bad darkroom layout can lead to spots.

HOW CAN I PREVENT THEM?

Don't splash chemicals of any kind. Make sure your film loading area is totally dry.



HAIR LINES

WHAT DO THEY LOOK LIKE?

Hair lines look like just what they are — a very slender white line across a film negative. They can also be spots created by lint or dust.

WHAT CAUSES THEM?

In most cases, a hair between the film and the screen causes a line. Lint or dust will cause irregular spots or shadow images.

WHEN CAN THESE OCCUR?

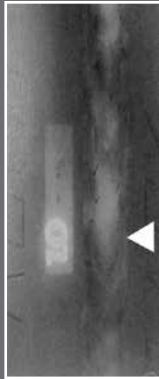
Contamination can occur anywhere in the process of handling films and screens.

HOW DO I CHECK FOR HAIR LINES?

Closely and carefully inspect cassettes and screens.

HOW CAN I PREVENT THEM?

Keep all your work areas clean, and as close to spotless as possible.



SCREEN MARKS

WHAT DO THEY LOOK LIKE?

A screen mark will appear as a dark line on a negative. Screen marks will also appear as white spots on a negative.

WHAT CAUSES THEM?

A dark line is caused by a deep scratch on the lead foil screen. Light spots are caused by flakes of foreign material on the screen.

WHEN CAN THESE OCCUR?

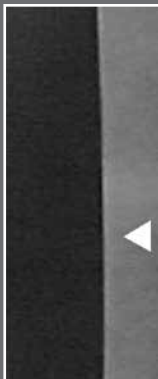
You'll see screen marks when a screen is scratched or damaged in some way. They're also produced when foreign materials get into your equipment.

HOW DO I CHECK FOR SCREEN MARKS?

Inspect your screens closely. If you see damage of any kind, they must be replaced. If you're not sure, replace the suspect screen with a new one and run some film tests.

HOW CAN I PREVENT THEM?

You should avoid scratching screens, of course, and always maintain meticulously clean work areas. In addition, use leadpack film formats when possible.



PAPER MARKS

WHAT DO THEY LOOK LIKE?

A paper mark will appear as a low density area that almost completely covers the film.

WHAT CAUSES THEM?

Paper marks appear when the paper gets on the film and screen and casts a shadow of itself.

WHEN CAN THESE OCCUR?

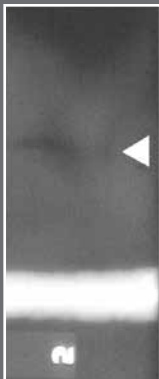
This happens when the interleaving paper is not removed.

HOW DO I CHECK FOR PAPER MARKS?

It's easy. Just run test exposures with and without the interleaving paper.

HOW CAN I PREVENT THEM?

Make sure you completely remove the interleaving paper before making an exposure.



BLACK STREAKS OR BLOTCHES

WHAT DO THEY LOOK LIKE?

They look just like their name: black streaks or blotches.

WHAT CAUSES THEM?

Extraneous light creates black streaks or blotches.

WHEN CAN THESE OCCUR?

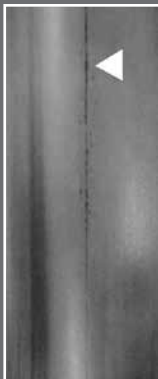
Most often these defects happen when light leaks in because a cassette or film holder is damaged or faulty.

HOW DO I TEST FOR STREAKS/BLOTCHES?

Remove a sample piece of film in total darkness, ensuring there's no chance it could have been exposed by light. Process the film and examine it.

HOW CAN I PREVENT THEM?

There are a number of steps you should take. Check and properly maintain your cassettes. Secure them with tape or rubber bands as necessary. And finally, make sure your safelights are really safe.



STREAKING

WHAT DOES IT LOOK LIKE?

Streaking is defined as a line, smear, or band. In this case it can be black or white

WHAT CAUSES IT?

Streaks are caused by any of several types of chemical contamination. The contamination often occurs in poor darkroom setups or because of improper processing technique.

WHEN CAN IT OCCUR?

