TEST PROJECT

Manufacturing Team Challenge

Submitted by:

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This Test Project proposal consists of the following documentation:

INTRODUCTION

PROJECT BRIEF

Teams must design an Electric Powered Forklift operated remotely by a joystick. The unit must be able to lift, to lower and to handle loads of 50kg across the pathway in order to place them over workbenches and shelves. Team will also have to achieve a surprise project during the competition days.

DESCRIPTION OF PROJECT AND TASKS

SURPRISE PROJECT

The surprise project must contain all the skills in manufacturing, design, assembly and quality control not necessarily covered in the main project elements. The surprise project must consist of the combination of the skills outlined in the MTC technical description. This project will be selected by Experts prior to the Competition and an evaluation scheme developed. The surprise project will be released to Competitors just before the start of the Competition. Teams can be awarded a maximum of 30 marks in this section.

MAIN PROJECT

Teams must design an Electric Powered Forklift operated remotely by a joystick. The unit must be able to lift, to lower and to handle loads of 50kg across the pathway in order to place them over workbenches and shelves. The system can be front drive or rear drive. The unit must have a brake system. The following requirements have to be applied:

ABLE TO LIFT AND LOWER 50 KG (2 MARKS)

The Electric Powered Forklift must lift and lower a load of 50 kg two (2) times, at a minimum stroke of 1 m between the lowest point and the highest point. Maximum time for attempt is 20 seconds for two cycles.

Maximum Marks: 2

Marks per Aspect:
The unit is able to lift a load of 50 kg at 1 m height - 2 marks
If time to attempt 2 cycles is over 20 seconds no mark will be awarded
Note: Marks will be calculated using calculations in the CIS scoring system

Evaluation process:

- Teams will place the fork (holding a load of 50kg) at the lowest point.
- Experts will set the highest point 1m far from the lowest point.
- Electric Powered Forklift must lift the load to the highest point then lower the load to the lowest point.
- Teams must run two (2) cycles (manual).
- Three Experts must agree the fork reached the extreme points.

ABLE TO HANDLE A LOAD OF 50 KG 10M AWAY (2 MARKS)

The operator should drive the unit forward for a distance of 10 m holding a load of 50 kg, with a fork at a minimum height of 500 mm above the floor. Then the team should drive the unit backwards to the start point. Maximum time for attempt is 20 seconds.

Maximum Marks: 2

Marks per Aspect:
- Team handle a load of 50 kg forward from starting point to 10m away and backwards to the starting point – 2 marks.
If time to attempt the cycle is over 20 seconds no mark will be awarded

Evaluation process:

- Teams will place the Electric Powered Forklift at the starting point.
- Teams will place the fork (holding a load of 50kg) at a minimum height of 500 mm above the floor.
- Experts will set the end point 10m far from the starting point.
- Electric Powered Forklift must handle the load forward to the end point and then backwards to the starting point

ABLE TO DO A SPIN (2 MARKS)

The unit must do a spin for clockwise and counter clockwise directions (360°) within a circle with 2 m in diameter.

Maximum Marks: 2

Marks per Aspect:

