

PORTABLE INDUSTRIAL OVEN

A Major Project Report

**Submitted to the Rajasthan Technical University
in partial fulfillment of requirements for the award of degree**

Bachelor of Technology

in

Mechanical Engineering

by

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TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY**

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March 2023

**DEPARTMENT OF MECHANICAL ENGINEERING
TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY
UDAIPUR, RAJASTHAN**

2022 - 23



CERTIFICATE

This is to certify that the report entitled **PORTABLE INDUSTRIAL OVEN** submitted by **Abdul Adil** (19etcme001), to Department of Mechanical Engineering in partial fulfillment of the B.Tech. degree in Mechanical Engineering is a bonafide record of the seminar work carried out by him under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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I **Abdul Adil** hereby declare that the major project report **PORTABLE INDUSTRIAL OVEN**, submitted for partial fulfillment of the requirements for the award of degree of Bachelor of Technology of the Rajasthan Technical University, Kota, Rajasthan is a bonafide work done by me under supervision of Mr.Abhishek Sharma

This submission represents my ideas in my own words and where ideas or words of others have been included, I have adequately and accurately cited and referenced the original sources.

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Udaipur
25-03-2023

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Abstract

The objective of my project was to design and fabricate a portable oven in the most economical and efficient ways possible. It is aimed to simulate a real world engineering design project and their challenges. It involves the planning and manufacturing tasks found when introducing a new product to the consumer in industrial market. Our main aim is to design a oven which is light in weight and easily be transported.

Industrial ovens can be used for both large and small applications. Walk-in ovens can create powder coatings and cure, dry or bake components of a final product. They're necessary for numerous industries, including pharmaceuticals, electronics, automotive manufacturing and food production.

Acknowledgement

I take this opportunity to express my deepest sense of gratitude and sincere thanks to everyone who helped me to complete this work successfully. I express my sincere thanks to **Mr. Abhishek Sharma**, Head of Department, Mechanical Engineering, Techno India NJR Institute of Technology Udaipur for providing me with all the necessary facilities and support.

I would like to place on record my sincere gratitude to my project guide Mr. Abhishek Sharma, Assistant Professor, Mechanical Engineering, Techno India NJR Institute of Technology for the guidance and mentorship throughout the course.

Finally I thank my family, and friends who contributed to the successful fulfilment of this project work.

Abdul Adil

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INTRODUCTION

Chapter-1

Introduction of the Project:

The objective is to build portable ovens for the industrial purposes for small operation like annealing of the metal at site or testing out the thermal property of the specimen at the site of inspection where this portable oven can be taken. Also in medical purpose where the medicine is to be preheated can be done in it.

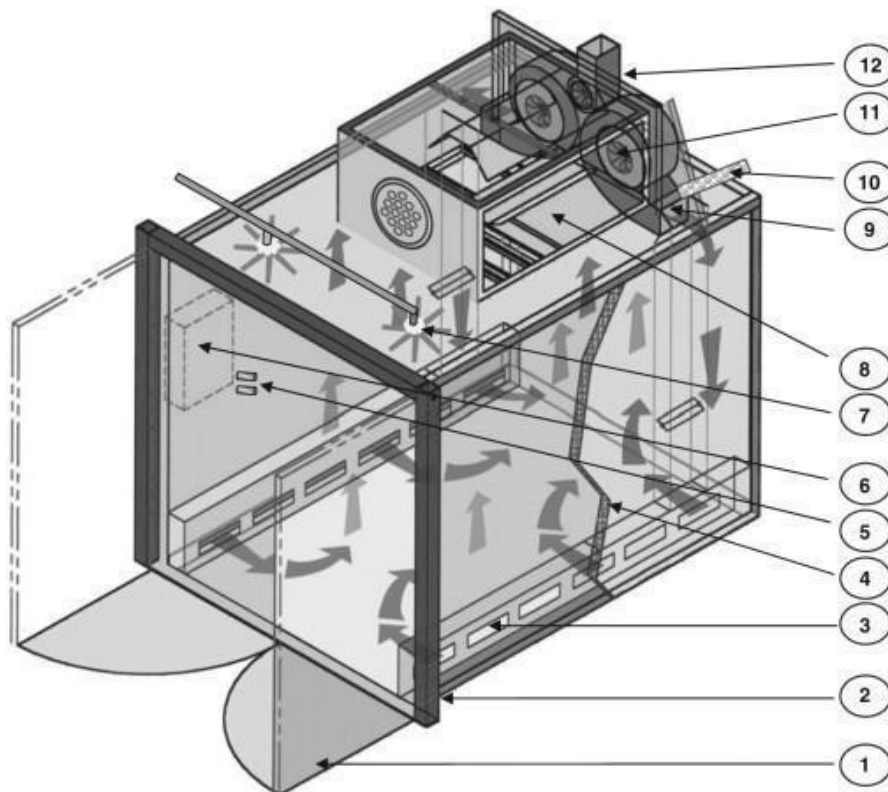


Fig. 1 Furnace

Scope:

Such ovens are also sometimes known as kilns, though they do not reach the same high temperatures as are used in ceramic kilns. Baking ovens – Combines the function of curing and drying ovens. An industrial oven is a device used to create high temperatures to heat treat parts, condition metals, and cure metal coatings. The two main types of industrial ovens are continuous and batch. As the name batch implies, batch industrial ovens treat large numbers of parts at the same time. Continuous industrial ovens are normally a part of mass production and may include heating and cooling functions.

