& WELD FLAW RADIOGRAPHS
PRODUCT SHOWCASE

sonaspection
INTERNATIONAL Ltd.

Leader in Flaw Manufacture and Implant Technology

with compliments

INTRODUCTION

Question: What is NDE?

Answer: A method of detecting and evaluating flaws without damaging the item being tested.

Question: What is essential when conducting NDE training and certification?

Answer: Real flaws with accurate location and size.

Conclusion: Quality NDE Training and Certification can only be achieved if technicians have access to representative test specimens containing real flaws.

Sonaspection are market leaders in the manufacture of flawed specimens and are an authority on the production and implanting of controlled flaws to a high level of accuracy.

Sonaspection's aim is to continue to support NDE training and certification which, we believe, will ultimately lead to improved and more reliable inspection. In keeping with this Sonaspection have produced this booklet of radiographs which are designed to be used as a training aid for describing weld flaw types.

The handbook also contains information describing Sonaspection products.

Please accept this useful booklet with our compliments	This book will be either distributed on its own or it will form part of an NDE Education Kit. If it is supplied as part of an NDE Education Kit the relevant images will be indicated on the index under 'This Kit Contains".

Flawed Specimens

Sonaspection manufacture flawed specimens for all levels of NDE Training and Certification.

- NDE Educational Kits - Introduction to weld flaws.
- Flawed Specimen Sets - Basic flaw evaluation.
- Standard Flawed Specimens - Advanced flaw evaluations.
- Custom Flawed Specimens - Advanced Training and Performance Demonstration.
- NEW NDE Training Modules for in-house training.
- All products are available in the following NDE disciplines: Ultrasonic, Radiographic, Magnetic, Penetrant & Visual.

See centre fold for our full product range and back page for mailing addresses and telephone and fax numbers.

CONTENTS

ABOUT THE RADIOGRAPHS

These radiographic images are intended for training purposes only.

The 30 images have been produced from 30 different specimens containing artificially induced flaws. The flaws are intentionally obvious and generally gross in nature making it easier to learn about flaw types and compare their typical radiographic images.

Photographs have been used to give consistent tone and density and to avoid the use of a viewer, therefore making viewing consistent and convenient.

It should be noted that in order to obtain the best possible image of some flaws, particularly planar flaws, the original radiographs were produced by varying the angle of the specimens in relation to the beam of radiation. For your information the following parameters were used:

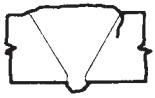
All specimens were 10mm (3/8") thick, carbon steel plate. Welding process used was either Manual Metal Arc or Tungsten Inert Gas.

The information given herein is intended for training purposes only and should therefore only be used as part of a training programme. The information is believed to be correct and reliable, but Sonaspection makes no warranties express or implied as to its accuracy and assumes no liability arising out of its use by others.

THIS KIT CONTAINS

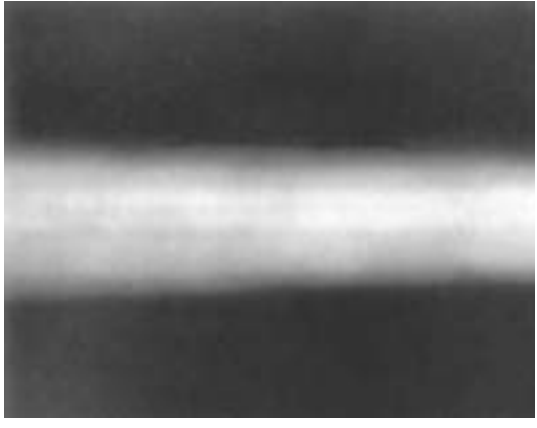
FLAW TYPE:

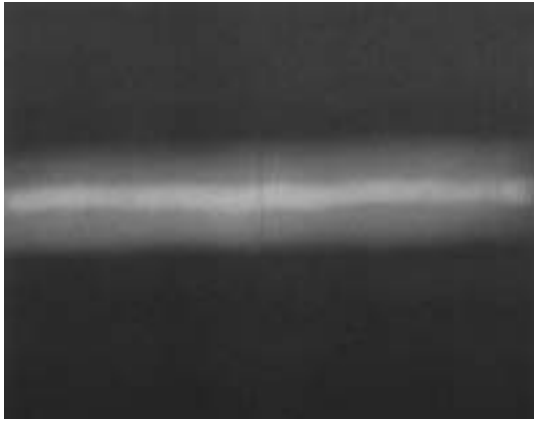
TOE CRACK



DESCRIPTION:
A crack which runs parallel to the edge of the weld cap. It may be situated in the weld metal, weld junction, heat affected zone or the parent metal.

RADIOGRAPHIC IMAGE:
Fine dark wavy lines (often discontinuous) with a feathery appearance and situated close together depending on the severity of the crack.





FLAW TYPE:

TRANSVERSE CRACK

DESCRIPTION:
A crack which runs across the main axis of the weld, sometimes extending into the heat affected zone and the parent metal.

