

TERM 2 – MECHANICAL SYSTEMS

- Pneumatic Systems
- Hydraulic Systems

- **Pneumatics**

The study and use of compressed air and other gases for the control of light forces such as quick assembly of electrical components.

- **Hydraulics**

The study and use of pressurised liquids or fluids such as oil or water for the control of large forces such as rudder control on an air plane.

PNEUMATIC SYSTEMS

Pneumatic systems use compressed air to make mechanisms work or move.

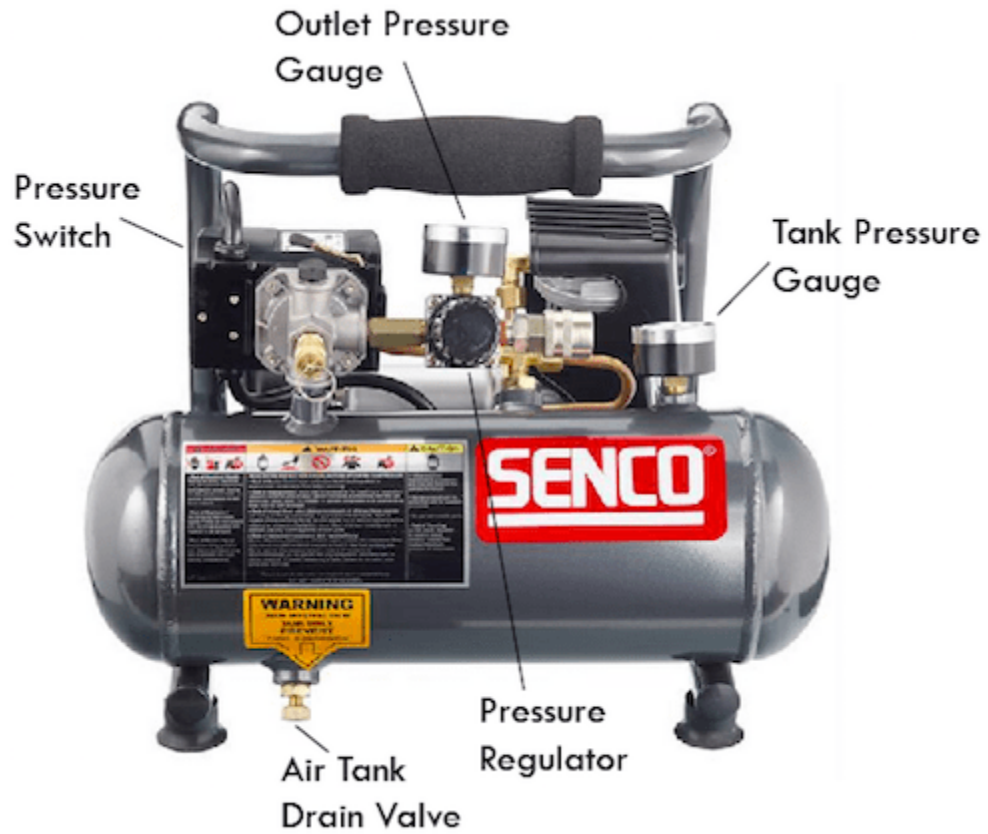
Compressed air is the ordinary air that you breathe which is forced into a small, but restricted space.

Compressed air is under pressure because it is forced into a confined space. More air molecules are forced into the confined space and are squeezed close together. These molecules bump into each other and push against the walls of the container, and these collisions create pressure.

Pressure can be calculated using the following formula:

$$\mathbf{Pressure} = \frac{\mathbf{force}}{\mathbf{area}}$$

A compressor is an example of a machine that compresses and stores air in tanks called receivers.



Pneumatic systems control movement in small appliances such as;

- Dentist's drills
- Tyre fitment bays to tighten or undo wheel nuts, to inflate or remove old tyres from wheel rims
- Automatic doors of trains and buses
- Truck air brakes

HYDRAULIC SYSTEMS

Used widely to transmit power. A well constructed hydraulic system has the following **advantages**:

- It does not need complicated systems such as gears, cams or levers.
- Movement is transmitted without any slack as in the case of solid machine parts.
- Liquids that are used such as oil and water cannot break like some mechanical parts.
- Mechanisms do not wear out.
- It can provide smooth action without any vibration.
- It is not affected by change of load.
- It is low-cost to operate.