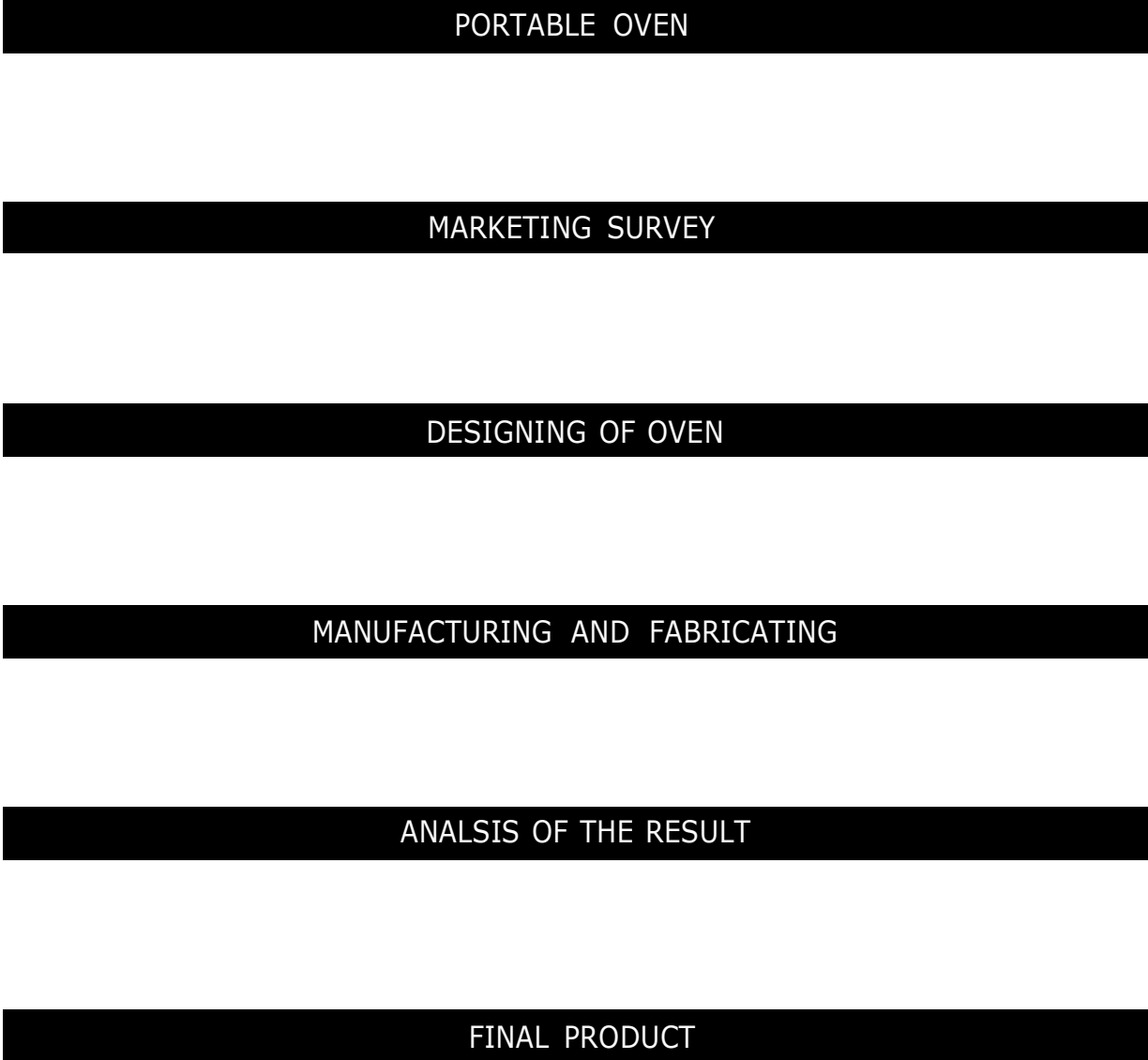


Figure 2: Planning and layout of Portable oven

Chapter-2

Design Procedure:

Design procedure includes various processes such as Product Planning, The Design Brief, Concept Generation, Theme Selection, 3D and Computer Model

1. Product Planning – involves Brainstorming before any work begins i.e., market research needed for the requirement of product, available factory capacity, manufacturing processes, necessary equipment.
2. The Design Brief- involves Guidelines on the vehicle being designed i.e., identification for whom the vehicle is designed, what type of vehicle it should be, it's expected cost, etc.
3. Concept Generation – it means putting ideas on paper. Basic thumbnail sketches to start which is followed by more detailed drawings.
4. Theme Selection-Designer sketches are reviewed and a theme selection is made on which design best meets the matching design brief and more interesting look.
5. Design Evaluation -Total evaluation of the project design includes review of full size models and drawing, evaluation of appearance, ergonomics is evaluated, potential customer reactions and feedback
6. Styling Freeze - Specifications are finalized under this process. Finalization of body style and mechanical specifications, assessment of financial viability are categorized under this segment of design.
7. Prototype Development and Product Testing- in this process prototypes are made.

