Lab Manual

MATERIALS PROCESSING LABORATORY

Department of Metallurgical and Materials Engineering

RAJIV GANDHI UNIVERSITY OF KNOWLEDGE TECHNOLOGIES, BASAR

Telangana - 504107

Materials Joining Lab manual

GENERAL INSTRUCTIONS

1. Dress Code: Students must come to the laboratory wearing (i) Trousers, (ii) half-sleeve tops and (iii) Leather shoes. Half pants, loosely hanging garments and slippers are not allowed.
2. To avoid injury, the student must take the permission of the laboratory staff before handling any machine.
3. Students must ensure that their work areas are clean and dry to avoid slipping.
4. Apron should be used by each student during Welding Exercise. Students not wearing the apron will not be permitted to work in the laboratory.
5. At the end of each experiment, students must clear off all tools and materials from the work area.
6. For individual/group experiments separate lab reports/group report should be submitted as instructed by lab incharge.
7. Careless handling of machines may result in serious injury.

Laboratory Experiments:

1. Disc Compression test
2. Ring Compression test
3. Erichsen cupping test
4. Manual Metal Arc Welding/ Shielded Metal Arc Welding
5. Gas Metal Arc Welding
6. Friction Stir Welding
7. Compression and Shear Strength test of Molding sand
8. Permeability test of Molding sand
9. Mold Preparation, Melting and Casting

DISC COMPRESSION TEST

Aim of the Experiment: To demonstrate the effect of friction and height-todiameter ratio in the axi-symmetric compression of a cylinder.

Apparatus Required:

1. A compression testing machine
2. Cylindrical or cube shaped specimen of Aluminium
3. Vernier caliper

Theory: A compression test is used to determine the behaviour of a material under compressive load. The specimen is compressed and deformations at various loads are recorded. Compressive stress and strain are calculated and plotted as a stress-strain diagram(fig-1) , which is used to determine elastic limit, proportional limit, yield point, yield strength and, for some materials, compressive strength.

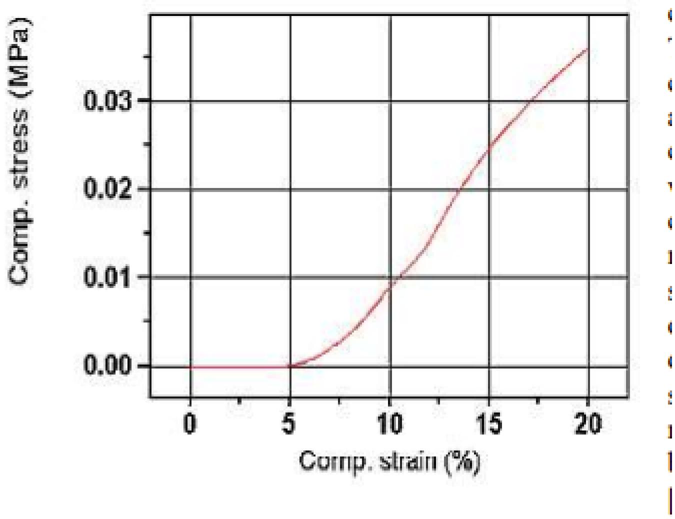
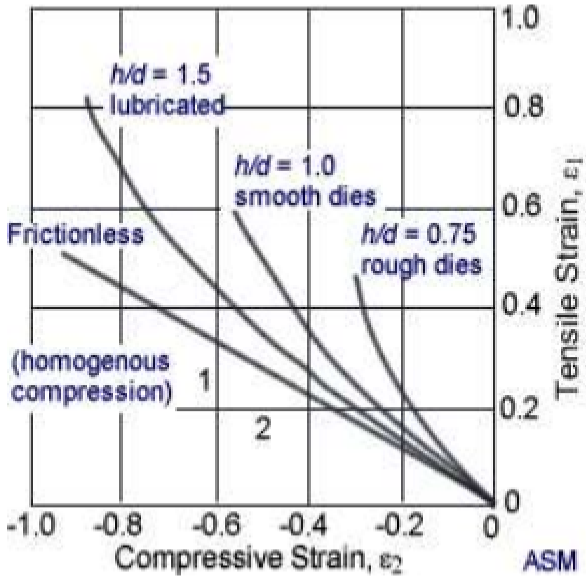


Fig-1: Compression test [Source: *www.instron.co*

Several machine and structured components such as columns and struts are subjected to compressive load in applications. These components are made of high compressive strength materials. Not all the materials are strong in compression. Several materials which are good in tension are poor in compression. Contrary to this, many materials poor in tension but very strong in compression. Cast iron is one such example. That is why determining of ultimate compressive strength is essential before using a material. This strength is determined by conducting the compression test.

The following materials are typically subjected to a compression test. Concrete, Metals, Plastics, Ceramics, Composites, Corrugated Cardboard. Compression test is just opposite in nature to tensile test. Nature of deformation and fracture are quite different from that in tensile test. Compressive load tends to squeeze the specimen with the gradual application of load. Brittle materials are generally weak in tension but strong in compression. Hence this test is normally performed on cast iron, concrete but ductile materials like aluminium, mild steel which are strong in tension are also tested in compression. Hence this test is normally performed on cast iron, concrete.

Why Perform a Compression Test?



shearing modes of deformation [1].

