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SENIOR WELDING INSPECTION-3.2.2

COURSE GUIDE MATERIAL

SBTIS

TRAINING INSPECTION

BEST SKILL TRAINING

SREE BALAJI TECHNICAL INSPECTION SERVICES

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EXAM-TIPS

I. Theory part what I have given already will be sufficient-*No Head braking for this paper.

II. Regarding RT Interpretation-please do keep look of RT films. I will give you weld defect films/will be useful for Exam

III. Regarding Multiple Choices. Please do not presume as easy. Finding is that which is critical one /many fail in it/so I advise you to study Radiography Basics not safety. Be thorough with ASNT Level II part. Hope you are having good book. If need will give a very good easy reference one.

IV. Fracture Analysis will be easy one. Dealt in class in detail-nothing to worry in it. Time you will save in Exam which can be used for other parts. Will be having sufficient pieces

V. Engineering drawing- Easy one. Simple thing BS EN22553 &AWS 699 .Read machine drawings pump/vessels etc.Basically being Engineer in Profession will be not much head-ache.

VI. Scrutiny of NDT Reports do collect different type of forms filled ones by different Inspection agency like SGS/AMYSCO /NDTCCS in the following NDT methods RT/MT./PT/UT. Even though it looks simple in this also people fail. Only thing utmost care to find missing essential elements which is mandatory in an Inspection Report Main thing you have to read the Instruction sheet. It will state not to accept or reject etc. you should be aware that signature/date/stamping/project name/contract no etc should be in a report fairly they will highlight in the class. /As a Senior Inspector this part one should know.

VII. Densitometry Calibration. Please do practice by taking Densitometer strip. This will be with any NDT agency. If need I will give my Density strip for this purpose. Simple thing people do fail in this exam too.

VIII. IQI Sensitivity Calculation. Do some problem solving one/which is available in ASNT Radiography level II book. Here refer to the given comparison I DIN /AFNOR/ASTM/ Material used for sensitivity calculation shall be same material i.e. C.S means pentameters will be cs not Al .In exam you will find such Question. Do calculation/say what is the wire dia to be seen etc but in comment column state that Pentameters shall be of the same material of the object.

IX. Viva it is a formal one but be prepared as a welding professional/sure the examiner will ask job related questions Wish that this will give a picture about exams .It takes almost 8 hours.

EXAMINATION

Examination in 5 (or 8) Parts

(Each part has a 70% pass mark)

If a candidate for the Senior Welding Inspector Examination does not hold a recognised qualification in Radiographic Interpretation (a CSWIP or PCN Certificate) he is required to sit 3 additional examination parts, namely: -

6. **Radiographic Interpretation (1h 30min)**
   - 6 dense metal welds - steel

7. **Multi-Choice Radiographic Theory Paper (30min)**
   - 30 questions

8. **Radiographic Density & Sensitivity (1h)**
   - Densitometer calibration using a Density Strip
   - Sensitivity calculations for 5 welds

EXAMINATION

Examination in 5 (or 8) Parts

(Each part has a 70% pass mark)

1. **Technical Paper (1h 15min)**
   - **6 Questions given (4 answers required)**
   - **Question #1 must be answered**
   - **Answer 3 other questions from the remaining 5 questions**
2. **Interpretation of Welding Symbols (1h)**
   - **Engineering drawing has welding symbols for 12 joints**
   - **Interpret the symbols & comment on any errors or inconsistencies**
3. **Fracture Face Examination (1h)**
   - **Examine fracture faces of 2 specimens & interpret modes of failure**
4. **NDT Reports (1h)**
   - **Scrutinise 3 NDT Reports & list all errors and all omissions**
5. **Oral (~ 10 to 15 min)**
   - 1 Question: - subject will be related to supervision of welding inspectors or to safety matters

GENERALWELDING TECHNOLOGY

TECHNICAL PAPER -CHAPTER-I

DUTIES OF SENOIR WELDING INSPECTOR

I. SIGNING OFF A PRODUCT

In an engineering fabrication industry the last activity in the sequence of manufacture is load out or dispatch. This activity cannot be initiated unless the product is signed off. As a matter of fact signing the product off is assurance of quality which is authenticated by a technically competent person such as "Senior Welding Inspector" who makes sure that complete manufacturing of product has been carried out in accordance with applicable standard and sound engineering practices,

However before signing the documents he should make enquiry which can give him the in sites in the past while product was being manufactured. Questions can be as followed,

1. What was the repair rate during production?
2. Whether any concessions or waiver were given, if yes why?
3. How were the weather conditions?
4. Whether there were any safety issues, fatalities, major accidents / incidents etc?
5. Whether there were any labour problems?

Further to this he can start reviewing of documents and he should make sure that he attaches the following documents as a minimum.

1. Quality control plan – ensure all stages are complete and signed off
2. Inspection check list ensure all the stage are completed and singed off
3. Verify material certificates such as mill test certificates etc.
4. Verify the following procedures which are to be attached have all been approved

A. Welding

B.Repair

C. NDT

D.PWHT

E.Hardness

F.PMI

G.Hydro test

H.Coating

5. Verify the qualification levels and validity of the welders and NDT personnel
6. Verify the inspection reports of following disciplines and ensure that they cover all appropriate joints and structure

A.Visual B.NDT C.Dimensional control etc.

7. Verify the calibration certificates of equipments and instruments such as pressure gauge, welding machines etc,
8. Verify hardness test reports

9. Verify PMI reports

10. Verify PWHT reports

11. Verify hydro test reports

12. Verify As-built drawings are completed

13. Verify weld maps are available for traceability

14. Verify nameplate, rubbing details are available when applicable

15. Verify the concession request, site query etc,

16. Verify permit to work

17. Verify painting and coating inspection reports

As a part of his own inspection he may be obliged to witness final hydro test, visual inspection of completed parts. As a matter of quality assurance he may view some radiographs at random and may even conduct radiographic audit.

2. DEFINE:

Quality Assurance

All the planned and systematic actions and activities required too provide an adequate level of Confidence in a product.

What is wanted?

Quality Control:

The operational techniques and activities used to fulfill quality. What must be done/controlled in order achieve what is wanted.

In-Process Inspection:

Inspection & surveillance carried out during production.

Non - Compliance:

A written report, that states that a clause or instruction in the contract documents, code or Standard cannot be, or was not met.

Concession:

An agreed deviation (with the customer) from a pre-agreed path, or specification

Inspection Specification:

A document containing, or referring to all information required in the level of inspection for a product.

Certificate of Conformance:

A signed certificate, declaring that a product has been produced in accordance with a specification

Defect:

A welding imperfection that falls outside of a level of acceptance in an applied standard

Minor Defect:

Unlikely to cause failure of the product

Major Defect:

Likely to cause failure, but small risk of loss of life.

Critical Defect:

Extremely likely to cause failure, with high risk of loss of life.

Audit Compliance:

It determines quality system complies with the applicable quality control procedures.

Material Specification:

The specification applicable to a raw material which is used in the fabrication of a product.

3. LAMINATION AND LAPS

Basic difference between lamination and lap is that lamination is a sub-surface discontinuity and lap is surface discontinuity

Lamination: In the steel mills the molten steel is poured into moulds to form ingots. While the solidification is taking place huge amounts of gases may remain trapped inside the solidified steel. This ingot when rolled, the gas pockets inside gets flattened in the form of lamination. This discontinuity adversely affects through thickness strength of the steel and is not traceable by MPI or RT. The only way to detect lamination is by UT. This discontinuity may also contribute to lamellar tearing in thick sections.

Laps: Laps are basically chunks of metal that has flown from the desired profile during operations such as hot forming. This chunk of material is connected to the base metal at some location and overhanging portion of the chunk simply lies on the metal without being the homogeneous part of it. As it is surface defect it can be found visually and can be confirmed by MPI.

4. It has come to your attention that the Morale of your inspection team appears to be low?
A. What could you have observed to determine this?

Low morale can be identified by the following symptoms

1. High rate of absenteeism
2. Sluggish response to the system
3. Casual approach towards the work
4. Negligence (poor record keeping, not inspecting the weld etc.) 5. Complaints from the client/ TPA

B.What would occur if this was not rectified quickly?

Low Morale may be result in the following

1. Lack of control over production activities from quality point of view
2. Highest rejection rate by client / TPA
3. Substandard work output
4. Delay in work schedule
5. Lack of credibility to the organization

C. What could you do to lift low morale?

Observing all above, it is imperative that lifting the low morale, this can be done as follows

1. Arrange the meeting of your entire sub coordinates staff for discussion on the subject matter
2. From their response you can form a collective opinion for low morale
3. Further to this you may have private discussion with each to solve his problems. This Problem is then sorted out as general problem and individual problems

As regard to the personal problems you can assure the team that you will do every thing Possible in your capacity to rectify it. It should be brought to the attention of the employees in Gentle but firm manner that their individual problem must not affect the morale and you will try to seek company's help for his personal problem also. These they should be noticed that the effect of high morale will reflect in good salary rise, better facilities etc. If low morale continues then the management will be obliged warning letters, demotions and in worst case termination also.

5. You suspect that a radiographic team under supervision of your inspector has radio graphed the same weld seam and only changing the lead letters?

A. What would be your initial course of action? Or what action would you take to confirm this?

B. If your Suspicion is proved to be correct, what would be your further course of action?

Or

What action would you take upon your conformation?

1. Review and compare all films for similarity, welds comparing by profile or by any parentmetal marks.
2. Physically inspect three or four joints to random mark with correct identification number and take new radiographs by using new radiographic crew.
3. Evaluate the new radiographs and compare with the previous taken radiographs of the respective joints

B. The outcome of this investigation could be of two types

1. Rare case of duplication.
2. Occurrence of duplicate in many cases

The former case it is most likely to be a human error, hence the matter can be resolved by making NDT supervisor aware of facts.

The later case is an action performed to help somebody's interest, which is obviously a set back to the quality. Following proposal can be made as disciplinary action.

1. Inform the occurrence to the higher authorities or supervisor and produce objective evidence.
2. Identify the crew which has taken with wrong identification.
3. Raise and NCR
4. Arrange to remove and replace the crew immediately.
5. Arrange to reshoot all joints by using new crew.
6. Establish a proper monitoring system to avoid re-occurrence of such problems.
7. Arrange for closing out the NCR.

A meeting of all inspectors to be conducated and they should be issued a strong warning letter to improve the level of their performance to avoid such incident in future

6. Course of investigation for vessel rupture with loud bang?

Based on the above information one can construe the failure must be catastrophic in nature, which means the mode of failure is to be brittle. However there could be more than one mode of failure. The initiation could be the fatigue mode followed by brittle. It is advisable to do the visual inspection of exposed surface to find out the mode of failure. If the failure found be brittle in nature the following will be the symptoms.

1. Rough and crystalline surface
2. The chevron mark having V shaped pointing towards the point of initiation.
3. Smooth surface having dull texture
4. Half round crescent or beach marks.

It is also important to note whether the initiation of rupture is in weld/HAZ or in the base metal then one can investigate the following.

If The Base Metal

1. Chemical compostion and physical properties certificates supplied by manufacture (material test certificates)
2. Heat treatment records and lab test report if any
3. Hardness of the base metal and thickness in the rupture zone.
4. Suitability of material for the given service condition.

If the Weld/HAZ

1. Check the WPS used for welding.
2. Visual inspection reports and weld logs.
3. Radiographic reports
4. Heat treatment records
5. Hardness reports.

Based on the outcome of the above investigation the reason of the failure can be judged.

7. You have over heard a conversation suggestion that a third party inspector who is under your charge has been allowing repairs of cracks to be made with out reporting them to QA/QC department

A.What would be your course of action?

B.If this is found to be correct what would be your course of action?

1. The senior welding inspector should go personally to the job site try to establish facts in a diplomatic way.

2. Once the facts are established and it is been proved beyond any reasonable doubts, then the prevention action should be taken in such a way that it will eliminate further occurrence of such events but will not break any relation. For the sake of disciplinary measures first, this should be discussed with TPI and may be questioned about his action and omissions. It is imperative that he must be made aware of the fact that you are aware of his omission. A meeting should be conducted for inspectors and they should be made alert against such instance and they should be instructed to report such occurrence if found, immediately to QA/QC department. A strong letter may be drafted and circulated to the higher management about the omission of TPI for their information and action.

8. What is transition joint?

What are the problems occur during welding of a transition joint?

Where corrosion will occur in transition joint

A transition joint is a joint between different thickness and dissimilar metals.

Transition joints could be of two categories

Different base metals

Different thicknes

Assuming that the transition joint in this discussion complied with both of the above two categories. Following care should be taken during welding.

A.Different base metal:

1. Proper selection of electrode to avoid dilution of the weld metal
2. Proper selection of current range and polarity type of current
3. Back purging required, if any
4. Cleanliness
5. Pre-heat, PWHT
6. Welding process

B.Different thickness:

1. The thicker member should be gradually tapered off to match the thickness of thinner member such that said taper will not exceed 1:4

2. The completed weld should be blended in such a way that it will follow the gradual transition

3. Proper heat treatment should be chosen taking consideration of thickness of thicker member]

On steels, the HAZ of the weld tends to be more brittle i.e. it has lower notch toughness, than the actual weld metal. The HAZ area is therefore more prone to cracking especially when hydrogen is induced, although it must be noted that the tensile strength of the HAZ is normally high in comparison with the weld and parent material. Unfortunately if a fusion welding process is being used then the HAZ cannot be eliminated.

Problems occur during welding a transition joint

1. Consumable selection.
2. Hot cracking due to thermal expansion of steel.
3. Cold cracking due to uneven expansion and contraction of thick and thin member.

9. LAMELLAR TEARING

It is a step like crack occurring in the parent plate or HAZ of steels with poor through thickness ductility, where the fusion boundary of the weld is parallel with plate surface. It is usually associated with restrained joints on corner, tee or fillet welds joining thick plate.

CAUSES

A.Poor through thickness ductility

B.Non-metallic inclusion in the direction of rolling

C.Restrained joint

D.Through thickness stresses

E.High sulphur content

F.Presence of hydrogen

CONTROL

A.Modify Joint design

B.Control restraint

C.Use forged products for critical work

D.Grind the parent metal and fill with ductile weld metal. A buttering layer of high ductility weld metal may be deposited where the vertical member is to be welded.

E.Asses the through thickness ductility by short tensile test

F.Inspect the plate for non- metallic inclusions

G.Carry out full chemical analysis to make sure sulphur is less than 0.05%

10. Solidification Cracking (Ferritic Steel)

Solidification cracking is a hot cracking mechanism that caused during solidification of weld in ferritic steels , containing high sulphur content. During welding sulphur in the plate may be remelted and will fuse with iron to form iron sulphide (FeS). These Iron-sulphides are low melting point impurities, so that collect around the grain Boundaries, which are under great stress due to the action of contractional forces. The bonding between the grains may now be insufficient to maintain cohesion and cracks Will result running through the length of the weld centreline.

Causes

A.High sulphur content

B.High dilution process

C.High carbon content in weld metal

D.High contractional stresses

Control

A.Control the sulphur content

B.Use low dilution process

C.Use consumables with high manganese

D.Keep Manganese – sulphide: carbon ratio as low as possible

E.Minimise restraints

11. Weld Decay – Solidification cracking in austenitic stainless steel

Solidification cracking is a hot cracking mechanism that occurs during solidification of weld metal in austenitic stainless steel. Austenitic stainless steels have large grain structure compared to ferritic steel grains. During welding low melting point impurities collect around these large solidifying austenitic grain structures in the weld centreline. These large grains have small gain boundaries compared to ferritic steels. This lack of grain boundary area causes all of the liquid impurities to concentrate in small area. Due to high contractional forces these grain boundaries are in great stress and the bonding between the grains may be insufficient to maintain cohesion and cracks occur in the centreline of weld along its length

Causes

A.Low melting point impurities

B.High dilution process

C.High contractional stress

Control

A.Select low dilution process, modify joint design

B.Limit the heat input, hence minimising expansion / contraction

C.Increase the grain boundary by adding delta ferritic

D.Minimise restrains

E.Ensure plates are very clean.

12. LIQUATION CRACKS:

Liquation cracks occur in steels, which have high sulphur. When welding low quality high sulphur content steels, it is possible that areas containing iron-sulphide (FeS) in the HAZ will liquefy. These low melting point iron-sulphide usually accumulate at the grain boundaries. If this melting occurs in the presence of a high contractional stress, then the boundaries will be pulled apart and liquation cracks occurs.

Causes

A.High sulphur content

B.High restraint

C.High contractional stresses

Control

A.Use high quality refined steel

B.Controlled heat input

C.Minimise restraint

D.Use pre-heat

13. REHEAT CRACKING:

Reheat cracking is also known as relaxation cracking. It mainly occurs in HAZ of welds particularly in low alloy steel during post weld heat treatment or service at elevated temperatures. Most alloy of steel subject to an increase of embrittlement ofthe coarse grained region of the HAZ when heated above 600 Deg. C. The problem is worse with thicker steels containing Cr, Cu, Mo, V, Nb and Ti. Sulphur and Phosphorus also have an influence. Typical steels susceptible would be the 2 ¼ Cr.Mo.V type. Example Creep-resisting steels.
During post weld stress relief and at high operating temperature the residual stresses would be relieved by creep deformation which involve grain boundary sliding and grain deformation. If due to metallurgical conditions these actions cannot occur, then grain boundaries may open up into cracks.

Causes

A.Areas of high stress concentration and existing weld defects.

B.The toes of badly shaped fillet welds, incomplete root penetration welds

C.High creep resistance

Control

A.Toe grinding, elimination of partial penetration welds

B.Rejection of poor weld profile

C.Heat quickly through the susceptible temperature i.e. 450 – 550 Deg. C.

D.Use high pre-heat temperature and stage wise PWHT during welding large fabrication to reduce the risk of reheat cracking in the final stress relieving

E.Use of weld metal with high ductility

14. PHENOMENON OF HIC OR UNDERBEAD CRACKING

These types of cracks often originate from sub-surface locations under or near the weld in HAZ This cracking is caused by two main factors.

High Carbon or low alloy content of steel that is allowed to cool too rapidly.

Presence of hydrogen during welding.Also presence of stress concentrations in the neighbourhood of weld can promote underbead cracking to a great extent. The phenomenon is as follows.

During welding , small amount of free hydrogen is generated due to decomposition of moisture from air, electrode coating , shielding gas or contaminations on the surface to be welded This hydrogen can dissolve in molten steel and from there diffuse into extremely hot but solidified base metal.If the cooling is sufficiently slow, this evolved hydrogen has enough time to escape into air by diffusion. However if the cooling is rapid some hydrogen may get trapped in HAZ. This hydrogen produces a condition called as "Hydrogen Embrittlement" in the locations of its entrapment, which are dislocations and voids between grains. Also it generates very high hydrostatic pressure in the space of its confinement. This pressure combined with shrinkage stress due to cooling produce tiny cracks in metal immediately next to weld bead, which are sub-surface initially but eventually propagate to surface.

15. Underbead cracking in quenched / tempered steels

Q / T steels are normally full alloyed steels which have high hardenability due to high carbon equivalent. Such steels subsequent to welding if allowed cooling down rapidly produce brittle microstructure in HAZ. In such circumstances if the hydrogen gets involved in the process and trapped in brittle microstructure as stibulated above in phenomenon of Underbead cracking and thereby cause Underbead cracks in Quench and Tempered steels.

Prevention:

A.Giving sufficient heat input by means of pre-heating

B.Reduce rate of cooling and adequate PWHT

C.Use of low hydrogen processes for welding,

D.Performing welding in stress frees conditions.

16. Underbead cracking in HSLA steels

Unlike in Q / T steels, HSLA steels are ferritic in nature. The properties of these steels are achieved by small amounts of alloying elements dissolved in their ferritic structure. For this very reason they are soft and ductile as compared to Q/T/ steels. Such steels, subsequent to welding if cooled too rapidly, may undergo a change of microstructure from ferritic to martensitic namely in HAZ. Once martensitic is formed it is hard and brittle. In such circumstances if any hydrogen pick-up takes place it may very well lead to phenomenon of HIC or Underbead Cracking.

Prevention

A.Ensure that base metals have enough ductility

B. Ensure that base metals have sufficiently low % of Carbon, manganese and other alloying element which cause appreciable amount of martensite formation.

C.Reducing the rate of cooling of weldment

D.Performing the welding in stress free conditions

E.Use of low hydrogen processes

17. FRACTURE MECHANISM

Fracture can be divided into three basic types.

A.Fatigue **B.Ductile** **C.Brittle**

A fatigue fracture is the outcome of cyclic loading and unloading which induces fatigue in the metal. Following appearances of exposed surfaces manifests these kinds of fractures.

A.Surface is smooth

B.It is encompassed by crescent marks or beach marks

A ductile fracture is an outcome of plastic deformation of material to the point of rupture. It is manifested by,

A.Surface is torn and rough

B.Shear lips at 45 Deg. C. applied stress

A brittle fracture is result of composition of hard, brittle material and an impulsive snappy load. It is manifested,

A. Bright, crystalline but rough surface.

b) "V" shaped chevrons on the surface, points towards the point of initiation.

Out of above types fatigue is always the first mode of failure. If failure is in second mode i.e. ductile or brittle, then these failures will always be following fatigue and not vice-versa. Otherwise there could be purely ductile or purely brittle failures also which are manifested by the appearances as mentioned above.

18. RESIDUAL STRESSES

Metals contract during solidification and subsequent cooling, but if this contraction is prevented or inhibited residual stresses will develop. Most metal products contain residual stresses, often up to the yield point. Pipe products for example are usually very highly stressed. The tendency to develop residual stresses increases when the heating and cooling are localised. So welding with its very localised heating and the presence of liquid and solid metal in contact can be expected to induce very high levels of residual stresses. Residual stresses can be difficult to measure with any real accuracy, but a rough guide is that when the weld metal exceeds 2 inch^3 (14 cm^3) then the total residual stress is about yield point in magnitude. Normal welds develop residual stresses:

A.Along the weld - Longitudinal residual stresses

B.Across the weld - Transverse residual stresses

C.Through the weld - Short transverse residual stresses

19. DISTORTION:

Distortion is caused by stress distortion related here to the change and shape of a component, which results from welding. This change in shape may be temporary (elastic) or permanent (plastic). If two pieces of materials eg. Plates, which are to be joined, are free to move during welding distortion will occur. If the two pieces of material are not free to move (restrained), the force will remain as residual stresses.

Types of distortion:

A.Longitudinal shrinkage

B.Transverse shrinkage

C.Angular distortion

D.Bowing

Factors which affect distortion:

A.Material properties and condition

B.Heat input

C.Lack of restraint

Method of reducing distortion

A.Pre-heating

B.Forced restraint

C.Using a balancing, welding technique eg. Back strip welding, back step welding

E.Using a different joint design to reduce the amount of weld deposited

F.Reducing the heat input

20. Distortion in a simple weld with single "v" preparation

The action of the residual stresses in welded joints is to cause distortion. Consider a simple weld with a single "vee" preparation.

The following movements can be detected.

1. Contraction in the weld and HAZ along with the length
2. Bowing due to the greater volume of metal at the top of the weld
3. Peaking due to the "vee" angle
4. Ripple (in-sheet) away from the weld
5. Contraction in the weld metal and HAZ transverse to the weld

Control of distortion is achieved in one or more of the following three ways:

1. Presetting – So that the metal distorts into the required position
2. Clamping – To prevent distortion, but this increases the level of residual stresses
3. Welding sequence i.e. balanced

21. Mechanical Testing

Transverse tensile test: To measure the transverse tensile strength under static loading

1) A reduced specimen assesses the tensile strength of the joint

2) A radius reduced specimen assesses the tensile strength of the weld metal.

Cruciform test: To measure the relative tensile strength of joints with fillet welds under static loading. NB: Load through welds

All weld tensile strength: To measure the tensile strength of

1) Electrodes of filler wire / flux combinations

2) Quality of the weld metal as deposited.

3. STRA- Short Transverse Reduction Areas to access lamellar tearing

Bend tests (Transverse and longitudinal) – To determine the

1) Soundness of the weld metal

2) Weld junctions

3) Heat affected zone.

Note: All specimens to be removed and prepared without causing significant distortion or heating

Side bend test: To determine the soundness of a joint in cross section

Charpy "V" notch test: to determine the energy absorbed at a specified temperature to fracture the specimen.

Nick-break test: To fracture the joint through the weld metal to permit examination of the fracture surfaces

Fillet weld fracture test: To fracture the joint through the weld metal to permit examinatio of the fracture surfaces.

Note: Sawn notch in compression

Macro – examination: To examine the whole joint for soundness

22. CTOD (Crack Opening Displacement Test

CTOD is a test method for the determination of a metals resistance to the initiation of a crac resulting from notch defects.

CTOD measures the elastic –plastic toughness of the metal in the ductile –brittle transition. The propagation of a crack in a welded structure depends upon factors including the Materials used. The size and sharpness of any notch present, operating temperature, the degree of restraint and welding procedure requirements.

CTOD test permits full size specimens to be used irrespective of metal thickness to which a notch of given width and depth is applied. The specimen is subjected to a high-speed resonance load cycling on a three point bending rig. A clip gauge is fixed to the mouth of the notch accurately measures the slow opening of the crack and a force sensing device enables the applied load to be plotted against displacement on a graph.

23. HAZ – Heat Affected Zone:

During welding using a fusion welding process there is a huge temperature difference between the weld and parent material. Because of this temperature difference, the material immediately adjacent to the weld undergoes micro structural changes.

This area which lies between the fusion boundary and the unaffected parent material is called the HAZ. The extent of changes in microstructure will depend on the following.

Material composition, especially carbon content

Heat input – The higher the heat input or arc energy, the wider HAZ. Metallurgical properties will also be affected

The rate of cooling - Higher the rate of cooling, harder the HAZ especially if the C.E. of the steel is high. The HAZ in a weld zone on steel consists of up to four separate regions, startin from the area immediately adjacent to the weld.

Coarse grained region (heat between 1100 Deg.C) and melting point)

Grain refined region (900 to 1100 Deg. C)

Region of partial transformation (750 to 900 Deg. C)

Region of spheroidization (just below 750 Deg. C)

24. SAW Wire / Flux details + SAW Consumables

AWS A5.17.89: Specification for carbon steel electrode and fluxes for SAW

The coding system shows the flux capabilities when combined with a specific electrode

Example coding,

F7A6 – EM12K or F6A4 – EC1 (trade name)

F- Indicates flux

7 – Indicates the weld metals minimum ultimate tensile strength in Kpsi x 10, when using the flux with the electrode identified

A – Designates the condition of heat treatment to the weld or which tests were conducted "A" is for as welded and "P" for PWHT

6 – Indicates the lowest temperature in Degree Fahrenheit x 10 at which a charpy value of 27 J was achieved

E – Indicates a solid electrode. EC would indicate a composite electrode

M- This may be L, M, or H indicating Low, medium or high manganese content

12 – This may be one or two digits and nominal carbon content of the electrode e.g. 12 = 0.12%, 8= 0.08%

K – Indicates the electrode is made from semi-killed steel

Additional flux information:

All fluxes to this specification must be of a granular nature and capable of flowing freely when used. Particle size is to be a matter of agreement between the purchaser and supplier. The flux must permit the production of smooth with depth of undercut. Fluxes are classified on the basis of mechanical properties of the weld metal. They produce and therefore have to be shown in conjunction with the electrode used. Fluxes used to this specification may contain fusible compounds of various proportions. Some fluxes contain de-oxidisers, others do not and fluxes may react differently with different electrodes and arc voltage used. A change of arc voltage during welding will change the amount of flux melted and May therefore change the composition of the weld metal. The effect of this change allows fluxes to be descried as neutral, active or alloy.

Neutral Fluxes are those which do not produce any significant change in the weld metal chemical analysis irrespective of arc voltage / arc length changes. Fluxes of this type contain little or no de-oxidisers and rely on the electrode for de-oxidation. They are mainly used for multi pass welds

Active Fluxes contain manganese and silicon as de-oxidisers and the effect of those on the weld metal will change as the arc voltage changes, these fluxes are used mainly for single pass welds.

Alloy fluxes are those which can be used with a carbon steel electrode to produce a low alloy weld metal as such they come under the scope of AWS A-5.23 , Low alloy steel electrodes and fluxes for SAW

Flux basicity or classification

Basic oxides tend to be more stable than acidic oxides. Fluxes for SAW may be classified as follows.

1. Acid – General purpose use and for dirty (rusty) steel
2. Neutral

3. Semi basic – Improving quality

4. Basic

5. High basicity – Maximum weld toughness and performance

25. Consumables – SAW process

Fused Flux

Fused fluxes are manufactured as follows. The ingredients are mixed and melted at high temperature, the mixture is the poured on to large chill blocks or directed into a stream of water to produce granules which have a hard glassy appearance. The material is then crushed, sieved and packaged.

Advantages:

Good chemical mix achieved

They do not attract moisture (not hygroscopic) this improves handling, storage, use and weld ability. Any moisture present is easily removed by low temperature drying.

The easy removal of impurities and fine particles etc. when recycling.

The main disadvantage is the difficulty in adding de-oxidants and ferro-alloys. These would be lost during the high temperature manufacture. The maintenance of a controlled flux depth is considered critical.

25.AGGLOMERATED FLUX

All the flux materials are dry mixed and then bonded with either potassium or silicate. They are then baked at a temperature below the fusion or melting point and therefore remain as a powder, which is sieved for size and packaged.

Advantages

Can be colour coded

Easy addition of de-oxidants and Ferro-alloys

Flux depth not so critical

Disadvantages

Tendency for flux to absorb moisture and difficult re-drying procedure

Possibility of molten slag, causing porosity

Difficult re-cycling i.e. the removal of impurities and sieving.

26. It has come to your attention that the morale of your inspection team appears to be low?

A. What could you have observed to determine this?

B. What would occur if this was not rectified quickly?

C. What could you do to lift low morale?

Low morale can be identified by the following symptoms

1. High rate of absenteeism

2. Sluggish response to the situation

3. Casual approach towards work

4. Negligence (Poor record keeping, not inspecting welds etc.)

5. Complaints from client / TPA

b) Low morale may result in the following

1. Lack of control over production activities from quality point of view

2. Higher rejection rates by client / TPA

3. Substandard work output

4. Delay in work schedule

5. Lack of credibility to the organisation

C.Observing all above, it is imperative that lifting the low morale is stitch in time this can be done as follows

1. Arrange the meeting of all your sub-ordinate staff for frank discussion on the subject matter

2. From their responses you can form a collective opinion for low morale

3. Further to this you may have private discussion with each individual which can help you to zero in on his problems. The problem is then sorted out as general problem and individual problems.

As regards to general problems, you can assure the team that you will do everything possible in your capacity to rectify it. For example lack of good working apparatus, salary problems, leave schedules etc. As regards to individual problems, it should be brought to the attention of the employees in gentle but firm manner that their individual problems must not affect the morale. Nevertheless on compassionate grounds you will try to seek company's help for his personal problem also. Further to this they should be noticed that the effect of high morale will reflect in good salary rise, better facilities etc. However if low morale continues then the management will be obliged warning letters, demotions and in worst cases termination also.

27) INTER GRANULAR CORROSION

It occurs in unstabilised austenitic stainless steel with 600 – 850 Deg. C. range of the HAZ. At this temperature range carbon is absorbed by the chromium and chromium carbide is precipitated at the grain boundaries as metal cools down. This causes a local reduction in chromium content, which has the effect of lowering the resistance to corrosive attack allowing to occur.

Control

Use stabilised stainless steels with the addition of Ni or Ti
Use low carbon stainless steels (below 0.04%C)
Heating at about 1100 Deg.C where chromium carbide will be dissolved. Then steel is normally quenched from this temperature to stop re-association.

Location: Weld HAZ (Longitudinal)

Susceptible microstructure: Sensitised grain boundaries

28) In service failure of a weld at -40 Deg.C

Service temperature of the order of -40Deg.C tells that the failure most probably has occurred due to lack of strength or toughness at that temperature. Compared to base metal, a weld is always of irregular shape and hence is considered as irregularity or discontinuity in surface profiles. Any discontinuity serves as a stress raiser when it comes across lines of stresses. The strength of material / metal drops at the locations of high stress concentration especially when temperature drops significantly.In brief metal tends to lose its 'notch toughness". Hence our area of investigation should be notch toughness of given weld at low temperature. This can be approached in following ways.

Verifying that WPS has recommended proper consumables to be used and all the essential variables were adhered to

Verify heat treatment records (if any)

Review and scrutinize lab test reports including that of charpy v notch tests for all weld specimens

Review batch certificates for consumables used

Location of failure should be inspected and point of initiation should be established

If the location of failure initiation happens to be without any defect viz., undercut or porosity then failure can be attributed to sheer lack of low temperature strength and consumable giving higher low temperature strength may be recommended and improvement in weld profile may also be advised. However if the point of initiation happens to be a defect such as porosity or any subsurface defect then corresponding radiograph for that section of weld may be closely examined and interpreted. In such cases more stringent acceptance criterion may be recommended in addition to recommendations mentioned above.