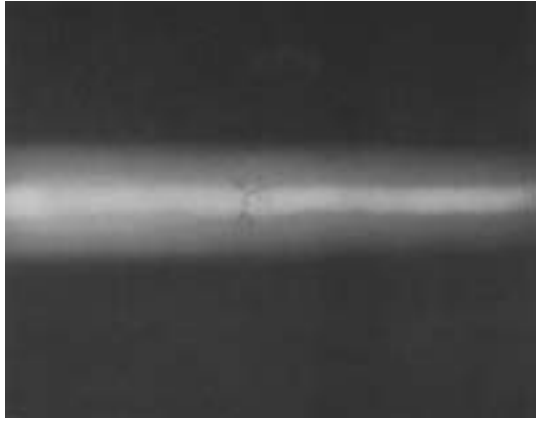
RADIOGRAPHIC IMAGE:
Fine dark wavy lines (often discontinuous) with a feathery appearance and situated close together depending on the severity of the crack.

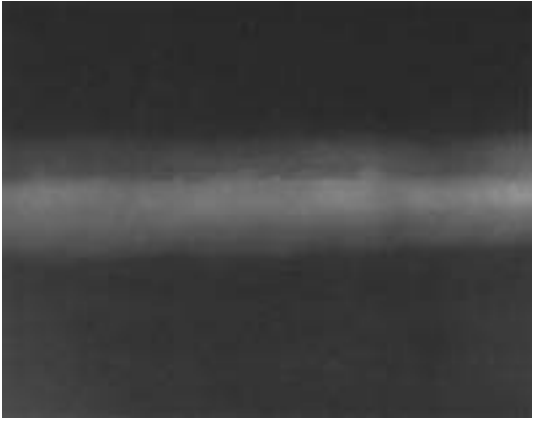
FLAW TYPE:

CRATER CRACK

DESCRIPTION:
Cracks which occur in the end crater of a weld run due to incorrect welding technique can be found either at the stop or start of a weld run.

RADIOGRAPHIC IMAGE:
Fine dark wavy lines with a feathery appearance usually emanating from the centre of the weld crater in the shape of a star. Sometimes as a single wavy line longitudinal or transverse to the crater.





FLAW TYPE:

ROOT CRACK

DESCRIPTION:
A crack which usually runs parallel with the weld run either along the centre line or at the edge of the root pass.

RADIOGRAPHIC IMAGE:
Fine dark wavy lines with a feathery appearance found along the edge or at the centre of the lighter image density of the root pass. Can be distinguished from incomplete root penetration because of the tortuous twisting effect.

FLAW TYPE:

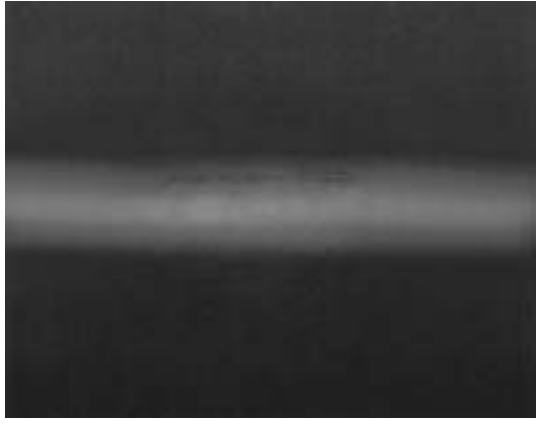
SIDE WALL CRACK

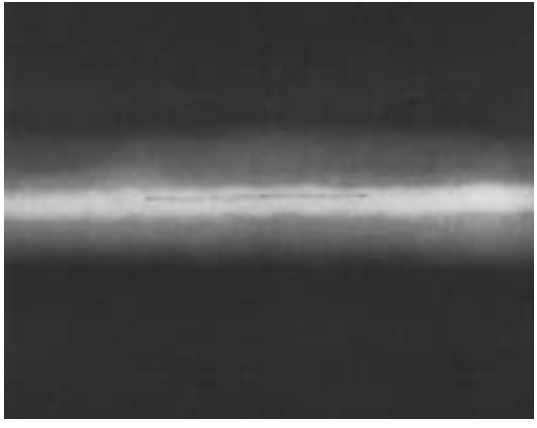
DESCRIPTION:

A crack which runs parallel to the centre line of the weld, midway between the cap and the root. It may be situated in the weld metal, heat affected zone or the parent metal.

RADIOGRAPHIC IMAGE:

Fine dark wavy lines with a feathery appearance usually seen midway between the lighter image of the root pass and the image of the outer edge of the cap weld. It can also be found to change direction.





FLAW TYPE:

CENTRE LINE CRACK - SURFACE

DESCRIPTION:
A crack which breaks the surface of the weld usually along the centre line of the weld cap sometimes changing direction diagonally.

RADIOGRAPHIC IMAGE:
Fine dark wavy lines with a feathery appearance running parallel to or along the centre line of the weld image. This defect usually has a better definition on the radiograph than sub surface cracks.

N.B. - Not to be confused with root cracks which follow the profile of the root pass.

