COURSEWORK ASSIGNMENT

AN INTRODUCTION TO 3D MODELLING AND DRAWING ON PTC CREO 2.0

University of Strathclyde
Engineering

Name: Guillaume Picard
Registration No.: 201321018
Degree Course: BEng Hons Aero-Mechanical Engineering
Class: 16165 – Engineering Analysis 1

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INTRODUCTION

Creo is a product design software (current stable release: Creo 2.0) launched in 2011 and developed by PTC Inc., a software design company which provides solutions for 2-D and 3-D Computer Aided Design (CAD) amongst its range of other programs for applications in areas such as Product Lifecycle Management (PLM) or Supply Chain Management (SCM). Creo enables its user to create, simulate, analyze and view discrete manufacturing products[1] through a scalable suite of product design apps.

In spite of its various capabilities for simulation and analysis, the task at hand explored the process behind the drawing and modelling of a manufactured product, while taking into account the various design specifications with relation to the chosen model. These specifications, when drawing the model, can involve aspects of design intent, parent/child relationships, bi-directional associativity and parametric relationships. Explorations into the possible manufacturing processes and finishes behind the model also need to be considered. This report hopes to explore the previously discussed design and manufacturing features, as well as provide comprehensive and detailed 2D and 3D drawings for our chosen object, a travel adapter for the UK.

[1] PTC Inc. 2013, *PTC Creo*. Available from: < http://www.ptc.com/product/creo/ >. [7 December 2013]

Design Brief

Our chosen object was an SMJ Travel Adapter for use in 3-pin UK plugs.

The way the components of the adapter come together in a final assembly will depend on our design intent for the object. Firstly, it is obvious that our design depends on a number of standardized parts; for example, the size of the fuse and the relative distances and dimensions of the 3-pin plug are governed by British Standards regulations[2]. This will affect the parametric relationship between elements in the design during the modelling stage, and we will intend to base our modelling around these standardized parts as their dimensions cannot change. However, as ratios need to be preserved (looking at the object we can say that the plug is located in the upper half of the adapter), we intended to locate the plug relative to the shape and ratio of the adapter shell while conserving the standard dimensions of the plug and fuse.

[2] The British Standards Institution 2013, *BS1362, BS1363*. Available from: < http://www.bsigroup.com/>. [7 December 2013]

There were a variety of parent-child relationships within individual parts, especially with regards to the more complex shapes for the copper connections behind the plugs. Despite efforts to measure these parts as accurately as possible, it was often difficult to determine exact values thus resulting in regeneration errors within the Creo software. The parent-child relationships defined for individual parts, along with the bi-direction associativity defined through the flexible modelling function in assembly, enable quick rectification of regeneration errors by editing a dimension which extended through the parent-child relationship of the individual part and the bi-directional associativity of the assembly with other parts. This was particularly crucial when aligning and fitting screws or centrelines to holes and fitting components within fixed dimensions in the assembled product.

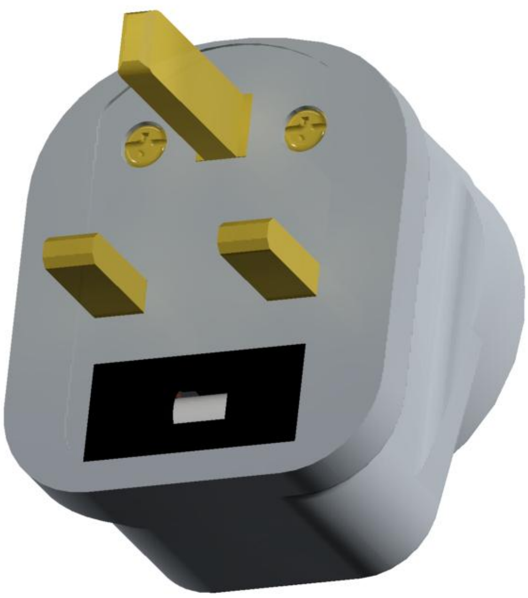
By ensuring that the parent-child relationships were well defined within the individual parts, and enabling flexible modelling enabling bi-directional associativity in assembly enabled us to effectively take advantage of the parametric relationships between elements without worrying about the possible regeneration failures of solids in Creo. Of course, it was essential to identify the intention of our design in order to correctly define these elements.

