INVESTIGATION OF MECHANICAL CHARACTERISTICS OF MARTENSITIC STAINLESS STEEL USING TIG WELDING

A PROJECT REPORT

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BONAFIDE CERTIFICATE

Certified that this project report **"INVESTIGATION OF MECHANICAL CHARECTARISTICS OF MARTENSITIC STAINLESS STEEL USING TIG WELDING"** is the bonafide work of **"SAITHARUN. K, SIVASHANKAR. J, SRIDHAR. D, SATHYANARAYANAN. J"** who carried out the project work under my supervision.

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ABSTRACT

Cold Metal Transfer (CMT) is a modified metal inert gas welding process based on short – circuiting the transfer process, characterised by low heat input and no-spatter welding. The mechanical characterisation have been studied by the tensile test using Universal Testing Machine (UTM). The process was used to join SS430 material in the form of Lap Joint. The results shows that no – spatter welding and low heat input during the welding process can be realized by Cold Metal Transfer, and a similar metal joint with good performance can be obtained by CMT process. In this proposed work we have fabricated the tensile test fixture for lap joint, which that the sample is coaxial in nature and the same is welded and bisected using wirecut edm and the tested using the above mentioned fixture and the results are observed and tabulated.

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CHAPTER 1

INTRODUCTION

Welding is a fabrication process whereby two or more parts are fused together by means of heat, pressure or both forming a join as the parts cool. Welding is usually used on metals and thermoplastics but can also be used on wood. The completed welded joint may be referred to as a weldment. Some materials require the use of specific processes and techniques. Number are considered ‘unweldable’ a term not usually found in dictionaries but useful and descriptive in engineering. The parts that are joined are known as a **parent material**. The material added to help form the join is called **filler** or **consumable**. The form of these materials may see them referred to as parent plate or pipe, filler wire, consumable electrode (for arc welding), etc. The welding process came to light when there was a search for the technique for developing iron into useful shapes. Welded blades were the first result of welding n the early years—the carburization of iron produced hard steel that was very brittle for usage. Later interlaying the rigid and soft iron with high - carbon material and hammer forging resulted in a tough and durable blade. The process of welding uses filler material. The filler material is the pool of molten material that aids in the formation of a strong link between the base metal. The shielding the process after welding the metals protects both the base and filler components from being oxidised. From gas flame to ultrasound, many energies are used in welding like electron beams, electric arc, LASER, and friction. Now let us understand various types of welding.

Joining Metals:

As opposed to brazing and soldering, which do not melt the base metal, welding is a high heat process which melts the base material. Typically with the addition of a filler material. Heat at a high temperature causes a weld pool of molten material which cools to form the join, which can be stronger than the parent metal. Pressure can also be used to produce a weld, either alongside the heat or by itself. It can also use shielding gas protect the melt and filler metals from becoming contaminated.

Joining Plastics:

Plastics welding also uses heat to join the materials (although not in the case of solvent welding) and is achieved in three stages. Firstly, the surfaces are prepared before heat and the pressure is the applied and, finally, the materials are allowed to the cool to create fusion. Joining methods for the plastics can be separated into the external or the internal heating methods, depending on the exact process used.

Joining Wood:

Wood welding uses heat generated from friction to join the materials. The materials to be joined are subjected to a great deal of pressure before a linear friction movement creates heat to bond the workpieces together. This is a fast process which allows wood to be joined without adhesives or nails in a matter of seconds. In this energy-efficient process, joints are produced by pressing and rubbing two timber surfaces together at high frequency (50-150Hz). The resulting friction and heat softens and resets lignin, the natural 'glue' in plant materials, as well as mechanically inter-locks the cellular material, causing the 'welding'.

1.1 CLASSIFICATION OF WELDING PROCESS

Welding is one of the methods to join two pieces (sometimes more) of metal together. Basically, there are 3 methods of joining metal, by mechanical fastening, adhesive bonding, and welding. They're all distinguished by how the metal joined. In welding, the two pieces of metal called base metal is melted into entering liquid phase along with filler metal (in most cases while a some cases filler metal is optional) and the mix of the two base metal and the filler metal solidify (this mix is called weld metal) becoming a welded joint that connects the two pieces of base metal. The further classification of welding is classified under how the metal is melted. If it's melted by the heat generated from electric arc, it's called arc welding (e.gSMAW, GMAW, TIG) which is the most common welding method nowadays. If some pressure is utilized during welding, it's called resstance welding (e.g. ERW, FSW, Spot Welding), usually being done in the workshop because of its machine immobility.

Gas welding, a welding process that requires burning fuel to generate heat (e.g. Oxy- Acetylene Welding). A welding process that involves chemical reaction to produce heat (e.g. thermite welding). So many processes that have the same goal, which is to produce enough heat required to melt the metal. Because welding is defined as a process of melting part of metal pieces before solidifying and become a weld joint. Welding is broadly divided into three groups: fusion welding, pressure welding, and brazing / soldering, each of which is made up of many welding methods. This is because the optimum welding method depends on the type of base materials to be welded, the functionality required for the welded product, and other considerations.

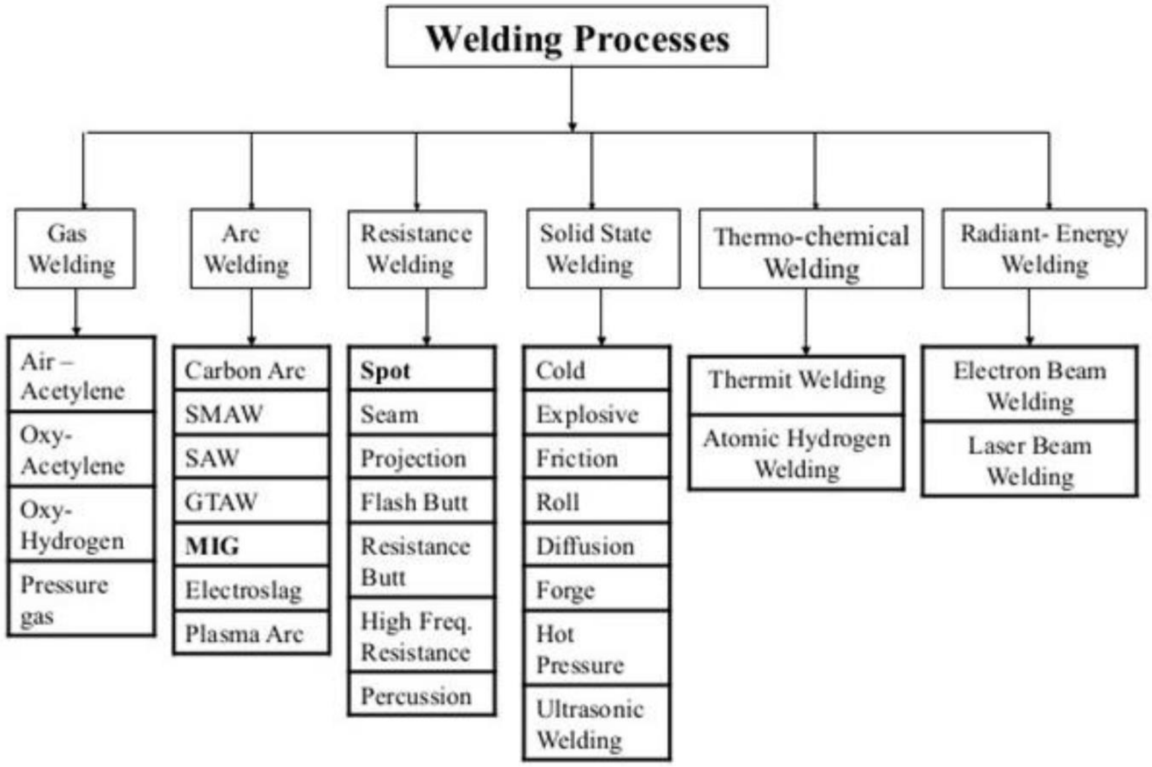

Fig 1.1 Classification of Welding Process

Fusion welding melts base materials or a base material and a welding rod used for joining the base material (filler material) pressure welding melts base materials mechanically through friction, pressure or electric current; and brazing /soldering uses a filler material (brazing paste) applied on the joining sections. There are many different welding methods in each group that allow selection of the optimum method depending on base materials to be joined and other conditions.

