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MANUFACTURE TEAM CHALLENGE

ISEIW Wales Regional Final

COMPETITION BRIEF

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Introduction

If you look at the average home and you will find lots of plastics that can be recycled; bottles and containers that previously contained food or drink being the most common. With a strong focus on recycling, many councils across the UK have reduced the frequency of general waste collections, some to fortnightly, others to monthly with only recycling being collected more regularly. Regardless, one of the largest problems many householders face is the large volume of space these items take up to store between collections as the nature of the packaging means they take up a lot of space containing mostly empty air.

This brief is looking for teams to come up with a clever and innovative idea to reduce the volume of this waste by producing a tabletop grinder for household use – to turn plastics into shredded or ground plastics which are easier to store. An additional purpose of this could be for 3D printing enthusiasts to break down PET bottles ready to be turned into an extrudable material.

The Project Brief

Each team will be required to design their own safe Plastic Shredder (PS) for turning small and large plastic bottles, ranging from 500ml drinks to 4 Pints milk bottles. This needs to be done with a keen eye on safety for the user, guarding and cutting surfaces. It also needs to be compact and take up as little space as possible but have a system for collecting the ground or shredded plastics.

Description of Project

The system must be designed to the following requirements:

- Tabletop, compact in size to allow for easy storage in a household kitchen.
- It must be able to shred or granulate a range of household plastics, such as PET, HDPE, LDPE etc.
- Be able to collect the shredded or granulated plastics without spillage.
- Be able to weigh the plastics and display the weight of shredded or granulated plastics via an LCD panel.

- **Safety**

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- Any mechanisms and surfaces should be free from being a trap, crushing or cutting hazard.
- The system should be able to be stopped by the control handset.
- All electrically conductive parts must be guarded.
- No sharp edges should be evident.

EQUIPMENT, MACHINERY, INSTALLATIONS AND MATERIALS REQUIRED EQUIPMENTS PROVIDED BY ORGANISERS

All lathes, cut-off saws, pillar drills, fabrication and welding equipment. MIG and TIG and associated tooling, but not Drill bits or Lathe tools.
Testing equipment and testing materials for the PS.

EQUIPMENT AND MATERIALS NOT PERMITTED

Laptop or portable computers. PDA's e.g., Palm, IPAQ etc. Memory sticks/MP3 Player/Digital Storage. Walkman radio/CD Player. Electronic organiser/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 the track or cart. Equipment that is similar or operates in similar manner as supplied equipment. Example – if a metal cut-off saw is provided by organisers, then no team may provide their own metal cut-off saw.

ITEMS TO BE PROVIDED BY TEAMS

It is the responsibility of the team to supply any materials that have not been sent to them that they wish to use. This may include but is not limited to the following items: Battery/batteries. Electronic circuit board – not mounted (circuit board components must be assembled on the board at the Competition). 25% of the components by number may be pre-mounted. Radio control handset, receiver and speed controller where applicable. All Electrical and electronic components. Electric cables, connectors and couplings. Readymade cables with connector are not permitted. All connectors must be fitted during the competition. Jigs, fixtures, formers and clamping devices. All materials with which to construct the solenoid engine and Vehicle and all other associated equipment and consumables (sheet metal, screws, nuts, pins, pegs, etc.). Machining consumable tooling required for manufacturing the components. Lathe tools and hand tools for manufacturing components. All hand tools, cutting tools and measuring equipment. All hand tools for assembly. All personal protective equipment. 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). Catalogue or standard must be provided. Hydraulic or pneumatic components and fittings not assembled.
DURING THE COMPETITION DURATION, NO TOOLS, EQUIPMENT, STATIONARY, COMPONENTS, MANUALS, DRAWINGS OR DIGITAL STORAGE DEVICES, UNLESS APPROVED BY THE CHIEF EXPERT, MAY BE REMOVED FROM OR BROUGHT INTO THE COMPETITION VENUE.

Note: For the ISEiW regional round only, both portfolio A and B are brought completed to the competition. All other levels have portfolio A only brought with them.