3D Assemblies and Part views

Final Assembly

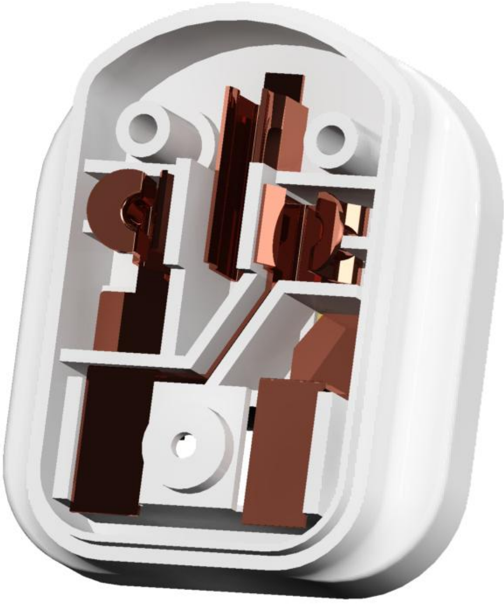
Final Assembly view - Rear

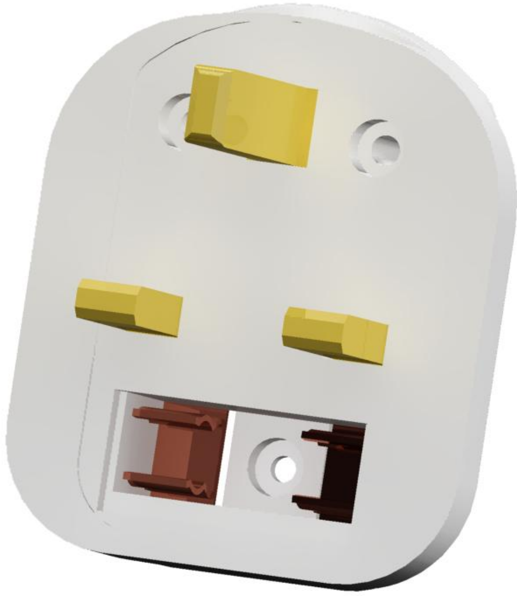
Final Assembly view - Front



Subassemblies

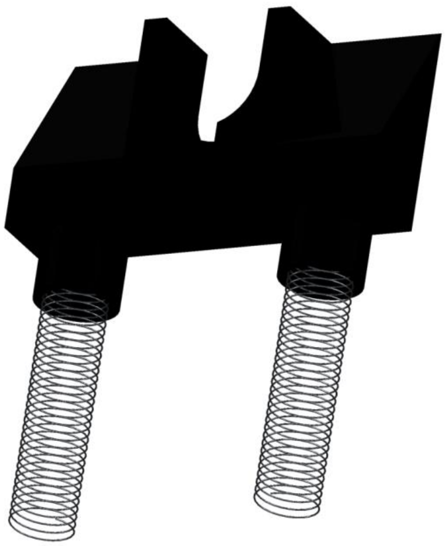
Front Adapter Plug Subassembly



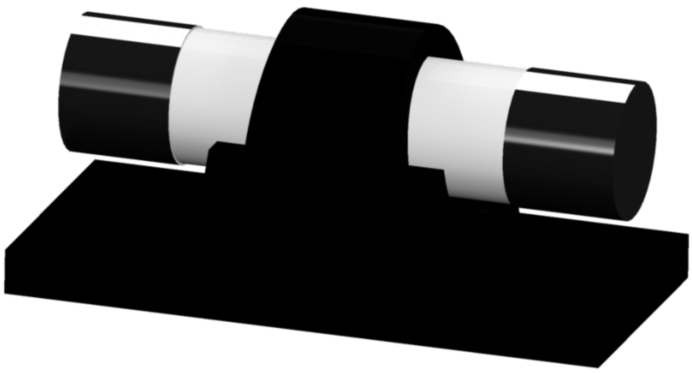


Back Adapter Plug Subassembly

Plug-guard Subassembly