Pascal's Law

- Pascal's principle tells us that pressure exerted on one part of a hydraulic system will be transferred equally, without any loss, in all directions to other parts of the system.
- Hydraulic systems use liquid to create a mechanical advantage. Since liquids are incompressible, they transfer any input force that is applied to the liquid, throughout the liquid.

Basic principles of hydraulics

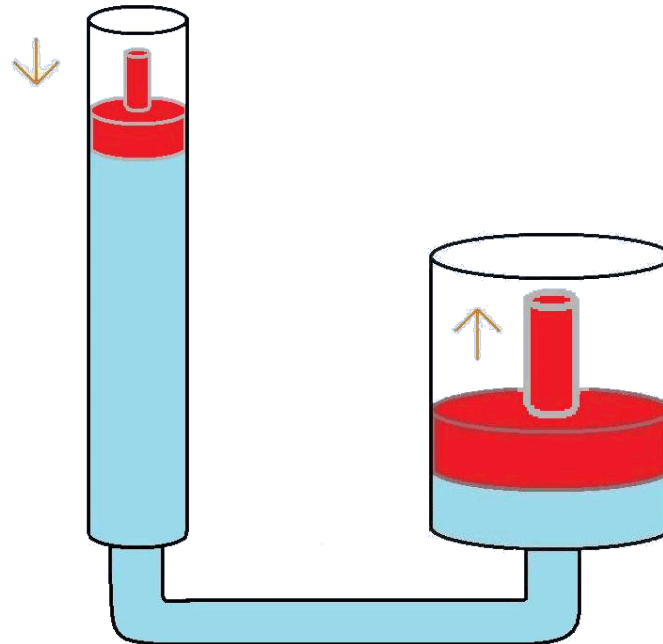
- A liquid has no shape of its own and changes shape according to its container. A liquid cannot be compressed.
- A liquid transmits the pressure applied to it in all directions and therefore proved great increase in work force.

Hydraulics and mechanical advantage

The large mechanical advantage in a hydraulic system is due to the ability of the fluid to transmit pressure equally. You can use a small input force to achieve a much larger output force.

Larger force versus greater distance to move..

- MA in hydraulic systems comes at a cost. The cost is that smaller force must move through an increased distance in order to make the large force move a small distance.



Mechanical advantage is determined as follows:

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$$MA = \frac{\text{load}}{\text{effort}}$$

Class Exercise

1. What is the difference between a pneumatic system and a hydraulic system?
2. State two uses of pneumatic systems.
3. Name two advantages of a hydraulic system.
4. What does Pascal's Law tell us about pressure in a hydraulic system?
5. What is your understanding of the basic principles of hydraulics?