Tools used for designing of oven:

Solidworks

solidworks is a solid modelling software that enables us to design objects in 3 dimensions. We create 2d profiles and then use features of solidworks such as extrude, swept, loft etc to create 3d models.

Solidworks gives a three-dimensional practical environment for these mechanical engineers to design cool stuff. Using three-dimensional CAD design software like Solidworks makes life simple for engineers because it saves time and money. Solidworks is broadly used to create, plan, or perform any project in terms of infrastructure or construction. According to engineers, it is most functional for users as a part of their work. Because it only works on MS Windows. As it works only on MS Windows, it is comprehensive for users to install it on their computers. The engineers find it most functional to use Solidworks as part of their work.

SolidWorks is a 3D modeling software application that is widely used by designers, drafters, architects, construction planners, product engineers, mechanical engineers, and artists. SolidWorks offers: 3D modeling.

SOLIDWORKS makes it quick and simple to share designs in 2D or 3D formats, meaning you can get instant feedback and continue to work on your designs. Designs can even be shared as 3D animations, which allows you to accurately demonstrate new products and features.

Solidworks has rapidly become a leader in mechanical computer aid design programming. Solidwork software tool lets you create, simulate, and publish while data management. This is a software program that provides the users a way to improvise the product design while they work quick and on economical basis.