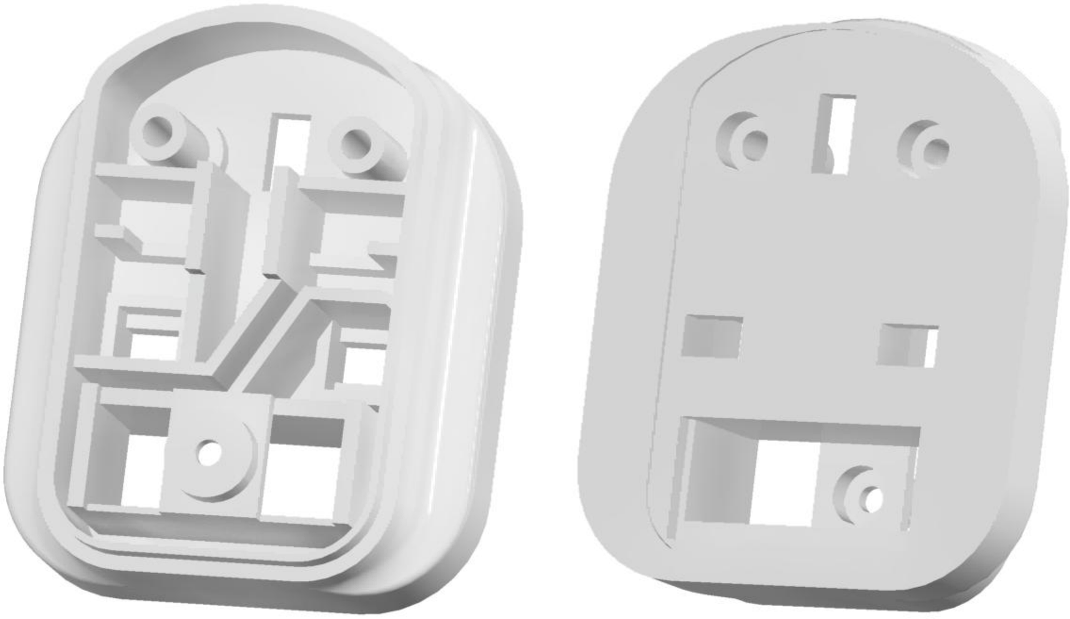


Fuse holder Subassembly

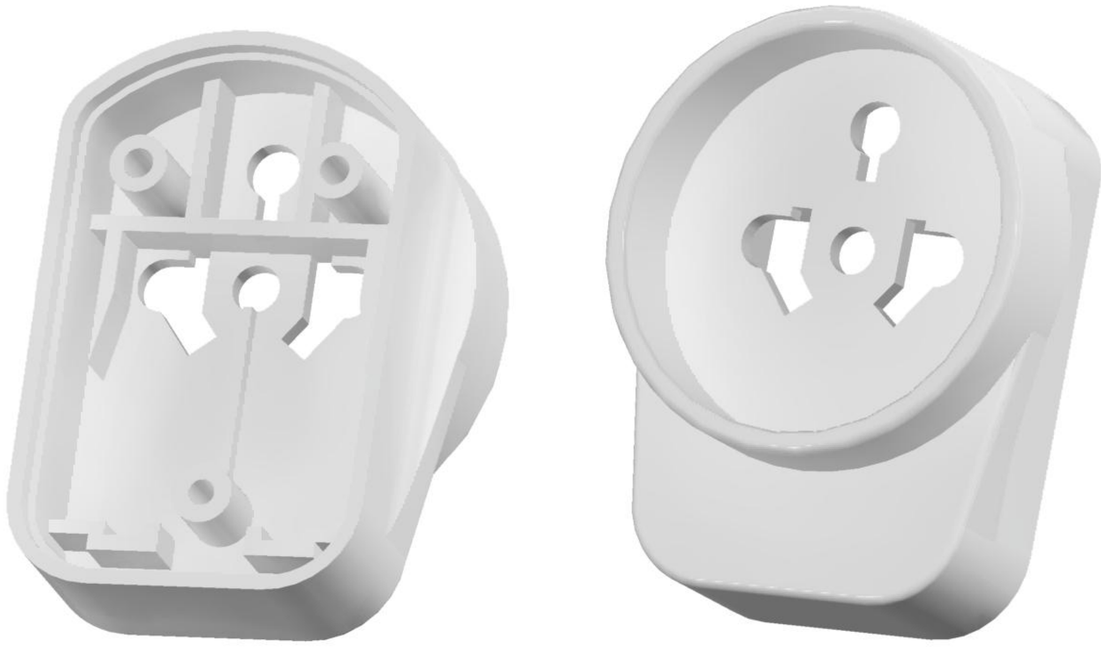


Individual Part Models

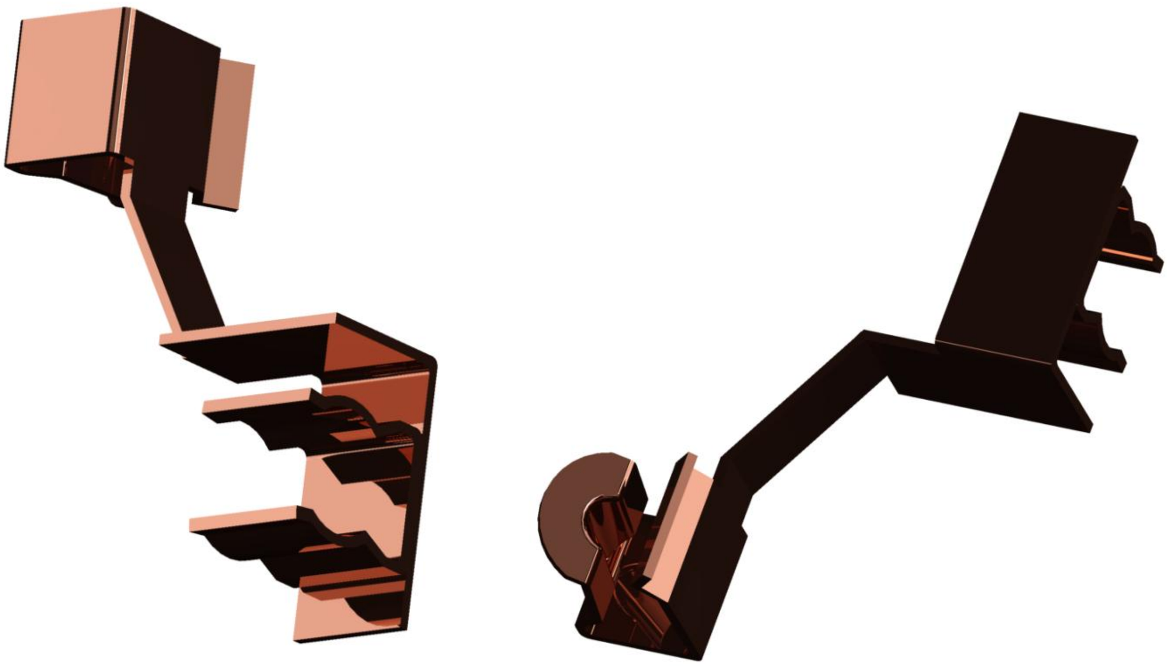
Front Adapter Casing



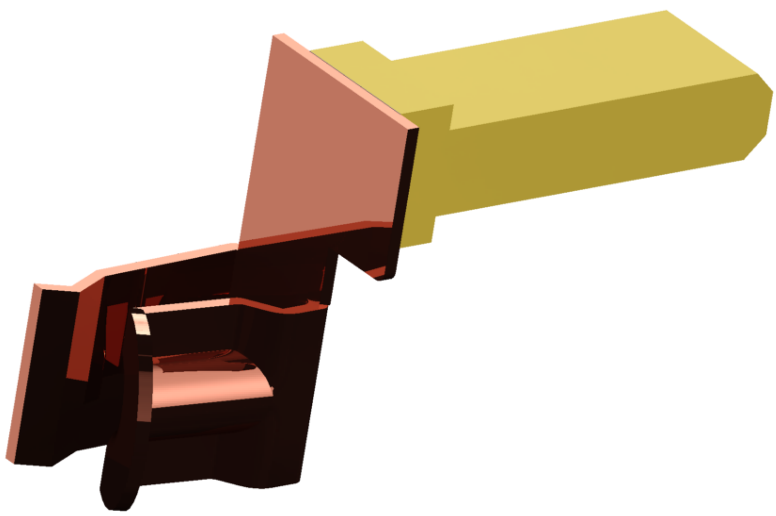
Rear Adapter Casing



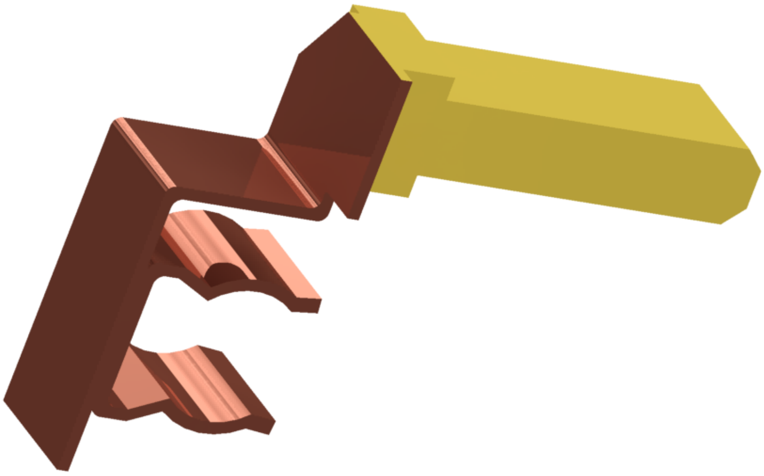
Fuse to Input Plug Connector



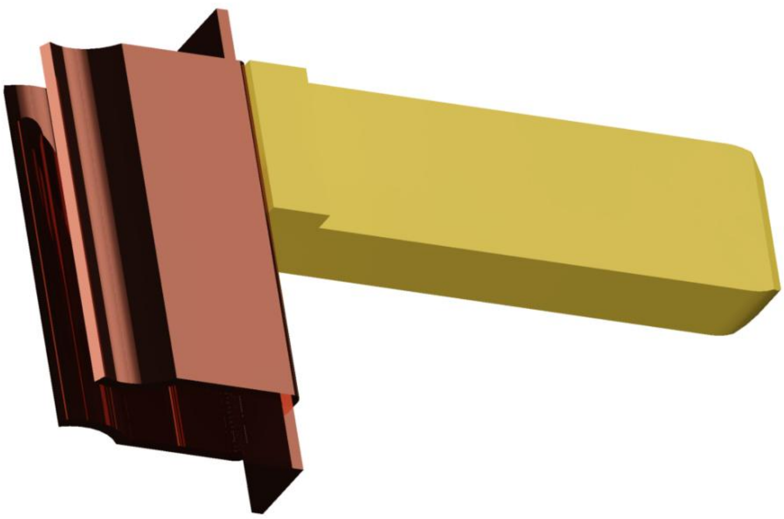
Right Plug 3-pin Output