Streaks of this type happen when chemicals from prior processing cycles are not completely removed from hangers.

HOW CAN I PREVENT IT?

Avoid overcrowding hangers. Make sure you rinse equipment carefully and completely. Also keep film loading areas dry and free of chemical splashes.



PRESSURE MARKS (FROM AUTOMATIC PROCESSING)

WHAT DO THEY LOOK LIKE?

Pressure marks appear as dark lines or dark spots.

WHAT CAUSES THEM?

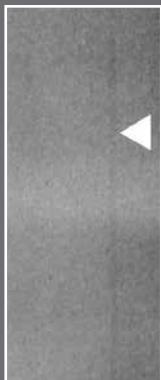
A buildup of chemical deposits in automatic processing or mechanical pressure on the film can create pressure marks.

WHEN CAN THESE OCCUR?

Poor processor maintenance is the primary cause. This includes both foreign matter on rollers and incorrect roller clearances.

HOW CAN I PREVENT THEM?

Thoroughly clean automatic processor rollers on a regular basis and make sure they are mechanically maintained and up to spec.



PI LINES (FROM AUTOMATIC PROCESSING)

WHAT DO THEY LOOK LIKE?

A Pi (π) line is a very specific artifact: a dark line at a distance from the leading edge of the film that's exactly equal to the circumference of the roller in your automatic processor.

WHAT CAUSES THEM?

Pi lines are caused when minute chemical deposits are transferred from the roller to the film.

WHEN CAN THESE OCCUR?

They are often spaced in a regular sequence, separated by the circumference of the roller.

HOW DO I TEST FOR PI LINES?

Measure the exact distance between the lines. If the artifact is repeated again and again at the same spacing with diminishing density or intensity, and the distance between the lines is equal to the circumference of the roller, you have Pi lines.

HOW CAN I PREVENT THEM?

Make sure the rollers in your automatic processors are carefully and completely cleaned and rinsed on a regular basis.



RANDOM BLACK SPOTS (FROM AUTOMATIC PROCESSING)

WHAT DO THEY LOOK LIKE?

Random black spots look like black comets with their tails extending in the direction of the film travel.

WHAT CAUSES THEM?

Chemical contamination causes random black spots.

WHEN CAN THESE OCCUR?

Either the processor or some of its components are contaminated, or foreign particles have fallen on the film as it enters the processor.

HOW CAN I PREVENT THEM?

Clean your automatic processor, carefully paying special attention to the feed trays and entrance rollers.

FILM HANDLING PRACTICES IN PROCESSING ENVIRONMENTS

Your images must be accurate and offer the highest quality. They must provide cool, clean image tones, low noise, high contrast and excellent definition. An image that's flawed is useless. A test that has to be repeated wastes time and resources and costs you money. Your productivity suffers.

In each category, defects can be drastically reduced with proper care and consideration. Ensure that you:

- Properly set-up your facility.
- Keep your darkrooms clean.
- Handle and process film using proper methods.
- Keep equipment and work spaces clean.
- Rigorously maintain film processing equipment.
- Be gentle.

To minimize the possibility of creating artifacts, make sure your darkrooms and film loading rooms are clean. Maintain film processors regularly, and always handle films with tender loving care and common sense.

Artifacts can be virtually eliminated by following these guidelines.

FILM HANDLING

- Be careful of metal surfaces.
- Handle film only by its edges.
- Use the fingertips of both hands.
- To carry a single sheet, fold film in half and hold it in a "3-point grip" between thumb and middle finger, with index finger in the center to keep film surfaces separated.
- Give yourself room to spread out.
- Carry film flat in trays or boxes.
- Wear gloves.
- Avoid jewelry that may have sharp edges.
- Clean film as recommended
 - Wipe in one direction, not in a circular motion.
 - Use Clean Room Wipes, Environmentally Safe Film Cleaners, TEKNEK Rollers or equivalent tacky roller cleaners.

IN THE PHOTO LAB

- Be careful removing raw film from the original package to avoid scratching and static.
- Load cassettes with care.
- Minimize exposure to dirt and dust when handling and transporting film.
- Carefully package and deliver film to the evaluators or technicians.