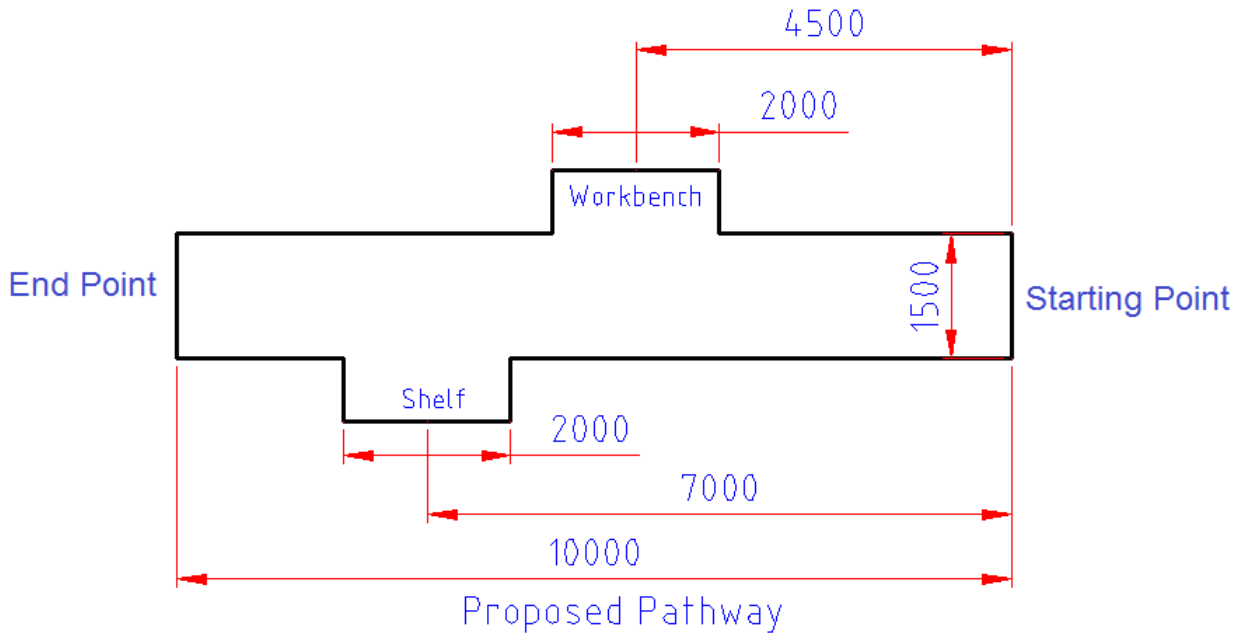
- Unit do a spin within the circle (360°) to clockwise direction – 1 Mark
- Unit do a spin within the circle (360°) to counter clockwise direction – 1 Mark

Evaluation process:

- Experts will draw a circle 2m in diameter.
- Teams will place the unit inside the circle.
- Teams must operate the unit to do a spin to clockwise direction within the circle (360°).
- Teams can repositions unit inside the circle.
- Teams must operate the unit to do a spin to counter clockwise direction within the circle (360°).

ABLE TO COMPLETE THE PATHWAY (5 MARKS)

The unit must handle the load 1 from the Starting point to the Workbench (600mm height) and the load 2 from the Workbench to the Shelf (1m height), then go to the End point. The unit must complete the pathway as shown at the image below:



Maximum Marks: 5

Marks per Aspect:

- Unit handles the load 1 from the Starting point to the Workbench – 1 Mark
- Unit handles the load 2 from the Workbench to the Shelf – 1 Mark
- Unit goes to the End point - 1 Mark
- From 0 mark for the longest time to complete the pathway up to 2 marks for the fastest one, proportionally awarded between both.

Evaluation process:

- Experts will place the load 1 on the floor at the Starting point and the load 2 over the Workbench.
- Teams will drive the unit to take the load 1 at the Starting point and place it over the Workbench.
- Teams will drive the unit to take the load 2 from the Workbench and place it over the Shelf.
- Teams will drive the unit from the Shelf to the End point.
- Two Experts will time the operations and the average of both measures will be calculated for scoring.

INTERFACE MACHINE/OPERATOR (6 MARKS)

The remote control panel must have a LCD display to provide information to the operator. The unit must have a rotating beacon light to indicate when it is in movement.

The control panel should show messages for these situations: "System in Operation", Movement direction the forklift "Forward/Reverse", direction of movement of the fork ("up" or "down") and load weight on the fork (in kilograms).

Maximum Marks: 6

Marks per Aspect:

- LCD shows the message: "System in Operation" - 1 Mark
- LCD shows the message: "Forward" when forklift is moving forwards and "Reverse" when forklift is moving backwards – 1 Marks
- LCD shows messages indicating the direction of movement of the forks (up or down) - 1 Mark
- LCD shows the mass of first weight on the fork (in kg, +/- 10 %) - 1 Mark
- LCD shows the mass of second weight on the fork (in kg, +/- 10 %) - 1 Mark
- The rotating beacon light is on when the Electric Powered Forklift is in movement (forks and/or wheels) - 1 Mark.

