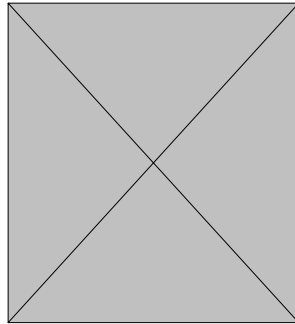


EPA Engineering Professions Association

P O Box 21885 Windhoek Republic of Namibia

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YOUNG ENGINEERS' CONSTRUCTION PROJECT NO. 6

1996

ELECTROMAGNET

In
collaboration with

D & S ENGINEERING

Motor Rebuild/Reconditioning

P O Box 22334

WINDHOEK

NAMIBIA

Team No: _____

School: _____

Specification for the Design & Construction of a Lifting Electromagnet Design

1. Scope/General Description

Entries are invited for the design and construction of an electromagnet. Care shall be taken to observe the criteria, constraints, requirements and assumptions.

The finally designed and constructed electromagnet will be energised from a 12V dc power supply (PSU) with a 10A-rated circuit breaker.

The electromagnet will be energised while in contact with the steel pick-up plate of the supplied hoist. Once fully energised, the winch crank will be turned very slowly so as to hoist a maximum mass of 25kg over a height of at least 1m.

The winning team will be the one with the design and construction that complies the closest with all criteria, constraints, requirements.

2. Standards

All designs and constructions shall be:

- 2.1 Neat
- 2.2 Safe to handle
- 2.3. Cost effective and efficient.

3. Design Parameters

The following design parameters shall be strictly complied with:

- 3.1 The mass of the electromagnet shall not exceed 1kg.
- 3.2 The resistance in the circuit shall not be less than 1.2 Ohms.
- 3.3 The coil shall be able to handle 120W at 12V, 10A dc.
- 3.4 The footprint area of the magnet shall not exceed 0.01 m².
- 3.5 The airgap(s) length shall be at least 1mm.
- 3.6 Any core material may be used (based on design choice).
- 3.7 No permanent magnet shall be incorporated anywhere in the final product.
- 3.8 The electromagnet shall have an eye of 50mm inside diameter to accommodate the lifting hook.

Extra care shall be taken in the design of the electromagnet's core and coil, due to the maximum mass limitation of 1kg.

4. Useful Formulae

4.1 Volume = density * cross-sectional area

4.2 Force = mass * acceleration

4.3 Magnetic Force = $\frac{N^2 i^2 \mu_0}{4 * x^2}$ [Newton] {for the specific type of core shape}

μ_0 = magnetic permeability = $4\pi \times 10^{-7}$ [H/m]

i = current in the coil [A]

N = number of turns [-]

4.4 Resistance = resistivity * length of material / cross-sectional area

4.5. Power = VI = I² R [Watt]

5. Assumptions

The following assumptions shall be made:

5.1 Leakage & fringing shall be ignored.

5.2 All energy is stored in the airgap(s).

6. Construction

6.1 The electromagnet should be constructed to ensure that the coil does not become loose.

6.2 The contact area of the magnet should be as smooth and square as possible.

7. Deliverables

In order to show that the design complies with the all above points, the following shall be provided:

7.1 A complete design with all engineering (i.e. design, cost, etc.) information on paper.

7.2 An electromagnet with two connection points for energising.

8. Identification

Your electromagnet should be clearly marked with a sticker.

9. Evaluation

9.1 Adjudication Procedure

The hoist used for the adjudication of entries will be supplied by D&S Engineering, and will be strong enough to lift the maximum mass allowed for in these specifications. Every attempt will be made to keep the acceleration while hoisting as small as possible.

Electromagnets will be judged in the following categories:

Documentation	10 points
Neatness	5 points
Geometry	5 points
Ingenuity	30 points
Performance	30 points

TOTAL	100 points

9.1.1 Documentation

The documents may be presented in your own format and cover.

The following must appear in the documentation:

- * School Name
- * Team Name
- * Names of the Team Members
- * Name of the Teacher assisting the Team
- * Project Name
- * Index/Table of Contents
- * Project Description
- * Calculations
- * Drawings
- * References (you should write who assisted you).

The inclusion of all these items is worth **4 points**. General impression and the verbal presentation by the team is worth another **4 points**.

For initiative in the documentation a maximum of **2 points** will be awarded.

9.1.2 Neatness

The construction will be judged for overall neatness, proportions and balance of the electromagnet. The points awarded will be in the discretion of the judges.

9.1.3 Geometry

This section will judge the proportions, the relative sizes of electromagnets, etc..

9.1.4 Ingenuity

The judges will be observing the quality of design and good engineering ideas used in the construction of the electromagnet. If you have any ideas as to how further improvements could be brought about, please include them in your documentation.

