CONTENTS

Section 1
Hydraulic principles

Contents

Safety regulations

Read this for your safety

The HIAB Cargo Handling Equipment can be hazardous if it is not operated correctly. Make sure you read and understand the general safety information given in this chapter.
The equipment must be operated in accordance with the instructions given in the relevant Operator's Manual. Using the equipment in any other way or for any other purpose is prohibited.
Warnings, cautions, notes and tips are given in this manual. Their meanings are as follows:

WARNING

A Warning is given where wrong action could result in death or injury to the operator and nearby personnel. Warnings must always be adhered to, and given precedence over written and verbal instructions as well as Cautions.

CAUTION

A Caution is given where wrong action could result in damage to the equipment. Cautions must always be adhered to, and given precedence over Notes, and written and verbal instructions.

NOTE!

A note emphasises an important piece of information or an instruction.
Warnings and Cautions that apply to the general operation of the HIAB Cargo Handling Equipment are given in the relevant Operators Manual.

TIP!

Tip to make work easy to carry out.

Excluded personnel

Untrained personnel must not operate or carry out repairs to the Cargo Handling Equipment.

Hydraulic principles

Energy transfer by oil

The advantage of using oil to transmit force is in its unlimited mobility. These qualities are shown in fig.1.

1. It can easily change form.
2. It can be divided up to enable it to work in several places at once.
3. It can be moved quickly from one point to another.
4. It will work in any direction or angle.

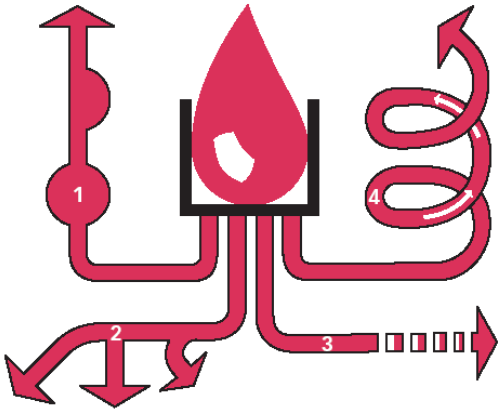


fig.1 H001-7

Transmission of force

In simplified form as in figs.1&2 the transmission of force is achieved by putting the oil under pressure so that the work, such as lifting a load is carried out.

The load is moved when the pressure created by the force acting on the left-hand piston is higher than the pressure generated by the load on the right-hand piston.

If the same force is applied to a smaller piston the pressure created will be higher and a bigger load can be moved using the same force.

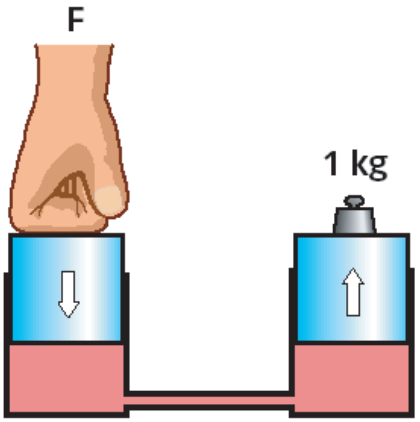


fig.2 H002-7

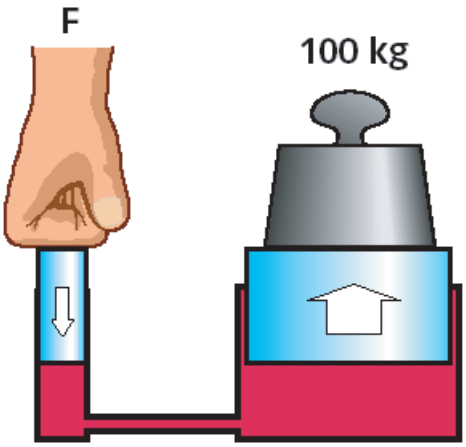


fig.3 H003-7

Pressure

Pressure is the load per unit of surface.

$$P = \frac{F}{A}$$

It follows that a small diameter piston produces a higher pressure compared to one with a large diameter when subjected to the same load.
The example in fig.4 shows pistons having an area of 500 mm2 and 5000 mm2. When subjected to a force of 100 N a pressure of 0.2 and 0.02 Mpa respectively will be generated.