Evaluation process:

- Teams will turn on the unit. When the message "System in Operation" is shown, unit must be fully operational.
- Teams will drive the unit to Forwards direction and backwards direction. The LCD will be checked.
- Teams will drive the forks up and down. The LCD will be checked.
- Teams will drive the forks up and down, and drive the unit forward and backward. The rotating beacon light must be on.
- Before the assessment two weights will be selected by ballot. Same weights will be used for all teams. Weights will be between 10 - 50 kg.
- Team will place first weight to the fork and will lift weight of the ground. The LCD will be checked.
  Team will place second weight to the fork and will lift weight of the ground. The LCD will be checked.

CONTROLS (2 MARKS)

Unit is to have a key on/off switch and an emergency stop button. The Electric Powered Forklift must have an EMERGENCY button to stop the movements and should NOT work while it is pushed.

Maximum Marks: 2

Marks per Aspect:
Key On/off switch – 1 Mark

Emergency stop – 1 Mark

Evaluation process:

- Unit will be inspected and the controls will be demonstrated for function.
- 50 kg weight will be placed on the forks and weight is lift up.
- All power should turn off when Key switch is turned off. Unit must be fully functional when Key switch is turned on. Weight may not fall when power is switched off (tolerance of 30mm allowed).
- Emergency stop button will be tested during a movement of the unit. Weight may not fall when emergency button is pressed (tolerance of 30mm allowed).

OPERATION (3 MARKS)

The Electric Powered Forklift should be controlled remotely, by joystick, at a minimum distance of 3 meters.

The joystick must have:

- All the switches and buttons to drive the forks and to drive the wheels of the Electric Powered Forklift.
- A button to activate a sound alert (horn) that reaches the operator 3 meters away. The horn must be placed on the Electric Powered Forklift.
- A push button to remain pushed by the operator while he drives the unit. When this button is released, the unit should NOT work.

Maximum Marks: 3

Marks per Aspect:

- Teams are able to drive the forks and to drive the wheels by a **wired** joystick (3 meters away) - 1 Mark.
- The sound alert is activated by a button in the joystick and the sound reaches the operator 3 meters away from the unit - 1 Mark.
- The switches and buttons don't work while the push button is released - 1 Mark.

Evaluation process:

- Teams will place the Electric Powered Forklift at the starting point. Operators must be at least 3 meters away.
- By joystick, operators will drive the forks up and down, drive the unit forward and backward and activate the sound alert.
- Operators must release the push button and test all the buttons and switches of the joystick.

SAFETY (4 MARKS)

All moving parts must be protected and not be accessible by anything bigger than a 12mm diameter rod 75mm long (exception: fork and wheels).
All the conductible parts of the electrical circuit must be protected to not be accessible at all.
All sharp edges are to be removed.
Unit must have suitable caution labels to warn operator from danger. Labels will be checked against operation manual.

Maximum Marks: 4

Marks per Aspect:

- 3 marks if no unsafe condition detected. Reduce marks by 1 mark for each area not complying (Three Experts must agree to confirm an area that could cause injury).
- Caution labels are placed as shown in operation manual – 1 Mark.

Evaluation process:

- All exposed components will be checked including edges that may be touched by operator in normal operating condition.
- All moving parts and gaps to be checked with a rod 12mm in diameter and 75mm long (simulating a finger). If the rod touches any moving component it is to be considered a pinch point.
- Guards must not be physically distorted or moved during this test.

UNIT POWER (2 MARKS)

The system must be supplied by batteries.

The system must have an electronic circuit to recharge the battery direct from the power source of the competition. Measurement points (Banana plug sockets) must be provided to show that the battery are being charged.

Maximum Marks: 2

Marks per Aspect:

- Unit has battery (batteries) – 1 Mark.
- Unit has an electronic circuit to recharge the battery direct from the power source - 1 Mark.

Note: If no Banana plug sockets are available on the unit no mark will be awarded.

Evaluation process

- Teams will show the battery (batteries).
- Teams will connect the recharger in the power source. The electronic circuit to recharge will be checked for electrical current (at the battery poles).

MAINTENANCE (2 MARKS)

The unit must be easy to replace the battery and to replace the set wheels.