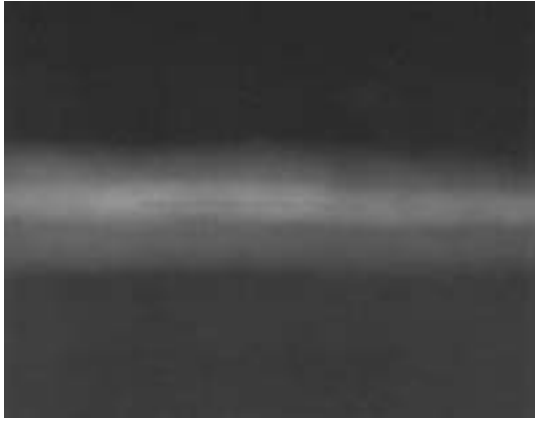
FLAW TYPE:

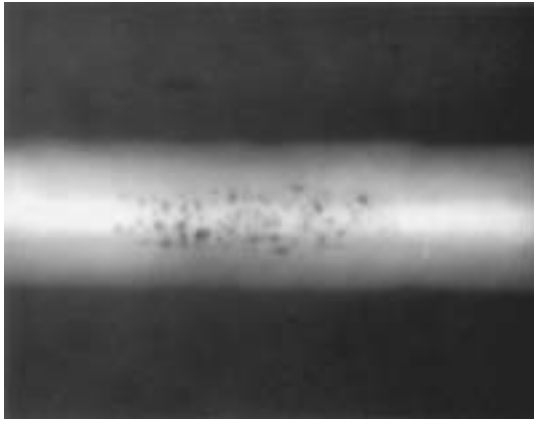
CENTRE LINE CRACK - WELD BODY

DESCRIPTION:
A crack beneath the top surface of the weld which usually runs parallel to or along the centre line of the weld, sometimes changing direction diagonally.

RADIOGRAPHIC IMAGE:
Fine dark wavy lines with a feathery appearance running parallel to or along the centre line of the weld (not quite as sharply defined as surface cracks).

N.B. - Not to be confused with root cracks which usually follow the profile of the root pass.





FLAW TYPE:

POROSITY - WELD BODY

DESCRIPTION:
Groups of gas pores formed by entrapped gas during solidification of the weld metal.

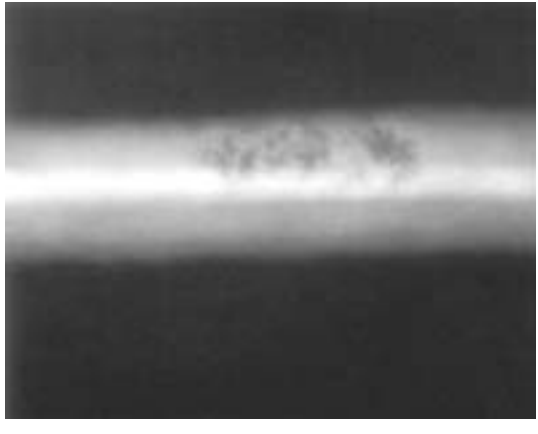
RADIOGRAPHIC IMAGE:
Gas inclusions form spherical blow holes or bubbles, their images appear as dark round spots with sharp contours randomly distributed. Porosity in the main weld body appears in the centre portion of the image of the weld.

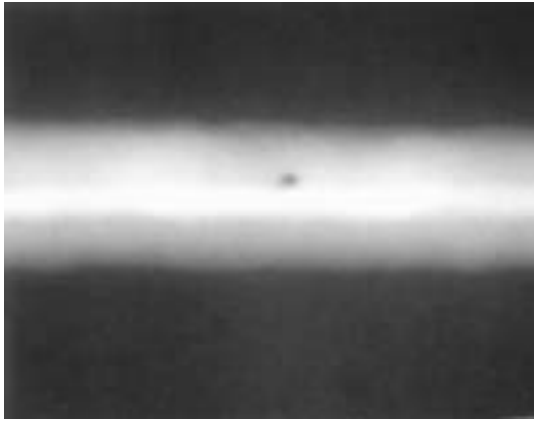
FLAW TYPE:

POROSITY - SURFACE BREAKING

DESCRIPTION:
Groups of gas pores formed by entrapped gas during solidification of the weld metal.

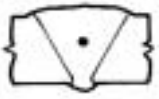
RADIOGRAPHIC IMAGE:
Gas inclusions form spherical blow holes or bubbles, their images appear as dark round spots with sharp contours randomly distributed. Surface breaking porosity usually appears spread out to the extremities of the image of the weld cap rather than more centrally distributed as when found in the weld body.





FLAW TYPE:

GAS PORE

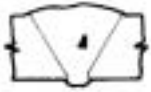


DESCRIPTION:
A cavity generally under 1.5mm in diameter, formed by gas trapped in the weld metal during solidification.

RADIOGRAPHIC IMAGE:
The image appears as a dark round spot with sharp contours.