THE HYDRAULIC PRESS AND HYDRAULIC JACK

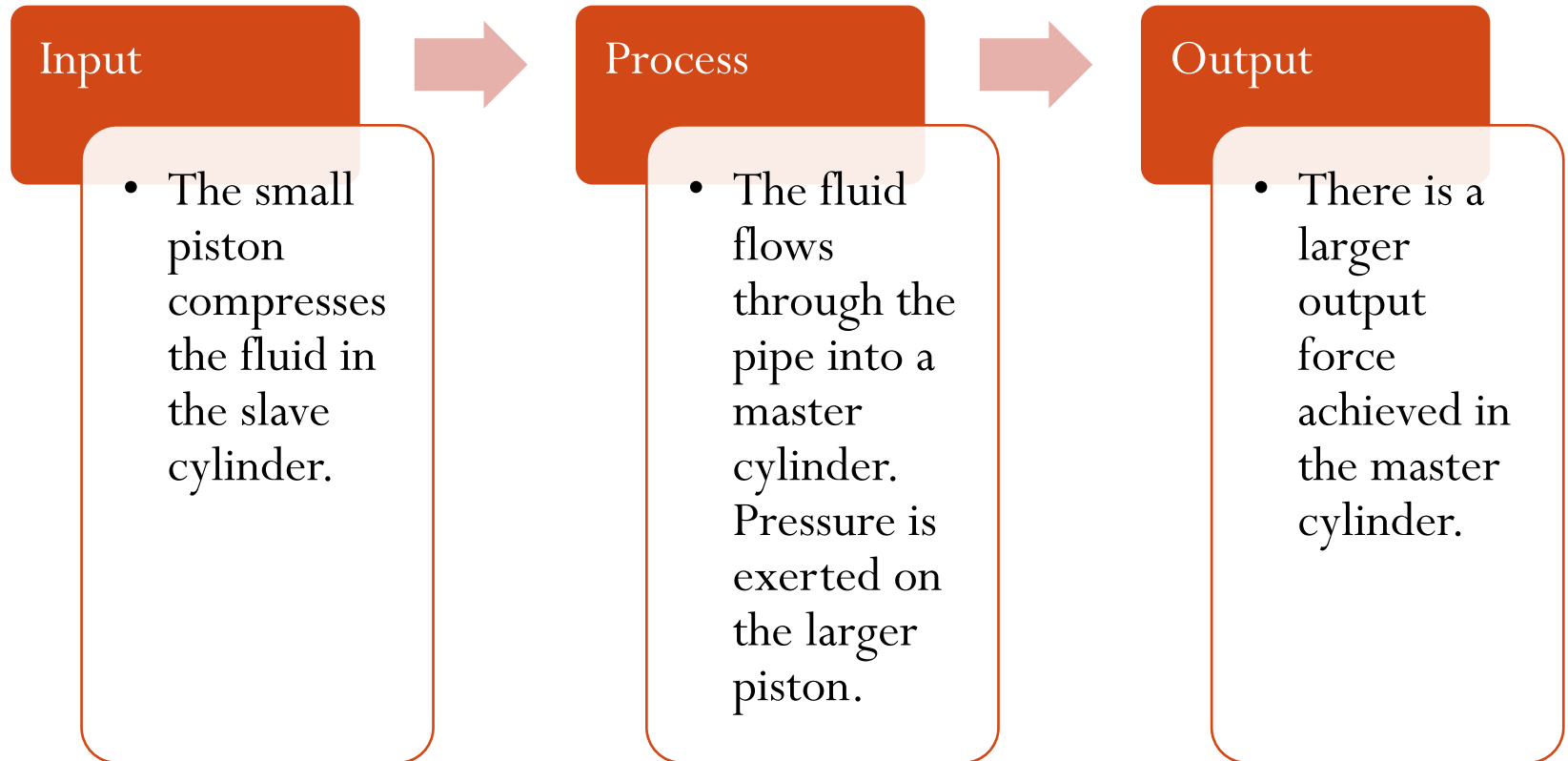
The hydraulic press

The hydraulic press has a bed or a plate in which metal is placed so that it can be crushed, straightened or moulded.

The hydraulic press is used for industrial purposes where large pressure is required for compressing metals into thin sheets.

The industrial hydraulic press uses the material to be worked on together with the help of the press plates to crush or punch the material into a thin sheet.

Systems diagram describing how the hydraulic press works..



Uses of the hydraulic press

A hydraulic press is usually used for:

- Transforming metallic objects into sheets of metal
- Thinning of glass
- Making powders for the cosmetic industry
- Forming tablets for medical use
- Crushing cars
- Sword making

Design considerations..

The technological process involves solving technological problems and satisfying consumer needs and wants.

A solution should be evaluated in terms of the design brief, specifications and constraints and whether it will meet the purpose for which it was designed.

The design stage requires that you write a design brief that has two parts:

- What are you going to design?
- What purpose will it serve?

Constraints..

There will always be factors that limit your design-and-making process, including tools and materials available, size and costs involved.

Specifications..

Rules for designing and making, including the following:

- What are you making?
- Who will use it?
- Will it do the job it's designed for?
- What materials should it be made of?
- What should it cost?
- It is cost effective?
- Does it look good?
- Is it safe for the end user to use? Is it easy for the end user to use?
- Is it environmentally friendly?

Aesthetics

Involves how the product looks and whether it looks good.

The five points that may be considered when evaluating aesthetics include:

1. Shape and form.
2. Texture, so that it is pleasing to look at and touch.
3. Colour depends on what is being designed, who will use it, the purpose it will be used for and the environment it will be used in.
4. Proportion requires that the product must look and feel right.
5. Balance is closely related to proportion and deals with symmetry which is when an object has exactly the same design on each side.

Ergonomics

Considers human factors when designing. The seven points to consider in ergonomics:

1. Size
2. Human body movements – Product must not require unnatural movement.
3. Comfort
4. Space
5. Senses
6. Surface finish – Product must be free of sharp edges and dangerous corners.
7. Safety