M23511- COMPUTER AIDED DESIGN
COURSEWORK 1:
DESIGN OF A THREE PIN PLUG

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Contents

1. Introduction 3
2. Analysis of existing product 3
2.1 Ergonomic aspects and usability 3
2.2 British Standards 4
2.3 Identify materials and component weight 9
3. Recreation of existing product in CAD 9
3.1 Individual part modelling 9
3.2 Assembly 11
3.3 Exploded View 13
4. Proposed design solution 14
4.1 Ideas and drawings 14
4.2 CAD modelling 16
4.3 Design communication (Technical Drawings, Renders, Prototyping) 18
5. Evaluation and Conclusions 20
6. References 20

Table of figures

Figure 1: Selected existing product 3
Figure 2: BS 1363 Torque values for screws and nuts 5
Figure 3: Dimension and disposition of pins 6
Figure 4: Dimension and disposition of pins (2) 7
Figure 5: Gauge for plug pins 8
Figure 6: Bottom case and big plug 10
Figure 7: Top case and small plug 10
Figure 8: Assembly of the different parts 11
Figure 9: Rendered assembly of the different parts with materials 12
Figure 10: Exploded view of the model 13
Figure 11: Exploded view of the model with materials 13
Figure 12: Sketch of the redesign product 14
Figure 13: Front and side view of the redesign product 15
Figure 14:Top view of the redisgn product 15
Figure 15: Model of the new fingers holder 16
Figure 16: Redesigned model of the product 16
Figure 17: Redesigned model of the product with materials 17
Figure 18: Big plug detail drawing 18
Figure 19: Assembly drawing 18
Figure 20: Rendered redesign product 19
Figure 21: Rendered redesign product 19

1. Introduction

In the world of design and innovation, there is always room for improvement in terms of the needs of the modern world. Having studied the basic features and functions of a BS 1363 three pin plug, an existing model has been redesigned to try and help with some of the difficulties experienced by some consumers when using the product.

You can see the individual designs of the different parts of the existing product, as well as the assembly and exploded view. After that you can see the assembly and detail drawings of the redesign of the product, as well as the ideas and sketches.

2. Analysis of existing product

2.1 Ergonomic aspects and usability

The selected existing product is a power cord with a BS 1363 ball outlet. An aesthetically simple product which has a clear defect, the side channels for the grip are too shallow and not wide enough. The use of the product is within the reach of many people, but as you will see below, there are consumers who will have problems with it.

Figure 1: Selected existing product

2.2 British Standards

Conditions of Use for UK Plugs:
Plugs shall be suitable for use under the following conditions:

a) An ambient temperature in the range -5 to +40Cº, the average value over 24 h not exceeding 25Cº.
b) A situation not subject to exposure to direct radiation from the sun or other source of heat likely to raise temperature above the limits specified in a) above.

c) An altitude not exceeding 2000 m above sea level.

d) An atmosphere not subject to abnormal pollution by smoke, chemical fumes, rain, spray, prolonged periods of high humidity or other abnormal conditions.

Classification:

- Rewirable or non-rewirable
- Switched or unswitched
- For normal use or rough use
- For electric vehicle (EV) charging
- Fitted with screw or clamp type (screwless) terminals
- For non-rewirable plugs for class II applications only, fitted with an un-terminated brass earth pin or ISOD

Provision for earthing:

-Conformity shall be checked by inspection and the following:

For metal parts connected to an earthing terminal or earthing plug pin, by the following test. A current of 25 A +0.75 A, derived from an a.c, source having a no-load voltage not exceeding 12 V, is passed for 60 s between the remote end of the protective conductor of a 3-care flexible cable (cut to a length of 150 mm ±5 mm measured from the nearest edge of the earthing pin) and the remote end of the earthing plug pin and any accessible metal part intended to be earthed, taking account of the following:

1) for non-rewirable plugs, the manufacturer' s connection is tested as supplied, with the flexible cable cut to a length of 150 mm ±5 mm measured from the nearest edge of the earthing pin, precoiled flexible cables being extended before measurement.

2) for rewirable plugs, 1.25 mm^2 flexible cable conforming to BS EN 50525-8-11-2011 shall be used:

I) for screw-type terminals the clamping screw shall be tightened with a torque equal to two thirds of the appropriate value given in Figure 2.

II) for clamp type (screwless) terminals the connection shall be made in accordance with the manufacturer's instructions.

The resistance between the earthing terminals or termination and any other nominated metal part shall not exceed 0.05Ω.

Torque values for screws and nuts:

Declared diameter of screw thread	Torque (see Note 1)		
	For metal screws (see Note 2)	For other metal screws and nuts	For screws of insulating material
mm	Nm	Nm	Nm
Up to and including 2.8	0.2	0.4	0.4
Over 2.8, up to and including 3	0.25	0.5	0.5
Over 3, up to and including 3.2	0.3	0.6	0.6
Over 3.2, up to and including 3.6	0.4	0.8	0.6
Over 3.6, up to and including 4.1	0.7	1.2	0.6
Over 4.1, up to and including 4.7	0.8	1.8	0.9
Over 4.7, up to and including 5.3	0.8	2.0	1.0
Over 5.3, up to and including 6	—	2.5	1.25

NOTE 1 The recording of a measured value given in this table is considered to conform to this part of BS 1363 on condition that the uncertainty of measurement at not less than 95% confidence level does not exceed ±10%.

NOTE 2 This column applies to metal screws without heads if the screw when tightened does not protrude from the hole, and to other metal screws which cannot be tightened by means of a screwdriver with a blade wider than the diameter of the screw.

