MODEL ANSWER

SUMMER– 17 EXAMINATION

Subject Title: Quality control and Inspection Subject Code: 17555

Important Instructions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more importance. (Not applicable for subject English and Communication Skills)
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) In case of some questions credit may be given by judgment on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

<table>
<tr><th>Q. No.</th><th>MODEL ANSWER</th><th>MARKS</th></tr>
<tr><td>1</td><td>Attempt any five</td><td>5 x 4</td></tr>
<tr><td>1.a</td><td>
<table>
<tr><td>Parameters</td><td>Line standard</td><td>End standard</td></tr>
<tr><td>Accuracy of measurement</td><td>Limited to +- 0.2mm for high accuracy, scale have to be used in conjunction with microscope</td><td>Highly accurate for measurement of close tolerances upto +-0.001 mm.</td></tr>
<tr><td>Time measurement</td><td>Quick and easy</td><td>Time consuming</td></tr>
<tr><td>Effect of use</td><td>Scale marking not subjected to wear but end of the scale is worn.Thus,it may be difficult to assume zero of scale as atum</td><td>Measuring faces get worn out. To take care of this end piece can be hardened. And of protecting type.</td></tr>
<tr><td>Other errors</td><td>Parallax error can occur</td><td>Improper wringing of step gauges may introduce error change in lab.temperature may lead to some error.</td></tr>
<tr><td>Manufacture and cost of</td><td>Simple and low</td><td>Complex process and high</td></tr>
</table>
</td><td>1mark per point

4 mark</td></tr>
</table>

MODEL ANSWER

SUMMER– 17 EXAMINATION

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	equipment			
	Example	Meter and yard,etc	SlipGauges,Microometer, etc	
1.b	Requirement of good comparator. 1) The comparators must be of robust design and construction so as to withstand the effect of ordinary usage without impairing its measuring accuracy. 2) The indicating devices are such that readings are obtained in the least possible time. 3) Provision is made for maximum compensation for temperature effects. 4) The scale is linear and having straight line characteristic. 5) Measuring pressure is low and constant			1mark-1 point (any four point)
1.c	SELECTIVE ASSEMBLY •In selective assembly, the parts of anyone type are categorized into several groups according to size. The mating parts are also categorized into same number of groups, so that the corresponding groups, when assembled will give the desired fit at assembly with little or no further machining. • In this process, the parts are manufactured to rather wider tolerances and then separated into number of groups according to their actual sizes. Assembly is then made from the selected groups. • Selective assembly results in reduced cost of production without affecting the quality of the product. <u>Advantage:</u> Reduced cost of production without affecting the quality of product. <u>Application:</u> Air craft, automobile industries and in ball and roller bearing industries.			selective assembly-3m adv -1m
1.d	Following are the different factors on which quality of a product depends. 1) The materials 2) Parts 3) Assemblies 4) Process and processing conditions Products including packing and packaging			01 mark for each factor.
1.e	Duties of Inspector; (1)Interpretation of specification (2)Measurement of product (3)Comparison with standards (4)Judging conformity (5)Recording data (6)Disposition of product			1mark-1 point (any four point)
1.f	Advantages of gamma radiography: 1. A permanent record of defects in a welded object is obtained.			adv-2m (any four point)

	2. Reference standards for defects are available. 3. Low initial cost. 4. This is a very good method for testing at the site. Disadvantages of gamma radiography: 1. Trained operator is required. 2. The method involves radiation hazards. 3. ϒ-ray source loses strength continuously. 4. ϒ-ray radiography possesses lower sensitivity and definition than X-ray radiograph	dis adv-2m (any four point)
1.g	Leak (or tightness) test by gas. Concept: (1)Leak refers to an actual discontinuity or passage through which a fluid flows or permeates. (2)Leak testing is the determination of the rate at which a gas will penetrate from inside a tight component or assembly to the outside as a result of pressure differential between the two regions. Purpose: To test welded pressure vessels, tanks and pipelines to determine if leaks are present. Absolute tightness of all the welded joints can be tested this way Procedure: The welded vessel, after closing all its outlets; is subjected to internal pressure using gas (e.g. CO2) Hydraulic pressure, using gas, is the usual medium employed in this test. Air will leak out more readily than water and gas (e.g. Hydrogen) will escape where air will not. When using air/gas, failure of vessel can cause injuries to persons around. Application: Find out leakage from pipe, pressure vessels, boilers, heat exchangers.	3mark-Explain APP-1M
2	**Attempt any two**	2 x 8
2.a	note: Electrical comparator or LVDT COMPARATOR can be considering for electronic comparator. LVDT-------- ELECTRO- MECHANICAL COMPARATOR: Electrical comparator has the highest magnification amongst all the comparator. LVDT is the most commonly used inductive transducer to translate linear motion into electrical signal (displacement). Here, L = Linear motion (displacement) V = Variable inductance D = Differential, which means output is difference of two secondary outputs	Working priccipal-4m advantages-4m (4point)

T = Transformer, because it functions as the former of primary and secondary windings

Working Principle:

The position of iron core (magnetic core or armature) is responsible for varying the differential voltage two secondary winding of transformer, which is measure of linear displacement.

Construction:

• It consists of an insulating hollow cylinder made up of Bakelite or any insulating material.

• On the circumference of this insulting cylinder, one primary winding (P) and two secondary windings (S1 and S2) are wound.

• The primary winding is wound at the center of insulating cylinder and on either side of it, two secondary windings S1 and S2are exactly opposite to each other.

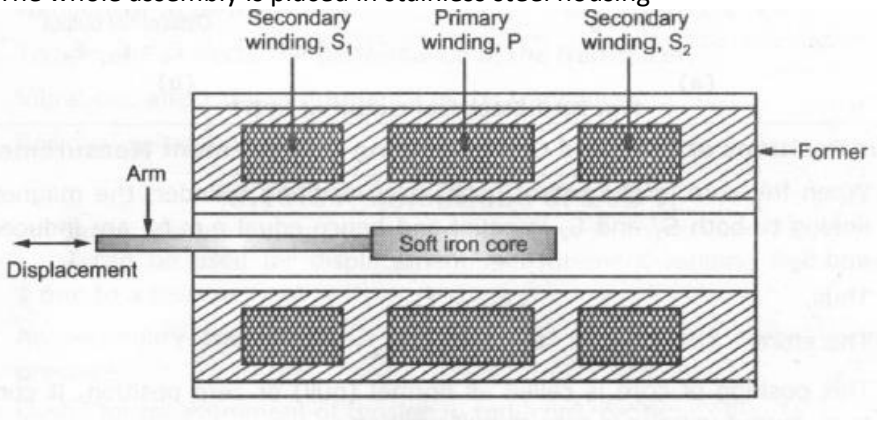
• The directions of S1 and S2 are exactly opposite to each other.

• Inside the hollow insulating cylinder, magnetic or armature core is placed, which is free to move back and forth.

• The displacement to be measured is attached to the soft iron core/magnetic core.

• The magnetic core is made up of nickel iron, which gives high sensitivity and low null voltage. This core is slotted longitudinally to reduce eddy current losses.