Maximum Marks: 2

Marks per Aspect:

From 0 mark for the longest time to complete the maintenance operations up to 2 marks for the fastest one, proportionally awarded between both.

Note: Marks will be calculated using calculations in the CIS scoring system

Evaluation process

- Teams will start 2 meters from the Electric Powered Forklift (at starting point).
- Teams will be timed to remove the battery (batteries), and the set of wheels.
- Then carry all components 2 meters away.
- Then carry all components back to the Electric Powered Forklift and reinstall all.
- Teams must drive the unit to starting point 2 meters away.
- Two Experts will time the operations and the average of both measures will be calculated for scoring.

DIMENSIONS (4 MARKS)

The length of the forks cannot be greater than 600 mm.

The distance between the forks cannot be greater than 500 mm (outer measure).

Maximum distance for wheelbase is 1000 mm

The track width (dimension from the centerline of the tire tread on one tire to the centerline of the tire tread on the opposite tire on the same end of the unit) must be between 600 mm and 1000 mm.

Maximum Marks: 4

Marks per Aspect:

- Length of the fork not greater than 600 mm - 1 Mark.
- Distance between the forks not greater than 500 mm (outer measure) - 1 Mark.
- Wheelbase is max. 1000 mm - 1 Mark.
- Track width is between 600 mm and 1000 mm - 1 Mark.

Evaluation process

- Experts will measure all the dimensions.

BRAKE SYSTEM (2 MARKS)

The unit should have a brake system (mechanical assembly with electric drive) automatically activated when movement of the wheels of forklift is not required.

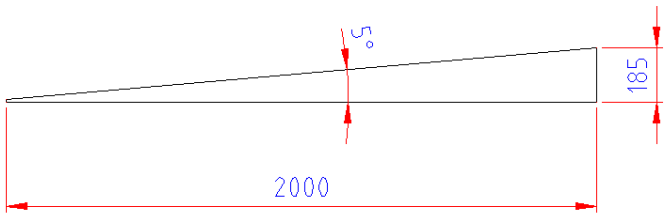
Maximum Marks: 2

Marks per Aspect:

- Unit has a brake system fully operational - 2 Marks.

Evaluation process

- Teams will place the unit over the ramp with 50 kg weight on the fork. Team will drive unit down the ramp and stop actions. The unit must brake and remain stable for 10 seconds on the ramp.



Ramp Proposed

TOOLBOX SIZE (2 MARKS)

To minimise tools and materials shipped to the competition, toolbox weight will be measured. Measurement will be done with pallet truck equipped with weight scale. Pallet truck will be specified to infrastructure list.

Maximum Marks: 2

Marks per Aspect:

- 2 Marks for the team with lightest toolbox. 0 Marks for the heaviest. Proportional marking for other.

Evaluation process

- Before the opening of the toolboxes mass of the tool box/boxes will be measured by the Experts.

WORK QUALITY AND VISUAL APPEARANCE (2 MARKS)

Maximum Marks: 2

Marks per Aspect:

- From 0 mark for the unit with a bad quality and visual appearance up to 2 marks for the unit that looks like a nice and reliable industrial product.

Evaluation process

- Experts will look at the unit to evaluate if its quality and appearance are representative of what is expected in the industry. Judgment assessment process will be applied.

ASSESSMENT ORDER

Work quality and visual appearance
Dimensions
Unit Power
Safety
Interface machine/operator
Controls
Operation
Brake system
Able to lift and lower 50 kg two times
Able to handle a load of 50 kg 10m away
Able to complete the pathway
Able to do a spin
Maintenance

MATERIALS AND PRODUCTION COSTS

NOTE: all costs to be calculated in Euro (€).

WORKING HOURS

NOTE: when one member of a team is working, all the team members will be counted, therefore team cost would be 90€/hour. Labor and equipment costs when working on the surprise project are to be included with the main project labor and equipment costs.

ADDITIONAL COST FOR USING EQUIPMENT

- For using workshop equipment, E.g. welding, grinding, sheet metalwork, drilling and saw: 15€/hour
- For using a conventional mill and lathe: 25€/hour
- For using a CNC mill: 35€/hour
- Consultant or training services: 60€/hour

The minimum time for each machine is fifteen (15) minutes.