Figure 2: BS 1363 Torque values for screws and nuts

Construction of plugs:

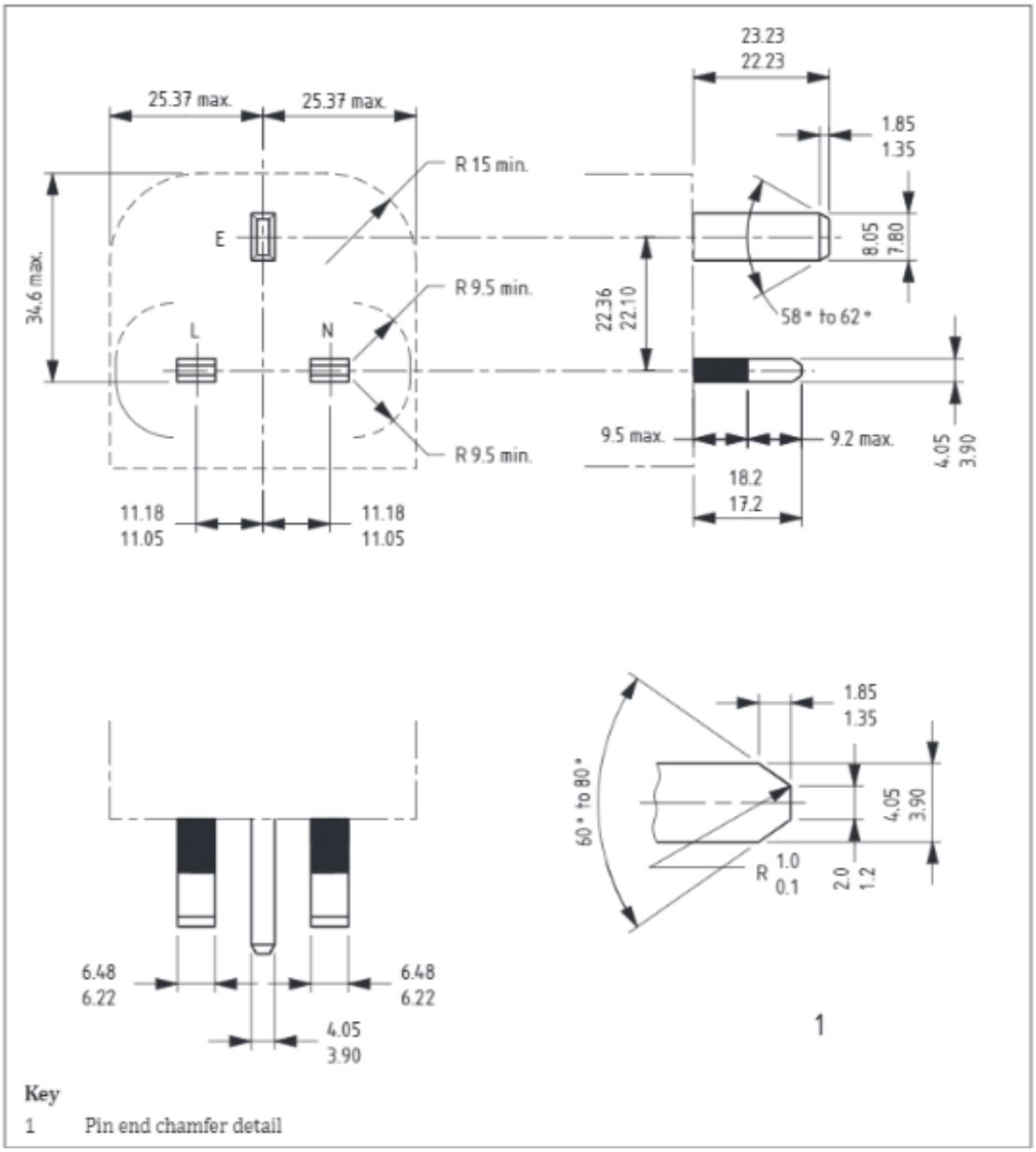
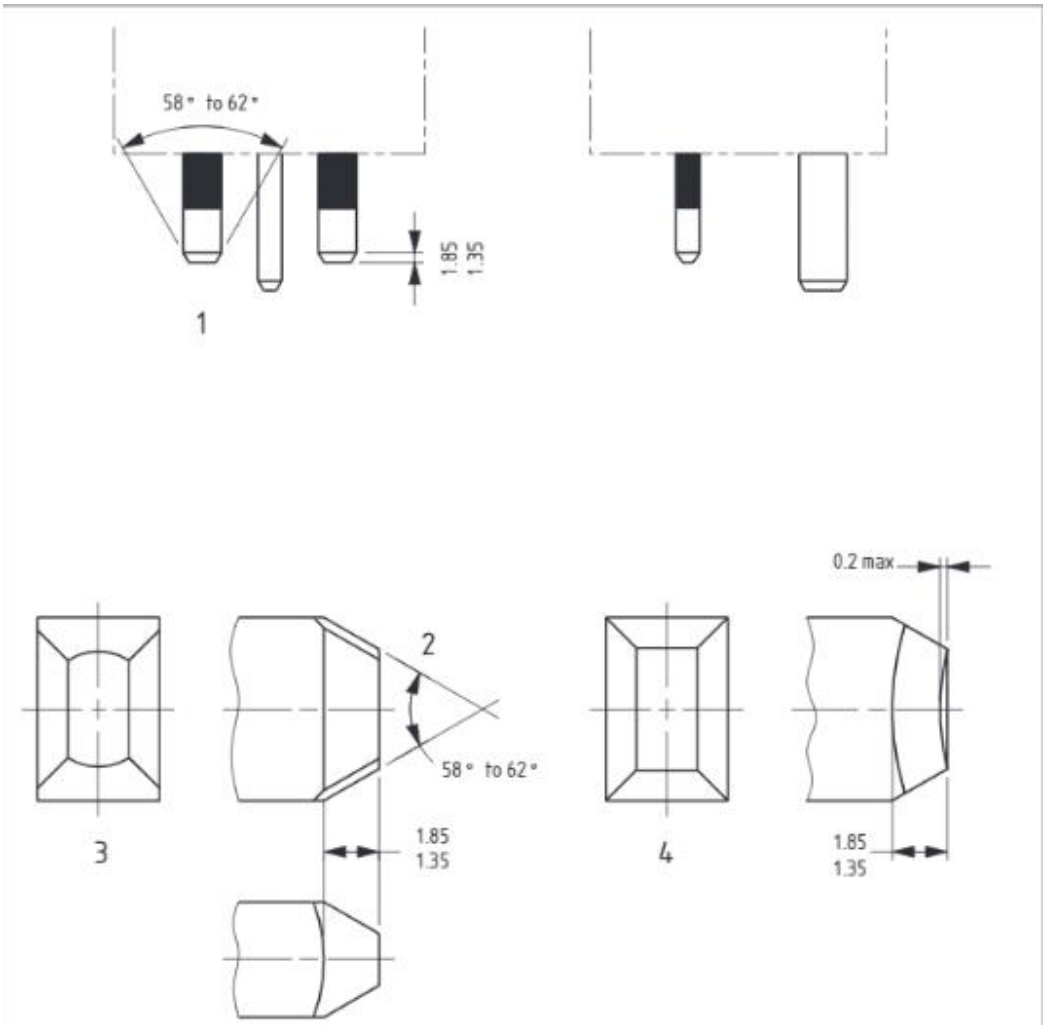