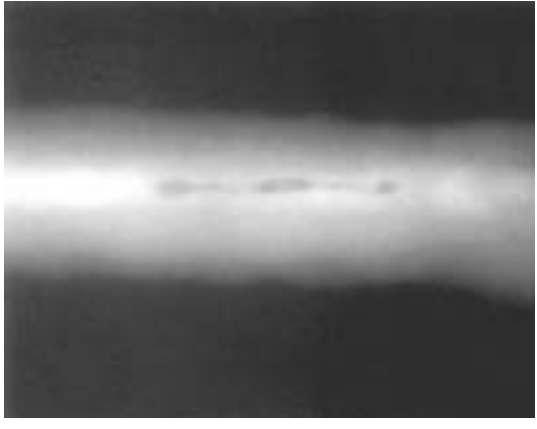
FLAW TYPE:

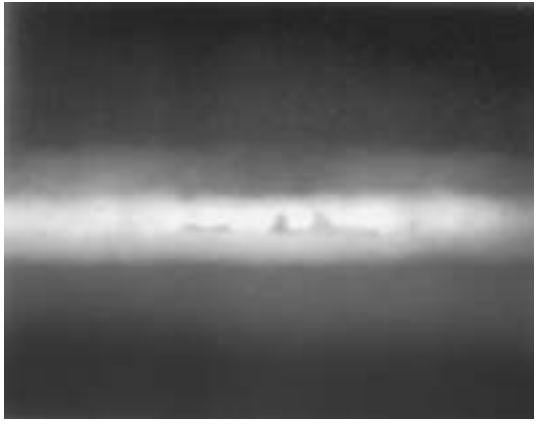
SLAG INCLUSION



DESCRIPTION:
Weld slag or the other foreign matter trapped in the weld metal. Usually formed by slag from a previous weld run that has not re-melted.

RADIOGRAPHIC IMAGE:
Dark indications with irregular shapes sometimes elongated with sharp pointed ends, usually following the line of the weld run.





FLAW TYPE:

LACK OF SIDE WALL FUSION

DESCRIPTION:
Lack of union between weld metal and parent metal at the fusion faces on the sloping sides of the weld preparation.

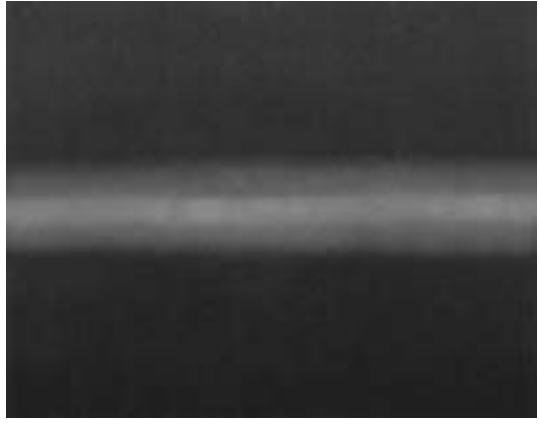
RADIOGRAPHIC IMAGE:
Indicated by a straight dark line which may be intermittent, situated at one or both sides of the weld often showing triangular areas along the length of the line pointing towards the centre of the weld.

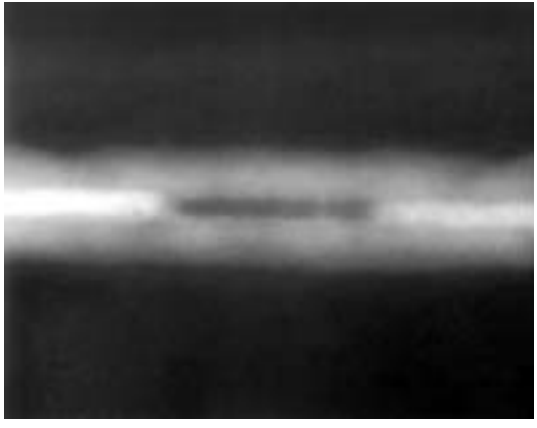
FLAW TYPE:

LACK OF ROOT FUSION

DESCRIPTION:
Lack of union between weld metal and parent metal at the root face of the weld preparation.

RADIOGRAPHIC IMAGE:
A very fine straight dark line running along one edge of the lighter image of the root penetration bead.





FLAW TYPE:

ROOT CONCAVITY

DESCRIPTION:
A shallow groove that sometimes occurs on the underside of the root pass.

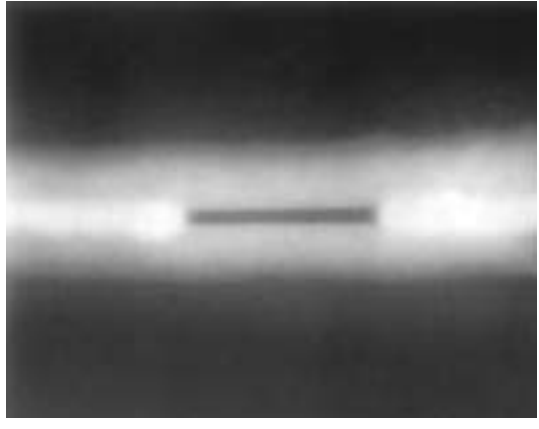
RADIOGRAPHIC IMAGE:
Indicated on the radiograph as a dark shadow intermittent between the lighter image of the root pass and usually the same width as the root penetration bead.