NOTE: After using a machine, the machine must be cleaned, i.e. swarf removed from working area of the machine. Each machine will be inspected by an Expert after each team's use of that machine and a penalty of 22.50€ (representing 15 minutes of cleaning time) will be applied if machine is not cleaned. If a machine is considered not cleaned, Experts will be called to inspect that machine – three Experts must agree. Their decision is final. Equipment use cost only to be applied to equipment supplied by the organizers. No cost for using portable equipment provided by teams.

RAW MATERIALS

Each team will provide weight of raw materials used and also cost of raw material using cost per kilogram listed below. The list of raw material details including weight and cost is to be presented in spreadsheet format and to be included in section A of portfolio. Extrusions and profile will be priced by length. Cost must be verified by Experts to reflect commercial cost. Cost for raw materials to be applied:

- Mild sheet – 7€/kg
- Aluminum – 10€/kg
- Brass – 37€/kg
- Stainless steel – 28€/kg
- Plastic – 20€/kg
- PCB – 0.50€/cm2
- Batteries Pb, NiCd, NiMh etc - 0,5€/Wh
- Batteries Lithium – 1.5€/Wh

Prices to be checked and aligned on current market in order to be relevant.

NOTE: Currency conversion rates will be fixed at Tuesday, 5th May 2015 and will be taken from http://www.xe.com/. These exchange rates will be posted on the MTC discussion forum on this date.

COST CALCULATIONS (10 MARKS)

Costing will be broken up into the following groups

- Working hours – 5 marks – From 0 mark for the most expensive up to 5 marks for the cheapest, and proportionally awarded between both.
- Additional cost for using equipment - From 0 mark for the most expensive up to 3 marks for the cheapest, and proportionally awarded between both.
- Raw materials – 2 marks - From 0 mark for the most expensive up to 2 marks for the cheapest, and proportionally awarded between both.

Note: *For all groups the following calculation will be made*

Step 1

The total cost of equipment, materials and labour will be modified by project compliance to specification.

$$\text{Final Cost} = \frac{\text{Total Cost}}{\text{\% compliance to specification}}$$

Example

- If total cost is €2,500 and compliance is 100% then build cost would be €2,500
- If total cost is €2,500 and compliance is 80% then build cost would be €3,125
- If total cost is €2,500 and compliance is 60% then build cost would be €4,167
- If total cost is €2,500 and compliance is 40% then build cost would be €6,2500
- If total cost is €2,500 and compliance is 20% then build cost would be €12,500
- If total cost is €2,500 and compliance is 0% then no marks awarded for cost section.

Note: Marks will be calculated using calculations in the CIS scoring system

PORTFOLIO ASSESSMENT

The portfolio will consist of two sections, section A and section B:

The section B includes documentation prepared during the Competition. The time taken to complete this section will be costed as part of the main project. Assessment of section B is included in the main project assessment.

Section A: This section will be presented prior to the Competition and will be assessed during the Competition. All portfolios are to be in the English language.

The section A is to be presented in hard copy form, and should include:

- Poster display
- List of all materials and components and their costs (with evidence) provided by the team.
- Operation and maintenance manual

NOTE: When assessing the portfolio using the above criteria, it is sufficient to award marks for inclusion of the information when it comes up to the minimum requirements, rather than consider the actual detail contained within it. Marks are awarded for each item as if acceptable – full marks, or if not acceptable – zero marks. (There will be no graduated marks).

POSTER DISPLAY (1 MARK)

Maximum Marks: 1 mark

A poster is also to be displayed explaining to the public how the Electric Powered Forklift operates.