Welding is one of the most common ways to join thermoplastic -coated materials used in the technical textile industry. Fabric welding is straightforward, relatively inexpensive, and offers unparalleled flexibility and strength when it comes to joining technical fabrics together. While not all types of fabrics can be easily welded, virtually all thermoplastics exhibit excellent weldability.

Table 1.1 Types of Welding

Metallurgical joining	Fusion welding	**Electrical energy** • Arc welding • Electron beam welding **Chemical energy** • Gas welding **Light energy** • Laser welding
	Pressure Welding	**Electrical energy** Resistance welding: • Resistance spot welding • Projection welding • Seam welding • Upset welding **Chemical energy** • Explosion welding **Mechanical energy** • Cold pressure welding • Friction welding • Friction stir welding (FSW) • Ultrasonic welding • Diffusion welding
	Brazing/soldering	**Electrical energy** • Induction heating brazing (soft brazing = soldering) **Chemical energy** • Torch brazing (flame brazing) **Light energy** • Light beam brazing • Laser brazing

1.2. TUNGSTEN INERT GAS (TIG) WELDING

Tungsten Inert Gas (TIG) welding, also known as Gas Tungsten Arc Welding (GTAW) is an arc welding process that produces the weld with a non-consumable tungsten electrode. Tungsten inert gas (TIG) welding became an overnight success in the 1940s for joining magnesium and aluminium. Using an inert gas shield instead of a slag to protect the weldpool, the process was a highly attractive replacement for gas and manual metal arc welding. TIG has played a major role in the acceptance of aluminium for high quality welding and structural applications.

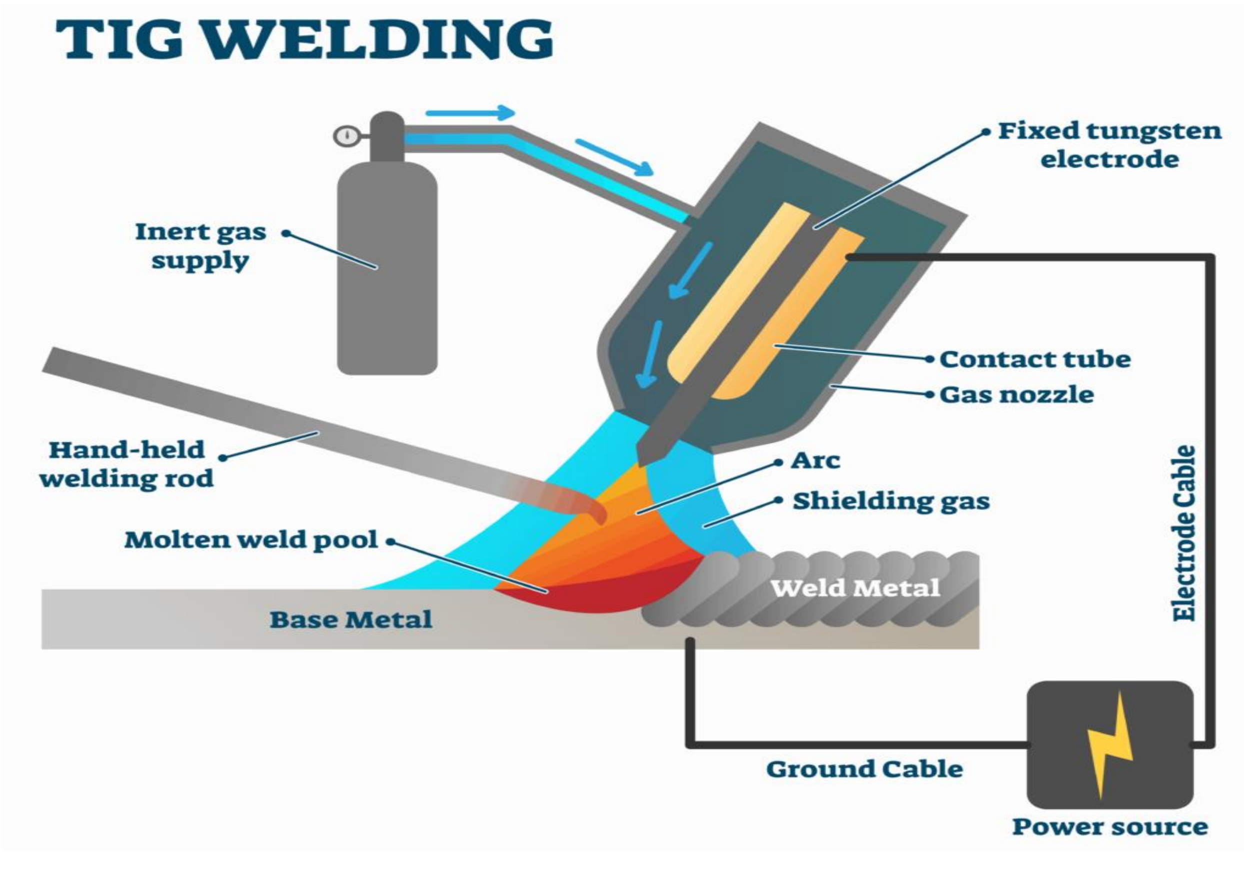

Fig 1.2 TIG Welding

1.2.1. Process characteristics:

In the TIG welding process the arc is formed between a pointed tungsten electrode and the workpiece in an inert atmosphere of argon or helium. The small intense arc provided by the pointed electrode is ideal for high quality and precision welding. Because the electrode is not consumed during welding, the TIG welder does not have to balance the heat input from the arc as the metal is deposited from the melting electrode. When filler metal is required, it must be added separately to othe weldpool.

1.2.2. Power source:

TIG welding must be operated with a drooping, constant current power source – either DC or AC. A constant current power source essential to avoid excessivel high currents being drawn when the electrode is short - circuited on the workpiece surface. This could happen either deliberately during arc starting or inadvertently during welding. If, as in MIG welding, a flat characteristic power source is used, any contact with the workpiece surface would damage the electrode tip or fuse the electrode to the workpiece surface. In the DC, because arc heat is thedistributed approximately one – third at the cathode (negative) and two-thirds at the anode (positive), the electrode is always negative polarity to prevent overheating and melting. However, the alternative power source connection of the DC electrode positive polarity has the advantage in that when the cathode is on the workpiece, the surface is cleaned of oxide contamination. For this reason, AC is used when welding materials with a tenacious surface oxide film, such as aluminium.