• The whole assembly is placed in stainless steel housing



Working:

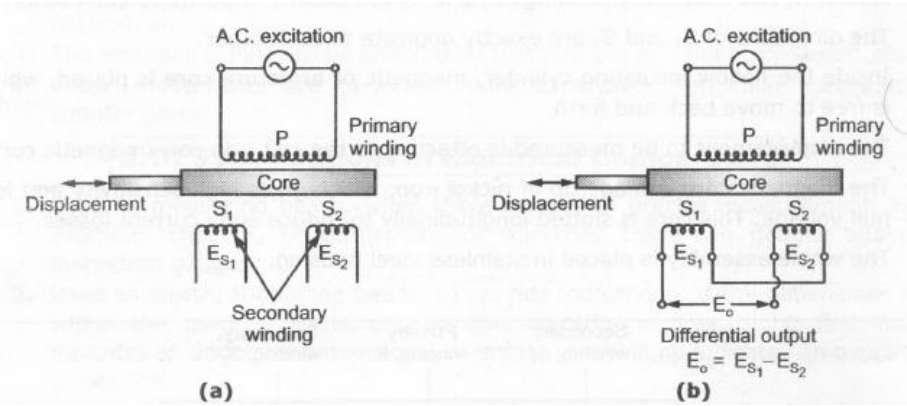
• When A.C. supply is given to the primary winding, it produces magnetic flux, which completes its path through 51 and 52.

• While completing the path, the flux produced by the primary winding is linked to the number of conductors of secondary windings.

• Therefore according to Faraday's law of electromagnetic induction, an e.m.f. is produced in the secondary winding.

• As shown in Fig., the output voltage of S1 is ES1 and that of S2 is ES2

• To convert the output of S1 and S2 into single voltage signal, 51 and 52 are connected in series as shown in Fig. With phase difference of 1800 (wounded in opposite to each other).
• Thus the output of transducer will be the difference of two voltages i.e. differential output voltage.



Electrical circuit of LVDT

Various Positions of Core and Corresponding Displacement Measurements:

(1) When the core is at central position of insulting cylinder, the magnetic flux linking to both S1 and S2 is equal and hence equal e.m.fs. are induced in S1 and S2.

Thus,

Therefore,

ES1 = ES2

Eo = ES1 - ES2 = 0

This position of core is called as normal (null) or zero position. It concludes that, output voltage is zero at null position

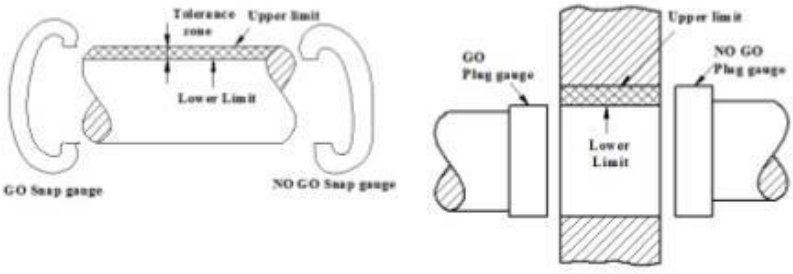
(2) When core is moved towards left, then flux linking to coil 51 will increase and at the same time flux linking to coil S2 decreases. Hence, e.m.f. induced in coil S1 (ES1) is greater than of S2 (Es2). As a result of which, output measurement between secondary terminals is in phase with primary voltage.

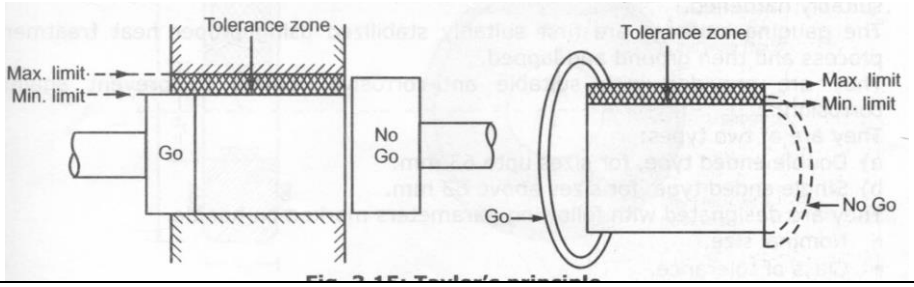
(3) When core is moved towards the right side, then flux linking to coil 52 (Es2) is more as compared to coil 51 (ES1). Thus, e.m.f. induced in 52 (Es2) is greater than e.m.f. in 51 (ES1). As a result of which, output measurement between secondary terminals is out of phase with primary voltage.

• Hence, output (ES1- Es2) measured between two secondary terminals of LVDT is directly proportional to the displacement of soft magnetic core.

<u>Advantages of Electronic Comparator over mechanical comparator are as follows:</u>

1. The electrical comparator has very few moving parts, so less wear and tear.It is possible to have high magnification and the same instrument can

	have two or more magnifications. Thus, wide range is available. 3. The mechanism carrying pointer is very light and not sensitive to vibrations. 4. As these instruments are usually operated on A.C. supply, the cycle vibration substantially reduces errors due to sliding friction. 5. The measuring unit can be made very small and it is not necessary that the indicating instrument be close to the measuring unit, rather it can be remote also.	
2.b	• Taylor's principle states that, GO gauges should be of full form, such that, 'GO' gauge should check all possible elements of dimension at a time (such as roundness, taper, location etc.), whereas 'NO GO' should check only one dimension at a time. Taylor's principle is applied in designing GO and NO GO gauges for checking maximum and minimum limits as - i) GO limit: This designation is applied to that limit of the two limits of size which corresponds to maximum material limit consideration, i.e. the upper limit of a shaft and lower limit of a hole. The form of the GO gauge should be such that it checks one feature of the component in one pass. ii) NO GO limit: This designation is applied to that limit of the two limits of size which corresponds to minimum material limit condition, i.e. the lower limit of a shaft and higher limit of a hole. “NO GO" gauges should check only one part or feature of the component at a time.  For designing of plug gauge and ring gauges following point are applied. •'GO' plug gauge is the size of minimum limit of the hole. 'NO GO' plug gauge is the size of the maximum limit of the hole. • 'GO' for snap gauge corresponds to maximum limit of the shaft and 'NO GO' to minimum limit of the shaft. • As GO gauge assembles with mating component, it should check number of dimensions, including errors of form such as straightness, roundness,	8mark

	squareness etc. which are outside the maximum metal limit. NO-GO gauge, on the other hand should check only one dimension of part at a time in order to find out any dimensions, which are outside the minimum metal limit.  	
2.c	Role of technician in QC. 1) Implement the quality policy of the company through his taskforce. 2) Involve in deciding the policy on quality by the organization. 3) Establish optimum quality of design. 4) Conduct quality audit, surveys. 5) Co-ordinate the activities of preparing and executing the quality plans. 6) Conduct process capability and machine capability studies. 7) Design sampling plans, control charts. 8) Approve gauges inspection and test devices. 9) Prepare job specifications, tracing of personnel for quality. 10) Plan and execute the work in the quality control Department. 11) Co-ordinate the activities of production , purchase and other department **Quality mindedness** for top management must be more than a lip service. The most earth-shaking pronouncement in support of product quality fades into nothingness for shop operators, when an order comes down to the factory to ship products of substandard quality to meet a delivery commitment. One of the key figures in any quality-mindedness programme or campaign is the shop supervisor. This individual represents first line management, i~ fact, as well as name, to the people who report to the supervisor, if a good employee relations programme is in place and working, the supervisor's position as a part of management is well-established. The employees look to the supervisor to keep them informed about company's problems and successes. A number of media can be used in promoting quality- rnindedness. These media should be used over a predetermined period, say 2 to 3 months. Even a modest promotion can effectively use the following devices :- 1. Short write-ups in plant papers. 2. Cartoon in plant papers.	4MARK ---role of technician (any 8, ½ mark each) 4 MARK-quality mindness

