"NON DESTRUCTIVE TESTING OF BARMER SALAYA PIPELINE"

A thesis submitted in partial fulfilment of the requirements for the Degree of
Master of Technology
(Pipeline Engineering)

By

ROHIT KUMAR GUPTA
R160207018

Under the guidance of

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College of Engineering
UPES, Dehradun

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Project Manager
Kazstroy Service Infra India Pvt. Ltd, Rajkot

College of Engineering
University of Petroleum & Energy Studies
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UNIVERSITY OF PETROLEUM & ENERGY STUDIES
(ISO 9001:2000 Certified)

CERTIFICATE

UPES Guide has ascertained quality of the project – II, Anti Plag certification etc for asserting this high quality academic activity.

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TO WHOM EVER IT MAY CONCERN

This is to certify that the work contained in this thesis titled **Non-Destructive testing of BSPL Pipeline Project** has been carried out by **Mr. Rohit Gupta** under my/our supervision and has not been submitted elsewhere for a degree.

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ABSTRACT

NDT plays a crucial role in everyday life and is necessary to assure safety and reliability. Materials, products and equipment which fail to achieve their design requirements or projected life due to undetected defects may require expensive repair or early replacement. Such defects may also be the cause of unsafe conditions or catastrophic failure, as well as loss of revenue due to unplanned plant shutdown.

Over recent years the use of NDT for pipeline girth welds has been rapid growth .On the current alliance pipeline project mechanized. NDT has been used almost exclusively for all girth welds. Non-destructive testing can be applied to each stage of an item's development, manufacture or construction. Such item's materials and welds can be examined using NDT and either accepted, rejected or repaired.

NDT is also a quality assurance production and management tool which can give impressive results when used correctly.

ACNOWLEDGEMENT

I am greatly indebted to my guides **Mr. R PARAMSHIVAM**, Project Manager, KazStroyServices Infrastructure India Pvt. Ltd., Rajkot for providing me an opportunity to work under their guidance. Their unflinching support, suggestions and directions have helped in smooth progress of the project work. They have been a constant source of inspiration in all possible ways for successful completion of my project work.

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ROHIT KUMAR GUPTA

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NOMENCLATURE

NDT	Non Destructive Testing
MPI	Magnetic Particle Inspection
DPI	Dry particle Inspection
WSI	Wet Suspension Inspection
UT	Ultrasonic Testing
LPT	Liquid Penetrant Testing
IP	Incomplete Penetration
SI	Slag Inclusion
IF	Incomplete Fusion

CHAPTER-1

INTRODUCTION

1.1 INTRODUCTION

Barmer Salaya is 24 inch skin heat traced pipeline with PUF insulation for crude oil transportation from the Mangala terminal at Barmer to the Salaya Oil Export terminal near Jamnagar. The pipeline travels 330 kilometers south from the Mangala Field to a pump station and oil take off point at Viramgam. From Viramgam the pipeline continues for 261 kilometers south west up to an Export Oil terminal at Salaya.

Another pipeline of 8 inch diameter will be laid for transporting Natural Gas from the Raageshwari Fields which will be laid alongside the 24 inch pipeline to the Salaya receiving facility for feeding the Gas generator sets located at 32 sites en route. These Gas generator sets are meant primarily for producing electricity for Skin Effect Heat Management System to maintain the fluidity of the waxy crude.

1.2 COMPANY PROFILE

KazStroyService is the leading engineering procurement and construction company in the Kazakhstan oil and gas sector. In 2006, the Company listed in the top thirty companies in Kazakhstan

KSS's value lies in its employees. Today KSS employs more than 5,000 people. Building on a core of high quality Kazakh experience and talent, we also employ leading experts from, Germany, India, Great Britain, Russia, Ukraine, Italy, New Zealand and South Africa. Based in and focused on Kazakhstan, KSS is now looking to leverage its local position and international partnerships to grow its business, both within the region and further a field.

The ongoing and constantly increasing exploitation of Kazakhstan's natural resources has provided massive growth potential, for not only upstream operators, but companies such as KSS, who provide the vital logistical services necessary to unlock the value of the Caspian region.
KSS has successfully completed over 100 construction projects in Kazakhstan and India to the highest of international standards. We have proved ourselves to be a valuable partner for such companies as Agip KCO, KPO BV, KazGerMunay, KazTransOil, KazTransGas, Intergaz Central Asia, Exploration & Production KazMunayGas, Kazakhstan – China Pipeline, Kazakhoil Aktobe and Almaty Power Consolidated. Through these projects, KSS has managed a key role in the economic development of Kazakhstan; helping to unlock is vast natural wealth. In line with the growing needs of the Kazakh market, KSS has diversified its business activities and therefore expanded its sphere of influence in the Kazakh engineering market. To its original activity of construction of oil and gas pipelines, the company has successfully added:

- Operation and maintenance of industrial sites
- Construction of oil refineries, pipelines and installations
- Civil construction
- Construction of railways
- Offshore construction and logistics

In 2007 KSS became the only Kazakh Company to join the International Pipeline and Offshore Contractors Association (IPLOCA). The company's financial growth, impressive performance indicators and first class international management are all testimony to its sound development strategy. In a resource hungry world, with predicted long-term high-energy prices, we look forward to our future with confidence.

Group Structure

KazStroy Engineering India Private Limited (**KEI**), established in January, 2006 has its corporate office located in Gurgaon, near New Delhi, India.

KEI is established to serve as a knowledge base and provides Engineering, Project coordination services and specialized inputs on project control / contract administration activities to all KSS Group projects covering cross-country Pipelines, Oil Field development, Refineries and Petrochemicals and Gas Processing plant projects in Kazakhstan and India.

KEI has a multi disciplinary setup including Process, Civil/Structural, Piping & Plant Design, Electrical & Instrumentation Engineers and Project Management & control and Procurement services and the setup is well equipped with state-of-the-art facilities to provide specialized technical support services to projects

JOINT VENTURES:-

1. Keppel Kazakhstan Limited

Keppel Kazakhstan Limited (KKL), 50 % owned by KSS, is located in Aktau and is engaged in offshore construction services for the Kashagan project. Strategically located adjacent to port Aktau, KKL has excellent access to resources and infrastructure, vital for supporting heavy industrial construction projects.

2. PSN KazStroy

PSN KazStroy - is a 50 / 50 joint venture with Aberdeen based Production Services Network, located in Atyrau. The company is engaged in the management of sea and coastal oil, gas, chemical, petrochemical and power projects, and assistance to companies, which work on a late development cycle.

3. KGNT

KSS owns 50 % of KGNT. KGNT is the leading Kazakh hydrocarbon engineering technology development company. For more than thirty years, KGNT has rendered highly skilled engineering services to the companies, engaged in field development, transportation and the processing of oil products.

4. PLK-KSS Caspian Offshore Construction LLP

"PLK-KSS Caspian Offshore Construction LLP" is a Joint Venture between "PUNJ LLOYD KAZAKHSTAN LLP" & "OGCC KAZSTROYSERVICE" for executing Offshore and shallow water Pipe laying & other construction activities associated with Oil & Gas Sector in Caspian Region.

1.3 DEFINITION OF NDT

NDT stands for non-destructive testing. In other words it is a way of testing without destroying.

In today's world where new materials are being developed, older materials and bonding methods are being subjected to higher pressures and loads, **NDT** ensures that materials can continue to operate to their highest capacity with the assurance that they will not fail within predetermined time limits

CHAPTER-2

LITERATURE REVIEW

2.1 WHAT IS NDT

Non-destructive testing is a descriptive term used for the examination of materials and components to determine surface and subsurface defects in a way that allows such materials to be examined without changing or destroying their original design or structure.

2.2 PURPOSE OF NON DESTRUCTIVE TESTING

NDT plays a crucial role in everyday life and is necessary to assure safety and reliability. Materials, products and equipment which fail to achieve their design requirements or projected life due to undetected defects may require expensive repair or early replacement. Such defects may also be the cause of unsafe conditions or catastrophic failure, as well as loss of revenue due to unplanned plant shutdown.

Non-destructive testing can be applied to each stage of an item's development, manufacture or construction. Such item's materials and welds can be examined using NDT and either accepted, rejected or repaired. NDT is also a quality assurance production and management tool which can give impressive results when used correctly.

The main purposes of performing nondestructive testing are followings.

1. To ensure product integrity, and in turn, reliability
2. To avoid failures, prevent accidents and save human life
3. To make a profit for the user
4. To ensure customer satisfaction and maintain the manufacturer's reputation;

5. To aid in better product design

6. To control manufacturing processes

7. To lower manufacturing costs

8. To maintain uniform quality level

TABLE 2.2: Objectives of nondestructive testing methods

Objectives	Attributes Measured or Detected
Discontinuites	
Surfaceanomalies	roughness, scratches, gouges, crazing, pitting, inclusions and imbedded foreign material
Surfaceconnected anomalies	cracks, porosity, pinholes, laps, seams,. folds, inclusions
Internal anomalies	cracks, separations, hot tears, cold shuts, shrinkage, voids, lack of fusion, pores, cavities, delaminations, disbonds, poor bonds, inclusions, segregations
Structure	
Microstructure	molecular structure, crystalline structure and/or strain, lattice structure, strain, dislocation, vacancy, deformation
Matrix structure	grain structure, size, orientation and phase, sinter and porosity, impregnation, filler and/or reinforcement distribution, anisotropy, heterogeneity, segregation
Smallstructural anomalies	leaks (lack of seal or through-holes), poor fit, poor contact, loose parts, loose particles, foreign objects
Grossstructural anomalies	assembly errors, misalignment, poor spacing or ordering, deformation, malformation, missing parts
Dimensions and metrology	
Displacement, position	linear measurement, separation, gap size, discontinuity size, depth, location and orientation
Dimensional variations	unevenness, nonuniformity, eccentricity, shape and contour, size and mass variations
Thickness, density	film, coating, layer, plating, wall and sheet thickness, density or thickness variations

2.3 RAPID GROWTH AND ACCEPTANCE OF NONDESTRUCTIVE TESTING

2.3.1 Increased Complexity of Modern Machinery

As an even more startling example of component reliability arithmetic, consider computers. They require complex microprocessors, chips, resistors; wire connections, counters and other parts whose functioning demands operational reliability in each component. The automobile and the electronic instrument industries are examples of complexity that could never have been achieved without parallel advances in nondestructive testing.

2.3.2 Increased Demand on Machines

As technology improves and as service requirements increase, machines are subjected to greater variations and to wider extremes of all kinds of stress, creating an.increasing demand for stronger materials. . Sufficient and proper nondestructive tests could have saved many lives.

2.3.3 Engineering Demands for Sounder Materials

Another justification for the use of nondestructive tests is the designer's demand for sounder materials. As size and weight decrease and the factor of safety is lowered, more and more emphasis is placed on better raw material control and higher quality of materials, manufacturing processes and workmanship.

An interesting fact is that a producer of raw material or of a finished product frequently does not improve quality or performance until that improvement is demanded by the customer. The pressure of the customer is transferred to implementation of improved design or manufacturing. Nondestructive testing is frequently called on to deliver this new quality level.

2.3.4 Public Demands for Greater Safety

The demands and expectations of the public for greater safety are apparent everywhere .The publicly supported activities of the National Safety Council, Underwriters Laboratories, the Environmental Protection Agency and the Federal Aviation Administration in the United States, and the work of similar agencies abroad, are only a few of the ways in which this demand for safety is expressed. It has been expressed directly by the many passengers who cancel reservations immediately following a serious aircraft accident. This demand for personal safety has been another strong force in the development of nondestructive tests.

2.3.5 Rising Costs of Failure

Aside from awards to the injured or to estates of the deceased, consider briefly other factors in the rising costs of mechanical failure. These costs are increasing for many reasons. Some important ones are:

- Greater costs of materials and labor;
- Greater costs of complex parts;
- Greater costs due to the complexity of assemblies;
- Greater probability that failure of one part will cause failure of others, due to overloads;
- Trend to lower factors of safety;
- Probability that the failure of one part will damage other parts of high value

2.4 CLASSIFICATION OF NDT METHOD:-

2.4.1 VISUAL INSPECTION

The oldest of all the methods. Components are scanned visually, sometimes with the aid of low or high power lenses, fibrescopes, cameras and video equipment, to determine surface condition.

2.4.2 EDDY CURRENT

In eddy current testing electrical currents are generated in a conductive material by an induced magnetic field. Distortions in the flow of the electric current (eddy currents) caused by imperfections or changes in a material's conductive properties will cause changes in the induced magnetic field. These changes, when detected, indicate the presence of the imperfection or change in the test material.