Fig-2: Variation of the strains during a compression test [Source: www.instron.com]

Axial compression testing is a useful procedure for measuring the plastic flow behaviour and ductile fracture limits of a material. Measuring the plastic flow behaviour requires frictionless (homogenous compression) test conditions, while measuring ductile fracture limits takes advantage of the barrel formation and controlled stress and strain conditions at the equator of the barrelled surface when compression is carried out with friction. Axial compression testing is also useful for measurement of elastic and compressive fracture properties of brittle materials or low-ductility materials. In any case, the use of specimens having large L/D ratios should be avoided to prevent buckling and shearing modes of deformation Figure-2 shows variation of the strains during a compression test without friction (homogenous compression) and with progressively higher levels of friction and decreasing aspect ratio L/D (shown as h/d). Modes of Deformation in Compression Testing: Figure-3 illustrates the modes of deformation in compression testing. (a) Buckling, when L/D > 5. (b) Shearing, when L/D > 2.5. (c) Double barrelling, when L/D > 2.0 and friction is present at the contact surfaces. (d) Barrelling, when L/D < 2.0 and friction is present at the contact surfaces. (e) Homogenous compression, when L/D< 2.0 and no friction is present at the contact surfaces. (f) Compressive instability due to work-softening material [1].

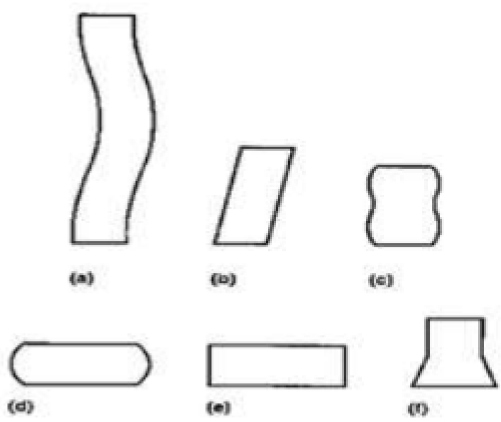


Fig-3: Modes of deformation in compression testing [Source: www.instron.com].

Procedure:

1. Dimension of test piece is measured at three different places along its height and length to determine the average values.

2. The specimen is placed centrally between the two compression plates such that the job axis is same as the axis of the plates.

3. Load is applied on the specimen by moving the top platen.

4. The load and corresponding contraction are measured at different intervals.

5. The load interval is taken as 2 tonne i.e. each time note the load reached and measures the height and diameter of the specimen.

6. Load is applied up to the maximum limit of the machine.

7. Plot the variation of load vs (rf /h)

Observation & Calculation:

Sl. No. Applied load (P) in Tonne , Diameter(2rf) in mm, Height(h) in mm

1. Draw the variation of load vs (rf /h)

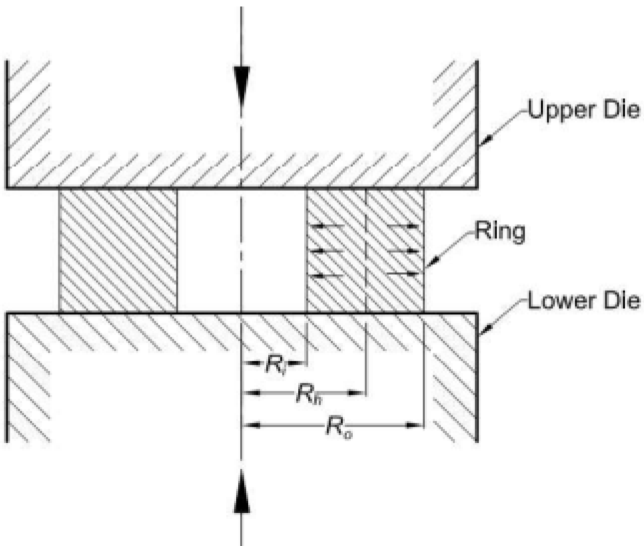
2. Determine young's modulus, Ultimate (maximum) compressive strength and percentage reduction in height of the specimen.

RING COMPRESSION

Aim of the Experiment: To determine the coefficient of interfacial friction during plastic deformation of metals by means of compression of a ring between two compression platens.

Theory: The friction at the interface of die/work piece plays an important role in the overall integrity of metal forming processes. Friction affects the deformation load, product surface quality, internal structure of the product, as well as dies' wear characteristics. Understanding of the friction phenomenon is, therefore, significant for understanding what actually happens at the die/work piece interface during deformation. So, several methods have been developed for quantitative evaluation of friction in metal forming processes. The most accepted one for quantitative characterization of friction is to define a coefficient of friction, μ, at the die/work piece interface is the Coulomb law of friction .

Coulomb law of friction: = μP, where, = frictional shear stress , μ is the coefficient of friction and P is the normal stress. The ring compression test is one of the best techniques to determine the frictional condition at the interfaces. This technique utilizes the dimensional changes of a test specimen to arrive at the magnitude of the friction coefficient.



Fig–1: Ring compression

When a flat ring specimen is plastically compressed between two flat platens, increasing friction results in an inward flow of the material, while decreasing friction results in an outward flow of the materials as schematically shown in fig-1.

If there were no friction between the dies and work piece, both the inner and outer diameters of the ring would expand. However, for large friction at material/ die interface, the internal diameter of the ring is reduced with increasing deformation (fig-2).