Figure 3: Dimension and disposition of pins



Key

1 Permitted additional chamfers on L and N pins (if additional chamfer is used it has to be on both pins)

2 58° to 62° cone

3 Alternative method of forming 58° to 62° included chamfer on pin ends

4 Alternative method of forming main chamfer on pin ends

NOTE 1 Dimensions are in millimetres.

NOTE 2 External edges of pins are to be free from burrs or sharp edges and may have a radius not exceeding 1 mm.

NOTE 3 The surfaces of pins are to be flat within the specified tolerances.

Figure 4: Dimension and disposition of pins (2)

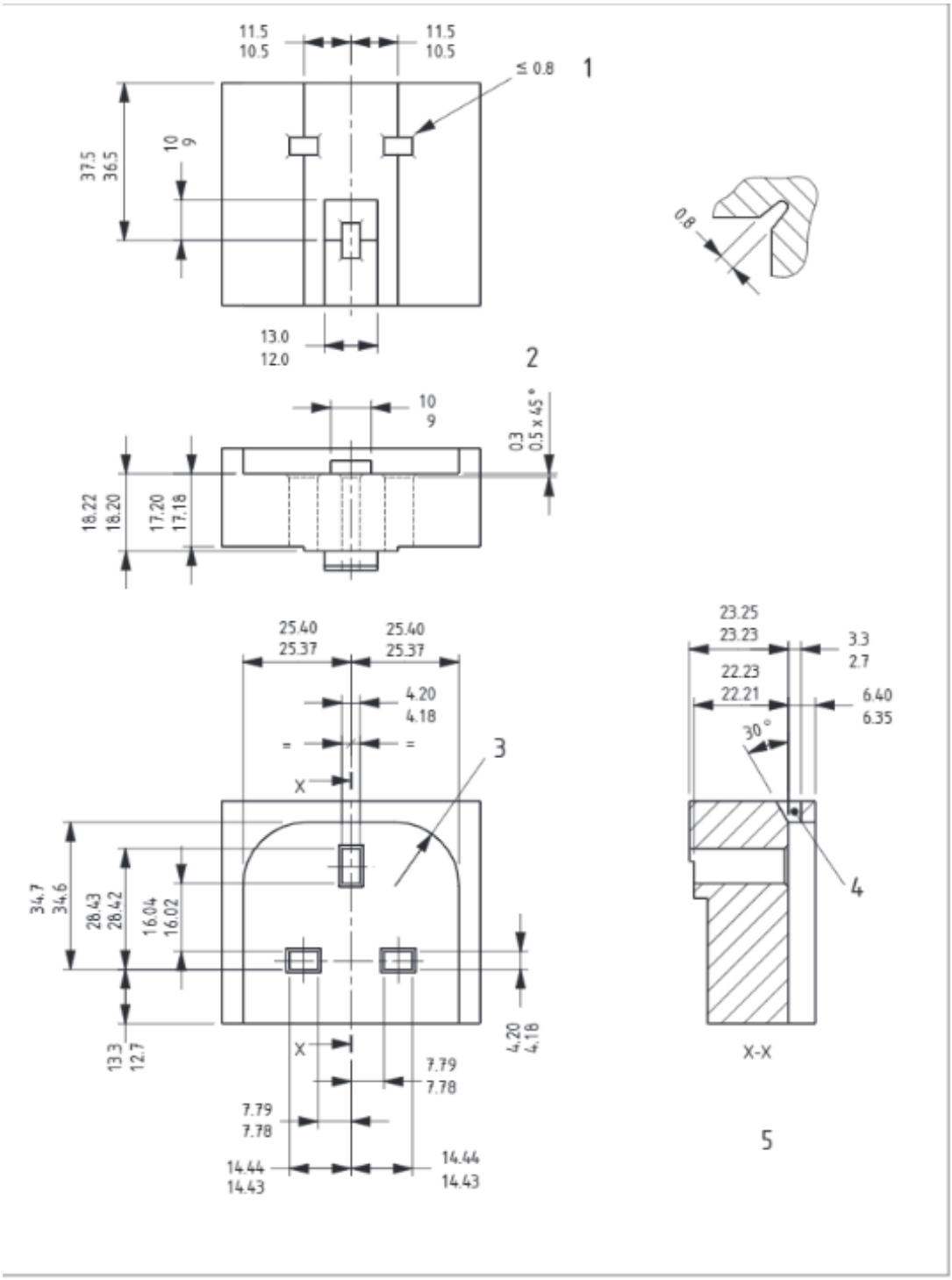


Figure 5: Gauge for plug pins

2.3 Identify materials and component weight

The case or cover, three pins, a fuse, and a cable grip make up a plug. The plastic or rubber pieces that enclose a plug are known as the case. Because plastic and rubber are insulators, they are used. Because brass is a good conductor of electricity, the pins within the plug are constructed of brass. If the electrical current is too high, the fuse stands between the pin and the terminal and breaks the circuit. It is essentially a safety feature that appliances have if they are found to be defective. A cable grip secures the cable as it is introduced into the plug, gripping the cable itself rather than the wires inside the cable. (Sam, 2015) (Mullins, 2006) (Saptari, 2015) (EATON, 2022)

After a research in the online market of several similar products, in this case 3 pin plug BS 1363, an average weight of approximately 45 grams has been conceived after the sum of the weights of all the components of the product.