29. If you detect an arc atrike what is the course of action?

If any arc strike is found on the parent metal it shouldbe ground smooth and MPI is to be conducted on the location if it is a ferrous material. For SS, PT is to be conducted.

30. What are the documents required to be repair?

Approved repair welding procedure, qualified welders, Method of exploration of crack, Method of crack removal, repair report.

31. What would be the result of using temperature 1300 Deg C in heat treatment?

Steel which are overheated above 1200 Deg C may suffer a permanent loss of toughness and also forms large quantities of mill scale on their surface.

32. What is the difference between a welding procedure approval and a welder qualification test?

The welding procedure approval test is carried out by a competent welder and the quality of the weld is assessed using non-destructive and mechanical testing techniques. The intention is to demonstrate that the proposed welding procedure will produce a welded joint which will satisfy the specified requirement of weld quality and mechanical properties.

Welder approval test examines a welder skill and ability in producing a satisfactory test weld. The test may be performed with or without a qualified procedure, (note without an approval welding procedure the welding parameter must be recorded.) Welder approval must be done prior to start the welding on the production site. Welder should be qualified to do the task.

33. Can a non approved welder be employed to perform a welding test?

Yes.

34. Describe two method of producing approval procedures?

1. By using pre qualified procedure
2. By establishing a procedure
3. by doing mock-up or by trial and error method.

35. How to improve team spirit?

1. If there are aged and young inspectors in my team I will give more responsibility to aged one than younger one so that every one will feel equal load with job according to their experience.

2. off the job. Play games like cricket, badminton etc against inter department which will make them united.

3. Once in a while call them for meeting to discuss the latest development.

4. Motivate them by giving small incentives or gift at the end of project to encourage the team work.

5. On special occasion arrange social programme against inter department.

6. Help them all personally with out partiality.

7. Discus often their site problems.

8. Offer them immediate rewards when they completed really risky and effortive job.

36. Going to sickness it has been necessary for you to replace a very experienced welding inspector he has been responsible for carrying out all welder approval testing. His replacement has to come from your existing staff that has not vast experience in this field.
How would you instruct the replacement in his new duties and what critical points would you emphasis?

Prior to assigning the job I would assess the inspector knowledge level in the Welder approval test then I would instruct to carry out and observe the following before test

1. Collect and go through relevant welding procedure specification and other procedures.

2. Prepare the measuring instrument those are required during the test for checking and inspection tools like tongue tester, temperature measuring crayons. Inspection mirror, torch light weld gauges, measuring tape etc and check their calibration validity.

3. Check the test piece material specification and dimension as per WPS.

4. Check the welding preparation for correct bevel angle, root face, root gap and mismatch.

5. Check consumable certificate such as filler wire, electrodes, fluxes and gases going to be used for welder test.

6. Check fixing position of the test piece that is 1G, 2G, 3G, 4G, 5G and 6G etc.

7. Mark the bottom and top position in case of pipe.

8. Measure the heat input.

9. Final weld visual inspection

10. Mark the welder's, name, date, WPS No and Position,

11. Prepare test report and submit to supervisor for record and NDE processing.

37. BANDS OR BANDING:

As the ingot is forged and rolled the segregation are elongated and reduced in cross section. If further processing is carried out, they may appear as very thin parallel lines of bands and is generally known as banding. Bandings is not usually significant.

38. QUANTITATIVE TESTS/QUALITIATIVE TEST

QUANTITATIVE TEST

For measuring a 'quantity' ('**quantity**'test = a mechanical property)

Typical mechanical tests - tensile test
- Hardness test
- Charpy V-notch test (& CTOD)

QUALITATIVE TESTS

For assessing joint 'quality' (**'quality' test** = good fusion & free from defects)

Typical qualitative tests - bend tests

- Macro examination (micro examination for some metals)
- Fillet fracture & nick-break tests

39. What does a procedure consist of?

Procedure consists of

A. Essential variables

B. Non-essential variables &

C. Supplementary variables

Essential variables: A change in welding parameters which effects the mechanical properties of a weld are called essential variables. E.g., Process, type of material,electrode / flux, shielding gas, preheating. PWHT, current and voltage etc,

Non-essential variables: Changes in welding parameters, which will not affect the mechanical properties of the weld metal, are called non-essential variables. E.g. Groove angle, method of cleaning etc.

Supplementary- variables: The. Welding procedure shall be attached: with PQR to show the evidence that the procedure meets the mechanical properties desired by the code/ specification.

40. Give typical example of approval for a) thickness. 5) Diameter. c) Process.

Thickness: When welder is qualified on thickness T' he s qualified to weld two times the thickness (2T)

Diameter: when weld is qualified on diameter 'D he is qualified to weld pipe size OD/2 and above

Process: When qualified in a particular process. He is qualified to weld only on that particular process using thickness parameters that are qualified

46. Explain why the quality of the parent plate may affect the incidence of weld metal cracking?

Lower quality or dirty steels have a higher residual content e.g. Sulphur, phosphorus etc. Due to the lower melting point these segregate during the solidifications of weld pool in to the centerline of the weld forming a plane of low ductility which may crack when acted upon by the normal transverse residual stress.

47. Preheat-

Preheating involves heating the base metal, either entirely or just the region surrounding the joint to a specific desired temperature, called the preheat temperature.

The purpose of preheat:-

Reduce the risk of hydrogen cracking

Reduce the hardness of the weld heat affected zone

Reduce shrinkage stresses during cooling and improve the distribution of residual stresses.

If preheat is locally applied it must extend to at least 75mm from the weld location and be preferably measured on the opposite face to the one being welded.

The selection of the preheat temperature should be based on three (3) factors, listed in order of importance:

1. Composition and harden ability of the base or parent metal.

2. The feasibility of post welding heat treatment

3. The size and configuration of the part to be welded.

The temperature of the part can be checked by use of "Temp- Sticks"

PWHT

Post weld heat treatment is a process in which the metal in the solid state is subjected to one or more controlled heating cycles after welding. This PWHT is normally carried out for the purpose of stress relief. PWHT may also be used to produce certain properties such as Softening after cold working.

Hardening to produce improved strength and hardness, this may be very hard and brittle

Tempering to improve hardness structures giving range of strength with toughness.

The following variables for PWHT must be carefully controlled.

1. Heating rate

2. Temperature attained

3. Time at the attained temperature

4. Cooling rate.

47.You have overheard a conversation suggesting that a third party inspector who is under your charge has been allowing repairs of cracks to be made without reporting them to the QA / QC department. What would be your course of action? If this is found to be correct what would be your course of action?

Since it is a grave consequence senior welding inspector should go personally to the job site try to establish facts in a diplomatic way. Once the facts are established and it is been proved beyond any reasonable doubts, then the preventive action should be taken in such a way that it will eliminate further occurrence of such events but will not make any relation sour. For the sake of disciplinary measures first, the TPIA should be summoned for a private discussion and may be questioned about hi action and omissions. It is imperative that he must be made aware of the fact that you are aware of his omission. Further to this meeting of all lie inspectors should be conducted and they should be made alert against such instances, also they should be instructed to report such occurrence if found, instantly to QA/QC department. In order to make higher management aware of the omissions of third party inspector, a strong letter may be drafted and circulated for their information and action.

SENIOR WELDING INSPECTION-3.2.2

GENERAL WELDING TECHNOLOGY

MODEL QUESTION

SBTIS

TRAINING INSPECTION

BEST SKILL TRAINING

PREPARED BY: R.MURALIMOHAN

PAPER-I-THEROY-QUESTION

DUTIES OF SENIOR WELDING INSPECTOR

A senior welding inspector may be required to manage and control and lead a team of welding inspectors who will look to him for guidance, especially on subjects of a technical nature. The SWI will be expected to give advice, handle problems, take decisions and lead from the front. The SWI will therefore require leadership skills in addition to technical skills and experience. Senior welding inspector is responsible for the following.

1. Signing of the product.
2. Prepare department budgets for personnel facilities and supplies.
3. Assign work to the inspectors.
4. Supervise and evaluate their work.
5. Motivate staff to meet standards of quality and efficiency.
6. Interlink with other departments to improve procedure and advice on quality problems.
7. Receive complying item, understand the problems and establish corrective measures.
8. Review plant equipment condition, inspection reports for fitness to use during service.
9. Prepare scrutinize documentation for quality.
10. Participate in inspection and planning, reviewing and approve procedure which is prepared by inspection department.
11. Develop team work, advice on training and other personnel qualification requirements.
12 Ensure adequate safety precaution for all personnel.

In other circumstances he may have a more technically demanding role that requires detailed knowledge of particular activities.

The technical skills required are:

1. Knowledge of technology
2. Knowledge of Codes of Practice
3. Knowledge of Planning
4. Knowledge of Organisation
5. Knowledge of Auditing

Knowledge of technology- required is similar to the welding inspector but with some additional cope and depth of

1. Commonly used NDT technique
2. Radiographic interpretation.
3. QA/QC Knowledge
4. Basic metallurgy of commonly welded materials including assessment of fracture surfaces.

Knowledge of Codes of Practice -The SWI should be aware of common standards applied in the welding industry.

Knowledge of Planning- planning of inspection will be required for all phase of inspection (Pre-In process- Post)

Knowledge of Organisation – Organisation skills are necessary to ensure the inspection requirement of any plan can be met on time using the correct personnel for the job.

Knowledge of Auditing- the knowledge of audit may involve in detailed checks of very limited area of inspection to ensure that documentation produced meet the requirement of the specification.

Leadership requires

1. Ability to if so required
2. Willingness to direct
3. Acceptance of responsibility
4. Understanding of problems
5. Ability to delegate - willingness to trust staff
6. Commitment to ones staff.

2. It has come to your attention that the Morale of your inspection team appears to be low?

A) What could you have observed to determine this?

Low morale can be identified by the following symptoms

1) High rate of absenteeism

2) Sluggish response to the system

3) Casual approach towards the work

4) Negligence (poor record keeping, not inspecting the weld etc.)

5) Complaints from the client/ TPA

B) What would occur if this was not rectified quickly?

Low Morale may be result in the following

1) Lack of control over production activities from quality point of view

2) Highest rejection rate by client / TPA

3) Substandard work output

4) Delay in work schedule

5) Lack of credibility to the organization

C) What could you do to lift low morale?

Observing all above, it is imperative that lifting the low morale, this can be done as follows

1) Arrange the meeting of your entire sub coordinates staff for discussion on the subject matter

2) From their response you can form a collective opinion for low morale

3) Further to this you may have private discussion with each to solve his problems. This Problem is then sorted out as general problem and individual problems

As regard to the personal problems you can assure the team that you will do everything Possible in you capacity to rectify it. It should be brought to the attention of the employees in Gentle but firm manner that their individual problem must not affect the morale and you will try to seek company's help for his personal problem also. This they should be noticed that the effect of high morale will reflect in good

salary rise, better facilities etc. If low morale continues then the management will be obliged warning letters, demotions and in worst case termination also.

3. You suspect that a radiographic team under supervision of your inspector has radio graphed the same weld seam and only changing the lead letters?

A) What would be your initial course of action? **Or** what action would you take to confirm this?

B) If your Suspicion is proved to be correct, what would be your further course of action? **Or** what actio would you take upon your conformation?

1. Review and compare all films for similarity, welds comparing by profile or by any parent metal marks

2. Physically inspect three or four joints to random mark with correct identification number and take new radiographs by using new radiographic crew.

3. Evaluate the new radiographs and compare with the previous taken radiographs of the respective joints

B) The outcome of this investigation could be of two types

1. Rare case of duplication.

2. Occurrence of duplicate in many cases

The former case it is most likely to be a human error, hence the matter can be resolved by making NDT supervisor aware of facts.

The latter case is an action performed to help somebody's interest, which is obviously a set back to the quality. Following proposal can be made as disciplinary action.

1. Inform the occurrence to the higher authorities or supervisor and produce objective evidence.
2. Identify the crew which has taken with wrong identification.
3. Raise and NCR.
4. Arrange to remove and replace the crew immediately.
5. Arrange to reshoot all joints by using new crew.
6. Establish a proper monitoring system to avoid re-occurrence of such problems.
7. Arrange for closing out the NCR.

4. Course of investigation for vessel rupture with loud bang?

Based on the above information one can construe the failure must be catastrophic in nature, which means the mode of failure is to be brittle. However there could be more than one mode of failure. The initiation could be the fatigue mode followed by brittle. It is advisable to do the visual inspection of exposed surface to find out the mode of failure. If the failure found be brittle in nature the following Will be the symptoms.

1. Rough and crystalline surface
2. The chevron mark having V shaped pointing towards the point of initiation.
3. Smooth surface having dull texture
4. Half round crescent or beach marks.

It is also important to note whether the initiation of rupture is in weld/HAZ or in the base metal then one can investigate the following.

If The Base Metal

1. Material test certificates.
2. Heat treatment records
3. Hardness of the base metal and thickness in the rupture zone.
4. Suitability of material for the given service condition.

If the Weld/HAZ

1. Check the WPS used for welding.
2. Visual inspection reports and weld logs.
3. Radiographic reports
4. Heat treatment records.
5. Hardness reports.

Based on the outcome of the above investigation the reason of the failure can be judged.

5. You have overheard a conversation suggestion that a third party inspector who is under your charge has been allowing repairs of cracks to be made without reporting them to QA/QC department

a) What would be your course of action?

b) If this is found to be correct what would be your course of action

a) The senior welding inspector should go personally to the job site try to establish facts in a diplomatic way.

b) Once the facts are established and it is been proved beyond any reasonable doubts, then the prevention action

should be taken in such a way that it will eliminate further occurrence of such events but will not break any

relation. For the sake of disciplinary measures first, this should be discussed with TPI and may be questioned

about his action and omissions. It is imperative that he must be made aware of the fact that you are aware of his omission. A meeting should be conducted for inspectors and they should be made alert against such instance and they should be instructed to report such occurrence if found, immediately to QA/QC department. A strong letter may be drafted and circulated to the higher management about the omission of TPI for their information and action.

6. A) what is transition joint?

B) What are the problems occur during welding of a transition joint?

C) Where corrosion will occur in transition joint

A) A transition joint is a joint between different thickness and dissimilar metals.

Different Thickness

1. During welding a transition joint between different thickness the higher thickness (T) and smaller thickness (t), to match the thickness, thickness (T) should be tapered by machining or Grinding with ratio of 1:3.

3. Proper heat treatment should be chosen, taking consideration of thickness of the thicker member. On steel the

HAZ of weld tends to be more brittle, has lower notch toughness, more prone to cracking when hydrogen is induced and tensile strength is normally high compare to weld and parent metal.

Different Base Metal

1. Proper selection of consumables and electrical characteristics.
2. Back purging if required.
3. Cleanliness, pre-heating, PWHT (if required)
4. Welding Process

Problems occur during welding a transition joint

1. Consumable selection.
2. Hot cracking due to thermal expansion of steel.
3. Cold cracking due to uneven expansion and contraction of thick and thin member.

7. Where corrosion will occur?

Corrosion will occur in SS side in HAZ

8. Distortion in simple weld with single "V" preparation

The action of residual stresses in welded joints is to cause distortion.

The following Movements can be detected

1. Contraction in the weld & HAZ along with length
2. Bowing due to the greater volume of metal at the top of the weld
3. Peaking due to "V" angle
4. Ripple (in -sheet) away from the weld
5. Contraction in the weld and HAZ transverse to the weld

Control of Distortion Is Achieved In One or More Of The Following Three Ways

1. Pre setting - so that the metal distort into the required Position
2. Clamping to prevent distortion, but increase the level of residual stress
3. Welding Sequence i.e. balanced
4. Reducing heat input

9. How to improve team spirit?

1. If there are aged and young inspectors in my team I will give more responsibility to aged one than younger one so that everyone will feel equal load with job according to their experience.

2. Off the job, Play games like cricket, badminton etc against inter department which will make them united.

3. Once in a while call them for meeting to discuss the latest development.

4. Motivate them by giving small incentives or gift at the end of project to encourage the team work

5. On special occasion arrange social programmers against inter department

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7 Discus often their site problems.

8. Offer them immediate rewards when they completed really risky and effective job.

9. going to sickness it has been necessary for you to replace a very experienced welding inspector how has been responsible for carrying out all welder approval testing. His replacement has to come from Your existing staff that has not vast experience in this field.

10. How would you instruct the replacement in his new duties and what critical points would you emphasis?

Prior to assigning the job I would assess the inspector knowledge level in the Welder approval test then

Would instruct to carry out and observe the following before test

1. Collect and go through relevant welding procedure specification and other procedures.

2. Prepare the measuring instrument those are required during the test for checking and inspection tools like tongue tester, temperature measuring crayons. Inspection mirror, torch light weld gauges, measuring tape etc and check their calibration validity.

3. Check the test piece material specification and dimension as per WPS.

4. Check the welding preparation for correct bevel angle, root face, root gap and mismatch.

5. Check consumable certificate such as filler wire, electrodes, fluxes and gases going to be used for welder test.

6. Check fixing position of the test piece that is 1G, 2G, 3G, 4G, 5G and 6G etc.

7. Mark the bottom and top position in case of pipe.

8. Measure the heat input.

9. Final weld visual inspection

10. Mark the welder's, name, date, WPS No and Position

11. Prepare test report and submit to supervisor for record and NDE processing.

11. In brief metal tends to lose its notch toughness of given weld at low temperature?

This can be approached in following ways.

1. Verifying that WPS

2. Verify the heat treatment record (if any)

3. Review and scrutinize lab test report including the charpy V notch test for all weld specimens

4. Review batch certificates for consumables used

5. Location of failure should be inspected and point of initiation should be established

If the location of failure initiation happens to be a defect viz., undercut or porosity then

Failure can be attributed to sheer lack of low temperature strength.

Recommendation: Use consumables giving high low temperature strength and improvement in weld profile. However if the point of initiation happens to be a surface or subsurface defect the corresponding radiograph for that section of weld may be examined and interpreted

12. Terms & Definitions for Senior Welding Inspector:

Quality Assurance

All the planned and systematic actions and activities required too provide an adequate level of confidence in a product. What **is** wanted?

Quality Control:

The operational techniques and activities used to fulfill quality. What must be done/controlled, in order achieve what is wanted.

In-Process Inspection:

Inspection & surveillance carried out during production.

Non - Compliance:

A written report, that states that a clause or instruction in the contract documents, code or standard cannot be, or was not met.

Concession:

An agreed deviation (with the customer) from a pre-agreed path, or specification

Inspection Specification:

A document containing, or referring to all information required **in** the level of inspection for a product.

Certificate of Conformance:

A signed certificate, declaring that a product has been produced in accordance with a specification

Defect:

A welding imperfection that falls outside of a level of acceptance in an applied standard

Minor Defect:

Unlikely to cause failure of the product

Major Defect:

Likely to cause failure, but small risk of loss of life.

Critical Defect:

Extremely likely to cause failure, with high risk of loss of life.

Audit Compliance:

It determines quality system complies with the applicable quality control procedures.

Material Specification:

The specification applicable to a raw material which is used in the fabrication of a product.

Auditor: The Certified Quality Auditor is a professional who understands the standards and principles of auditing and the auditing techniques of examining, questioning, evaluating and reporting to determine a quality system's adequacy and deficiencies.

13. As a Team leader what steps u will take for improving Quality? If a member has to be replaced what all things to do? What are the things u will brief in a Start of a Job for your new member?

IMPROVING QUALITY:

1 Conduct periodic and systematic audit, based on audit finds such non conformance, any other Quality related issues, take preventive actions and avoid such a things occur in future.

2. Conduct quality related meetings with inspectors, other department members, and look for any ideas improve quality or any quality related concerns they have in their job, take necessary preventive actions

3. Any complaints from clients /TPI or feedback from clients, take necessary preventive actions

4 Technical information related to quality; circulate to all concern departments members

5. Conduct training programs for specialized jobs and critical jobs

6. provide motivation, motivated employees provide a better working environment in addition to the product or service output benefits

REPLACING MEMBER

Get hand over note from replacing member,

hand over note including completed status, which was handled by him, current job status, any quality related issues such as site query, concession request, NCR log etc

Document management etc

Contact details client representative /contractor personals e mail address, contact telephone no's etc

NEW MEMBER

Welcome and introduced all staff including higher authority

Safety induction explain minimum PPE, emergency exit, and emergency contact numbers

Brief explain about work system organization chart, reporting channels etc

Brief explain about project specification, quality control procedure, ITP, method statements, safety procedures, quality management system, location available of those documents

Brief explain about site query NCR log, WPS, PQR, WQT records etc

14. Misunderstand between NDT Inspector and QC Inspector, Why it is rectified? How will you rectify why it is rectified?

1. It will lead to miscommunication which will affect the quality of NDT such as wrong identification of weld joint, wrong NDT method, wrong weld details etc

2. Back log in work, sub standard work output, work delay in schedule

HOW YOU WILL RECTIFY?

1. Conduct the meeting with QC Inspector and NDT Inspector

2. Open discuss with them, find the actual problem

3. May have technical problem, communication problem like language problem or personal problem like leave over due, sick, family problem

4. Analysis the root causes of problem and solve

Verify the correct system is followed, if not, establish the correct system

5 continuous monitoring the inspectors activates

15. Give brief describes of the difference between macro and micro examination also state the purpose of each examination?

Difference

Macro examination magnification of 10 X or lower

Micro examination grater 10X, usually 100 X or higher

Macro specimen need rough ground with 80 grit finish

2. Micro specimen need very fine grinding at 600 grit and polish/ etching to produce a mirror finish

PURPOSE OF EXAMINATION

Macro examination: To determine depth of fusion, depth of penetration, effective throat, weld soundness, degree of fusion presence of weld discontinuity, weld configuration, number of weld pass etc

Micro examination: To determine micro structural constituents, presence of inclusions, presence of microscopic defects, and nature of cracking etc constituents

16. List five items of information that could be recorded on an ultrasonic test report, which would never be present on radiographic report?

A. couplant type

B. Probe details: type, angle, size, frequency

C. Scanning method/type

D. Correction sensitivity (+2 db)

E. Db (disable)

17. What is the difference between inspection for quality control and inspection for fitness for purpose?

Inspection for quality control

1. Ensure product has been fabricated as per approved drawing such as correct dimension etc

2 visual inspection of completed product

3. Verify the project specification followed inspection for fitness purpose, verify the fabricated product against approved drawing, If dimension of product not meets the requirement of drawing and approved specification,

Measure the deviation of the product, if it is fit for purpose, accept as it is, provided the deviation request to be raised and approved

3. Once deviation is approved, deviation to be incorporated in as builds drawing

18. What is the consideration for QA/QC and inspection department if it is required to increase the toughness and tensile strength of welds on a specific type of component?

1. Selection of high tensile and toughness welding consumable and alloying elements which will increase the toughness and tensile strength

2. Select the welding parameters to control the heat input and followed by PWHT

This will increase the tensile strength and toughness

3. Select the suitable joint design

19. Without approval of drawing piping fabrication has been completed. What will be your course of action?

1. Raise a non conformance report

2. Check with approved drawing. If minor changes noted, which will not affect the product design requirement accept as it is provided a deviation request to be raised and approved

3. The changes to be incorporated in the as build drawing

4. If any major changes noted compared with approved drawing, to be re fabricated as per approved drawing

5. Concern person involved, to issues a warning letter

6. Conduct meeting with all inspector and make them awareness, such a things re occur in future

20 Going to sickness it have been necessary for you to replace a very experienced welding inspector who has been responsible for carrying out all welder approval testing. His replacement has to come from your existing staffs that have not vast experience in this field.
How would you instruct the replacement in his new duties and what critical points would you emphasis?

Prior to assigning the job I would assess the inspector knowledge level in the Welder approval Test then I would instruct to carry out and observe the following before test

1. Collect and go through relevant welding procedure specification and other procedures.
2. Prepare the measuring instrument those are required during the test for checking and Inspection tools like tongue tester, temperature measuring crayons. Inspection mirror, torch, Light weld Gauges, measuring tape etc and check their calibration validity.
3. Check the test piece material specification and dimension as per WPS.
4. Check the welding preparation for correct bevel angle, root face, root gap and mismatch.
5. Check consumable certificate such as filler wire, electrodes, fluxes and gases going to be used for Welder test.
6. Check fixing position of the test piece that is 1G, 2G, 3G, 4G, 5G and 6G etc.
7. Mark the bottom and top position in case of pipe.
8. Measure the heat input.
9. Final weld visual inspection
10. Mark the welder's, name, date, WPS No and Position,
11. Prepare test report no remarks and submit to supervisor for record and NDE processing

GENERAL WELDING QUESTIONS

1. During an audit no material mill certificate was found. How would you proceed?

If MTC is not available ask the supplier to provide it. If it is not available with the supplier then the material should be sent to lab for verifying its chemical and mechanical properties.

2. Why is it desirable to seal in a lamination which is found to break during an edge preparation?

Lamination is to be seal welded prior to welding because these areas will open up during welding due to the heat produced while welding

3. Describe briefly two methods of producing approved procedures?

A. By using prequalified procedures

B. By establishing a procedure

C. By doing mock-up or by trial and error method.

4. In a welder approval test should the procedure be explained to the welder?

No, it is not necessary.

5. What is the difference between a welding procedure approval and a welder qualification test?

The welding procedure approval test is carried out the quality of the weld using NDT and Mechanical testing. Procedure provides guidelines to the welder in order to produce the sound weld.

Welder approval test examines a welder's skill and ability of the welder or welding operator to make sound weld.

6. What does a procedure consist of?

Procedure consists of

A. Essential variables

B. Non-essential variables &

C. Supplementary variables

Essential variables: A change in welding parameters which effects the mechanical properties of a weld are called essential variables. E.g., Process, type of material, electrode / flux, shielding gas, preheating. PWHT, current and voltage etc,

Non-essential variables: Changes in welding parameters, which will not affect the mechanical properties of the weld metal, are called non-essential variables. E.g. Groove angle, method of cleaning etc.

Supplementary- variables: The. Welding procedure shall be attached: with PQR to show the evidence that the procedure meets the mechanical properties desired by the code/ specification.

7. Give typical example of approval for a) thickness. 5) Diameter. c) Process?

Thickness: When welder is qualified on thickness T' he s qualified to weld two times the thickness (2T)

Diameter: when weld is qualified on diameter 'D he is qualified to weld pipe size OD/2 and above

Process: When qualified in a particular process. He is qualified to weld only on that particular process using thickness parameters that are qualified

8. State the objectives of a) a reduced transverse tensile test, b) a radius-reduced transverse tensile test?

a) A reduced transverse tensile test specimen assesses the tensile strength of the joint

b) A radius reduced transverse tensile test specimen assesses the tensile strength of the weld metal.

9. What is the purpose of a) 'all weld' tensile test, b) A radius reduced tensile test?

a) An all weld tensile test is to measure the tensile strength of electrodes / flux combination and quality of the weld metal as deposited

b) A radius reduced tensile specimen assesses the tensile strength of the weld metal.

10. State three factors which contribute to or control the mechanical properties of wrought steel?

Wrought steel grain much refinement during the hot/cold working and many defects are also removed. This improvement is marked in the rolling direction but it usually results in a loss of strength through the thickness.

11. What is the metallurgical production cause of lamellar tearing?

Due to the presence of inclusions of sulphur, phosphor, and higher percent of carbon.

12. Does a wrought plate contain residual stresses due to manufacture?

Yes.

13. Give the composition for tool steel?

0.8%Cr, 1.0%Mn, 0.4%C 0.3%Mo, +Ti or Al, +residuals

14. If a bend test failure has occurred what would be your course of action?

Set aside the piece, take one more test piece and repeat the test. Assess the failure, whether the failure is within the weld metal, weld junction or in the HAZ. A retest is 'very much needed in case of failure.

15. Can a non-approved welder be employed to perform a welding procedure test?

Yes.

16. In which steels can it be expected that hydrogen induced cracking is found in the weld metal if present at all ?

High strength Mn steels.

17. State four mechanisms of cracking, which may be found in the weld metal of ferritic steel weldments?

a) Hydrogen induced cracking

b) Solidification cracking

c) Solidification pipe or void

d) Reheat cracking.

18. State six methods of procedure for avoiding solidification or center line cracking?

1. Add manganese to base metal
2. Increase metal
3. Reduce welding speed
4. Reduce amount of parent metal melting by welder technique and reduce amps.
5. Use of 1/3 - 2/3 joint preparations.
6. Use cooling bar
7. Reduce restraint
8. Use soft weld metal
9. Use clean metal

19. State three methods of procedures for avoiding solidification pipe in weld metal?

1. Correct depth to width ratio (open v groove)
2. Correct bead shape
3. Correct surface chilling effect due to

a) No slag covers process

b) Gas not heated

c) Flow rate too high

20. Explain why the quality of the parent plate may affect the incidence of weld metal cracking?

Lower quality or dirty steels have a higher residual content e.g.. Sulphur, phosphorus etc. Due to the lower melting point these segregate during the solidifications of weld pool in to the centerline of the weld forming a plane of low ductility which may crack when acted upon by the normal transverse residual stress.

21. State the four factors which give rise to hydrogen cracking and suggest how control can be exercised?

a) Stress, b) Hardness, c) Hydrogen and d) Temperature - thickness

A.STRESS

1. Minimize stress by

I) Presetting,

ii) Back stitch welding,

iii) Stringer bead, Joint design (double sided joint),

iv) Reduce restrains (J preparation - lower included angle)

B. Minimize hardness by lower C.E Limit heat input to 1.7 kg / m / ml (avoid grain enlargement) use BS 5135 for preheat

C. Minimize hydrogen presence in three ways

i) Removal by a combination. Preheat -Heat input (interpass temp.) and PWHT (electric not flame).

ii) Prevent entry by — selection of process, consumable control, surface cleanliness, welding techniques (short arc)

iii) Making hydrogen acceptable by control of formation of microstructure. Use an austenitic or nickel weld metal.

21. Why are austenitic SS electrodes sometimes specified for the welding of steels which might be subject to hydrogen cracking?

Austenitic stainless steel welds can absorb more hydrogen than carbon steel.

22. In what way does the thickness of the metal influence hydrogen cracking?

Increase rate of cooling, larger volume of hydrogen, greater stress.

23. In what steel group is PWHT almost always used?

Group 4 — High carbon steel

24. of the high carbon — no alloys, the carbon content is critical. State the % carbon above Which the welding becomes very difficult?

Carbon content in excess of 0.45

25. State two results, which may be expected from stress relief of welded products

1. Will reduce internal stress –
2. Hydrogen is diffused
3. Grain refinement

26. What would be the result of using temperature of 1300°C in heat treatment?

Steels which are overheated ie above 1200°C may suffer a permanent loss of toughness and also Form large quantities of mill scale on their surface.

27. State. Two types of cracking which can result from heat treatment

1. Stress relief or reheat cracking in steals containing chromium.
2. Thermal cracking.

28. What is the main advantage of using austenitic electrodes?

The advantage of using austenitic stainless steel electrodes for repairs that hydrogen entering the weld metal during welding is held in the weld metal and so will not diffuse in to the hardened HAZ. Hence hydrogen cracking in the HAZ is unlikely to happen

29. What is the main problem of weldability when using 18/8 type austenitic electrodes to repair ferritic steels?

1. Solidification cracking
2. Weld decay
3. Reduces the corrosion resistance of weld metal

30. Why is it recommended that 29/10 is used for buttering and 18/8 is used to fill when using austenitic electrodes for repair?

To avoid cracking it is desirable (at least in joints with high restraint) to butter with an electrode With high dilution tolerance and to make the closing weld with low strength electrode.

31. Explain why the depth to width ratio of the bead is important?

To take care of residual stresses in welds which developed

A. longitudinal along the weld,

B. across the weld,

C. through the weld

32. Outline the metallurgical features of weld decay?

Weld decay — steels with high carbide forming characteristics such as these will react if the Temperature is allowed to dwell about 550°C. If this occurs then the chromium is no longer Available for combination with oxygen for the reformation of the protective oxide film and corrosion may result. –

Weld decay — Depletion of chromium carbides in stainless steel

33. State three methods of avoiding weld decay?

i) Reduce the carbon content i.e. 308L

ii) Heat treatment 1100°C and quench.

iii) To stabilize the steel by added Ti or Nb (to form carbides in preference to Cr carbides)

34. Why are backing gases often specified when welding stainless steel?

To avoid contamination.

To prevent formation of porosity

To avoid formation of oxides.

35. Why is carbon-di-oxide not normally uses as a shielding as when welding stainless steel?
Low carbon carbon6. When stainless steel is welded to mild steel buttering is recommended why?

1. Seals carbon in

2. to stops dilution.

37. When welding SS to a large root gap (3mm) are often used why?

Distortion (to avoid distortion), closes gap.

38. What is the essential feature of a stainless steel?

Chromium content about 11% Cr is the minimum the formation.of.SS:29% Cr is the maximum For the formation of SS.

39. What is the principal reason for the development of residual stresses in metals?

Metals contract during solidification and subsequent cooling, but if this contraction is prevented or inhibited residual stresses will develop.

40, Name the three directions of residual stresses in welded joints?