DARKROOM CONDITIONS: PRACTICE AND MAINTENANCE

Darkroom practices may be considered under several categories:

MATERIALS

- Avoid shedding materials such as paper, or cardboard boxes by using intermediate containers (such as plastic containers) to transport materials to the darkroom.
- Avoid large storage areas near the darkroom by practicing Just-In-Time delivery.

EQUIPMENT

- Should not generate contaminants (such as rust).
- Should not interfere with filtered air flow and/or cause turbulence.
- Surfaces should be easy to clean. (i.e., smooth, glossy, no crevices)
- Perform maintenance outside the dark environment when possible.
- Stainless steel tables and wire coated racks are good choices for use in darkrooms.

PHYSICAL LAYOUT

- Locate equipment to optimize process flow.
- Steps of the workflow should physically follow each other and not traverse back and across the work area.

TRAINING

- Operators should understand why darkroom cleanliness is necessary and how they can contribute to keeping it clean.
- Encourage people to spot problems and provide solutions to maintain a clean darkroom.

FACILITY

- Inspect all surfaces of the facility and equipment; tables, chairs, etc.
- Inspect and remove rust, corrosion, and flaking paint.
- Repaint with epoxy paint where necessary or use high-gloss paint for easy cleaning.
- Use hard surface materials for flooring, never carpet.
- Use laminate coated ceiling tiles.
- Lighting must meet needs of the process and product. You should follow the manufacturers' safelight recommendations.
- Delivery systems and conduits should be made of non-shedding inert material.

CLEANING

- Schedule cleaning so it does not interfere with production.
- Cleaning should proceed from highest surface level to lowest, and from cleanest areas to less clean.
- Cleaning should be followed by a period of time to allow dust to settle; do this before restarting production.

FILM PROCESSING

Make sure you are processing film at the recommended development time and temperature. Carestream recommended times and temperatures can be found in the Technical Data sheets on our website for all types of films.

Underdeveloping will cause low D-max and affect image quality. Make sure processor guides and rollers are properly aligned and crossovers adjusted correctly. Clean tanks of bioslime and maintain the processor to avoid:

- Dirty entrance rollers.
- Dirty top rollers.
- Salt crystals on crossover guides.
- Dirty squeegee rollers at entrance to dryer.
- Particulates on dryer rollers.

PREVENTATIVE MAINTENANCE PRACTICE:

Developer and Fixer Filtration	Use 10 μ m filter. Change weekly.
Water Filtration	25 μ m or smaller filter is best. Change weekly.
Daily Maintenance	Clean all top rollers, entrance rollers, crossovers, wash to dryer squeegee rollers.
Weekly Maintenance	Remove all racks, developer, fixer, and clean with high pressure hot water. Use brushes to clean. Avoid scratching stainless steel with SCOTCHBRITE Pads or equivalent.
Roller Transport Cleanup Film 4955	Use daily to remove particles. Especially important to use immediately after cleaning racks and after system cleanings.

PROCESSOR MAINTENANCE:

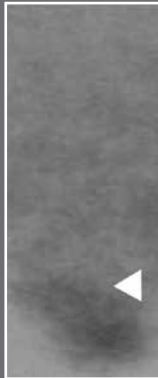
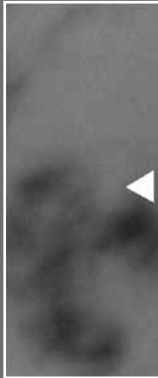
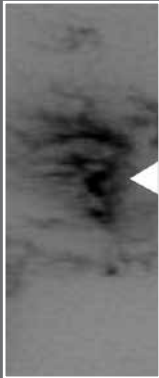
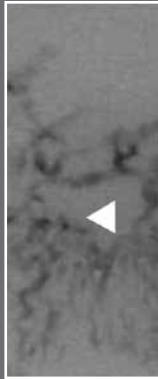
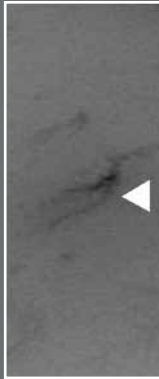
Controlling bioslime growth

- Minimize bioslime, a major cause of pinhole emulsion pick off.
- Daily addition of 30 mL (1-oz) of household bleach will help to dissolve gelatin particles, preventing redeposits and minimizing bioslime growth.
- WASHCLEAR, from Rothtech Ecological, has also proven to be very effective.
- Proxel GLX from Avecia, Inc. is also effective with a convenient auto-feed dispenser to the processor.
- Drain wash tanks when not in use or when shutting down your processor.