2.4.3 RADIOGRAPHY

Radiography uses an x-ray device or radioactive isotope as a source of radiation which passes through the material and is captured on film or digital device. After processing the film an image of varying density is obtained. Possible imperfections are identified through density changes.

2.4.4 ULTRASONICS

Ultrasonic inspection uses high frequency sound waves to detect imperfections or changes in properties within the materials. It can also be used to measure the thickness of a wide range of metallic and non-metallic materials where access from one side only is available.

2.4.5 MAGNETIC PARTICLE

Magnetic Particle inspection is used to identify surface and near surface discontinuities in ferromagnetic materials such as steel and iron. The technique uses the principle that magnetic lines of force (flux) will be distorted by the presence of a discontinuity. Discontinuities (for example, cracks) are located from the flux distortion following the application of fine magnetic particles to the area under test.

2.4.6 LIQUID PENETRANT

In Liquid Penetrant the test object or material is coated with a visible or fluorescent dye solution. The excess dye is removed from the surface and a developer which acts like a blotter is applied drawing penetrant out of imperfections open to the surface. With visible dyes, the vivid colour contrast between the penetrant and the developer is used. With fluorescent dyes an ultraviolet lamp is used to make the 'bleed out' fluoresce brightly allowing the imperfection to be seen readily

CHAPTER:-3

THEORETICAL DEVELOPMENT ON NON DESTRUTIVE TESTING METHODS

3.1 RADIGRAPHIC METHOD

3.1.1Introduction

The process of making radiograph producing an image on radio sensitive surface by radiation other than visible light.

3.2.1 Physics of radiography

3.2.1.1 Nature of Penetrating Radiation

Electromagnetic Spectrum:-

X-rays and gamma rays differ only in their source of origin. X-rays are produced by an x-ray generator and gamma radiation is the product of radioactive atoms. They are both part of the electromagnetic spectrum. They are waveforms, as are light rays, microwaves, and radio waves. X-rays and gamma rays cannot be seen, felt, or heard. They possess no charge and no mass and, therefore, are not influenced by electrical and magnetic fields and will generally travel in straight lines. However, they can be diffracted (bent) in a manner similar to light.

Both X-rays and gamma rays can be characterized by frequency, wavelength, and velocity. However, they act somewhat like a particle at times in that they occur as small "packets" of energy and are referred to as "photons." Due to their short wavelength they have more energy to pass through matter than do the other forms of energy in the electromagnetic spectrum. As they pass through matter, they are scattered and absorbed and the degree of penetration depends on the kind of matter and the energy of the rays.

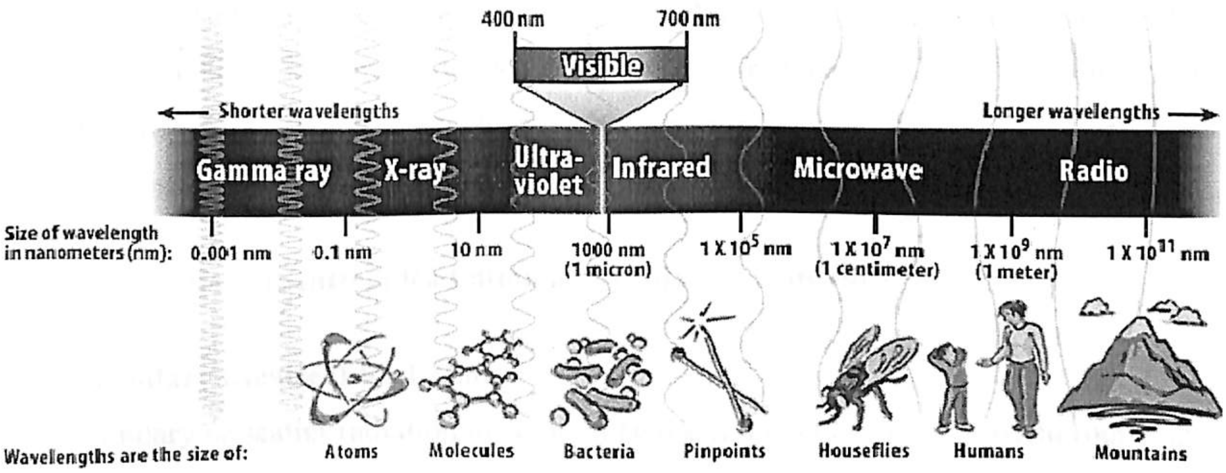


Fig-3.2.1.1-Electromagnetic Spectrum

Properties of X-Rays and Gamma Rays:-

- They are not detected by human senses.
- They travel in straight lines at the speed of light.
- Their paths cannot be changed by electrical or magnetic fields.
- They can be diffracted to a small degree at interfaces between two different materials.
- They pass through matter until they have a chance encounter with an atomic particle.
- Their degree of penetration depends on their energy and the matter they are traveling through.
- They have enough energy to ionize matter and can damage or destroy living cells.

3.2.1.2 Gamma Radiation:-

Gamma radiation is one of the three types of natural radioactivity. Gamma rays are electromagnetic radiation, like X-rays. The other two types of natural radioactivity are alpha and beta radiation, which are in the form of particles. Gamma rays are the most energetic form of electromagnetic radiation, with a very short wavelength of less than one-tenth of a nanometer. Gamma radiation is the product of radioactive atoms. Various types of penetrating radiation may be emitted from the nucleus and its surrounding electrons. Nuclides which undergo radioactive decay are called radio nuclides. Any material which contains measurable amounts of one or more radionuclides is a radioactive material.

3.2.1.3 Secondary (Scatter) Radiation and Undercut Control:-

Secondary (Scatter) Radiation:-

Secondary or scatter radiation must often be taken into consideration when roducing a radiograph. The scattered photons create a loss of contrast and definition. Often secondary radiation is thought of as radiation striking the film reflected from an object in the immediate area, such as a wall, or from the table or floor where the part is resting. Side scatter originates from walls, or objects on the source side of the film. Control of side scatter can be achieved by moving objects in the room away from the film, moving the x-ray tube to the center of the vault, or placing a collimator at the exit port, thus reducing the diverging radiation surrounding the central beam.

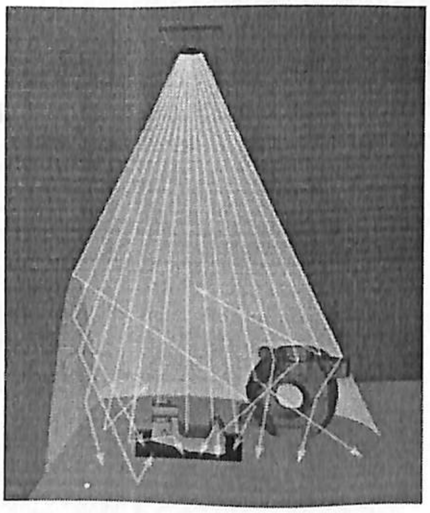


Fig No.-3.2.1.3-Scatter radiation

UNDERCUT

Another condition that must often be controlled when producing a radiograph is called undercut. Parts with holes, hollow areas, or abrupt thickness changes are likely to suffer from undercut if controls are not put in place. Undercut appears as a darkening of the radiograph in the area of the thickness transition. This results in a loss of resolution or blurring at the transition area. Undercut occurs due to scattering within the film. At the edges of a part or areas where the part transitions from thick to thin, the intensity of the radiation reaching the film is much greater than in the thicker areas of the part. The high level of radiation intensity reaching the film results in a high level of scattering within the film. It should also be noted that the faster the film speed, the more undercut that is likely to occur. Scattering from within the walls of the part also contributes to undercut, but research has shown that scattering within the film is the primary cause. Masks are used to control undercut. Sheets of lead cut to fill holes or surround the part and metallic shot and liquid absorbers are often used as masks.

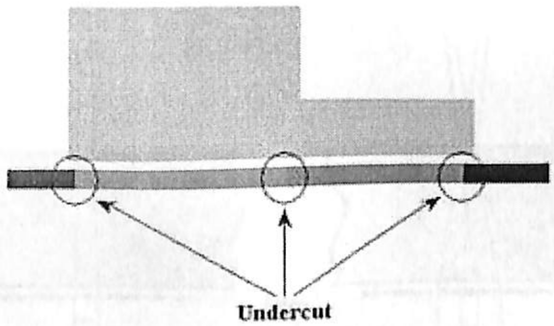


Fig No.-3.2.1.3-Undercut

3.2.1.4 GEOMETRIC UNSHARPNESS

Geometric unsharpness refers to the loss of definition that is the result of geometric factors of the radiographic equipment and setup. It occurs because the radiation does not originate from a single point but rather over an area. Consider the images below which show two sources of different sizes, the paths of the radiation from each edge of the source to each edge of the feature of the sample, the locations where this radiation will expose the film and the density profile across the film. In the first image, the radiation originates at a very small source. Since all of the radiation originates from basically the same point, very little geometric unsharpness is produced in the image. In the second image, the source size is larger and the different paths that the rays of radiation can take from their point of origin in the source causes the edges of the notch to be less defined.

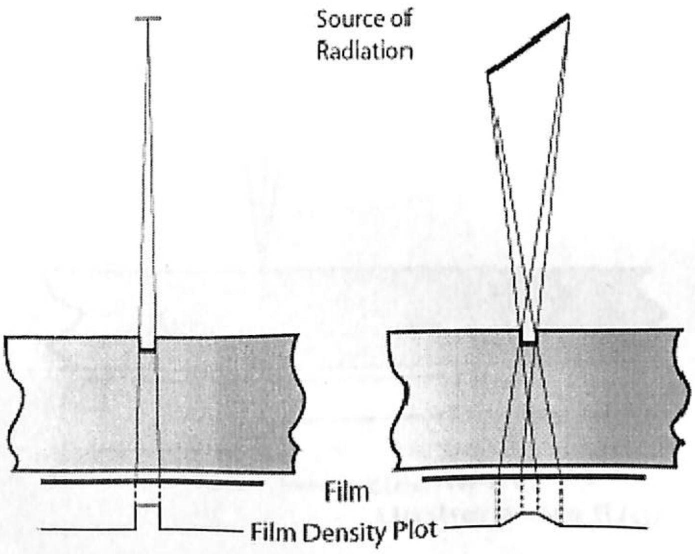


Fig-3.2.1.4-Geometric unsharpness

The three factors controlling unsharpness are source size, source to object distance, and object to detector distance. The source size is obtained by referencing manufacturers specifications for a given X-ray or gamma ray source. Industrial x-ray tubes often have focal spot sizes of 1.5 mm squared but micro focus systems have spot sizes in the 30 micron range. As the source size decreases, the geometric unsharpness also decreases. For a given size source, the unsharpness can also be decreased by increasing the source to object distance, but this comes with a reduction in radiation intensity. The object to detector distance is usually kept as small as possible to help minimize unsharpness. However, there are situations, such as when using geometric enlargement, when the object is separated from the detector, which will reduce the definition. The applet below allow the geometric unsharpness to be visualized as the source size, source to object distance, and source to detector distance are varied. The area of varying density at the edge of a feature that results due to geometric factors is called the penumbra. The penumbra is the gray area seen in the applet.

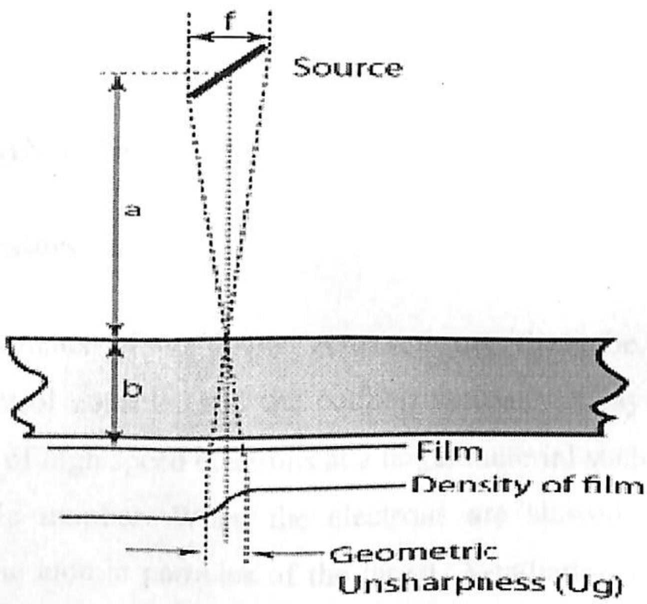


Fig-3.2.1.4-Geometric unsharpness

3.2.1.5 FILTERS IN RADIOGRAPHY

At x-ray energies, filters consist of material placed in the useful beam to absorb, preferentially, radiation based on energy level or to modify the spatial distribution of the beam. Filtration is required to absorb the lower-energy x-ray photons emitted by the tube before they reach the target. The use of filters produce a cleaner image by absorbing the lower energy x-ray photons that tend to scatter more.