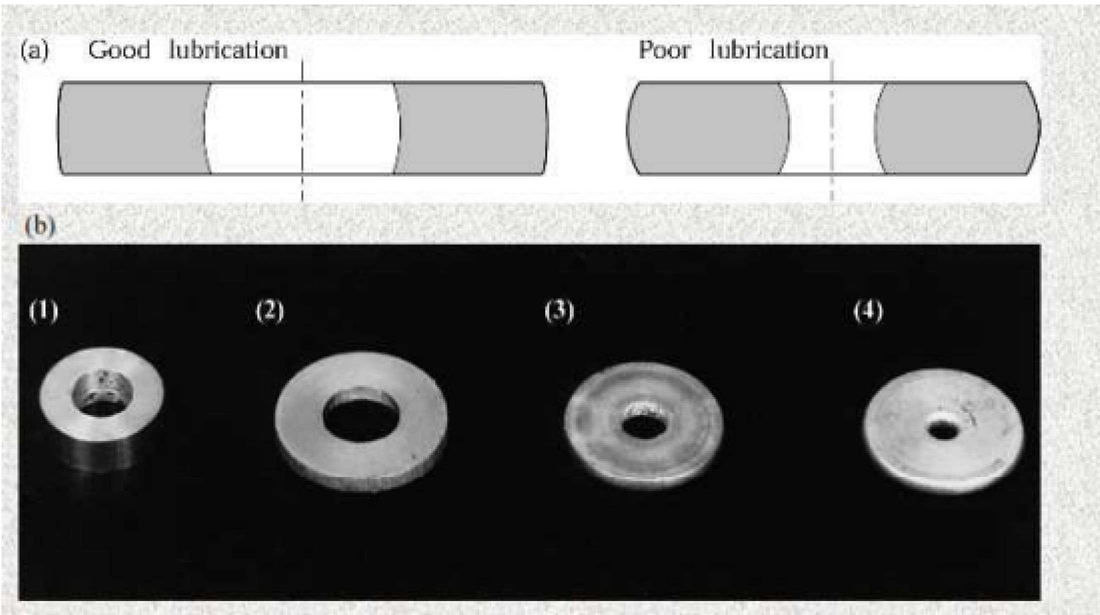
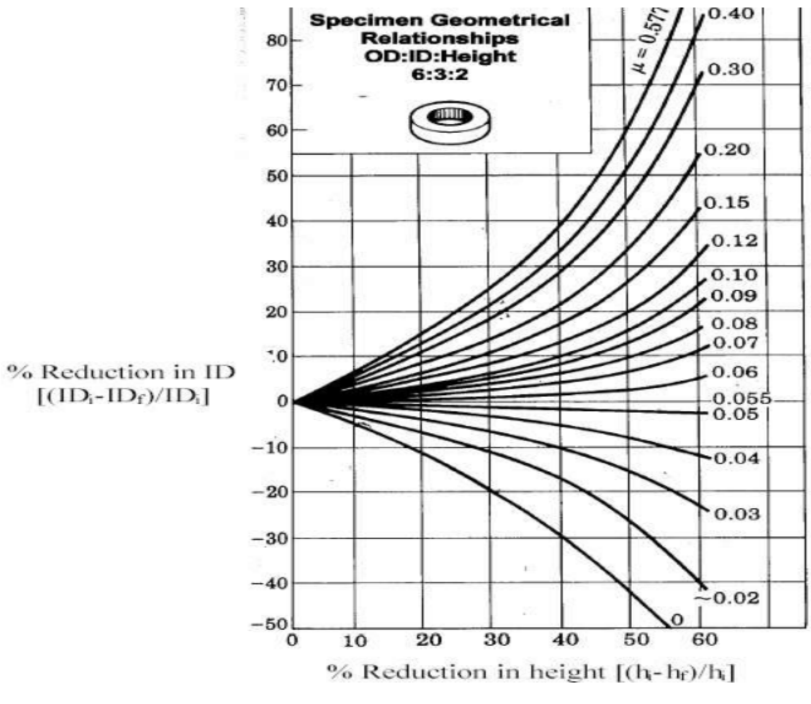


Fig- 2: Ring compression test between flat dies. (a) Effect of lubrication on type of ring specimen barrelling. (b) Test results: (1) original specimen and (2) - (4) increasing friction.
[Source: *Kalpakjian S, Schmid S R, "Manufacturing Engineering and Technology", Prentice Hall, 6th Edition, 2009, fig.32.2*]

For a given percentage of height reduction during compression tests, the corresponding measurement of the internal diameter of the test specimen provides a quantitative knowledge of the magnitude of the prevailing coefficient of friction at the die/work piece interface. For lower friction, specimen's internal diameter increases during deformation but for higher friction internal diameter decreases during the deformation. Using this relationship, speci curves, later called friction calibration curves, were generated by Male and Cockcroft relating the percentage reduction in the internal diameter of the test specimen to its reduction in height for varying degrees of the co-efficient of friction (fig-2) The chart (fig-3) gives the calibration curves for a specific ring geometry (OD: ID: Height = 6:3:2) and for different coefficients of friction, . In this chart, the variation of the % change in internal diameter is given for % reduction in height of the compressed ring.



Procedure:

1. Measure and record the initial dimensions of the ring type cylindrical specimen (I.D, O.D and Height) ID= inner diameter, OD= outer diameter using vernier caliper.