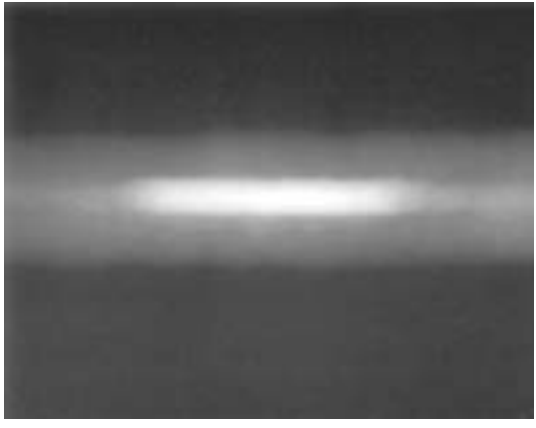
FLAW TYPE:

INCOMPLETE ROOT PENETRATION (SINGLE VEE)

DESCRIPTION:
When the weld has failed to completely penetrate through the full depth of the root faces of the weld preparation.

RADIOGRAPHIC IMAGE:
This appears in the radiograph as a continuous or intermittent straight dark line with a noticeable lack of the lighter image of the root penetration bead in these areas.





FLAW TYPE:

ROOT OVER PENETRATION

DESCRIPTION:
Excess weld metal protruding beyond the normal depth of the root penetration bead in a single vee weld.

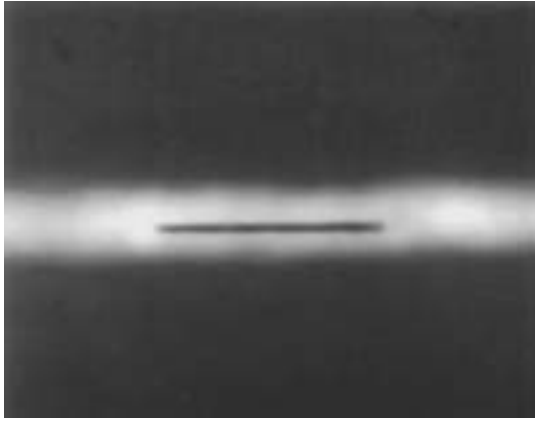
RADIOGRAPHIC IMAGE:
It appears as a broad white band superimposed on the same line as the root bead and slightly wider than the normal root bead.

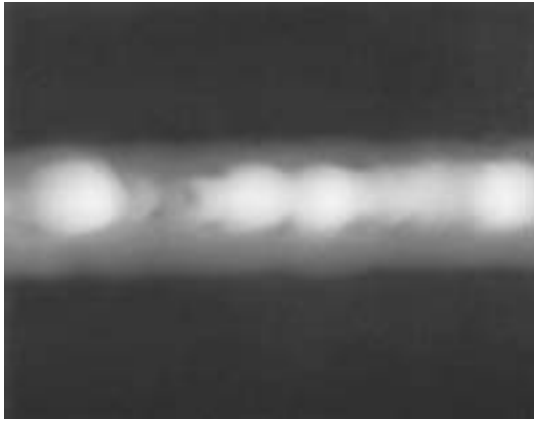
FLAW TYPE:

INCOMPLETE ROOT PENETRATION (DOUBLE VEE)

DESCRIPTION:
When the weld has failed to completely penetrate through the full depth of the root faces into the underside weld.

RADIOGRAPHIC IMAGE:
This appears in the radiograph as a continuous or intermittent dark line or shadow with straight edges. The width of the shadow depending upon the root gap.





FLAW TYPE:

IRREGULAR ROOT PENETRATION

DESCRIPTION:
Intermittent excessive weld metal protruding beyond the normal root bead combined with areas of under penetration.

RADIOGRAPHIC IMAGE:
An irregular broad light band with areas of higher density superimposed on the same line as the normal image of the root bead.

N.B. -
Over penetration - *Lighter density than normal root image.*
Under penetration *- Darker density than normal root image.*

NDE EDUCATION KITS

Training - Introducing Flaws

sonaspection INTERNATIONAL Ltd.

- Introduces weld flaw types for applicable NDE method
- Demonstrates the principals of flaw detection
- Demonstrates typical flaw response from chosen NDE method
- Introduces techniques for flaw interpretation and identification

Contact:
UK *Tel:* 44 (0) 1524 34991 *Fax:* 44 (0) 1524 381488 **USA** - *Tel:* 1 704 262 3384 *Fax:* 1 704 262 3387

sonaspection INTERNATIONAL Ltd.

FLAWED SPECIMENS SETS

Training - Basic Flaw Evaluation

- Provide training and practice for basic flaw detection
- Allows for decisions on flaw type and location
- Provide introduction to flaw sizing
- Builds confidence in flaw detection capabilities

Contact:

USA - *Tel:* 1 704 262 3384 *Fax:* 1 704 262 3387 **UK** - *Tel:* 44 (0) 1524 34991 *Fax:* 44 (0) 1524 381488

STANDARD FLAWED SPECIMENS

Training & Certification to LII
Advanced Flaw Evaluation

- Realistic size welds (minimum 12"/300mm)
- Realistic weld configurations (single vee and double vee)
- Complex weld geometries (plate, pipe, tee, nozzle node)
- Larger range of flaws
- More realistic flaw distribution

sonaspection INTERNATIONAL Ltd.