1.2.3. Arc starting:

The welding arc can be started by scratching the surface, forming a short-circuit. It is only when the short-circuit is broken that the main welding current will flow. However, there is a risk that the electrode may stick to the surface and cause a tungsten inclusion in the weld. This risk can be minimised using the 'lift arc' technique where the short -circuit is formed at a very low current level. The most common way of starting the TIG arc is to use HF (High Frequency). HF consists of high voltage sparks of several thousand volts which last for a few microseconds. The HF sparks will cause the electrode - workpiece gap to break down or ionise. Once an electron/ion cloud is formed, current can flow from the power source.

HF is also important in stabilising the AC arc; in AC, electrode polarity is reversed at a frequency of about 50 times per second, causing the arc to be extinguished at each polarity change. To ensure that the arc is reignited at each reversal of polarity, HF sparks are generated across the electrode/workpiece gap to coincide with the beginning of each half-cycle.

1.2.4. Electrodes:

Electrodes for DC welding are normally pure tungsten with 1 to 4% thoria to improve arc ignition. Alternative additives are lanthanum oxide and cerium oxide which are claimed to give superior performance (arc starting and lower electrode consumption). It is important to select the correct electrode diameter and tip angle for the level of welding current. As a rule, the lower the current the smaller the electrode diameter and tip angle. In AC welding, as the electrode will be operating at a much higher temperature, tungsten with a zirconia addition is used to reduce electrode erosion. It should be noted that because of the large amount of heat generated at the electrode, it is difficult to maintain a pointed tip and the end of the electrode assumes a spherical or 'ball' profile.

1.2.5. Applications:

TIG welding is the applied in all industrial sectors but is especially suitable for high quality welding. In manual welding, the relatively small arc is ideal for thin sheet material or controlled penetration (in the root run of pipe welds). Because deposition rate can be quite low (using a separate filler rod) MMA or MIG may be preferable for thicker material and for fill passes in thick-wall pipe welds. TIG welding is also the widely applied in the mechanized systems either autogenously or with the filler wire. However, several 'off the shelf' systems are available for orbital welding of pipes, used in the manufacture of chemical plant or boilers. The systems require no manipulative skill, but the operator must be well trained. Because the welder has less control over arc and weldpool behaviour, careful attention must be paid to edge preparation (machined rather than hand-prepared), joint fit-up and control of welding parameters.

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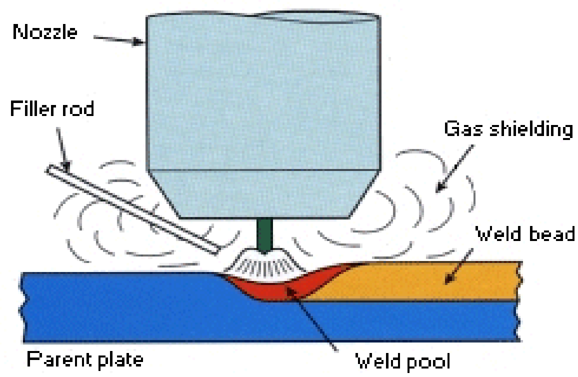

Fig 1.3 Process of TIG Welding

1.3. TYPES OF WELD JOINTS

There are five major welding joint types, which are each made to stand up to the needs and forces of different applications. Keep reading to learn about each of the different weld types and how they can apply to a career in the field.

1.3.1. Butt Joint

A butt joint, or butt weld, is a joint where two pieces of metal are placed together in the same plane, and the side of each metal is joined by welding. A butt weld is the most common type of joint that is used in the fabrication of structures and piping systems. It’s fairly simple to prepare, and there are many different variations that can be applied to achieve the desired result.

Butt welds are made in a variety of ways, and each one serves a different purpose. Varying factors include the shape of the groove, layering and width of the gap. Listed below are some typical examples of butt weld joints.

1.3.2. Corner Joint

Corner joints have similarities to te welding joints. However, the difference is the location of where the metal is positioned. In the tee joint, it’s placed in the middle, whereas corner joints meet in the ‘corner’ in either an open or closed manner—forming an ‘L’ shape.

These types of joints are among some of the most common in the sheet metal industry, such as in the construction of frames, boxes and other applications.

1.3.3. Edge Joint

In an edge joint, the metal surfaces are placed together so that the edges are even. One or both plates may be formed by bending them at an angle. The purpose of a weld joint is to join parts together so that the stresses are distributed. The forces causing stresses in welded joints are tensile, compression, bending, torsion and shear. The ability of a welded joint to withstand these forces depends upon both the joint design and the weld integrity. Some joints can withstand certain types of forces better than others.

1.3.4. Lap Joint

Lap welding joints are essentially a modified version of the butt joint. They are formed when two pieces of metal are placed in an overlapping pattern on top of each other. They are most commonly used to joint two pieces with differing thicknesses together. Welds can be made on one or both sides. Lap joints are rarely used on thicker materials, and are commonly used for sheet metal. Potential drawbacks to this type of welding joint include lamellar tearing or corrosion due to overlapping materials. However, as with anything, this can be prevented by using correct technique and modifying variables as necessary.

1.3.5. T-Joint

Tee welding joints are formed when two pieces intersect at a 90° angle. This results in the edges coming together in the center of a plate or component in a ‘T’ shape. Tee joints are considered to be a type of fillet weld, and they can also be formed when a tube or pipe is welded onto a base plate. Tee joints are not usually prepared with groove, unless the base metal is thick and welding on both sides cannot withstand the load the joint must support. A common defect that occurs with tee joints is lamellar tearing — which happens due to the restriction experienced by the joint. To prevent this, welders will often place the stopper to prevent joint deformities.