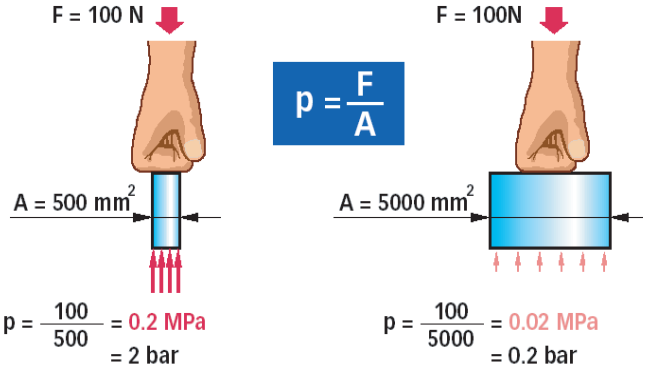


fig.4 H004-7

Force

Inversely, pressure against a surface will produce a force.

F= p x A

Assuming as in (fig.4) a force of 100 N on the small piston, thereby producing a pressure of 0.2 Mpa and letting this pressure act on the larger piston having a surface 10 times larger, a force of 1000 N is produced, this corresponds to a weight of 100 kgs. (fig.5)

This demonstrates the force is in direct proportion to the pressure and the area.

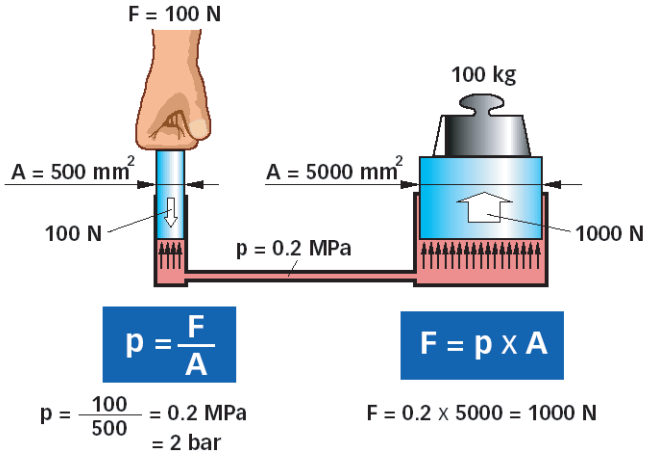


fig.5 H005-7

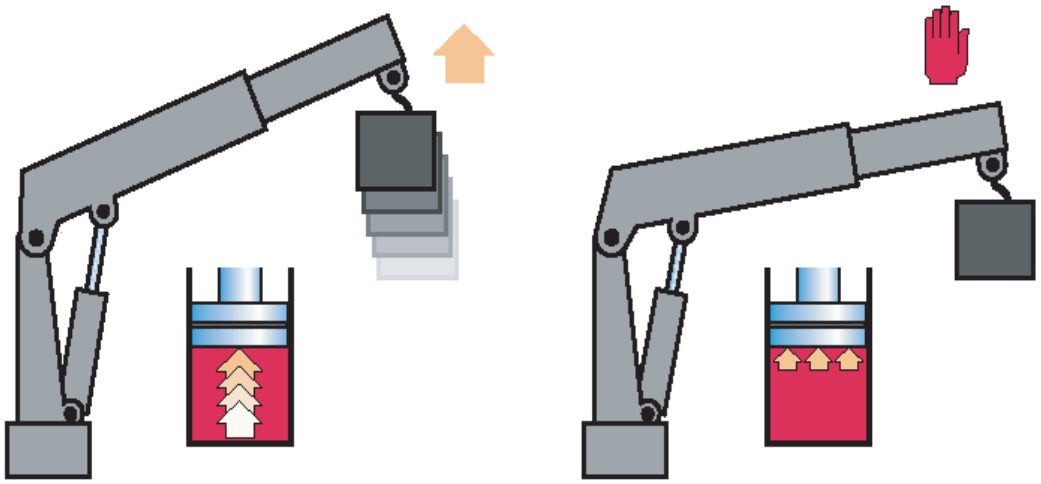
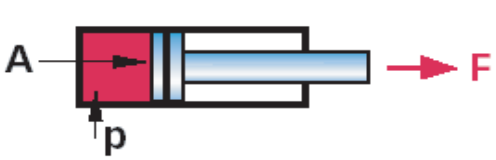