To include:

- Minimum size 500mm x 700mm
- Explanation of basic operation of the Electric Powered Forklift.
- 3D model drawing of Electric Powered Forklift
- Performance specifications of team's Electric Powered Forklift
- Poster in English language (may also have duplicate in team's language)
- Poster complete and displayed to the public during the Competition.
- Details of team members (Team member pictures, Country, names, year of birth, educational and vocational background, role in the team)
- 1.0 mark if the poster is complete and meets minimum requirements
- Minimum poster size – 0.10 marks
- Explanation of basic operation of the Electric Powered Forklift – 0.15 marks
- 3D model drawing of Electric Powered Forklift – 0.15 marks
- Performance specifications of team's Electric Powered Forklift – 0.15 marks
- Poster in English language (may also have duplicate in team's language) – 0.15 marks
- Details of team members (Team member pictures, Country, names, year of birth, educational and vocational background, role in the team) – 0,15 Marks
- Poster complete and displayed to the public during the Competition. – 0.15 marks

LIST OF ALL MATERIALS AND COMPONENTS PROVIDED BY THE TEAM (2 MARKS)

Maximum Marks: 2 marks

Each team will provide weight of raw materials used and also cost of raw material using cost per kilogram listed below. The list of raw material details including weight and cost is to be presented in spreadsheet format and to be included in section A of the portfolio. Refer to the raw material cost section to know the prices applied. Extrusions and profile sections will be priced by length. Cost must be verified by Experts to reflect commercial cost. Cost for raw materials to be applied:

For each used purchased item a receipt or a current catalogue price (without discounts or goods and services taxes applied) must be provided. A printout of a website is acceptable if website address and date are included on printout.

A list of purchased items, raw materials and their costs is to be presented in Spreadsheet format.

- 1.5 marks if the spreadsheet contains all raw materials and purchased items and is complete and in spreadsheet format and meets minimum requirements – drawings will be checked for materials and components.
- List in English language – 0.5 mark
- 0 mark if incomplete or does not meet minimum requirements

OPERATION AND MAINTENANCE MANUAL (2 MARKS)

Maximum Marks: 2 marks

A operation and maintenance manual for the Electric Powered Forklift is to be provided

(The other controls for operation of the Electric Powered Forklift should be clearly described in the Operation and Maintenance Manual)

Should include

- Set up of Electric Powered Forklift
- Operation of Electric Powered Forklift
- Replacement of batteries, motors, wheels and tires.
- Safe operating procedures
- List and place of caution labels on the forklift
- Presented in a folder

- 2 marks if the troubleshooting guide is complete and meets minimum requirements

- Set up of Electric Powered Forklift – 0.3 marks
- Operation of Electric Powered Forklift – 0.3 marks
- Replacement of batteries, motors, wheels and tires – 0.3 marks
- Safe operating procedures – 0.3 marks
- Presented in a folder – 0.2 marks
- List and place of caution labels on the forklift – 0.3 Marks
- Manual in English language – 0.3 marks

PORTFOLIO ASSESSMENT PART B

2D DETAIL DRAWINGS (7 MARKS)

CAD generated manufacturing drawings (2D detail drawings) of all components (Electric Powered Forklift) are to be created during the Competition and be presented for assessment in a folder.

Maximum Marks: 7 marks

Assessment process

7 marks if drawings acceptable and for at least 90% of components

Evaluation process

NOTE: only manufactured items by the team during the Competition must be drawn in 2D.

STEP 1

- Count the number of drawings required for all manufactured components - check Electric Powered Forklift
- all manufactured components
- Count the number of drawings presented and calculate the % of drawings submitted
- 1 mark if more than 90% of drawings are presented

STEP 2

Select three (3) drawings randomly (independent Expert to select) - assess these drawings only – each drawing 2 marks maximum. Marking is to be recorded on a chart which is to be verified by all members of the marking team.

Mark Allocation for drawings 1 to 3

- 0.5 marks if drawing has title block drawing title, drawing number (must refer to assembly drawing), sheet number, paper size, scale and drawing border
- 0.5 marks if drawing contains correct views and projection
- 0.5 marks if drawing is accurate to the Electric Powered Forklift.
- 0.5 marks if drawing has appropriate dimensions with tolerances or general tolerance, and machine finishes (where required)
- If drawing is not CAD/electronically created no marks will be awarded

ELECTRICAL/ELECTRONIC CIRCUIT DRAWING (2 MARKS)

Maximum Marks: 2 marks

Assessment process

- 2 marks if drawing acceptable, and meets assessment checklist
- If drawing is not CAD/electronically created no marks will be awarded

Evaluation process

NOTE: labeled block representation is accepted as well as Electrical/electronic graphics library

- 0.5 marks if drawing has drawing title, drawing number and drawing border
- 0.5 marks if drawing uses Electrical/electronic symbols or block representation with component values
- 0.5 marks if drawing to contains battery, motor, & switches, display
- 0.5 marks if drawing has component values or component identifications.