Normal welds develop residual stresses.

a) Along the weld longitudinal residual stresses

b) Across the weld — transverse residual stresses

c) Through the weld — short transverse residual stresses

41. What causes distortion in welded products?

The action of the residual stresses in welded joints is to cause distortion.

42. Give four consequences of using excessive current?

a) Excess spatter, b) excess metal profile, c) center line cracking, d) undercuts

43. Give four consequences of using excessive arc lengths?

A) Unstable arc,

b) Lack of penetration,

c) Uneven profile bead.

44. State the defects which occur when the tack weld is not correctly incorporated into the weld?

Lack of penetration or fusion

45. Give three consequences of incorrect electrode angle?

a) Undercut. h) Spatter. c.) 1ac.k of penetration or fusion.

46. Give one consequence of a) too fast a travel speed and b) Too slow travel speed ?

a) Lack of penetration or fusion

b) Slag inclusion

47. What defect is associated ah excessively larg size electrods?

Lack of penetration

48. What defect is caused by inadequate cleaning between runs?

Slag inclusions.

SAW Defects

49. What defects can be caused by use of high welding speeds?

a) Lack of penetration or fusion, b) undercut

49. What defects can be caused by the use of excessive gaps?

Excess penetration or bum through.

50. What are the likely causes of slag in the weld metal?

Slag inclusions: Insufficient inter-run cleaning, poor bead- profile (convex shape)

51. What adjustment must be made in submerged arc welding to reduce the bead width?

a. Lower the voltage

b. Increase travel speed (if still within the parameters)

52. What defects can be caused by a plate having poorly cut joint preparation?

Lack of penetration or fusion

53. A. weld is to be made on a close square butt joint with excessively high current. What defect would occur?

Excess weld metal

54. What is the likely defect to be caused by a excessive flux burden?

Porosity.

55. What is the critical level of hydrogen in a weld, can it be measured at any time or after stress- relief ?

A. 5ml per 100gm of weld metal

b. All weld metal hydrogen diffusion test possible but not for the actual weldment.

56. Describe how and why hydrogen increases the incidence of hydrogen cracking?

Hydrogen in the weld/HAZ builds up internal pressure which could be higher that yield point of Metal low hydrogen= stress.

57. Describe a heat treatment designed to remove hydrogen. When the treatment must is applied?

PWHT for 10-20-30 hours.

58. Why must basic hydrogen controlled electrodes be kept at 150 deg C?

Prevents re-absorbing of hydrogen –

59. What is the cause of lamellar tearing?

Lamellar tearing is a defect in the parent metal of a weldment due to high through thickness Residual stresses and a low through thickness strength and ductility arising from the bands Within the steel.

60.Where is lamellar tearing found in a well-meant?

The crack is stepped. The crack is parallel to the surface of the plate.

61. How do bands (segregation) within steel influence the incidence of lamellar tearing?

Low through thickness strength and ductility arising from bands within the steel and of high residual stress.

62. Can susceptibility to lamellar tearing be assessed by ultrasonic NDE?

No.

63. Can lamellar tear be detected by NDE?

No.

64. State three methods of avoiding lamellar tearing?

1. Reduce the residual stress by low restraints i.e. by pre-setting rather than clamping by use of Gaps.
2. Buttering
3. Change in joint design

65. Name three types of stainless steel?

1. Martens tic
2 Austenitic
3. Ferritic –

66. State the main weldability problem of the Fe 11% chromium steels?

Hydrogen cracking

67. Name two methods of avoiding hydrogen cracking in martensite stainless steel?

I. Control by hydrogen limitation i.e. the use of Tig welding process.

2. Control by hardness, normal pre-heat and heat inputs, so select a very low carbon grade.

68. Why do micro alloyed steels suffer hydrogen cracking in the weld metal?

In the micro alloyed steels the hydrogen is held in the weld metal and so hydrogen tends to be Located there also.

69. What are the factors which give rise to hydrogen cracking in alloyed steels?

In the HAZ the tensile residual stresses are across the weld, so the hydrogen cracks are along the length of the weld. In the weld metal the tensile residual stresses are along the weld, so the hydrogen cracks are across the weld.

70. What are the two types of SAW flux?

1. Fused

2. Agglomerated

71. Why are hydrogen cracks in the weld metal positioned across the width of the weld?

Hydrogen cracking is typically formed at right angles to the stress and is positively identified by its trans-granular appearance when viewed at X- 100 magnification. In ferritic steels hydrogen which enters the weld metal during welding moves into the HAZ and due to, gas -forming characteristics and the residual stress, cracking may result.

72. State three items -which may contribute to excessive hardness in a weldment?

1. Grain size

2. Quenching

3. C.E. carbon and alloys

73 State two elements which cause center-line cracking?

Sulphur

Phosphorus

74. State the methods of minimizing solidification cracking?

1. Increase weld metal

2. Reduce the welding speed

3. Increase the manganese content of the weld pool

4. Use of cooling bars

5 use of clean metal –

6. Use of 1/3 — 2/3 joint preparation

7. Reduce the amount of metal melted out of the parent plate by

8. Skill / technique of the welder

9. reduce the amperage.

75. A crack is observed along the center line of the weld metal. Give two reasons for its formation?

When the weld metal has been deposited and its contracts during solidification it is vital that the

Contraction can be fed by the depression of the outer surface

Contraction fed by the weld metal surface

76. Give three reasons why pipe may form in the weld metal?

1. Pre-mature freezing of the surface
2. Excessive depth of bead related to width
3. Bad bead shape

77. Give three reasons which contribute to pre-mature freezing of the weld pool surface?

Pre-mature of the surface due to,

a. No slag covers i.e. the process

b. Gas not heated

c. Flow rate too high

78. Why is ferritic material usually added to austenitic electrodes?

To avoid center line e cracking

79. Why are austenitic electrodes used for welding carbon-manganese steel?

To control the hydrogen level i.e. making the hydrogen level acceptable to avoid hydrogen cracking

80. When ferrite is added to electrodes what are two possible consequences?

It tends to avoid solidification cracking; it does induce magnetism and makes the weld metal Avoid so reducing the corrosion resistance.

81. Describe the thermal conditions which give rise to weld decay in austentic. SS weld ments

550 degree C for six seconds

82. Why are small stringer beads usually recommended for SS weldments?

To reduce the level of heat input and to avoid cracking.

83. State the special mechanical properties of 25%Cr in Fe alloys?

Ferritic SS Weldabiiity poor due to cracking, brittleness and temper embitterment. It is a single phase alloy which is ferritic at all solid temperatures, so solidification cracldng is a problem.

84. What is a specification?

Specification is a description of what to use in the making of a product i.e. type of material, type of process, type of consumables.

85. What is the extent of approval in a procedure?

Extent of approval is the range over which certain variables may alter without requiring new Procedure i.e. when there is a limitation in the welding qualification i.e.

1. The minimum and maximum diameter of the pipe that the test sample covers e.g. two inch test piece would allow pipe down to 1" and upto 4"

2. The test may only allow welding of consumables in the same grouping, any other consumable Would require re-test

3. The use of set electrical characteristics would not allow change without retest

4. The direction of welding. If changed may require re-test

5. Change of material to be tested would require re-testing.

86. When is a procedure to be re-established?

When there is change in following essential variables

1. Change of welding process
2. Change of shield in gases or fluxes
3. Chance of direction of welding
4. Change in parent metal to be welded
5. Change in joint design
6. Change in welding consumables

7 Change in welding parameter range

87. State the four factors which must be satisfied for good welds?

Fusion welding factors

1. Fusion (melting) — the metal must be melted which requires a high intensity of heat source.
2. The process must remove any oxide and other contaminants from the joint faces
3. Contamination by the atmosphere must be avoided
4. The welded joint must possess adequate properties

88. If you detect arc strike what is the course of action?

If any arc strike is found on the parent metal it should be ground smooth and I is to be Conducted on the location if it is a ferrous material. For SS, PT is to be conducted

89. What are the documents required to do a repair?

Approved repair welding procedure, qualified welders, method of crack removal, repair report.

90. If visual examination of weld is not possible how will you ensure that the joint is okay?

It. can be examined by appropriate NDT methods like RT, UT etc.,

91. What are minor defects?

Mis-alignment (linear & angular) , slag, porosity etc.,

92. What are the major defects?

Lack of side wall fusion, overlap, lamination. Lack of interun fusion, lack of penetration, incomplete fusion

93. What is the course of action if he weldment has been accepted or rejected?

After inspection results to be recorded in an approved format. If the sample is rejected then the

type of defect and the location has to incorporated in a sketch and the report has to be given for further remedial action.

94 What features of steel determine its weldability?

Carbon content & carbon equivalent.

95. What is the main advantage of using 29/10 type austenitic electrodes to repair ferritic steels?

The defects of dilution will be to lower the alloy content of the weld metal during cooling so it is Advisable to use it.

96. In Service Failure of a weld @ -- 40 Deg C

Service temperature of - 40 Deg C tells that the failure most probably has occurred due to lack of strength or toughness at that temperature. Compared to base metal, a weld is always irregular shape and hence is considered as irregularity or discontinuity in surface profiles. Any discontinuity serves as stress raisers when it comes across line of stresses. The strength of material drops at the locations of high stress concentration especially when temperature drops significantly.

In brief metal tends to lose its notch toughness of given weld at low temperature.

This can be approached in following ways.

1) Verifying that WPS

2) Verify the heat treatment record (if any)

3) Review and scrutinize lab test report including the charpy V notch test for all weld specimens

4) Review batch certificates for consumables used

5) Location of failure should be inspected and point of initiation should be established

If the location of failure initiation happens to be a defect viz., undercut or porosity then failure can be attributed to sheer lack of low temperature strength.

Recommendation: Use consumables giving high low temperature strength and improvement in weld profile.

However if the point of initiation happens to be a surface or subsurface defect the corresponding radiograph for that section of weld may be examined and interpreted.

SENIOR WELDING INSPERCTOR-3.2.2

WELDING TECHNOLOGY MODEL QUESTION

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SWI-MULTICHOICE QUESTION PAPER-001

1. Which are the five areas of technical knowledge required of an SWI?

A. Planning, leadership, NDT, costing and metallurgy.

B. Costing, organization, technology, normative documents and auditing

C. Technology, Procedures, organization, normative documents and auditing.

D. Training, normative documents, metallurgy, organization and auditing

2. In relation to planning what is meant by C.P.A.?

A. Current project assessment

B. Controlled project analysis

C. Critical path analysis

D. Critical path assessment requirements

3. Quality Control asks the question?

A. Has the work or service fulfilled the requirements?

B. Is the work or service fulfilling

C. The work must always meet the requirements at any cost

D. Both a and b

4. What is the meaning of the terminology code of practice?

A. A documents that provides rules and legal requirements

B. A checklist

C. A document. This recommends practices or procedures.

D. A standard for standardization.

5. What are the four task elements which may assist in the analysis of a quality problem?

A. Planning, leadership, organization and control

B. Item, information, people and equipment

C. Item, information, Procedures and equipment

D. People. Leadership, information and control.

6. What is the purpose of an audit?

A. To check against documented criteria

B. To check cost related information only.

C. to check process variations only

D. To provide evidence of conformity in the form of certification.

7. Which of the following audits may provide an independent certificate of conformity?

A. an Internal audit

B. Second party audit

C. Third Party audit

D. All audits provide independent certificates of conformity.

8. What is meant by the term inspection?

A. Visual examination of a product or service

B. Determining conformity by measuring/gauging characteristics and comparing with specified requirements,

C. The actual measurement of quality

D. Monitoring and elimination of the causes of defective components.

9. What is meant by the term quality assurance?

A. Providing adequate confidence that given requirements for quality have been met through planned and systematic actions.

B. To correct process and produce variations.

C. The operational techniques and activities that are used to fulfil the requirements for quality.

D. Visual inspection and measurement of a product or process.

10. What is meant by the term normative document?

A. General term used to cover standards, specifications etc.

B. A legal document, the requirements of which must be carried out

C. A document approved by a recognized body through consensus

D. A written description of all essential parameters for a given process.

11. What is meant by the term specification?

A. A documents that prescribes the requirements with which the product or service has to confirm.

B. A set of guidelines recommending practices or procedures

C. A written description of the exact steps to be followed in manufacturing a product

D. All of the above

12. What are the typical features on a fatigue fracture with ductile failure as the secondary mode?

A. Flaw; smooth surface, beach mark. Grey fibrous appearance and a reduction in area.

B. Flaw; beach mark, reduction in area, smooth fracture surface and a bright crystalline appearance.

C. Flaw. Beach marks, no reduction in area, smooth fracture surface and grey fibrous appearance

D. All of the above

13. Some application specifications ask for the weld toes to be blended. What is the main reason for this?

A. Appearance

B. Improved coating application

C. Increase fatigue life

D. All of the above

14. Planar defects may be best described as?

A. Linear from at least one direction

B. Rounded indications

C. linear from at least one direction with volume

D. May be classed as all of the above.

15. Which of the following materials has the poorest weldability?

A. Austenitic stainless steel

B. Martensitic stainless steel

C. Carbon manganese steel

D. HSLA steel.

16. Sketch a "J" preparation and show the bevel angle, land root face, root gap and root radius, discuss briefly the uses of this weld preparation and in what situations might it be used?

17, Sketch three different types of joints made using fillet welds?

18. State five essential variables on a W.P.S.?

19. Describe the features of a fatigue fracture giving reasons and causes for this fractures occurrence.

20. Briefly discuss the metallurgical differences between three types of stainless steels?

SWI-MULTICHOICE QUESTION-PAPER-002

1. Which of the following statements is true when using a flat characteristic power source?

A. The electrode is DC-VE

B. The shielding gas will be pure argon

C. The wire feed speed remains constant

D. The electrode extension will have no effect on weld quality.

2. What five parameters would be checked when calibrating welding equipment for automatic GMAW welding? (WFS= wire feed speed)

A. Joint geometry, flux coating polarity, travel speed and amps/volts

B. Amps/Volts WFS, gas flow rate, polarity and travel speed

C. Amps/Volts, WFS, wire diameter, polarity and electrical stick out.

D. Electrical stick out, WFS amps/Volts travel speed and wire diameter.

3. Which type of material is the most susceptible to re-heat cracking?

A. Carbon steel

B. Killed steel

C. Creep resisting steel

D. Austenitic stainless steel

4. What is hot shortness?

A. Susceptibility of a material to crack during hot working

B. Brittleness at elevated temperatures

C. Susceptibility of a material to crack during cold working

D. A dimensional problem occurring during hot rolling

E. Both a and b

5. Which of the following could be considered to be a concession?

A. Written authorisation to use already produced items. Processes or procedures that do not confirm to specification.

B. Written authorisation to use a new specification, which is not specified in the contract documents, supplied to date.

C. Written authorisation to use non-conforming equipment.

D. All of the above could apply.

6. What is a lap in steel?

A. A folds occurring in the steel during forming or rolling

B. A sub-surface lamination, which may affect the strength of the steel

C. A type of crack occurring in the parent material.

D. A non-metallic inclusion.

7. Three essential factors for fusion welding are: melting/fusion. Removal of oxide from the joint surfaces and the elimination of the atmosphere from the arc region. Name the fourth.

A. The weldment must be free from stress

B. The filler material must match that of the weld in terms of content of alloying elements

C. The completed joint must match the required physical and mechanical properties.

D. An arc for a heat source.

8. What is a quality plan?

A. A job specific document setting out quality practices and sequence of activities.

B. A procedure for carrying out a given task

C. A quality control documents to record set Variables

D. A plan stating how customer acceptance will be achieved.

9. Which of the following do you consider to be the duties of a SWI?

A. Supervision of welders

B. Qualification of welders

C. Training of welders

D. All of the above.

10. In accordance with BSEN 22553 which of the following symbol best represents a double J butt weld

11. In general it is not easy to mechanise the MMA welding process because?

A. Short electrode lengths, the control of the arc length and the process uses a flat characteristic

B. Short electrode lengths. The control of the arc length and flux coverings.

C. The control of the arc length, stop/start problems and short electrode lengths.

D. Flux coverings, short electrode lengths and the relationship between amps and volts.

12. The welding arc could be characterized as?

A. High current, low voltage with a flow of electrons from cathode to anode

B. Low current, high voltages with a flow of electrons from cathode to anode.

C. Medium current, medium voltage with a flow of electrons anode to cathode.

D. A voltage, which remains almost constant at a constant potential.

13, most metals expand when he heated, this change in length is expressed as?

A. Thermal conductivity

B. Modulus of elasticity

C. Coefficient

D. Yielding

14. a multi-run butt weld made on C/Mn steel consists of 5 weld passes using a 6 mm diameter Electrode, A12 pass weld made on the same joint using a 4mm diameter electrode on the same material (assuming no post heat treatment has taken place) will?

A. Have a lower heat input and a higher degree of grain refinement

B. Have a lower heat input and a coarse grain structure.

C. Have a lower amount of distortion and higher grain refinement

D. Have a higher amount of distortion and a lower degree of grain refinement.

15. What are the possible effects of having a high heat input?

A. An increase in hardness and lower yield strength

B. A reduction in toughness and an increase in hardness

C. Entrapped hydrogen and lack of fusion

D. A lower toughness and lower yield strength

16. What is the difference between inspecting for quality control and inspecting for fitness for purpose?

17. What are the considerations for QA/QC and inspection departments if it is required to increase the toughness and tensile strengths of welds on a specific type of component?

18. List the main advantages of planning and what aspects of planning a senior welding inspector should consider?

19. Using weld symbols to BS EN 22553 show how the following would be indicated on a Fabrication drawing

A. Fillet welds 8 mm throat thickness, weld to be made other side?

B. Welded other side, four intermittent fillet welds 6mm leg lengths 20mm in length, Distance between each weld 10mm. Welded arrow side?
Three intermittent fillets weld 6mm leg lengths 10mm in length, Distance between each weld 20mm. Welds to be staggered?

C. Welded arrow side, steep flanked single-bevel butt weld

D. Welded arrow side. Single j butt weld with a 6mm leg length fillet weld superimposed cap to be flush. Welded other Side, Fillet weld 8mm leg length?

20. by the use of a diagram show the following features on a fillet weld, leg length, design and actual throat thickness?

SWI-MULTICHOICE QUESTION PAPER-003

1. What is an active flux?

A.A material used to clean the surfaces of the joint through continued chemical reaction

B.A material used to protect the molten weld pool during welding

C.A material used to promote fusion between the joint surfaces

D. All of the above

2. How many N/mm2 in 1 MPa?

A.1

B.10

C.14.9

D.144.9

3. What does the standard AWS A5.5 refer to?

A. Specification for carbon steel electrodes for SMAW

B. Specification for low alloy steel electrodes for SMAW

C. Specification for carbon steel electrodes and fluxes for SAW

D. Specification for carbon and carbon Mn steel tubular cored electrodes for FCAW.

4. Which two aspects of radiographic images are normally measured?

A. Density and contrast

B. Sensitivity and definition

C. Density and sensitivity

D. Contrast and definition

5. What is the primary purpose of CTOD testing?

A. To induce a fatigue crack

B. To determine a materials resistance to the initiation of a crack resulting from a notch defect

C. To assess a material's resistance to high-speed resonance load cycling

D. To provide fracture surface assessment

6. When considering a post weld heat treatment which of the following need to be monitored?

A. Heating rate

B. Temperature attained

C. Soaking time

D. Cooling rate

E. All of the above

7. Why is aluminium added to steel during the steel making process?

A. To improve toughness and aid grain refinement

B. To improve deoxidation and aid grain refinement

C. To improve strength and ductility.

D. To improve hardness and the resistance to wear.

8. What information, unique to penetrate testing, is relevant to record on a penetrate testing report?

A. Dwell time, developer type and development time.

B. Type of white contrast paint, dwell time and drying time

C. Dwell time, couplant type and drying time

D. Dwell time, development time and ink type

9. Which of the following mechanical test(s) can give a quantitative assessment of ductility?

A. Tensile test

B. Nick-break test

C. Bend test

D. All of the above.

10. Which of the following are reasons for applying pre-heat?

A. The removal of residual stresses and the removal of moisture from the joint

B. To aid slow cooling and to reduce the carbon content

C. To reduce the chance of a brittle grain structure and to reduce the chance of hydrogen entrapment

D. Increase overall weld ability and to increase UTS values.

11. A tensile test piece had original gauge length of 63mm; after testing the gauge length had increased to 73.4mm. What is the percentage elongation value?

A. 16.5%

B. 116%

C. 0.18%

D. 18.5%

12. What is the UTS value of a tensile specimen if the leased CSA is 37.5mmX19.35mm and the maximum load?

Applied 335 KN?

A.461.7KN/mm2

B.461.7N/mm2

C.487.tN/mm2

D.487.7KN/mm2

13. How many um in 0.1812 mm?

A.181.2

B. 0001812

C. 181200

D. 1812

14. How many mm in 3.6 X10 2 cm?

A. 360mm

B. 3600mm

C. 36mm

D. 0.036mm

15. What are the axes found on a stress stain curve?

A. Vertical axis strain, horizontal axis stress.

B. Vertical axis load, horizontal axis extension.

C. Vertical axis extension, horizontal axis strain.

D. Vertical axis extension, horizontal axis stress.

16. Discuss the advantages and disadvantages of conventional ultrasonic testing and site radiography?

17.What is the difference between shall and should when used in specifications?

18. Give a brief description and the purpose of the following mechanical tests.

A. Bend test

B. Carpy test

C. Tensile Test

D. Fracture fillet test.

19. Give a brief description of the differences between macro and micro examination: also state the purpose of each examination.

20. List five items of information that could be recorded on an ultrasonic test report, which would never be Present on a radiographic report?

SWI-MULTICHOICE QUESTION PAPER-004

1. What is weld decay?

A. Local reduction in chromium content occurring in unsterilized austenitic stainless steel, lowering the Materials resistance to corrosion attack.

B. Slow plastic deformation of a material under constant stress at any temperature.

C.A type of crack, which may occur in materials, that are in a state of tensile stress and in contact with Corrosive material.

D.A type of crack which occurs in the HAZ of welds of low alloy steels during PWHT or service elevated Temperatures

2. Which of the following are essential factors for lamellar tearing?

A. High residual stress, poor through thickness ductility, and existing plate laminations.

B. Poor through thickness ductility, fusion face parallel with rolled direction of parent plate, most Commonly occurs in single-V butt welds.

C. Stress, poor through thickness ductility, fusion face parallel with the rolled direction of the parent Material.

D. Tensile stress, deoxidized parent plate. Poor through thickness ductility.

3. What are the units used when measuring light intensities for viewing test specimens using MPI or DPI Testing?

A. Tesla.

B. Lux

C. Hertz

D. Gray

4. What instrument would be used to measure the density of a radiograph?

A. Pentameters

B. Densitometer

C. Light meter

D. TLD

5. Which of the following may be used to reduce distortion?

A. The least amount of deposited weld metal possible with as few weld passes as possible.

B. The least amount of deposited weld metal possible with as many weld passes as possible.

C. Use a faster welding process with as many weld passes as possible.

D. Use materials with low thermal conductivity and lower elasticity.

6. If it was a requirement to radiograph a 10mm thick steel well-meant, which of the following Isotopes would be the most suited with regards to application and quality?

A.Yb169

B. Tm 170

C. Ir192

D. Co 60

7. Which of the following applies to plate laminations?

A. It is a product defect, which occurs during the steel making process

B. It is a rolled out casting defect

C. It is caused mainly by poor through thickness ductility

D. Both a and b

E. All of the above

8. When welding rimming steel with autogenous TIG process which of the following Problems may occur?

A. Porosity

B. Tungsten inclusions

C. Burn through

D. Excessive cap reinforcement

9. What does PQR stand for?

A. Production quality control record

B. Production quality record

C. Procedure qualification record

D. Procedure quality record.

10. Basic coated electrodes have which of the following properties?

A. High mechanical properties may be used to produce welds of high deposition rates and if used correctly may produce welds of a low hydrogen contents.

B. Friable slag, high mechanical properties and if used correctly may produce welds of low hydrogen contents.

C. Ease of use, Good stop/starting properties and may produce welds of low carbon Contents.

D. All of the above could apply to basic coated electrodes.

11. Which of the following are considered heat affected zone cracks?

A. Solidification cracks lamellar tearing and re-heat cracks.

B. Hydrogen cracks, solidification cracks and liquation cracks

C. Re-heat cracks, solidification cracks and liquation cracks

D. Re-heat cracks, liquation cracks and hydrogen cracks.

12. Which of the following is the most likely appearance of lack of root fusion on a radiograph taken of a single vee butt weld?

A. Dark straight line with a light root

B. Dark straight line with a darker root

C. Dark root with straight edges.

D. Dark uneven line with a light root

13. Which of the following best describes a semi-automatic welding process?

A. The welder is responsible for the arc gap and travel speed.

B. The welder is responsible for the travel speed only.

C. the Welding plant controls both arc gap and travel speed but under constant **Supervision**.

D. The welding plant controls both travel speed and arc gap, no supervision required.

14. What would be the main effect produced by increasing the KV's in a radiograph?

A. An increase in sensitivity.

B. An increase in definition

C. A reduction in density

D. A reduction in contrast.

15. Which of the following defects are likely to be missed using x-ray as the inspection medium?

A. Plat laminations, lack of sidewall fusion on a single U butt weld and cap overlap.

B. Toe crack, plate laminations and lack of sidewall fusion on a double U butt weld.

C. Plate laminations, lack of inter-run fusion with the MIG/MAG welding process and cap overlap.

D. All defects are detectable when using x-ray.

16. You are required to visit a site on which your welding inspectors have been involved. The work concerns the inspection of a welded structure to a specified application standard and is now completed and ready for final approval.

What questions do you ask, what documents do you review and what inspections do you require before submitting Your inspection report to the authorities concerned?

17. Describe the relationship between the four essential factors involved in the formation of hydrogen induced cold cracking?

18. Briefly discuss the essential factors involved with solidification cracking and its effects Oil steel welds?

19. Discuss the reasons for the existence of arc blow and state possible methods of Minimizing arc blow?

20. Discuss the factors involved with lamellar tearing, with the aid of a diagram show its typical location?

SWI-MULTICHOICE QUESTION PAPER-005

1. Which are the five areas of technical knowledge required of an SWI?

A. A. Planning, leadership. NDT, costing and metallurgy.

B. Costing. Organization, technology normative documents and auditing

C. Technology, Planning, organization normative documents and auditing

D. Training, normative documents, metallurgy, organization and auditing.

2. Which of the following is not a fusion weld?

A. Thermit welding

B. Electro slag welding

C. Laser welding

D. Friction welding

3. which of the following is not variable used in penetrate testing?

A.

B.

C.

D.

4. Which of the following statements is true if applicable to a charpy vee notch impact test?

A. It's a destructive test used to determine materials ductility in the weld zone.

B. its mechanical test used to determine a welds resistance to creep.

C. It's a dynamic test, which is used to give a measure of notch toughness.

D. It's a static test used to determine materials toughness in the notch region.

5. How can you tell the difference between an EN/ISO weld symbol and a BS weld symbol?

A. the EN/ISO weld symbol will always have the arrow side weld at the top of the Reference line.

B. the EN/ISO symbol has the welds elementary symbol placed on a dashed line

C.Laying above or below the solid reference line to indicate a weld on the other side.

D. the EN/ISO symbol has a fillet weld leg length identified by the letter "a"

E. the EN/ISO symbol has a fillet weld throat thickness identified by the letter "Z".

6. What is the possible effect of having the heat input too during welding?

A. Low toughness, entrapped hydrogen and low hardness.

B. High hardness, lack of fusion and entrapped hydrogen.

C. Entrapped hydrogen, low toughness and high ductility,

D. Lack of fusion, low toughness and a reduction in ductility.

7. An MMA electrode classified as E7018 is?

A. A basic low hydrogen electrode containing iron powder.

B. A rutile electrode containing iron powder.

C. A Cellulose electrode suitable for welding in all positions.

D. A rutile electrode depositing weld metal with a tensile strength of a least 70,000 Psi.on firm.

9. Which of the following may be used for the TAG welding of austenitic stainless steel?

A. Lanthanum electrode, DC-ve

B. Cerium electrode, DC-ve

C. Zirconium electrode, AC

D. Thorium electrode, DC+ve

10. Which of the following is the most likely to be considered an essential variable for a Procedure qualification test?

A.A change from an electrode classified to BSEN 499 as an E46 3 INI B to an electrode Classified to AWS A5.1 as an E7018.

B. A change of pipe wall thickness by at least 15mm.

C. A change in pre-heat temperature from 50'C to 100'C.

D. All of the above.

11. What is meant by the term specification?

A. A document that prescribes the requirements with which the product or service has to conform.

B. A set of guidelines recommending practices or procedures.

C. A written description of the exact steps to be followed in manufacturing a product.

D. All of the above.

12. Which of the following gives information on the susceptibility of a material to lamellar tearing?

A. CTOD test

B. Charpy vee notch test

C. Through thickness test

D. None of the above

13.Name the fourth weld process crack which has a totally different formation mechanism to HICC, Solidification cracking and lamellar tearing?

A. Liquiation cracking

B. Re-heat cracking

C. Crater cracking

D. Hot tearing

14. Which of the following material types is the most susceptible to re-heat cracking:

A. Austenitic stainless steel

B. C-Mn steel

C. Cr-Mo-V steel

D. HSLA steel.

15. Assuming the radiograph to be of a good quality initially, which of the following Changes would give the most adverse result on the radiograph produced when using x-ray equipment?

A. A change in exposure from 1 minutes 12 ma to 3minutes 4ma.

B. A change from 200 kv to 300kv.

C. A change in development time from 4 minutes to 4 minutes 30 seconds

D. All of the above would have the same adverse affect on the radiograph.

16. Which of the following is most likely to increase the change of Solidification cracking?

A. Reduction in sulphur content of the parent material

B. Increased restraint on the joint during welding

C. Increased in weld hydrogen content from 15m/100g to 25m/1100g

D. Poor through thickness ductility in the materials being welded.

17. Which of the following are never reasons for using P.W.H.T?

A. Hydrogen release

B. Stress relief

C. Grain refinement

D. Carbon reduction

18. A multi-run MMA. Butt weld made on c-mn steel consists of 5 passes,12 pass weld made with a smaller diameter electrode on the same joint on the same material will have?

A. a lower heat input and a higher degree of grain refinement

B. A lower heat input and a coarse grain structure

C. A higher heat input and a higher degree of grain refinement

D. A higher heat input and a greater degree of distortion

19. When considering the advantages of site radiography over ultrasonic inspection which of the following applies?

A. A permanent record produced, good for detecting defects that do not have significant depth in relation to the axis of the radiation beam and defect identification.

B. A permanent record produced, good for the detection of all surface and sub-surface defects and assessing the through thickness Depths of defects.

C. Permanent record produced, good for defect identification and not as reliant upon surface preparation.

D. No controlled areas required on site, a permanent record produced and good for assessing pipe wall thickness reductions due to internal Corrosion.

20. Inverter systems?

A. Changes ac to dc at a higher frequency

B. changes dc to ac at a higher frequency

C. Keeps dc constant thus giving an increase in arcstability

D. All of the above,

21. Which of the following mechanical tests can give a quantitative Assessment of ductility?

A. Tensile test

B. Nick-break test

C. Bend test

D. All of the above

22. Which of the following are applicable to dc electrode-ve when using MMA welding process?

A.A broad heat affected zone, a reduction in hardness and a narrow deep fast freezing weld pool.

B.A narrow heat affected zone, fast freezing weld pool and good Penetration properties.

C. Mechanically and metallurgical no different to dc=ve

D. wide shallow weld pool, flat weld profiles and lower hardness Values.

23. When welding aluminium with the MMA welding process?

A. The use of ac current only.

B. The use of dc electrode+ ve only.

C. The use of dc electrode-ve only

D. Both a and b

24. a tee joint on a support bracket is to be welded both sides using 5 mm leg length fillet welds, each weld is to be intermittent 50 mm in Length, the gap between each weld is to be 25mm. In accordance with en 22553 which of the following symbols gives the correct Representation?

25. Which of the following is likely to reduce the chances of arc blow?

A. Change the welding current from dc to ac

B. Change the welding current from ac to dc

C. Change from dc+ve electrode to dc -ve electrode

D. Change from dc-ve electrode to dc - ve electrode.

26. A welder qualified in the pg position would normally be qualified for welding?

A. All diameters of pipe

B. Welding positions Pa, PC, PG and Pf

C. In position pg only

D. All pipe wall thickness.

27. The welding arc could be characterised as?

A. A high current, low voltage arc with a flow of electrons flowing from cathode to anode

B. A low current. High voltage arc with a flow of electrons flowing from cathode to anode

C. A medium current and medium voltage with a flow of electrons and +ve ions flowing from anode to cathode.

D. A voltage, which always remains constant at a constant potential with a flow of electrons and -ve ions from cathode to anode.

28. The heat affected zone of a fusion weld?

A .Usually has the highest tensile strength

B. Cannot be avoided

C.Is usually martensitic

D. Both a and b

E. All of the above

29. When using basic electrodes, to keep the weld metals hydrogen, Content down to <15ml/100g of weld metal deposited, which of the Following applies?