Marking Scheme

Section	Criteria	Marks
A	Main project performances (Inc. Section B of portfolio)	50 20
B	Main project costs: Materials	10
C	Portfolio (Section A only)	20
Total		**100**

A. Main Project (50 Marks)

The PS will be assessed against the following criteria:

- **Toolbox weight. (2 Marks)**
  Test: before competition starts each team shall weigh all the tools they intend to use. The team that has the lightest toolbox shall gain 2 marks. The heaviest toolbox shall be awarded 0 marks. All other teams shall gain marks proportional between.

- **Material weight. (2 Marks)**
  Test: Each team shall weigh the raw materials they will use to construct the PS. The team that has the lightest materials shall gain 2 marks. The heaviest materials shall be awarded 0 marks. All other teams shall gain marks proportional between.
  Note: All lengths of material must be 50mm oversize in 1 direction, sheet materials in 2 directions.

- **Weight of the PS. (2 Marks)**
  Test: Each team shall weigh the PS. The team that has the lightest PS shall gain 2 marks. The heaviest PS shall be awarded 0 marks. All other teams shall gain marks proportional between.

- **Battery power system. (2 Marks)**
  Test: The team shall demonstrate the presence of a battery supply for the PS which provides a supply of 12V or less. If the battery is 12V or less 2 marks are awarded. If the battery is greater than 12V or has batteries that combine to a supply over 12V, IE in series, 0 marks are awarded.

- **The PS has a manual shredding/grinding option. (2 Marks)**

Test: The team shall demonstrate a single 500ml PET bottle being shredded with no electrical power but powered by some manual means.

- **The PS has a powered shredding/grinding option. (2 Marks)**

  Test: The team shall demonstrate a single 500ml PET bottle being shredded with electrical power but powered by some manual means.

- **Safe operations. (2 Marks)**

  Test 1: Judges will examine the system to ensure that a user can not touch any cutting or grinding surfaces. (1 Mark)

  Test 2: The team shall demonstrate that any size bottle or carton is securely contained while any shredding or grinding operation takes place. It is critical that a user has no chance of any debris or particles coming out of the system and causing injury. (1 Mark)

- **Safety. (4 Marks)**
  - All mechanisms and surfaces are free from being a trap, crushing or cutting hazard.
    (2 Marks reduce by 0.2 marks for each problem seen)

  Test: Judges shall use the detailed video above to judge that the surfaces are free of cutting hazards and that the moving parts are suitably guarded. 1 Marks awarded for no problems found. 0.2 marks deducted for each problem found.

  - All electrically conductive parts are guarded.
    (2 Marks reduce by 0.2 marks for each problem found)

  Test: Judges shall use the detailed video above to judge that all conductive parts. No unguarded conductive parts 1 Marks. Reduce by 0.2 for each unguarded conductive part found.

- **The PS has a compact size, folded for storage or physically (2 Marks)**

  Test: Each PS shall be measured by a judge. The largest size will receive 0 marks. The smallest size shall receive 2 marks. All other teams will be marked proportionally between.

- **The PS has a collection method that does not allow shredded or ground plastic to fall out. (1 Marks)**

  Test: Under all tests the PS shall be observed, any amount of shredded or ground plastic that comes out will remove this mark. The system must be easy to empty into a recycling collection point and demonstrate this without spillage to gain his mark.

- **Weighing system. (9 Marks)**
  - **The PS has an LCD display for a Weighing system.**

  Test: A judge shall inspect the system to confirm an LCD panel is present. An LCD screen present shall receive 2 marks.

- **The LCD shows System Active when the PS is turned on.**

  Test: The team shall turn on the system and demonstrate to a judge that the LCD shows "System Active". The correct words shown shall be awarded 2 marks.

- **The LCD is able to weigh the shredded/ground plastic to within 10%.**

  Test: Following the course time trial the system shall weigh the shredded/ground plastic. If the full weight shown is 900 grams to 1100 grams then 5 marks are awarded. A figure of less than 980 or more than 1100 shall receive 0 marks.

  Note: a genuine weight will be observed by judges on the LCD for the mark to be valid.

- **PS Material sorting (10 Marks)**

  The system is able to sort different plastics. As recycling is different for each type of plastic they need to be sorted. The system shall require:

  1. A sorting section for PET plastics, 3 Marks.
  2. A sorting section for HDPE plastics, 3 Marks.
  3. A sorting section for PP plastics, 4 Marks.