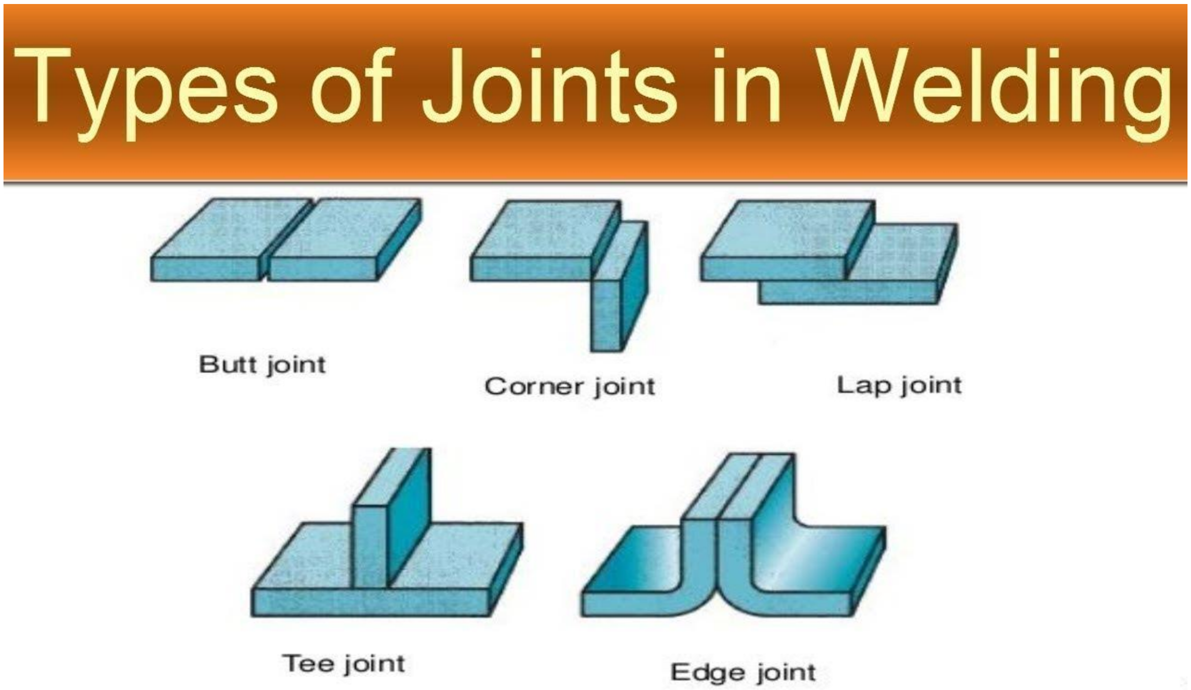

Fig 1.4 Types of Welding

CHAPTER 2
LITERATURE SURVEY

[1] The Effects of TIG Welding Rod Compositions on Microstructural and Mechanical Properties of Dissimilar AISI 304L and 420 Stainless Steel Welds.

420 quality martensitic stainless steels are preferred in various industries where medium corrosion resistance in mildly aggressive ambients is adequate and besides they are demanded especially for their high strength values as compared to other groups of stainless steels.

304L quality austenitic stainless steels are used especially in oxidizing corrosive medias and they exhibit high toughness from cryogenic up to high temperature applications.

While austenitic stainless steel alloys are not transformation hardenable, martensitic alloys on the other hand are hardenable, therefore joining these two groups of stainless steels requires some precautions before, during and after fusion welding techniques.

Many authors proposed studies about 304L and 420 stainless steels welds with other groups of alloys but welding of dissimilar 304L with 420 is not reported.

This research is the distinctive at this standpoint. The decision to weld together different types of material groups is commonly due to economic considerations. The second main reason is taking the advantage of the chemical and/or physical properties of both separate groups altogether in one uniform structure to meet optimum requirements of weldments.

[2] Highly efficient TIG welding of Cr13Ni5Mo martensitic stainless steel.

To overcome these disadvantages, Gurevich et al. (1965) of the E.U. Paton Institute of Electric Welding first proposed the A - TIG welding process in the 1960 s, a process in which a fine layer of activating flux (halides or oxides) is smeared on the surface of a workpiece prior to welding. Leconte et al. (2006) have found that the weld depth of A-TIG welding via a single pass can be increased by a factor of 1.5–4 compared with that of traditional TIG welding. However, the fusion zone profile of A - TIG welding is sensitive to the quantity of the activating flux smeared on the plate surface, and slag is easily retained on the weld surface.

Another improvement to traditional TIG welding is mixed-gas TIG welding, a process that utilizes the addition of an active gas to the shielding gas and has been explored with H_2 by Hisieh et al. (1999), with SO_2 by Heiple and Burgardt (1985), with O_2 by Lu et al. (2007), with CO_2 by Lu et al. (2008) and with Ar-(Ar + CO_2) double shielding by Lu et al.

[3] Review on Dynamic Recrystallization of Martensitic Stainless Steels during Hot Deformation : Part I —Experimental Study.

Generally, hot working refers to the temperature of mechanical processing that is above half of the melting temperature (Tm) of base metal. Being above 0.5 Tm decreases yield strength and hardness and increases the ductility of metallic materials. From a metallurgical point of view, the plastic deformation above the metal’s recrystallization temperature is called hot working (forming).

From the manufacturing processes point of view, metal forming is divided into two main groups : sheet metal forming and bulk metal forming. One of the main parameters to find specific material that the specific process can form is the workability or formability test. There are several kinds of formability tests in sheet metal forming. Uniaxial and multiaxial tensile tests in various temperatures are a well - known approach to find the formability of sheet metals. The formability limitation, mechanical properties, and prediction of fracture during sheet metal forming are accessible by formability test results.

[4] A Review on Welding of AISI 304L Austenitic Stainless Steel - Kondapalli Siva Prasad*, Chalamalasetti Srinivasa Rao and Damera Nageswara Rao.

P. Johan Singh et al. [15] evaluated fatigue life on Gas Tungsten Arc Welded (GTAW) load -carrying cruciform joints of AISI 304L stainless steel with Lack Of Penetra - tion (LOP) using conventional S-N and crack initiation- propagation (IP) methods. The crack process normally comprises two major phases: (1) the crack initiation life (Ni) : and (2) the crack propagation life (Np). The local stress-life approach was used to estimate the crack initiation life and a fracture mechanics approach for predicting crack propagation life of welded joints. Constant amplitude fatigue tests with stress ratio, R = 0 were carried out using 100 KN servo-hydraulic DARTEC universal testing machine with frequency of 30 Hz. An automatic crack monitoring system based on crack propagation gauges was used to find the crack initiation and propagation data during fatigue process.

CHAPTER 3

EXPERIMENTAL DETAILS

3.1. TIG WELDING MACHINE

If you’re working with metal, you know how important it is to have the right tools for the job. A TIG (Tungsten Inert Gas) welding machine is a crucial piece of equipment for the welding metal. TIG welding machines use an electric arc and tungsten electrodes to heat metal and combine two pieces. This welding machine can be used on aluminium, stainless steel, magnesium, and other metals. TIG welding machines use an electric arc to heat the metal you are joining. The arc is created between the tungsten electrode and the base metal being welded – this creates a plasma arc that heats both pieces of metal until they melt together. The tungsten electrode never actually melts – instead, it conducts electricity while keeping its shape and protecting the weld area from the further oxidation or contamination. This makes TIG welding machines ideal for working on thin sheets of material or delicate metals like aluminium or magnesium.

IG welding machines are often used for more intricate projects, such as those requiring the precise control over heat input and weld penetration depth – such as when working with thin sheet materials or aluminium alloys that can easily deform under too much heat input. They are also used in applications where aesthetics matter – since there is no spatter from stick electrodes during this process, your finished welds will look much cleaner than those produced by MIG welders or stick welders alone ! In addition, they can be used in situations where corrosion needs to be minimized – such as in medical applications where sterile conditions must be kept throughout each step of production.