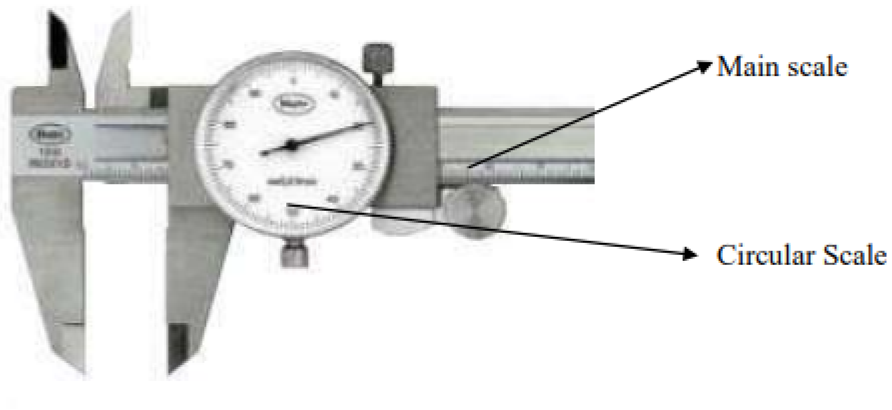


Fig-4: Vernier Caliper

2. The smallest value that can be measured by the measuring instrument is called its least count.

   Here L.C= 0.05 mm Actual reading= main scale reading + circular scale reading* L.C

3. The specimen is compressed and measured at different load interval as done in case of disc compression.
4. Once the ring compression test is completed, the ID and height of the upset ring is measured for each loading condition and the % reduction is found out.
5. By superimposing the measured data on the fig-3 From the location of the experimental point on the chart, μ can be estimate (Ref-fig-3).

Results:

Erichsen sheet metal testing

Aim: To perform the Erichsen sheet metal test.

Theory: This is a mechanical test used to determine the ductility and drawing properties of sheet metal. It consists in measuring the maximum depth of bulge or cup which can be formed before fracture. Cupping number is the depth of impression at fracture, in the cupping test, usually expressed in millimetres.

Procedure:

1. Measure the dimension of the test piece.

2. Place the test piece in the machine dies and touch the penetrator.

3. Rotate the handle of the machine to penetrate the penetrator in the test piece by pressing the retaining ring.

4. As soon as crack appears in the test piece stop rotating the handle.

5. Determine the depth of cup from med,which is the cupping number.

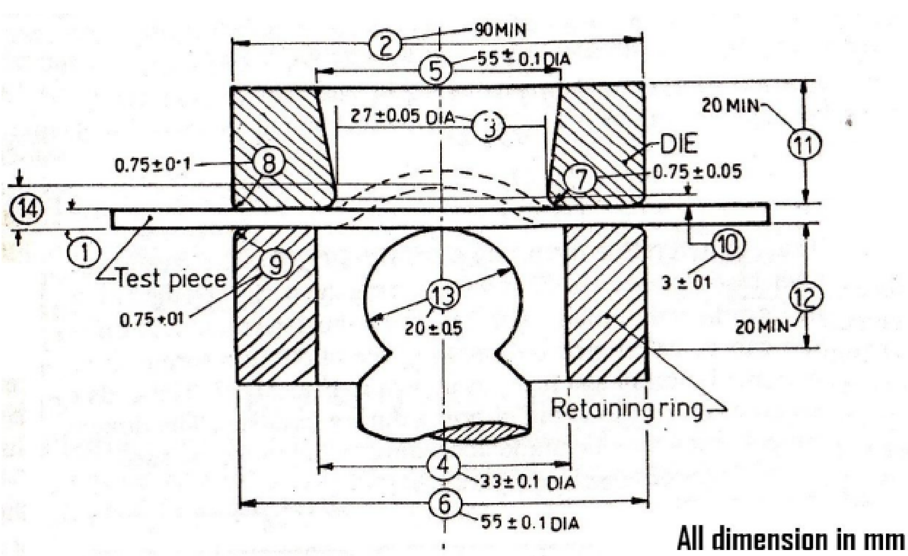
OBSERVATION:

1. Thickness of testpiece: 0.5 to 2 mm.

2. Rotation speed: 5 to 20 mm per minute.

3. Diameter of ball: 20 mm

Sr.No.	Test piece thickness in mm	Reading		Cupping Number
		Initial	Final	
1				



All dimension in mm

FIG.-MODIFIED ERICHSEN CUPPING TEST

Precaution:

1. Test piece should be perfectly flat.

2. Testpiece should be free from foreign matter.

3. The cup formed should be continuously watehed.

4. The handleshould be rotated uniformly and continuously.

Sources of error':

1. Handle being rotated with jerks.

2. Test piece not perfectly flat.

Manual Metal Arc Welding

Objective: To prepare a butt joint with mild steel strip using MMAW technique.

Equipment and Materials:

Welding unit, consumable mild steel wire, mild steel flats, protecting gas(if used), Wire Brush, Tongs etc.

Background Information

Shielded metal arc welding (SMAW), also called “stick welding,” or in many other countries manual metal arc (MMA), is an arc welding process that uses a solid rod coated with flux. This rod or electrode can be made from a variety of metals and flux components, making the process one of the most versatile in welding many materials. The rod carries electric current from a power supply to create an arc that melts both the base metal and the rod. As the weld is deposited, the flux coating of the electrode provides both a shielding gas (by burning of flux components) and a slag layer that protects the molten metal from the atmosphere.