A. The electrodes must be used indoors, can only be used in the down, Hand position and the use of pre heat is essential.

B. The electrodes must be used in a dry condition but never baked, the use of pre heat and used with a short arc gap.

C. The electrodes must be used with a short arc gap; the use of a minimum weave and the electrodes must be used in a baked condition.

D. The electrodes must be pre baked, used on dc. Electrode + ve and with a minimum arc gap.

30. In accordance with BS en 22553 which welding symbol best represents a fillet weld, Welded other side?

SENIOR WELDING INSPECTION-3.2.2

ENGINEERING DRAWING -CHAPTER

SREE BALAJI TECHNICAL INSPECTION SERVICES

NO-10A, VASUDEVAN STREET, SHANKAR ABODES,

THIRUVANIKOVIL, TRICHY-620005

PHONE-91-9942217610/0431-4250109

MAIL:sbtis2010@gmail.com

PREPARED BY: R.MURALIMOHAN

First aids to the practised thoroughly

To make
12 aths - 1 hr

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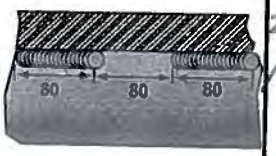
BS 499 part2 Answers DRG B

1. **Welded all way around:** 6mm leg length fillet weld, site weld (peripheral weld)

2. **Welded both sides:** 8mm fillet weld, peripheral weld, weld to be welded all around the part.

3. **Welded arrow side:** 10mm leg length fillet weld
Welded other side: Single-J butt with an 8mm leg length fillet weld superimposed, after welding UT inspection to be carried out

4. **Welded arrow side:** 10 fillet welds 8mm leg lengths, the length of each weld 80mm the distance between each weld 80mm.



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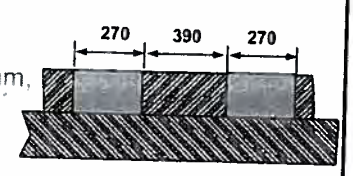
BS 499 part2 Answers DRG B

5. **Welded both sides:** 16mm leg length fillet weld, fillet welds to large for the parent materials thickness

6. **Welded arrow side:** Fillet weld, 8mm throat thickness, 10mm leg length

7. **Welded arrow side:** Single-bevel butt weld, flush finish

8. **Welded arrow side:** Two plug welds, slot width 8mm, length of each weld 270, gap between each weld 390mm.



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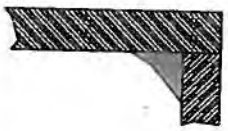
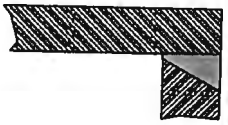
BS 499 part2 Answers DRG B

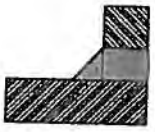
9. **Welded arrow side:** 6mm fillet weld. After welding completed MT to be carried out.



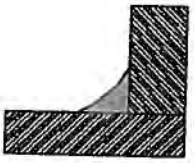
10. **Welded arrow side:** Single-bevel butt weld, flat (flush) profile



11. **Welded arrow side:** Square butt weld, convex profile.
Welded other side: 6mm leg length fillet weld.



12. **Welded arrow side:** 8mm leg length fillet weld concave profile.



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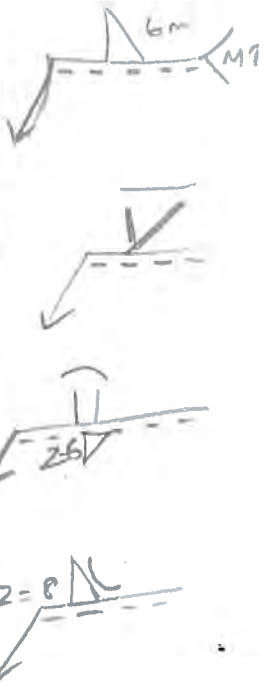

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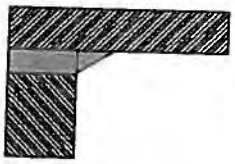
BS 499 part2 Answers DRG B

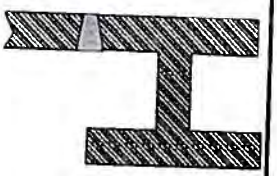
13. **Welded arrow side:** Backing run weld flat (flush) finish.
Welded other side: Single-V butt weld.

14. **Welded arrow side:** Square butt weld, flat finish.
Welded other side: 8mm leg length fillet weld.



15. **Welded arrow side:** Single-U butt weld. flat (flush) finish

16. Welded other side: Single-V butt weld.
Welded using the MAG welding process



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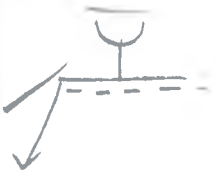

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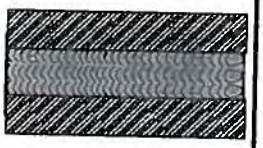
BS 499 part2 Answers DRG B

17. **Welded arrow side:** 8mm leg length fillet weld.

18. **Welded all way around:** Surfacing weld (hard facing).
B.2. Indicates specific instructions



19. **Welded arrow side:** Single-bevel butt weld
Welded other side: 6mm leg length fillet weld.

20. **Welded arrow side:** 12mm leg length filiet weld
Welded other side: 8mm leg length fillet weld.
Note leg length to large for material thickness

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Any Questions

M.S.Rogers

TECHNOLOGY

BS EN 22553 Answers DRG C

1. **Welded arrow side:** Single-J butt, flat (flush) finish.
   Welded other side: 12mm leg length fillet weld.

2. **Welded arrow side:** Single-bevel butt partial penetration, depth of preparation 25mm
   Welded other side: 6mm leg length fillet weld, welded all way around, Drawing indicates the pipe to be prepared incorrect set-up

3. **Welded both sides:** 12mm leg length fillet weld, toes blended smooth, welded all way round (peripheral weld). After welding is completed MT to be carried out.

4. **Welded arrow side:** Single-bevel butt weld, smooth finish.
   Welded other side: 12mm leg length fillet weld.

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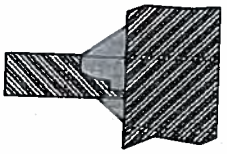
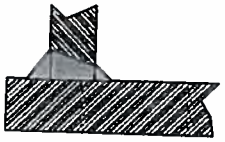
BS EN 22553 Answers DRG C

5. **Welded both sides:** Double-bevel butt weld with a broad root face, A.1 reference symbol indicates specific instructions e.g. procedure sheet.

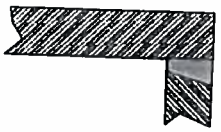
6. **Welded arrow side:** Single-J butt depth of preparation 50mm with a 35mm leg length fillet weld superimposed, toes shall be blended smooth
   Welded other side: 8mm leg length fillet weld



7. **Welded arrow side:** Steep-flanked single-bevel butt with a 12mm leg length fillet weld superimposed.
   Welded other side: 12mm leg length fillet weld.



8. Welded arrow side: Steep flanked single-bevel butt flush finish



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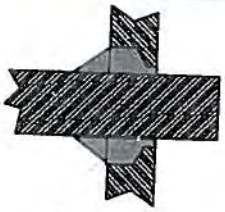
BS EN 22553 Answers DRG C

9. **Welded arrow side:** Square butt, site or field weld.

10. **Welded arrow side:** Surfacing weld (hard facing).

11. **Welded arrow side:** Single-J butt with a 25mm leg length fillet weld superimposed, reference symbol indicates specific instruction.



12. **Welded arrow side:** Double bevel butt weld, 16mm leg length fillet weld superimposed, weld to be made all way around component.
Note: fillet weld should be placed on other side.

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13. **Welded both sides:** Five fillet welds 8mm leg lengths, Length of each weld 20mm distance between each weld 20mm

14. **Welded arrow side:** 35mm leg length fillet weld concave profile

15. **Welded arrow side:** 12mm leg length, welded all way around part (peripheral) weld

16. **Welded other side:** 12mm leg length,concave profile welded all way around part (peripheral) weld

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17. **Welded both sides:** Double-bevel butt with a 12mm leg length fillet weld superimposed peripheral weld. After welding to be inspected with UT.

18. **Welded both sides:** Three 16mm leg length fillet welds, each weld 25mm in length, gap between each weld 50mm welds to be staggered.

19. **Welded both sides:** Three 12mm leg length fillet welds, each weld 50mm in length, To be welded with the MAG process.

20. **Welded arrow side:** Single-bevel butt weld with a 10mm leg length fillet weld superimposed, peripheral weld. After welding weld to be inspected with UT

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21. **Welded both sides:** Single-J butt, flush finish, peripheral weld

22. **Welded arrow side:** Steep-flanked single-V butt, flat (flush finish).
Welded other side: Backing run flat (flush) finish, weld to be made all around the part welded using the MAG process

23. **Welded both sides:** Double-U butt weld, flat (flush finish peripheral weld

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24. **Welded arrow sides:** Convex single-V butt weld with permanent backing strip.

25. **Welded both sides:** Concave fillet weld with 12mm leg lengths. MT inspection required.

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Any Questions

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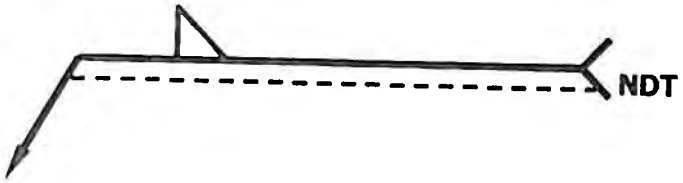
COMPLEMENTARY INDICATIONS.

Non Destructuve Testing -
other than visual



WELD SYMBOLS .

QUESTIONS ?

BS EN 22553 rules

Welds Arrow Side of joint, Symbol on the Solid reference line. Welds on Other Side of the joint, Symbol on the Dashed identification line.

Symbols with a Vertical Line component must be drawn with the vertical line to the Left side of the symbol

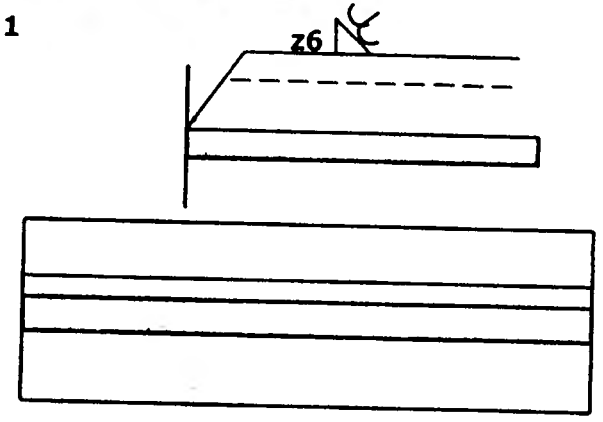
All CSA dimensions are shown to the Left of the symbol

All Linear dimensions are shown on the Right of the symbol i.e. number of welds, length of welds and distance between welds

ANSWERS TO EXERCISES.

BS EN 22553 FILLET WELDS

1

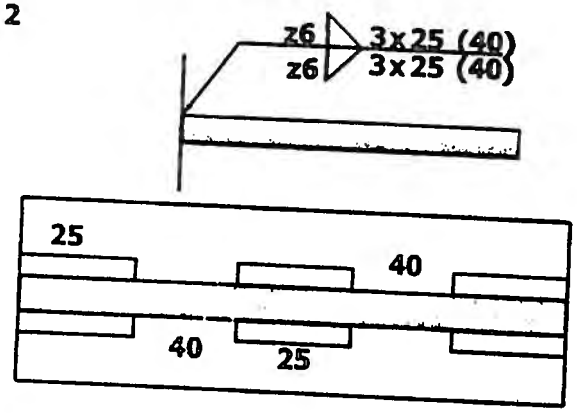


PART 9 (W.S)

ANSWERS TO EXERCISES.

BS EN 22553 FILLET WELDS

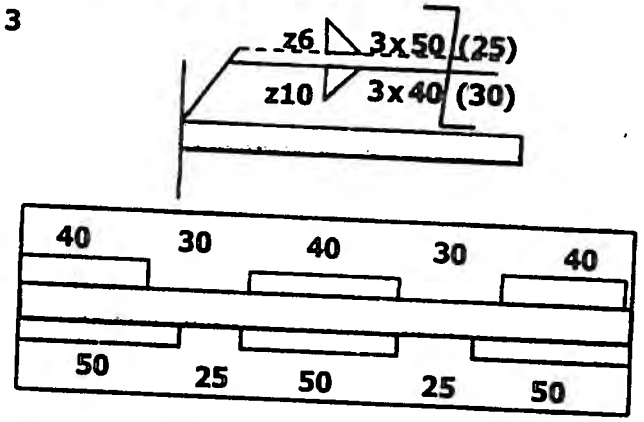
2



ANSWERS TO EXERCISES.

BS EN 22553 FILLET WELDS

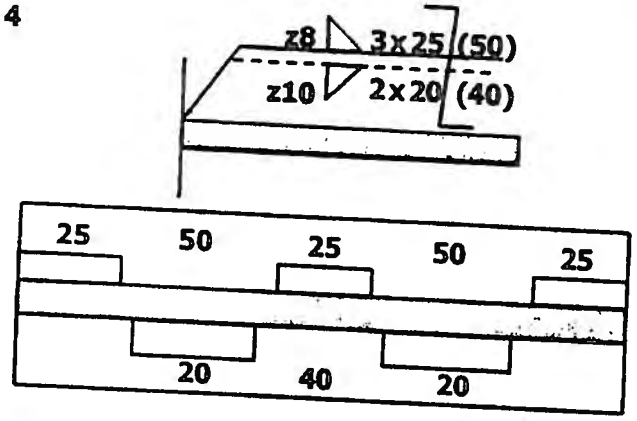
3



ANSWERS TO EXERCISES.

BS EN 22553 FILLET WELDS

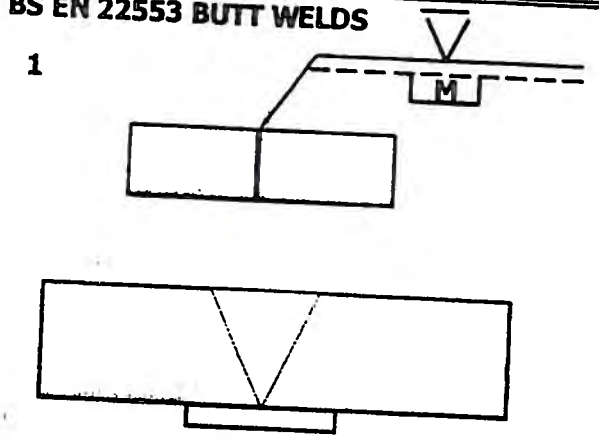
4



ANSWERS TO EXERCISES.

BS EN 22553 BUTT WELDS

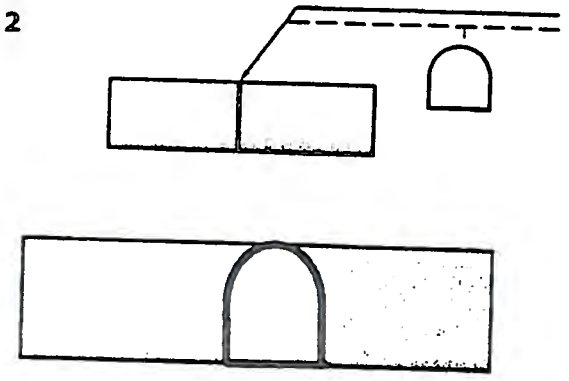
1



ANSWERS TO EXERCISES.

BS EN 22553 BUTT WELDS

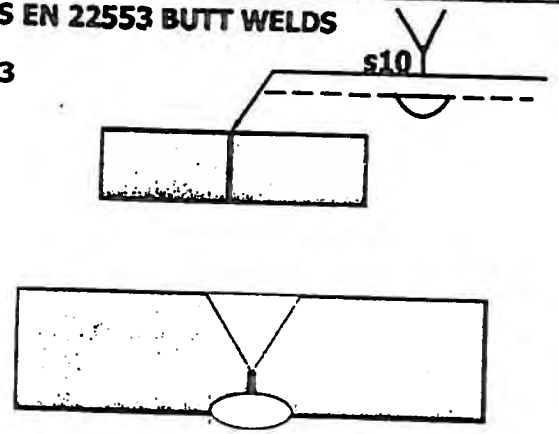
2



ANSWERS TO EXERCISES.

BS EN 22553 BUTT WELDS

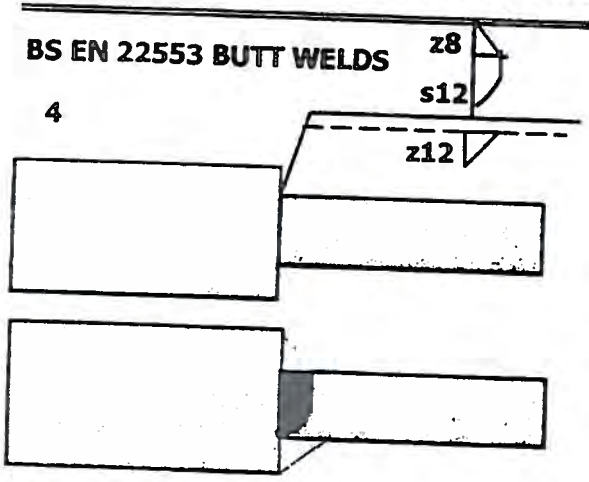
3



ANSWERS TO EXERCISES.

BS EN 22553 BUTT WELDS

4



AWS A 2.4 RULES

Welds "on arrow side" of joint go underneath the reference line while welds "the other side" of the joint, go on top of the reference line

Symbols with a vertical line component must be drawn with the vertical line to the left side of the symbol

All CSA dimensions are shown to the left of the symbol

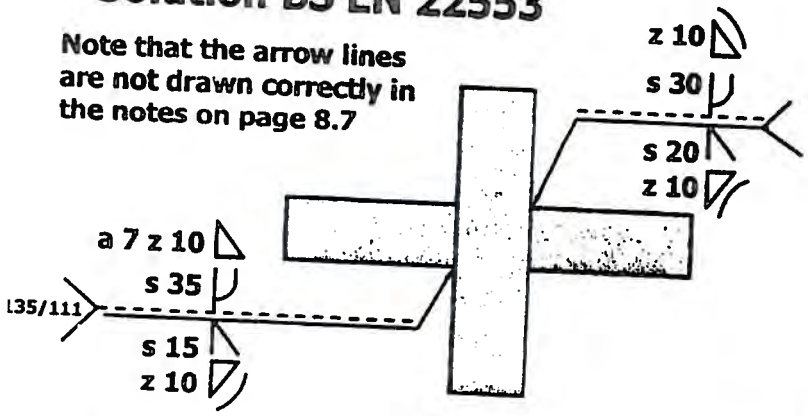
All linear dimensions are shown on the right of the symbol i.e. number of welds, length of welds, length of any spaces

Included angle and root opening are shown on top of the symbol

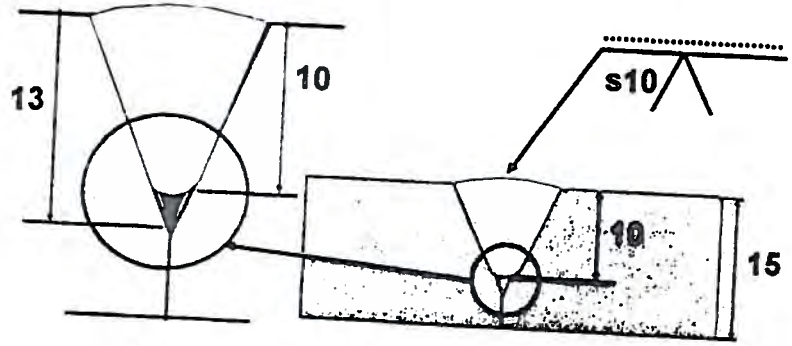
Weld symbols on drawings

Solution BS EN 22553

Note that the arrow lines are not drawn correctly in the notes on page 8.7



BS EN 22553 Welding Symbols



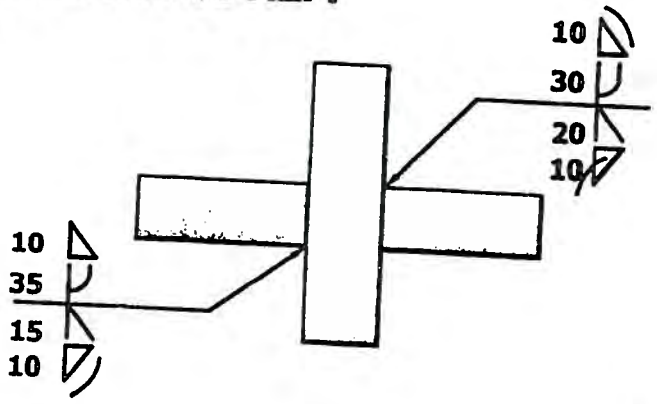
Partial penetration single-V butt
'S' indicates the depth of penetration

WELD SYMBOLS .

QUESTIONS ?

Weld symbols on drawings

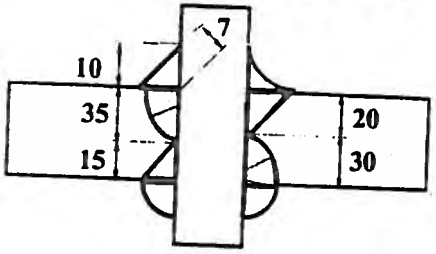
Solution AWS A2.4



Weld symbols on drawings

Student symbols exercise

Complete a symbols drawing for the welded joint given below to AWS A2.4 & BS EN 22553



All fillet weld leg lengths are 10 mm

SENIOR WELDING INSPECTION-3.2.2

FRACTURE ASSESSMENT-CHAPTER

SREE BALAJI TECHNICAL INSPECTION SERVICES

NO-10A, VASUDEVAN STREET, SHANKAR ABODES,

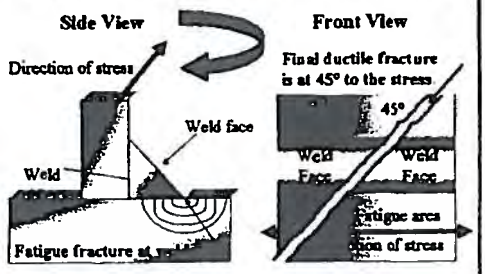
THIRUVANIKOVIL, TRICHY-620005

PHONE-91-9942217610/0431-4250109

MAIL:sbtis2010@gmail.com

PREPARED BY: R.MURALIMOHAN

Observations of Ductile Fractures 11.10



Summary of Ductile Fractures 11.15

1) Ductile fractures occur from areas of stress concentration
2) They may also be the final mode of fracture in a fatigue fracture
3) Ductile fractures always occur at 45° to the applied load
4) Ductile fractured surfaces are rough, and often show shear lips
5) It is possible to find areas of all 3 modes mentioned in this presentation on a single fractured surface

Summary of Brittle Fracture Analysis 11.20

Factors to be considered when investigating Brittle Fractures

Brittle fractures are likely to occur in steels that exhibit good toughness at normal room temperatures after they have been exposed to sub zero temperatures for any length of time. (At temperatures below the transition range)

The presence of sudden impact will cause the steel to undergo brittle fracture with characteristic sudden failure. This is most often accompanied by a sharp and loud noise

Factors to be ascertained would include eyewitness accounts of these elements and further investigative work to establish other possible contributory factors, such as the carrying of cryogenic liquid gases under pressure

Summary of Fatigue Failure Analysis 11.25

Factors to be considered when investigating Fatigue Fractures
Fatigue fractures are initiated from areas of high stress concentration such as a sharp toe blend, or undercut, or convex fillet weld toes. They are initiated by the action of cyclic stresses at much lower stress levels that the UTS

In analysing fatigue failures, the presence of cyclic stress is a prime requirement in the initiation and further propagation of fatigue cracks. It would therefore play an important part of the investigation to establish the nature of such a loading, which may be as simple as a degree of vibration

Analysis of the fracture surface and identification of epicentres of the plastic slip will lead to the discovery of the fracture initiation point

Summary of Ductile Failure Analysis 11.30

Factors to be considered when investigating Ductile Fractures
Ductile fractures are initiated from areas of high stress concentrations
When analysing the failure pattern of ductile failures, the propagation rate of the crack may have been extremely slow, but final fracture will be rapid if the component is loaded
Analysis of the fracture surface will initially show that the fracture occurred at 45° to the load, and the surface and may be accompanied by shear lips, or areas of plastic movement
Ductile materials may very often show *indications* associated with brittle fracture, caused during fracture by the "*Plain Strain*" effect

Practical Failure Analysis 13.10

Example Fracture Report Specimen number 001
Double V butt weld

Side view

Plan view

a) © Initiation points Fatigue at weld root due to lack of root fusion in 2 positions.
1 Fatigue area 1st mode of fracture (35%)
2 Area showing plain strain effect. (35%)
3 Ductile area showing shear lips. (30%)

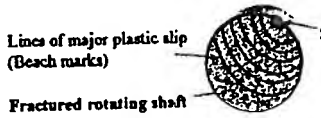
Signed J G Plenty 05/09/04

Observations of Fatigue Fractures 10.40

Fatigue fractures are initiated from stress concentrations and then progress slowly through the section in ductile materials until there is insufficient CSA to support the applied load

Areas of sudden plastic slip are characterised by beach marks, which can be observed on the final fracture surface.

The epicentre of the radii always points to the crack start



Summary of Fatigue Failures 10.45

1) Fatigue failures are always initiated from stress concentrations
2) The final fractured surface is characterised by areas of plastic slip, these are known as beach marks
3) The epicentre of the radii is the initiation point of the fracture
4) The fracture generally continue to move until insufficient CSA is available to carry the increased level of stress
5) Fatigue will not be the final mode of fracture, but it is very often the first

Brittle Fracture Failures 10.50

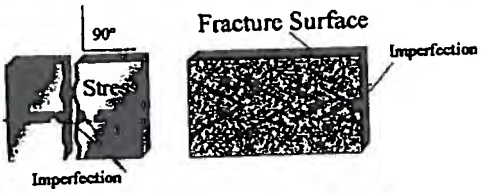
Brittle fractures are rapid failures of metallic structures that occur when a metal has become brittle and in the presence of some kind of stress and on most occasions a low temperature

This stress can be static or dynamic stress, or the final mode of failure associated with another form of fracture

The fractured surface is characterised by its flat and featureless appearance that is always at 90° to the plain of the stress

The surface is marked with chevrons (>>>#<<<<) which point in the direction of the fracture initiation point

Observations of Brittle Fractures 10.55



Chevrons point to the fracture initiation point

Summary of Brittle Fractures 11.00

1) Brittle fractures occur from areas of stress concentration
2) They may also be the final mode of fracture in a fatigue fracture
3) Brittle fractures always occur at 90° to the applied load
4) Brittle fractured surfaces are crystalline, flat & featureless
5) Areas indicating brittle fracture may be observed in otherwise ductile specimens caused by plain strain effect
6) Ductile ferritic steels tend to become brittle when exposed to sub zero temperatures (Acute Ductile/Brittle Transition)

Ductile Fracture Failures 11.05

Ductile fractures are generally a final mode of fracture and are more often associated with final failure of fatigue cracks

The final fracture is characterised by a distinct failure at 45° to the line of applied stress This is often accompanied by shear lips on the fracture face

Ductile tears are often identified in fabrications well before final fracture and are regularly monitored by NDT

Ductile tears can often arrest themselves in a metal structures

FRACTURE ASSESSMENT REPORT.

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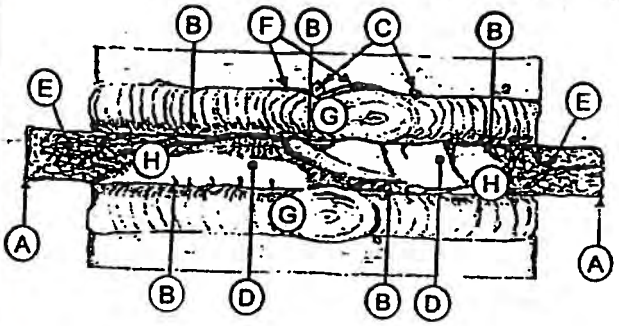
Fracture Assessment Report specimen 1.

SWI 3.2



A. *Shear lips*
B. *Initiation points/weld toe undercut*
C. *Weld spatter*
D. *Fatigue fracture surface*
E. *Ductile fracture surface*
F. *Weld undercut*
G. *Poor weld craters*
H. *Possible beach marks*

Primary mode of failure: Fatigue perpendicular to the applied stress
Secondary mode of failure: Ductile fracture

Conclusion: *Fatigue failure occurred at the weld toes of a fillet weld on both sides of the joint. The fatigue failure has initiated at a number of points along the weld toes (B), theses separately initiated into fatigue cracks and joined up by a series of steps on each side of the of the joint (D) this is evident by the smooth appearance of the fracture surface. The fatigue crack stopped at he possible beach marks (H).*

The secondary and final mode of failure is a ductile fracture (E) this is evident by the rough fibrous appearance and areas of shear lips (A). Other points of interest are the poor weld craters (G) and the weld undercut (F).

Name: Mark Rogers Date: 13/06/03 Signature: M.S Rogers

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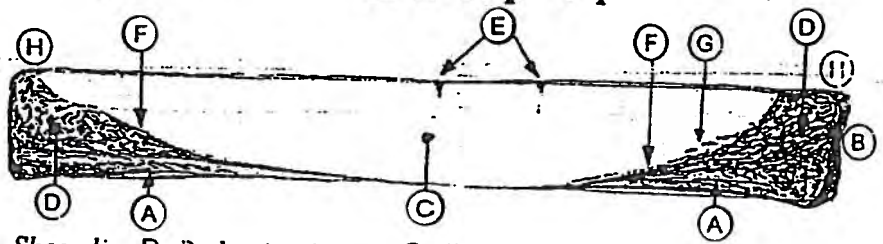
Fracture Assessment Report specimen 2.

SWI 3.2



A. *Shear lips* B. *Reduction in area* C. *Fatigue fracture* D. *Ductile fracture*
E. *Stepping* F. *Beach markings* G. *Inclusions* H-H *Initiation point*

Primary mode of failure: Fatigue perpendicular to the applied stress
Secondary mode of failure: Ductile fracture

Conclusion: *Fracture occurred at the weld toe (H-H) of a butt weld along its entire length.*

A fatigue crack has initiated at the weld toe (H-H) along the welds entire length, this is evident by the smooth fracture surface (C). The fatigue crack stopped at point (F).

The secondary mode of failure is a ductile fracture this is evident by the rough fibrous fracture surface (D), the evidence of shear lips (A) and a reduction in area (B). Other points to notice are the opening up of the plate inclusions (G) in the rolled direction

Name: Mark Rogers Date: 13/06/03 Signature: M.S Rogers

M. S. Rogers

FRACTURE IDENTIFICATION:- 70%. 2 Sets. (2 days)

15

1. DUCTILE
2. FATIGUE
3. BRITTLE

---

① DUCTILE:-

Surface Condition : Rough turn.
load : 45° load.
Primary mode : Ductile fracture.
Secondary : "
Weld defects : Toe area crack Start Point
= Shear lip area.
= Inclusion

② FATIGUE :-

Surface Condition = Smooth
= Bounded by curve.
= @ 90° to load.

Primary mode : Fatigue.
Secondary : Ductile fracture.
Conclusion = dull fibrous apperance.

③ Brittle :-

Surface = Rough hor turn.
@ 90 load.
= Vee Marking develop away the Start Point

Primary & Sec = Brittle.

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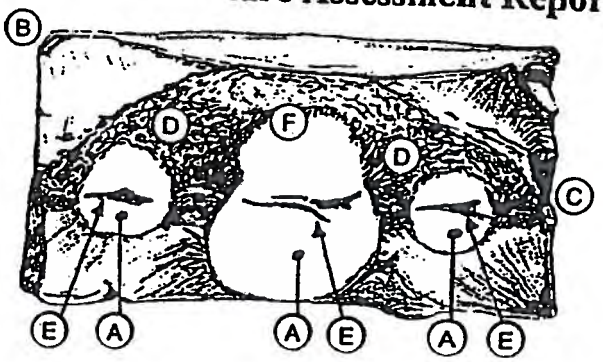
Fracture Assessment Report specimen 3.

SWI 3.2



A. *Fatigue fracture surface*
B. *Shear lips*
C. *Reduced area*
D. *Ductile fracture surface*
E. *Weld defects (slag inclusions)*
F. *Beach markings*

Primary mode of failure: *Fatigue perpendicular to the applied stress*

Secondary mode of failure: *Ductile fracture*

Conclusion: *The butt weld failed due to fatigue cracks which initiated from weld metal defects (E). The cracks have a smooth appearance this is evidence of fatigue fracture (A). The secondary mode of failure which is the final mode is a ductile fracture this is evident by the dull fibrous appearance of the fracture surface (D), shear lips (B) and a slight reduction in area (C).*

Name: Mark Rogers Date: 13/06/03 Signature: M.S Rogers

M. S. Rogers

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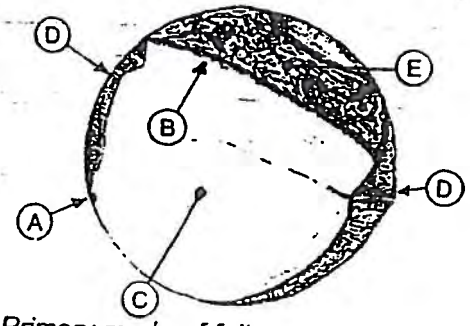
Fracture Assessment Report specimen 4.