The total filtration of the beam includes the inherent filtration (composed of part of the x-ray tube and tube housing) and the added filtration (thin sheets of a metal inserted in the x-ray beam). Filters are typically placed at or near the x-ray port in the direct path of the x-ray beam. Placing a thin sheet of copper between the part and the film cassette is a effective method of filtration.

3.1.3 EQUIPMENT AND MATERIAL

3.1.3.1X-ray Generators

The major components of an X-ray generator are the tube, the high voltage generator, the control console, and the cooling system. X-rays are generated by directing a stream of high speed electrons at a target material such as tungsten, which has a high atomic number. When the electrons are slowed or stopped by the interaction with the atomic particles of the target, X-radiation is produced. This is accomplished in an X-ray tube . The X-ray tube is one of the components of an X-ray generator.

The tube cathode (filament) is heated with a low-voltage current of a few amps. The filament heats up and the electrons in the wire become loosely held. A large electrical potential is created between the cathode and the anode by the high-voltage generator. Electrons that break free of the cathode are strongly attracted to the anode target. The stream of electrons between the cathode and the anode is the tube current. The tube current is measured in milliamps and is controlled by regulating the low-voltage, heating current applied to the cathode. The higher the temperature of the filament, the larger the number of electrons that leave the cathode and travel to the anode. The milliamp or current setting on the control console regulates the filament temperature, which relates to the intensity of the X-ray output.

The high-voltage between the cathode and the anode affects the speed at which the electrons travel and strike the anode. The higher the kilovoltage, the more speed and, therefore, energy the electrons have when they strike the anode. Electrons striking with more energy results in X-rays with more penetrating power. The high-voltage potential is measured in kilovolts, and this is controlled with the voltage or kilovoltage control on the control console. An increase in the kilovoltage will also result in an increase in the intensity of the radiation.

A focusing cup is used to concentrate the stream of electrons to a small area of the target called the focal spot. The focal spot size is an important factor in the system's ability to produce a sharp image. Much of the energy applied to the tube is transformed into heat at the focal spot of the anode. The anode target is commonly made from tungsten, which has a high melting point in addition to a high atomic number. However, cooling of the anode by active or passive means is necessary. Water or oil re circulating systems are often used to cool tubes. Some low power tubes are cooled simply with the use of thermally conductive materials and heat radiating fins.

It should also be noted that in order to prevent the cathode from burning up and to prevent arcing between the anode and the cathode, all of the oxygen is removed from the tube by pulling a vacuum. Some systems have external vacuum pumps to remove any oxygen that may have leaked into the tube. However, most industrial X-ray tubes simply require a warm-up procedure to be followed. This warm-up procedure carefully raises the tube current and voltage to slowly burn any of the available oxygen before the tube is operated at high power.

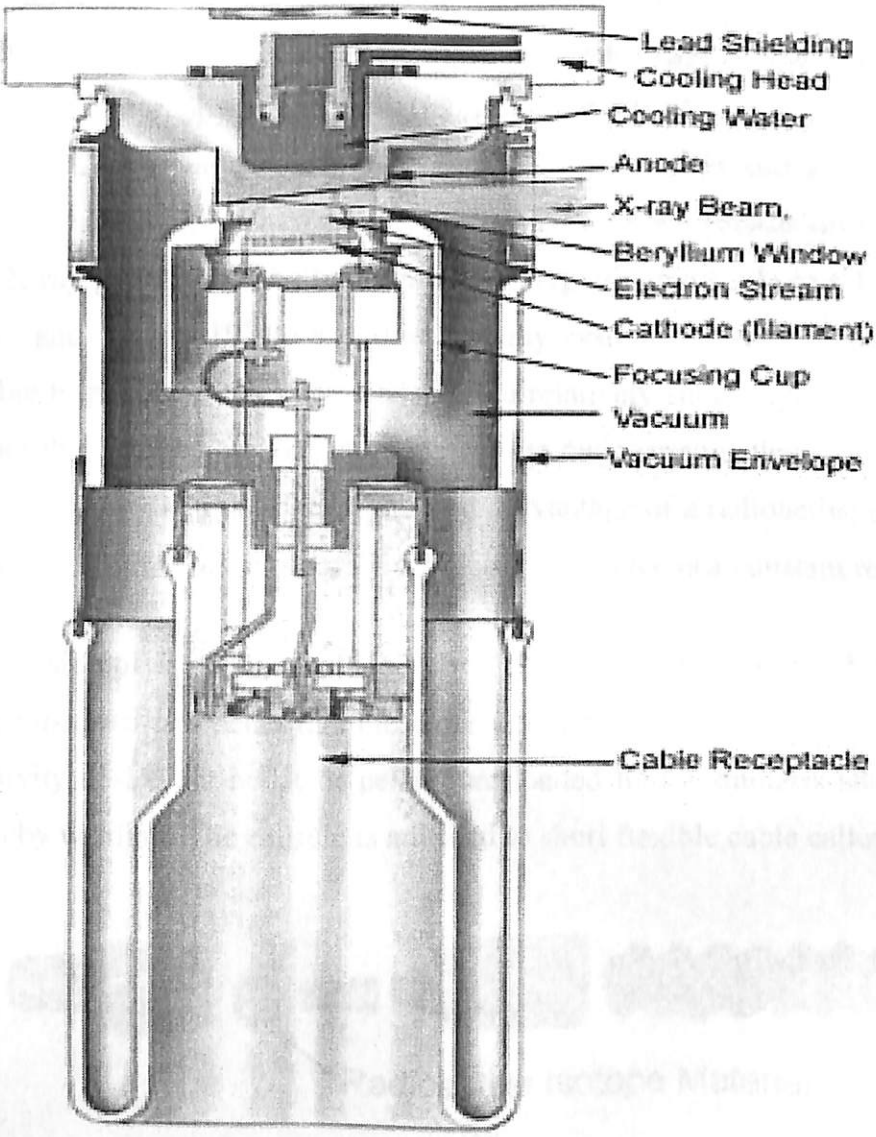


Fig no.-3.1.3.1-X-ray generator

3.1.3.2 RADIO ISOTOPE SOURCES

Manmade radioactive sources are produced by introducing an extra neutron to atoms of the source material. As the material rids itself of the neutron, energy is released in the form of gamma rays. Two of the more common industrial gamma-ray sources for industrial radiography are iridium-192 and cobalt-60. These isotopes emit radiation in a few discreet wavelengths. Cobalt-60 will emit a 1.33 and a 1.17 MeV gamma ray, and iridium-192 will emit 0.31, 0.47, and 0.60 MeV gamma rays. In comparison to an X-ray generator, cobalt-60 produces energies comparable to a 1.25 MeV X-ray system and iridium-192 to a 460 keV X-ray system. These high energies make it possible to penetrate thick materials with a relatively short exposure time. This and the fact that sources are very portable are the main reasons that gamma sources are widely used for field radiography. The disadvantage of a radioactive source is that it can never be turned off and safely managing the source is a constant responsibility.

Physical size of isotope materials varies between manufacturers, but generally an isotope material is a pellet that measures 1.5 mm x 1.5 mm. Depending on the level of activity desired, a pellet or pellets are loaded into a stainless steel capsule and sealed by welding. The capsule is attached to short flexible cable called a pigtail.

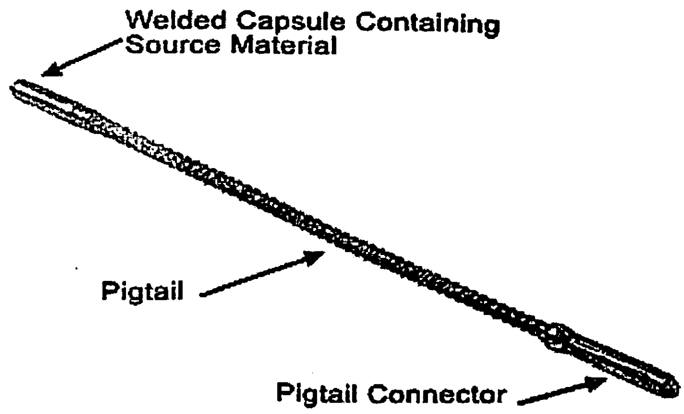


Fig no.-3.1.3.2 Radio isotope material and equipment

The source capsule and the pigtail is housed in a shielding device referred to as a exposure device or camera. Depleted uranium is often used as a shielding material for sources. The exposure device for iridium-192 and cobalt-60 sources will contain 45 pounds and 500 pounds of shielding materials, respectively. Cobalt cameras are often fixed to a trailer and transported to and from inspection sites. When the source is not being used to make an exposure, it is locked inside the exposure device.

3.1.3.3 RADIOGRAPHIC FILM

X-ray films for general radiography consist of an emulsion-gelatin containing radiation sensitive silver halide crystals, such as silver bromide or silver chloride, and a flexible, transparent, blue-tinted base. The emulsion is different from those used in other types of photography films to account for the distinct characteristics of gamma rays and x-rays, but X-ray films are sensitive to light. Usually, the emulsion is coated on both sides of the base in layers about 0.0005 inch thick. Putting emulsion on both sides of the base doubles the amount of radiation-sensitive silver halide, and thus increases the film speed. The emulsion layers are thin enough so developing, fixing, and drying can be accomplished in a reasonable time. A few of the films used for radiography only have

Film Selection

The selection of a film when radiographing any particular component depends on a number of different factors. Some are of the factors that must be considered when selecting a film and developing a radiographic technique.

1.Composition, shape, and size of the part being examined and, in some cases, its weight and location.

2.Type of radiation used, whether x-rays from an x-ray generator or gamma rays from a radioactive source.

3.Kilovoltages available with the x-ray equipment or the intensity of the gamma radiation.

4.Relative importance of high radiographic detail or quick and economical results.

3.1.4 Techniques and calibrations:-

3.1.4.1 Image Considerations

The usual objective in radiography is to produce an image showing the highest amount of detail possible. This requires careful control of a number of different variables that can affect image quality. **Radiographic sensitivity** is a measure of the quality of an image in terms of the smallest detail or discontinuity that may be detected. Radiographic sensitivity is dependant on the combined effects of two independent sets of variables. One set of variables affects the **contrast** and the other set of variables affects the **definition** of the image.

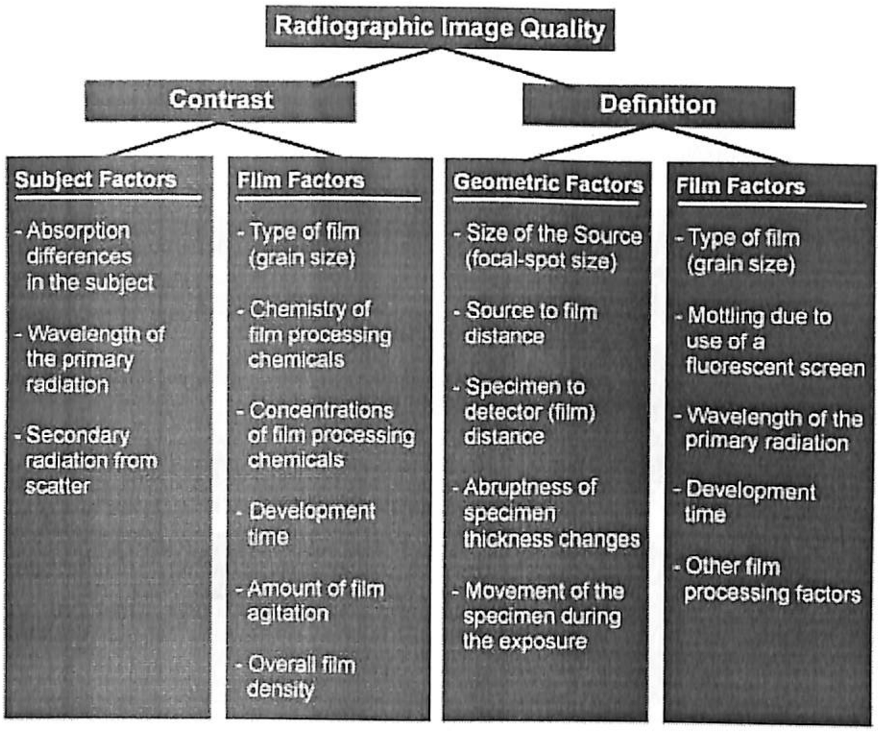


Table no.-3.1.4.1-Radiographic image quality

Radiographic contrast is the degree of density difference between two areas on a radiograph. Contrast makes it easier to distinguish features of interest, such as defects, from the surrounding area. The image to the right shows two radiographs of the same step wedge. The upper radiograph has a high level of contrast and the lower radiograph has a lower level of contrast. While they are both imaging the same change in thickness, the high contrast image uses a larger change in radiographic density to show this change. In each of the two radiographs, there is a small circle, which is of equal density in both radiographs. It is much easier to see in the high contrast radiograph.