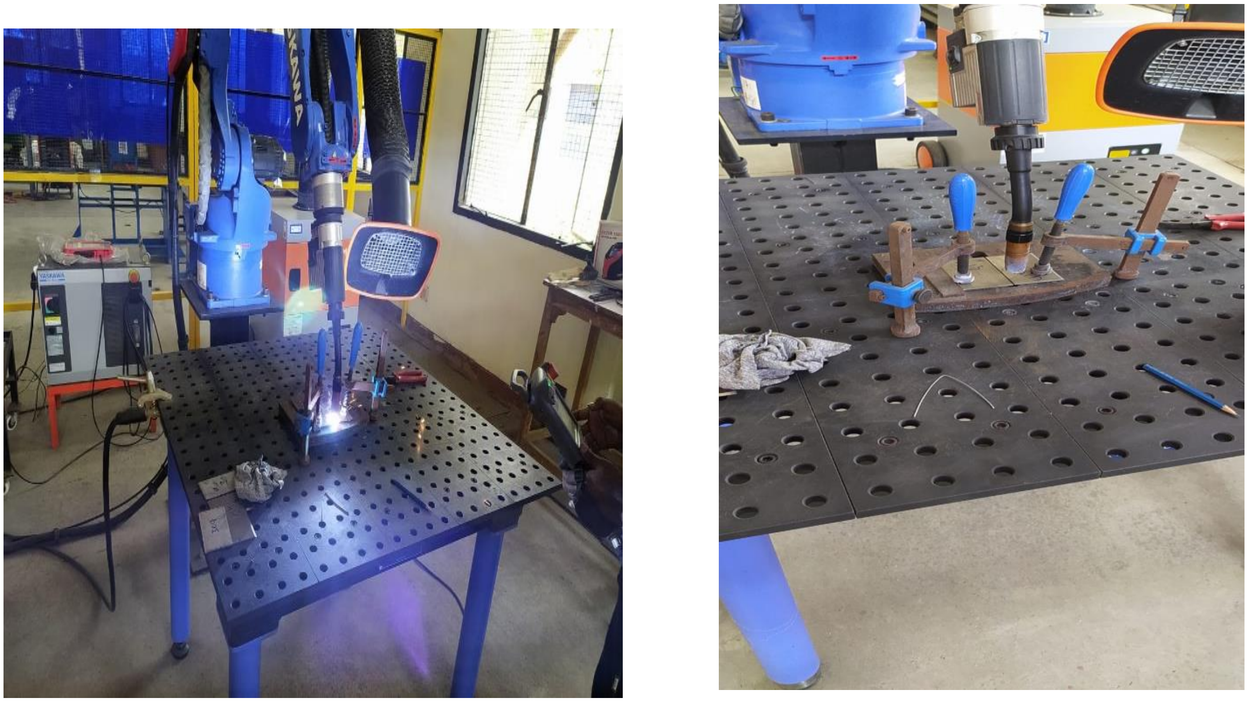

Fig.3.1 Tig Welding Machine

3.2. WELDING MACHINE SPECIFICATION

Table 3.1 specification of TIG welding machine

PRODUCTS TYPE	TIG 250
Model	RT 25
Input Voltage (V)	AC 415 + 15%
Rated Input	0.9 / 13.0
Power (KVA)	9.5
No- load voltage	70
Output current range	10-250
Rated output voltage (V)	30
Duty cycle	60
No load loss (W)	40
Efficiency	85
Power Factor	0.93
Pre-flow (s)	0
Post-flow (sec)	2.5
Arcing Way	High Frequency
Net weight (Kg)	17.5

3.3. SHIELDING GAS

The normal gas for TIG welding is argon (Ar). Helium (He) can be added to increase penetration and fluidity of the weld pool. Argon or argon/helium mixtures can be used for welding all grades. In some cases, nitrogen(N_2) and /or hydrogen (H_2) can be added to the achieve special properties. For instance, the addition of hydrogen gives a similar, but much stronger, effect as adding helium. However, hydrogen additions should not be used for welding martensitic, ferrite or duplex grades.

Alternatively, if nitrogen is added, the weld deposit properties of nitrogen alloyed grades can be improved. Oxidizing additions are not used because these destroy the tungsten electrode.

Recommendations for shielding gases used in TIG welding of different stainless steel are the given in the table. For plasma arc welding, the gas types with hydrogen addition in the table are mostly used as plasma gas, and pure argon as shielding gas.

3.4. WORK PIECE DETAILS

In this study, SS430 is used as a base metal. This base metal is used in both Butt joint and Lap joint. Let us briefly discuss about the properties of SS430 base metal.

3.4.1. MATERIAL PROPERTIES OF SS430

As ferritic steels go, 430 stainless steel is the most common. It is used in a variety of applications, mostly indoors. Its high chromium content offers great corrosion resistance, especially under normal atmospheric conditions. It is able to form passivated chromium oxide barriers, which are both tough and durable. And it's high chromium content allows the 430 grade to self-renew this thin protective layer particularly fast. 430 stainless steel resists chloride-induced stress corrosion cracking better than many ferritic steels. It also holds up well against corrosion in the presence of dilute organic acids and many alkalis. This makes stainless steel 430 ideal for use in kitchen applications, such as utensils and working areas. It has also been shown to resist nitric acid well, making it suitable for certain chemical applications.

The 430 grade is a stainless steel best suited for mild corrosive environments. For more aggressive environments, it might be better recommended to choose a 300 series stainless like 304 of 316L . Without Molybdenum or Nickel additions, 430 stainless steel is significantly less expensive 316. This makes 430 stainless steel a good value choice for non – critical indoor environments. In a elevated temperatures, 430 stainless steel offers good resistance to oxidation as well.

430 stainless steel does have its drawbacks. It becomes brittle in cryogenic temperatures, a side – effect of its ferritic crystal structure. It is also not as easy to form and weld as the 300 – series grades , but still has good drawdown facility. Galling is a possibility whenever it is machined, and the cutting edges can become extremely hot due to 430's low thermal conductivity. Plenty of coolant is required while machining stainless steel 430.

3.4.2. CHEMICAL COMPOSITION OF SS430

430 stainless steel has high chromium but the very low nickel content. Chromium content is between 16 and 18%, while nickel content is 0.5% max. Its other constituents are present in trace amounts. There's a maximum 1% each of manganese and silicon , 0.12 % carbon, and 0.03 % and 0.04% respectively for sulfur and phosphorous. As before, the balance is made up of iron, around 80%.

Table.3.2. Composition of SS430

ELEMENTS	CONTENT(%)
CHROMIUM	16% - 18%
NICKLE	0.5%
MANGANESE	1%
SILICON	1%
CARBON	0.12%
SULPHUR	0.03%
PHOSPHOROUS	0.04%
IRON	80%

3.5. FIXTURE USED

This welding fixture is fabricated for the conducting the tensile strength on co-axial component such as the welded component using lap joint for the fixture. This fixture is used to minimize the testing time and difficulties faced on the tensile strength of the co-axial component, the fixture is made up of the die steel 2 and fabricated in such a way that to handle they high tensile strength component which is about more than 900 mpa. This fabricated fixture is getting hardened. This hardened is done because to avoid the distortion and instability during the tensile test.

Anyway, this fixture is used in a way to reduce the difficulties in finding the tensile strength of the lap joint material. In this fixture, the upper rod should be fixed in the upper jaw and the lower rod should be fixed in the lower jaw. After fixing these rods, the test specimen has to be fixed in the designed pin.