9.1.5 Performance

This section will be based on analytical results:

- # The amount of mass lifted through the required height
- # The coil resistance and current drawn
- # The magnet circuit efficiency
- # The force brought about, etc..

10. Conclusion

You have the basic information in front of you. The challenge to prove your skills is worth your effort.

So go ahead, enjoy yourself. The proof of the pudding is in the eating.

Figure 1 on the next page should also help.

Contact persons are:

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Fritz Jacobs Tel: 201 2558

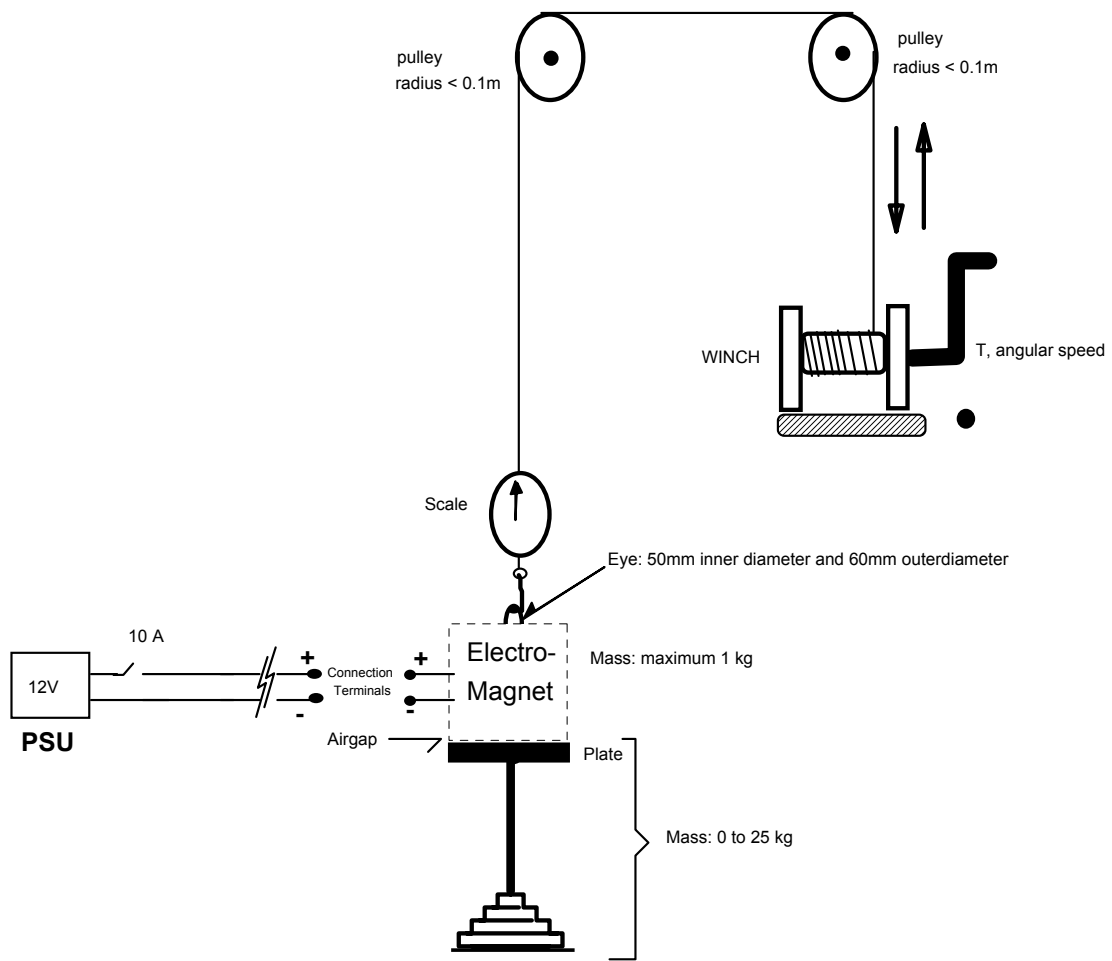


Figure 1: Electrical and Mechanical Arrangement

SAMPLE ADJUDICATION FORM

YOUNG ENGINEER'S CONSTRUCTION PROJECT

School :

Team Name :

Judge :

	Points Max	Points Awarded
Documentation		
All points included	4	
Written & Oral Presentation	4	
Originality / Initiative	2	
TOTAL		_____

Neatness		
Presentation of Electromagnet	2	
Appearance	3	
TOTAL		_____

Geometry		
Balance & relative proportion	3	
Tightness	2	
TOTAL		_____

Ingenuity		
Originality / Good ideas	10	
Construction	20	
TOTAL		_____

Performance		kg	A
Mass & current measurement	No. 1		
	No. 2		
	No. 3		

	Average	_____	

Performance points allocated on a linear scale between 0 & 50 : _____

GRAND TOTAL _____

Judge's comments