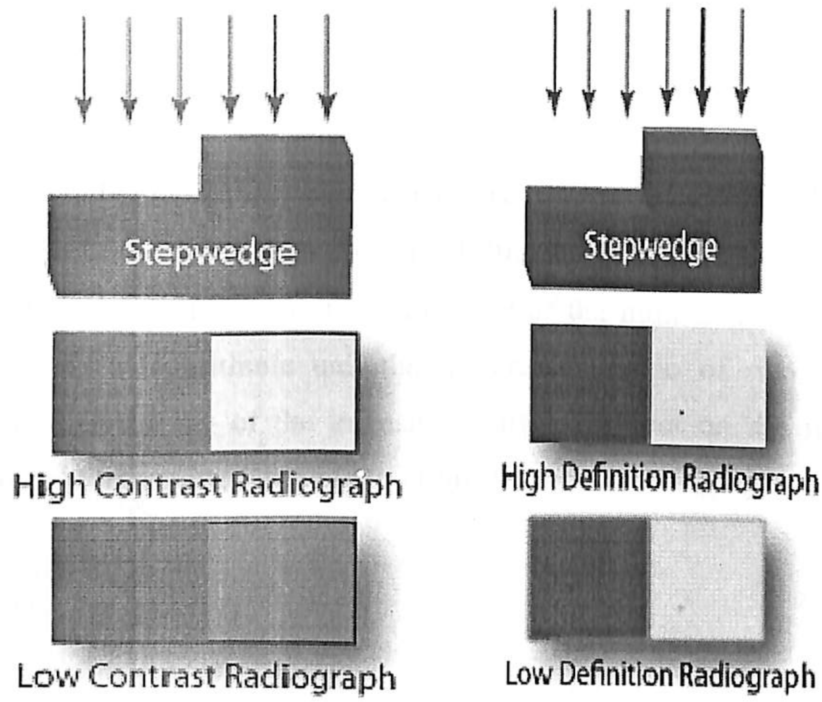


Fig no.-3.1.4.1-Image consideration

Radiographic definition is the abruptness of change in going from one area of a given radiographic density to another. Like contrast, definition also makes it easier to see features of interest, such as defects, but in a totally different way. In the image to the right, the upper radiograph has a high level of definition and the lower radiograph has a lower level of definition. In the high definition radiograph it can be seen that a change in the thickness of the stepwedge translates to an abrupt change in radiographic density. It can be seen that particularly the small circle, are much easier to see in the high definition radiograph. It can be said that the detail portrayed in the radiograph is equivalent to the physical change present in the stepwedge.In the lower image, the radiographic setup did not produce a faithful visual reproduction. The edge line between the steps is blurred. This is evidenced by the gradual transition between the high and low density areas on the radiograph.

3.1.4.2 RADIGRPHIC DENSITY

Photographic, radiographic or film density is a measure of the degree of film darkening. Technically it should be called "transmitted density" when associated with transparent-base film since it is a measure of the light transmitted through the film. Density is a logarithmic unit that describes a ratio of two measurements. Specifically, it is the log of the intensity of light incident on the film (I_0) to the intensity of light transmitted through the film (I_t).

$$D = \log \frac{I_0}{I_t}$$

Similar to the decibel, using the log of the ratio allows ratios of various sizes to be described using easy to work with numbers. The following table shows the relationship between the amount of transmitted light and the calculated film density.

Transmittance (I_0/I_t)	PercentTransmittance	Film Density Log(I_0/I_t)
1.0	100%	0
0.1	10%	1
0.01	1%	2
0.001	0.1%	3
0.0001	0.01%	4
0.00001	0.001%	5
0.000001	0.0001%	6
0.0000001	0.00001%	7

Table-3.1.4.2-Radiographic density

Contrast within a film increases with increasing density, so in general the higher the density the better. When radiographs will be digitized, densities above 4.0 are often used since digitization systems can capture and redisplay for easy viewing information from densities up to 6.0.

Film density is measured with a densitometer. A densitometer simply has a photoelectric sensor that measures the amount of light transmitted through a piece of film. The film is placed between the light source and the sensor and a density reading is produced by the instrument.

3.1.4.3 FILM PROCESSING

Radiographic film consists of a transparent, blue-tinted base coated on both sides with an emulsion. The emulsion consists of gelatin containing microscopic, radiation sensitive silver halide crystals, such as silver bromide and silver chloride. When x-rays, gamma rays or light rays strike the crystals or grains, some of the Br^- ions are liberated and captured by the Ag^+ ions. In this condition, the radiograph is said to contain a latent (hidden) image because the change in the grains is virtually undetectable, but the exposed grains are now more sensitive to reaction with the developer.

When the film is processed, it is exposed to several different chemicals solutions for controlled periods of time. Processing film basically involves the following five steps.

Development - The developing agent gives up electrons to convert the silver halide grains to metallic silver. Grains that have been exposed to the radiation develop more rapidly, but given enough time the developer will convert all the silver ions into silver metal. Proper temperature control is needed to convert exposed grains to pure silver while keeping unexposed grains as silver halide crystals.

Stopping the development - The stop bath simply stops the development process by diluting and washing the developer away with water.

- Fixing - Unexposed silver halide crystals are removed by the fixing bath. The fixer dissolves only silver halide crystals, leaving the silver metal behind.
- Washing - The film is washed with water to remove all the processing chemicals.
- Drying - The film is dried for viewing.

Manual Processing & Darkrooms

Manual processing begins with the darkroom. The darkroom should be located in a central location, adjacent to the reading room and a reasonable distance from the exposure area. For portability, darkrooms are often mounted on pickups or trailers.

Automatic Processor Evaluation

The automatic processor is the essential piece of equipment in every x-ray department. The automatic processor will reduce film processing time when compared to manual development by a factor of four. To monitor the performance of a processor, apart from optimum temperature and mechanical checks, chemical and sensitometric checks should be performed for developer and fixer. Chemical checks involve measuring the pH values of the developer and fixer as well as both replenishers. Sensitometric checks may be carried out to evaluate if the performance of films in the automatic processors is being maximized. These checks involve measurement of basic fog level, speed and average gradient made at 1° C intervals of temperature.

3.1.4.4 VIEWING RADIOGRAPH

Before beginning the evaluation of a radiograph, the viewing equipment and area should be considered. The area should be clean and free of distracting materials. Magnifying aids, masking aids, and film markers should be close at hand. Thin cotton gloves should be available and worn to prevent fingerprints on the radiograph. Ambient light levels should be low. Ambient light levels of less than 2 fc are often recommended, but subdued lighting (rather than total darkness) is preferable in the viewing room. The brightness of the surroundings should be about the same as the area of interest in the radiograph. Room illumination must be arranged so that there are no reflections from the surface of the film under examination.

Film viewers should be clean and in good working condition. There are four groups of film viewers. These include strip viewers, area viewers, spot viewers, and a combination of spot and area viewers. Film viewers should provide a source of defused, adjustable, and relativity cool light as heat from viewers can cause distortion of the radiograph. A film having a measured density of 2.0 will allow only 1% of the incident light to pass. A film containing a density of 4.0 will allow only 0.01% of the incident light to pass. With such low levels of light passing through the radiograph, the delivery of a good light source is important.

3.1.4.5 CONTROLLING RADIOGRAPHIC QUALITY

One of the methods of controlling the quality of a radiograph is through the use of image quality indicators (IQIs). IQIs, which are also referred to as penetrameters, provide a means of visually informing the film interpreter of the contrast sensitivity and definition of the radiograph. The IQI indicates that a specified amount of change in material thickness will be detectable in the radiograph, and that the radiograph has a certain level of definition so that the density changes are not lost due to unsharpness. Without such a reference point, consistency and quality could not be maintained and defects could go undetected.

3.1.4.6 EXPOSURE CALCULATION

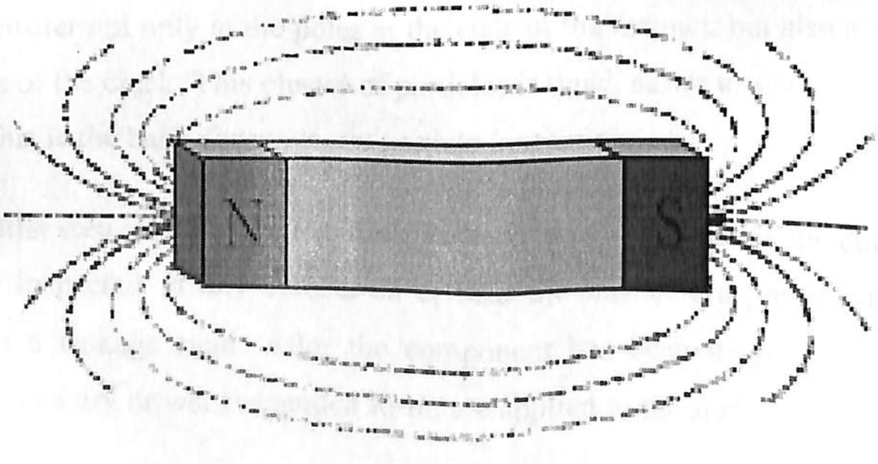
Properly exposing a radiograph is often a trial and error process, as there are many variables that affect the final radiograph. Some of the variables that affect the density of the radiograph include:

- The spectrum of radiation produced by the x-ray generator.
- The voltage potential used to generate the x-rays (KeV).
- The amperage used to generate the x-rays (mA).
- The exposure time.
- The distance between the radiation source and the film.
- The material of the component being radiographed.
- The thickness of the material that the radiation must travel through.
- The amount of scattered radiation reaching the film.
- The film being used.

3.2 MAGNETIC PARTICLE TESTING

3.2.1 Basic Principles

Magnetic particle inspection (MPI) is a relatively simple concept. It can be considered as a combination of two nondestructive testing methods: magnetic flux leakage testing and visual testing. Consider the case of a bar magnet. It has a magnetic field in and around the magnet. Any place that a magnetic line of force exits or enters the magnet is called a pole. A pole where a magnetic line of force exits the magnet is called a north pole and a pole where a line of force enters the magnet is called a south pole.



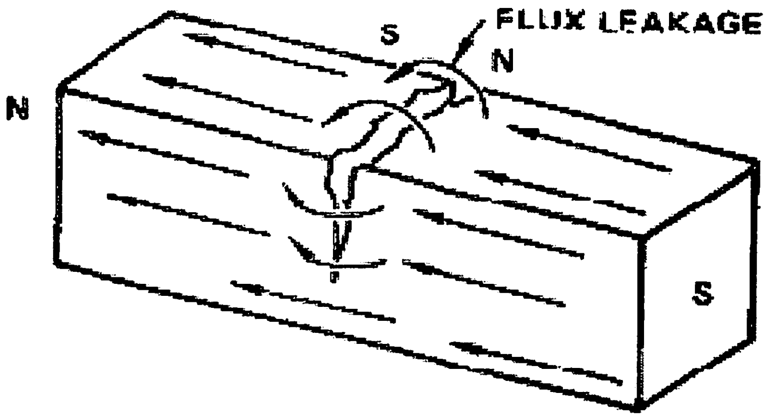


Fig no.-3.2.1 Magnetic flux

When a bar magnet is broken in the center of its length, two complete bar magnets with magnetic poles on each end of each piece will result. If the magnet is just cracked but not broken completely in two, a north and south pole will form at each edge of the crack. The magnetic field exits the north pole and reenters at the south pole. The magnetic field spreads out when it encounters the small air gap created by the crack because the air cannot support as much magnetic field per unit volume as the magnet can. When the field spreads out, it appears to leak out of the material and, thus is called a flux leakage field.

If iron particles are sprinkled on a cracked magnet, the particles will be attracted to and cluster not only at the poles at the ends of the magnet, but also at the poles at the edges of the crack. This cluster of particles is much easier to see than the actual crack and this is the basis for magnetic particle inspection.

The first step in a magnetic particle inspection is to magnetize the component that is to be inspected. If any defects on or near the surface are present, the defects will create a leakage field. After the component has been magnetized, iron particles, either in a dry or wet suspended form, are applied to the surface of the magnetized part. The particles will be attracted and cluster at the flux leakage fields, thus forming a visible indication that the inspector can detect.