fig.6 H006-7

Pressure x cylinder area = Force

If this theory is applied to a practical crane application fig.6 it can be seen that a certain oil pressure can lift or, stop and hold a load.



$$F = p \times A$$

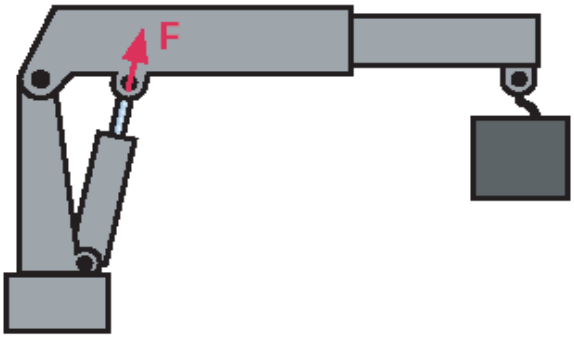


fig.7 H007-7

Force = Pressure x cylinder area

The force exerted by a crane inner boom (fig.7) depends on oil pressure and piston area. Nothing else. For example increasing a trucks engine speed will not affect the pressure in the cylinder.

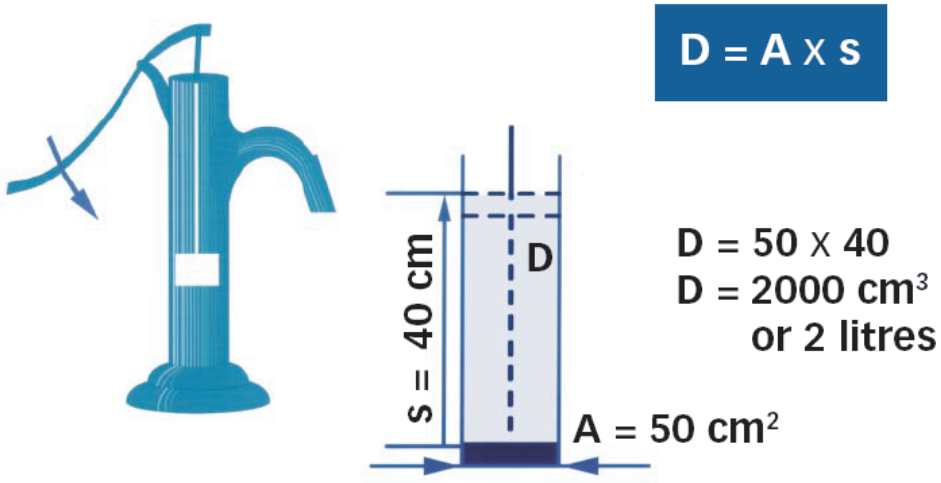


fig.8 H008-7

Displacement

Displacement is the same thing as swept volume.
The swept volume is calculated by multiplying the piston area by the stroke. (fig.8)
In a hydraulic pump the displacement is taken to be the swept volume per revolution, which is the volume of oil that the pump moves in one revolution of the shaft.