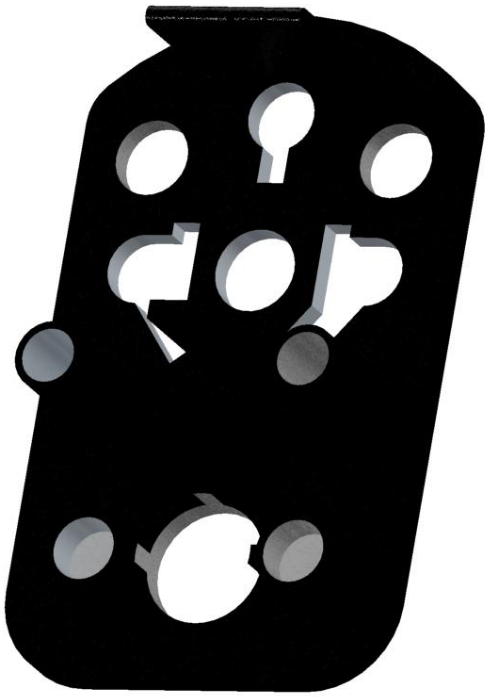
Left Plug 3-pin Output



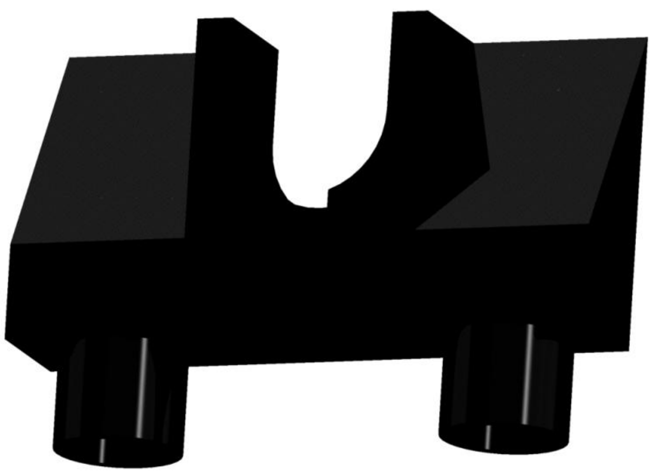
Ground Plug 3-pin Output



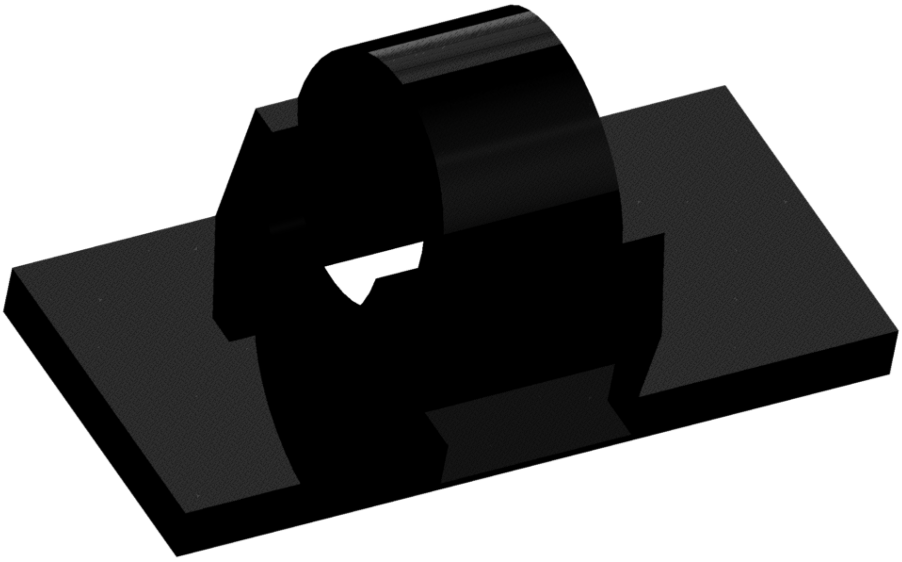
Separator Plate



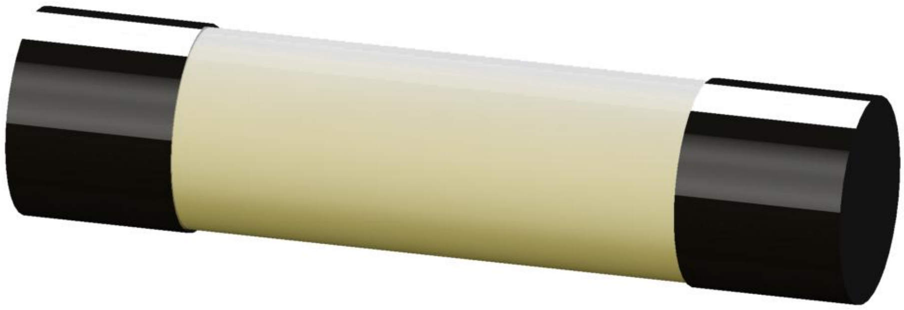
Plug-guard



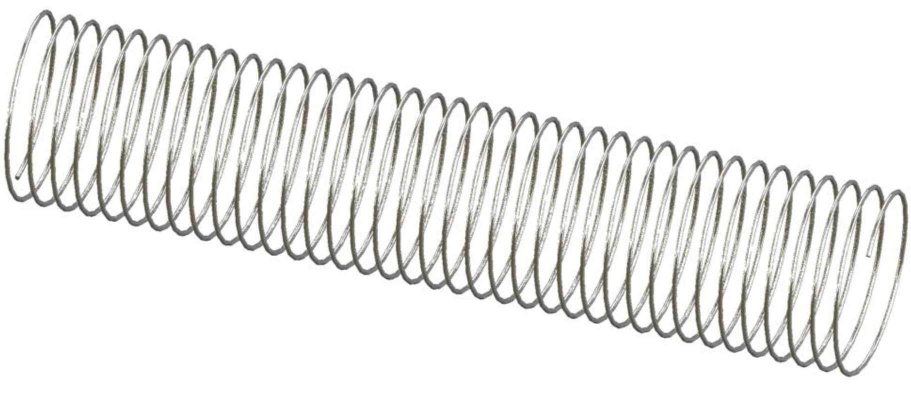
Fuse Holder



Fuse

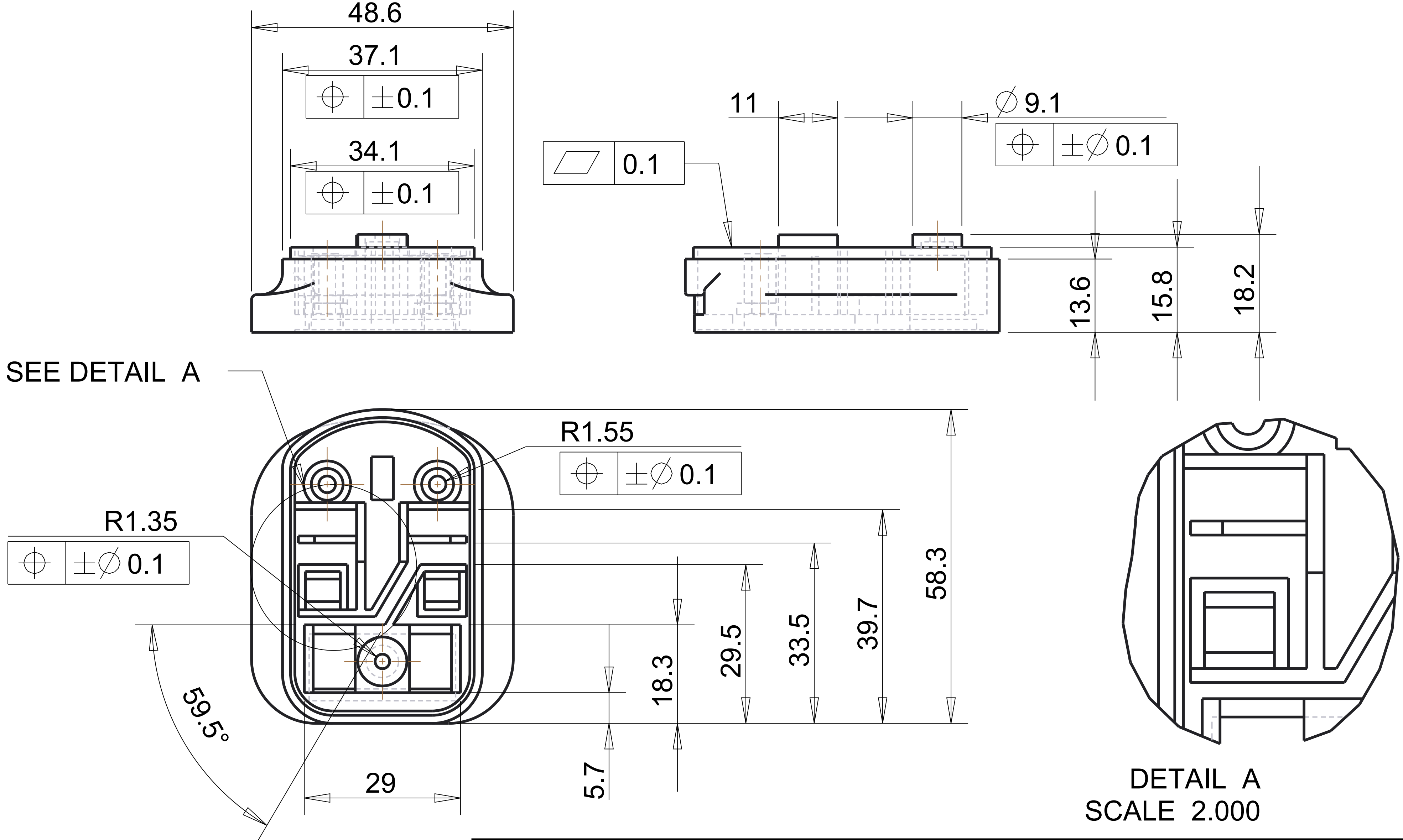


Plug-guard Spring