	3. Poster displays in work area [These can be of a general nature of showing "Why to do it better" or "How to do it better".] 4. Quality slogans and 5. Increased suggestion awards for quality improvement suggestions,	
3	**Attempt any two**	2 x 8
3.a	inspection planning 1.Selection of type for different stages in production flow 2. Planning inspection operations in details. 3. Designing the station and inspection to take place. 4.Providing inspectors with the inspection specification ,gauages, tools,testequipment and other information necessary for inspection. <u>It is performed by considering following points:</u> • ***What is inspect*** 1. Dimension governing fits should be checked in piece part prior to assembly. Inspection planning includes determining how a certain dimension is to be gauged so that proper gauges can be ordered and procedure ,prior to stat of manufacture 2. Where raw materials, compomnents,sub assembly are purchased at least an idenficating the type of inspections is made by the receiving inspector. 3. Where appropriate, electrical characteristics of such components as resistors, condensers and vacuum tube should be determine as to acceptability prior to assembly. when to inspect 1. Purchase parts and raw material should be inspected when received, prior to being ware house stocked out send directly to assembly. 2. While a job is running it is advisable to make occasional check by means of part inspection or operator inspection. 3.Ehen a die ,mold or tool is being setup first part should be inspected and OK run should be given when the first parts are proved to meat requirement 4. Dies, tools or mold going into storage should be tagged with their status.	Necessity -4M Performance-4M (any two)

- ***Where to inspect***

1.Receiving inspection should be located at the receiving when in such a manner that the part must pass through a receiving and inspection room before being moved in storage

2. Patrol inspection by its nature requires the inspector ty to call periodically at the machine for the parts to be checked.

3. Precisions measurement is located in air condition rooms.

4.Proper factory layouts permits area should be located so that work entering finished parts stores will have to pass through the acceptance inspection area

- ***how much to inspection***

1. The amount of inspection needed to decide the acceptability of a lt.go for the either 100% inspection or as per sampling plan.

2. The actual amount of inspection needed is governed mainly by the amount of prior knolled avainblbel as to the quality and specially as to the homogeneity of the lot

3. In some case 100% inspection of each of the items may be necessary to attained the control desired.

In 100% inspection all of the items are checked for the characteietsic being measured .In sampling inspection, on the other hand does not involve a check of each item.

- ***How to inspect;***

1. Inspection is carried out by means of suitable inspection device capable of measuring the characteristics desired .These surface finish, ductility, Colour, shrinkage, viscosity, operating characterizes and many others.

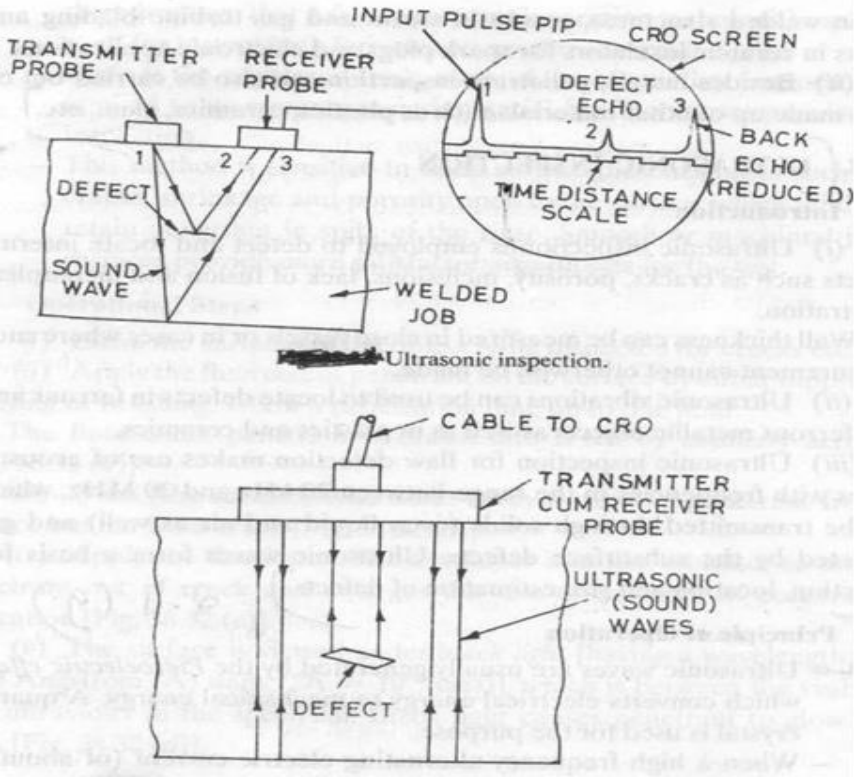
2.mnay of the inspection device are referred to as gauges .these may be used for checking the actual dimension against the standard .These are the fixed gauges(GO- NOO10 guages,ring gauges, plug gauges)and the indicating gauges(Micrometer, Dial indicators, Vernier calipers)

3. The surface analysis and priilmometer are two instruments widely used for measuring surface smoothness.

4.Industrial radiography, Ultrasonic magnetic particle inspection all are

	recent development that have found extensive application in the inspection of defects in the interior or surface of metals.	
3.b	CLASSIFICATION OF LEAKS: (1) REAL LEAK: It is an essentially localized leak that is a discrete passage through which fluid make flow. (2) Virtual leak: it is leak that involves gradual distortion from surface or components within a vacuum system. Leak test under fluid pressure: <u>Procedure:</u> • Leak refers to an actual discontinuity or passage through which a fluid flows or permeates. • The welded vessel, after closing all its outlets; is subjected to internal pressure using water, oil, air or gas (e.g. CO2), • Hydraulic pressure, using water as the fluid, is the usual medium employed in this test. • Oil if it is thin/hot will penetrate leaks that do not show up with water under equal pressure. • Air will leak out more readily than water and gas (e.g. Hydrogen) will escape where air will not. • Where feasible, it is better to use water or oil because there will be very less tendency for the parts to be violently thrown out in case of a sudden release of pressure. • When using air/gas, failure of vessel can cause injuries to persons around. <u>Importance</u> • Leak testing is the determination of the rate at which a liquid or gas will penetrate from inside a tight component or assembly to the outside as a result of pressure differential between the two regions. • To test welded pressure vessels, tanks and pipelines to determine if leaks are present. Absolute tightness of all the welded joints can be tested this way.	2 m-Classification Procedure-4M Importance-2m
3.c	<u>(i) Principle of Operation:</u> Ultrasonic waves are usually generated by the Piezoelectric effect which Converts electrical energy to mechanical energy. A quartz crystal is used for	3 mark-principal

	the purpose. - When a high frequency alternating electric current (of about 1 million cycles per second) is impressed across tile faces of the quartz crystal, the crystal will expand during the first half of the cycle and contract when the Electric field is reversed. In this manner the mechanical vibrations (sound waves) arc produced in the crystal. - The surface of job to be inspected by ultrasonic is made fairly smooth either by machining or otherwise so that ultrasonic waves can be efficiently transmitted from the probe into the job and even small defects can be detected properly. - Ultrasonic inspection employs separate probes (or search units), one for transmitting the waves and other to receive them after passage through the welded jobs alternatively, since the ultrasonic waves are transmitted as a series of intermittent pulses, the same crystals may be employed both as the transmitter and receiver (Fig.) (ii) testing standard and procedure: - Before transmitting ultrasonic waves, an oil film is provided between the probe and the job surface - For operation, ultrasonic wave is introduced into the metal and the time interval between transmission of the outgoing-and reception of the incoming signals is measured with a cathode ray oscilloscope (CRO). - The time base of CRO is so adjusted that the full width of the trace represents the section being examined. - To start with, as the wave is sent from the transmitter probe, it strikes the upper surface of the job and makes a sharp (peak) or pip (echo) at the left hand side of the CRO screen (Fig.). If the job is sound, this wave will strike the bottom surface of the same (Fig.), get reflected and indicated by a pip towards the right-hand end of CRO screen.	procedure: 3m adv-1m disadv-1m