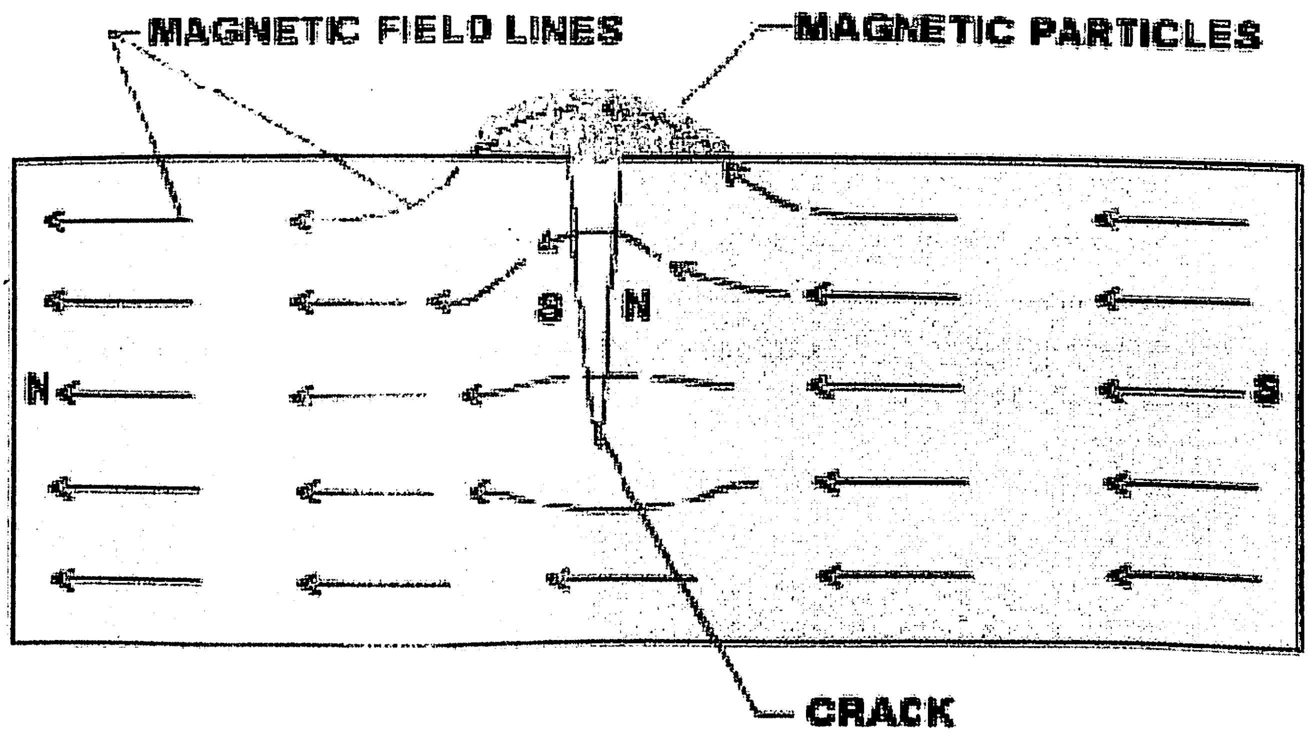


Fig no.-3.2.1 Magnetic field lines

3.2.2 TESTING PRACTICES:-

3.2.2.1 Dry Particle Inspection

In this magnetic particle testing technique, dry particles are dusted onto the surface of the test object as the item is magnetized. Dry particle inspection is well suited for the inspections conducted on rough surfaces. When an electromagnetic yoke is used, the AC or half wave DC current creates a pulsating magnetic field that provides mobility to the powder. The primary applications for dry powders are unground welds and rough as-cast surfaces.

Dry particle inspection is also used to detect shallow subsurface cracks. Dry particles with half wave DC is the best approach when inspecting for lack of root penetration in welds of thin materials. Half wave DC with prods and dry particles is commonly used when inspecting large castings for hot tears and cracks.

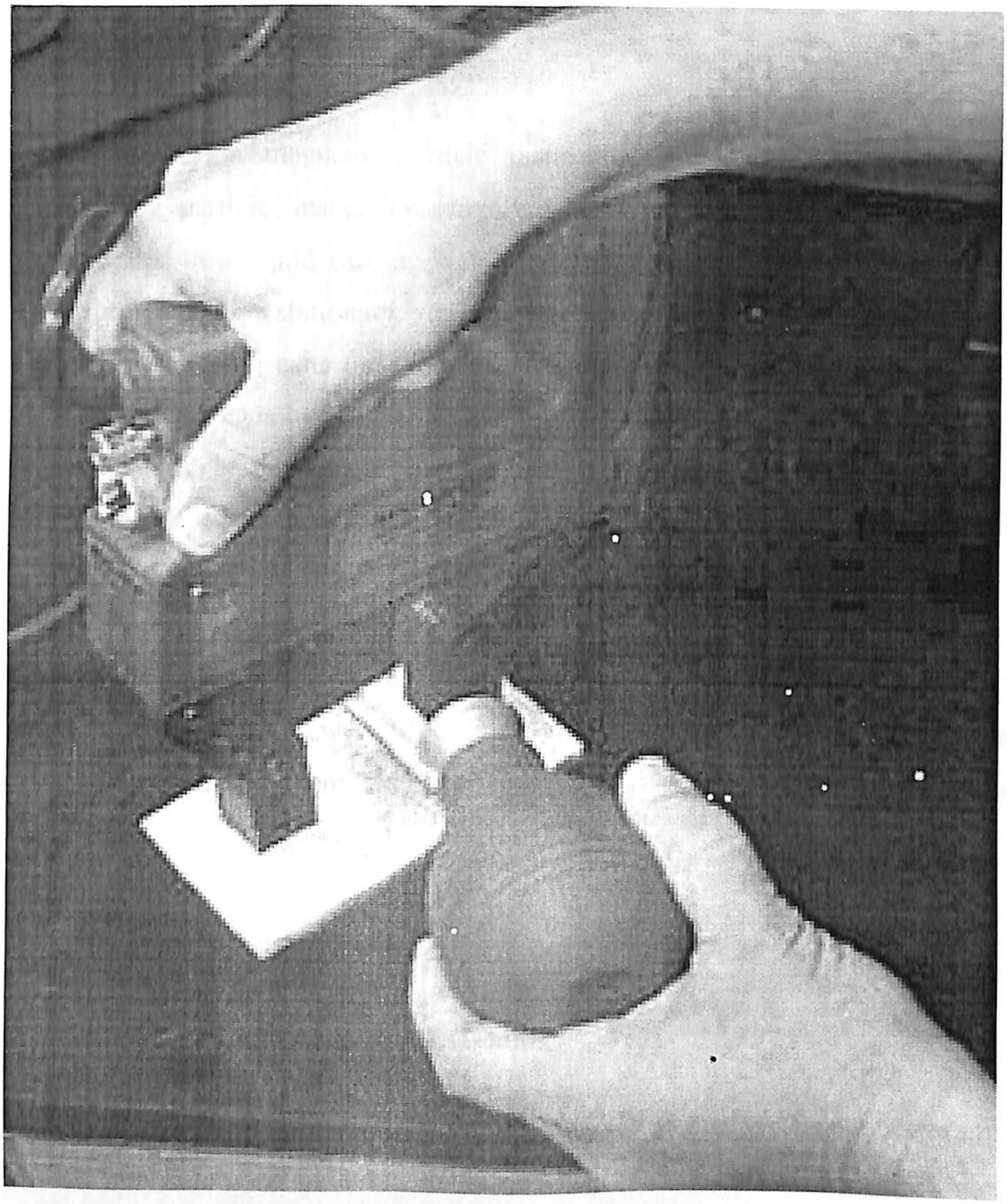


Fig no.-3.2.2.1 Dry particle inspection

3.2.2.2 Wet Suspension Inspection

Wet suspension magnetic particle inspection, more commonly known as wet magnetic particle inspection, involves applying the particles while they are suspended in a liquid carrier. Wet magnetic particle inspection is most commonly performed using a stationary, wet, horizontal inspection unit but suspensions are also available in spray cans for use with an electromagnetic yoke. A wet inspection has several advantages over a dry inspection. First, all of the surfaces of the component can be quickly and easily covered with a relatively uniform layer of particles. Second, the liquid carrier provides mobility to the particles for an extended period of time, which allows enough particles to float to small leakage fields to form a visible indication. Therefore, wet inspection is considered best for detecting very small discontinuities on smooth surfaces. On rough surfaces, however, the particles (which are much smaller in wet suspensions) can settle in the surface valleys and lose mobility, rendering them less effective than dry powders under these conditions.

3.3 ULTRASONIC TESTING

3.3.1 Basic Principles of Ultrasonic Testing

Ultrasonic Testing (UT) uses high frequency sound energy to conduct examinations and make measurements. Ultrasonic inspection can be used for flaw detection/evaluation, dimensional measurements, material characterization, and more.

A typical UT inspection system consists of several functional units, such as the pulser/receiver, transducer, and display devices. A pulser/receiver is an electronic device that can produce high voltage electrical pulses. Driven by the pulser, the transducer generates high frequency u ltrasonic energy. The sound energy is introduced and propagates through the materials in the form of waves. When there is a discontinuity (such as a crack) in the wave path, part of the energy will be reflected back from the flaw surface. The reflected wave signal is transformed into an electrical signal by the transducer and is displayed on a screen. In the applet below, the reflected signal strength is displayed versus the time from signal generation to when a echo was received. Signal travel time can be directly related to the distance that the signal traveled. From the signal, information about the reflector location, size, orientation and other features can sometimes be gained.

Ultrasonic Inspection is a very useful and versatile NDT method. It is sensitive to both surface and subsurface discontinuities.

ADVATAGES:-

- The depth of penetration for flaw detection or measurement is superior to other NDT methods.
- Only single-sided access is needed when the pulse-echo technique is used.
- It is highly accurate in determining reflector position and estimating size and shape.
- Minimal part preparation is required.
- Electronic equipment provides instantaneous results.
- Detailed images can be produced with automated systems.
- It has other uses, such as thickness measurement, in addition to flaw detection.

LIMITATIONS:-

- Surface must be accessible to transmit ultrasound.
- Skill and training is more extensive than with some other methods.
- It normally requires a coupling medium to promote the transfer of sound energy into the test specimen.
- Materials that are rough, irregular in shape, very small, exceptionally thin or not homogeneous are difficult to inspect.

- Cast iron and other coarse grained materials are difficult to inspect due to low sound transmission and high signal noise.
- Linear defects oriented parallel to the sound beam may go undetected.
- Reference standards are required for both equipment calibration and the characterization of flaws.

3.3.2 MEASUREMENT TECHNIQUE

3.3.2.1 Normal Beam Inspection

Pulse-echo ultrasonic measurements can determine the location of a discontinuity in a part or structure by accurately measuring the time required for a short ultrasonic pulse generated by a transducer to travel through a thickness of material, reflect from the back or the surface of a discontinuity, and be returned to the transducer. In most applications, this time interval is a few microseconds or less. The two-way transit time measured is divided by two to account for the down-and-back travel path and multiplied by the velocity of sound in the test material. The result is expressed in the well-known relationship

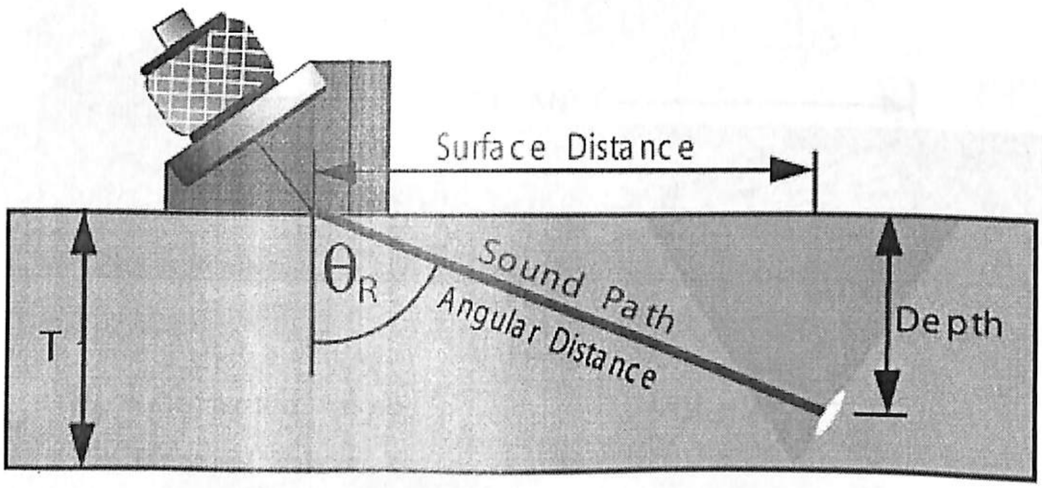
$$\mathbf{d = vt/2 \text{ or } v = 2d/t}$$

where **d** is the distance from the surface to the discontinuity in the test piece, **v** is the velocity of sound waves in the material, and **t** is the measured round-trip transit time.