CLEANING FILM

To clean film, use only isopropyl alcohol (91 percent) or heptane. Soft, lintless, absorbent cotton pads, Webril Handi-Pads, or their equivalent should be used. Never use water because it will soften the gelatin.

- Apply cleaner to the cleaning wipe.
- Wipe film in a single up-and-down direction, NOT in a circular motion.
- Fold the cleaning wipe frequently to keep dirt particles away from the film surface.
- Change wipes often.



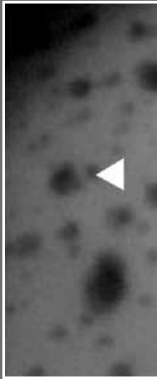
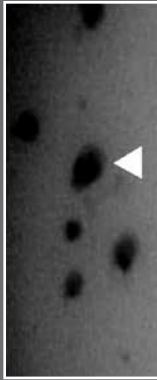
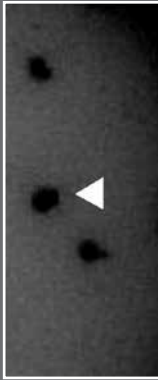
SHRINKAGE

WHAT DOES IT LOOK LIKE?

Shrinkage is indicated when you see several minor areas of differing density branching away from a major, abrupt linear defect. Shrinkage looks a lot like a tree with a thick trunk and several branches.

WHAT CAUSES SHRINKAGE?

When adjacent thick and thin portions of a casting cool unevenly, and the portions shrink at varying rates, a discontinuity becomes evident.



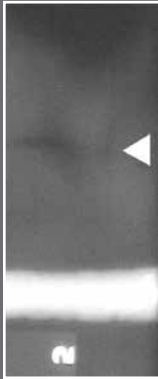
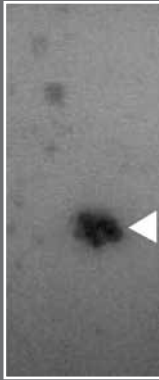
GAS VOIDS

WHAT DO THEY LOOK LIKE?

A gas void appears as a smooth dark spot. It can be round, oval, or elongated. The sizes of these spots can vary considerably.

WHAT CAUSES GAS VOIDS?

When gas is trapped in a casting, it naturally produces a void. The gas can erupt spontaneously from molten metal, and it can develop from water vapor or green sand in a mold. In addition, during the pouring of a mold, gas voids can form as a result of simple turbulence.



INCLUSIONS

WHAT DO THEY LOOK LIKE?

Inclusions usually exhibit lower density than gas voids. They're more diffuse than gas voids and irregular in shape, that is, not oval or spherical.

WHAT CAUSES INCLUSION?

Inclusions develop when low-density foreign matter and/or sand are entrapped in the molten metal and don't dissolve.



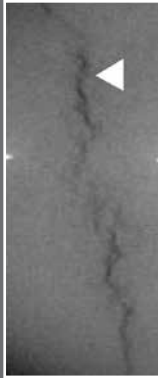
UNFUSED CHAPLET

WHAT DO THEY LOOK LIKE?

An unfused chaplet is the dark outline of a shape similar to the shape of the chaplet itself.

WHAT CAUSES AN UNFUSED CHAPLET?

Chaplet's are used to maintain cores in their correct position during the casting process. When a chaplet is not fused completely by the molten metal, a discontinuity is formed.



HOT TEAR

WHAT DOES IT LOOK LIKE?

A hot tear is a dark, jagged, linear indication. It may be intermittent.

WHAT CAUSES THEM?

Excessive thermal stress in cooling metal may produce this tearing or rendering.