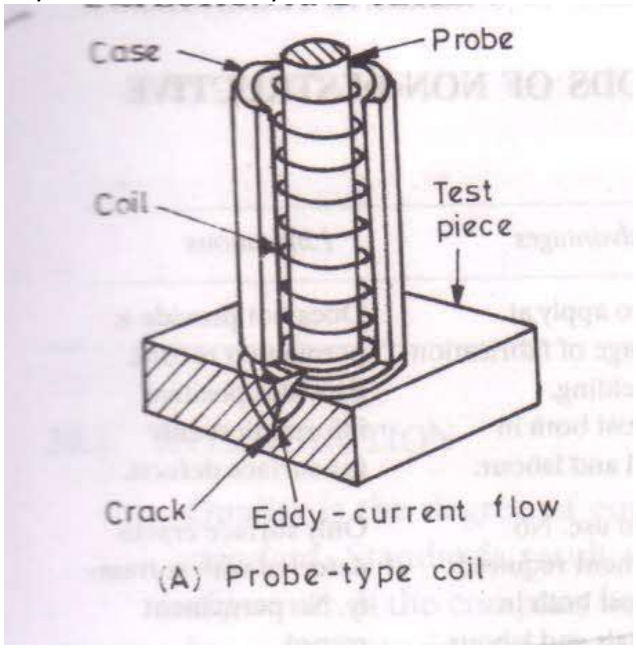
Ultrasonic inspection.

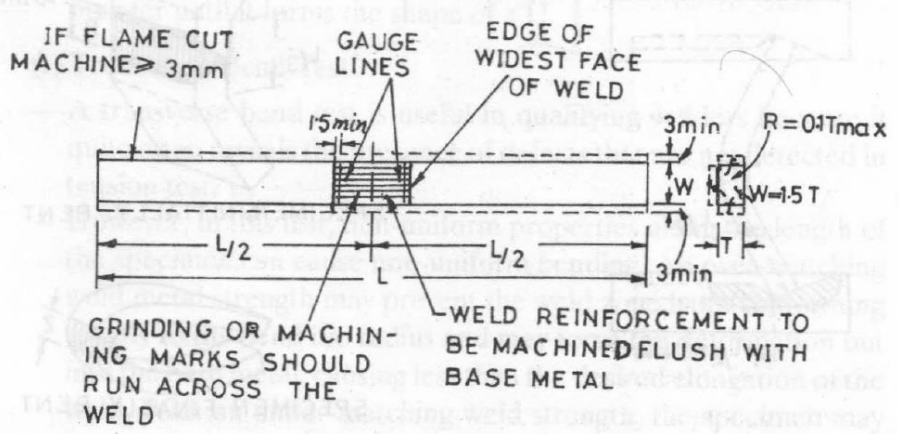
(iii) Advantage:

1. It is a fast and reliable method of non-destructive inspection.
2. This method of locating flaws with metal objects is more sensitive than radiography.
3. The minimum flaw size which can be detected is equal to about 0.1% of the distance from the probe to the defect.
4. Big weldments can be systematically scanned for initial detection of major defects.
5. Ultrasonic inspection involves low cost and high speed of operation.
6. The sensitivity of ultrasonic flaw detection is extremely high, being at a maximum when using waves of highest frequency.

(iii) Limitations

1. Surface to be tested must be ground smooth and clean.
2. Skilled and trained operator is required.
3. It is not suited to the examination of weldments of complex shape or

	configurations.	
4	**Attempt any two**	2 x 8
4.a	EDDY CURRENT TESTING Principle of Operation An A.C. coil is brought up close to the weldment to be tested. The A.c. Coil induces eddy currents in the welded object. These eddy currents produce their own magnetic field which opposes the field of the A.C. coil. The result is an increase in the impedance (resistance) of the A.c. Coil. Coil impedance can be measured. If there is a flaw in the weldment, as soon as the coil passes over the flow, there is a change in the coil impedance which can be wired to give a warning light or sound and thus the flaw and its location can be determined. **Flaws Indicated** Flaws at or close to the surface such as cracks, weld porosity, poor fusion or any linear discontinuity can be detected  APPLICATION: 1. It can be applied to round,flat and irregularity shaped object. 2. Eddy current testing can be conducted sucessfully employed for online testing wires,rodes and tubes. 3. It can be useful setting material mesurement and control of dimension of tube,sheet an rods. 4. Different varible like conductivity,hardness strenght,dimension and heat treatment variable discontinuties,coating thickness can be removed by eddy current testing.	4mark-principle 4mark application. (any four point) 1mark-1 point

4.b	Purpose of bend test: Bend tests may be used to find a number of weld properties such as (i) Ductility of the welded zone (ii) Weld penetration (iii) Fusion (iv) Crystalline structure (of the fractured surface) (v) Strength. . -The bend test assists in determining the soundness of the weld metal, the weld junction and the heat -affected zone. - The test shows the quality of the welded joint. -Any cracking of the metal will indicate false fusion or defective penetration. Free Bend Test - Free bend test determines the ductility of weld metal. - Free bend test may be conducted on a tensile testing machine or a vise capable of exerting a sufficiently large compressive force. - For bend test, the test pieces are cut from the plate so as to include the weld as shown in Fig. The top of the weld is ground or machined so that it becomes flush with the base metal' surface.  Preparation of Free Bend Specimen. **DIMENSIONS OF TEST SPECIMEN (mm)** T 10 20 25 40 50 W 15 30 38 60 75 L, Min 200 275 300 375 450 B, Min 30 50 50 50 50 -The specimen (after the gauge length has been scribed on the face of the weld) may be bent initially by using a device as shown in Fig.. - After giving an initial bend on to the specimen, it is placed in another fixture. The bending is continued until a crack or open defect exceeding 1.5	purpose-2m free bend test -3m guided bend test -3m

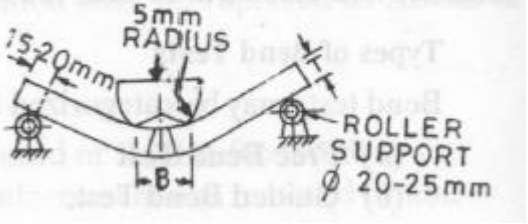
mm in any direction appears on the convex surface of the specimen. If no crack appears, the specimen shall be bent double.