Precision ultrasonic thickness gages usually operate at frequencies between 500 kHz and 100 MHz, by means of piezoelectric transducers that generate bursts of sound waves when excited by electrical pulses. A wide variety of transducers with various acoustic characteristics have been developed to meet the needs of industrial applications. Typically, lower frequencies are used to optimize penetration when measuring thick, highly attenuating or highly scattering materials, while higher frequencies will be recommended to optimize resolution in thinner, non-attenuating, non-scattering materials.

3.3.2.2 Angle Beams I

Ultrasonic weld inspections are typically performed using a straight beam transducer in conjunction with an angle beam transducer and wedge. A straight beam transducer, producing a longitudinal wave at normal incidence into the test piece, is first used to locate any laminations in or near the heat-affected zone. This is important because an angle beam transducer may not be able to provide a return signal from a laminar flaw.



θ_R = Angle of Refraction

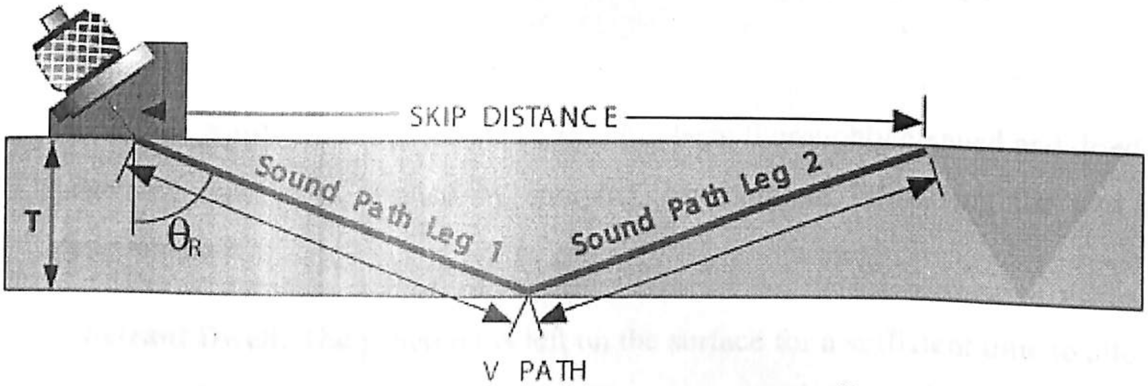
T = Material Thickness

Surface Distance = $\sin\theta_R \times$ Sound Path

Depth (1st Leg) = $\cos\theta_R \times$ Sound Path

Fig No.-3.3.2.2 Angle Beams I

The second step in the inspection involves using an angle beam transducer to inspect the actual weld. Angle beam transducers use the principles of refraction and mode conversion to produce refracted shear or longitudinal waves in the test material. [Note: Many AWS inspections are performed using refracted shear waves. However, material having a large grain structure, such as stainless steel may require refracted longitudinal waves for successful inspections.] This inspection may include the root, sidewall, crown, and heat-affected zones of a weld. The process involves scanning the surface of the material around the weldment with the transducer. This refracted sound wave will bounce off a reflector (discontinuity) in the path of the sound beam. With proper angle beam techniques, echoes returned from the weld zone may allow the operator to determine the location and type of discontinuity.



θ_R = Refracted Angle

T = Material Thickness

Skip Distance = $2T \times Tan\theta_R$

$$Leg = \frac{T}{Cos\,\theta_R}$$

$$V\text{-}Path = \frac{2T}{Cos\,\theta_R}$$

Fig No.-3.3.2.2 Angle Beams I

To determine the proper scanning area for the weld, the inspector must first calculate the location of the sound beam in the test material. Using the refracted angle, beam index point and material thickness, the V-path and skip distance of the sound beam is found. Once they have been calculated, the inspector can identify the transducer locations on the surface of the material corresponding to the crown, sidewall, and root of the weld.

3.4 PENTRATION TESTING

3.4.1 Basic Processing Steps of a Liquid Penetrant Inspection

Surface Preparation: One of the most critical steps of a liquid penetrant inspection is the surface preparation. The surface must be free of oil, grease, water, or other contaminants that may prevent penetrant from entering flaws. The sample may also require etching if mechanical operations such as machining, sanding, or grit blasting have been performed. These and other mechanical operations can smear metal over the flaw opening and prevent the penetrant from entering.

1. **Penetrant Application:** Once the surface has been thoroughly cleaned and dried, the penetrant material is applied by spraying, brushing, or immersing the part in a penetrant bath.

2. **Penetrant Dwell:** The penetrant is left on the surface for a sufficient time to allow as much penetrant as possible to be drawn from or to seep into a defect. Penetrant dwell time is the total time that the penetrant is in contact with the part surface. Dwell times are usually recommended by the penetrant producers or required by the specification being followed. The times vary depending on the application, penetrant materials used, the material, the form of the material being inspected, and the type of defect being inspected for. Minimum dwell times typically range from five to 60 minutes. Generally, there is no harm in using a longer penetrant dwell time as long as the penetrant is not allowed to dry. The ideal dwell time is often determined by experimentation and may be very specific to a particular application.

3. **Excess Penetrant Removal:** This is the most delicate part of the inspection procedure because the excess penetrant must be removed from the surface of the sample while removing as little penetrant as possible from defects. Depending on the penetrant system used, this step may involve cleaning with a solvent, direct rinsing with water, or first treating the part with an emulsifier and then rinsing with water.

4. **Developer Application:** A thin layer of developer is then applied to the sample to draw penetrant trapped in flaws back to the surface where it will be visible. Developers come in a variety of forms that may be applied by dusting (dry powdered), dipping, or spraying (wet developers).

5. **Indication Development:** The developer is allowed to stand on the part surface for a period of time sufficient to permit the extraction of the trapped penetrant out of any surface flaws. This development time is usually a minimum of 10 minutes. Significantly longer times may be necessary for tight cracks.

6. **Inspection:** Inspection is then performed under appropriate lighting to detect indications from any flaws which may be present.

7. **Clean Surface:** The final step in the process is to thoroughly clean the part surface to remove the developer from the parts that were found to be acceptable.

3.4.2 Penetrant Testing Materials

To perform well, a penetrant must possess a number of important characteristics. A penetrant must:

- Spread easily over the surface of the material being inspected to provide complete and even coverage.
- Be drawn into surface breaking defects by capillary action.
- Remain in the defect but remove easily from the surface of the part.
- Remain fluid so it can be drawn back to the surface of the part through the drying and developing steps.
- Be highly visible or fluoresce brightly to produce easy to see indications.
- Not be harmful to the material being tested or the inspector.

Penetrant materials come in two basic types. These types are listed below:

- Type 1 - Fluorescent Penetrants
- Type 2 - Visible Penetrants

Fluorescent penetrants contain a dye or several dyes that fluoresce when exposed to ultraviolet radiation. Visible penetrants contain a red dye that provides high contrast against the white developer background. Fluorescent penetrant systems are more sensitive than visible penetrant systems because the eye is drawn to the glow of the fluorescing indication. However, visible penetrants do not require a darkened area and an ultraviolet light in order to make an inspection. Visible penetrants are also less vulnerable to contamination from things such as cleaning fluid that can significantly reduce the strength of a fluorescent indication.

Penetrants are then classified by the method used to remove the excess penetrant from the part. The four methods are listed below:

- Method A - Water Washable
- Method B - Post-Emulsifiable, Lipophilic
- Method C - Solvent Removable
- Method D - Post-Emulsifiable, Hydrophilic

CHAPTER-5

ANALYSIS ON THE RADIOGRAPHY

RADIOGRAPH INTERPERTAION WELD

In addition to producing high quality radiographs, the radiographer must also be skilled in radiographic interpretation. Interpretation of radiographs takes place in three basic steps:

a. Detection
b. Interpretation
c. Evaluation

All of these steps make use of the radiographer's visual acuity. Visual acuity is the ability to resolve a spatial pattern in an image. The ability of an individual to detect discontinuities in radiography is also affected by the lighting condition in the place of viewing, and the experience level for recognizing various features in the image.

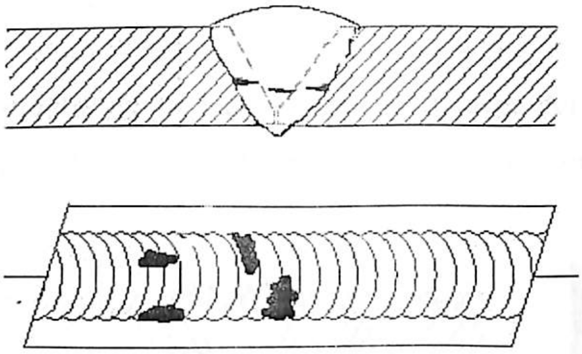
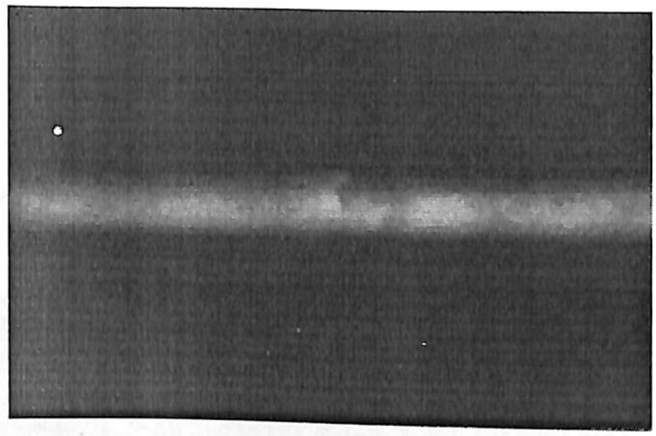
Discontinuities

Discontinuities are interruptions in the typical structure of a material. These interruptions may occur in the base metal, weld material or "heat affected" zones. Discontinuities, which do not meet the requirements of the codes or specifications used to invoke and control an inspection, are referred to as defects.

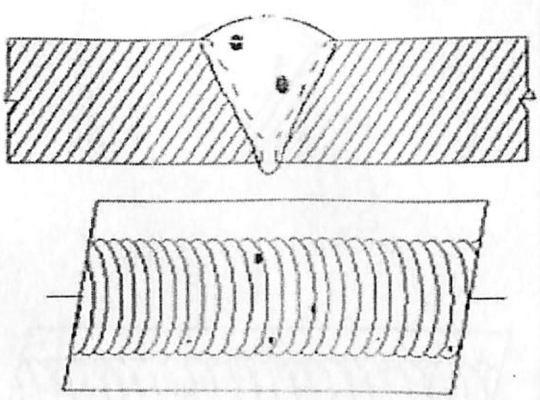
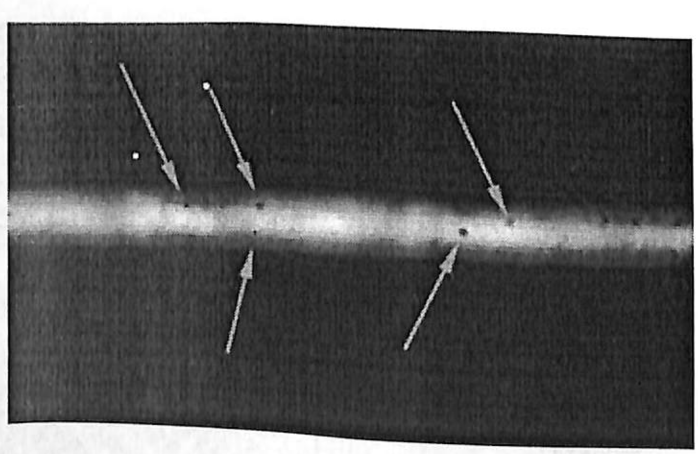
General Welding Discontinuities

The following discontinuities are typical of all types of welding.

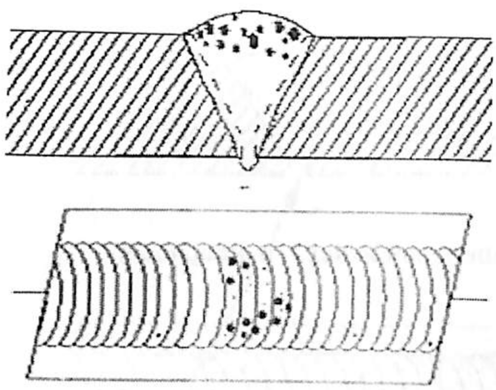
Cold lap is a condition where the weld filler metal does not properly fuse with the base metal or the previous weld pass material (interpass cold lap). The arc does not melt the base metal sufficiently and causes the slightly molten puddle to flow into the base material without bonding.