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ULTRASONIC
Calibration & Reference Blocks

sonaspection INTERNATIONAL Ltd.

Sonaspection now manufacture a range of ultrasonic calibration and reference blocks.

- ASME Reference Blocks
- IIW, IOW, BS2704 and AWS Calibration Standards
- Step Wedges
- Custom Standards: Flat and Curved Blocks, Side Drilled Holes, Flat Bottom Holes, Machined Notches, COM Slots and Notches, Welding
- Various Materials: Carbon Steel, Stainless Steel, Clad Materials, Inconel, Aluminium

Contact:

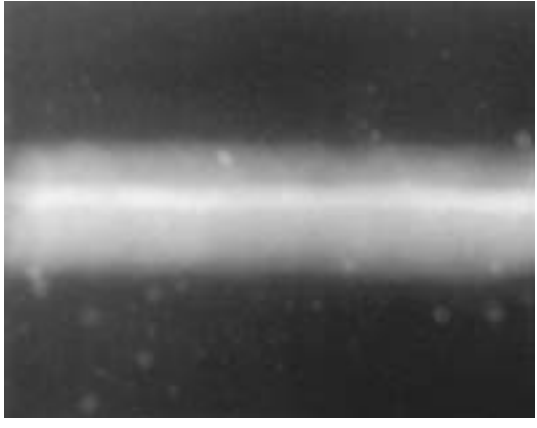
USA - *Tel:* 1 704 262 3384 *Fax:* 1 704 262 3387 **UK** - *Tel:* 44 (0) 1524 34991 *Fax:* 44 (0) 1524 381488

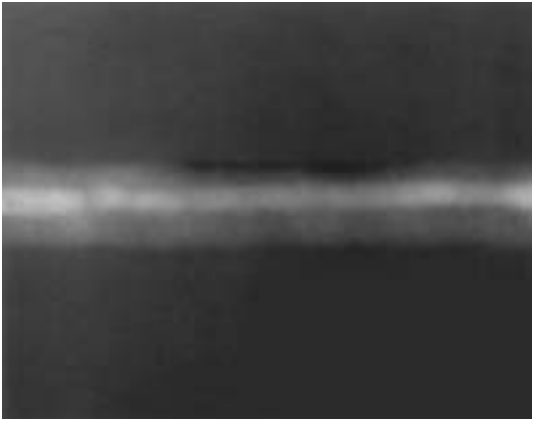
FLAW TYPE:

WELD SPATTER

DESCRIPTION:
Small droplets of weld metal deposited on the surface of the parent metal and sometimes on the surface of the weld.

RADIOGRAPHIC IMAGE:
Small round light spots on the image of the parent metal and on the image of the weld.





FLAW TYPE:

UNDERCUT

DESCRIPTION:
A fine irregular groove which runs along the toe edge of the weld run.

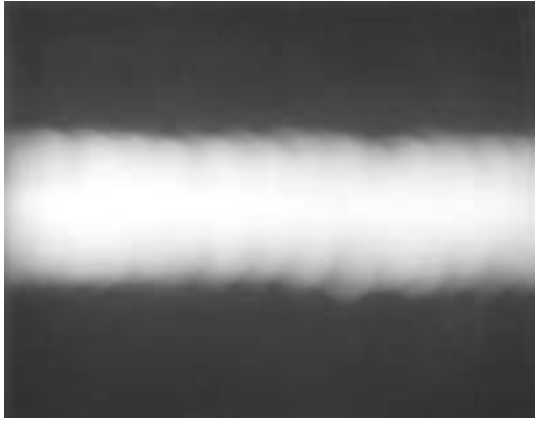
RADIOGRAPHIC IMAGE:
A sharp dark irregular line running along the toe edge of the weld run. This line normally follows the edge profile of the weld cap.

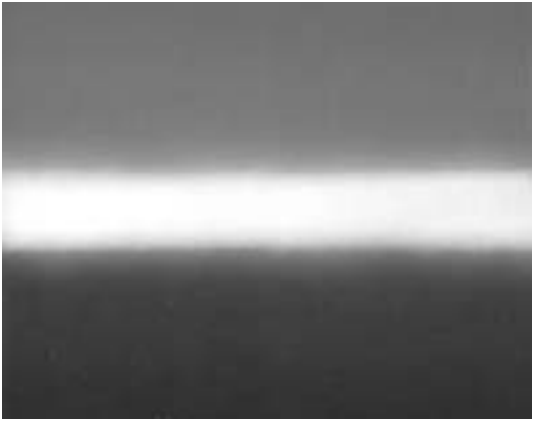
FLAW TYPE:

EXCESS CAP

DESCRIPTION:
A heavy deposit of the final weld run giving a convex shape with an abrupt change in thickness at the boundary between the parent metal and the weld reinforcement.