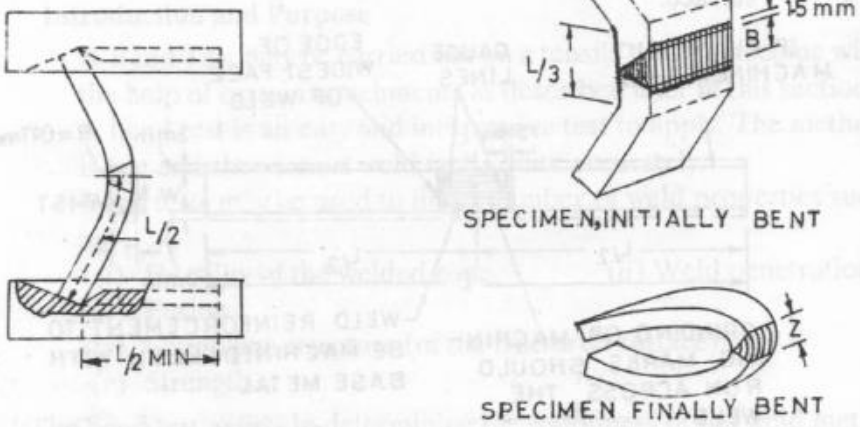
- The per cent of elongation is obtained as follows

$$\% \text{ Elongation} = \frac{Z - B}{B} \times 100 \quad \ldots(i)$$

where B is the original distance between gauge lines (Fig.)

Z is the distance between gauge lines after the bend. (Fig.).





Assume $B = 50$ mm

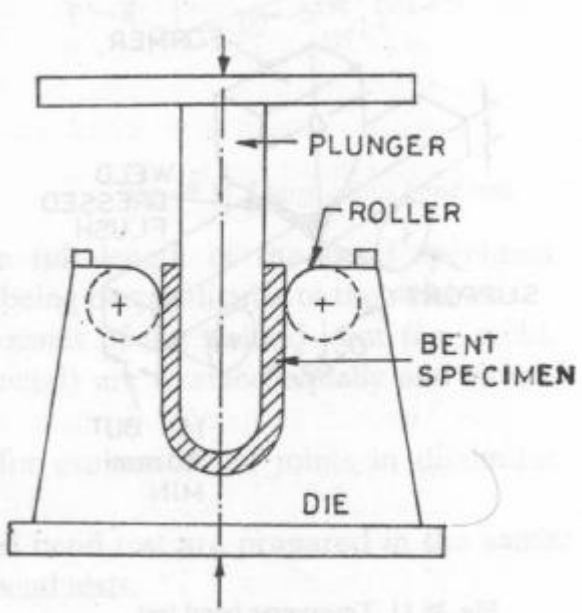
$Z = 60$ mm

$$\text{then } \% \text{ Elongation} = \frac{Z - B}{B} \times 100 = \frac{60 - 50}{50} \times 100 = 20\%.$$

The ductility of the specimen is therefore considered to be 20% in 50 mm. ' '

The elongation percentage must be a 15% minimum or (it means) the weld has failed the free bend test. In addition, no cracks greater than 1.5 mm should occur.

Guided Bend Test

	- A guided bend test shows surface imperfections near and in the weld bead. - A guided bend test is performed on the specially designed jig (Fig.). - The specimen to be tested is first ground smooth so that all weld reinforcement is removed. The specimen is then placed across the die supports and bent by depressing the plunger until it forms the shape of a U  	
4.c	Steps involved for inspection of pressure vessel and pipes 1) By visual inspection we have to found out flows defects and discontinuities of pressure vessel and pipe. 2) Welding defects of pressure vessels and pipe can be find out by liquid penetration test 3) By leak test we can find out any leakage of pressure and pipes <u>1) Visual inspection:</u> Visual inspection is the simplest, fastest, economical and most commonly used test for detecting defects on the surfaces of the welded objects. (2) The weld surface and joint is examined visually, preferably with the help of a magnifying lens. Careful examination of what can be seen on the surface of a welded joint can assist in determining the ultimate acceptability of the weldments. <u>(2) Leak (or tightness) test:</u> Concept: (1)Leak refers to an actual discontinuity or passage through which a fluid flows or permeates. (2)Leak testing is the determination of the rate at which a liquid or gas will	procedure-4m provision-4m

penetrate from inside a tight component or assembly to the outside as a .result of pressure differential between the two regions.

Purpose:

To test welded pressure vessels, tanks and pipelines to determine if leaks are present. Absolute tightness of all the welded joints can be tested this way.

Procedure:

The welded vessel, after closing all its outlets; is subjected to internal pressure using water, oil, air or gas (e.g. CO2),

Hydraulic pressure, using water as the fluid, is the usual medium employed in this test.

Oil if it is thin/hot will penetrate leaks that do not show up with water under equal pressure.

Air will leak out more readily than water and gas (e.g. Hydrogen) will escape where air will not.

Where feasible, it is better to use water or oil because there will be very less tendency for the parts to be violently thrown out in case of a sudden release of pressure. When using air/gas, failure of vessel can cause injuries to persons around.

Major provisions made in ASME CODES.

Division 1 provides requirements applicable to the design, fabrication, inspection, testing, and certification of pressure vessels operating at either internal or external pressures exceeding 15 psig. Specific requirements apply to several classes of material used in pressure vessel construction, and also to fabrication methods such as welding, forging and brazing.

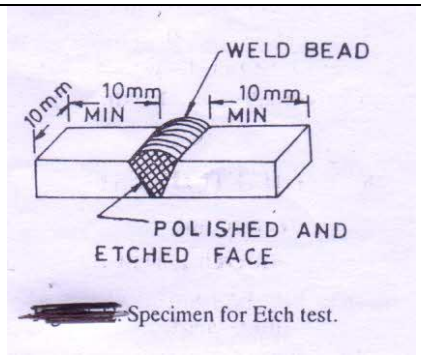
Division 1 contains mandatory and non-mandatory appendices detailing supplementary design criteria, nondestructive examination and inspection acceptance standards. Rules pertaining to the use of the single ASME certification mark with the U, UM and UV designators are also included.

Division 2 requirements on materials, design, and nondestructive examination are more rigorous than in Division 1; however, higher design stress intensify values are permitted. Rules pertaining to the use of the single ASME certification mark with the U2 and UV designators are also included.