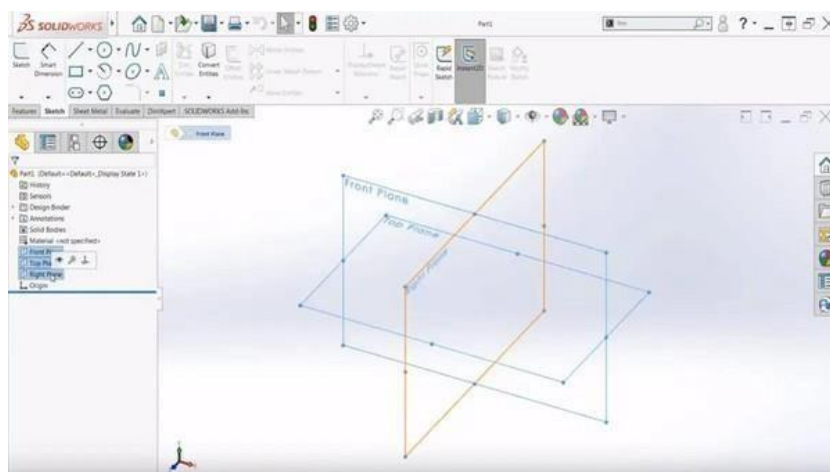


Figure 3: Solidworks interface

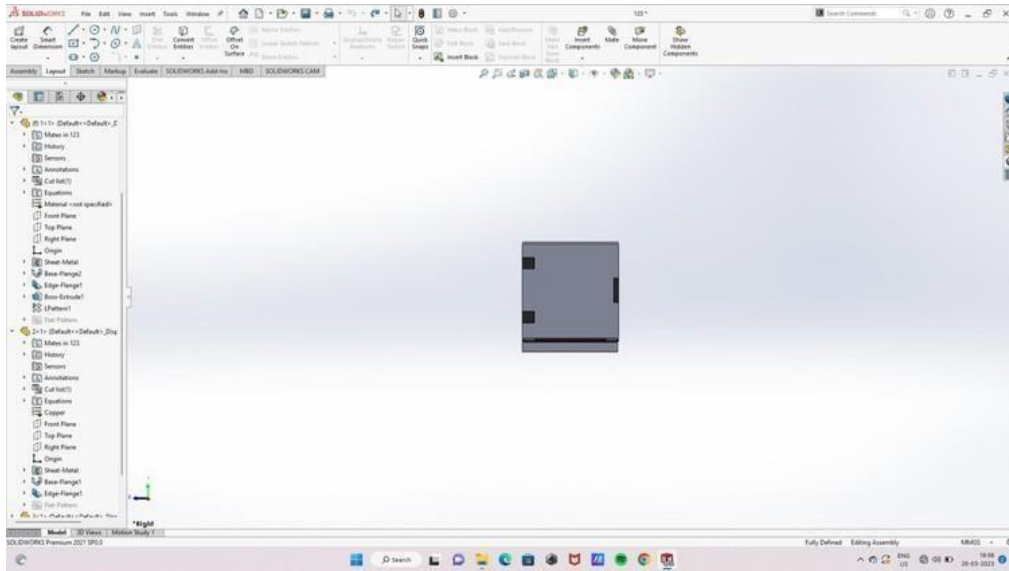


Figure 4: Solidworks Image Front View of Oven

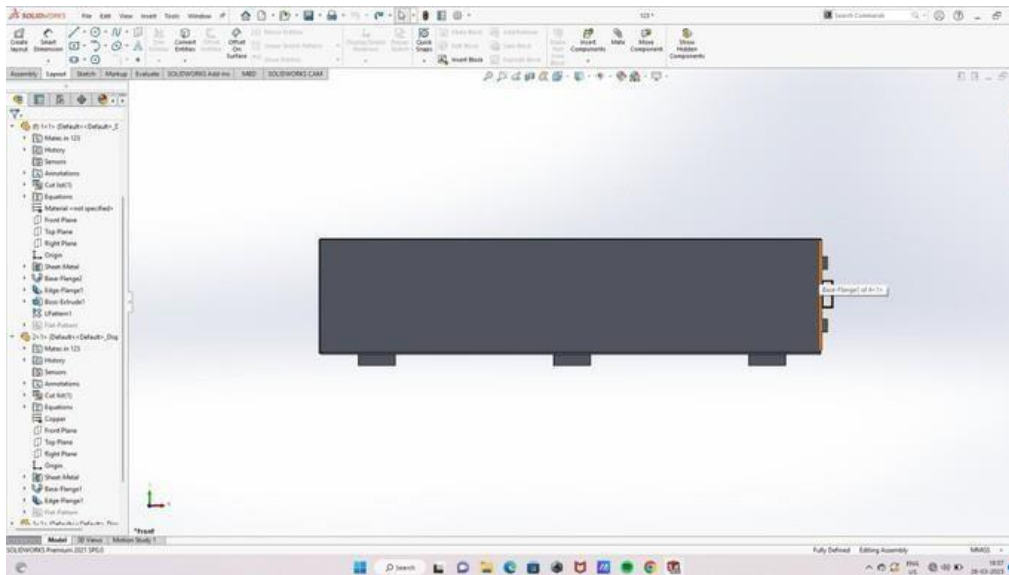


Figure 5: Solidworks Image Side View of Oven

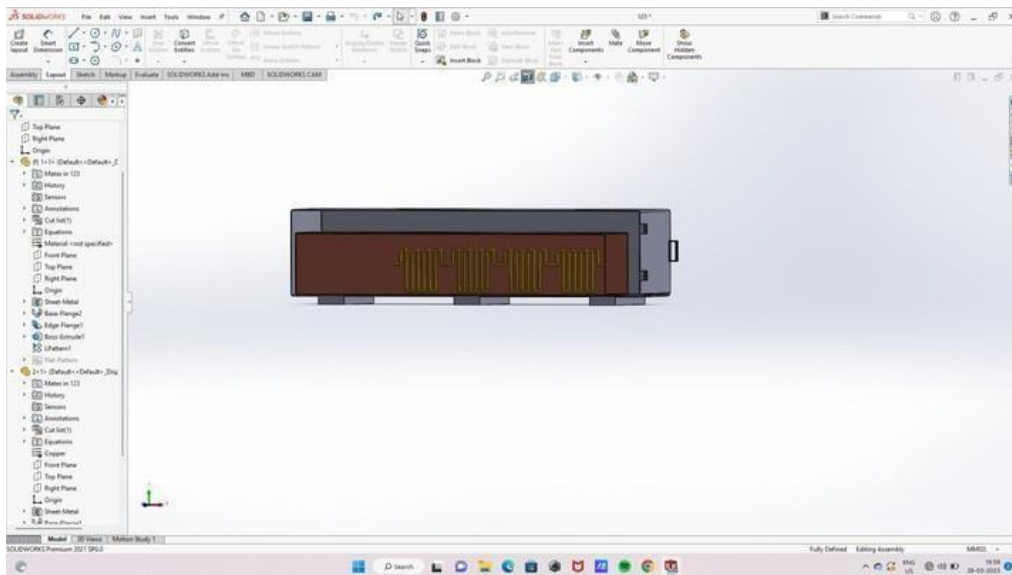


Figure 6: Solidworks Image Side View with Heaters and Chambers

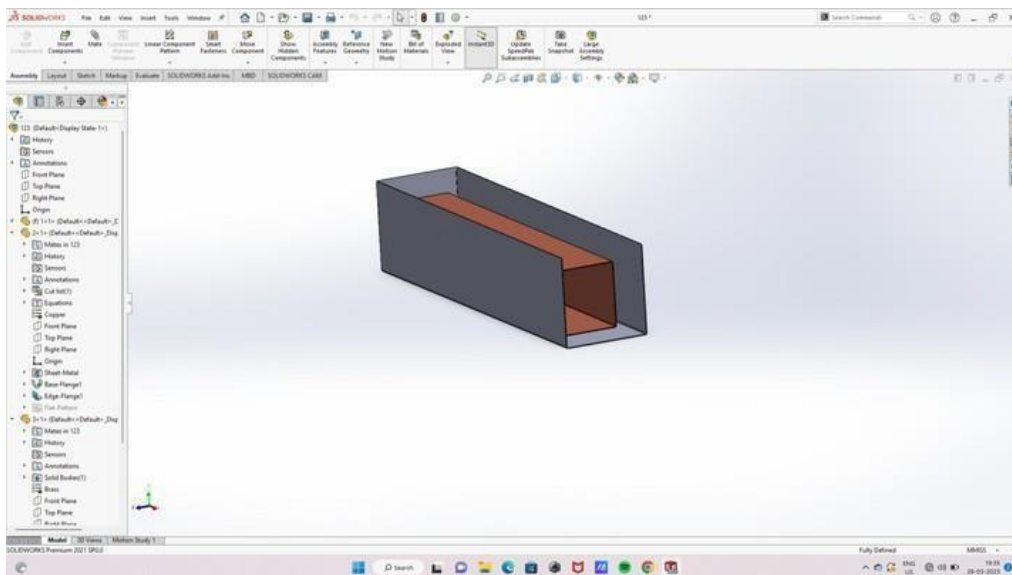


Figure 7: Solidworks Isometric View of Oven

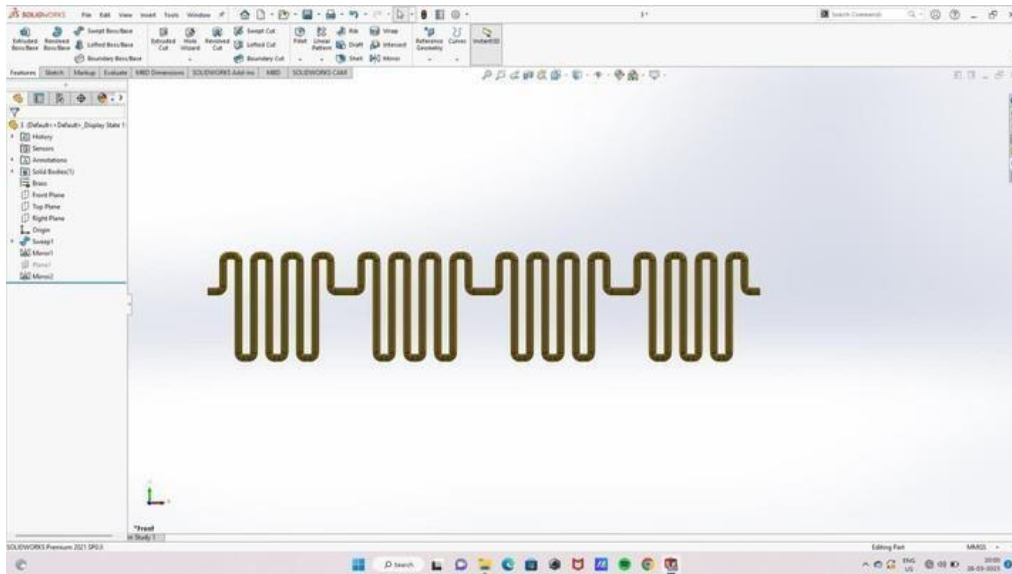


Figure 8: Heater used according top the temperature required

An oven that uses electrical energy to heat the food is known as an electric oven. The electric oven uses electrical energy, and it converts the electricity into heat using heating elements. The electric oven has multiple cooking methods as per the heating method used in it.

An oven's functions increase when there are two or more heating elements. Nowadays, electric ovens are also known as conventional ovens. The electric oven has racks, a convection fan, heating elements, and knobs to set the temperature and cook time. The main components of an electric oven are

- Cabinet.
- Heating Element
- Thermostat
- Power regulating switch

Chapter-3

AutoCAD

Engineers, especially Mechanical Engineers, use it extensively to design everything from simple tools to things as complicated as the space shuttle. CAD drawings can also be adapted and fed into 3D printers and CNC machines to manufacture design prototypes, custom tools, and parts for larger devices. Smaller pieces can be precisely fabricated from CAD drawings that fit together to make larger machines. AutoCAD is software that helps engineers transfer designs from their minds to the real world.

AutoCAD is a commercial computer-aided design (CAD) and drafting software application. Developed and marketed by Autodesk, AutoCAD was first released in December 1982 as a desktop app running on microcomputers with internal graphics controllers.