Significance and Use

SMAW dominates other welding processes in the maintenance and repair industry. Although flux-cored arc welding is growing in popularity, SMAW continues to be used extensively in the construction of steel structures and in industrial fabrication. The process is used primarily to weld iron and steels, including stainless steel, but most alloys can be welded with this method.

Procedure

– Clean the mild steel flats to be joined by wire brush
- Arrange the flat pieces properly providing the gap for full penetration for butt joint (gap ½ thicknesses of flats).
- Practice striking of arc, speed and arc length control - Set the welding current, voltage according to the type of metal to be joined.
- This power supply can be operated on alternating current (AC), direct current electrode positive (DCEP), or direct current electrode negative (DCEN) depending on the type of electrode being used.
- Strike the arc and make tacks at the both ends to hold the metal pieces together during the welding process
- Lay beads along the joint maintaining proper speed and arc length (Speed 100-150 mm/min).
- Clean the welded zone and submit.

Advantages

• Wide variety of metals welded due to wide choice of electrodes
• Simple and portable equipment
• Low cost
• Adaptable to confined spaces and remote locations
• Suitable for out-of-position welding

Disadvantages

- Not as productive as continuous wire processes
- More costly to deposit a given quantity of metal due to labor costs
- Frequent stop/starts to change electrode
- Relatively high metal wastage (electrode stubs)
- Slag can become trapped in the weld Common

Discontinuities

• Slag inclusions • Porosity • Spatter • Incomplete fusion • Incomplete joint penetration • Arc strike

Results:

Conclusions:

Gas Metal Arc Welding

Objective: To prepare a butt joint with mild steel strip using GMAW technique.

Equipment and Materials:

Welding unit, consumable mild steel wire, mild steel flats, protecting gas(if used), Wire Brush, Tongs etc.

Background Information

Gas Metal Arc Welding (GMAW) is a semi-automatic arc welding process which uses a continuously-fed and consumed solid or metal cored wire electrode and an external gas shield supplied from a cylinder. The process is commonly called MIG Welding for "Metal Inert Gas"; however, many of the gases used today are not inert. While this process is one of the easiest to do, it is often misunderstood as there are three different "modes of transfer" which is the manner in which the molten metal is melted and transferred across the arc.

Procedure

- The filler metal is typically on a spool or coil mounted to a wire feeder which is connected to one lug of a constant voltage welding power supply.
- A cable connected to the work is attached to the other lug.
- The welder holds a welding gun through which the wire is fed, exiting through a contact tip sized to the wire.
- When the trigger on the gun is pulled, the machine is energized, gas flow begins, the wire is fed to the work from a wire feeder, and the arc is initiated.
- The welder then moves the electrode along the weld joint.
- When the welder moves the gun, the process is termed semi-automatic as the wire is being machine fed.
- If the gun is attached to a travel device and the welding operator just observes, the process type is considered "mechanized" or "machine welding".

Advantages • Semiautomatic process • High productivity • No slag to remove • Clean process • Welds most alloys

Disadvantages • Unsuitable for windy conditions • Little tolerance for contamination • Usually limited to shop welding • Equipment can be complex

Common Discontinuities • Porosity • Incomplete fusion • Incomplete joint penetration

Transfer Modes

The manner in which the solid wire melts and "transfers" across the arc changes as the level of energy is applied.

Short Circuiting Transfer

At the lowest energies the wire actually touches the work forming an electrical short causing the voltage to drop and the current to rise. As the wire heats a large droplet will "pinch" off and be deposited in the weld pool. These shorts occur from 20-200 times per second and produce a distinct "bacon frying" sound. Some spatter is produced which can vary with the shielding gas used. This transfer mode is usable in all welding positions, but produces the lowest level of weld penetration and fusion.

Globular Transfer

As energy is increased the heat of the arc causes the end of the wire to form a larger ball before the wire actually shorts to the work. This ball is then flung across the arc splashing into the molten puddle creating maximum amounts of spatter. This transfer mode should be avoided.

Spray Transfer

Also called Axial Spray Transfer. As energy is again increased a “transition” level is reached where large droplets happening relatively slowly changes to very small droplets happening very rapidly. At this point an arc cone is visible and no shorting occurs. Very little spatter is produced. This mode is only usable in the flat and horizontal positions but produces the greatest level of weld penetration and fusion.

Pulsed Spray Transfer

This is not a separate transfer mode, but is Spray Transfer created by varying the weld energy between two levels. The higher level sprays off a few droplets and then the lower level “cools” the arc down. This process requires more sophisticated equipment, but produces spray transfer with lower overall heat input which becomes usable in all positions.

Gases

When considering the energy required for these transfer modes, amps and volts are not the only consideration. Different shielding gases have varying ionizing potentials which affect their ability to carry the required current. The primary gases used in GMAW are CO_2, mixes of Argon with CO_2 and mixes of Argon with Oxygen. As a rule of thumb, a minimum of 80% Argon is required to achieve spray transfer. Common gases for short circuit transfer are 100% CO_2 and 75%Argon/25%CO_2 (produces a more stable arc with less spatter than 100% CO_2). Common gases for spray transfer are 98%Ar/2%O_2 and 90%, 92%, 95%, 98% Argon-Balance CO_2. 92% or greater Argon/balance CO_2 is typically used for pulsed spray transfer.