Division 3 requirements are applicable to pressure vessels operating at either internal or external pressures generally above 10,000 psi. Rules pertaining to the use of the single ASME certification mark with the

	U3, UV3 and UD3 designator are also included. ASME codes & standards for pressure vessels. Division 1: • 5 Standards from the B1 Series on screw threads • 13 Standards from the B16 Series on pipe flanges and fittings • 9 Standards from the B18 Series on hex bolts • B36.10M — Welded and Seamless Wrought Steel Pipe • B36.19M — Stainless Steel Pipe • NQA-1 — Quality Assurance Program Requirements for Nuclear Facilities • PCC-1 — Guidelines for Pressure Boundary Bolted Flange Joint Assembly • PCC-2 — Repair of Pressure Equipment and Piping • PTC 25 — Pressure Relief Devices • QAI-1 — Qualifications for Authorized Inspection Division 2: • API 579-1/ASME FFS-1 — Fitness-For-Service • 3 Standards from the B1 Series on screw threads • 9 Standards from the B16 Series on pipe flanges and fittings • 4 Standards from the B18 Series on hex bolts • B36.10M — Welded and Seamless Wrought Steel Pipe • B36.19M — Stainless Steel Pipe • NQA-1 — Quality Assurance Program Requirements for Nuclear Facilities • PCC-1 — Guidelines for Pressure Boundary Bolted Flange Joint Assembly • PTC 25 — Pressure Relief Devices • QAI-1 — Qualifications for Authorized Inspection Division 3: • API 579-1/ASME FFS-1 — Fitness-For-Service • 3 Standards from the B1 Series on screw threads • 4 Standards from the B16 Series on pipe flanges and fittings • 7 Standards from the B18 Series on hex bolts • B36.10M — Welded and Seamless Wrought Steel Pipe • B46.1 — Surface Texture (Surface Roughness, Waviness and Lay) PTC 25 — Pressure Relief Devices NOTE: Any other provisions rather than this are acceptable.	
5	**Attempt any two**	2 x 8

5.a	DIN: Deutsches Institute for Normung DIN stands for "*Deutsches Institut für Normung*", meaning "German institute for standardisation". DIN standards that begin with "DIN V" ("*Vornorm*", meaning "pre-issue") are the result of standardization work, but because of certain reservations on the content or because of the divergent compared to a standard installation procedure of DIN, they are not yet published standards. DIN: 86041-1:1996 Welding flanges-part-1.tanks& sea boxes,nominal pressure 10& 16. • DIN 2615-2:1992 Steel butt-welding pipe fittings; tees for use at full service pressure • DIN 2616-1:1991 Steel butt-welding pipe fittings; eccentric reducers with reduced pressure factor • DIN 2616-2:1991 Steel butt-welding pipe fittings; reducers for use at full service pressure • DIN 2617:1991 Steel butt-welding pipe fittings; caps • DIN 2618:1968 Butt welding steel fittings; welding saddles, nominal pressure • DIN 2619:1968 Butt welding steel fitting; bends for welding, nominal pressure 16 • DIN 2826:1994 Hose fittings with clamp unit for steam and hot water, DN 15 up to DN 50, up to 18 bar • DIN 2848:2002 Flanged steel pipes and flanged steel or cast iron fittings with lining - PN 10, PN 25 and PN 40 • DIN 2856:1986 Capillary solder fittings; assembly dimensions and testing • DIN 2873:2002 Flanged fitting pipes and flanged steel glass lined - PN 10 and PN 25 • DIN 2874:2002 Steel flanged pipes and steel and cast iron flanged fittings	DIN -4m IBR-4M

	lined with PTFE or PF IBR : INDIAN BOILER REGULATION ➢ REG 1 – Regulation 1 is set for short title, extents ,application and commencement ➢ REG 8 - set for use of welding ➢ REG 7 - Boiler shells not in accordance with standard condition ➢ REG 15 – Tensile test Note: Other regulations are also considered.	
5.b	 THE ETCH TEST - An etch test involves inspecting the welded test specimen after polishing and etching the same with a chemical reagent e.g., a dilute acid. Types of - There are two types of etch tests, namely (i) Macro-etch examination, (ii) Micro-etch examination. Concept and Purpose (i) Macro-etch examination: After preparing the specimen by polishing and etching, it is examined either by the naked eye or by low power magnification up to X15. - Macro-examination gives a broad picture of the specimen by studying relatively large sectioned areas. - Macro-examination reveals in welded specimen (i) Cracks, (ii) Slag inclusion, (iii) Blowholes, (iv) Shrinkage porosity, (v) Penetration of the weld, (vi) The boundary between the weld metal and the base metal, etc. (ii) Micro-etch examination: After preparing the specimen by polishing and etching, it is examined under a microscope at magnifications from X20 to X2000. - Micro-etch examination involves areas much smaller than those	Concept-4m compare -4m

<table>
<tr>
<td></td>
<td>considered in macro-etch examination and brings out information that can never be revealed by macro-examination.
- Micro-examination determines in a welded specimen
(i) Cracks and inclusions of microscopic size.
(ii) Grain boundaries and solidification structures of weld metal, heat affected zone and the base metal.
(iii) Distribution of micro-constituents in the weld metal.
(iv) The quality of heat-treatment, etc.

<table>
<tr><th>Macro Etch test</th><th>Micro Etch Test</th></tr>
<tr><td>1. It is examined either by naked eye or by low power magnification up to X15</td><td>1. It is examined under a microscope at magnifications from magnification up to X20 to X2000</td></tr>
<tr><td>2. Macro-examination gives a broad picture of the specimen by studying relatively large sectioned areas</td><td>2. Micro-etch examination involves areas much smaller than those considered in macro-etch examination and brings out information that can never be revealed by macro-examination.</td></tr>
<tr><td>3. Macro-examination reveals in welded specimen: Cracks, Slag inclusion, Blowholes, Shrinkage porosity, Penetration of the weld, The boundary between the weld metal and the base metal, etc.</td><td>3. Micro-examination determines in a welded specimen Cracks and inclusions of microscopic size. Grain boundaries and solidification structures of weld metal, heat affected zone and the base metal Distribution of microconstituents
in the weld metal.
The quality of heat-treatment, etc.</td></tr>
</table>
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<td></td>
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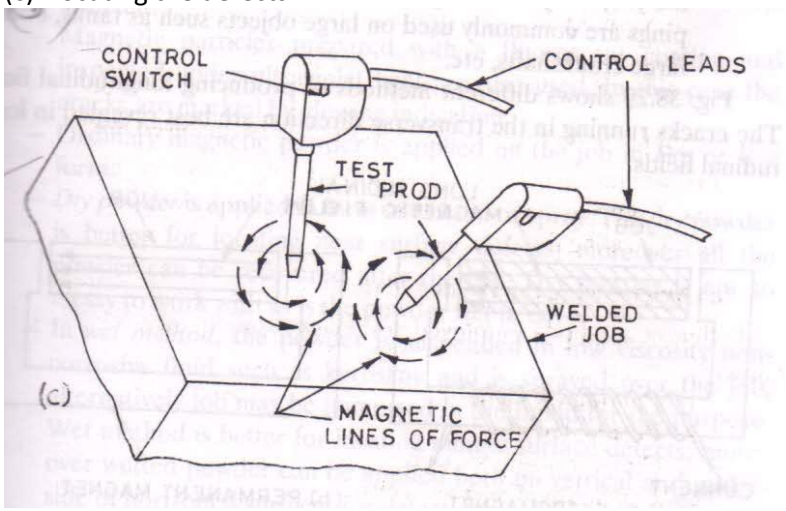
<tr>
<td>5.c i</td>
<td>MPT is used for testing material which can be easily magnetized
MPT required equipment is cheap and robust and can easily be handled by semiskilled personnel without requiring elaborate protection such as that needed for radiography.
(i) Principle:
• When a specimen is magnetized the magnetic lines of force are periodically inside ferrous magnetic material.
• The lines of magnetic flux get intersection by a discontinuity magnetic poles are induced either side of discontinuity.
• When a magnetic particles are sprinkled unto the specimen these particles are attendee by magnetic poles to create visual indication approximating the size and shape of flux.
• The discontinuity causes an abrupt change in the path of magnetic</td>
<td>PRINCIPAL-2M
Flaws detected-2m
scop –limitation-2m
sensitivity-2m</td>
</tr>
</table>

flux.