AutoCAD Interface

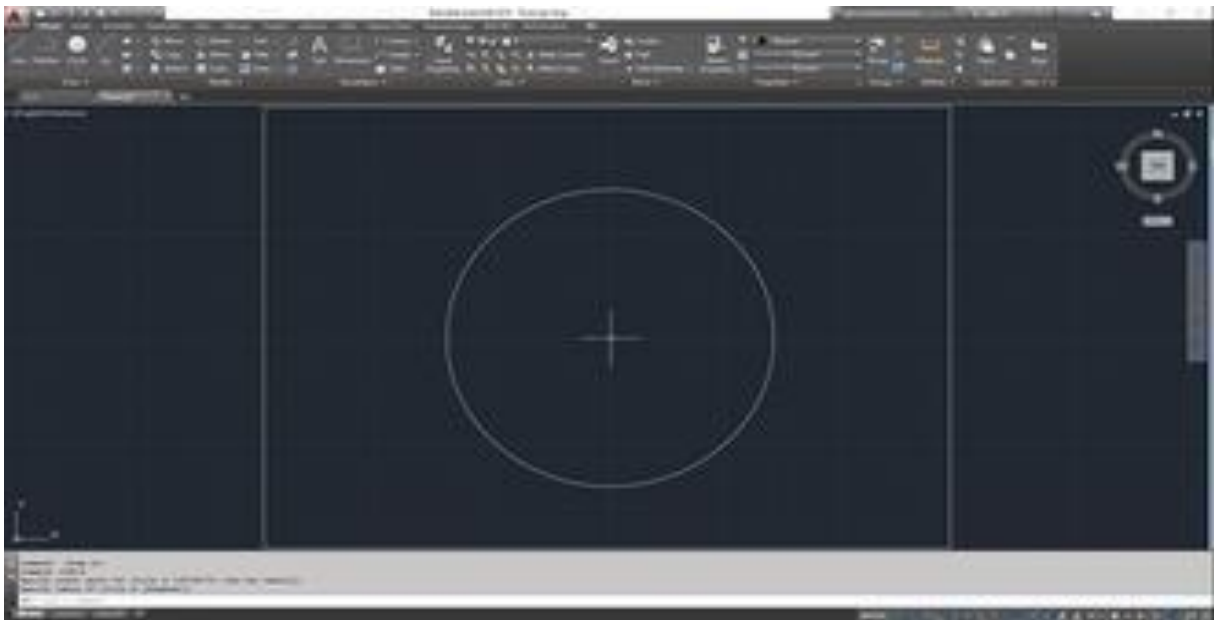


Figure 9: Autocad Interface

Chapter-4

Laser Cutting

Laser cutting is mainly a thermal process in which a focused laser beam is used to melt material in a localized area. A co-axial gas jet is used to eject the molten material and create a kerf. A continuous cut is produced by moving the laser beam or work piece under CNC control. There are three major varieties of laser cutting: fusion cutting, flame cutting and remote cutting.

In fusion cutting, an inert gas (typically nitrogen) is used to expel molten material out of the kerf. Nitrogen gas does not exothermically react with the molten material and thus does not contribute to the energy input.

In flame cutting, oxygen is used as the assist gas. In addition to exerting mechanical force on the molten material, this creates an exothermic reaction which increases the energy input to the process.

In remote cutting, the material is partially evaporated (ablated) by a high-intensity laser beam, allowing thin sheets to be cut with no assist gas.



Figure 10: Laser Cutting Operation

Chapter-5

Sheet Metal Bending Operation

Metal bending is a process by which metal can be deformed when applying force to the subject, which causes it to bend at an angle and form the anticipated shape, which often results in it being in a 'V' or a 'U' shape. A press brake is a tool used in order to bend sheet metal and uses a punch and die to do this.

Which operation is suitable for bending?

Sheet Metal Bending – Methods, Design Tips & K Factor. Bending is one of the most common sheet metal fabrication operations. Also known as press braking, flanging, die bending, folding and edging, this method is used to deform a material to an angular shape. This is done through the application of force on a workpiece

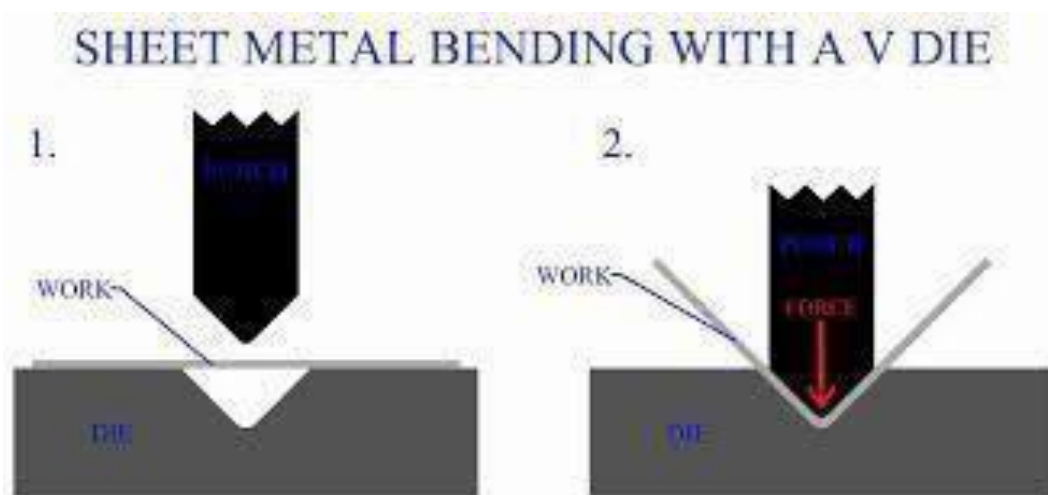


Figure 11: Sheet Metal bending

Types of Bending

Mechanical

Due to this press brakes design, it isn't a suitable option for air bending. The two major benefits of a mechanical press brake are speed and accuracy, however other press brakes are safer and easier to use, such as the CNC press brakes.