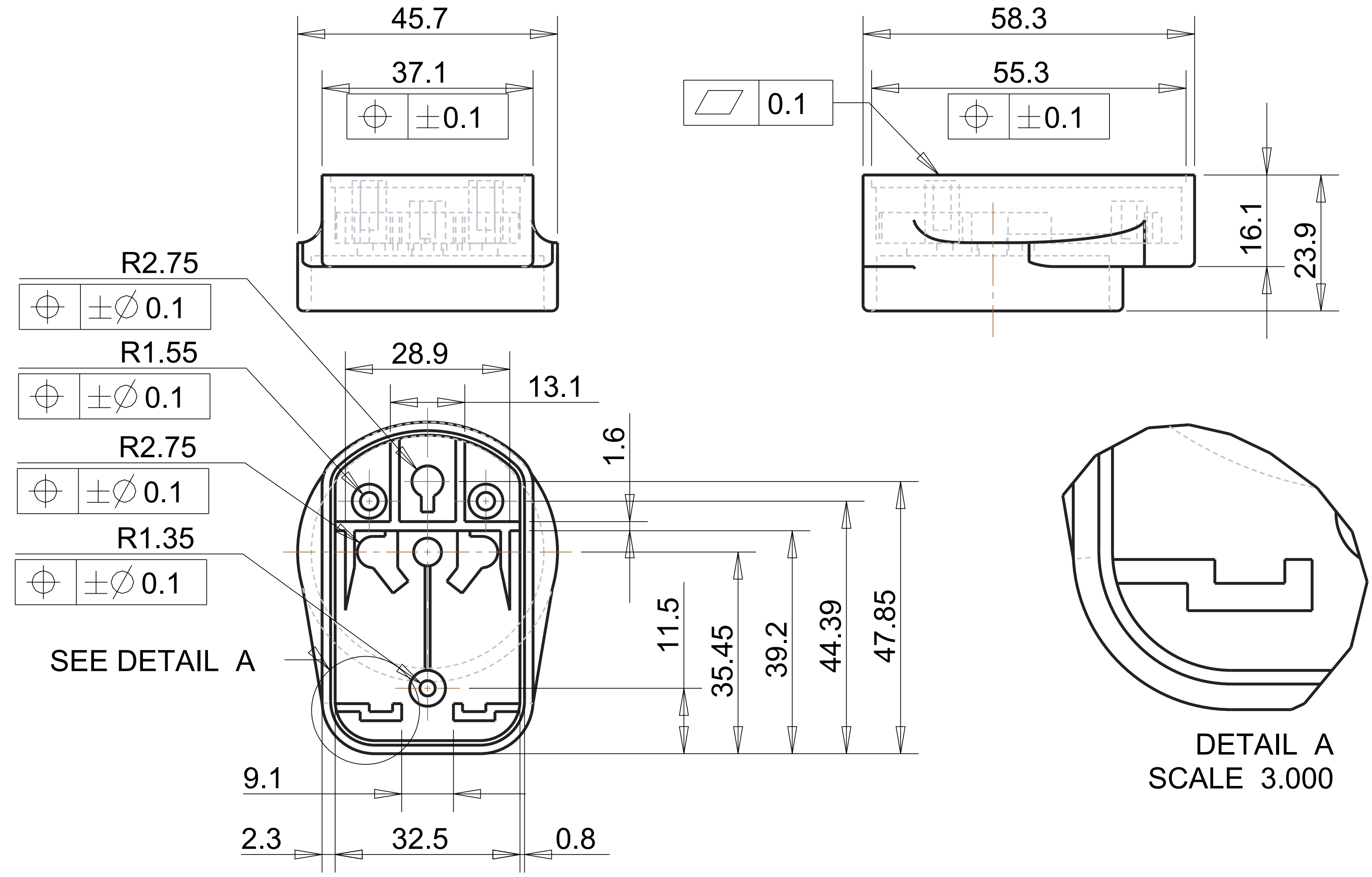


ORTHOGRAPHIC DRAWINGS OF INDIVIDUAL PARTS

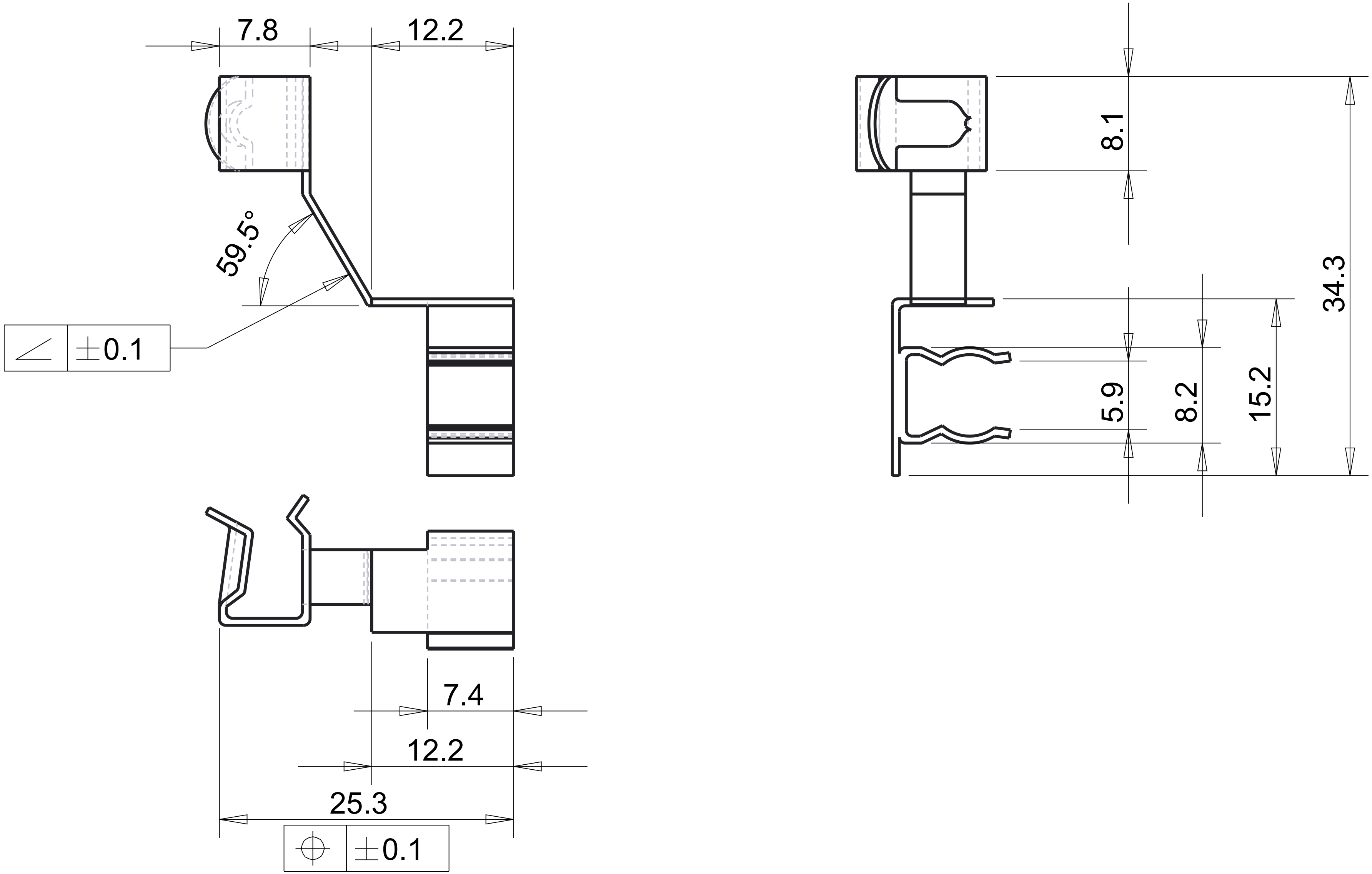
In this section, we will develop and detail individual parts through a variety of orthographic views. Certain parts will also contain manufacturing tolerances, scrap views, local sections as well as sections. This section will attempt to define and describe the object in as much detail