(ii) flaws detected by following methods

(a) Magnetising the component part :(e.g., a welded plate).
(b) Applying magnetic particles on the component part.
(c) Locating the defects.

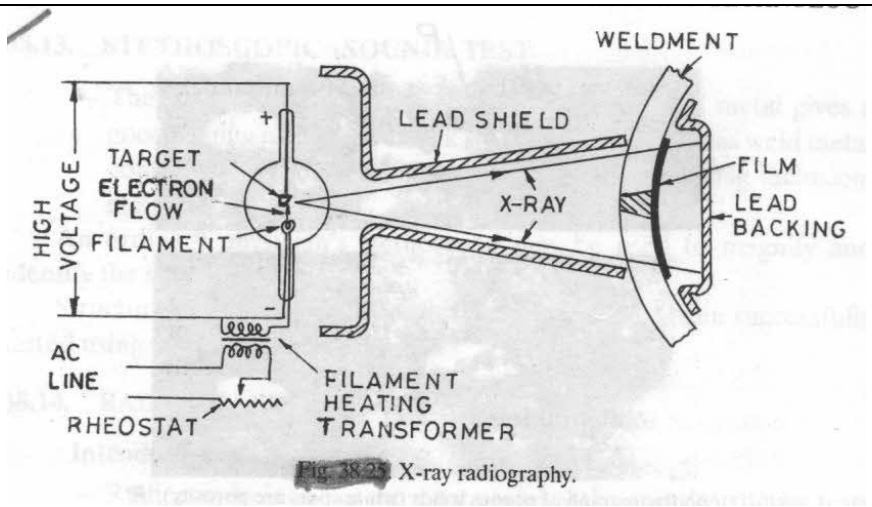


- A surface crack is indicated by a line of fine particles following the crack outline.
- A subsurface defect by fuzzy collection of the magnetic particles on the surface near the discontinuity.
- The color of magnetic particles should be in good contract to color of surface of specimen for easy detection.
- For maximum sensitivity the flux density should be oriented 90^0 to the discontinuity.

(iii) Scope and limitations.

Advantages of the Magnetic Particle method of Non-Destructive Examination are:

- It is quick and relatively uncomplicated
- It gives immediate indications of defects
- It shows surface and near surface defects, and these are the most serious ones as they concentrate stresses
- The method can be adapted for site or workshop use
- It is inexpensive compared to radiography
- Large or small objects can be examined
- Elaborate pre-cleaning is not necessary

	Disadvantages of the Magnetic Particle method of Non-Destructive Examination are: • It is restricted to ferromagnetic materials - usually iron and steel, and cannot be used on austenitic stainless steel • It is messy • Most methods need a supply of electricity • It is sometimes unclear whether the magnetic field is sufficiently strong to give good indications • The method cannot be used if a thick paint coating is present • Spurious, or non-relevant indications, are probable, and thus interpretation is a skilled task • Some of the paints and particle suspension fluids can give a fume or fire problem, particularly in a confined space Books on the subject are: (iv) sensitivity: Maximum sensitivity of indication is obtained when the discontinuity lies in a direction normal to the applied magnetic field and when the strength of magnetic field is just enough to saturate the section being inspected	
6		2 x 8
6.a (i)	 Fig. 38.25 X-ray radiography. (I) Working principal: X rays are produced in X ray tube where cathode produce electron which move towards the anode. A part of K.E.is converted to energy of radiation	principal-2m safety -2m application-2m disadvantages-2m

	on X rays. 1. The portion of weld metal where defects are to be suspected is exposed to X rays emitted from the tube. 2. X-rays are produced in X-ray tube were a cathode produced electrons which move towards anode.A part of K.E is converted to energy of rotation of x-rays 3. A cassetle containing X ray film is place behind and in contact with weldment perpendicular to the rays. 4. During expose X rays penetrated the welded object and thus affect welded X- ray film. 5. The X- Ray photograph shows the existence of flaw, internal crack,Leak or any deformity with their exact location. (ii) Safety precautions to be taken in X ray testing equipment: Investigators shall ensure that there is a one-to-one correlation between stock vials or sources and - Use appropriate personal protective clothing and equipment including gloves, gowns or lab coats, and eye protection. - Use appropriate dosimeters - Practice contamination control at the point of administration, in CCM and in laboratories. Radiation Safety Handbook - Survey administration areas to identify contamination and promptly clean it up - Handle sharps safely. Prevent puncture wounds from contaminated needles by recapping (iii) Applications 1. Pressure vessels and boilers. 2. Penstocks. 3. Aircraft and ship structures. (iv) Disadvantages of Radiography 1. Trained operator is required. 2. The method involves radiation hazards. 3. Skilled worker is required. 4. Many safety precautions for the use of high intensity radiation. 5. Access to both sides of sample required. 6. Orientation of equipment and flaw can be critical. 7. Determining flaw depth is impossible without additional angled exposures. 8. Expensive initial equipment cost	
6.b	THE TENSILE TEST	

Preparation of Test Specimen

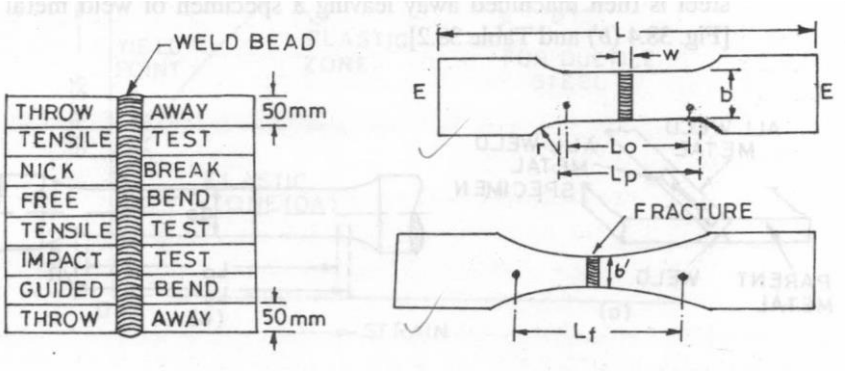
tensile test -4m

all weld metal test-4m

1. *Transverse Tensile Test* — Using Reduced Specimen
— Using Radius Reduced Specimen

All-weld Metal Tensile Test

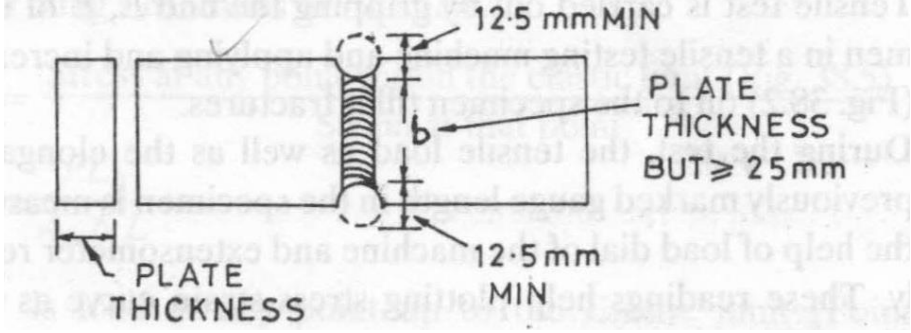
- A transverse Tensile Test specimen is cut from a welded butt joint (at right angle to the weld direction (Fig.) and is used to determine its transverse tensile strength.