3.5.1. 3D VIEW OF FIXTURE

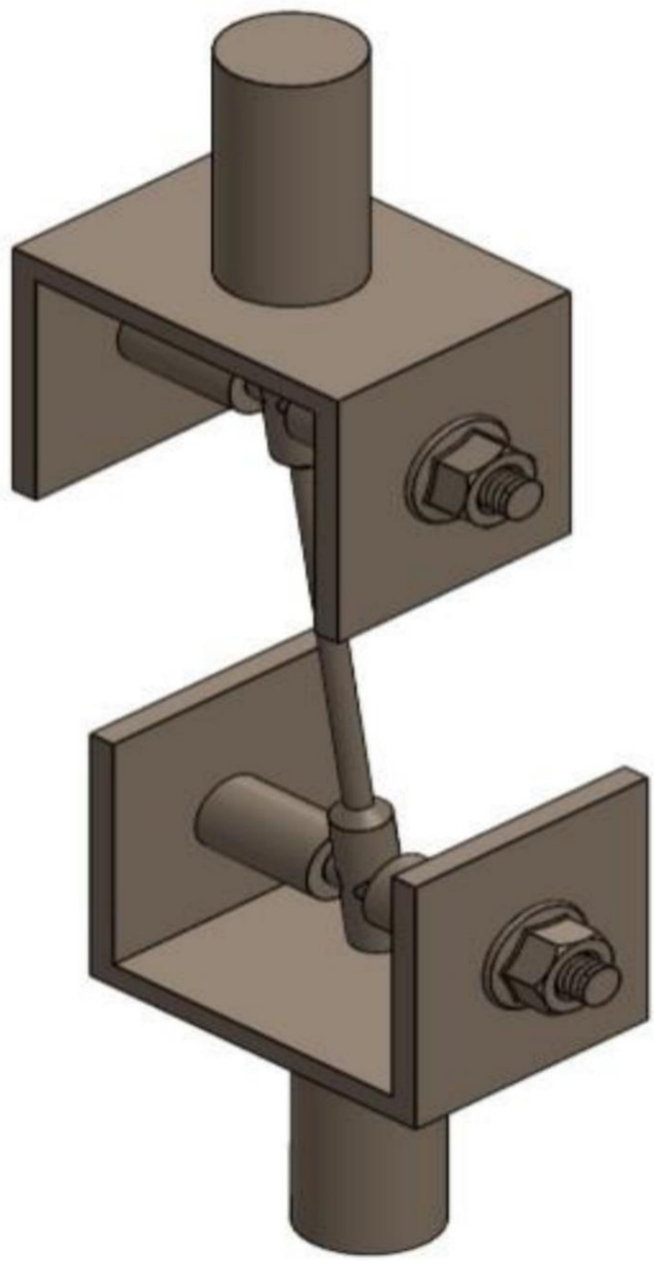

Fig.3.2. 3D View of fixture

3.5.2. DIMENSIONS OF FIXTURE

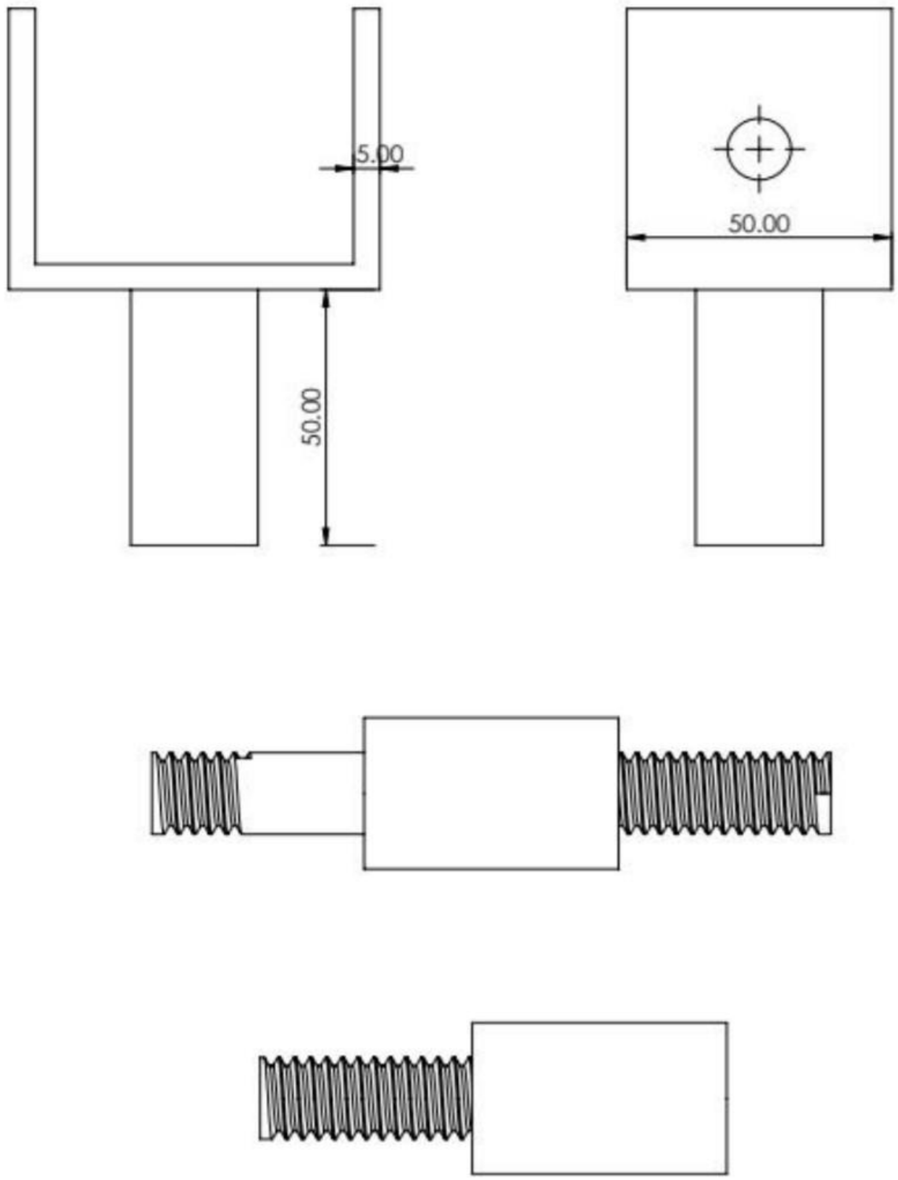

Fig.3.3 Dimensions of Fixture

3.5.3. MATERIAL USED IN FIXTURE

In this fixture, Die steel 2 (D2) material is used for the fabrication of the fixture. Let us briefly see about the properties of Die steel 2 material.

D2 steel is an air hardening, high - carbon, high-chromium tool steel. It has high wear and abrasion resistant properties. It is heat treatable and will offer a hardness in the range 55-62 HRC, and is machinable in the annealed condition. D2 steel shows little distortion on correct hardening.

If you need better machinability then consider A2 tool steel which has a chromium content of 5% and is more readily machinable.