Pneumatic

A compressor is used to supply air power for bending the metal sheets. This type of press brake is often used when less pressure is needed. A pneumatic press brake is also best used for bending small parts of metal.

Hydraulic

Hydraulic press brakes often have the latest technology incorporated within them and are best used for precise bending of metal sheet, which makes them a popular choice for sheet metal bending.

Computer Numerically Controlled (CNC)

Salamander Fabrications has 4 CNC press brakes, including a 4.2 meter bed with 180 ton capacity. These machines produce very accurate result and are able to bed sheet metal work from just a few millimeters across to sections which are meters long on some of the larger machines.

Manufacturing

The manufacturing is defined as the processing of raw material or parts into finished goods through the use of tools, human labor, machinery and chemical processing. Manufacturing allows businesses to sell finished products at a very high cost than the value of raw material used.

Welding

Welding is a fabrication process that joins materials by using high heat to melt the parts together and allowing them to cool causing fusion. In this process we used arc welding for some selected components where using MIG welding was not possible. MIG welding was used to fabricate the frame and chassis and a few other components such as collars and foot rests of the vehicle.

Metal Inert Gas (MIG)

welding Metal Inert Gas (MIG) welding is an arc welding process that uses a continuous solid wire electrode heated and fed into the weld pool from a welding gun. The two base materials are melted together forming a joint. The gun feeds a shielding gas alongside the electrode helping protect the weld pool from airborne contaminants.

MIG/MAG

welding is a versatile technique suitable for both thin sheet and thick section components. An arc is struck between the end of a wire electrode and the work piece, melting both of them to form a weld pool. The wire serves as both heat source (via the arc at the wire tip) and filler metal for the welding joint. The wire is fed through a copper contact tube (contact tip) which conducts welding current into the wire. The weld pool is protected from the surrounding atmosphere by a shielding gas fed through a nozzle surrounding the wire. Shielding gas selection depends on the material being welded and the application. The wire is fed from a reel by a motor drive, and the welder moves the welding torch along the joint line.

Wires may be solid (simple drawn wires), or cored (composites formed from a metal sheath with a powdered flux or metal filling). Consumables are generally competitively priced compared with those for other processes. The process offers high productivity, as the wire is continuously fed.

Manual MIG/MAG welding is often referred to as a semi-automatic process, as the wire feed rate and arc length are controlled by the power source, but the travel speed and wire position are under manual control. The process can also be mechanised when all the process parameters are not directly controlled by a welder, but might still require manual adjustment during welding. When no manual intervention is needed during welding, the process can be referred to as automatic.

The process usually operates with the wire positively charged and connected to a power source delivering a constant voltage. Selection of wire diameter (usually between 0.6 and 1.6mm) and wire feed speed determine the welding current, as the burn-off rate of the wire will form an equilibrium with the feed speed. The process usually operates with the wire positively charged and connected to a power source delivering a constant voltage. Selection of wire diameter (usually between 0.6 and 1.6mm) and wire feed speed determine the welding current, as the burn-off rate of the wire will form an equilibrium with the feed speed.



Figure 12: Manufacturing

Angle Grinder

An angle grinder, also known as a side grinder or disc grinder, is a handheld power tool used for grinding (abrasive cutting) and polishing. Although developed originally as tools for rigid abrasive discs, the availability of an interchangeable power source has encouraged their use with a wide variety of cutters and attachments.

Angle grinders can be powered by an electric motor or compressed air. The motor drives a geared head at a right-angle on which is mounted an abrasive disc or a thinner cut-off disc, either of which can be replaced when worn. Angle grinders typically have an adjustable guard and a side-handle for two-handed operation. Certain angle grinders, depending on their speed range, can be used as sanders, employing a sanding disc with a backing pad or disc. The backing system is typically made of hard plastic, phenolic resin, or medium-hard rubber depending on the amount of flexibility desired.

Angle grinders are standard equipment in metal fabrication shops and on construction sites. They are also common in machine shops, along with die grinders and bench grinder.



Figure 13: Angle Grinding

Angle grinders may be used for removing excess material from a piece. There are many different kinds of discs that are used for various materials and tasks, such as cut-off discs (diamond blade), abrasive grinding discs, grinding stones, sanding discs, wire brush wheels and polishing pads. The angle grinder has large bearings to counter side forces generated during cutting, unlike a power drill, where the force is axial.