Reduced transverse test specimens (refer Fig. and Table) are not intended to give the tensile strength of the weldmetal, but Radius reduced specimens (Fig.) do occasionally

Dimensions (mm) for Reduced Transverse test specimens

Width *b*	*Gauge Length** *Lo*	*Minimum Parallel Length* *Lp*	*Minimum Radius at Shoulder* *r*	*Total Length* *L*
Plate thickness but	50	60	25	200
not less than 25	100	110	25	300
mm	200	225	25	375

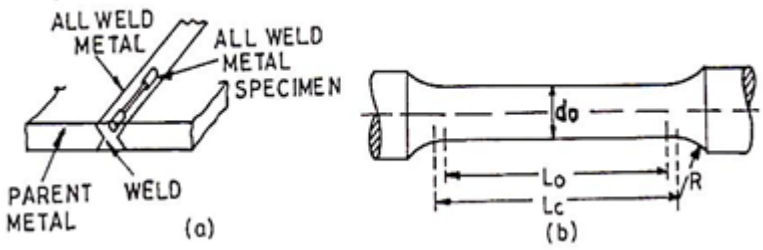


All weld metal test:

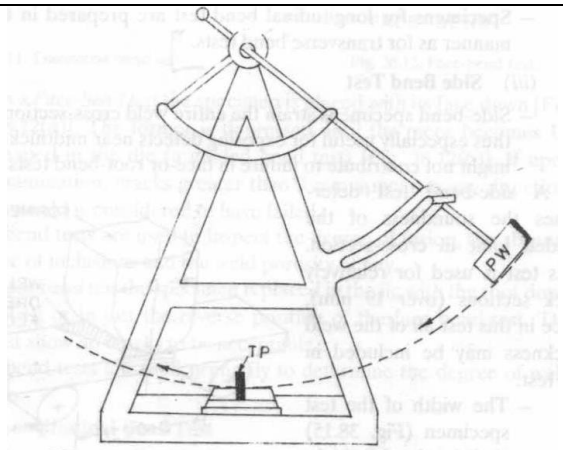
• A transverse Tensile Test specimen is cut from a welded butt joint(at right angle to the weld direction and is used to determine its transverse tensile strength.

• In an all-weld metal tensile test, the specimen is prepared from all-weld metal [Fig. (a)].

- This type of specimen is prepared by machining a groove in a plate of steel and then completely filling the groove with deposited weld metal
- The surrounding steel is then machined away leaving a specimen of weld metal.



6.c



TP = Test pipe *PW* = Pendulum weight

Impact Testing Machine.

principal-3m
Izod test -3m
reporting of result-2m

THE IMPACT TEST

Introduction

- Impact testing becomes essential in order to study the behaviour of welded objects under dynamic loading.
- An impact test determines the behaviour of welds when subjected to high rates of loading, usually in bending.
- An impact test gives an indication of the relative toughness of the material. Toughness is defined as the resistance of a metal to fracture after plastic deformation has begun.
- The purpose of impact testing is to determine the amount of impact a specimen will absorb before fracturing.
- In an impact test, a specimen machined or surface ground and notched is struck and broken by a single blow in a specially designed testing machine (Fig.). The quantity measured is the energy absorbed in breaking the specimen by a single blow

The ideal impact test would be one in which all the energy of a blow is transmitted to the test specimen.

The Izod (Cantilever) Test.

Izod specimen is placed in the vise such that it is in the form of a cantilever.

Test Procedure (Refer to Figs.)

1.The swinging pendulum weight is raised to standard height depending upon the type of specimen to be tested.

2.With reference to vise holding the specimen,the higher the pendulum, the more potential energy it has got.

3. As the pendulums released, its potential energy is converted into kinetic energy until it strikes the specimen.

4. The Charpy specimen is hit behind the V notch while the lzod specimen, placed with the V notch facing the pendulum, will be hit above the V notch.
5. A portion of the energy possessed by the pendulum is used to rupture the specimen and the pendulum rises on the other side of the machine to a height lower than its initial height on the opposite side of the impact testing machine.
6. The energy consumed in breaking the specimen is the weight of the Pendulum times the difference in two heights of pendulum on either side the machine.
7. This energy in foot-pounds or metre-kg is the notched impact Strength and can be read from the dial of the impact testing machine.

Reporting of Results: The following results shall be reported after the test:
1. Nature of specimen, i.e. Charpy or Izod.
2. Testing Temperature.
3. The energy absorbed.
4. Appearance of fractured surface and defects, *if any, present hereover*.

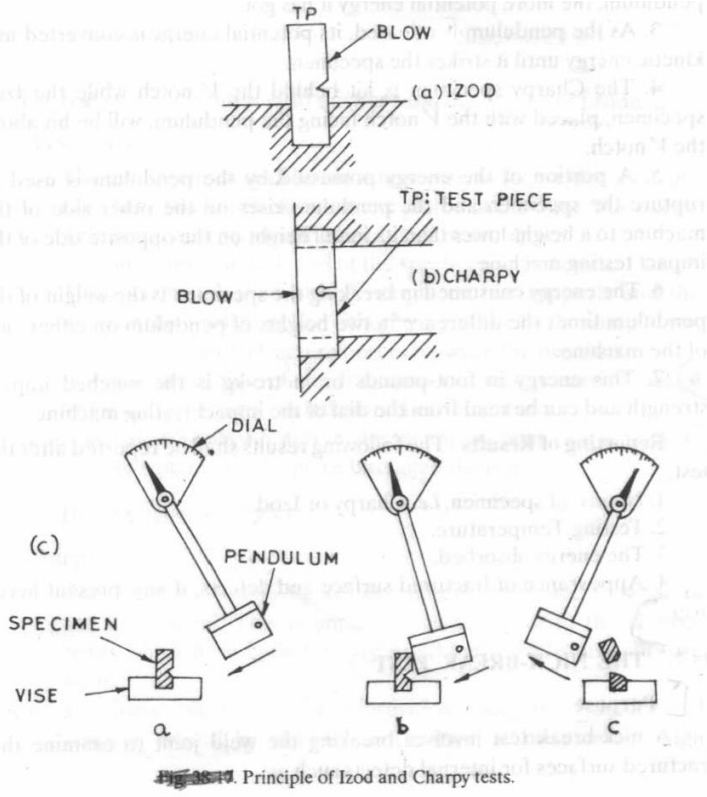


Fig. 38.14. Principle of Izod and Charpy tests.

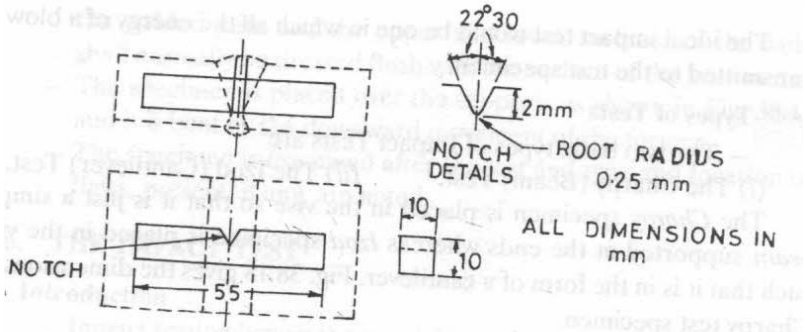


Fig. 38.18 Dimensions of Charpy test specimen.