Results:

Conclusions:

Friction Stir Welding

Aim:

To perform friction stir welding (FSW) on two similar aluminum sheets of same gauge by varying the FSW tool rotational and work table translational speeds.

Instruments required:

Numerically controlled FSW machine having load cell attached to it (to measure force and torque during welding),

Fixture for clamping the workpiece on the machine table Al sheets of dimensions (100✐50✐2.5 mm3),

FSW tool (having flat shoulder surface and straight circular pin), Few others necessary equipments for tightening and loosing the desired nuts and bolts.

Theory of FSW:

In friction stir welding a rotating non-consumable tool with specially designed shoulder and pin is plunged on the abutting edge of firmly clamped work piece than traversed along the weld line to form a weld and finally plunge out from the work-piece (as shown in Fig. 1). Tool serves two purposes, firstly softening of material by heat generation through friction and plastic deformation, and secondly mixing of material by pin stirring to form weld. The side of the workpiece where the tool rotation and tool translation vectors are same, is called advancing side (AS); and the side where the tool rotation and translation vectors remain opposite is called retreating side (RS). Furthermore, a typical friction stir welding cross-section consists of four microstructural zones; namely stirred zone or nugget zone (NZ), thermo-mechanically affected zone (TMAZ), heat affected zone (HAZ) and unaffected or base metal zone (BM). Threadgill gave the nomenclature to different FSW zones. The stirred zone is the region where the work-piece material gets stirred due to influence of both rotary shoulder and pin. Obviously, materials at this zone remain subjected to high strain, high strain rate and higher temperature (due to heating by both friction and large plastic deformation). TMAZ is subjected to heat and some inertia of the materials from the NZ (which causes grain orientation) and material in HAZ is subjected to heat. Temperature in HAZ is less as compared to HAZ of fusion welding. After HAZ the region which remains unaffected is called base metal.

Experimental procedure:

1. Switch on the MCB switch (electric input to the machine), On/Off switch on the machine body at the left side and start the computer monitor attached with the machine.
2. Then, double click on the ‘stir welding’ icon on the desktop in order to start the software. Once the software gets started; it will ask for pressing hydraulic knob for switching it on, and then for spindle home.
3. Fix the FSW tool into the spindle through proper dimension of collet, and then tight the adapter nut using semicircle spanner.
4. Place the work-piece on the anvil of machine work-table. Make sure the sheets are being placed in such a manner that the joining line is parallel to the machine X-axis, and then clamp the work-piece using bolts.
5. Once it will be done, choose the ‘manual mode’ option from the available options. Insert suitable values for work-table movement, and move the work-table against fixed FSW tool for obtaining the Y start, Y end and Z end position values. Here, Y start, Y end denotes start and end point of welding on the workpiece clamped, and Z end position denotes the point up to which the FSW tool will reach during plunging.
6. Come out from the ‘manual mode’ and then go to the ‘parameter’ for specifying the parameters for weld to be conducted. If required change the spindle tilt angle.
7. After specifying the parameters go to the ‘auto mode’ and click on icon ‘continue’, to start the weld. But, before pressing ‘cycle on’ switch, make sure that the coolant pump for spindle is switched on.
8. After finishing of the weld, switch off the coolant pump, and hydraulic knob.

Precautions:

1. Before clamping the work-piece on the anvil the edges of the faying surfaces should be straight, so that there should not be any gap between faying surfaces; in order to achieve good weld.
2. The joining line should be parallel to the machine X-axis, and the anvil should be placed in such a position so that the FSW tool pin centre should not be off-set from the expected joining line.
3. When coming out from the manual mode, move the spindle up in the Z-axis; otherwise while selecting auto mode the spindle will directly move to the last Z-value the spindle had in the manual mode.
4. Before pressing the 'cycle on' knob in the monitor panel the work-piece should be rigidly clamped on the anvil, and the allen bolts (placed at the right bottom side of the anvil) must be tightened in order to prevent the vibration of anvil along Y-axis

Results and Discussion:

Conclusion:

COMPRESSION AND SHEAR STRENGTH TEST FOR MOULDING SAND

AIM: To find the green Compression and Shear strength test of the given specimen at different percentage of clay and moisture

Materials used: Base sand, clay, water,

Apparatus used: Sand Ramming machine (Rammer) with specimen tube with base, stripper, universal sand testing machine with Compression, shear shackles, weighing pan, measuring jar, steel scale, Electronic weighing scale..

Theory:

1. Periodic tests are necessary to check the quality of foundry sand and compression Shear strength and permeability test are among them.
2. The constituents of moulding sand are silica sand, clay, water and other special additives.
3. Clay imparts the necessary bonding strength to the moulding sand when it is mixed with water bentonite etc.
4. Compression test determines the bonding or adhesiveness power of various bonding materials in green sand.
5. The green compressive strength of foundry sand is the maximum compression strength a mixture is capable of developing when it is in most condition.
6. Shear strength is the ability of sand particles to resist the shear stress and to stick together.
7. Insufficient Shear strength may lead to the collapsing of sand in the mould or its partial destruction during handling. The mould and core may also be damaged during flow of molten metal in the mould cavity.
8. The moulding sand must possess sufficient strength to permit the mould to be formed to the desired shape and to retain the shape even after the hot metal is poured into the mould cavity.
9. In shearing, the rupture occurs parallel to the axis of the specimen.