Test: each team shall provide 1 x 500ml drinks bottle (PET), 1 x 4 pint milk bottle (HPDE), the lids for such, (PP). The team shall shred/grind all three sections and demonstrate that the different plastics have been deposited into 3 distinct collection areas. For each collected correctly, the marks above will be given.

- **PS time trial (10 Marks)**

  Each team will be required to bring with them 2 batches of plastic bottles for this test. Each batch must contain at least 2 x 4 pint HPDE milk bottles and at least 2 x 500ml PET bottles. Any other type is the team's choice and can be anything from household recycling that is made of plastic.

  - **Time trial 1.**

    Test: The team's PS shall be timed while being manually powered, shredding/grinding the first 1Kg batch of plastic. The team must load and collect the entire contents of the system into a box or bag for weighing. It must weigh 1Kg or greater. The fastest team to do this will receive 5 marks, the slowest team shall receive 0 marks. All other teams shall receive a proportional mark between.

  - **Time trial 2.**

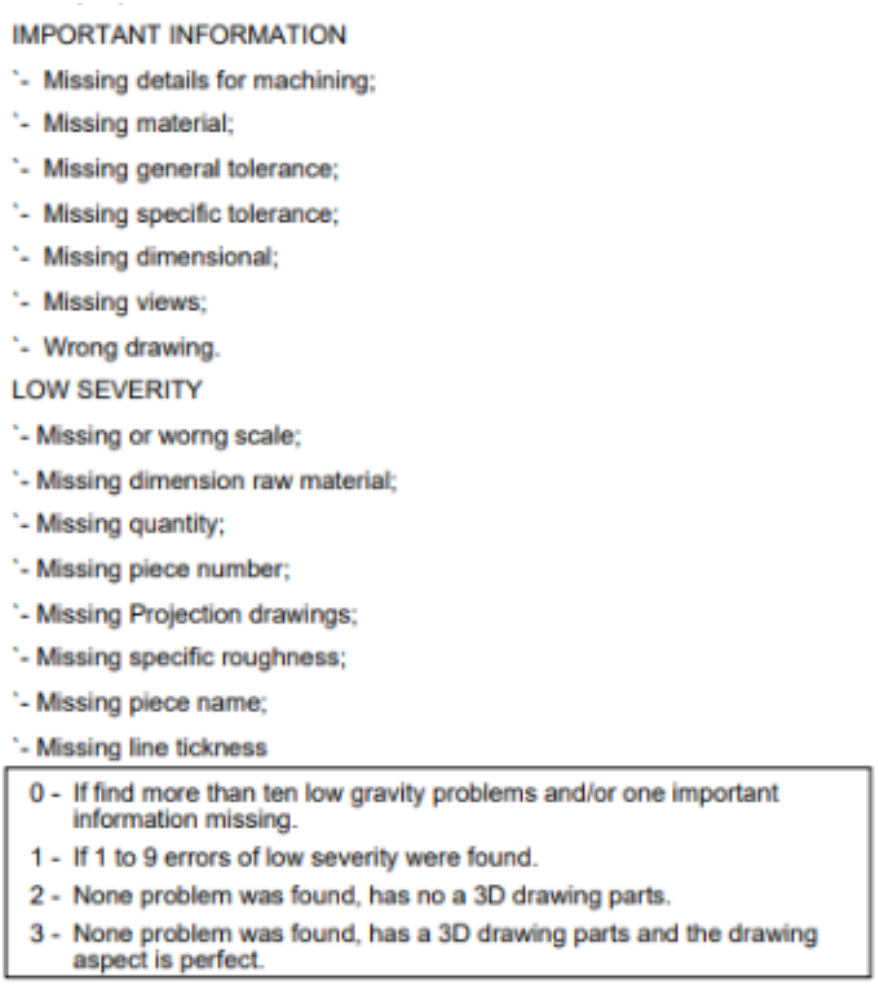
    Test: The teams PS shall be timed while being electrically powered, shredding/grinding the first 1Kg batch of plastic. The team must show the weight of their ground/shredded plastic of 1Kg or greater to stop the test and register a time. The fastest team to do this will receive 5 marks, the slowest team shall receive 0 marks. All other teams shall receive a proportional mark between.