3. Recreation of existing product in CAD

3.1 Individual part modelling

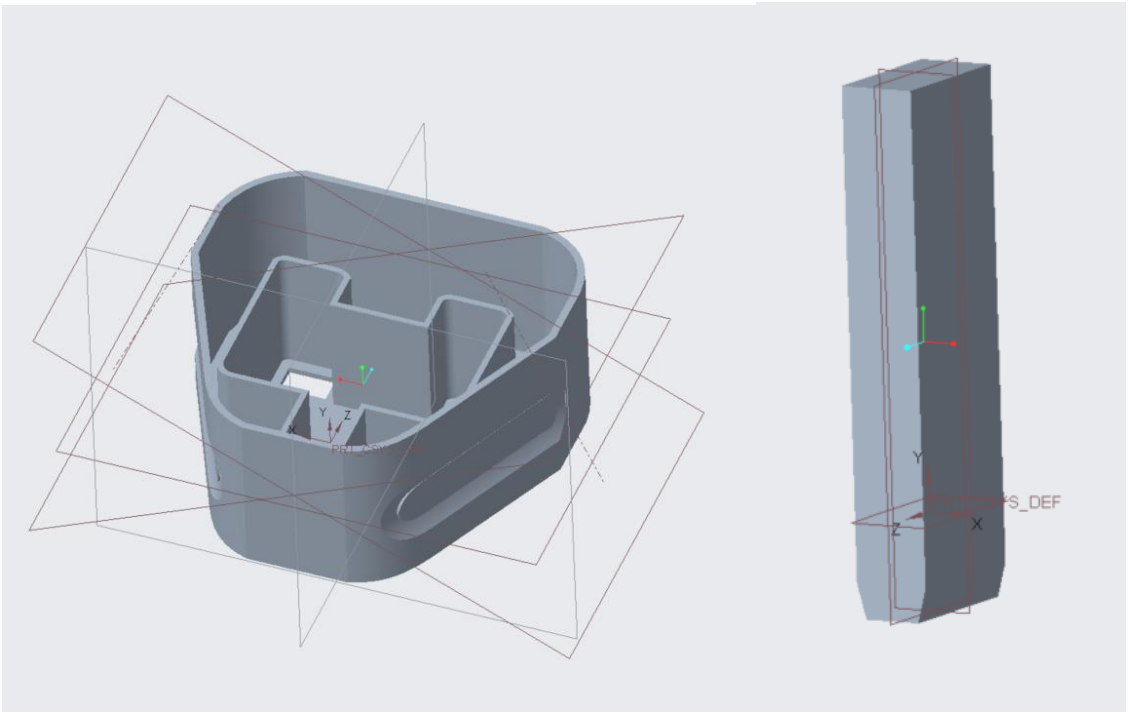


Figure 6: Bottom case and big plug

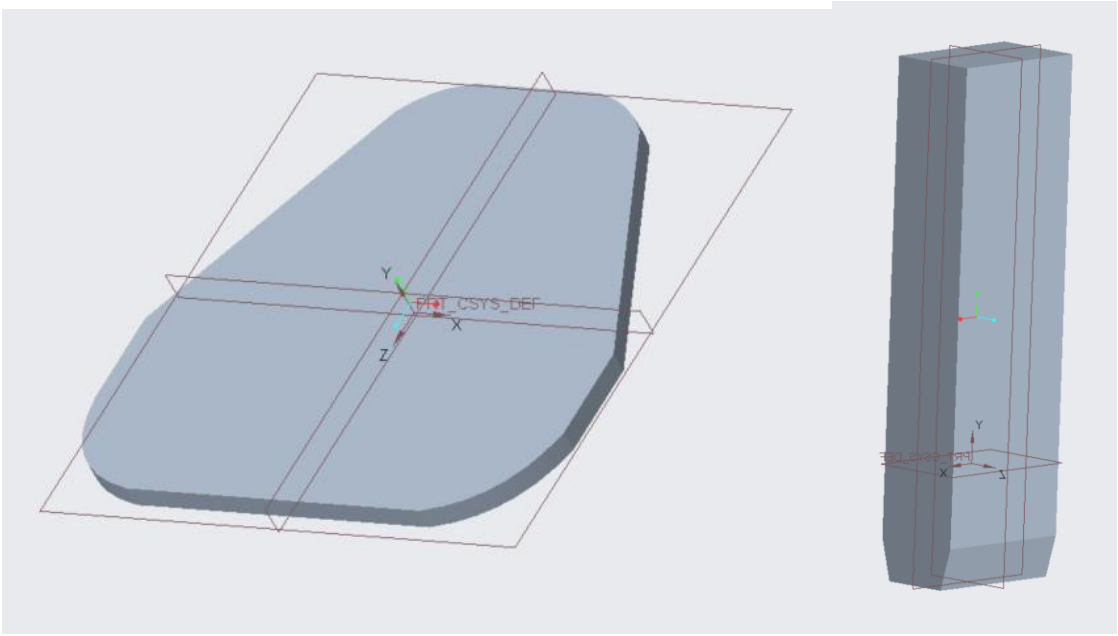


Figure 7: Top case and small plug

3.2 Assembly

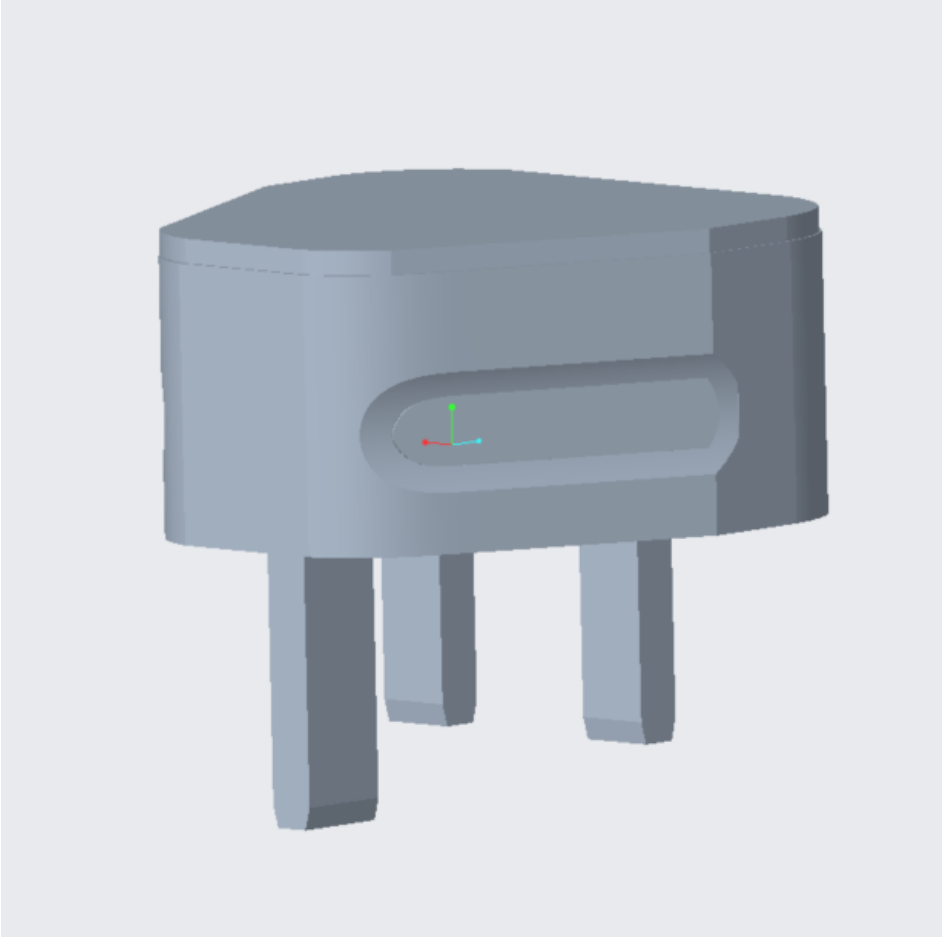


Figure 8: Assembly of the different parts

Figure 9: Rendered assembly of the different parts with materials

3.3 Exploded View

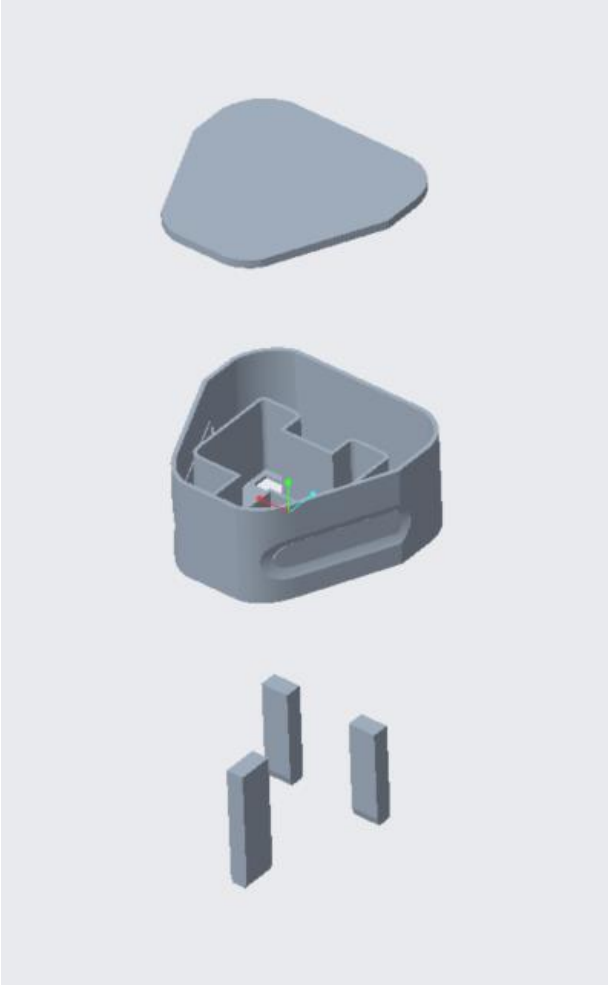


Figure 10: Exploded view of the model

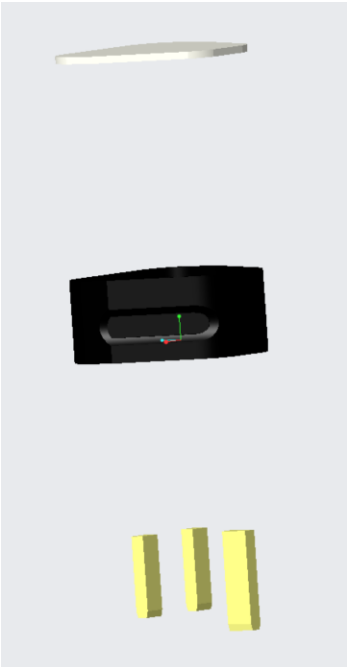


Figure 11: Exploded view of the model with materials

4. Proposed design solution

4.1 Ideas and drawings

As mentioned in the section "Ergonomic aspects and user-friendliness", the lateral grip channels are too shallow and not wide enough, which prevents a good number of consumers from using the product comfortably. People suffering from hand diseases such as carpal tunnel syndrome, multiple sclerosis, arthritis of the hands, tendinitis of the thumb, etc., should not use this product. Or an elderly person who no longer has strength in their fingers, will find it very difficult to unplug the product. For this reason, the redesign of the product has a half-arch finger holder that will make it much more comfortable to use the lever to unplug the device.