SWI 3.2



A. *Gas pore*
B. *Beach mark*
C. *Fatigue fracture surface*
D. *Shear lips/slight reduction in area*
E. *Ductile fracture surface*

Primary mode of failure: *Fatigue perpendicular to the applied stress*

Secondary mode of failure: *Ductile fracture*

Conclusion: *The metal shaft failed due to a fatigue crack which initiated from a small gas pore (A)*

The primary mode of failure is from a fatigue crack (C) this is evident by the smooth appearance of the fracture surface.

The secondary and final mode of failure is a ductile fracture (E) this is evident by the dull gray fibrous appearance of the fracture surface, evident of shear lips (D) and a reduction in area (D).

Name: Mark Rogers Date: 13/06/03 Signature: M.S Rogers

M. S. Rogers

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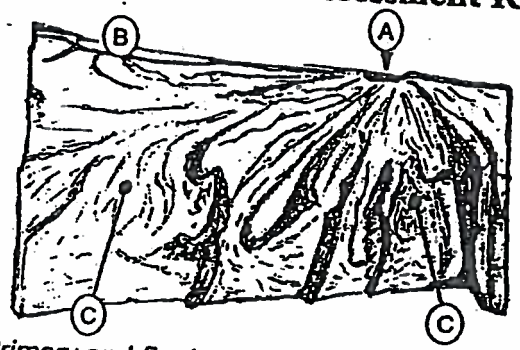
Fracture Assessment Report specimen 5.

SWI 3.2



A. *Weld defect, possible toe crack*

B. *Shear lips*

C. *Patterned brittle fracture*

Primary and final mode of failure: *Brittle fracture*

Conclusion: *The brittle fracture initiated from a welding defect, possible toe crack. A straight brittle fracture occurred in a butt weld, initiated from a welding defect, possible toe crack (A).*

The brittle fracture surface (C) has a distinctive pattern of markings which radiate from the surface of the weld toe defect, possible toe crack (A). It should be noted that the pattern points back towards the initiation point (A). Other features of interest are the slight shear lips (B).

Name: Mark Rogers Date: 13/06/03 Signature: M. S Rogers

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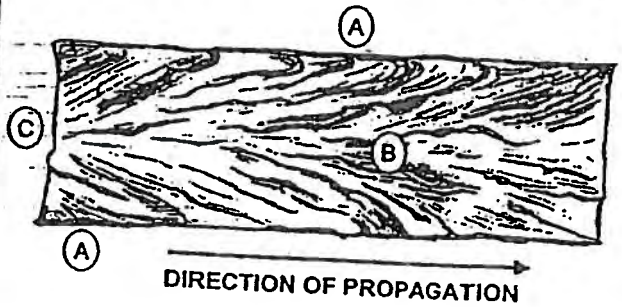
Fracture Assessment Report specimen 6.

SWI 3.2



A. *Slight shear lips*

B. *Brittle fracture surface/chevron pattern*

C. *Initiation point*

Primary and final mode of failure: *Brittle fracture*

Conclusion: *This service failure has no visible initiation point, the fracture is a brittle fracture this is evident by the uniform chevron pattern (B), which points back towards the origin of the fracture initiation point.*

Other interesting points are the slight shear lips (A) and no reduction in area evident.

Name: Mark Rogers Date: 13/06/03 Signature: M. S Rogers

M. S. Rogers

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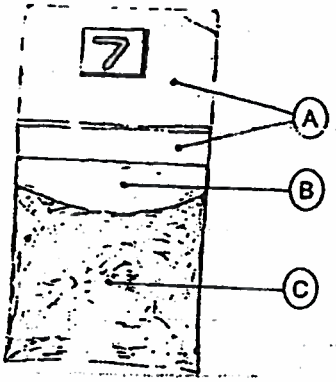
Fracture Assessment Report specimen 7.

SWI 3.2



A. *Machined notch, initiation point*

B. *Fatigue fracture surface*

C. *brittle fracture surface*

Primary mode of failure: *Fatigue fracture*

Secondary mode of failure: *Brittle fracture.*

Conclusion: *The CTOD sample failed from a purposely initiated fatigue crack The primary mode of failure is a fatigue fracture (B) this is evident by the smooth fracture surface, which initiated from a machined notch (A). The secondary mode of failure is a brittle fracture (C) this is evident by the crystalline fracture surface with very little evidence of plastic deformation (very little reduction in area) and no evidence of shear lips*

Name: Mark Rogers Date: 13/06/03 Signature: M.S Rogers

M. S. Rogers

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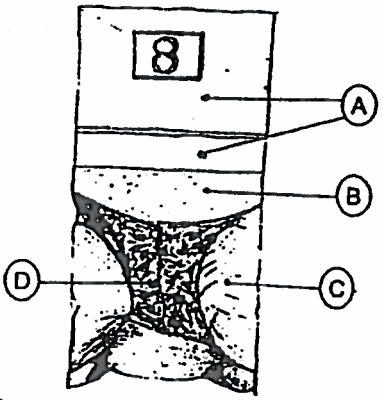
Fracture Assessment Report specimen 8.

SWI 3.2



A. *Machined notch, initiation point*

B. *Fatigue fracture surface*

C. *Shear lips*

D. *Ductile fracture surface*

Primary and final mode of failure: *Fatigue fracture*

Secondary mode of failure: *Ductile fracture.*

Conclusion: *The CTOD sample failed from a purposely initiated fatigue crack The primary mode of failure is a fatigue fracture (B) this is evident by the smooth fracture surface, which initiated from a machined notch (A). The secondary mode of failure is a ductile fracture (D) this is evident by the fibrous appearance of the fracture surface with evidence of plastic deformation, a large reduction in area and shear lips (C).*

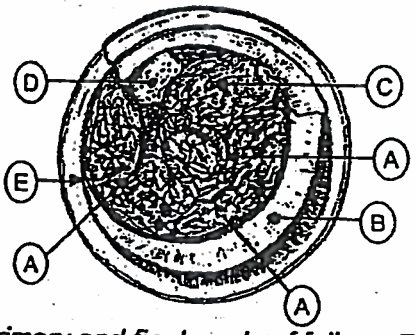
Name: Mark Rogers Date: 13/06/03 Signature: M.S Rogers

M. S. Rogers

TWI TECHNOLOGY

Fracture Assessment Report specimen 9.

SWI 3.2



A. *Cracks/forging bursts*
B. *Fatigue fracture surface*
C. *Ductile fracture surface*
D. *Brittle fracture surface*
E. *Initiation point*

Primary and final mode of failure: Fatigue fracture

Secondary mode of failure: Brittle fracture. Third mode of failure: Brittle fracture

Conclusion: *The threaded bar failed from a fatigue crack, which initiated at the base of the thread (E).*

The primary mode of failure is a fatigue fracture (B) this is evident by the smooth fracture surface, which initiated from the base of the thread (E). The secondary mode of failure is a ductile fracture (C) this is evident by the fibrous appearance of the fracture surface with evidence of plastic deformation. The final mode of failure is brittle (D) this is evident by the bright crystalline fracture surface.

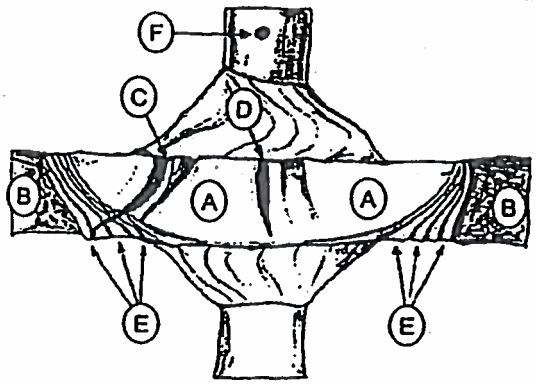
Name: Mark Rogers Date: 13/06/03 Signature: M. S Rogers

M. S. Rogers

TWI TECHNOLOGY

Fracture Assessment Report specimen 10.

SWI 3.2



A. *Fatigue fracture surface*
B. *Ductile fracture surface*
C. *Initiation point, weld toe undercut*
D. *Initiation point, weld toe undercut*
E. *Beach markings*
F. *Weld spatter*

Primary mode of failure: Fatigue perpendicular to the applied stress

Secondary mode of failure: Ductile fracture

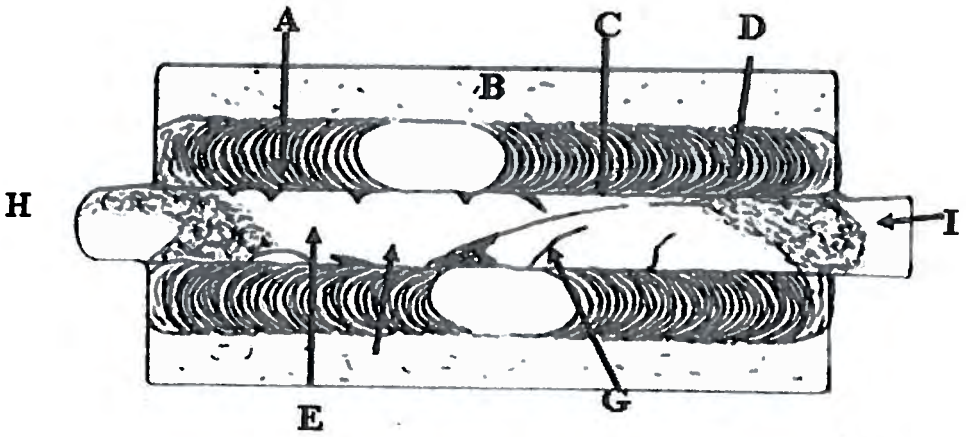
Conclusion: *The fabricated cruciform joint failed as a result of a fatigue fracture this is evident by the smooth fracture surface (A), its point of initiation (C,D), possible undercut at the weld toe. The fatigue cracks tip is evident by the beach markings (E), where the crack stop and starts with each stress cycle.*

The secondary and final mode of failure is a ductile fracture (B) this is evident by the fibrous appearance of the fracture.

Name: Mark Rogers Date: 13/06/03 Signature: M. S Rogers

M. S. Rogers

Specimen No 1.



A, B, C, & D - Crack initiation points
E, F & G - Crack initiation points
H - I Shear lips

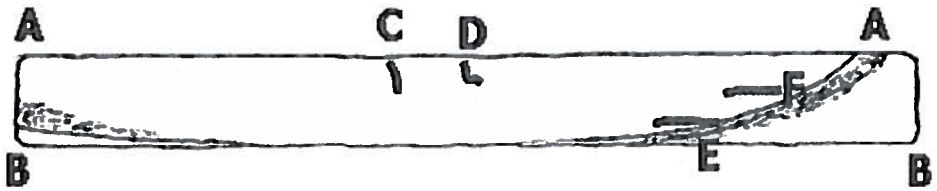
Primary Mode of Failure: Fatigue

Secondary Mode of Failure: Ductile Fracture

Conclusion: The primary mode of failure is fatigue fracture which has initiated at the toes of the vertical legs of fillet welds on two opposite surfaces of a load carrying plate. It has initiated at a number of points along these weld toes.(A,B,C,D,E,F&G). These separately initiated fatigue cracks eventually joined up to form a semi -elliptical fatigue fracture. The secondary mode of failure is a ductile fracture as evidenced by the small shear lips and dull, grey fibrous appearance of the fracture surface. (H & I).

Name, Sign & date your report.

Specimen No 2.



A-A Fatigue crack
B-B Small shear lips:
C - D Stepping / Crack initiation points:
E & F Inclusions

Primary Mode of Failure: Fatigue

Secondary Mode of Failure: Ductile Fracture

Conclusion:
The primary mode of failure is a fatigue fracture which has occurred at the toe of a butt weld along its entire length. Evidenced by a smooth flat fracture surface. A - A.

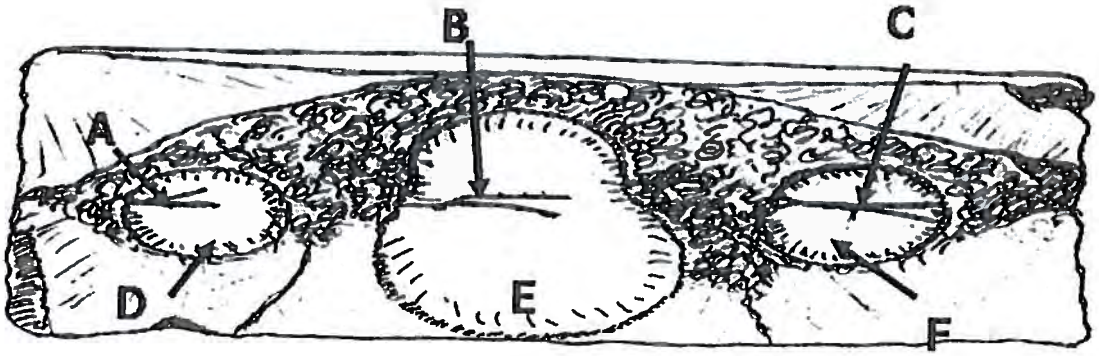
The secondary mode of failure is a ductile fracture as evidenced by the small shear lips and dull, grey fibrous appearance of the fracture surface. B - B.

Separate small crack initiation points are visible at C & D.

Inclusions in the rolling direction at the extremities of the fatigue crack have opened up prior to final fracture occurring.

Name, Sign & date your report.

Specimen No 3.



A, B & C - Internal weld defects (slag inclusions):
D, E & F - Fatigue Cracks.

Primary Mode of Failure: Fatigue

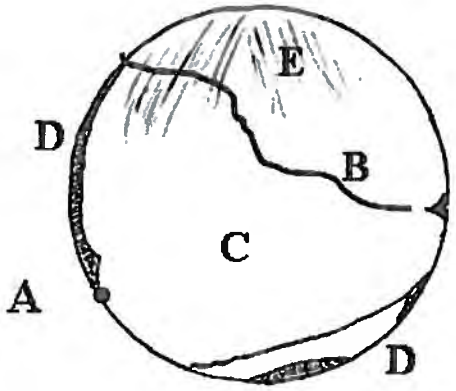
Secondary Mode of Failure: Ductile Fracture

Conclusion:
The primary mode of failure is a fatigue fracture which has occurred due to internal weld defects A, B & C. The fatigue cracks, as evidenced by the smooth flat fracture surface. D, E & F., have developed into circular configurations as the fatigue cracks have propagated through the material.

The secondary mode of failure is a ductile fracture as evidenced by the shear lips and dull, grey fibrous appearance of the final fracture surfaces.

Name, Sign & date your report.

Specimen No 4.



A Gas pore:
B Beach mark:
C- Smooth fracture surface:
D-Shear lips & slight reduction in area.
E -Dull grey fibrous appearance

Primary Mode of Failure: Fatigue

Secondary Mode of Failure: Ductile Fracture

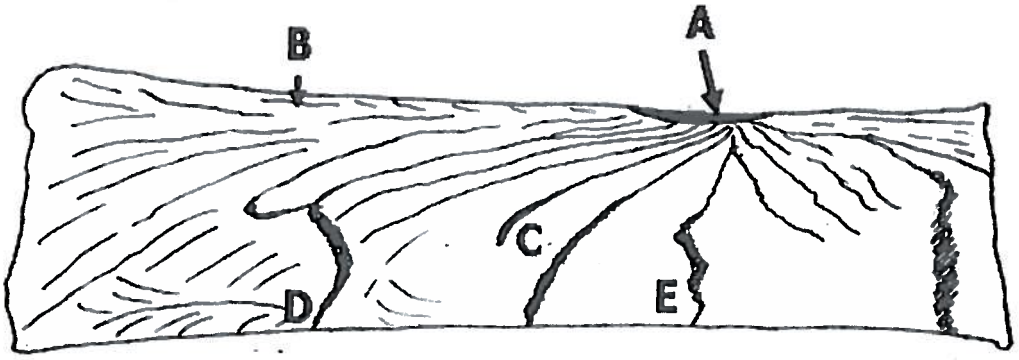
Conclusion:
The metal shaft failed due to fatigue failure initiated from a small pore near the surface. This is evident by the smooth fracture surface and the beach mark at the end of crack propagation.

The secondary/final mode of failure is a ductile fracture as evidenced by the small shear lips and dull, grey fibrous appearance of the fracture surface.

Name, Sign & date your report.

.

Specimen No 5



A - Surface crack
B Small 45° shear lip
C Striations / chevrons
D & E Shear Lips.

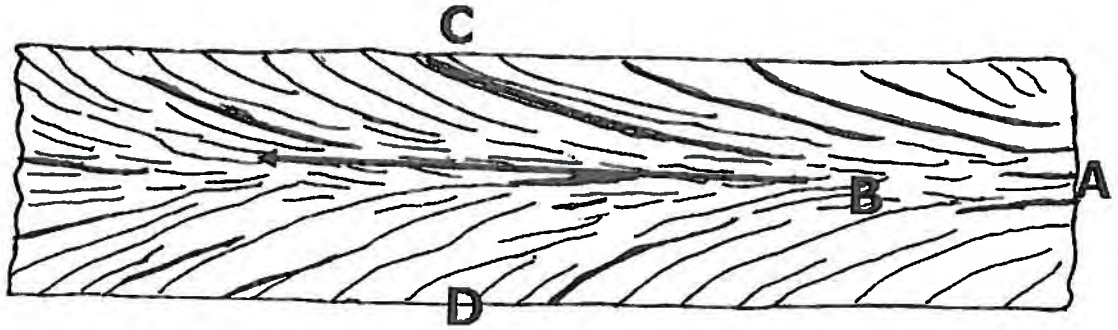
Primary & Secondary Mode of Failure: Brittle

Conclusion:

Brittle fracture is both the primary and secondary mode of failure in this example. The crack was initiated at A, possibly from a surface defect at the toe of the weld. There is evidence of a shear lip at B but the pattern of markings on the fracture surface, radiating from the surface crack would indicate a brittle fracture.
The small shear lips at D & E have been created as two advancing fractures, which are not in the same plane, have been forced to join up. This could be due in part to the complex stress patterns developed at the head of the advancing crack

Name, Sign & date your report.

Specimen No 6



A-A Origin of fracture
B Direction of crack propagation
C & D Small shear lips.

Primary & Secondary Mode of Failure: Brittle Fracture

Conclusion:

This sample is part of a service fracture remote from the region of fracture initiation. The fracture surface shows characteristics typical of a propagating crack through a brittle material, B. The surface markings which show a herringbone or chevron pattern, point back towards to origin of the fracture at A. The small shear lips at C & D indicate uniform stresses through the plate thickness, and that the fracture was very brittle.

Name, Sign & date your report.

Time allowed 1 hour for two samples.
Instructions:
1. **Sketch the fracture surface.**
2. **Indicate fracture initiation points (if known).**
3. **Show any weld / parent material defects (if present).**
4. **Identify primary mode of failure.**
5. **Identify secondary mode of failure.**
6. **State whether failure occurred in the weld, parent material or both.**
7. **Write a conclusion to summarise, provide reasons for / evidence to support your findings.**
8. **Sign & date your report.**

SENIOR WELDING INSPECTION-3.2.2

NDT REPORT -SCRUTINISE

SREE BALAJI TECHNICAL INSPECTION SERVICES

NO-10A, VASUDEVAN STREET, SHANKAR ABODES,

THIRUVANIKOVIL, TRICHY-620005

PHONE-91-9942217610/0431-4250109

MAIL:sbtis2010@gmail.com

PREPARED BY: R.MURALIMOHAN

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TECHNICAL INSPECTION SERVICES
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Phone: 0431 - 4250109, Cell: 99422 17610, E.mail: sbtis2010@gmail.com

RADIOGRAPHIC TESTING REPORT

Customer			Job No.		Report No.		
Project			Date		Page(s)	of	
Project No,			Location				
Code		Specification	Procedure				
Item			Condition	As welded	Ground		
Material		Diameter/ Length	Schedule/ thickness		Heat Treatment		
					Lighting		
X-ray data		Gamma ray data	Film Data		Exposure data		
Unit No.		Projector No.	Manufacturer		Source/Object	mm	
Unit type		Source No.	Type		Object/Film	mm	
KVp		Source type	Size		H&D density		
mA		Activity GB(Ci)	Screens(Pb)	Front & Back	IQI type / size	ASTM	
						EN	
Exposure time		Exposure time	Thickness	0.125mm	IQI Sensitivity	%	

Weld /item identification	Welder ID	Location	Evaluation	Result

ABBREVIATIONS:	BT- Burn through	CP - Cluster porosity	LF - Lack of fusion
NSD No significant defect	EP- Excessive penetration	ELP - Elongated porosity	I - Inclusion
UC - Undercut	LP -Lack of penetration	IGP - Isolated gas pore	TI - Tungsten Inclusion
SD -Surface depression	RC- Root concavity	P - Porosity	C - Crack

Technician:	Name :
Level :	Client Rep :
Signature :	Signature :
Date :	Date :

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ULTRASONIC INSPECTION REPORT

Client :		Job No.		Report No.	Date:
Location :				Item ID :	
Drawing No :				Material :	
Project :				Thickness :	

Probe	0 ° (TWIN)	45°	60°	70°	Specification :
Frequency MHz					UT Procedure :
Primary Reference dB					Flaw Detector : Serial No :
Transfer correction dB					Calibration Certification No :
Scanning Sensitivity dB					Couplant :
Range (mm)					Weld type :
					Limitations :

Result :

	ACC	REJ
Result		

Technician :	Client Rep :	AI / TPI ;
Level :	Name :	Name :
Signature :	Signature :	Signature :
Date :	Date :	Date :

SBTIS/UT/2011/REV-0

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Phone: 0431 - 4250109, Cell: 99422 17610, E.mail: sbtis2010@gmail.com

DYE PENETRANT INSPECTION REPORT

Date		Job #		Report #	
Client					
Project					
Job Location					
Job Description					
Material		Heat Treatment			
Surface Condition		Test Temperature			
Weld ID		Welder ID			
Weld Type		Weld process			
PT Procedure		Acceptence Criteria			
Drg/ISO Number		Penetrant System			
Dwell Time (Penetrant)		Dwell Time (Developer)			

Cleaner	Penetrant	Developer

Technician:		Client's rep / supervisor	
level		postion	
Signature		signature :	
Date :		Date	

SBTIS/PT/2011/REV-0

SREE BALAJI
TECHNICAL INSPECTION SERVICES
10A, Vasudevan Street, Shankar Abodes, Thiruvanaikovil, TRICHY - 620 005
Phone: 0431 - 4250109, Cell: 99422 17610, E.mail: sbtis2010@gmail.com

MAGNETIC PARTICLE INSPECTION REPORT

Date		Job:		Report No.	

Client			
Project			
Job Location			
Job Description			
Material		Heat Treatment	
Surface Condition		Test Temperature	
Weld ID		Welder ID	
Weld Type		Drg / ISO Number	
Procedure		Acceptance Criteria	
Method		Equipment	
Illumination		Sensitivity	

Degreaser:	Background	Detecting Media

Technician :	Client Rep :	AI / TPI ;
Level :	Name :	Name :
Signature :	Signature :	Signature :
Date :	Date :	Date :

SBTIS/MT/2011/REV-0

RADIOGRAPHIC REPORT

Imports points should be checked in the reports

1. Client
2. Project No.
3. Report No
4. Request No.
5. Date of test.
6. Location
7. Reference Code
8. Welding Process
9. Material Type, thickness & diameter
10. Weld geometry
11. Surface condition
12. Identification No
13. Drawing No
14. Type of radiation
15. X-ray voltage or source strength
16. Source or focal spot size
17. Density
18. Exposure technique
19. Viewing technique
20. Film type, brand & size
21. Pentameters designation size, position & sensitivity
22. Exposure time
23. Film processing (manual or automatic)
24. Welder symbol
25. Area of interest
26. Interpretation (type & size of defect)
27. Result (accepts or reject)
28. Legends
29. Technician name, date, signature & qualification
30. Interpreter name, date, signature & qualification
31. Other discrepancies found which is not matching with the report
32. Suggestions

ULTRASONIC TESTING REPORT

Imports points should be checked in the reports

1. Client
2. Item number
3. Weld identification
4. Relevant specification/procedure
5. Relevant acceptance criteria
6. Operators name, signature and qualifications,
7. Date of test
8. Stage of test
9. Location
10. Flaw dector used (including serial number)
11. Details of all probes used including all performance checks and serial numbers
12. Reference to inspection sensitivities and db used for each probe
13. Details of all areas where the surface preparation is out of specification
14. Details of surface condition during test and parent material quality
15. All attenuation checks/measurements
16. Weld geometry's and welds condition
17. Details of any areas with limited access
18. Details of all flaws, which exceed the recording threshold/acceptance criteria
19. Any flaws exceeding the acceptance criteria limits shall be shown on a drawing
20. The position of any inspection datum's used and the dimensions of the component under test (weld thickness, circumference
21. Flaw sizing technique used
22. Report number any report numbers of any complementary inspection reports (if known)

DYE PENETRANT REPORT

Imports points should be checked in the reports

1. Client
2. Project contractor
3. Item number
4. Weld identification
5. Weld geometry/set-up
6. Relevant specification/procedure
7. Relevant acceptance criteria
8. Date of test
9. Stage of test
10. Location
11. Description of equipment used including manufacture and serial numbers
12. Material type
13. Surface condition
14. Method
15. Penetrant type
16. Cleanear type
17. Developer type
18. Soak time
19. Method of reporting defects
20. Details of any test restrictions
21. Details of all flaws which exceed the acceptance criteria
22. The position of any inspection datum's used and the dimensions of the items under test
23. Post test cleaning if applicable
24. Report number and any report numbers of complementary inspection reports (if knows)
25. Operators name, signature and qualifications,

MAGNETIC PARTICLE REPORT

Imports points should be checked in the reports

1. Client
2. Project/ contractor
3. Item number
4. Weld identification
5. Weld geometry/set-up
6. Relevant specification/procedure
7. Relevant acceptance criteria
8. Date of test
9. Stage of test
10. Location
11. Description of equipment used including manufacture and serial numbers
12. Back ground and viewing condition
13. Detection medium including manufacture and batch numbers
14. Method of flux generation
15. Distance between contact areas
16. Current type used, ac/dc, half-wave /full wave rectified
17. Current used if applicable
18. Test sensitivity
19. Surface condition
19. Method of reporting defects
20. Details of any test restrictions
21. Details of all flaws which exceed the acceptance criteria
22. The position of any inspection datum's used and the dimensions of the items under test
23. Post test cleaning if applicable
24. Report number and any report numbers of complementary inspection reports (if knows)
25. Operators name, signature and qualifications,

مختبر الأمارات الصناعي
Emirates Industrial Laboratory
Oilfield, Marine & Industrial Consultants

Certificate No: 943807

RADIOGRAPHIC REPORT

3K-4868/RT/28

Client:
Cleveland Bridge and Engineering ME
P.O. Box – 16765
Dubai, UAE

Attention Mr. Bernard D' Silva

EIL Job Number	3K – 4868
Order Number	Contract No. 6019
Date Tested	December 30, 2002
Test Code	ASME Sec V : 2001
Acceptance Criteria	ASME Sec IX : 2001
Tested By	137,129
Operating Procedure	CBME QCP-08

Radiography on Production control test coupon

Vessel ID : V.T – 6205 DRG.NO.:6019/002 **Heat No: Y 31424** **WPS: 100-5**

PARAMETERS

Material	Carbon Steel	No of Films per Cassette	One.
Thickness	45 mm	No. of Films / Exposure	One
Technique	SWSI	Exposure Time	43.2 mA. Mts
Radiation Source	280 Kvp X-Ray	Film	Kodak AA 400
Focal Spot Size	3 mm dia x 3 mm	Screens	0.125 mm Pb
Focal Spot to Object Distance	555 mm	I. Q. I. Type	ASTM 1B
Focal Spot to Side of the Object Film Distance	45 mm	Sensitivity	AS per Table T-276
Joint Type	Butt weld	Density	2.3 – 2.5
Max. Weld Reinforcement	3mm	Film Viewing	Single Wall

RESULTS

WELD NO.	WELDER NO.	RAD NO.	OBSERVATION	RESULT
			PQR # 417 Plate # 28922-01	
J1 (Before PWHT)	1096, 728	A - B	No Recordable Indication	Acceptable

No of Radiographs: (10 X 40) 1 No.

TESTED BY	CBME QC	LAMPRELL	ABS-EUROPE / SBM	AI
	Accepted 31/01/2003 SUBRAMANIAN			

دبي : ص.ب : ١٨٩٢، تليفون ٠٤-٣٤٥٧٤٨٠، فاكس ٠٤-٣٤٥٢٣٣٦ - أبو ظبي : ص.ب : ٢٦٠٢٣، تليفون ٠٢-٥٥٤٢٨٨٩، فاكس ٠٢-٥٥٤٢٨٨٦
Dubai : P O Box 6892, Tel.:04-3457480, Fax 04-3452336, Email : eilab@emirates.net.ae - Abu Dhabi : P O Box 26023, Tel.: 02-5542889, Fax 02-5542886

مختبر الأمارات الصناعي
Emirates Industrial Laboratory
Oilfield, Marine & Industrial Consultants

Certificate No: 943807

MAGNETIC PARTICLE INSPECTION REPORT

CBEME CONTRACT NO: 6031	Date:	Report No.: MWS
Client: Dept. of Civil Aviation, Government of Dubai		
Main Contractor: Cleveland Bridge And Engineering Middle East (Pvt) Ltd		
Project:	Dubai International Airport Expansion (Phase II), Terminal 3, Concourse 2 & Car Park - AX060 - Structural Steel Works.	
Specification	: ASTM E 709 / ASME Sec V	
Acceptance Criteria	: AWS D1.1 Table 6.1	
CBE. Work Procedure No.	: WP-88/6031	
Surface Condition: As Welded / Ground	Ferro Mag. Material: Ready Mix Aerosol Can; Make: Magnaflux; Batch:	Equipment: Ardrox Model BCI/833; Sr. No. 1079; Long. Magnetisation Yoke; Continuous - WET - AC
Light: Natural / Artificial		
Prior Cleaning: Chisel & Wirebrush	White Contrast Paint: Make: Magnaflux; Batch:	Lifting Power: 10 LBS Min. For AC
Part Temperature: From 10 Deg. To 50 Deg. C	Application Method: By Spray	Position Of Yoke: 45 Deg. To Weld In Criss Cross Position
Post Cleaning: Not Required	Yoke Spacing: 6"	Magnetic Field Strength Indicator: ASTM E 709 Fig. 15 PIE Indicator

Sl. No.	Part Identity	Weld Length Tested	Interpretation

The above results are compliant with acceptance criteria and client specification - 05120 - Structural Steel Works	Yes	No

EIL Signature: Date:	CBEME	ITA

دبي : ص.ب : ٦٨٩٢، تليفون ٠٤-٣٤٥٧٤٨٠، فاكس ٠٤-٣٤٥٢٣٣٦ - أبو ظبي : ص.ب : ٢٦٠٢٣، تليفون ٠٢-٥٥٤٢٨٨٩، فاكس ٠٢-٥٥٤٢٨٨٦
Dubai : P O Box 6892, Tel.:04-3457480, Fax 04-3452336, Email : eilab@emirates.net.ae Abu Dhabi : P O Box 26023, Tel.: 02-5542889, Fax 02-5542886

مختبر الأمارات الصناعي

Emirates Industrial Laboratory

Oilfield, Marine & Industrial Consultants

Certificate No: 943807

ULTRASONIC REPORT

Report# MWS 404

Client: Cleveland Bridge ME P.O. Box - 16765 Dubai U.A.E		EIL Job #	3K -
		Order Number	6031
		Date Tested	21-03-04
		Test Code	ASTM E 164 / ASME Sec. V
		Acceptance Criteria	As per 5.5 of CBE-WP90 / 6031
Attention Mr. B. D'Silva		Tested By	S. NAVANEETHAN

Project: Dubai International Airport Expansion (Phase II), Terminal 3, Concourse 2 & Carpark AX060 - Structural Steel Works

PARAMETERS

Weld Type	PP	Technique(s)	1, 2, 3
Material	Carbon Steel	Material Size	25, 30, 40 mm
Equipment	Krautkramer USM25	Couplant	Cellulose Paste
Equipment No.:	EIL/N/ 181	Operating Procedure	CBE-WP90 / 6031

Probe	Angle	Mhz	Dia	Cal. Block	Range mm	Cal.dB	Scan dB
1.	0°	4	10 mm	V1 / V2	0-50	54	60
2.	45°	4	10 mm	V2 / DAC	–	–	–
3.	60°	4	10 mm	V2 / DAC	0-150	74	84
4.	70°	4	10 mm	V2 / DAC	0-150	78	88

Sensitivity 80% FSH from 2.4 mm Dia Hole → Angle probe calibrate for 3 of 4

RESULT

Ultrasonic testing was carried out on welds as per details given below and the results are as follows.