3D ASSEMBLY DRAWING (3 MARKS)

Maximum Marks: 3 marks

A CAD generated 3D assembly drawing (3D model) of the complete unit(s) is to be created during the Competition and a printout to be presented for assessment in a folder.

- 3 marks if drawing is acceptable
- If drawing is not CAD/electronically created no marks will be awarded

Evaluation process

- 0.5 marks if drawing has drawing title, drawing number, sheet number, and drawing border
- 1 mark if drawing has parts/material list and parts/material list to be referenced to drawings
- 0.5 marks if drawing contains 90% of manufactured components
- 0.5 marks if drawing has Electric Powered Forklift frame - should contain the frame or base – this should be included in the drawing.
- 0.5 marks if drawing has lifting mechanisms – all hydraulics or gear systems should be shown

NOTE: Purchased items may be drawn as a block and not drawn in detail.

PRESENTATION OF DRAWINGS (1 MARK)

Maximum Marks: 1

Marks per Aspect:

- 1 mark if drawings are presented in folder with team identifications (may be one drawing folder with all Drawings)

Evaluation process

- Experts will check if the drawings are presented in a folder with team identification label.

VISUAL QUALITY OF DRAWINGS (2 MARKS)

Maximum Marks: 2

Marks per Aspect:

- From 0 mark for the drawings with poor quality and appearance up to 2 marks for the drawings that look to be easily workable and with a user friendly aspect.

Evaluation process

- Experts will look at the drawings to evaluate if their quality and appearance are representative of what is expected in the industry. Judgment assessment process will be applied.

INSTRUCTIONS TO THE COMPETITOR

COMPETITION REQUIREMENTS

Each team will provide at the event

- 01 (one) Electric Powered Forklift, also nominated as "Unit";
- 01 (one) Joystick;
- Section B of the portfolio;
- A surprise project – the surprise project will be released to Competitors just before the start of the Competition. This project must consist of the combination of the skills outlined in the MTC technical description. This project will be selected by Experts prior to Competition.

ACTIVITIES TO BE DONE BEFORE THE COMPETITION

- Section A of the portfolio.
- Purchase of all raw materials and components needed by the team to manufacture their main project
- Materials may be rough cut into billets, or length but may not be machined to size. Burrs or sharp edges are to be removed. Refer to the Technical Description for further information.
- Manufacture of electronic circuit boards, but these boards may not have components mounted before the Competition

NOTE: Purchased items are not to be modified in any way prior to the Competition.

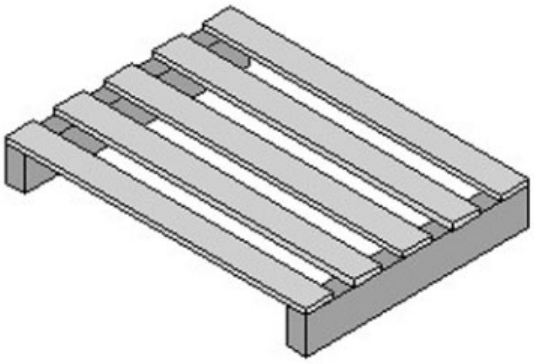
ACTIVITIES TO BE ATTEMPTED DURING THE COMPETITION

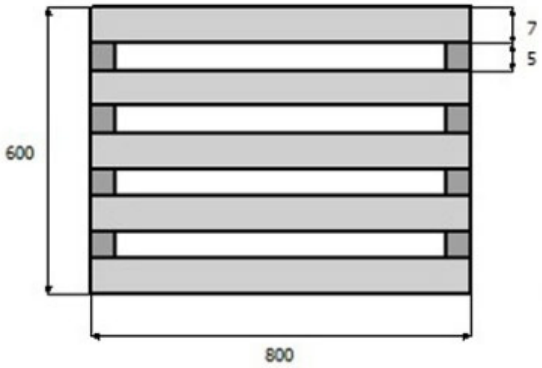
- Section B of the portfolio, including drawings;
- Manufacturing of all components of the Electric Powered Forklift;
- Electricity/electronic assembly – all individual components must be assembled during the Competition;
- Mechanical assembly of complete Electric Powered Forklift;
- Testing of Electric Powered Forklift;
- Surprise project.