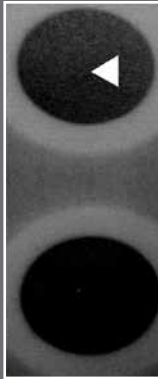
CRACKS

WHAT DO THEY LOOK LIKE?

Cracks in castings appear as dark linear indications. They may be either feathery or jagged.

WHAT CAUSES CRACKS?

Cracks are caused when metal fractures during or after solidification.



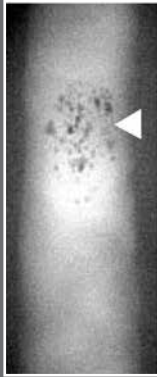
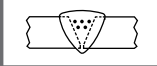
CORE SHIFT

WHAT DOES IT LOOK LIKE?

A core shift is just what it sounds like. The shift of the core is easily seen because the cored-out section is always darker than the metal.

WHAT CAUSES IT?

Sometimes, as molten metal is being poured, the core material shifts.



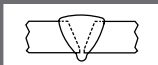
CLUSTER POROSITY

WHAT DOES IT LOOK LIKE?

Cluster porosity will appear as rounded or slightly elongated dark spots that appear in clusters.

WHAT CAUSES IT?

Clusters of trapped gas cause cluster porosity.



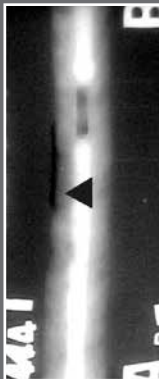
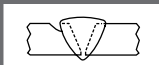
EXCESS PENETRATION

WHAT DOES IT LOOK LIKE?

Excess penetration appears as a lighter density area in the center of a weld image. This area can be extended along the weld or isolated in circular drops.

WHAT CAUSES IT?

These indicators can appear when there is excess metal at the root of the weld.



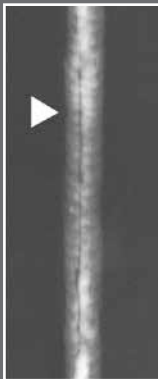
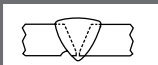
EXTERNAL UNDERCUT

WHAT DOES IT LOOK LIKE?

External undercut appears as an irregular dark density line that follows the edge of the weld image.

WHAT CAUSES EXTERNAL UNDERCUTS?

These appear when there's a groove or channel in the surface of the plate along the edge of the weld.



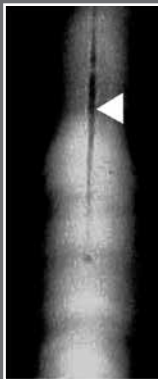
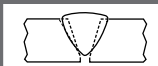
INTERNAL (ROOT) UNDERCUT

WHAT DOES IT LOOK LIKE?

Internal (root) undercut appears as an irregular dark density near the center of the weld image and along the edge of the root pass image.

WHAT CAUSES IT?

An internal undercut is caused by a groove in the main object stretched along the edge, either at the bottom or at the inner surface of the weld.



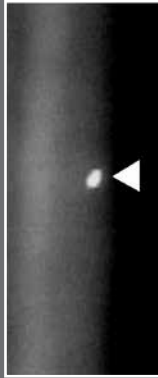
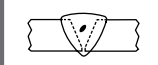
LACK OF PENETRATION

WHAT DOES IT LOOK LIKE?

Lack of penetration will appear as dark lines, either continuous or intermittent, in the center of the weld.

WHAT CAUSES IT?

There are two causes: either a lack of fusion in the root of the weld, or a gap left by the failure of the weld metal to fill the root.



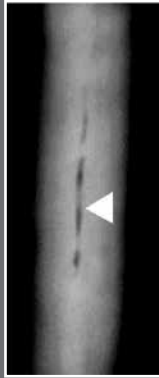
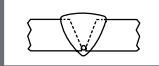
TUNGSTEN INCLUSIONS

WHAT DOES DO THEY LOOK LIKE?

Tungsten inclusions appear as random spots in the weld image that exhibit irregular lower densities.

WHAT CAUSES THEM?

They're caused when small pieces of tungsten become trapped during the welding process.