as possible, and a final exploded assembly view will briefly outline the various materials which are comprised within the travel adapter



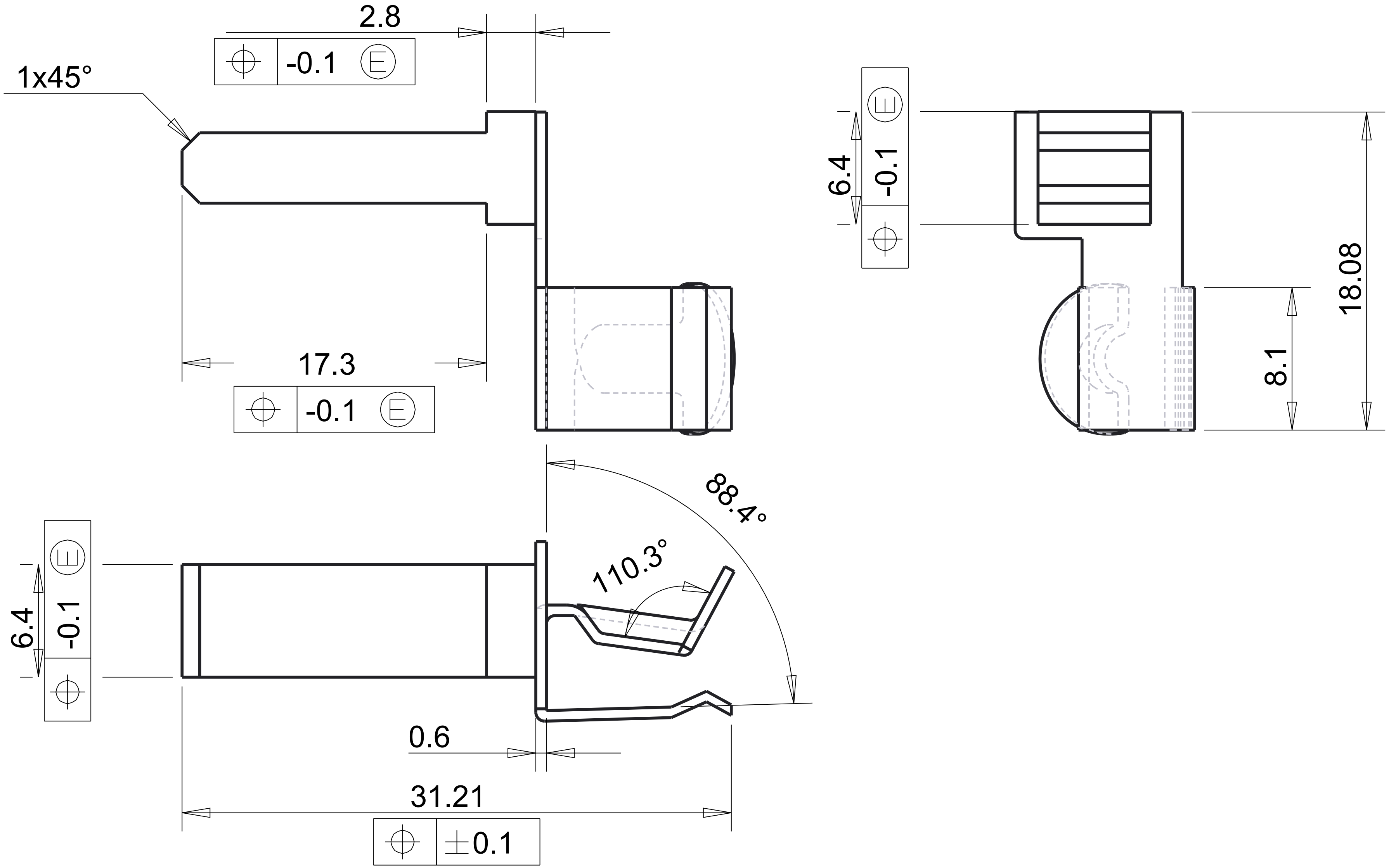
Drawn by Guillaume Picard	Title Front Casing Orthographic View		
	Class 16165	Course Aero-Mechanical Eng	Date 06/12/13
Department of Mechanical and Aerospace		All dimensions in mm	
		FIRST ANGLE	Scale 1:1