Figure 12: Sketch of the redesign product

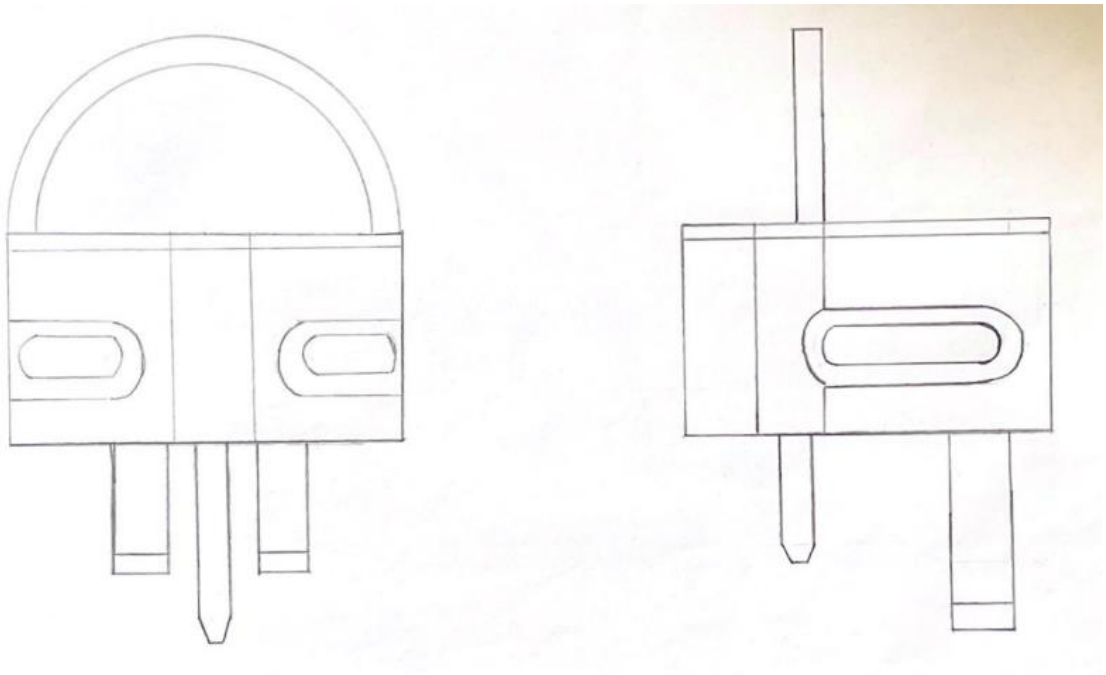


Figure 13: Front and side view of the redesign product

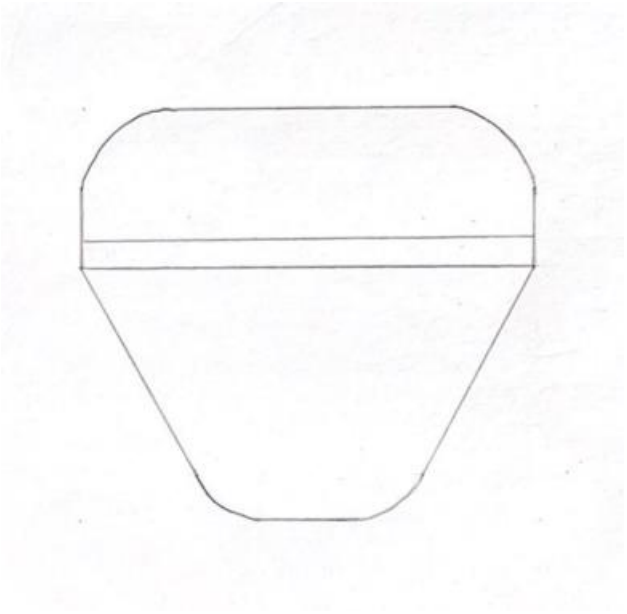


Figure 14:Top view of the redisgn product

4.2 CAD modelling

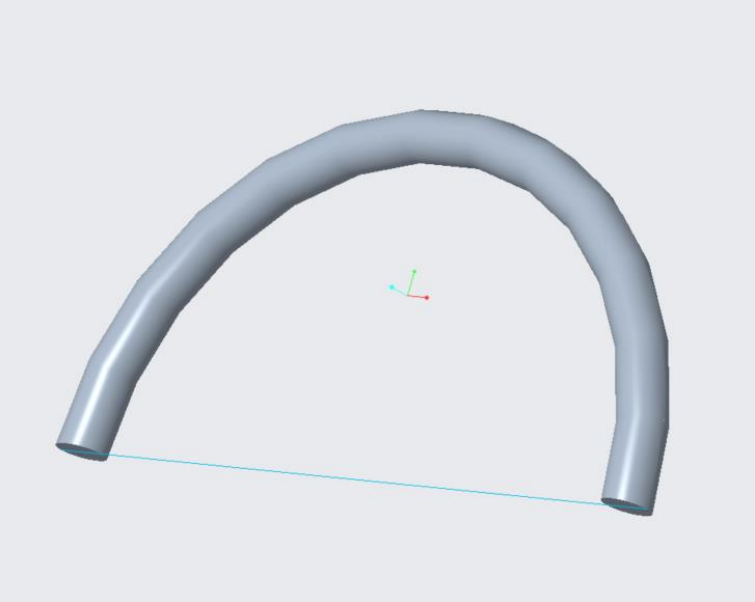


Figure 15: Model of the new fingers holder

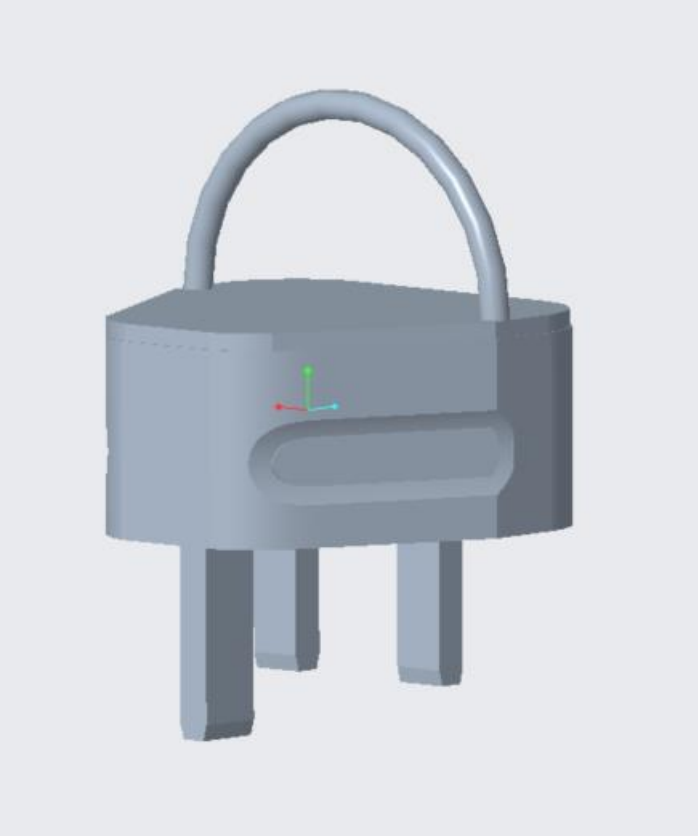


Figure 16: Redesigned model of the product

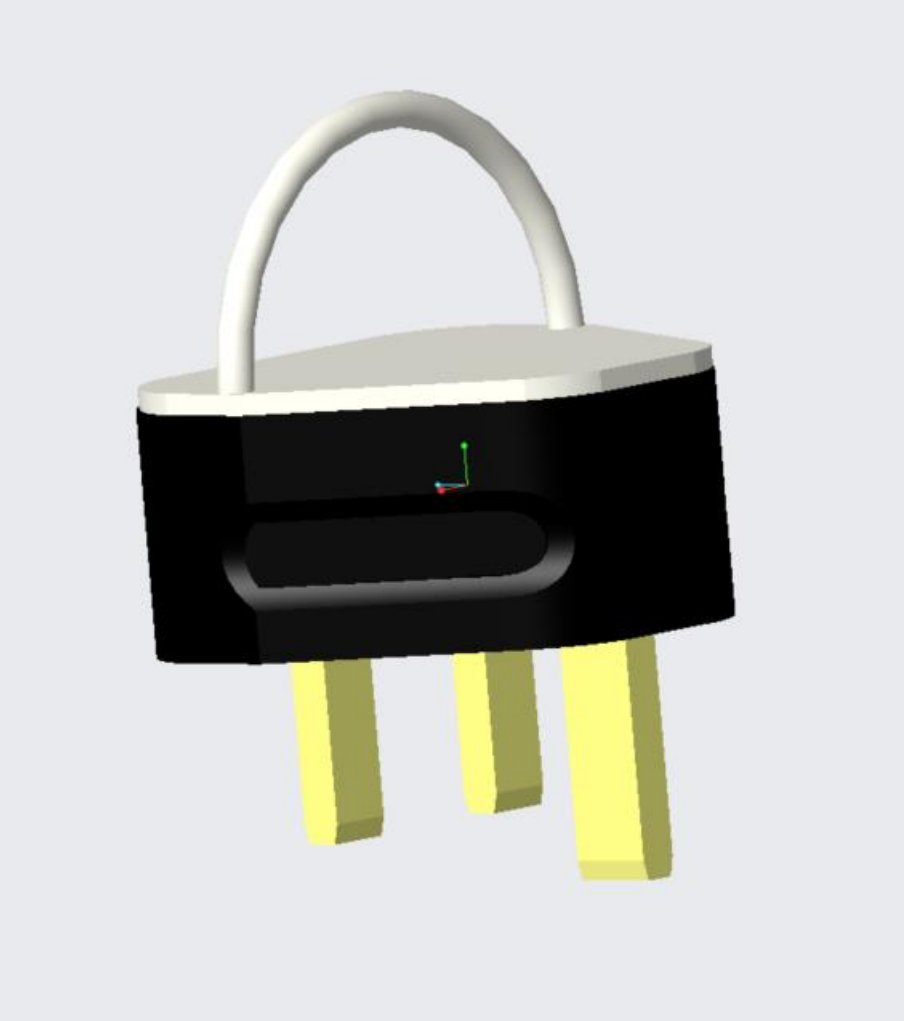


Figure 17: Redesigned model of the product with materials

4.3 Design communication (Technical Drawings, Renders, Prototyping)

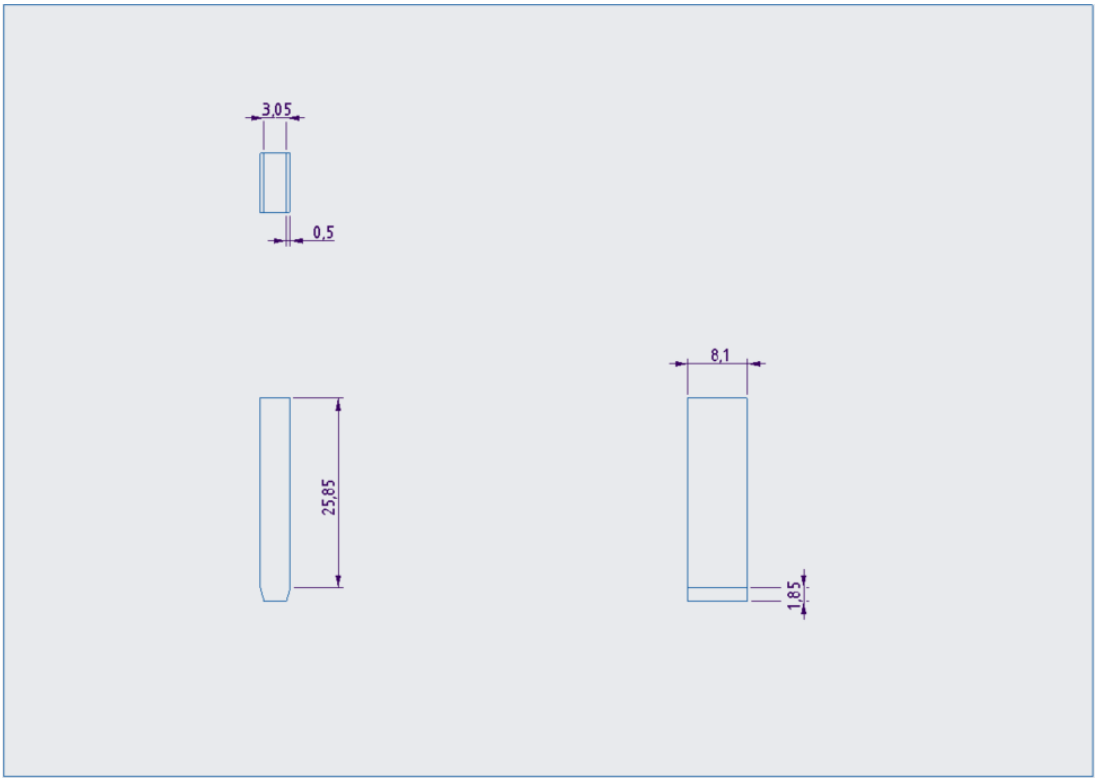


Figure 18: Big plug detail drawing

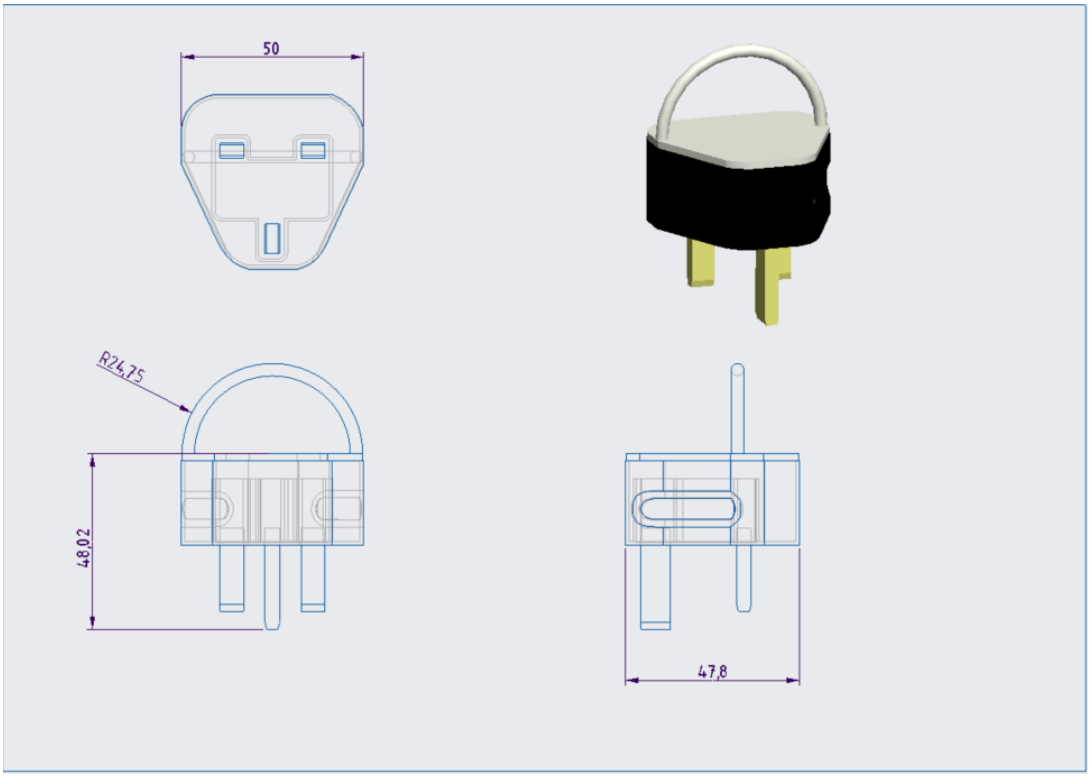


Figure 19: Assembly drawing