Angle grinders are widely used in metalworking and construction, emergency rescues and even for bicycle thefts. Generally, they are found in workshops, service garages and auto body repair shops. There are a large variety of angle grinders to choose from when trying to find the right one for the job.

Painting And Aesthetics

Surface finishing was done on the body and different components of the vehicle with the help Regmar (Sand Paper) papers of coarse grade(80 and 160 no. grit) followed by finer grades (320 and 400 no. grit). Surf acer paint was applied on the body. Any gaps or dents were evened out with the help of filler (NC) putty.

With help of an Air compressor paint sprayer the body was painted with three coats of metallic paint (gloss). Other small components were painted with the help of brush.

Metals include any elements which have metallic properties, including the ability to conduct electricity, being able to create permanent shape and form as well as deformed at average temperatures and typically have a luster. There are also a few elements defined as 'metalloids' that in some conditions behave like metals, such as boron, carbon, germanium, silicon and antimony.



Figure 14: Painting And Aesthetics

Metals are typically grouped into two categories: those containing iron (ferrous metals) and those not containing iron (non-ferrous metals). The ferrous metals range from wrought iron, cast iron and many iron compounded materials containing carbon (carbon steel) as well as alloys of various other metals such as nickel steel, tungsten steel, chrome vanadium steel, etc.

Wiring and Configuration

Wiring includes the connection of heater and wires to the oven , does not have any complex connections just heater connected to the wires. A wiring diagram is a simplified conventional pictorial representation of an electrical circuit. It shows the components of the circuit as simplified shapes, and the power and signal connections between the devices.

The selection and configuration of an industrial oven involves a team of sales, engineering, operations, and financial experts, all working together to manufacture the right oven that will significantly impact an OEM's top and bottom lines.

Based on your requirements and the components needed to fulfill those requirements, heat processing ovens can range in price from the low five figures to over one million dollars. Industrial ovens can be based on designs incorporating conveyor belt processing or batch processing. Each type of design can be customized in dozens of different ways.

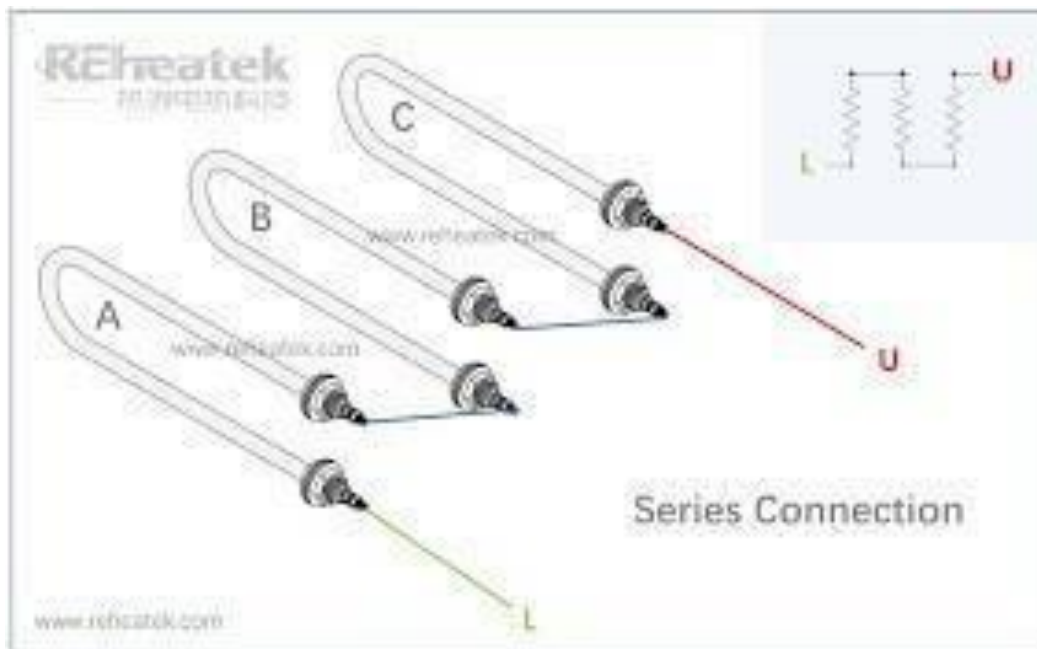


Figure 15: Wiring and configuration

Conclusion

The primary benefits of an electrical industrial oven over a gas oven are cleanliness and accuracy of temperature control. Electrical heating is very clean because there are no 'products of combustion' contaminating the chamber. Electrical heating achieves very precise temperature control because the power to the heating elements can be controlled very quickly and accurately.

An industrial oven is a heated chamber that is used to perform a wide range of applications within industry. Generally, industrial ovens process a raw material at extremely high temperatures to perform a heat treatment process.

Typical applications for industrial ovens include food production, chemical processing, and even the electronics industry. This blog post will discuss some common industrial ovens and their applications.

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