Typical applications for D2 Steel:

- Stamping or Forming Dies
- Punches
- Forming Rolls
- Knives, slitters, shear blades
- Tools
- Scrap choppers
- Tyre shredders

3.6. STRESS ANALYSIS OF PIN

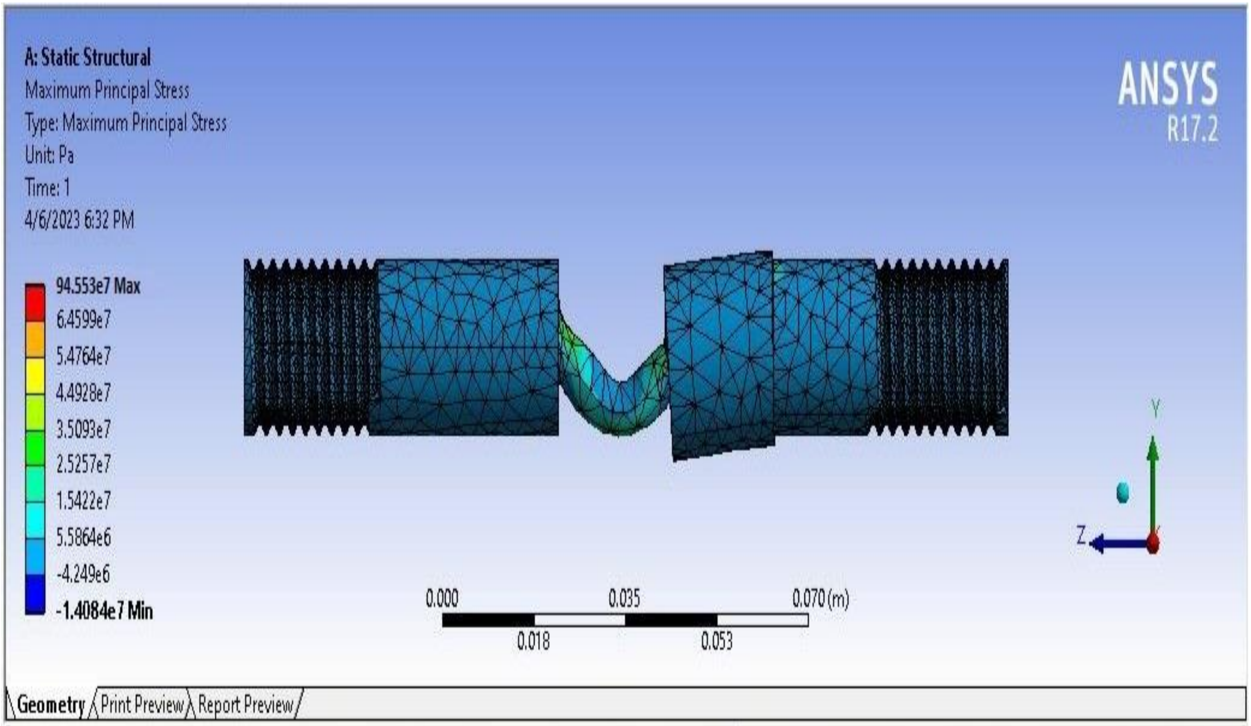

Fig.3.4. Maximum Priciple Stress

The above image shows the stress analysis of the designed pin. In the ansys 17.2 the design of the pin is inserted and the maximum and minium principle stress is calculated. The maximum principle stress of the given pin is **94.553e7 pa.** The minimum principle stress of the given pin is **-1.4084e7 pa.**

CHAPTER 4

RESULT AND DISCUSSION

4.1. TENSILE TEST

The basic idea of a tensile test is to place a sample of a material between two fixtures are called "grips" which clamp the material. The material has known dimensions, like length and cross-sectional area. We then begin to apply weight to the material gripped at one end while the other end is fixed.

Tensile testing is a destructive test process that **provides information about the tensile strength, yield strength, and ductility of the metallic material**. It measures the force required to break the composite or plastic specimen and the extent to which the specimen stretches or elongates to that breaking point.

During the tensile test, the sample's shape is changes as load is applied. Understanding the change in the sample's dimension at various or specified forces helps determine the material's performance and suitability for a given application or product.

Tension test is performed on mild steel, tor steel and high tensile steel **to determine the properties like Young's modulus, ultimate strength, and the percentage elongation**. In the tension test, a steel rod is subjected to tension load by the means of a Universal testing machine(UTM).

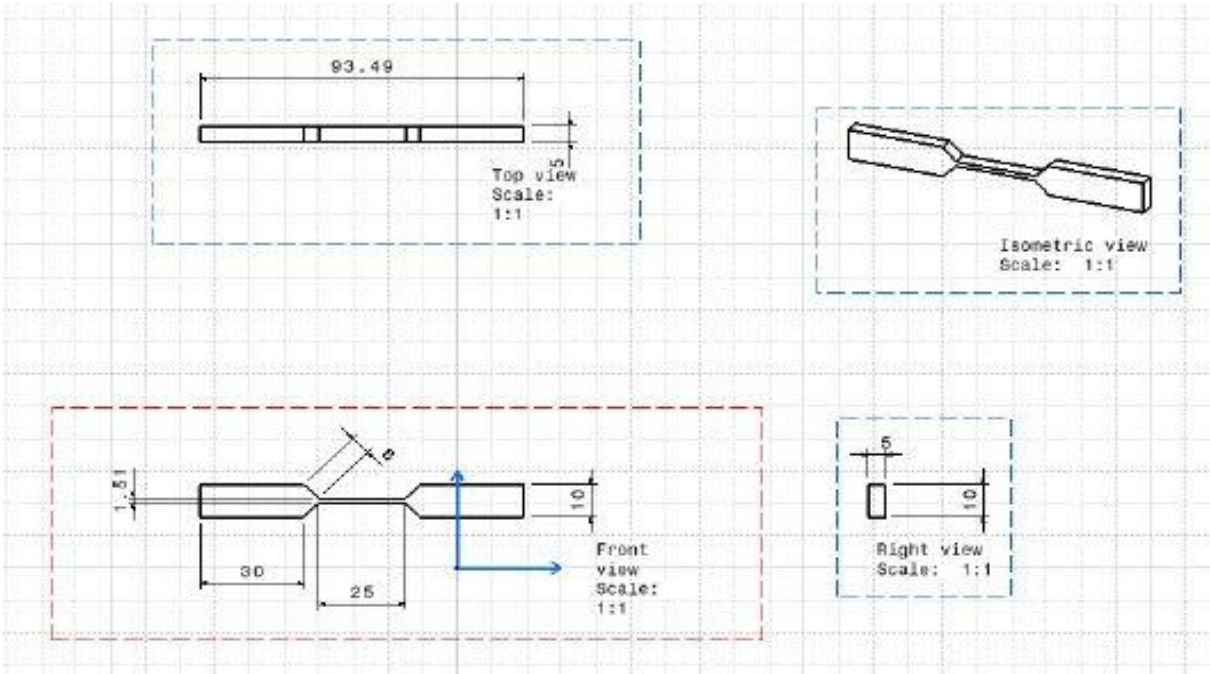

Fig.4.1. Tensile Test specimen

4.2. UTM MACHINE

Universal testing machines (UTMs) that test mechanical properties such as tensile, flexural, compressive and shear. The UTM is the great multi -purpose instrument for an R&D lab. or quality control department.

Operation of the machine is by hydraulic transmission of load from the test specimen to the separately housed load indicator. The system is ideal since it replaces transmission of load through levers and knife edges, which are prone to wear and damage due to shock on rupture of test pieces. Load is applied by a hydrostatically lubricated ram. Main cylinder pressure is the transmitted to the cylinder of the pendulum dynamometer system housed in the control panel. The cylinder of the dynamometer is also of self - lubricating design. The deflection of the pendulum represents the absolute load applied on the test specimen. Return movement of the pendulum is effectively damped to absorb energy in the event of sudden breakage of the specimen.