Portfolio B Section A (20 Marks)

The teams will submit a set of drawings:

- 2D Manufacturing drawings for all components to be made. (Autodesk Inventor, AutoCAD or similar.) To be completed to ISO standards.
  Three drawings will be chosen at random and be marked to the following standards.

  1. 90% of all required drawings are submitted. (2 Marks)
  2. Three drawings selected at random. Important information and Low severity items will be assessed. The drawing will be marked according to the following: (9 Marks, 3 per drawing)



IMPORTANT INFORMATION

- Missing details for machining;
- Missing material;
- Missing general tolerance;
- Missing specific tolerance;
- Missing dimensional;
- Missing views;
- Wrong drawing.

LOW SEVERITY

- Missing or worng scale;
- Missing dimension raw material;
- Missing quantity;
- Missing piece number;
- Missing Projection drawings;
- Missing specific roughness;
- Missing piece name;
- Missing line tickness

0 - If find more than ten low gravity problems and/or one important information missing.
1 - If 1 to 9 errors of low severity were found.
2 - None problem was found, has no a 3D drawing parts.
3 - None problem was found, has a 3D drawing parts and the drawing aspect is perfect.

- 3D Assembly drawing(s). (Autodesk Inventor or similar) To be completed to ISO standards.
  1. Assembly drawing(s) contain all manufactured parts referenced with appropriate balloons and a BOM. (2 Marks)
  2. Assembly drawing(s) show all parts required, using standard or exploded

views. (2 Marks)

- Electronic block diagrams/drawings. (AutoCAD Electrical or similar). (5 Marks)

B. Manufacturing Costs (10 Marks)

Raw Material costs. (3 Marks)

Raw materials shall be costed as per piece purchased for anything not listed below, which shall be costed by weight or KWH.

Steel: £7 per kilo
Aluminium: £9 per kilo
All other metals: £12 per kilo
Plastic: £4 per kilo
Cardboard: £1 per kilo
Batteries: £0.5 per KWH

For any other item used you will need to provide the cost and a link to a place of purchase to prove the cost, using a suitable spreadsheet.

Each team shall provide 1 spreadsheet only, with all costs for the team detailed.
The lowest cost team after compliance has been applied to the cost shall receive 3 marks.
From this cost to 200% of this cost each team shall be given a proportional grade.
Any team over 200% of the cost shall receive 0 marks.

Example: The lowest cost is £50. Team 1
Team 2 has a cost of £70, this team shall receive 6 marks.
Team 3 has a cost of £90, this team shall receive 2 marks.
Team 4 has a cost of £110, this team shall receive 0 marks.

Team Working time: (4 Marks)

The team shall book, using the provided forms, the time used to complete the project.
The cost is £90 per hour per team. If one team member is working, all team members shall be costed.
Judges will calculate the cost and apply compliance.

The lowest cost team after compliance has been applied to the cost shall receive 4 marks.
From this cost to 200% of this cost each team shall be given a proportional grade.
Any team over 200% of the cost shall receive 0 marks.

Team Equipment usage: (3 Marks)

Supplied equipment shall be charged for use in 15-minute slots and must be booked on the supplied form. The costs are as follows:

Lathe: £25 per hour

Welding equipment: £20 per hour

Fabrication equipment: £15 per hour

Pillar drill: £10 per hour

Judges will calculate the cost and apply compliance.

The lowest cost team after compliance has been applied to the cost shall receive 3 marks.

From this cost to 200% of this cost each team shall be given a proportional grade.

Any team over 200% of the cost shall receive 0 marks.

Compliance.

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

Compliance to specification means that your marks for your built project will be calculated as a percentage and adjust your costings as follows.

$$\text{Final build cost} = \frac{\text{Total cost} \times 100}{\%\ \text{compliance to specification}}$$

Examples

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.

C. Portfolio A (20 Marks)

A portfolio is to be presented prior to the competition start. This portfolio is to be assessed as a component of this project. The portfolio is to be presented in hard copy in a folder and to include: -

- Team member details.
- Teamwork time taken for the build.
- Design calculations and sketches/drawings.
- The size and type of power supply used.
- A spreadsheet list of materials and components used with catalogue prices.
- Evidence of material and component costs that are not supplied.
- A description of the project solution including a 3D model of the design used