Extent of testing 100%

Description	WPS	Welder	Observation	Remarks
CF-03 FBF 308			Item 2886 & 2399, 2762	
dng# 03 FBF 308			Item 2762 to 2775	
Rev-0		1273	Item 2793, 2792 to 2761, 2762	
	100-15	1742	Item 2885 to 2761	NRI-Acceptable
			Item 2787, 2786 to 2761, 2762	
			Item 2887 to 2762, 2897	
Ring - 1			Item 2897 to 790, 1953	
			Item 1953 to 790	

Legend: NRI: No Recordable Indication.

The above results are compliant with acceptance criteria and client specification - 05120 - Structural Steel Works. Yes ✓ No

EIL

S. Navaneethan

S.NAVANEETHAN
ASNT Level - II (UT, MT & PT)
Signature :
Date : 21-3-04

CBEME

كليف لاند للجسور والهندسة الشرق الأوسط
CLEVELAND BRIDGE & ENG. M.E.
قسم مراقبة الجودة
QUALITY CONTROL DEPT.

ITA

6031E.DOC/Maha

Dubai : P O Box 6892, Tel.:04-3457480, Fax 04-3452336, Email : eilab@emirates.net.ae Abu Dhabi : P O Box 26023, Tel.: 02-5542889, Fax 02-5542886
دبي : ص.ب : ٦٨٩٢، تليفون ٠٤-٣٤٥٧٤٨٠، فاكس ٠٤-٣٤٥٢٣٣٦ - أبو ظبي : ص.ب : ٢٦٠٢٣، تليفون ٠٢-٥٥٤٢٨٨٩، فاكس ٠٢-٥٥٤٢٨٨٦

TWI

THE WELDING INSTITUTE

TWI INSPECTION SERVICES	
RADIOGRAPHIC TESTING REPORT Bad example 2	
Work location:	
Radiographic test procedure applicable: *AP 126/567*	
Defect acceptance criteria: *BS 2910*	Radiographic technique: *DWSI*
Weld identification: *SEC 21 W8*	Material type: *Steel*
Weld process: *SMAW*	Wall thickness: *12 mm*
Radiation Source: *X-ray*	IQI type: *BS 3971 type 2 13-18*
Joint type: *Single V butt; pipe to pipe 10 inch diameter*	Weld preparation: *Root gap 3.5* *Root face 2.5* *60° included angle*
Exposure time: *12 ci mins*	FFD/SFD: *1200 mm*
Source strength: *350 kv's* Kilovoltage: *N/A*	Source size: *N/A* Focal spot size: *6 × 3 mm*
Film type: *Medium grain factor 25*	Screens: *Salt*
Development: Time: *5 mins* Temp: *40°C*	Fixing: Time: *6 mins* Temp: *20°C*

Report on test item:

Shot A:	*Density 2 - 3*	*IQI 6 wires visible*	*Re-shoot*
Shot B:	*Density 1.5 - 1.8*	*IQI not visible*	*Accept*
Shot C:	*Density 4.3 - 4.8*	*IQI 4%*	*Accept*
Shot D:	*Not yet completed*		

Operators name: .....

Signature: .....

RT REPORTS (NDT SCRUNITIES)
CHAPTER.

TWI

THE WELDING INSTITUTE

TWI INSPECTION SERVICES

ULTRASONIC INSPECTION REPORT Bad example 4.

Report ref. no: *34*	Date of test: *11/6/96*	Sheet *1 of 1*
Work location: *Abington*		
Defect acceptance/rejection criteria: *BS EN 25817*		
Weld No: *Spool 7 W66*	Material type: *Low carbon steel*	
Weld process: *MMA root* *TIG fill & cap*	Wall thickness: *25 mm*	
Joint type: *Single V*	Weld preparation: *70° bevel* *2.0 mm root face* *2.0 mm root gap*	
Ultrasonic test equipment: *Krautkramer USN 50*	*serial No: KK445L*	

Probes used:	Diameter	Frequency	Angle
Double compression	*10 mm*	*1.5 MHz*	*0°*
Single shear	*10 mm*	*4.0 MHz*	*45°*
Double shear	*10 mm*	*4.0 MHz*	*60°*
Single shear	*10 mm*	*5.0 MHz*	*85°*

Scanning pattern: *As to procedure*

Sensitivity: *0° scanning: 2nd BWE to FSH*
Angle probe scanning: 1.5 mm hole from calibration block

Calibration: *0 to 100 mm range from calibration block*

Report on test item:

Acceptable as to specification

Name: .....

Signature: .....

Date of test: .....

TWI

THE WELDING INSTITUTE

TWI INSPECTION SERVICES		
PENETRANT INSPECTION REPORT Bad example 6.		
Report ref. no: *134589*	Date of test: *03/11/97*	Sheet 1 of 1
Work location: *Loss of power station, Rotherham*		
Penetrant test procedure: *A34/5621TR*		
Weld No: *LL3 - W34*	Material type: *Austenitic stainless*	
Weld process: *GTAW*	Wall thickness: *12 mm* Excess Weld Metal: *As welded*	
Joint type: *V - Butt*	Weld preparation: *60° bevel* *2.0 mm root face* *2.0 mm root gap*	
Test Information: *Penetrant Test*		
Magnetic Particle Test: *N/A*	Penetrant: *Colour contrast solvent*	
Magnetising Apparatus: *N/A*	Remover: *Water*	
Detecting Medium: *N/A*	Developer: *Dry powder*	
Accessories:	Dwell Time: *5 mins*	
Field Strength:	Development Time: *5 mins*	
Viewing Conditions: *Johnson & Allen UV-A Light*		
Sensitivity: *Castrol Strip (brass type) Three indications*		
Report on test item:		

Name: *J BLOGGS...*

Signature: *J Bloggs...*

Date of test: *10/07/02...*

TWI

THE WELDING INSTITUTE

TWI INSPECTION SERVICES		
MAGNETIC PARTICLE INSPECTION REPORT Bad example 1.		
Report ref. no: *134589*	Test Date: *12/12/98.*	Page: *1 of 1*
Test Item: Fabrication number *21A.*		
Magnetic Particle test procedure: *A34/5621TR*		
Weld No: *23 and 24.*	Material type: *Austenitic stainless*	
Weld process: *M.I.G.*	Wall thickness: *10 mm*	
Joint type: *Single V butt.*	Weld preparation: *60° bevel* *2.0 mm root face*	
Equipment Used: Detection unit: *Johnson and Allen prod unit* Prods: *Copper* Black magnetic ink: *Johnson and Allen* Penetrameter :		
Test Sensitivity: *150 amps per inch of weld.*		
Report on test item: *1. Two cracks 25 mm long, 60 mm from reference.* *2. One indication 10 mm long, 120 mm from reference.* *3. Irrelevant indication at six o'clock position on W21R.*		
Action: *All defects to be removed by grinding and cleared by penetrant testing before welding*		
Name: ..... Signature: ..... Date:		

WELD TEST REPORT: RADIOGRAPHY 001

NAME AND ADDRESS OF INSPECTING COMPANY: JOE BLOGGS ENGINEERING LTD
ABINGTON HALL
ABINGTON, CAMBRIDGE

Customer / Contract No

WORK LOCATION: WORKSHOP Date of ...

REPORT REFERENCE NO.: NDT WIS/10/11

WELD IDENTIFICATION: 74361/2

WALL THICKNESS: 30mm t CARBON STEEL PLATE

WELD PROCESS: SUBMERGED ARC WELDING

EXCESS WELD METAL: 3.0mm

Backing plate

Steel or weld

BACK GOUGED

Root gap, Root face, Angle of bevel prep

TEST INFORMATION

DETAIL	DESCRIPTION	RESULT	ACTION
SOURCE IRIDIUM 192	5 CURIES		Use separate sheet if required
FFD/SFP	500mm		
FOCAL SPOT SCREENS	1mm x 1mm not required		
IQI	B.S.		
TECHNIQUE	SOURCE @ 90° TO WELD CENTRELINE		
DEVELOPMENT TIME: FILM FILM 10 A – B B – C C – D D – E E – F	4 MINS. @ 68°C KODAK C X 10 X 40 cm TO BS:2910 SENSITIVITY / DENSITY 2.4 / 1.8 2.4 / 1.9 2.4 / 1.8 2.4 / 1.7 2.4 / 2.0	N.S.D. INCLUSIONS N.S.D. N.S.D. LACK OF PEN	

ADDITIONAL COMMENTS

The above was carried out to the specified Code

ACCEPTABLE/~~NON-ACCEPTABLE~~ TO SPECIFICATION

NAME ..J BLOGGS.....

SIGNATURE .....

DATE ...25/8/95.....

SCHOOL OF WELDING TECHNOLOGY

WELD TEST REPORT: RADIOGRAPHY 002

NAME AND ADDRESS OF INSPECTING COMPANY: JOE BLOGGS ENGINEERING LTD
ABINGTON HALL
ABINGTON, CAMBRIDGE

WORK LOCATION: WORKSHOP

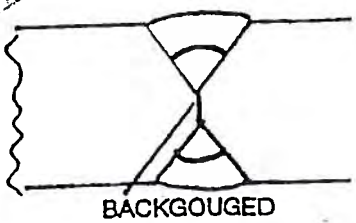
REPORT REFERENCE NO: NDT WIS/10/11

WELD IDENTIFICATION: —

WALL THICKNESS: 30mm t CARBON STEEL PLATE

WELD PROCESS: SUBMERGED ARC WELDING

EXCESS WELD METAL: 3.0mm



TEST INFORMATION

	TASK	DESCRIPTION	DETAILS	RESULT	ACTION
1	SOURCE	IRIDIUM 192	30 ci	Use separate sheet if required	
		SFD =	18"		
		SOURCE DIMENSION	1.5 X 2.0mm		
		LEAD SCREENS	0.15mm		
		IQI	BS3971 9–15 AJ		
		EXPOSURE IN MINS.	60 MINS.		
2		DEVELOPMENT: TIME 4 MINS @ 20°C FILM KODAK CX 10 X 40 cm	SENSITIVITY & DENSITY		
		FILM ID 1 – 2	— —	NO DEFECTS PRESENT	
		2 – 3	1.8 1.5	LACK OF PENETRATION	
		3 – 4	1.8 1.5	NO DEFECTS OBSERVED	

ADDITIONAL COMMENTS

The above was carried out to BS:2910

~~ACCEPTABLE~~/NON ACCEPTABLE TO SPECIFICATION

NAME J BLOGGS

SIGNATURE

DATE 25/8/03

SCHOOL OF WELDING TECHNOLOGY

N 3 of 6

58

WELD TEST REPORT: ~~MAGNETIC PARTICLE INSPECTION~~/DYE PENETRANT 005

NAME AND ADDRESS OF INSPECTING COMPANY: JOE BLOGGS ENGINEERING LTD
ABINGTON HALL
ABINGTON, CAMBRIDGE

WORK LOCATION: SHOP

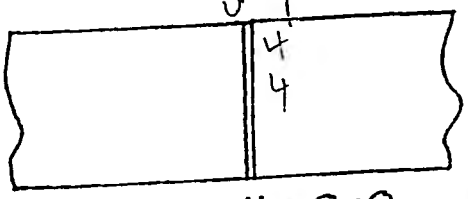
REPORT REFERENCE NO: XYZ 005

WELD IDENTIFICATION: XYZ 005

WALL THICKNESS: 25mm NICKEL 400

WELD PROCESS: ELECTRON BEAM

EXCESS WELD METAL: AS WELDED



TEST INFORMATION

TASK	DESCRIPTION	RESULT	ACTIONS
CONSUMABLES	ADDROX 996 RED DYE ADDROX 9 PR SS1 REMOVER ADDROX 9D6 DEVELOPER		~~Use separate sheet if required~~
PEN TIME	1 MIN.	NO DEFECTS FOUND	

ADDITIONAL COMMENTS

Carried out to BS:6151

ACCEPTABLE/~~NON ACCEPTABLE~~ TO SPECIFICATION

NAME ....J BLOGGS.....

SIGNATURE .....

DATE .....25/8/93.....

N6 of 6

WELD TEST REPORT: ULTRASONICS 003

NAME AND ADDRESS OF INSPECTING COMPANY: JOE BLOGGS ENGINEERING LTD
ABINGTON HALL
ABINGTON, CAMBRIDGE

WORK LOCATION: SITE

REPORT REFERENCE NO: NDT WIS/10/11

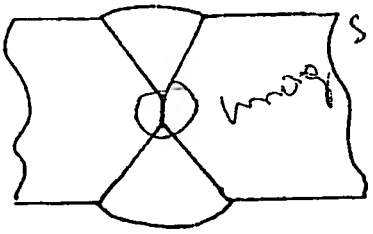
WELD IDENTIFICATION:

WALL THICKNESS: 30mm t CARBON STEEL PLATE

WELD PROCESS: SUBMERGED ARC WELDING

EXCESS WELD METAL: 3.0mm

TEST INFORMATION



EQUIPMENT	DESCRIPTION	DETAILS	RESULT	ACTION
COUPLANT PROBE	GREASE 45° 4 MHz ~~45° 10 MHz~~ 60° 4 MHz 0° MAP: FSH 1.5 HOLE LONGITUDINAL & TRANSVERSE SCANS CARRIED OUT FROM TOP AND BOTTOM	ROOT DEFECT FOUND WITH 60° PROBE	~~Use separate sheet if required~~	

ADDITIONAL COMMENTS

Specification Is BS:5135

ACCEPTABLE/NON ACCEPTABLE TO SPECIFICATION

NAME .....J BLOGGS.....

SIGNATURE .....J Bloggs.....

DATE ...16/2/94.....

WELD TEST REPORT: MAGNETIC PARTICLE INSPECTION/DYE PENETRANT 004

NAME AND ADDRESS OF INSPECTING COMPANY: JOE BLOGGS ENGINEERING LTD
ABINGTON HALL
ABINGTON, CAMBRIDGE

WORK LOCATION:

REPORT REFERENCE NO: XYZ/004

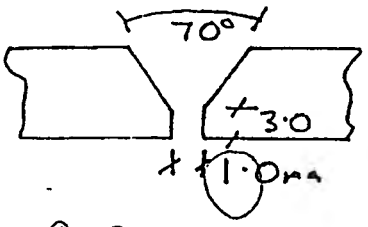
WELD IDENTIFICATION: XYZ/004

WALL THICKNESS: 10mm PLATE AUSTENITIC STAINLESS STEEL

WELD PROCESS: MMA

EXCESS WELD METAL: AS WELDED

TEST INFORMATION



TASK	DESCRIPTION	RESULT	ACTION
EQUIPMENT & TECHNIQUE	AC ELECTROMAGNET WITH PROBES 300mm SPACING		Use separate sheet if required
PULL FORCE CONSUMABLES	2.25Kg BLACK INK TO BS:4069	NO DEFECTS DETECTED	NO ACTION NECESSARY

ADDITIONAL COMMENTS

Code of Practice EN:288

ACCEPTABLE/~~NON-ACCEPTABLE~~ TO SPECIFICATION

NAME J BLOGGS

SIGNATURE

DATE 22/8/91

RADIOGRAPHY -CHAPTER

SREE BALAJI TECHNICAL INSPECTION SERVICES

NO-10A, VASUDEVAN STREET, SHANKAR ABODES,

FLAT-A, THIRUVANIKOVIL, TRICHY-620005

PHONE-91-9942217610/0431-4250109

MAIL:sbtis2010@gmail.com

PREPARED BY: R.MURALIMOHAN

AGFA NDT D8 Film

Medium grain film with high contrast and very high speed. Suitable for a variety of applications. This film can be used for direct exposure, or with lead screens. It gives good image quality with short exposure times.

D4W Wide Latitude Film

This extra fine grain, medium-high contrast and certified class W-B film according to the Industrial Film Systems Classification ASTM 1815 is specially designed for in-process radiography and the inspection of objects with a wide range of thickness, such as castings.

D6W Wide Latitude Film

This fine grain, medium contrast film combining good image quality and wide latitude is recommended for in process-radiography to inspect wide range thickness objects.

- Data Sheet (165KB)

AGFA NDT F6 Film

Medium speed, high contrast fine grain film, preferably suited for use in combination with fluorometallic (RFC) screens or similar fluorescent screens. To be preferably processed in short cycle (90 sec.). If needed standard 8 min. cycle can be used alternatively.

AGFA NDT F8 Film

High speed, high contrast fine grain film, mainly for exposures in combination with fluorometallic (RFC) screens or fluorescent screens.

AGFA NDT RCF Fluorometallic Screen

One of the most important applications of lies in the inspection of off-shore pipelines. Combining the screens sensitivity and rapid processing of the Agfa NDT F6 Film provides an ideal film-screen system.

AGFA NDT 1200 Fluorescent Screen

AGFA NDT D2 Film

Extremely fine-grain film with low sensitivity and high contrast. Ideal for exposures requiring the finest possible detail rendering.

AGFA NDT D3 Film

Ultra fine grain film with very high contrast.This film obtains a very high detail perceptability, which meets the requirements of the most critical NDT applications.For exposure with lead screens using either X-ray, gamma rays or radiation from megavolt equipment.

AGFA NDT D3 s.c. Film

Single coated film with very high image quality, (accurate interpretability), high contrast and pleasant image tint. The ideal film for optical enlargements. The colourless back coating guarantees a very flat film under all conditions.

AGFA NDT D4 Film

Extra fine grain film with very high contrast. Suitable for a wide variety of critical applications. For exposure with lead screens using either X-ray, gamma rays or radiation from megavolt equipment.

AGFA NDT D4 s.c. Film

Single coated film with very high image quality, (accurate interpretability), high contrast and pleasant image tint. The ideal film for optical enlargements. The colourless back coating guarantees a very flat film under all conditions.

AGFA NDT D5 Film

Very fine grain film with high contrast. Excellent for visualisation of discontinuities. This film is intended for use with lead screens using either X-ray or gamma rays.

AGFA NDT D7 Film

Fine grain film with high contrast and high speed. Designed for direct exposure or with lead screens. For exposure with lead screens using either X-ray or gamma rays.

KEY-NOTES FOR RT FILM

1. Radiographic less penumbra : 0.25
2. Developer or chemical mixing : replishment
3. RT film will get exposed due to : light
4. SAW welding unlikely to occur : Tungsten inclusion
5. TIG welding defect : Lack of penetration
6. RT density range : 2 to 2.5
7. Developer strength will go down due to : open to atmosphere, number of times Developing
8. Film image will produce due to : silver bromides
9. Characteristic curve of RT : Exposure and density
10. When compared is X ray, gamma will produce---- High contrast

RT FILM REFERENCE

1. Offset/ mismatch : 50 percent weld more density, 50 percent less dense
2. Lack of penetration : centre of weld straight line noted
3. External cavity : looks like dark area at weld location (insufficient fill top side)
4. Excess penetration : more brighter
5. External undercut
6. Internal undercut (root)
7. Internal concavity (Suck back)
8. Burn through
9. Incomplete lack of penetration
10. Slag inclusion
11. elongated slag (wagon drog)
12. Lack of side wall fusion
13. Inter pass cold lap
14. Scattered porosity
15. Cluster porosity
16. Root pass aligned porosity (hollow bead)
17. Transverse crack
18. Longitudinal crack
19. Tungsten inclusion

ARTIFICTS

1. Stry Fragment **light area theory multi front of cassette)**
2. Mottle; **long storage/ fumes / heat/ dampness**

3. Light fog-(one side)	**excess exposure of safe light**
4. Fog near edge	**cassette not closed**
5. Light crescent	**crimping buckling/pressure before exposure**
6. Dark crescent	**crimping buckling/pressure after exposure**
7. Small spot less density	**dust on surface screen**
8. Light streaks	**poor handling + screen**
9. Dark spot (one side)	**developer splashes**
10. Light spot (one side)	**fixer splashes**
11. Flow mark	**lack of agitation**
12. Reticulation	**temp difference**
13. Red in colour	**contamination of developer**
14. Drying mark	**drops of water run down on film**
15. Buckled	**sticking together**
16. Frilling or loosening-(emulsion)	**warm water and contaminating fixer**
17. Scratches	**poor handling**
19. Static mark	**(black tree) poor handling**

SENSITIVITY

The term sensitivity, when used in its general sense, is an overall assessment of quality which relates to the radiographic technique's ability to detect fine defects on a radiograph. The sensitivity associated with a radiograph is directly affected by the radiographic contrast and definition therefore all those factors which affect contrast and definition will also affect the sensitivity.

MEASURING SENSITIVITY

Sensitivity is measured by the use of image quality indicators (IQI's), also known as a Pentameters'. There are various types of I.Q.I; the type commonly used consists of seven thin Wires within a plastic Packaging. The wires are placed transversely across the weld area being examined during exposure, the sensitivity on the resultant radiograph is then given a numerical Value by dividing the thickness Of the smallest wire visible on the radiograph by the thickness of the specimen in the area being examined; this is then multiplied by 100 in order to express the result as a percentage of the Specimen thickness.

The lower the figure obtained, the higher the sensitivity. It must be noted however, that the obtained IQI sensitivity value does not directly relate to the minimum thickness change or defect size detectable by the radiographic technique used.

BS 3971 —Image quality indicators is a standard which specifies three types of 1.Q.I·

Type I — **wire type.**

Type II — **step wedge/hole type.**

Type III — **duplex wire type** for exclusively measuring definition.

Technically, the best position to place an IQI is on the source side of the specimen, but for Practical reasons IQI. (s) Are often placed on the film side, i.e. between the film and the specimen. It may also be stated that they must be positioned in the area where the worst sensitivity is expected. A specification relating to radiographic testing large diameter pipe welds may state:

For a panoramic exposure at least one I.Q.I. must be present, placed at the 6 o'clock position".

Reason: because this area is more susceptible to back scatter from the ground.

1 Sometimes the minimum number of wires which have to be visible on the radiograph is specified instead.

2 Although it is desirable for the IQI and the specimen to be of the same material, it is not always possible or practicable to accomplish due to lack of availability. For test specimens made

From alloy elements, the IQI material chosen should have similar radiation Absorption/Transmission properties to the test specimen.

3. BS 2910 calls for four IQI's placed at the 3, 6, 9 and 12 o'clock positions

RT SENSITOMETRY

1. RT strip calculation difference to write
2. Followed 5 question to calculate sensitivity (To calculate thickness of wire (pentameters, etc.)
3. Tabular column available for standard

DENSITOMETER METER STRIP READING

<u>For example;</u> 1 to 14 steps each step 0 .3 density difference

0.3, 0.6, 0.9, 1.2, 1.5, 1.8, 2.1, 2.4, 2.7, 3.0, 3.3, 3.6, 3.9, 4.2, 4.5

FOR EXAMPLE

Actual strip density value	**0.9**	**1.5**	**2.7**	**3.3**	**3.9**	**(it is printed on strip)**
Actual density measurement	**0.905**	**1.495**	**2.704**	**3.303**	**3.904**	**with densitometer**
Difference	**+0.005**	**1.495**	**+0.004**	**+ 0.003**	**+0.004**	

IQI SENSITIVITY

The ability of a radiograph to reveal internal defects is determined by the quality or sensitivity of the image produced. In addition it should be noted that planar weld defects such as cracks or lack of side wall fusion may appear faint or even be invisible if they are unfavourably orientated with the direction of the radiation beam. The sensitivity of the radiograph produced is affected by many factors but basically, the higher the contrast and definition (sharpness) of the image the more sensitive the technique will be for detecting imperfections in the object being examined.

WIRE TYPE IQI

$$\text{SENSITIVITY \%} = \frac{\text{Diameter of the Smallest Visible Wire}}{\text{Thickness of the Material}} \times 100$$

STEP –HOLE TYPE IQI

$$\text{SENSITIVITY \%} = \frac{\text{Diameter of the Smallest Visible hole}}{\text{Thickness of the Material}} \times 100$$

IMAGE QUALITY INDICATORS (IQIS)

Are used in order to demonstrate that adequate radiographic sensitivity has been achieved. An image quality indicator is a device placed on the surface of the component prior to radiography. The indicator provides a comparative measure of the definition and contrast achieved on the radiograph and at least one IQI should appear on each individual radiograph.

Two types of indicator are in common use - **the wire type and the plate/hole type.**

WIRE-TYPE IQI

The wire-type **IQI** is a **DIN 54-109 IQI** with dimensional requirements in accordance with ASTM E 747.

The wires are encased in plastic and are available in three different packets with seven wires in a packet

The three packets contain wires:

1 ISO7, 6 ISO12 and, 10 ISO16. If the wires are damaged or bent where the wires cannot be distinguished from one another, the IQI needs to be discarded. The Quality of a radiograph is determined by the wire number which is visible on a radiograph.

PLATE/HOLE-TYPE IQI

A block-type IQI consists of a uniform thickness block that is 2% of the specimen thickness. It has three drilled holes which have a diameter of one times the IQI thickness (1T) two times the IQI thickness (2T) and 4 times the IQI thickness (4T). The lead letter identification on the IQI represents the thickness of the IQI in Thousand thus of an inch. Most standards require a sensitivity level of 2-2T which means that the outline of the IQI can be seen on the radiograph with the 2T hole visible.

There are two types of IQI in common uses which are

1. Wire type IQI

2. Plate hole IQI

WIRE TYPE IQI

This type of IQI consists of a series of metal wires mounted in a flexible plastic holder. The wires are mounted parallel to each other about 5 mm apart and are each about 60 mm long. The standard models consist of three series, each containing seven wires, numbered 1 to 7, 6 to 12 and 10 to 16.

DIN WIRE TYPE PENETRAMETER

Din type pentameters' described in din 54 109, ISO type pentameters described in ISO1027, or ASTM type pentameters described in ASTM SE-749/90 shall be used, table1, 2, and 3 shows the standard Identification numbers found on the pentameters packs and wire sizes found in the DIN type, ISO type and ASTM type typical packs.

TABLE-IQI SELECTION

Unless otherwise stated in the scope of work, penetrameters shall be selected as shown in the following columns			
Nominal material thickness		source side	Film side
Inch	mm	Wire number	Wire number
Up to 0.25, inch	Up to 6, inch	13	14
Over 0.25 through 0.375	6 through 10	12	13
Over 0.375 through 0.50	10 through 12	11	12
Over 0.50 through 0.75	12 through 18	10	11
Over 0.75 through 1.00	18 through 25	9	10
Over 1.00 through 1.50	25 through 40	8	9
Over 1.50 through 2.00	40 through 50	7	8
Over 2.00 through2.50	50 through 60	6	7
Over 2.50through 4.00	60 through 100	5	6
Over 4.00 through 6.00	100 through 150	4	5
Over 6.00 through 8.00	150 through 200	2	4
Over 8.00 through 10.00	200 through 250	1	2

TABLE-1-DIN WIRE TYPE PENETRAMETER

DINPACK Designation	WIRE DIA METER MM(INCH) CORRESPONDING WIRE NUMBER						
1FE DIN	3.20 (0.125) 1	2.50 (0.098) 2	2.00 (0.078) 3	1.60 (0.062) 4	1.25 (0.050) 5	1.00 (0.040) 6	0.80 (0.032) 7
6FE DIN	1.00 (0.040) 6	0.80 (0.032) 7	0.63 (0.024) 8	0.50 (0.020) 9	0.40 (0.016) 10	0.32 (0.013) 11	0.25 (0.010) 12
10 FE DIN	0.40 (0.016) 10	0.32 (0.013) 11	0.25 (0.010) 12	0.20 (0.008) 13	0.16 (0.006) 14	0.125 (0.004) 15	0.1 (0.004) 16

TABLE-2-ISO WIRE TYPE PENETRAMETER

DINPACK Designation	WIRE DIA METER MM(INCH) CORRESPONDING WIRE NUMBER						
1 ISO 7	3.20 (0.125) 1	2.50 (0.098) 2	2.00 (0.078) 3	1.60 (0.062) 4	1.25 (0.050) 5	1.00 (0.040) 6	0.80 (0.032) 7
6 ISO 12	1.00 (0.040) 6	0.80 (0.032) 7	0.63 (0.024) 8	0.50 (0.020) 9	0.40 (0.016) 10	0.32 (0.013) 11	0.25 0.010 12
10 ISO 16	0.40 (0.016) 10	0.32 (0.013) 11	0.25 (0.010) 12	0.20 (0.008) 13	0.16 (0.006) 14	0.125 (0.004) 15	0.1 (0.004) 16

TABLE-3-ASTM WIRE TYPE PENETREMETER

ASTM SET Designation	Wire Diameter MM(Inch)					
A	.081(.0032)	.102(.004)	.127(.005)	.160(.0063)	.203(.008)	.254(.010)
B	.254(.010)	.330(.013)	.406(.016)	.508(.020)	.635(.025)	.813(0320)
C	.813(.032)	1.016(.040)	1.27(.050)	1.6(.063)	2.03(.080)	2.54(.100)
D	2.54(.100)	3.2(.126)	4.06(.160	5.08(.200)	6.35(.250)	8.13(.320)

Damaged IQIs Shall Not Be Used (E.G. Bent Wires)

IQIs shall be selected from either the same alloy material group or grade as identified in ASTM SE-747 or from an alloy material group or grade with less radiation absorption than the material being radiographed.

VIEWING FACILITIES

The Viewing facilities should provide subdued background lighting of intensity that will not cause Trouble some reflections, shadows, or glare on the radiograph.

Radiographic viewers shall meet the minimum requirements set forth in ISO 5580 and shall provide a variable light source for the essential designated wire to Be visible for the specified density range.

Light coming from the outer edges of the radiograph or through low density_Portions of the radiograph shall not interfere with interpretation.

Densitometers shall be used to measure the density of the film. The densitometer shall be calibrated annually in accordance with ASTM SE-1079. Performance shall be verified before each use with a density film strip traceable to a national standard.

EXAMINATION

A single wall exposure technique shall be used for radiography whenever practical. When it is not practical to use a single wall technique, a double Wall technique shall be used. (See Table for Technique

and Exposure Requirements

RT TECHNIQUE:

SWS, PANOROMICI, (DWSI) (3" on wards)	one wall thickness only—for calculation purpose
DWDI-(SUPERIMPOSE LESS THAN 2")	two wall thickness—for calculation purpose
DWDI (ELLIPSE LESS THAN 2")	two wall thickness---For calculation purpose

TABLE-TECHNIQUE AND EXPOSURE REQUIREMENTS

Nominal Pipe size	Technique	Type of exposure And viewing	Min.num.of. Exposure	Location figure
3-1/2" or less	elliptical	Dbl.wall exp Dbl.wall viewing	2 (0.90)	2F
	elliptical	Dbl.wall exp. Sgl.wall viewing	4 (0,90,180,270)	2E OR F
	superimposed	Dbl.wall.exp Dbl.wall viewing	3 (0,120,240)	3G
above 3-1/2"	Contact	Sgl.wall exp. sgl.wallviewing	3 (0.120,240)	2D OR E
	panoramic	Sgl wall exp Sgl.wall viewing	1	1A
		Sgl wall exp Sgl.wall viewing	4 0,90,180,270).	1B,1C
		Sgl wall exp Sgl.wall viewing	4	1A,1B,1C

Single wall exposure –single wall viewing (SWE/SWV) technique- the radiation passes through only one wall of the weld (material), which is viewed on the radiograph for acceptance, double wall exposure-single wall viewing (DWE/SWV) technique –radiation passes through two walls and only the weld (material) on the film side wall is viewed for acceptance on the radiograph. For full weld coverage of Circumferential welds at least 3 exposures taken 120' a part shall be taken

Double wall exposure- double wall viewing (DWE/DWV) technique –radiation passes through two walls and both wall side viewed for acceptance on the radiograph. These techniques shall only be used for materials and weld in piping 3.5 inch NPS or less only a source side pentameter shall be used for the double wall viewing technique, For the elliptical Dwe /Dwv technique the radiation beam shall be offset from the plane of the weld at an angle sufficient to separate the images of the source side and film side portions of the weld so that there is no overlap of the area to be interpreted

The elliptical technique require at least 2exposures 90' to each weld to be radiographed to achieve complete coverage

In the superimposed Dwe/Dwv technique, the source shall be at right angles to the weld and the image of the weld and the image of both walls are superimposed. The superimposed technique, as a minimum,

requires three(3) exposure taken either 60'or 120' to each other for each weld to be radiographed to achieve compete coverage

SWI-RT-DARK ROOM &QUESTION PAPER-I

1. How do you control and monitor the developer activity is?

Replishment

2. Which will give good definition if the un sharpness is?

A.0.5

B.0.25

C.0.75

D.1.0

3. Intensity of the x ray is mainly depending on?

Tube current

4. Unlikely defect occurs in SAW weld?

1. Slag inclusion
2. Tungsten inclusion
3. Lack of penetration

5. Likely defect in TIG welding?

Lack of penetration,

Tungsten inclusion

6. Gas entrapment defect?

Porosity

7. KV selection finally depends on what factor?

1. Film type
2. Film type & SFD Distance increase
3. Material thickness

8. Image formation of the radiographic film (after development)?

1. Silver bromide
2. Metallic silver
3. Black silver

9. Intensifying screen action main purpose?

1. To absorb long wave length and absorb back scatter
2. To absorb short wave length and back scatter

10. Radiographic film characteristic curve refers to?

A. Contrast and density B. Film and density

C. exposure and density

11. Reduction in developer strength cause main?

A. expose to air

B. No of film developing

C. both A and B

D. none of the Air

12. Instead of X –ray same strength source used for exposure affect which factor mainly?

A. density

B. contrast

C. definition

D. SFD

13. If source is higher to compensate this action required?

A. Increase exposure time

B. Increase SFD

C. Increase film to object distance

14. A fine irregular high density on weld cap across the weld?

A. Hair placed b/w film & sheen

B. Transverse crack

15. Artefacts on film emulsion can be identified verify easily?

A. high intensity viewer

Reflected light placing film at an angle

16. Lead screens were used for?

To reduce the back scatter

17. In MIG weld it is identified that hard very low density indications?

Tungsten inclusions

18. A typical indication connected with TIG weld?

Tungsten inclusions

19. A typical indications connected with TIG weld?

Tungsten inclusions.