RADIOGRAPHIC IMAGE:
A high contrast between the density of the image of the parent metal and the image of the weld with little or no sign of the image of the root run.





FLAW TYPE:

MISMATCH

DESCRIPTION:
Variation in thickness between adjoining pieces of parent metal with the root faces aligned flush.

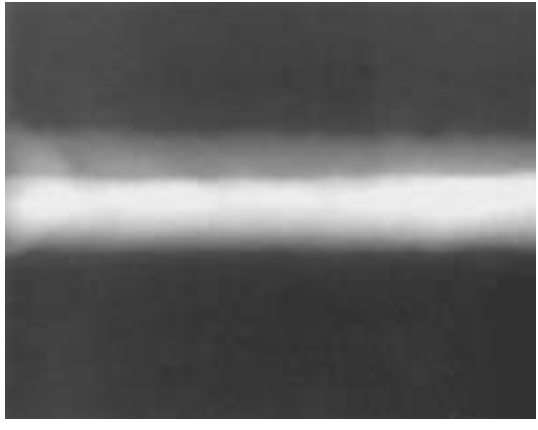
RADIOGRAPHIC IMAGE:
High contrast between the images of the parent plates. The image of the root run appears to be offset towards the thinner (dark) plate because of the low contrast of the cap weld in this zone.

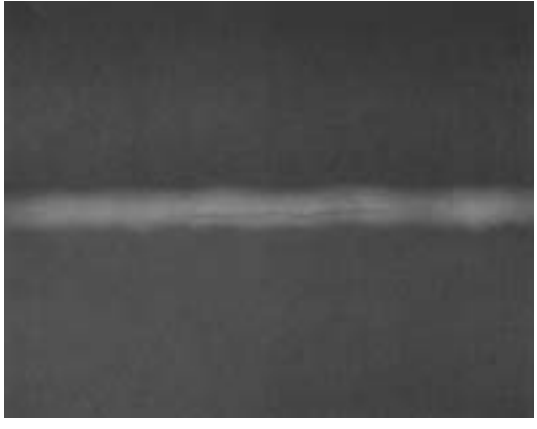
FLAW TYPE:

MISALIGNMENT

DESCRIPTION:
When the root faces are not aligned correctly on setting up of the weld joint causing a step at the top and bottom of the parent metal.

RADIOGRAPHIC IMAGE:
A sudden change in density of the image of the weld cap along the edge of the root run adjacent to the high side of the parent metal. This is due to excess reinforcement of the cap weld on the low side superimposed on the image of the root run.





FLAW TYPE:

CRACK - SUBSURFACE

DESCRIPTION:

A crack which runs parallel with the weld run sometimes changing direction along it's path. Usually caused by internal stresses on shrinkage of the weld metal during cooling.

RADIOGRAPHIC IMAGE:

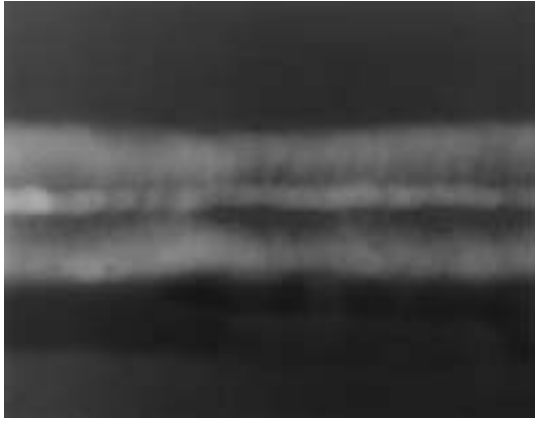
Fine dark wavy lines (often discontinuous) with a feathery appearance and situated close together depending on the severity of the crack.

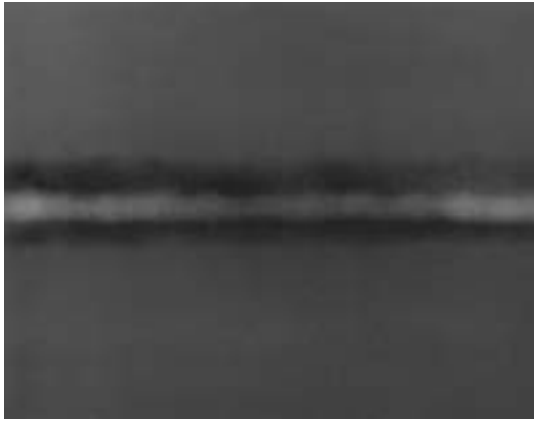
FLAW TYPE:

CONCAVE CAP

DESCRIPTION:
A shallow depression on the surface of the weld which lies below the top surface of the parent metal.

RADIOGRAPHIC IMAGE:
A broad dark band which varies in width and runs along the weld surface mostly central. It has a higher density than the image of the weld cap and the parent plate.





FLAW TYPE:

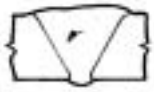
INCOMPLETE WELD FILL

DESCRIPTION:
A continuous or intermittent channel in the surface of the weld running along it's length due to insufficient weld metal.