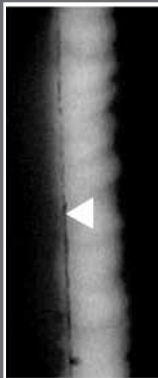
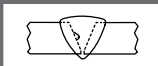
SLAG LINES

WHAT DOES DO THEY LOOK LIKE?

Slag lines are darker density lines that are irregular in width running parallel to the edge of the weld.

WHAT CAUSES THEM?

Elongated cavities that contain slag or other low-density foreign matter will produce slag lines.



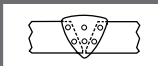
LACK OF FUSION

WHAT DOES IT LOOK LIKE?

Lack of fusion appears as an elongated single, or several parallel, darker density lines. Unlike winding and elongated slag lines, lack of fusion lines are very straight and aligned lengthwise. Sometimes darker density spots are dispersed along the lack of fusion lines.

WHAT CAUSES IT?

Lack of fusion is the result of elongated voids between the weld metal and base metal.



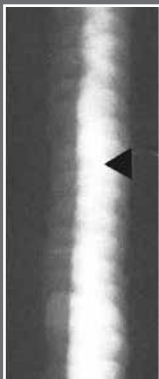
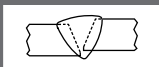
SCATTERED POROSITY

WHAT DOES IT LOOK LIKE?

Scattered porosity appears as a dark and sharply-defined shadow with rounded contours.

WHAT CAUSES IT?

Gas trapped in cavities produces scattered porosity.



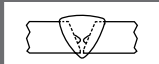
MISMATCH

WHAT DOES IT LOOK LIKE?

A mismatch is an abrupt change in film density across the entire width of the weld image.

WHAT CAUSES A MISMATCH?

Mismatches occur when plates are not aligned properly before welding.



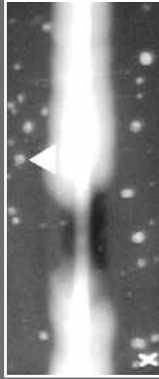
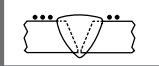
ELONGATED SLAG INCLUSIONS OR "WAGON TRACKS"

WHAT DO THEY LOOK LIKE?

Elongated slag inclusions or "wagon tracks" are darker density lines — either a single line or several in parallel — that are irregular in width.

WHAT CAUSES ELONGATED SLAG INCLUSIONS OR "WAGON TRACKS"?

These are caused when elongated cavities develop on both sides of the root, and the cavities contain slag or other foreign matter.



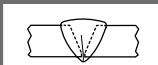
WELD SPATTER

WHAT DOES IT LOOK LIKE?

Weld spatter appears as white spots near the weld.

WHAT CAUSES THESE SPOTS?

These spots are caused by the metal particles expelled during fusion welding that do not form a part of the weld.



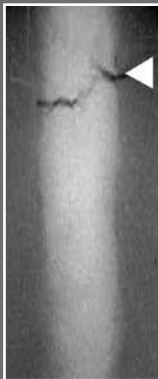
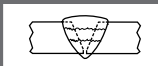
LONGITUDINAL CRACKS

WHAT DO THEY LOOK LIKE?

Longitudinal cracks are dark lines, either continuous or intermittent, along the length of a weld.

WHAT CAUSES THEM?

These cracks are discontinuities caused by fractures along the length of a weld.



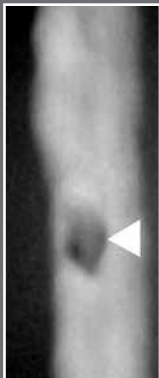
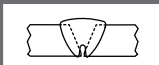
TRANSVERSE CRACKS

WHAT DO THEY LOOK LIKE?

A transverse crack is a fine dark line running across a weld image. These lines can be straight or wandering.

WHAT CAUSES THEM?

These cracks are caused by metal fractures that occur across a weld.



BURN THROUGH

WHAT DOES IT LOOK LIKE?

A burn through is a localized darker density area with fuzzy edges right in the center of the weld image.

WHAT CAUSES IT?

These are caused by a severe depression or a crater-type hole at the bottom of the weld.

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