20. Crater pipe due to?

Sudden take off heat at weld finish

21. All film bases shall have most common property?

Transparency

22. The chemical compound on un developing film grain?

Ag Br

23. The range of thickness of specimen can be viewed more easily on radiograph due?

Cathode

24. The developed shall be free of?

A. finger mark

B. pressure mark

C. static mark

D. All of the above

25. The penetrability of x ray beam controlled by?

Kilo voltage

26. The geometry of an image is connected with?

UN sharpness

27. Maximum un Sharpness permissible?

0.50

28. The slow film has good definitions constant due to?

Finer grains

29. The grain at the film forms visual impression called?

Grainneness

30. Gas entrapment in welding caused?

A. porosity

b. Undercut

31. Folding of the film before processing will give?

A. Light folding mark

B. Dark folding mark

C. Grey fold mark

32. Penetrating ability of x ray depends on?

A. milli ampere

B.curie

C. Killo voltage applied

33. Intensity in x ray machine depends on?

A. tube current

B. KV

34. Final selection of KV depends on?

A. specimen thickness

B. source strength

C. source size

35. Compare to X ray to gamma ray has?

1. Low contrast

2. High contrast

3. Low definition

4. High sensitivity

36. Large source size compensated by?

1. SFD

B. source strength

37. Characteristics curve?

Density Vs exposure time

38. T x ray machine mille amp X Time =?

1. Density

2. Intensity

3. Exposure time

39. Developer activity is constantly monitored by?

.1.Replishment

40. Developer strength solution reduced by due to?

1. Number of film processed

2. Contact with atmospheric air

3. Contamination

4. All of the above

41. Before development film should not involve?

1. Pressure on it

2. Expose to chemicals

3. from dust

4. All of the above.

42. Why film to object distance closer, what factor will affect?

A. un sharpness

B. contrast

C. density

43. Light crescent mark found in the film due to?

A. pressure mark after exposure

B. nail mark before exposure

C. nail mark after developer

44. RT film will get affected by?

A. safe light

B. chemical vapours

C. x or gamma rays

D. all of the above

45. Slow speed film density range varies between?

A. 1.8—2.5

B.2.2-- 3.2

C.2.8---3.5

D.1.0---1.8

46. X- ray tube filters for the function of?

A. heat dissipate

B. to absorb short wave length or primary radiation

C. absorbing secondary radiation

47. MA mins refer to?

A. Strength

B. Intensity

C. Energy

D. Exposure

48. Which penumbra value must have good definition?

A. 1.00mm

B.1.75mm

C. 0.5mm

D, 0.25mm

49. Which are likely occurring defect in saw process?

A. Tungsten inclusion

B. Slag

C. Lack of fusion

D. Lack of penetration

50. Likely occurring defect in TIG process?

A. lack of side wall fusion

B. slag

C. Hot cracking

51. How to monitor the developer activity?

Replishment

52. Lead screen absorb high energy (short wave length) unexposed film will be affected by?

A. chemical dust

B. safe light

C. keeping weight on that

D. all of the above

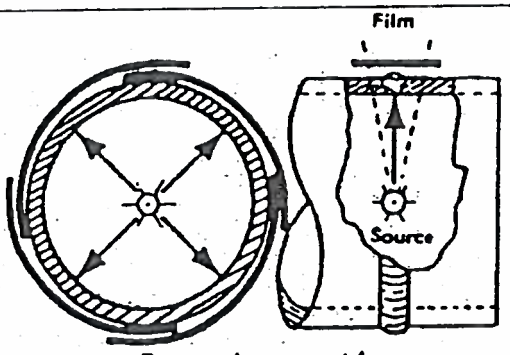
53. Purpose filter in x ray machine?

A. filter long wave length (lower energy)

54. X ray has better than gamma ray?

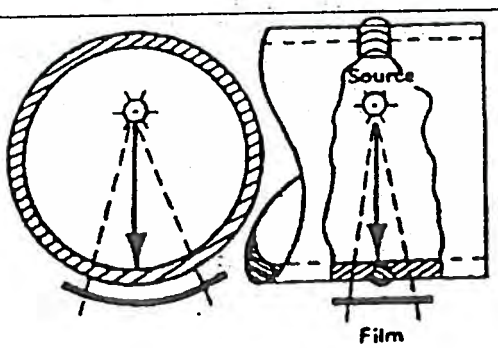
Figure 3. 0 – Exposure Arrangement 'A' – Single wall Single Image – Panoramic techniques (source centre) – source inside and film outside

Section 1.01 Figure 3 – Single Wall Radiographic Techniques

Pipe OD	Exposure Technique	Radiographic Viewing	End View / Side View	IQI Placement Side	Location Marker Placement
≥ 12"	Single Wall	Single Wall	 Exposure Arrangement A	Source side if accessible, film side if not	Either Side

Exposure arrangement 'A' is commonly known as panoramic exposure since the entire circumference of the weld is radiographed in once exposure. The source is positioned at the center of the pipe or vessels with the film placed around the circumference of the weld. Figure 3. 0 illustrates **exposure arrangement 'A'.**

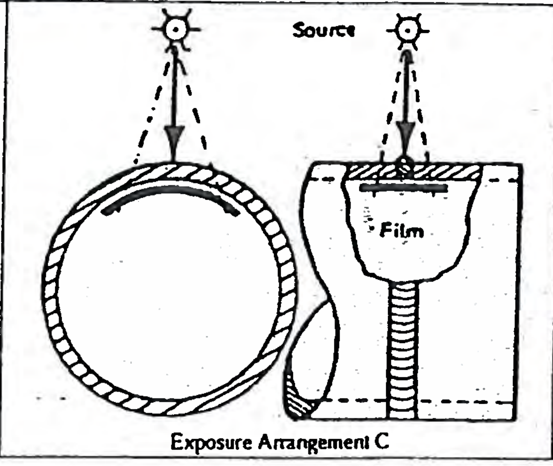
Figure 3. 1 Exposure arrangement 'B' Single wall Single Image – Radiation source inside , film inside

Pipe OD	Exposure Technique	Radiographic Viewing	End View / Side View	IQI Placement Side	Location Marker Placement
≥ 12"	Single Wall	Single Wall	 Exposure Arrangement B	Source Side	Source Side

Exposure arrangement 'B' is used to radiograph a selected area of a weld as in a weld repair area. The source is positioned anywhere on the inside of the pipe or vessel with the film placed on the outside of the weld. Figure 3. 1 illustrates the **exposure arrangement of 'B'**

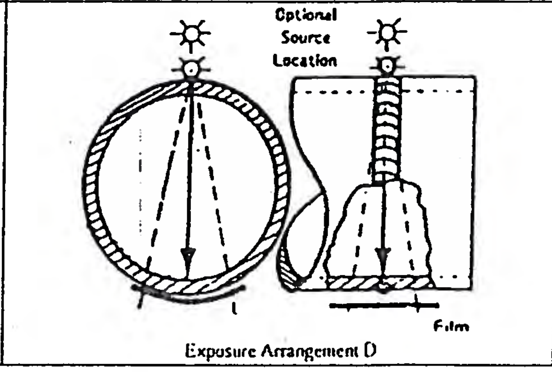
RT FILM INTERPATION INFORMATION (SENSIVITY)

Figure 3. 2 - Exposure Arrangement 'C' Single Wall single Image – Radiation source outside – film inside

Pipe OD	Exposure Technique	Radiographic Viewing	End View	Side View	IQI Placement Side	Location Marker Placement
Any	Single Wall	Single Wall			Source Side	Source Side

Exposure arrangement 'C' is used for a weld that has limited access on the outside of the pipe and the film cannot be placed on the weld. It is also useful when inspecting for root pass discontinuities since the film is placed directly on the weld root. A major disadvantage of this type arrangement is that a limited length of weld can be radiographed due to the film being curved away from the radiation source. Numerous exposure are required to cover the entire weld. The source is positioned on the outside of the pipe or vessel and film placed on the inside surface of the weld. Figure 3. 2 illustrates **exposure arrangement 'C'**

Figure 3. 3 - Exposure Arrangement 'D' Double Wall single Image – Radiation source outside – film outside

Pipe OD	Exposure Technique	Radio-graphic Viewing	End View	Side View	IQI Placement Side	Location Marker Placement
Any	Double Wall, at least 4 exposures 90° to each other for complete coverage	Single Wall			Either Side	Film Side

Exposure arrangement 'D' commonly known as contact exposure is used when there is no convenient access to the inside of a pipe or on smaller diameter pipe. The source is positioned against the weld on the outside of the pipe or vessel and the film is placed on the outside, opposite of the source. This exposure arrangement requires a minimum of three exposures. Figure 3.3 and 3.3A - illustrates **exposure arrangements 'D' and 'E'**

Figure 3. 3A - Exposure Arrangement 'E' Double Wall single Image – Radiation source outside – film outside

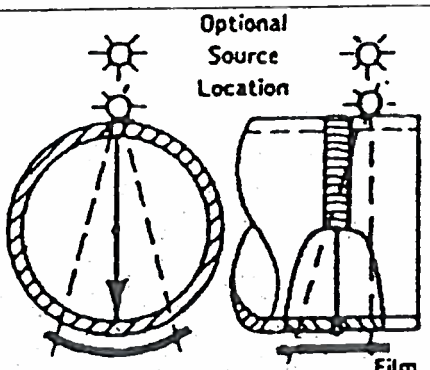
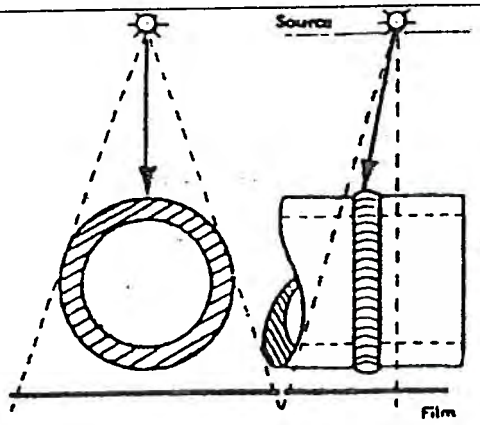
Pipe OD	Exposure Technique	Radio-graphic Viewing	End View / Side View	IQI Placement Side	Location Marker Placement
Any	Double Wall, at least 4 exposures 90° to each other for complete coverage	Single Wall	 Exposure Arrangement E	Either Side	Film Side

Figure 3. 4 - Exposure Arrangement 'F' Double Wall Double Image – Radiation source outside – film outside

Section 1.02 Double Wall Radiographic Techniques

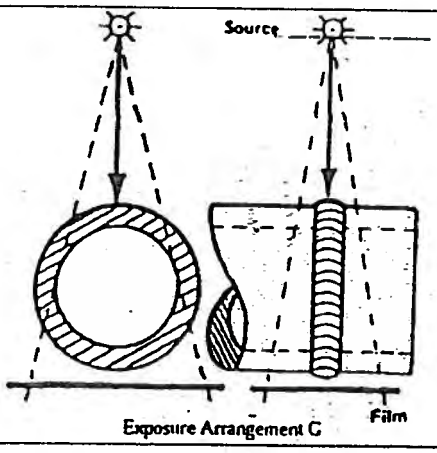
Pipe OD	Exposure Technique	Radio-graphic Viewing	End View / Side View	IQI Placement Side	Location Marker Placement
3-½" or less	Double Wall, at least 2 exposures at 90° to each other for complete coverage	Double Wall: (Ellipse) Read offset source side and film side images	 Exposure Arrangement F	Source Side	Either Side

Section 1.03

Exposure arrangement 'F' commonly known as an elliptical exposure is used for pipe which is less than 3 ½" in outside diameter. The source is positioned offset from the plane of the weld at a pre determined distance away from the weld and the film is placed on the back side of the weld. This exposure arrangement requires two exposures 90 degree from each other. Figure 4 illustrates **exposure arrangement of 'F'**

Figure 3. 5 - Exposure Arrangement 'G' Double Wall Double Image – Radiation source outside – film outside

Section 1.04

Pipe OD	Exposure Technique	Radio-graphic Viewing	End View / Side View	IQI Placement Side	Location Marker Placement
3-½" or less	Double Wall, at least 3 exposures at 60° or 120° to each other for complete coverage	Double Wall: Read Super-imposed source and film side images	 Exposure Arrangement G	Source Side	Either Side

Exposure arrangement 'G' commonly known as a superimposed technique is also used for pipe that is less than 3 ½" in out side diameter. The source is positioned away from the pipe directly above the weld at a pre determined distance and the film is placed on the back side of the weld. The resultant image of the weld that have been radiographed by the superimposed technique

Better definition

55. To comp step the large source size?

A. increase the distance between source object

B. increase the object to film

C. degrees the SFD

D. increase the SFD

56. What chemical in radiograph?

A. Black solver

57. Gap mark how if look after developing?

Ans. White mark

58. Contrast and definition will affect which of the following?

A. density

B. sensitivity

59. Lead foil screens were used with film for intensification due to following property?

A. emit electrons with film side

60. Wire pentameters will be placed on the radiograph?

Across the weld on the source side

61. IQI sensitivity is to check?

A. a small defect can be detected

B. IQI=$\frac{\text{eliminating the specimen}}{\text{Wire}}$ x100

C. All the above.

D. to access the radiographic technique

SWI-RT-MODELQUESTION PAPER-I

1. If it were necessary to radiograph a 7-inch thick steel product, which of the following gamma ray source would most likely be used?

A. Co60

B. Ir192

C. Ce 137

D. Yb 169

2. The kilo voltage applied to an x-ray tube effects?

A. The quality of the x-ray beam

B. The quantity of the x-ray beam

C. Has no effect on subject contrast

D. All of the above

3. Isotopes of a single element differ only in the number of?

A. Protons

B. Neutrons

C. Electrons

D. Positrons

4. Calcium tungstate screens used in industrial radiography are usually used to?

A. Improve definition

B. Improve contrast in the radiograph

C. Decrease exposure times

D. None of the above

5. the most common causes for excessively high-density radiographs are?

A. Insufficient washing and overdevelopment

B. Contaminated fixer and insufficient washing

C. Overexposure and contaminated fixer.

D. Overexposure and overdevelopment

6. Movement, geometry and screen contact are three factors that affect radiographic?

A. Contrast

B. Un sharpness

C. Reticulation

D. Density

7. The half-life of a source is dependent on?

A. It's original intensity

B. The source to film distance

C. The physical size of the isotope

D. The isotope

8. If a film is placed in a developer solution and allowed to develop without agitation?

A. The radiograph will not show correct contrast

B. It will be impossible to fix the radiograph permanently

C. There will be a general fogging condition over the entire radiograph

D. Bromide streaking may result.

9. When a radiograph of a weld which contains a large. The crack will appear on the radiograph as?

A.A dark intermittent or continuous line

B.A light, irregular line

C. Either a dark or light line

D.A dark rounded indication

10. Which one of the following persons is allowed to work with ionizing radiation?

A. An authority person

B. A qualified person

C. A classified person

D. A radiation person

11. Which of the following units is used for measuring the amount of absorbed dose?

A. Sievert

B. Rem

C. Roentgen

D. Gray

12. Lead foils direct contact with x-ray film

A. Intensifies the scatter radiation more than the primary radiation

B. Decreases the contrast of the radiographic image

C. Intensifies the primary radiation more than the scatter radiation

D. Should not be used when gamma rays are emitted by the source of radiation.

13. Which of the following defects are likely to be missed using x-ray as the inspection medium?

A. Plate laminations, lack of side wall fusion on a single U butt weld and cap overlap.

B. Toe cracks, plate laminations and lack of side wall fusion on a single U butt weld,

C. Plate laminations, lack of inter run fusion using the MIG/MAG welding process and cap overlap.

D. All defects are always detected using x-rays.

14. Which of the following is the most likely appearance of lack of root fusion on a radiograph taken of a single V butt weld?

A.A dark straight line with a light root

B.A dark straight line with a root of higher density

C. A dark root with straight edges.

D. A dark uneven line with a light root.

15. Which of the following defects would show up as light indications?

A. Copper inclusions, slag inclusions and excessive root penetration

B. Tungsten inclusions spatter and lack of root penetration

C. Tungsten inclusions, excessive root penetration and spatter.

D. Excessive cap height, copper inclusions and under flushing.

16. If an exposure time of 3 minutes and 30 seconds were necessary using a 5-metre source to film distance for a particular exposure, what time would be necessary if a 3-metre source to film distance is used and all other variables remain the same?

A.1 minute 43 seconds

B.1 minute 15 seconds

C.65 minutes 12 seconds

D.2 minutes 55 seconds

17. In order to increase the intensity of X-radiation?

A. The tube current should be increased

B. The tube current should decreased

C. The test specimen should be moved nearer to the film

D.A lower kilo voltage should be applied to the tube.

18. Excessive exposure of film to light prior to development of the film will most likely result in?

A.A fogged film

B. Yellow stains

C. An increase in film contrast

D. Frilling

19. The Penetrating ability of gamma rays is governed by?

A. The isotopes activity

B. Time plus activity

C. The isotopes half-life

D. The atomic number of the element used for the isotope.

20. Two different gamma isotopes of the same activity?

A. Will produce different wavelengths of radiation.

B. Will produce the same quality of radiation

C. Will produce the same intensities and wavelengths of radiation.

D. Will produce only electromagnetic and ionizing radiation.

E. Good radiograph is produced using the following exposure conditions, 4 minutes at 3mA.

21. What exposure time would be needed if the mA were reduced to 2mA?

A.6 minutes

B.3 minutes

C.2 minutes

D.4 minutes

22. Reticulation resulting in a puckered or netlike film surface is probably caused by?

A. Crimping the film after exposure

B. Sudden extreme temperature change while processing

C. Crimping the film before exposure.

D. Warm or exhausted fixer.

23. A pentameters on the film side of the object is used to indicate?

A. The size of discontinuities in a part

B. The density of the radiograph

C. The amount of film contrast

D. The overall quality of the radiographic technique used.

24. X-rays and gamma rays are:

A. Corpuscular and ionizing radiation

B. Particulate and ionizing radiation

C. Particulate and corpuscular radiation

D. Electromagnetic and ionizing radiation.

25. The activity of the developer solution is maintained stable by?

A. Constant agitation

B. Maintaining processing solutions within the recommended temperature range.

C. Avoiding contamination from the water wash.

D. Addition of replenisher.

26. The small area in the x-ray tube from which the x-radiation emanates is called the?

A. Focal spot

B. Filament

C. Focusing cup

D. Cathode

27. The absorption of gamma rays from a given source when passing through matter depends on?

A. The atomic number, density and thickness or the matter.

B. the Young's modulus value of the matter

C. The specific activity value of the source

D. All of the above

28. the fact that gases, when bombarded by radiation, ionize and become electrical conductors makes them useful in?

A. x-ray transformers

B. x-ray tubes

C. Radiation detection equipment

D. Radiographic film

29.A graph showing the relation between material thickness, kilo voltage and exposure are called?

A.A bar chart

B. An exposure chart

C.A characteristic curve

D. an H & D curve

30. Beta particles are:

A. Neutrons

B. Protons

C. Electrons

D. Positrons.

SWI-RT-MODELQUESTION PAPER-2

1 .what qualities would a radiograph of a 10mm thick steel weld possess, if it had been produced using 30-curie Cobalt source over 5 minutes?

A. High contrast relative to a radiograph produced using a 10-curie cobalt source.

B. It would have high density unless solarisation has occurred

C. It would have high definition

D. It will probably be blank

2. Whilst engaged in radiographic exposures, a classified person is required by law to wear a?

A. TLD and radiation dose rate meter

B. Film badge or a TLD

C. Geiger counter

D. None of the above

3. Why are radiographic densities in the weld area of approximately 1.5 and below are usually considered too?

A. Low for acceptance of the radiograph?

B. Because the radiographic definition is too low

C. Because the subject contrast is too low regardless of the light intensity of the viewer used.

D. Because the radiographic contrast is impaired

E. Radiographs with these densities in the weld are not usually considered unacceptable.

4. Low voltage x-ray tubes are generally fitted with windows made of?

A. Tungsten

B. Lead

C. Steel

D. Beryllium

5. Lead screens intensify primary radiation by?

A. By emitting alpha radiation

B. By emitting Beta radiation

C. By emitting visible or ultraviolet light

D. None of the above.

6. Which of the following isotopes has the longest half-life?

A. Cobalt 60

B. Ytterbium 169

C. Iridium 192

D. Thulium 170

7. The Primary form of energy conversion when electrons strike a target in an x-ray tube results in the Production of?

A. Long Wavelength radiation

B. Soft radiation

C. Primary X-rays

D. Heat.

8. The purpose of circulating oil in some types of X-ray tubes is?

A. To dissipate heat.

B. For lubrication purposes

C. To reduce the chance of scatter radiation reaching the tube head.

D. To reduce the need of high currents.

9. The damage inflicted by ionizing radiation on living tissue is measured in?

A. Roentgens

B. Grays

C. Curies

D. Sieverts

10. after a period of 296 days the activity of an iridium 192 source, activity 400-Gbq would be?

A. 100Gbq

B. 50 Gbq

C. 25 Gbq

D. 12.5 Gbq

11. What are the axes found on a films characteristic curve?

A. Film contrast and exposure time

B. Kilo voltage and exposure time

C. Film density and exposure time

D. Exposure time and kilo voltage used

12. An increase in Kilo voltage will result in: (if all other considerations remain the same)?

5. Lead screens intensify primary radiation by?

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B. By emitting Beta radiation

C. By emitting visible or ultraviolet light

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11. What are the axes found on a films characteristic curve?

A. Film contrast and exposure time

B. Kilo voltage and exposure time

C. Film density and exposure time

D. Exposure time and kilo voltage used

12. An increase in Kilo voltage will result in: (if all other considerations remain the same)?

A. A reduction in film contrast

B. An increase in radiographic contrast

C. No overall changes to the radiographs definition

D. A reduction in subject contrast

13. If the main aim is to determine the quality of the radiographic technique, the IQI should be placed?

A. As near to the radiation source as possible

B. As far from the radiation source as possible

C. On the side of the object being radio graphed remote from the radiation source

D. On the source side of the object

14. A lead sheet containing a pin hole may be placed half way between x-ray tube and the film in order to?

A. Measure the intensity of radiation

B. Used to set up exposure times

C. Reduce secondary radiation

D. Determination of focal spot size.

15 .When considering penumbra, what is usually the maximum permitted value?

A. 0.25mm

B.25mm

C.1.25mm

D. 0.125mm

16. Which of the following applies to constant potential X-ray tubes?

A. Thicker cables and larger tube heads

B. Faster sets and more commonly used on site

C. More robust and lighter sets

D. Faster sets and smaller tube heads

17. Which of the following are reasons for insufficient density on a radiograph?

A. Over development and insufficient final wash

B. Low Kilo voltage and excessive exposure times

C. Developer temperature to low and under exposure

D. Under development and developer temperature to high

18. A large physical source size may produce an equivalent quality radiograph if?

A. The source to film distance is increased

B. The object to film distance is increased

C. Exposure times are reduced

D. A faster film speed is used.

19. The General method of producing x-rays involves the sudden deceleration of high velocity electrons in a solid bod called?

A. Focusing cup

B. Filament

C. Target

D. Cathode

20. in an X-ray tube, the filament and focusing cup are the two essential parts of the?

A. Anode

B. Cathode

C. Rectifier

D. Control panel

21. An X-ray tube with a small focal spot is considered better than one with a large focal spot size when it is desired to obtain?

A. Greater Penetration

B. Better geometric un sharpness

C. Better inherent film un sharpness

D. Improved radiographic contrast

22. One method of reduction radiographic contrast is to?

A. Increase the distance between the radiation source and the object

B. Decrease the distance between the radiation source and the object

C. Increase the potential difference between the anode and cathode

D. Increase development time within manufactures recommendations

23. in X-ray radiography, alternating current must be changed to pulsating direct current in order to satisfy the need fo fast and more efficient x-ray sets, this change may be accomplished by

A. Transformers

B. Rectifiers

C. Inverters

D. Filaments

24. Which of the following applies to salt screens?

A. They intensify radiation by emitting light radiation

B. They increase exposure times when compared with lead screens

C. They produce radiographs of better definition when compared with no screens

D. They are the most common screens types used on welds in industrial radiography.

25. The Penetrating ability of an X-ray beam is governed by?

A. the Kilo voltage or wavelength

B. Time

C. The source to film distance

D. The mille amperage or intensity

26. Two factors which greatly effect the suitability of the target material in an x-ray tube are?

A. The melting point and magnetic strength

B. Electrical resistance and the melting point

C. The material Z number and the melting point

D. All of the above

27. An X-ray tube which is designed to operate in large diameter pipes and cylindrical vessels which Produces a panoramic x-ray beam over the full 360' is termed?

A. Bio polar

B. Rod anode

C. High voltage generator

D. Betatron

28. Filters used at the port of the X-ray tube?

A .Intensify the X-ray beam by intensifying the secondary radiation

B. Filter out hard radiation and secondary radiation

C. Filter out short wavelength radiation to provide softer radiation

D. Filter out soft radiation and secondary radiation.

29. The ability to detect a small discontinuity of flaw on a radiograph is called?

A. Radiographic contrast

B. Radiographic sensitivity

C. Radiographic density

D. Radiographic definition

30. A Cobalt 60 source has a half-life of?

A.1.2 Years

B.6 months

C.5.3 Years

D. 74 Days.

SWI-RT-MODELQUESTION PAPER-3

1. Calcium tungstate screens used in industrial radiography are usually used to?

A. Improve definition in radiographic images

B. Improve contrast in radiographic images

C. Decrease exposure time

D. Make films with multi-million volt radiation.

2. The penetrating ability of an x-ray beam is governed by?

A. Kilo voltage or wavelength

B. Time

C. Milliamp rage

D. Source-to-film distance

3. The two most common causes for excessively high-density radiographs are?

A. Insufficient washing and overdevelopment

B. Contaminated fixer and insufficient washing

C. Overexposure and contaminated fixer

D .Overexposure and overdevelopment

4. When struck by X-rays or gamma rays, lead screens emit?

A. Alpha particles

B. Beta particles

C. Fast neutrons

D. Ultraviolet light

5. The ability to detect a small discontinuity or flaw on a radiograph is called?

A. Radiographic contrast

B. Radiographic sensitivity

C. Radiographic density

D. Radiographic definition

6. Movement, geometry and screen contact are three factors that affect radiographic?

A. Contrast

B. Un sharpness

C. Reticulation

D. Density

7. The degree of difference between the densities of two areas of a radiograph is called?

A. Radiographic contrast

B. Subject contrast

C. Film contrast

D. Definition

8. Which are the axes found on a characteristic curve?

A. Exposure and contrast

B. Density and definition

C. Log relative exposure and density

D. Density and contrast

9. If a film is placed in a developer solution and allowed to develop without any agitation?

A. The radiograph will not show proper contrast

B. It will be impossible to fix the radiograph permanently

C. There will be a general fogging condition over the entire radiograph

D. Bromide streaking may result

10. When radio graphing a part which contains a large crack, the crack will appear on the radiograph a?

A. A dark intermittent or continuous line

B A light, irregular line

C. Either a dark or light line

D. A fogged area on the radiograph

11 .A cobalt-60 sources have a half-life of?

A.1.2 years

B. 6 months

C.5.3 Years

D.75 days

12. Lead foil in direct contact with x-rays film?

A. Intensifies the scatter radiation more than the primary radiation

B. Decreases the contrast of the radiographic image

C. Intensifies the primary radiation more than the scatter radiation

D. Should not be used when gamma rays are emitted by the source of radiation.

13. Radiographic sensitivity, in the context of the minimum detectable flaw size, depends on?

A. Graininess of the film

B. The un sharpness of the flaw image in the film

C. The contrast of the flaw image on the film

D. All three of the above.

14. In order to decrease geometric un sharpness?

A. Radiation should proceed from as small a focal spot as other considerations will allow.

B. Radiation should proceed from as large a focal spot as other considerations will allow.

C. The film should be as far as possible from the object being radiographic

D. The distance from the anode to the material examined should be as small as is practical.

15. In order to increase the intensity of x-radiation?

A. The tube current should be increased

B. The tube current should be decreased

C. The test specimen should be moved further from the film

D. A lower kilo voltage should be applied to the tube.

16. Excessive exposure of film to light prior to development of the film will most likely result in?

A.A fogged film

B. Poor definition

C. Streaks

D. Yellow strain

17. White crescent-shaped marks on an exposed x-ray film will most likely result from?

A. Crimping film after exposure

B. Crimping film before exposure

C. Sudden extreme temperature change while processing

D. Warm or exhausted fixer.

18. Reticulation resulting in a puckered or netlike film surface is probably caused by?

A. Crimping film after exposure

B. Sudden extreme temperature change while processing

C. Water or developer on unprocessed film

D. Excessive object to film distance.

19. If an exposure time of 60 seconds was necessary using a 4-metre source-to-film distance for a Particular exposure, what time would be necessary if a 2-meter source- to- film distance is used and all other variables remain the same?

A.120 seconds

B. 30 seconds

C.15 seconds

D.240 seconds

20.A pentameters on the film side of the object is used to indicate?

A. The size of discontinuities in a part

B. The density of the film

C. The amount of film contrast

D. The quality of the radiographic technique.

21. A fluorescent intensifying screen will:

A. Transform electronic x-ray energy into visible or ultraviolet light to which a photographic Emulsion is sensitive.

B. Result in reticulation

C. Decrease the graininess of the image when using gamma rays

D. Increase the definition in a radiograph.

22. Lead foil screens are used in radiography to improve the quality of the radiograph by preferentially reducing the effect scatter?

A. To reduce the exposure time.

B. Both A and B are reasons for using lead foil screens.

C. Neither A nor B is reasons for using lead foil screens.

D. To prevent excessive backscatter from reaching a radiographic film, one should;

23. Back the cassette with a sheet of lead, the thickness needed depending on the radiation quality?

A. Place a mask between the specimen and the front surface on the film.

B. Back the exposure holder with a thick sheet of lead (at least 0.5 inch)

C. Place a filter in the x-ray or gamma ray beam near the source or x-ray tube.

24. A. The purpose of agitating an x-ray film during development is to?

A. Protect the film from excessive pressure

B. Renew the developer at the surface of the film.

C. Disperse unexposed silver grains on the film surface.

D. Prevent reticulation.

25. when manually processing films, the purpose for sharply tapping hangers two or three times after the films have been lowered into the developer is to:

A. Disperse unexposed silver grains on the film surface

B. Prevent frilling

C. Dislodge any air bubbles clinging to emulsion

D. All of the above

26. The activity of the developer solution is maintained stable by?

A. Constant agitation

B. Maintaining processing solutions within recommended temperature range

C. Avoiding contamination from the water wash

D. Addition of replenisher.

27. The purpose of fixation is?

A. To remove all the undeveloped silver salts of the emulsion

B. To leave the developed silver as a permanent image

C. To harden the grlatine

D. All of the above

28. Water spots on films can be minimized by?

A. Rapid drying of wet film.

B. Immersing wet film for one or two seconds in a wetting agent solution.

C. By using a fresh fixer solution

D. By cascading water during the rinse cycle

29. The small area in the x-ray tube from which the x-radiation emanates is called the?

A. Focal spot

B. Filament

C, Focusing cup

D. Cathode

30. with a given exposure time and kilo voltage, a properly exposed radiograph is obtained with a 6 millamperage-minutes exposure at the distance of 20 inches. It is desired to increase the sharpness of detail in the image by increasing the source-to-film distance to 40inches. The correct mill amperage-minutes exposure to obtain the desired radiographic density at the increased distance is?

A.12 milli amperage-minutes

B.24 milli amperage-minutes

C.3 milli amperage-minutes

D.1.7 milli amperage-minutes.