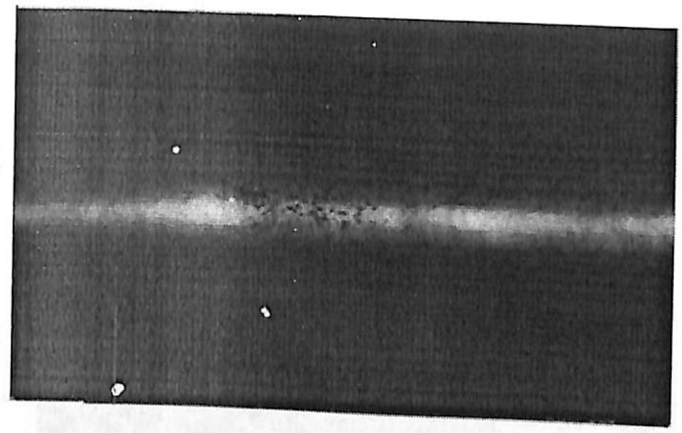
 

Porosity is the result of gas entrapment in the solidifying metal. Porosity can take many shapes on a radiograph but often appears as dark round or irregular spots or specks appearing singularly, in clusters, or in rows. Sometimes, porosity is elongated and may appear to have a tail. This is the result of gas attempting to escape while the metal is still in a liquid state and is called wormhole porosity. All porosity is a void in the material and it will have a higher radiographic density than the surrounding area.

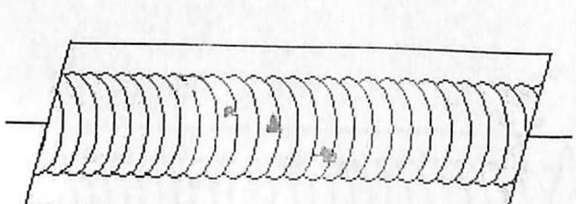
 

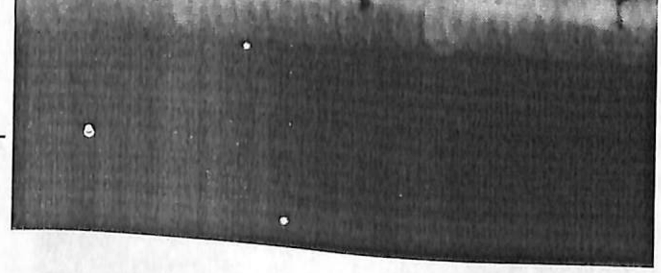
Cluster porosity is caused when flux coated electrodes are contaminated with moisture. The moisture turns into a gas when heated and becomes trapped in the weld during the welding process. Cluster porosity appear just like regular porosity in the radiograph but the indications will be grouped close together.



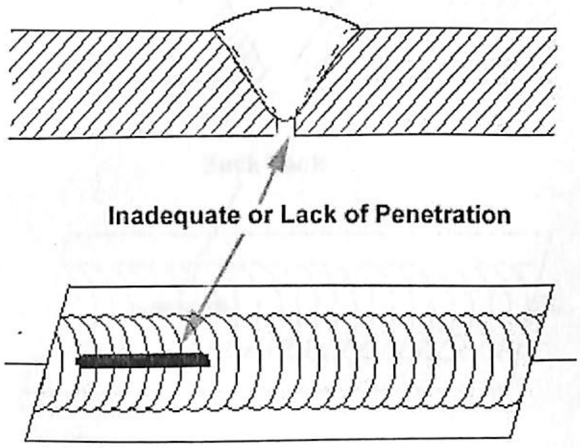


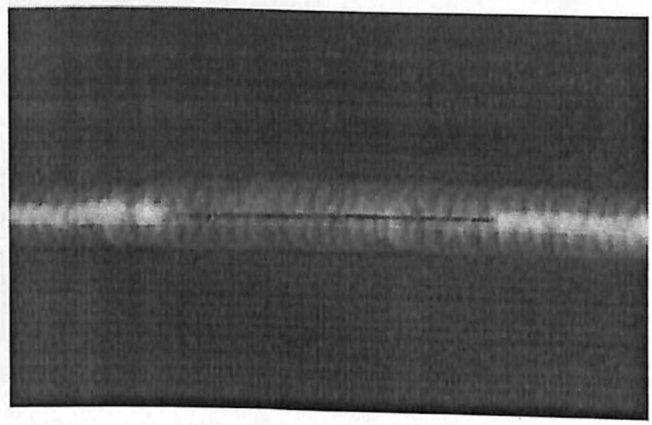
Slag inclusions are nonmetallic solid material entrapped in weld metal or between weld and base metal. In a radiograph, dark, jagged asymmetrical shapes within the weld or along the weld joint areas are indicative of slag inclusions.



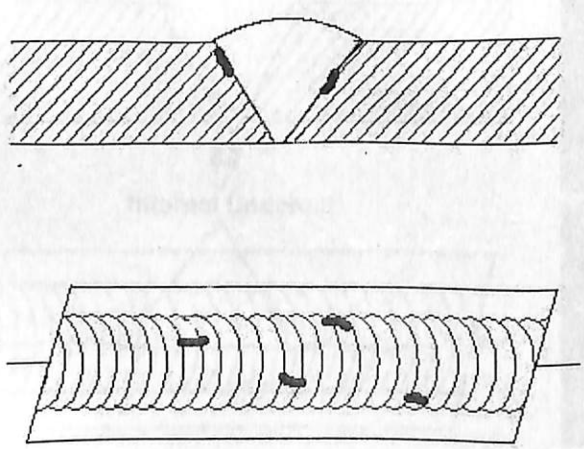


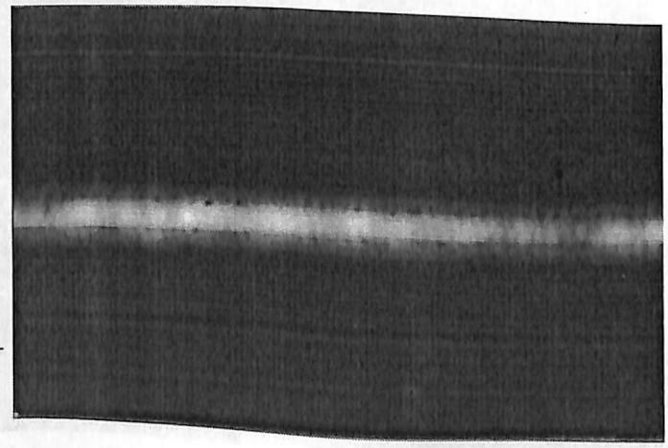
Incomplete penetration (IP) or lack of penetration (LOP) occurs when the weld metal fails to penetrate the joint. It is one of the most objectionable weld discontinuities. Lack of penetration allows a natural stress riser from which a crack may propagate. The appearance on a radiograph is a dark area with well-defined, straight edges that follows the land or root face down the center of the weldment.



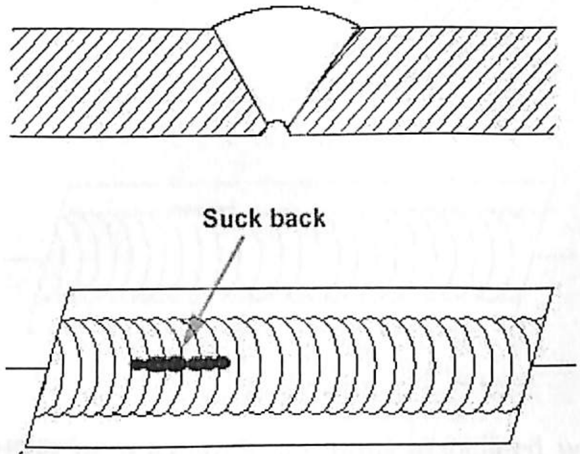


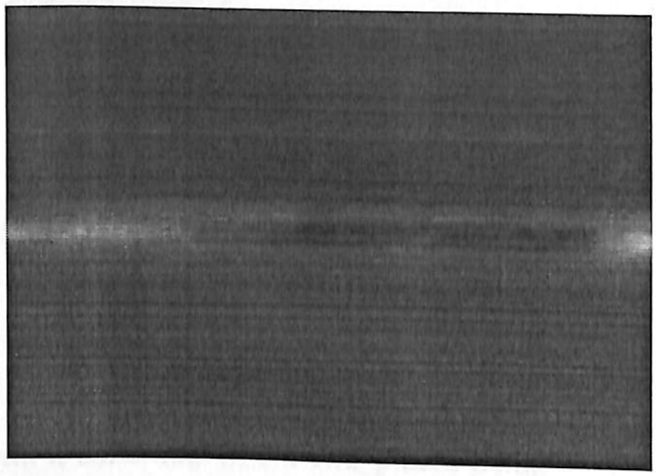
Incomplete fusion is a condition where the weld filler metal does not properly fuse with the base metal. Appearance on radiograph: usually appears as a dark line or lines oriented in the direction of the weld seam along the weld preparation or joining area.



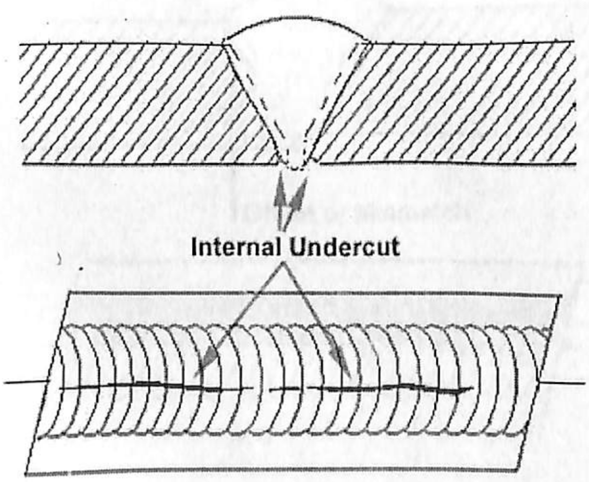


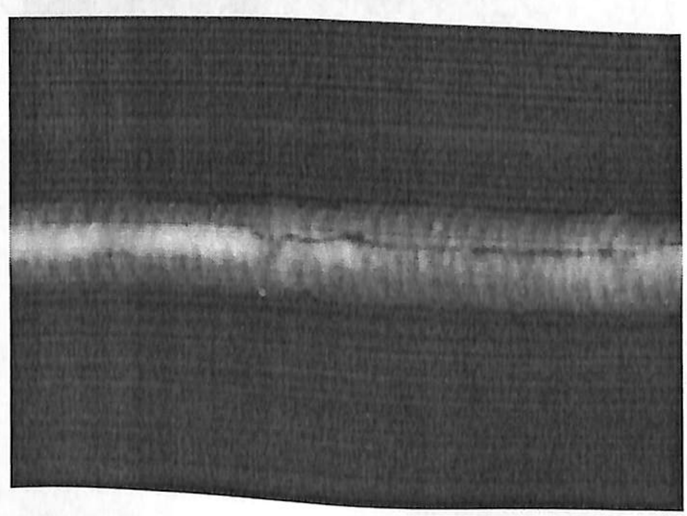
Internal concavity or suck back is a condition where the weld metal has contracted as it cools and has been drawn up into the root of the weld. On a radiograph it looks similar to a lack of penetration but the line has irregular edges and it is often quite wide in the center of the weld image.



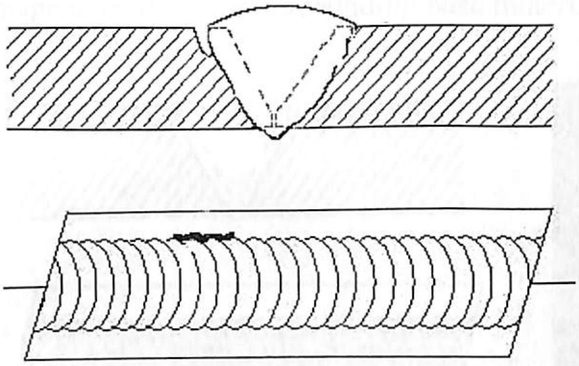


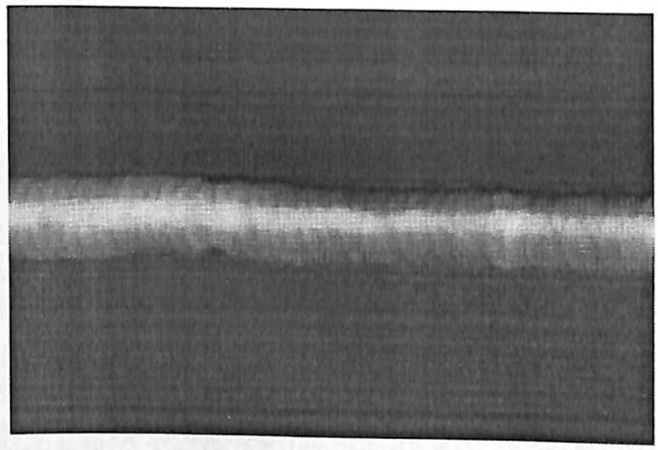
Internal or root undercut is an erosion of the base metal next to the root of the weld. In the radiographic image it appears as a dark irregular line offset from the centerline of the weldment. Undercutting is not as straight edged as LOP because it does not follow a ground edge.