Procedure:

1. Conduct the experiment in twoparts: a) Vary the clay content keeping the water content constant b) Vary the water content keeping the clay content constant
2. Take weighed proportions of sand and clay and dry mix them together in a Muller for 3minutes.
3. Adjust the weight of the sand to get standard specimen
4. Remove the standard specimen by the stripper and place it between shackles which are fixed in the sand testing machine.
5. Rotate the handle of the testing machine to actuate the ram. Thus, hydraulic pressure is applied continuously till the specimen raptures.
6. Read the compression and shear strength from the gauge and record the same.
7. Conduct the experiment for the above said two cases and tabulate the result.

Result and discussion

Plot the graphs with compression strength on y-axis & percentage clay on x-axis and the other with compression strength on y-axis v/s percentage water on x-axis. Shear strength on y-axis & percentage clay on x-axis and the other with shear strength on y-axis v/s percentage water on x-axis Discuss the result with respect to the variation of percentage of clay on compression, shear strength and percentage of water on compression, shear strength.

TABULAR COLUMN

VARYING THE % OF CLAY

Sl. No.	Percentage of sand	Percentage of clay	Percentage of water	Compression Strength gm/cm^2
1				
2				
3				

VARYING THE % OF WATER

Sl. No.	Percentage of sand	Percentage of clay	Percentage of water	Compression Strength gm/cm^2
1				
2				
3				

PERMEABILITY TEST

AIM: To find the effect of water content, clay content on green permeability of foundry sand.

Materials used: Base sand, clay and water. Apparatus used: Sand rammer, Permeability meter, Electronic weighing scale, stripper, stop watch, measuring jar, specimen tube, specimen tube cup.

Theory:

1. Molten metals always contain certain amount of dissolved gases, which are evolved when the metal starts freezing.
2. When molten metal comes in contact with moist sand, generates steam or water vapour.
3. Gases and water vapour are released in the mould cavity by the molten metal and sand. If they do not find opportunity to escape completely through the mould, they will get entrapped and form gas holes or pores in the casting. The sand must therefore be sufficiently porous to allow the gases and water vapour to escape out. This property of sand is referred to as permeability.
4. Permeability is one of the most important properties affecting the characteristic of moulds which depends upon the grain size, grain shape, grain distribution, binder content, moisture level and degree of compactness.
5. Permeability is a physical property of the physical sand mixture, which allows gases to pass through it easily.
6. The AFS (American Foundry Men Society) definition of permeability is "the number obtained by passing 2000cc of air through a standard specimen under a pressure of 10 gm/cm2 for a given time in minutes".
7. The permeability number PN can be found out by the equation

$$P_N = \frac{(VH)}{(PAT)}$$

Where V = Volume of air passing through the specimen, 2000cc
H = Height of the specimen = 50.8 mm (standard value)
P = Pressure as read from the manometer in gm/cm2
A = Area of the specimen = $\pi d^2/4$ Where d = 50.8 mm (standard value)
T= time in minutes for 2000 cc of air passed through the sand specimen.

Experimental setup details:

Permeability meter has a cylindrical water tank in which an air tank is floating. By properly opening the valve, air from the air tank can be made to flow through the sand specimen and a back pressure is setup. The pressure of this air is obtained with the water manometer. The meter also contains the chart, which directly gives the PN depending on pressure.

Procedure:

1. Conduct the experiment in two parts. In the first case vary water percent keeping clay percent constant. In the second case vary clay percent and keep water percentconstant.

2. Take weighed proportions of sand dry mix them together for 3 minutes. Then add required proportions of water and wet mix for another 2 minutes, to get a homogeneous and mixture. Take the total weight of the mixture between 150-200 grams. The correct weight has to be determined by trial and errormethod.

3. Fill the sand mixture into the specimen tube and ram thrice using sand rammer. Use the tolerance limit provided at the top end of the rammer for checking the specimen size. If the top end of the rammer is within the tolerance limit, the correct specimen is obtained. If it lies below the limit, increase the weight of sand mixture and prepare a new specimen. The specimen conforming to within limits represent the standard specimenrequired.

4. Now the prepared standard specimen is having a dia.50.8mm and height50.8mm.

5. Place the standard specimen along with the tube in the inverted position on the rubber seal or on the mercury cup (specimen in the top position in the manometerreading).

6. Operate the valve and start the stop watch simultaneously. When the zero mark on the inverted jar just touches the top of water tank, note down the manometerreading.

7. Note down the time required to pass 2000cc of air through the specimen. Calculate the permeability number by using the formulagiven.

Direct scale reading:

The permeability can also be determined by making use of the graduated marker provided near the manometer.

Procedure to be followed:

- Coincide the graduations on the transparent scale with the meniscus of the manometer liquid.

- Note the reading of the scale.

- This reading represents the permeability number of the sand.