31. a graph showing the relation between material thickness, kilo voltage and exposure is called?

A.A bar chart

B. An exposure chart or technique chart

C.A characteristic curve

D.A H & D curve

32. A graph which expresses the relationship between the logarithms of the exposure applied to a Photographic materia and the resulting photographic density is called:

A. A bar chart

B. An exposure chart

C. The characteristic curve

D.A logarithmic chart

33. Two X-rays machines operating at the same nominal kilo voltage and mill amperage settings?

A. Will produce the same intensities and qualities of radiation

B. Will produce the same intensities but may produce different qualities of radiation

C. Will produce the same qualities but may produce different intensities of radiation

D. May give not only different intensities but also different qualities of radiation.

34. When producing radiographs, if the kilo voltage is increased:

A. The subject contrast decreases

B. The film contrast increased

C. The subject contrast increases

D. The film contrast decreases.

35. An unshielded isotope source gives a dosage rate of 900 MR per hour at 10feet. What would the Unshielded dosage rate be at 30 feet?

A.300mR/hr

B.600mR/hr

C.100mR/hr

D.2700mR/hr

36. Beta particles are?

A. Neutrons

B. Protons

C. Electrons

D. Positions

37. The lead symbol "B" is attached to the back of the film cassette to determine?

A. Sensitivity

B. Whether excessive backscatter is present

C. Radiographic contrast

D .Density

38. During manual film processing, the purpose of the stop bath is to?

A. Change the exposed silver salts to black metallic silver.

B. Neutralize the developer and stop the developing silver

C. Eliminate most water spots and streaks

D. None of the above.

39. A large source size can be compensated for by?

A. Increasing the source-to-specimen distance

B. Addition of lead screens

C. Increasing the specimen-to-film distance

D. Increasing penumbra.

40. X-rays and gamma rays are?

A. Particulate radiations

B. Electromagnetic radiations

C. Microwave radiations

D. All of the above.

SWI-RT-MODELQUESTION-PAPER-4

1. Low voltage X-ray tubes are generally fitted with windows made of?

A. Plastic

B. Beryllium

C. Glass

D. Lead

2. A monochromatic X-ray beam?

A. is a narrow beam used to produce high-contrast radiographs

B. is also referred to as a heterogeneous X-ray beam

C. is a beam containing only characteristic X-radiation

D. is a beam consisting of single wavelength

3. The general method of producing X-rays involves the sudden deceleration of high velocity electrons in a solid body called a?

A. focus cup

B. filament

C. target

D. cathode

4. If it were necessary to radiograph a 7-inch thick steel product, which of the following gamma-ray sources would most likely be used?

A.Cobalt-60

B.Thulium-170

C.Iridium-192

D.Cesium-137

5. A cobalt-60 gamma-ray sources has an approximate practical thickness limit of?

A.2 ½ inches of steel or its equivalent

B.4 inches of steel or its equivalent

C.9 inches of steel or its equivalent

D.11 inches of steel or its equivalent

6. The absorption of gamma rays from a given source when passing through matter depends on?

A. the atomic number, density, and thickness of the matter

B. the Young's modulus value of the matter

C. the Poisson's ratio value of the matter

D. the specific activity value of the source

7. The fact that gases when bombarded by radiation ionize and become electrical conductors makes them useful in?

A.X-ray transformers

B.X-ray tubes

C. Masks

D. Radiation detection equipment

8. The velocity of electrons striking the target in an X-ray tube is a function of?

A. the atomic number of the cathode material

B. the atomic number of the filament material

C. the voltage difference between the cathode and anode

D. the current flow in the rectifier circuit

9. The uneven distribution of developed grains within the emulsion of a processed X-ray film causes the subjective impression of?

A. graininess

B. streaks

C. spots

D. white scum

10. Cobalt-60 is reported to have a half-life of 5.3 years. By how much should exposure time be increased (over that used initially to produce excellent radiographs when the cobalt-60 source was new) when the source is two years old?

A. No change in exposure time is needed

B. Exposure time should be about 11 percent longer

C. Exposure time should be about 31 percent longer

D. Exposure time should be about 62 to 100 percent longer

11. A source of iridium-192, whose half-life is 75 days, provides an optimum exposure of given test object today in a period of 20 minutes. Five months from now, what exposure time would be required for the sample radiographic density, under similar exposure conditions?

A.10 minutes

B.20 minutes

C.1 hour and 20 minutes

D.6 hours

12. of the following, the source providing the most penetrating radiation is?

A.Cobalt-60

B.220 KVP X-ray tube

C.15 Mev x-ray betatron

D. Electrons from iridium-192

13. The gamma ray intensity at one foot from a one curie source of radioactive cobalt -60 is nearest?

A.15 roentgens per hour

B.1, 000 roentgens per hour

C.1 roentgens per minute

D.10 mill roentgens per day

14. The focal spot in an X-ray tube?

A. is inclined at an angle of 30 degrees from the normal to the tube axis.

B.Is maintained at a high negative voltage during operations

C. Should be as large as possible to ensure a narrow beam of primary radiation

D. Should be as small as possible without unduly shortening the life of the tube

15. in an x-ray tube, the filament and focusing cup are the two essential parts of the?

A. Anode

B. Cathode

C. Rectifier

D.X-ray transformer

16. the quantity of radiation which will produce, by means of ionization, one electrostatic unit of electricity in 0.001293 grams of dry air is known as?

A. a milli curie

B. a gamma

C. a roentgen

D. a curie

17. The specific activity of an isotopic source is usually measured in?

A. Million electron volts

B. Curies per gram

C. Roentgens per hour

D. Counts per minute

18. Which of the following isotopes has the longest half-life?

A.Thulium-170

B. Cobalt -60

C.Iridium-192

D.Cesium-137

19. The primary form of energy conversion when electrons strike a target in an x-ray tube results in the production of?

A. Primary X-rays

B. Secondary x-rays

C. Short wavelength x –rays

D. Heat

20. The slope of a straight line joining two points of specified densities on a characteristic curve of a film is known as the?

A. Speed of the curve

B. Latitude

C. Average gradient

D. Density

SWI-RT-MODELQUESTION-PAPER-5

1. An x-ray film having wide latitude also has by definition?

A. poor definition

B. Low contrast

C. High speed

D. None of the above

2. The purpose for circulating oil in some types of x-ray tubes is?

A. to lubricate moving parts

B. to absorb secondary radiation

C. to decrease the need for high current

D. to dissipate heat

3. An x-ray tube with a small focal spot is considered better than one with a large focal spot when it is desired to obtain?

A. greater penetrating power

B. better definition

C. less contrast

D. greater film density

4. One method of reducing radiographic contrast is to?

A. Increase the distance between the radiation source and the object

B. Decrease the distance between the object and the film

C. Decrease the wavelength of the radiation used

D. Increase development time within manufacturer's recommendations

5. Thin sheets of lead foil in intimate contact with x-ray film during exposure increase film density because?

A. they fluoresce and emit visible light which helps expose the film

B. they absorb the scattered radiation

C. they prevent back scattered radiation from fogging the film

D. they emit electrons when exposed to x and gamma radiation which help darken the film

6. X-ray tubes are often enclosed in a shockproof casing in order to?

A. dissipate heat

B. protect the operator from high-voltage shock

C. shield the tube from secondary radiation

D. increase the efficiency of the rectifier

7. An x –ray tube is rated for a maximum of 250 kvp. This tube may be operated at a maximum of?

A.250, 000 volts peak voltage

B.250 KV effective voltage

C.250, 000,000 volts rms voltage

D.250 kv average voltage

8. A voltage selector consisting of an iron core transformer with a single winding having a series of caps at various points on the winding is called?

A. a high-voltage transformer

B. a filament transformer

C. an autotransformer

D. a power transformer

9. in X-ray radiography, alternating current must be changed to pulsating direct current in order to satisfy the need for unidirectional current. This change may be accomplished by?

A. transformers

B. rectifiers

C. anodes

D. cathodes

10. When radiographic to the 2-2T quality level, an ASTM pentameter for 2.5 inch steel has a thickness of?

A. one half inch

B.2.5 mils

C.5 mils

D.50 mils

11. Valve tubes are used in X-ray equipment to?

A. Provide necessary rectification

B. Activate and deactivate the x-ray tube

C. Heat the filaments in the x-ray tube

D. Adjust the size of the target

12. A good cobalt-60 radiograph is made on a 3 inch steel casting using an exposure time of 10 minutes and a source to film distance of 36 inches. It is necessary to change the source to film distance to 24 inches, what exposure time would produce a similar radiograph if all other conditions remain the same?

A.1.6 minutes

B.4.4 minutes

C.6.4 minutes

D.8.8. minutes

13. When sharp, black, bird foot shaped marks which are known not to correspond with any discontinuities appear at random on radiographs, they are probably caused by?

A. prolonged development in old developer

B. exposure of the film by natural cosmic ray showers during storage

C. static charges caused by friction

D. inadequate rinsing after fixing

14. The adjustment of tube current in conventional x-ray tube circuits is made by?

A. adjusting the filament heating current

B. adjusting the target-to cathode distance

C. inserting resistance in the anode lead

D. opening the shutter on the x-ray tube port

15. In comparison with lower voltage radiographs high energy radiographs show?

A. greater contrast

B. greater latitude

C. greater amounts of scatter radiation relative to primary beam intensity

D. none of the above

16. Filters used at the port of the x-ray tube?

A. intensify the x-ray beam by contributing secondary radiation

B. filter short wavelength x-ray beams to provide softer radiation

C. provide the most readily adjusted means for modifying x-ray intensity

D. filter out soft radiation to provide a more homogeneous x-ray beam

17. An ASTM pentameters for use when inspecting a one-half inch thick steel plate to the 2 – wT quality level using a 15 inch source to film distance would be made of?

A.5 mil thick aluminium

B.50 mil thick aluminium or steel

C.10 mil thick steel

D.2 mil strip of any metallic material

18. The kilovolt age applied to an X-ray tube affects?

A. the quality of the beam

B. the intensity of the beam

C. both a and b above

D. neither a nor b above

19. Filters placed between the x-ray tube and specimen tends to reduce scatter radiation undercutting the specimens?

A. by absorbing the longer wavelength components of the primary beam

B. by absorbing the shorter wavelength component of the primary beam

C. by absorbing back scatter radiation

D. by decreasing the intensity of the beam

20. besides serving as a filter, screens of high atomic number such as lead and lead antimony also?

A. decrease the source to film distance needed for a proper radiograph

B. provide some image intensifying action

C. permits the use of higher speed film

D. decrease the graininess in a radiograph

SWI-RT-MODELQUESTION-PAPER-6

1. The range of thickness over which densities are obtained that are satisfactory for interpretation is a measure of the?

A. subject contrast of a radiograph

B. sensitivity of a radiograph

C. latitude of a radiograph

D. definition of a radiograph

2. Almost all gamma radiography is performed with?

A. natural isotopes

B. Iridium-192 or cobalt-60

C. Radium

D. Thulium-170

3. The amount of un sharpness or blurring of a radiograph is?

A. Directly proportional to the object to film distance and inversely proportional to the size of the focal spot

B. Directly proportional to the size of the focal spot and inversely proportional to the source to object distance

C. Inversely proportional to the object to film distance and directly proportional to the source to object Distance

D. Inversely proportional to the size of the focal sport and the object to film distance

4. Images of discontinuities close to the source side of the specimen become less clearly defined as?

A. source to object distance increases

B. the thickness of the specimen increases

C. the size of the focal spot decrease

D. the thickness of the specimen decreases.

5. The inherent filtration of an X-ray tube is a function of?

A. The thickness and composition of the X-ray tube port

B. The voltage setting of the instrument

C. The source to object distance

D. The material used as a target

6. X-ray films with large grain size?

A. will produce radiographs with better definition than film with small grain size

B. the voltage setting of the instrument

C. the source to object distance

D. the material used as a target

7. as the effective energy of the radiation increases up to about 250 kV?

A. film graininess increases

B. film graininess decreases

C. radiographic definition increases

D. film speed decreases

8. The specific activity of cobalt- 60 depends on?

A. The time the material has been in the reactor

B. The atomic number of the material

C. The gamma ray flux to which it was exposed

D. the Young's modulus value of the material.

9. the most commonly used target material in an X-ray tube is?

A. copper

B. carbon

C. carbide

D. Lungsten

10. The purpose for including a disc-shaped target that rotates rapidly during operation in some X-ray tubes is to?

A. increases the intensity of X-radiation

B. Decrease the voltage needed for a specific quality of radiation

C. Increase the permissible load

D. None of the above answers is correct

11. A device which is basically a combination of magnet and transformer designed to guide and accelerate electrons in a circular orbit to very high energies is called a?

A. electrostatic belt generator

B. linear accelerator

C. betatron

D. loroidal electromagnetic type X-ray tube

12. Two isotopic sources of a given strength have two different specific activity values. The source with the higher specific activity value will?

A. be of smaller physical size than the source with a lower specific activity

B. has a shorter half-life than the source with a lower specific activity

C. produces harder gamma rays than the source with lower specific activity

D. Be of larger physical size than the source with the lower specific activity

13. A gas filled region located in an electrical field created by electrodes across which potential difference is applied forms the major portion of?

A. a low voltage X-ray tube

B. a megger

C. a hot cathode X-ray tube

D. an ionization chamber.

14. Two serious obstacles to high-sensitivity fluoroscopy are?

A. The inability to reproduce results and the need for periodic replacement of screen

B. The limited brightness and large grain size of fluoroscopic screens.

C. Cost and slow speed.

D. The need for using long wavelength X-rays and the lack of X-ray intensity associated with this method.

15. In general, the quality of fluoroscopic equipment is best determined by?

A.densitometer readings.

B. Pentameters sensitivity measurements

C. Discontinuity area measurements

D. Reference standards.

16. In fluoroscopic testing, a fundamental difficulty is the relative low brightness level of the images. One method for increasing brightness utilizes one of the following which converts light energy from the initial phosphor surface to electrons which are accelerated and focused onto a smaller fluorescent screen?

A. Betatron

B. electron amplifier

C. image amplifier or intensifier

D. electrostatic belt generator

17. A general rule governing the application of the geometric principles of shadow formation states that?

A. the X-ray should precede from a larger a local spot as other considerations will all

B. the distance between the radiation source and the material examined should be as small as Practical

C. the film should be as far a possible from the object being radio graphed

D. the central ray should be as nearly as perpendicular to the film as possible to preserve spatial Relationships.

18. In order to utilize the principles of geometric enlargement placing the film at a distance from the specimens?

A. The source to specimen distance must be one-half the source to film distance.

B. The source of radiation must be extremely small.

C.A magnetic focusing coil must be used near the port of the X-ray tube

D. The specimen must be of uniform thickness.

19. The X-ray absorption of a specimen depends on?

A. the thickness and density of the material

B. the atomic number of the material

C. both A and B above

D. neither A nor B.

20. The radiographic absorption of a material will tend to become less dependent upon the composition of the material when?

A. the kilo voltage is increased

B. the source to film distance is decreased

C. the kilo voltage is decreased

D. a filter is used.

SWI-RT-QUESTION- SET-04

1. The formula (mille amperes X time) ÷ distance is?

A. used to calculate film gradient

B. the reciprocity law

C. used to determined radiographic contrast

D. the exposure factor

2. The load that can be handled by an X-ray tube focal spot is governed by?

A. the composition of the cathode

B. the size of the focal spot and the efficiency of the cooling system of the anode

C. the distance from the anode to the cathode

D. the high-voltage waveform

3. X-ray exposure holders and cassettes often incorporate a sheet of lead foil in the back which is not intimate contact with the film. The purpose of this sheet of lead foil is?

A. to act as an intensifying screen

B. to protect the film from backscatter

C. both A and B above

D. neither A nor B above.

4. A lead sheet containing a pinhole maybe placed halfway between the x-ray tube and the film indoor to?

A. Determine the approximate size of the focal spot

B. Measure the intensity of the central ray.

C. Filter scatter radiation

D. Soften the X-radiation

5. the most common way of cooling the anode of a high power X-ray tube is?

A. Cooling by radiation, in which a solid tungsten anode attains such high temperatures that it radiates an appreciable amount of heat.

B. Cooling by means of circulating cooled air

C. Cooling by circulation of water or oil in the anode

D. Cooling by means of external finned radiation.

6. In certain cases, it may be advantageous to pack lead shot around specimen. The purpose for doing this is?

A. to prevent movement of the specimen

B. to increase the subject contrast

C. to generate smaller wavelength X-radiation

D. to decrease the effect of the scattered radiation undercutting the specimen.

7. The mottling cause by diffraction when radiography fairly large grained metallic specimens can be reduced and in some cases eliminated by?

A. raising the kilo voltage and using fluorescent screens

B. lowering the kilo voltage and using lead foil screens

C. raising the kilo voltage and using lead foil screens

D. lowering the kilo voltage and using fluorescent screens

8. When radio graphing steel with the thickness less than one inch?

A.cobalt-60 would give greater radiographic sensitivity than a 250 KV X-ray machine

B. a 250 kV X-ray would give greater radiographic sensitivity than cobalt-60

C. the use of fluorescent screens would result in a radiograph of better quality than would lead foil screens.

D. the use of lead foil screens will require a shorter exposure time than will fluorescent screens.

9. A radiograph made with an exposure of 12mA per minute has a density of 0.8 in the region of maximum interest. It is desired to increase the density to 2.0 in this area. By reference to a characteristic curve of the film, it is found that the difference in a log E between the density of 0.8 and 2.0 is 0.76. The antilogarithm of log 0.76 is 5.8. What must the new exposure time be to produce a radiograph with a density of 2.0?

A. 9.12 MA per minute

B.21.12 MA per minute

C.69.6 MA per minute

D.16 MA per minute

10. The absorption of the radiation by a material varies?

A. Directly with the square of the distance from the source.

B. Directly with the thickness of the material

C. Inversely with the amount of scattering in the material.

D. In a approximately exponential manner with the thickness of the material.

11. In the micro radiographic technique?

A. Soft X-ray are usually employed

B. a kilo voltage range of 5 kV is usually employed

C. the photographic material is often finer grained than ordinary X-ray film

D. all three of the above choices is correct

12. In order for a radiograph to have a Pentameters sensitivity of 2-2T or better?

A. the radiographic procedure must has to be able to differentiate a 2 percent difference in specimen thickness

B. the radiographic procedure must be able to define the 2T hole in a pentameters which is 2 percent of the thickness of the specimen

C. the radiograph must be able to distinguish a discontinuity with a length equivalent to 2 percent of the specimen thickness

D. none of the above choices are correct.

13. for practical purposes, the shape of characteristic curve of an X-ray film?

A. is independent of the type of film used.

B. is independent of the quality of X or gamma radiation

C. is drastically changed when the quality of X-ray radiation is changed

D. is primarily determined by the subject contrast.

14. The term which describes the total absorption of the useful beam caused by the X-ray tube wall, the wall of the tube housing and any material between the tube and the housing is?

A. stray absorption

B. source absorption

C. characteristic filtration

D. inherent filtration

15. The interval between the time of a film is placed in fixer solution and the time when the original diffuse, yellow milkiness disappears is known as:

A. clearing time

B. fixing time

C. hardening time

D. oxidation time

16. Excessive subject contrast caused when the thickness range in the test specimen too great for the radiation quality used may be corrected by?

A. increasing the kilo voltage

B. using a filter at the X-ray tube and increasing the exposure time

C. both A and B are method for correcting excessive subject contrast

D. decrease the exposure time

17. Improper geometric factors, poor contract between film and lead foil screens and graininess of film are possible causes of?

A. high film density

B. poor definition

C. fogged film

D. low film density

18. In fluoroscopy the most common means for minimizing operator fatigue is to?

A. equip operators with special glasses

B. place a filter over the viewing screen

C. vary the intensity of the background light

D. change operators periodically

19. Which of the following X-ray generators would produce the narrowest cone of X-radiation?

A. 10 MeV

B 15 MeV

C. 25 MeV

D. 1 MeV

20. A radiograph is taken at a voltage of 500kV. If the voltage is increased with a resultant increase in the energy of radiation while all other conditions remain the same?

A. the graininess of the film will increase significantly if a high-speed film is used

B. the graininess of the film will decrease significantly if a low-speed film is used

C. the graininess of the film will increase significantly if a class I film is used

D. there will be little significant change in the graininess of the film.

MCQ SWI paper 1

1	C
2	C
3	B
4	C
5	B
6	A
7	C
8	B
9	A
10	A
11	A
12	A
13	C
14	BA
15	B

MCQ SWI paper 2

1	C
2	B
3	C
4	A
5	D
6	A
7	C
8	A
9	B
10	D
11	C
12	A
13	C
14	B
15	B

MCQ SWI 3

1	
2	
3	
4	
5	A
6	E
7	B
8	A
9	A
10	C
11	A
12	B
13	A
14	B
15	B

MCQ SWI 4

1	A
2	C
3	B
4	B
5	A
6	C
7	B
8	A
9	C
10	A
11	D
12	A
13	B
14	D
15	C

SWI-RT PAPER-1		SWI-RT PAPER-2		SWI-RT PAPER-3		SWI-RT PAPER-4		SWI-RT PAPER-5		SWI-RT PAPER-6		SWI-RT PAPER-7	
1	A	1	B	1	C	1	B	1	B	1	C	1	D
2	A	2	B	2	B	2	D	2	D	2	B	2	B
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		19	C	19	C	19	D	19	A	19	C	19	C
		20	A	20	D	20	C	20	B	20	A	20	D
		21	B	21	A								
		22	C	22	C								
		23	B	23	A								
		24	A	24	B								
		25	A	25	C								
		26	C	26	D								
		27	B	27	D								
		28	D	28	B								
		29	B	29	A								
		30	C	30	B								
				31	B								
				32	C								
				33	D								
				34	A								
				35	C								
				36	C								
				37	B								
				38	B								
				39	A								
				40	B								

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D. there will be little significant change in the graininess of the film.

	MCQ Set 1 paper 1		MCQ Set 1 paper 2		MCQ Set 1 paper 3		MCQ Set 1 paper 4	
	C	1	C	1		1	A
	C	2	B	2		2	C
	B	3	C	3		3	B
	C	4	A	4		4	B
	B	5	D	5	A	5	A
	A	6	A	6	E	6	C
	C	7	C	7	B	7	B
3	B	8	A	8	A	8	A
1	A	9	B	9	A	9	C
3	A	10	D	10	C	10	A
1	A	11	C	11	A	11	D
2	A	12	A	12	B	12	A
3	C	13	C	13	A	13	B
4	BA	14	B	14	B	14	D
5	B	15	B	15	B	15	C

NI-RT PED-1		SWI-RT PAPER-2		SWI-RT PAPER-3		SWI-RT PAPER-4		SWI-RT PAPER-5		SWI-RT PAPER-6		SWI-RT PAPER-7	
	A	1	B	1	C	1	B	1	B	1	C	1	D
	A	2	B	2	B	2	D	2	D	2	B	2	B
-		3	C	3	D	3	C	3	B	3	B	3	B
,	A	4	D	4	B	4	A	4	C	4	B	4	A
1	C	5	B	5	B	5	C	5	D	5	A	5	C
5	D	6	A	6	B	6	A	6	B	6	C	6	D
>	B	7	D	7	A	7	D	7	A	7	A	7	C
?	D	8	A	8	C	8	C	8	C	8	A	8	B
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4	A	10	C	10	A	10	C	10	D	10	C	10	D
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3		14	D	14	A	14	D	14	A	14	B	14	D
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		22	C	22	C								
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		27	B	27	D								
		28	D	28	B								
		29	B	29	A								
		30	C	30	B								
				31	B								
				32	C								
				33	D								
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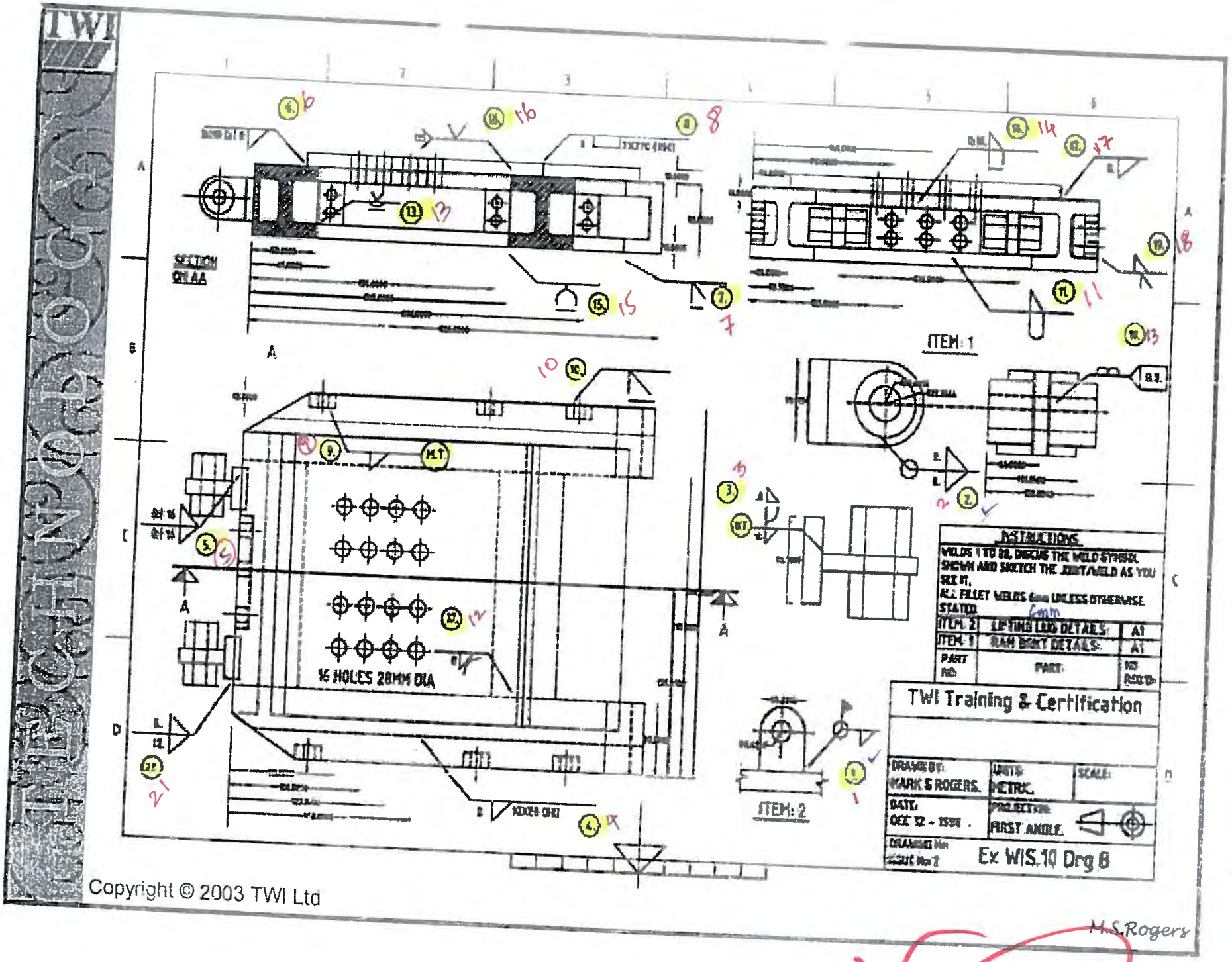
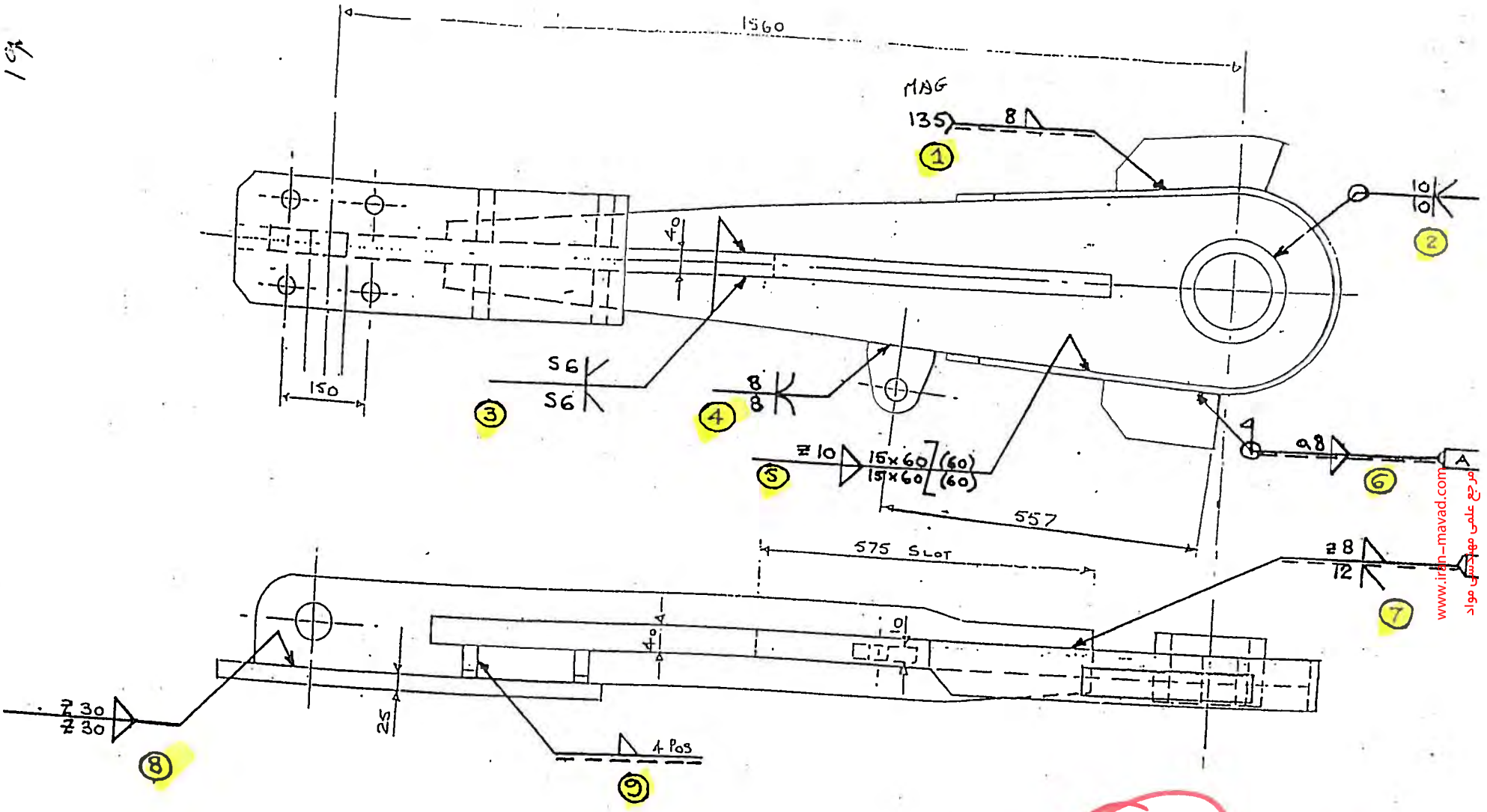
				37	B								
				38	B								
				39	A								
				40	B								



M.S.Rogers

Ex. 2 (T.3) Ex-2

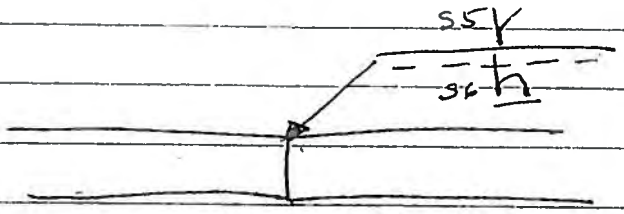


Eng. 1

Q1. WHAT ANGLE OF PROJECTION

Q2. WHAT STANDARD OF WELD SYMBOLS ARE SHOWN?

1



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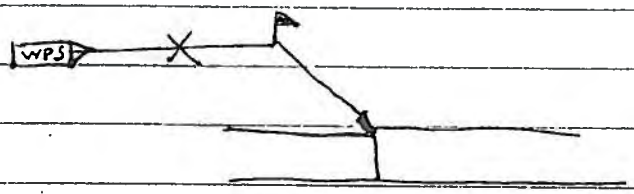

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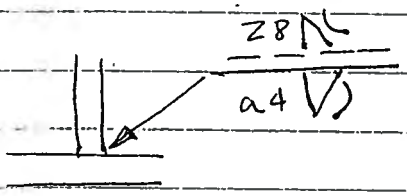

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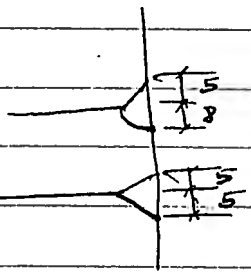

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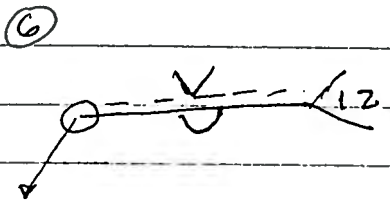

7