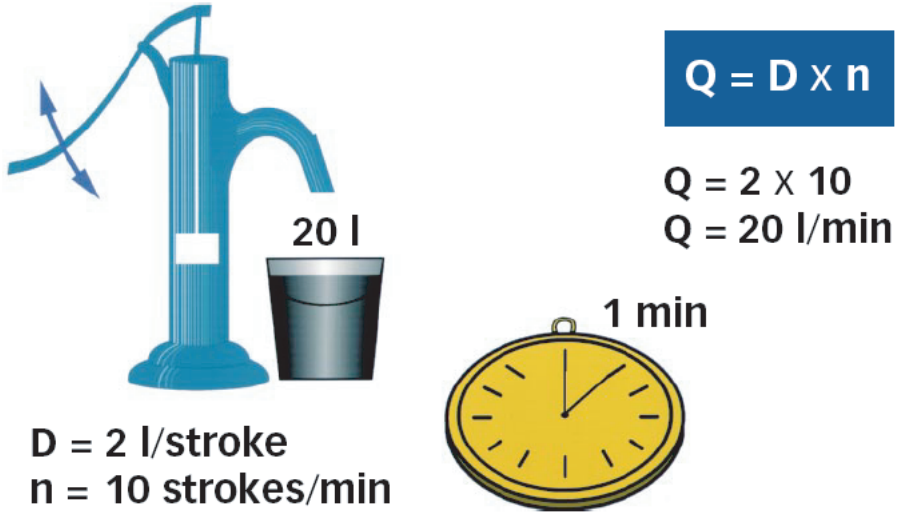


fig.9 H009-7

Flow

Flow is the volume passing per unit time. (fig.9)
If the displacement is two litres per stroke, and the pump does 10 strokes per min, the flow will be 2 x 10 = 20 Litres/min.
A hydraulic pump with a displacement of 53 cm^3 per rev, and running at 1000 rpm, delivers 53,000 cm^3 per min or 53 litres/min.

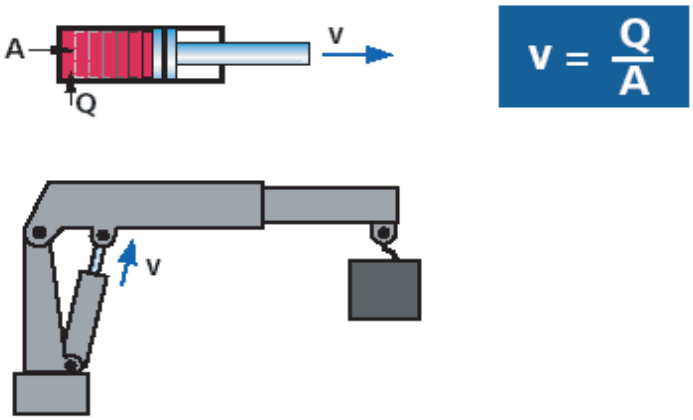


fig.10 H010-7

Speed

At a given flow to a cylinder we get a particular speed. The speed will be inversely proportional to the piston area. (fig.10)

$$\text{Speed} = \frac{\text{flow}}{\text{area}}$$

If we open the throttle of a truck and increase engine/pump speed, the flow will increase and we achieve more speed.

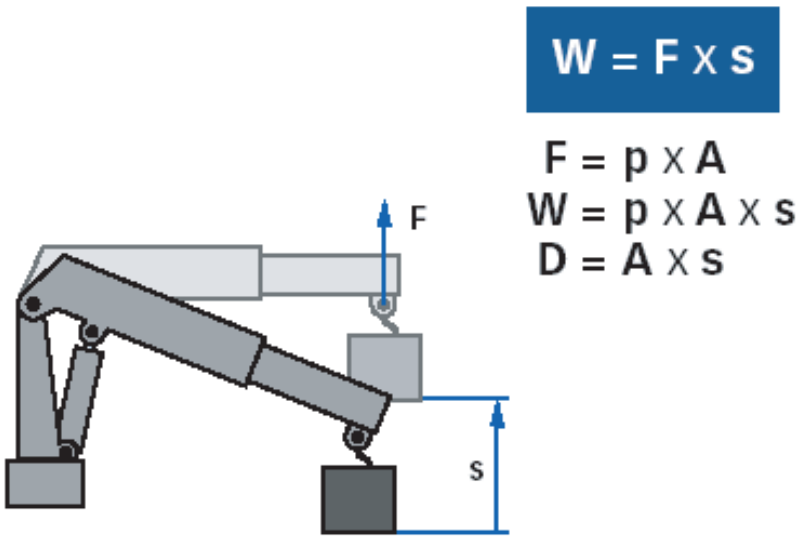


fig.11 H011-7