FUNCTIONAL SPECIFICATION
For the
PP175 Vertical Displacement Pump

To: UNSW product development team

This specification document outlines the design requirements for the PP175 Vertical Displacement Pump.

You and your team are required to design a pneumatic pump capable of supplying compressed air at pressures sufficient to explode a water balloon. The pump must be comprised of the following sub components:

- **Base:** for interfacing between the pump and the pump test jig.
- **Piston housing:** A cylinder that contains the piston and allows compression of the working fluid, in this case air.
- **Piston + Connecting rod:** The piston and connecting rod are to be made from one part.
- **Input/Output valves:** To control the input and output of air.
- **A Cover:** To seal the piston housing.

Should your group comprise of only 4 members, you are allowed to combine the Cover and Piston housing as **one** component.

The pump will be designed with a vertical piston travel. The piston housing shall have a maximum external dimension of 50mmx50mm. The base shall have dimensions of 100mmx70mm with a thickness of 10mm.

The displacement volume will be in the range of 20 to 22.5cm^3.

The piston will include a 10mm diameter shaft with a 6mm hole at its base. The center of this hole will be 10mm below the base when the piston is at the top of its stroke (see Figure 1).

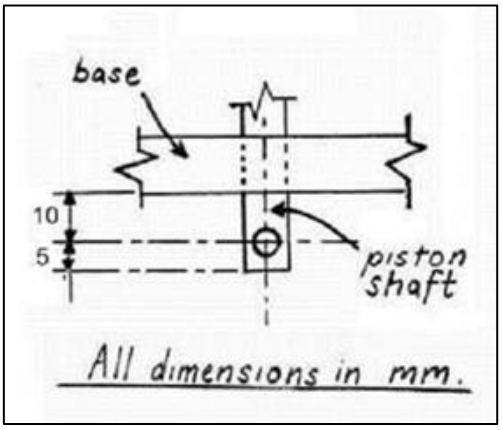

Figure 1

The piston shall be actuated by being attached to an electric motor via the hole at the base of the piston shaft. Note: The transformation of circular motion to linear motion will create side forces on the piston therefore the hole in the base should be a good fit with an expected tolerance of +0.1mm.

Fasteners such as nuts and bolts shall be used to hold the pump components together. Fasteners cannot be modified to manufacture any of the main components of the pump. Adhesives are **not** to be used. (silicone used as a sealant may be used)

For your prototype, the material **MUST** be selected from the material list below or as provided by TAFE except for off-the-shelf components such as nuts, bolts, o-rings and bearings. *(Please ignore the material cost in the table below. You will not be required to pay for raw materials at TAFE)*

Material List Material Section	Material	Cost per metre
50.0mm diameter round bar	Aluminium	$136.67
	Steel	$83.33
39.0mm diameter round bar	Aluminium	$105.33
	Steel	$62.00
10.0mm diameter round bar	Aluminium	$6.00
	Steel	$3.00
50mm x 50mm square	Aluminium	$140.00
	Steel	$122.67
Flat section: 100mm wide x 10mm thick	Aluminium	$56.00
	Steel	$47.33

The prototype will be tested by using a jig developed in-house. The prototype must include two parallel slots on the base to fix the prototype on to the jig. Each slot must be designed to suit M5 bolts as show in Figure 2. The M5 slots must have a distance between the centre to centre of each slot as 75mm

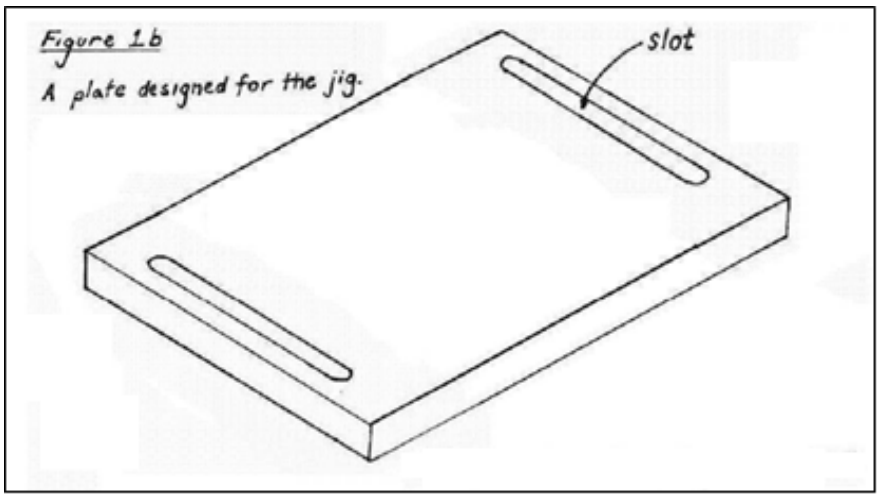

Figure 2

The pump will be tested by attaching a water balloon to the output valve and operating the pump until the balloon bursts due to air pressure being too high. Water balloons expand to a maximum of around 20mm at their inlet, therefore attention must be paid to how the balloon will be attached to the output valve. All sharp edges or corners around the outlet valve region must be deburred to prevent premature bursting of the balloon.

During functional prototype testing the pump will be actuated by an electric motor. The prototype will be connected to the electric motor with a crankshaft in the 6mm hole on the piston shaft.

The stroke length should be specified based on the given specifications. It should be noticed that we have 4 different testing rigs where the stroke lengths are set as 20, 25, 30 and 35mm. Your pump should be designed based on these values otherwise your pump cannot be tested. We also highly recommend adhering to 25, 30 and 35mm lengths.

Requirements

General

Id	Requirement
GEN_01	Pump shall be a vertically reciprocating, simplex, positive displacement pump.
GEN_02	Pump shall be pneumatic (compress air) from atmospheric pressure to a maximum pressure sufficient to burst a water balloon.
GEN_03	Pump shall be designed for maximum life (>65 Million revolutions)
GEN_04	Pump shall contain 5 components (or 4 components for 4 member groups[1]): 1. A base

[1] A 4 member pump group may combine Cover and Pump housing, totaling a 4 component pump.

	2. A piston housing 3. A Piston and connecting rod 4. A Cover to seal the piston housing 5. Input/Output valves
GEN_05	The pump prototype must be made from one of the materials in the provided material list with some off the shelf components allowed.
GEN_09	Adhesives are to be avoided.
GEN_07	Pump will connect to a motor via 6mm hole.
GEN_08	Pump shall be driven by an electric motor.

Base

Id	**Requirement**
BASE_01	Base maximum outer dimensions of 100mm x 70mm
BASE_02	10mm hole for piston shaft shall have a +0.1mm tolerance
BASE_03	Base shall have two parallel slots designed to clearance fit M5 Bolts. The distance between the centre to centre of slots must be 75mm.

Piston Housing

Id	**Requirement**
HOUSING_01	The piston housing shall have a maximum external dimension of 50mmx 50mm.
HOUSING _02	The piston housing shall have a maximum displacement volume of 20cm^3 to 22.5cm^3

Piston

Id	**Requirement**
PISTON_01	Piston connecting rod shall have a 10mm diameter shaft with a 6mm hole (Hole is 10mm below the base when the piston is at top dead center).

Cover

Id	**Requirement**
COVER_01	Must enclose and seal the top of the housing.

Valves

Id	**Requirement**
VALVES_01	Pump shall have valve(s) to control the direction of airflow.
VALVES_02	A valve with an output of airflow shall have a dimension which a water balloon is able to be fitted on it.