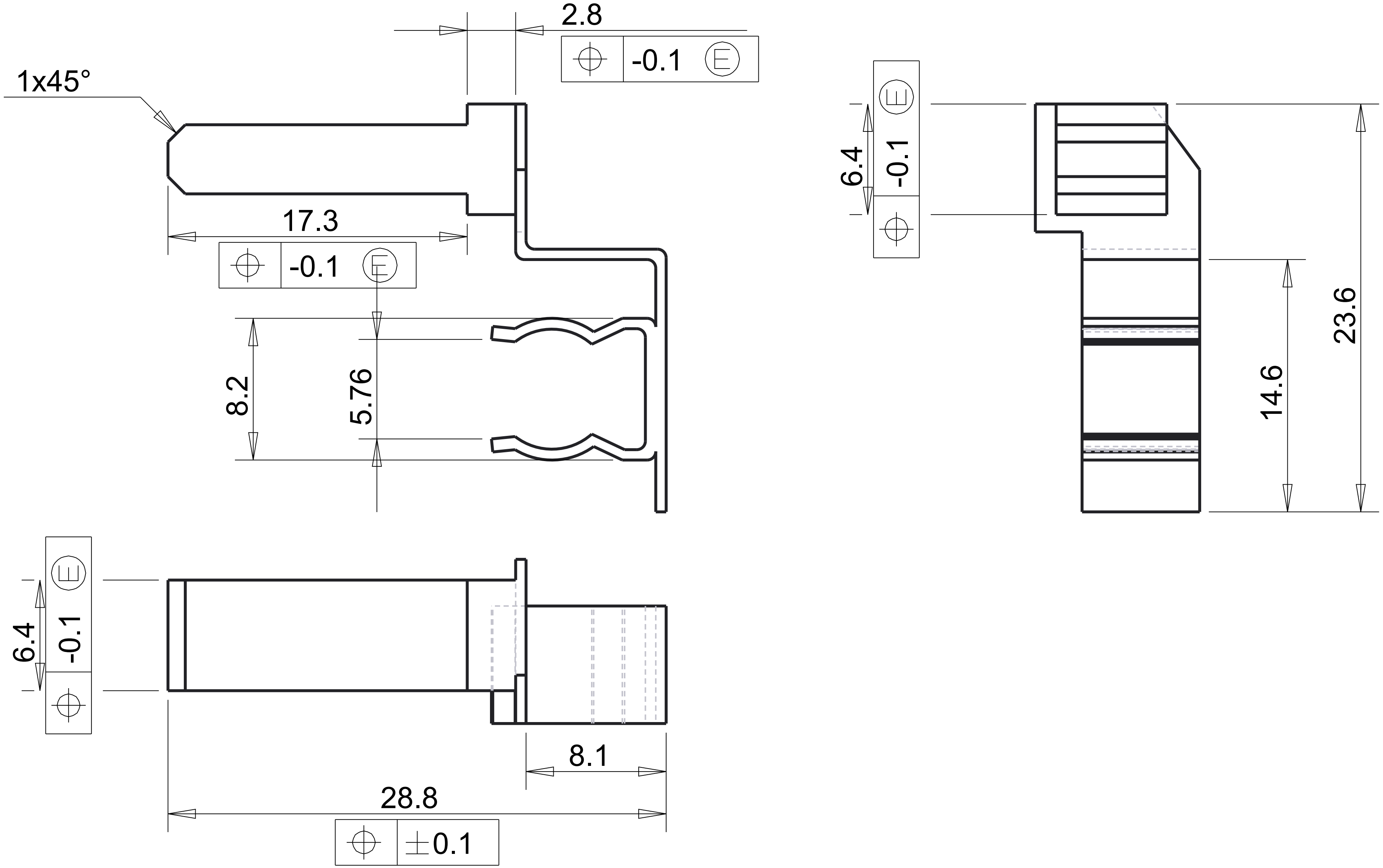
Drawn by Guillaume Picard	Title Back Casing Orthographic View		
	Class 16165	Course Aero-Mechanical Eng	Date 06/12/13
Department of Mechanical and Aerospace	All dimensions in mm		
	FIRST ANGLE		Scale 1:1



Drawn by Guillaume Picard	Title: Fuse to Input Plug Orthographic View		
	Class 16165	Course Aero-Mechanical Eng	Date 06/12/13
Department of Mechanical and Aerospace		All dimensions in mm	
		FIRST ANGLE	Scale 2:1



Drawn by Guillaume Picard	Title Right Plug Orthographic View		
	Class 16165	Course Aero-Mechanical Eng	Date 06/12/13
Department of Mechanical and Aerospace		All dimensions in mm	
		FIRST ANGLE	Scale 3:1