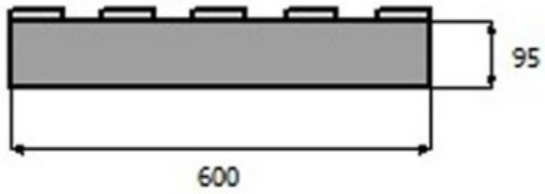
EQUIPMENT, MACHINERY, INSTALLATIONS AND MATERIALS REQUIRED

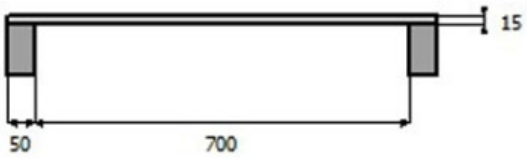
EQUIPMENTS PROVIDED BY ORGANIZERS

- All equipment, tooling and materials in the infrastructure list – see MTC forum and technical description.
- All materials for surprise project as listed in the technical description.
- Testing equipment for Surprise Project
- Testing equipment and testing materials for the Electric Powered Forklift, as shown below:
  - Two bags of 50kg of sand (or other similar material)
  - Two wooden pallets as shown below: (ISO 800x600)









ITEMS TO BE PROVIDED BY TEAMS

Each team must provide and wear team identification (e.g. coloured shirt) or armbands that indicate their region. These must be worn at all times during the Competition.

It is the responsibility of the team to supply all the components and raw materials to manufacture the Electric Powered Forklift. This may include but not limited to the following items:

- Electrical motors.
- Battery.
- Electronic circuit board – not mounted (circuit board components must be assembled on the board at the Competition).
- All Electric and electronic components.
- Electric cables, connectors and couplings. Readymade cables with connector are not permitted. All connector must be fitted during the competition.
- Jigs, fixtures, formers and clamping devices.
- All materials with which to construct the Electric Powered Forklift and all other associated equipment and consumables (sheet metal, screws, nuts, pins, pegs, etc…).
- Machining consumable tooling required for manufacturing the components.
- Lathe and mill tools and hand tools for manufacturing components.
- All hand tools, cutting tools and measuring equipment.
- All hand tools for assembly.
- All personal protective equipment.
- Standard tooling kit as described in the MTC technical description
- Other specific manufacturing equipment required that is not in the infrastructure list.
- Bearings (unmodified)
- Sprockets, pulleys, gears, couplings, chain and belts (as supplied and must not be altered). Catalog or standard must be provided.
- Hydraulic or pneumatic components and fittings not assembled.

EQUIPMENT AND MATERIALS NOT PERMITTED

- Laptop or portable computers.
- PDAs e.g. Palm, IPAQ, etc
- Memory sticks/MP3 Player/Digital Storage.
- Walkman radio/CD Player.
- Electronic organizer/diaries.
- Wireless communication devices.
- None approved CDs or floppy discs – approval by Experts or delegate is required for all CDs and floppy discs.
- Any additional software not supplied by organizers unless approved by Experts.
- Pre-programmed IC's
- Purchased items modified in any way prior to the Competition.
- All subassemblies for fork lifting mechanics.
- Equipment that is similar or operates in similar manner as supplied equipment. Example – if metal cutoff saw is provided by organizers, then no team may provide own metal cut-off saw.
- During the Competition duration, no tools, equipment, stationary, components, manuals, drawings or digital storage devices may be removed from or brought into the Competition venue, unless approved by Chief Expert.

MARKING SCHEME

ASSESSMENT CRITERIA

SECTION	CRITERIA	MARKS
A	Main project performances (including section B of portfolio)	55
B	Main project costs (including time to complete section B of portfolio)	10
C	Portfolio (section A only)	5
D	Surprise project	30
	Total	**100**