RADIOGRAPHIC IMAGE:
It produces in the radiograph a dark band of higher density than the parent metal with straight outer edges of the weld preparation.

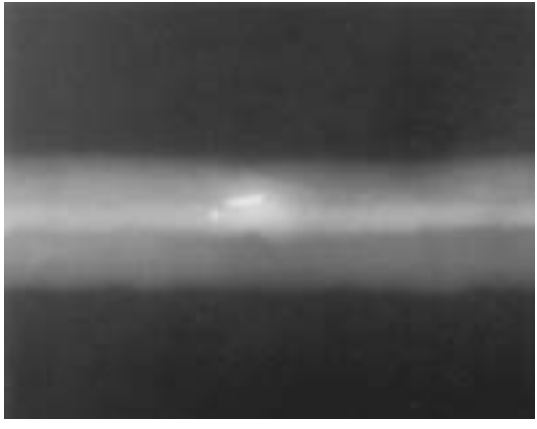
FLAW TYPE:

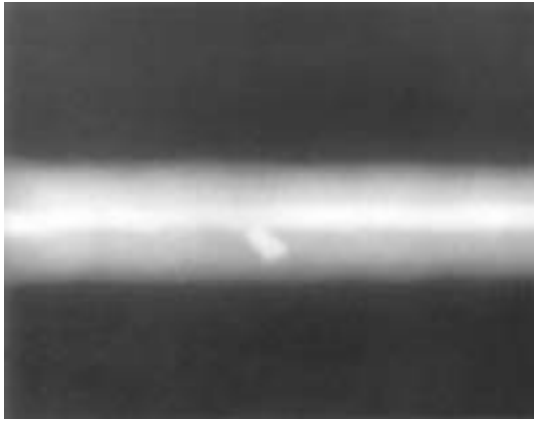
TUNGSTEN INCLUSION



DESCRIPTION:
Small droplets of tungsten included in the weld metal which are deposited from the electrode used in the tig/tag welding process.

RADIOGRAPHIC IMAGE:
It appears in the radiograph image as bright white spots with sharp outlines and can be of any shape (tungsten does not alloy with the weld metal).





FLAW TYPE:

COPPER INCLUSIONS

DESCRIPTION:

An inclusion in the weld metal of small particles of copper which are deposited from the contact tip used in mig/mag and submerged arc welding processes.

RADIOGRAPHIC IMAGE:

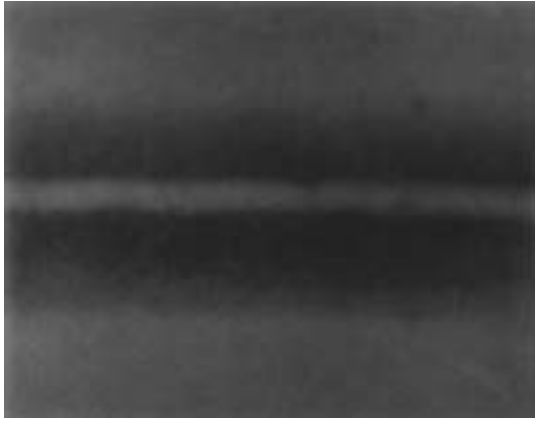
It appears in the radiograph as light spots of any shape with indistinct edges due to partial alloying with the weld metal and can be differentiated from tungsten inclusions because of this.

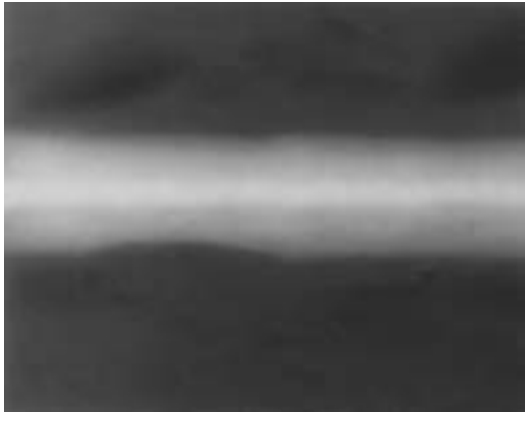
FLAW TYPE:

UNDERFLUSH (EXCESS DRESSING)

DESCRIPTION:
A reduction in metal thickness caused by the removal of the weld cap and adjacent areas to below the surface of the parent metal.

RADIOGRAPHIC IMAGE:
This imperfection produces a broad dark area wider than the usual weld cap. Sometimes accompanied by dark curved marks across the weld line caused by the curvature of the grinding wheel.





FLAW TYPE:

GRINDING, CHIPPING AND HAMMER MARKS

DESCRIPTION:

All caused by indenting the parent metal or weld metal with various tools when dressing, removing weld slag or setting distorted parts.

RADIOGRAPHIC IMAGE:

***Grinding Marks -** Dark curved areas of higher density than the parent metal or weld metal.*

***Chipping Marks -** Dark shadows of corresponding shape usually with straight or square edges.*

***Hammer Marks -** Dark crescent moon shapes with higher density at the centre of the crescent.*

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