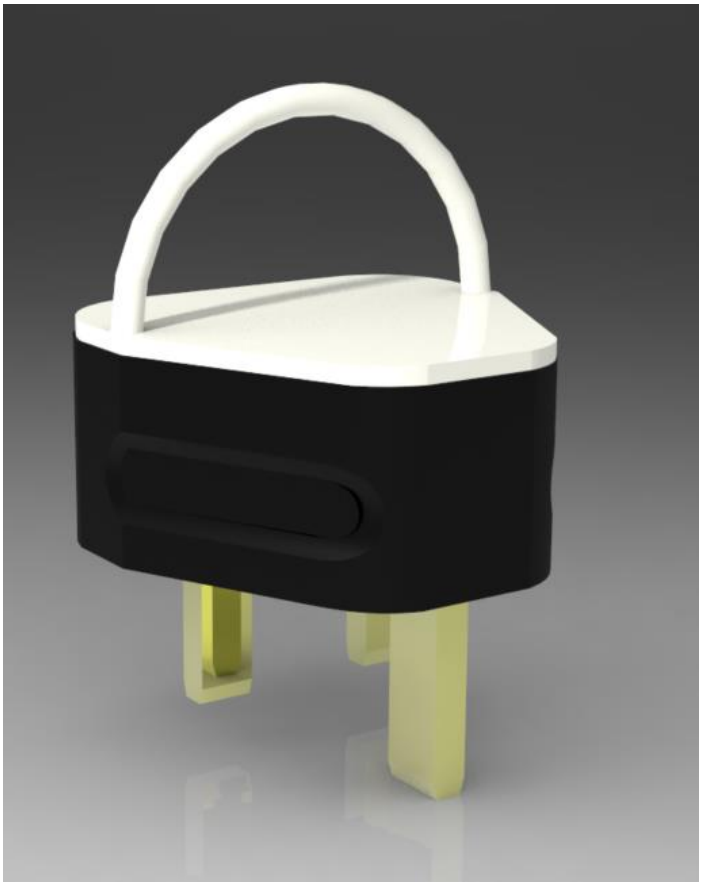


Figure 20: Rendered redesign product

Figure 21: Rendered redesign product

5. Evaluation and Conclusions

Many products need to be improved, they need to adapt to new situations, to the passing of time, to new demands and to new technologies. It is not always necessary to change a lot of things or make a complex redesign to improve a product, many designers have achieved success by simply changing or adding a grain of sand. A socket with a basic problem for people with a handicap or simply lack of strength can be greatly improved by a simple detail such as a hook or a finger support. Surely, these people would appreciate this extra help when they are in a difficult situation like when the plug is too hard and won't come out. A small change can help a lot of people.

6. References

EATON. (2022). *UK Computer Power Cord, C19 to BS1363, 13A, 250V, 16 AWG, 8 ft. (2.43 m), Black*. Retrieved from tripplite.

Institution, B. S. (2016). *13 A plugs, socket-outlets, adaptors and connection units. Specification for rewirable and non-rewirable 13 A fused plugs*. Retrieved from bsol.bsigroup: https://bsol.bsigroup.com/Bibliographic/BibliographicInfoData/000000000030365272

Mullins, M. (2006). The origin of the BS1363 plug and socket outlet system. *Writing Matters*, 6-8.

Sam, M. (2015). *Basic Electrics: How to Correctly Wire a Plug*. Retrieved from buildingmaterials.

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