TABULAR COLUMN

Varying the percentage of Clay and keeping percentage of Water constant. Indicate percentage of Clay (No. of arms = 3)

Sl. No.	Percentage of Clay	Pressure gm/cm^2	Time in min.	P_N	
				Indicated	Calculated
1					
2					
3					

Varying the percentage of water and keeping percentage of Clay constant. Indicate percentage of Water (No. of arms = 3)

Sl. No.	Percentage of water	Pressure gm/cm^2	Time in min.	P_N	
				Indicated	Calculated
1					
2					
3					

Draw graph:

Permeability number v/s % Clay

Permeability number v/s % water

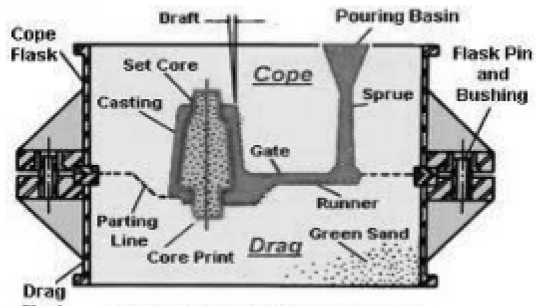
Discuss the effect of water and clay on Permeability

Mold Preparation, Melting and Casting

Aim: To prepare a green mould for casting using only two boxes.

Tools And Pattern: Wooden pattern is made in two halves, dowelled together, the division passing through the center of the grooves; cope and drag moulding tools parting sand, brick dust etc.

Stage Sketches: The mould can be prepared by using three boxes without any difficulty. However the same can be prepared using two boxes using an ingenious method known as false-core method.



Green Sand Mold Section

Procedure:

1. One half of the pattern is molded in the bottom box, the parting being cut an incline as shown. The other half pattern is then placed in position and sand poured and rammed to form the second parting with a slope down wards from the upper flange of the pulley

2. The top box is next placed on the bottom box and properly located. Sand is poured and rammed without damaging the false core.

3. The top box is gently removed; the upper half pattern is gently taken out from the top box.

4. The top box is replaced on the drag and the entire mould is turned upside down. The bottom box, which now is at the top, is gently lifted and the remaining half of the pattern is withdrawn.

5. The bottom box is replaced and the mould id inverted. The spruces are removed, pouring basin is cut and the mould is finished after piercing holes (vents).

Observations:

1. After ramming using moulds hardness tester check the mould hardness on all the four sides of the pattern.

2. Locate the rumen and riser 900 exactly.

Precautions:

1. Ramming should be uniform to impart uniform strength to the mould.

2. Apply parting sand at the partitions for esy separation of boxes.

3. Locate the two halves of pattern properly to avoid mismatch. Result: Sand mould is prepared for the given pattern.

Melting Procedure For Aluminum Alloys:-

The charge materials, chemicals should be free from moisture, oil, and corrosion powder and should be preheated before charging. The calculation of charge should be done considering the melting loss of each element in the melting furnace for final desired analysis.

1. The furnace crucible should be clean and red hot for charging.

2. Aluminium alloys get readily oxidized and form dross, using proper covering top with flux and chemicals help to reduce this. Different proprietary chemicals are available for different alloys.

3. Melting should be done under steady conditions without agitation. Stirring is done to reduce gas pickup.

4. Once melting is complete, degassing using solid chemicals like hexachloro-ethane which evolves chlorine by purging with nitrogen or argon gas is done to remove the dissolved hydrogen. Hydrogen is evolved from moisture. $3H_2O+2Al \rightarrow Al_2O_3+6H$ Hydrogen absorbed by liquid metal causes serious porosity in casting during solidification. Degassing should be done in the temperature range 7300 C to 7500 C

5. Liquid metal after degassing is treated with sodium containing chemicals to improve mechanical properties.

6. Liquid metal once ready should not be super heated. Agitated or kept long in the furnace which will cause dressing and gas pickup. Dross should be skimmed properly before pouring.

7. Alloys containing magnesium should be melting carefully as it is highly reacting. Special fluxes and chemicals like sulphur are used to inhibit the reactivity and prevent spontaneous ignition, melting loss and dross.

Casting Defects Due To Improper Melting:

1. Improper chemical analysis: Incorrect charge, calculations, including wrong estimates of melting losses, metal recovery, excessive losses due to improper fluxing and slogging operations, improper covering of non Ferrous melt causes this defect.

2. Gassy metal/hydrogen pickup/pinhole porosity: unclean melting causes formation and absorption of hydrogen into liquid metal. As casting solidifies, the absorbed hydrogen losses solubility and forms cavities inside casting.

3. Oxygen absorption Excessive oxygen furnace operations in atmosphere following oxidation during melting cause this defect. It also causes loss of costly metal added in the charge.

4. Slag inclusions Improper fluxing and slag removal slag particles to be mixed in the metal being poured. Careless pouring, lip pouring for alloys with fluid slag causes slag particles to enter casting.

5. Cold shut, misrun, unfilled castings Low pouring temp, delay in pouring, due to many folds being poured, loss of heat from lable, due to improper covering failure of ladle opening in the bottom pouring cause premature solidification of metal causing defects.

6. Sand fusion, metal penetration, rough surface Excessive pouring temp of liquid causes damage to the casting surface by attacking mould surface.

7. Sand erosion sand inclusions Uncontrolled high pouring rate from ladle into mould leads to erosion of mould/core

PRECAUTIONS: 1. The furnace crucible should be clean and red hot for charging 2. Charge material should be free from oil, moisture etc., 3. Melting must be done under steady condition to reduce gas pickup.

RESULT: Melting practice is observed