Fig.4.2. UTM Machine

4.3. TESTING OF LAP JOINT:

A lap joint is formed when the surfaces of the two pieces overlap one another. The weld is deposited in the joint where the two intersect. A lap joint exhibits good mechanical properties, especially when both sides of the overlapped pieces are welded, which provides extra reinforcement.

A lap joint falls into the category of halving joints – where two halves make a whole. It is a relatively easy joint to cut and a great learning joint if you are just getting going in the woodwork. While not particularly strong, lap joints are simple joints you can use **to make picture frames and mirrors**.

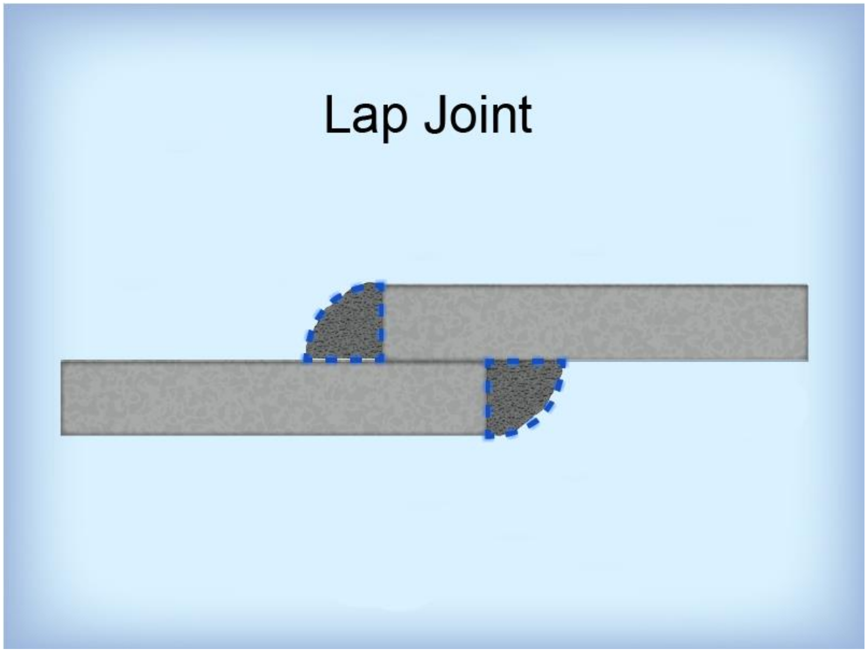

Fig.4.3. Lap Joint

4.4. RESULT AND GRAPH

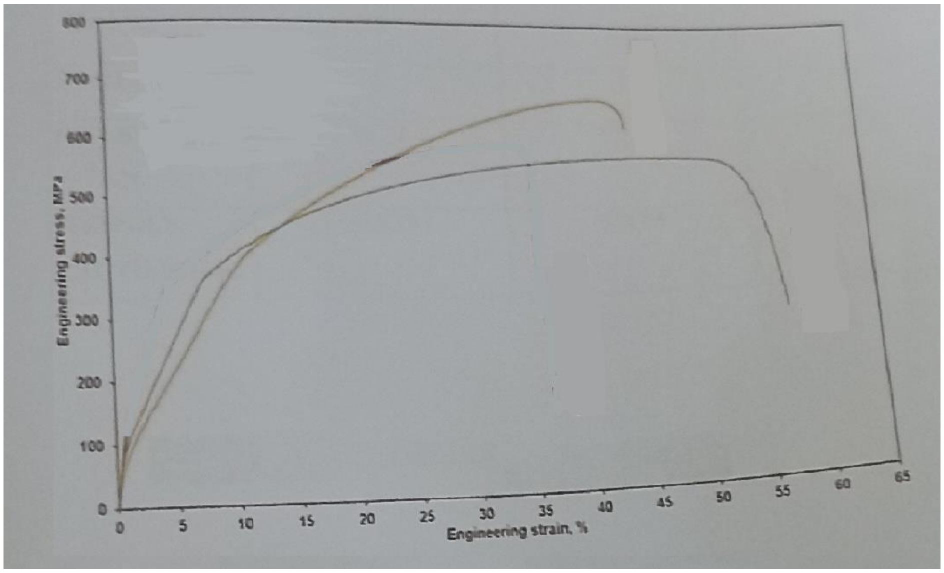

Fig.4.4. Representation of Stress vs strain

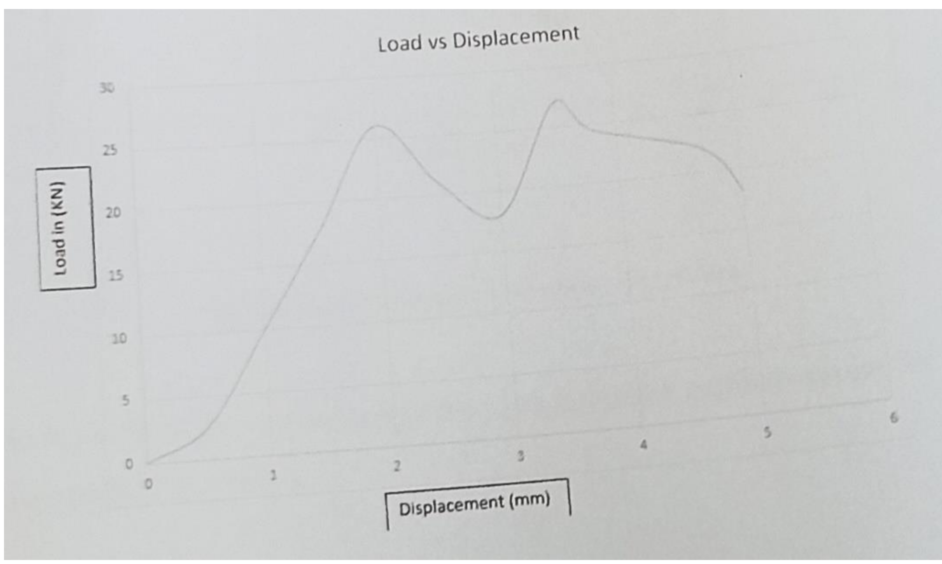

Fig.4.5. Representation of Load vs Displacement

Table 4.1 Tensile Strength result

NO OF TEST TRIALS	1	2
AMPS	150	170
VOLTS	18	22
GAS PRESSURE	4	5
TENSILE LOAD (KN)	18.21	17.58
TENSILE STRENGTH (N/mm2)	505.22	615.73

CHAPTER 5

CONCLUSION

The processed joints exhibit desired mechanical and surface charectaristics. Intrestingly, weld current used should be the suitable with filler size in order to achieve good joints. Process parameter plays a vital role in eliminating the defects. High welding current (140-A) with the filler (3-mm) and constant flow rate is beneficial for high strength joint since weld uniformity become poor. At lower welding speeds strength is more due to more intensity of current.

With the increase in the current tensile strength of the weld joint increases. Using manual welding systemon the single side gives desired results. With the automated welding system, uniform welding of the plate can be possible. This study investigates the tensile strength and impact strength of charectarizations of the similar metal welding of an austhentic stainless steel SS430, obtained by TIG welding.

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