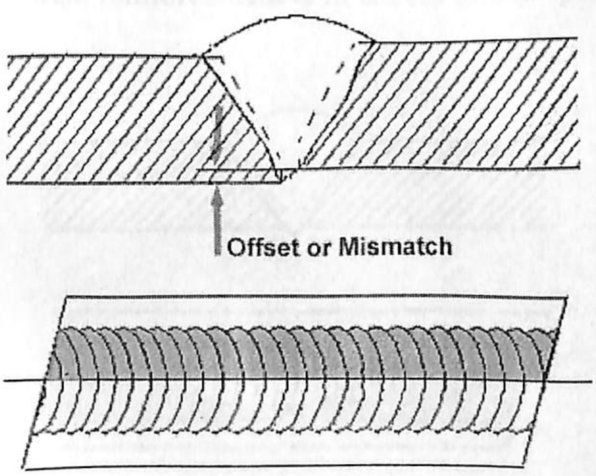


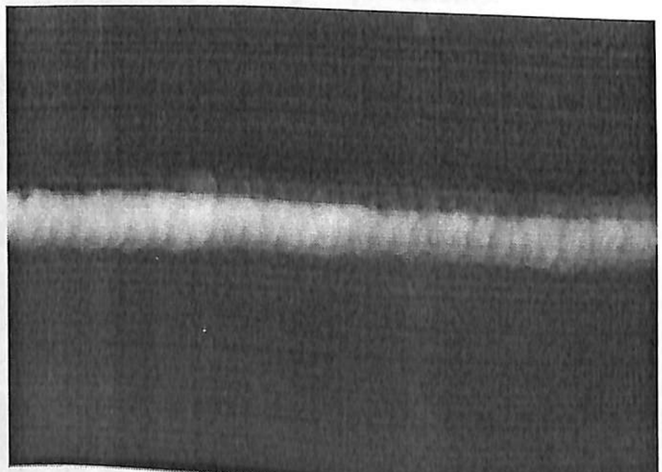
External or crown undercut is an erosion of the base metal next to the crown of the weld. In the radiograph, it appears as a dark irregular line along the outside edge of the weld area.



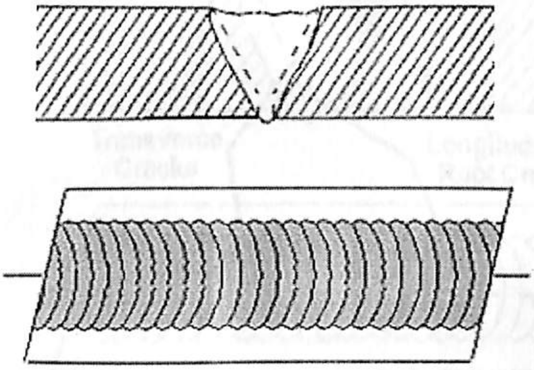
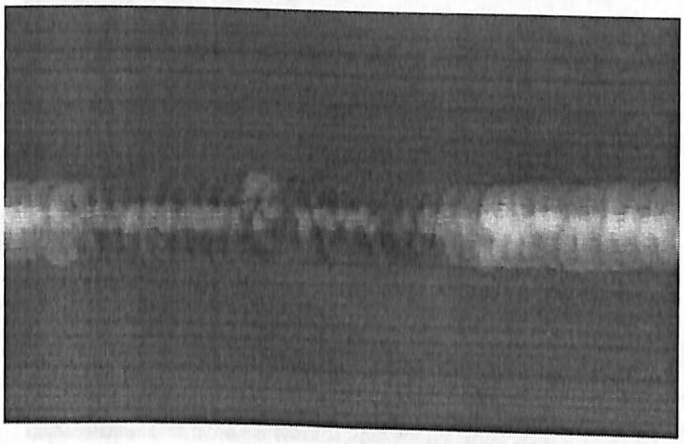


Offset or mismatch are terms associated with a condition where two pieces being welded together are not properly aligned. The radiographic image shows a noticeable difference in density between the two pieces. The difference in density is caused by the difference in material thickness. The dark, straight line is caused by the failure of the weld metal to fuse with the land area.

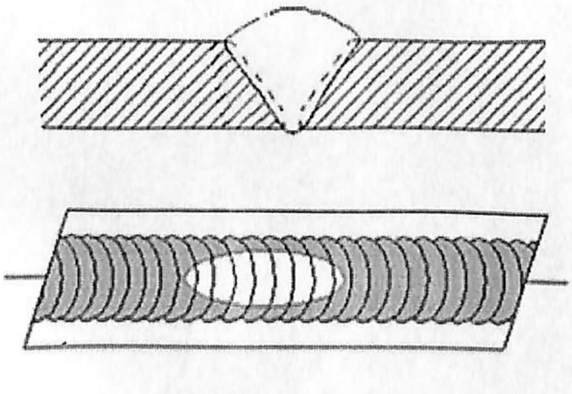
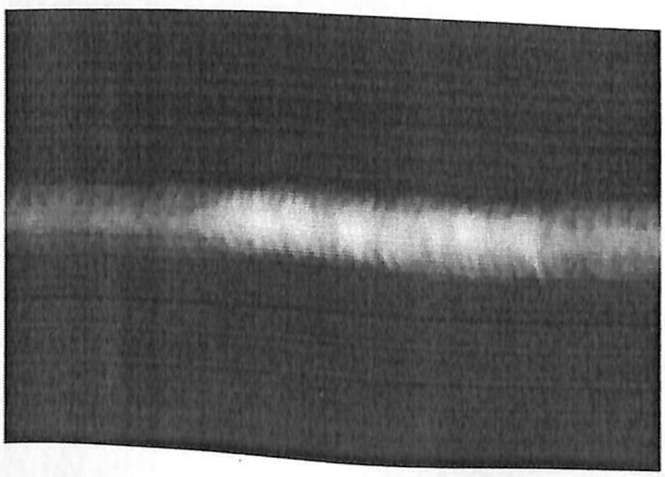




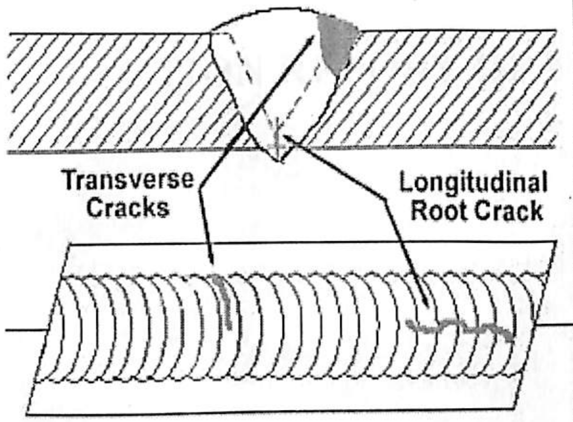
Inadequate weld reinforcement is an area of a weld where the thickness of weld metal deposited is less than the thickness of the base material. It is very easy to determine by radiograph if the weld has inadequate reinforcement, because the image density in the area of suspected inadequacy will be higher (darker) than the image density of the surrounding base material.

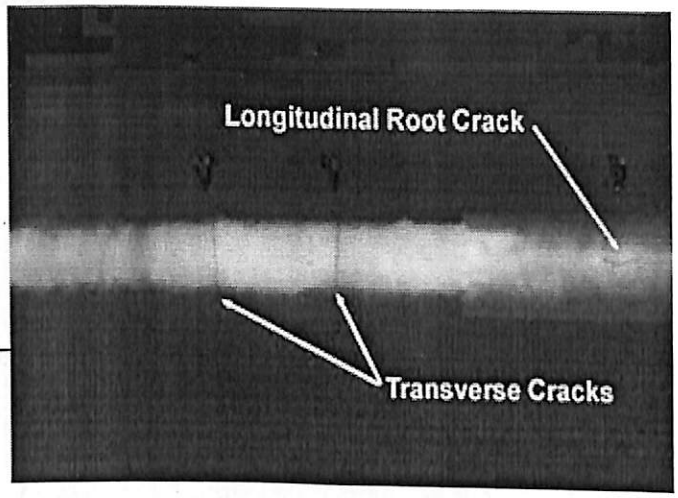



Excess weld reinforcement is an area of a weld that has weld metal added in excess of that specified by engineering drawings and codes. The appearance on a radiograph is a localized, lighter area in the weld. A visual inspection will easily determine if the weld reinforcement is in excess of that specified by the engineering requirements.

Cracks can be detected in a radiograph only when they are propagating in a direction that produces a change in thickness that is parallel to the x-ray beam. Cracks will appear as jagged and often very faint irregular lines. Cracks can sometimes appear as "tails" on inclusions or porosity.





CHAPTER-6

INSPECTION REPORT OF NDT ON BSPL PROJECT

BARMER SALAYA PIPELINE PROJECT				
MANUAL ULTRASONIC TESTING REPORT				
Report No.		04		
Date		11-04-09		
Spread		07		
Chain age		UT technique	Pulse echo	Reference reflector
Joint No.	Kp-157	Couplant	Oil Grease	Path length
Parent material	API 5LX65	Probe	Normal	Sensitive setting
Weld metal	Nil	Angle	0°	
Surface condition	Smooth	Equipment name	Finstion	
Surface temperature	Normal	Calibration block	V2 Block	

SI.NO.	Joint No.	Segment	Observation	Evaluation
1	KP-157	0-190	NRI	Accept
2	KP-157	0-190	NRI	Accept

BARMER SALAYA PIPELINE PROJECT					
LIQUID PENETRANT INSPECTION REPORT					
Report No.		09			
Date					
Spread		07			
		Brand used		Material Spec.(under Testing)	
Surface Temperature	38°C	Cleaner	PMC	Types of dye penetrant	
Dwell Time	7:00	Penetrant	PMC	Acceptance criteria	API 1104
		Developer	PMC		

SI.NO.	Joint No.	Segment	Observation	Evaluation	
1	WQT	A	OK	OK	
		B	OK	OK	

BARMER SALAYA PIPELINE PROJECT		
MAGNETIC PARTICLE INSPECTION REPORT		
Spread :07 Chain age :157		
Equipment description : Yoke Type of test : Yoke Method Surface condition/Temp :Smooth Location : KP 157 Material :API 5LX65 Acceptance criteria : API 1104	pole Spacing : 3" field checked By :FI magnetic medium used : DC Demagnetized : NO	
Joint No./Job description	Indications	Evaluation
KP 157 M69 M70 M71	No surface of subsurface indication observed	Accepted

BARMER SALAYA PIPELINE PROJECT					
RADIOGRAPHY INTERPERTAION REPORT					
Report No.	9				
Date	07/04/09				
Spread	07				
Pipe size		24"	IQI Type		10-ISO1 6
Thickness(mm)		10.6	Sensitivity		1.5%
Technique		S.W.S.I.	Density		2.3
Source		X-RAY	Acceptance criteria		API 1104
SI. No.	Weld Joint No.	Segment	Observation	Evaluation	
1	KP157 M69	0-95,95-0	2ISI,65FM,99P	Accept	
2	KP157 M70	0-95,95-0	0EP,88ESI	Accept	
3	KP157 M71	0-95,95-0	4P,10FM	Accept	
4	KP159 M09	0-95,95-0	105ISI,148P	Accept	
5	KP159M44	0-95,95-0	9P,105FM	Accept	

CHAPTER-6

CONCLUSION AND RECOMMENDATION

6.0 CONCLUSION

NDT department in a pipeline sector is a very intense area. Lot of emphasis is given by both of side whether it is from contractor side or the owner side. The authorized person from the owner side make decision from NDT reports and improve results leads the cost of project to satisfy the authorized person ,so for the good NDT and better result so that repair work will be less . some consideration should be taken

These are as follows:

1. Working condition should be ideal.
2. Previous record of welder should be known.
3. Time to time check of records.
4. Use of material according to specifications.

REFERENCES

- Wenk, S.A. and R.C. McMaster. Choosing NDT: Applications, Costs and Benefits of Nondestructive Testing in Your Quality Assurance Program. Columbus, OH: American Society for Nondestructive Testing (1987).
- McMaster, R.C. and S.A. Wenk. A Basic Guide for Management's Choice of Nondestructive Tests. Special Technical Publication No. 112. Philadelphia, PA: American Society for Testing and Materials (1951).
- API Recommended Practice 1104 fourth edition March 1997.