Drawn by
Guillaume Picard

Title Left Plug Orthograhic View

Class
16165

Course
Aero-Mechanical Eng

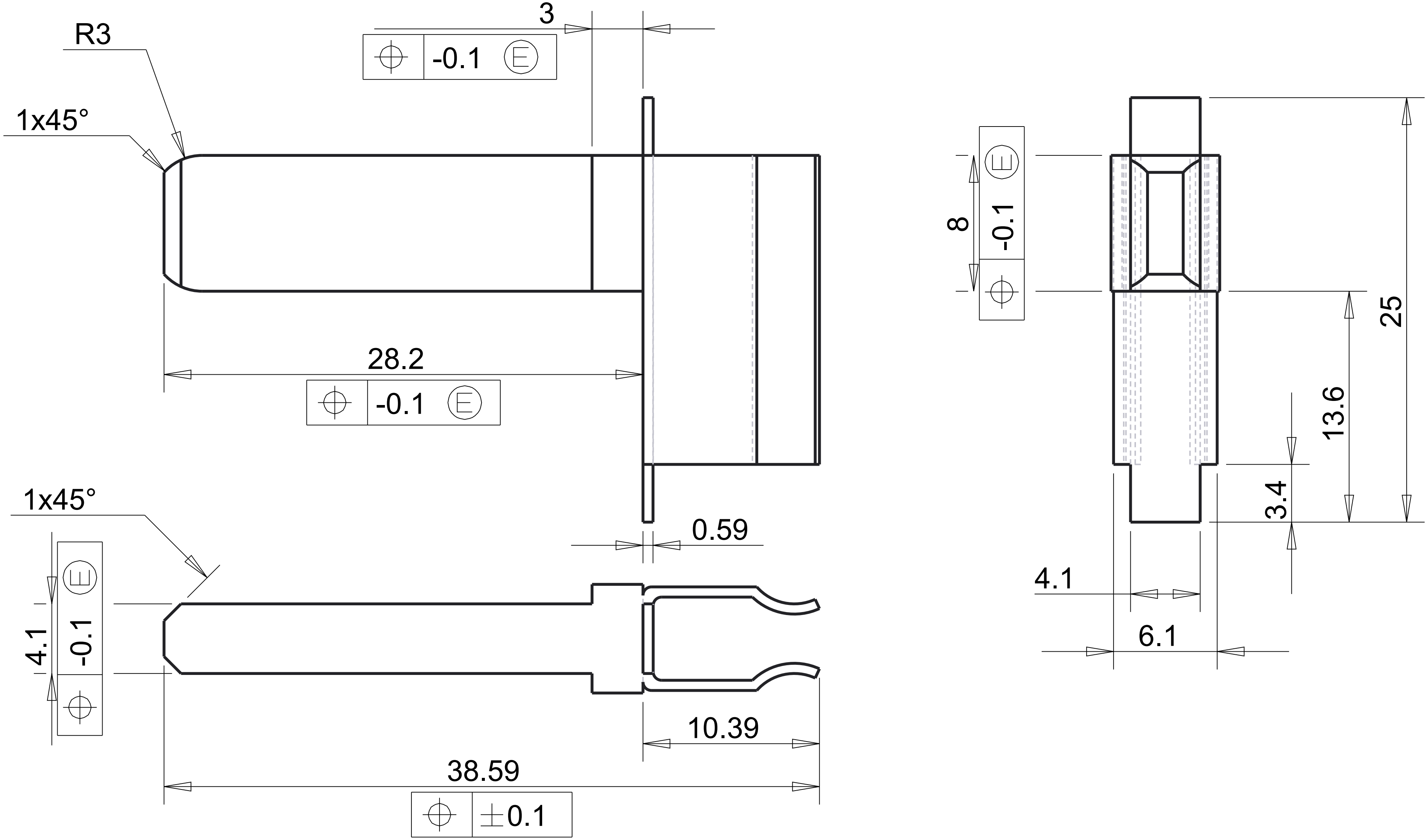
Date
06/12/13

Department
of
Mechanical and Aerospace

All dimensions in mm

FIRST ANGLE

Scale
3:1



Drawn by Guillaume Picard	Title: Ground Plug Orthographic View		
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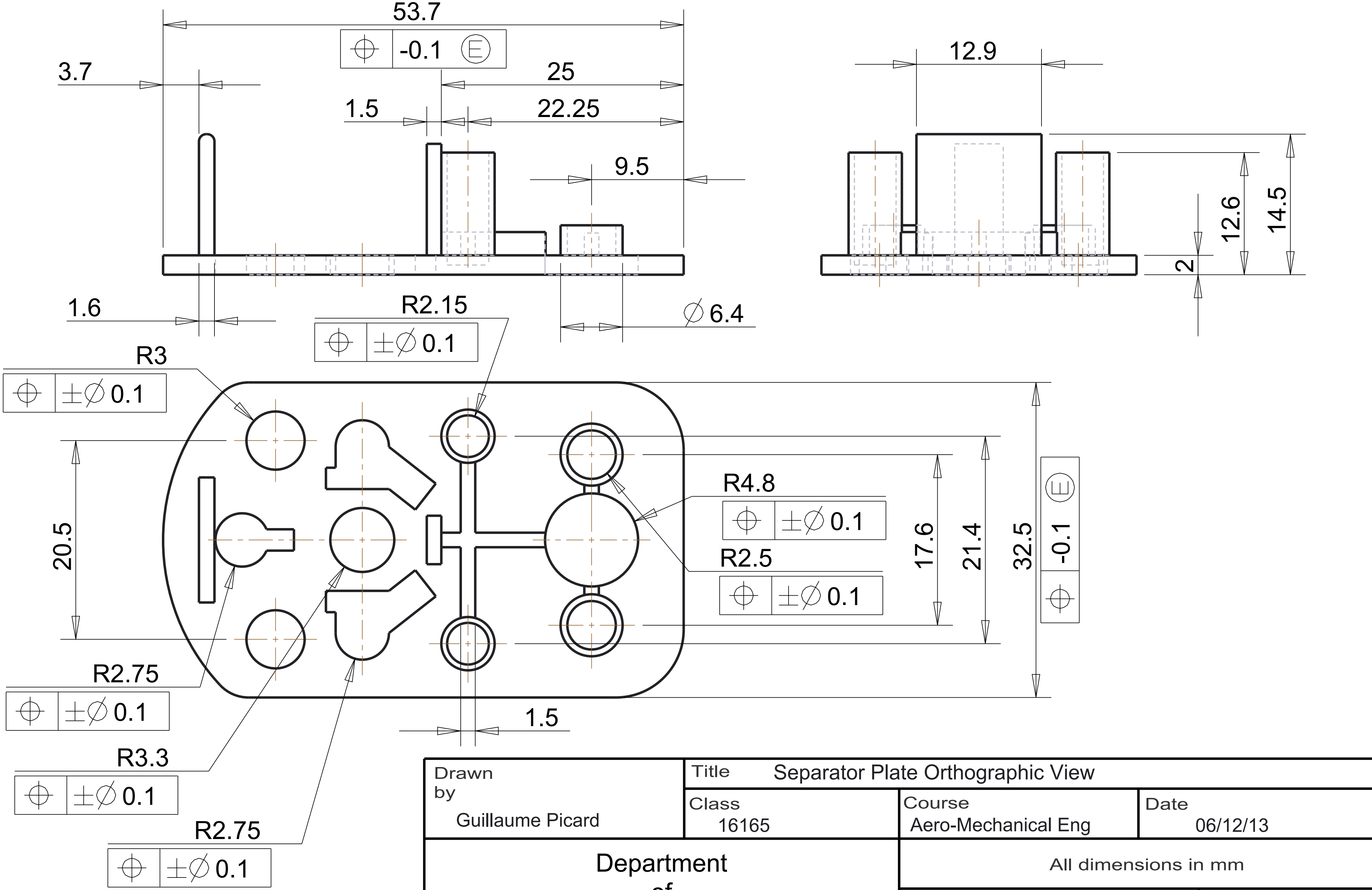
Department of Mechanical and Aerospace	All dimensions in mm		
	FIRST ANGLE		Scale 3:1



Drawn by Guillaume Picard	Title Separator Plate Orthographic View		
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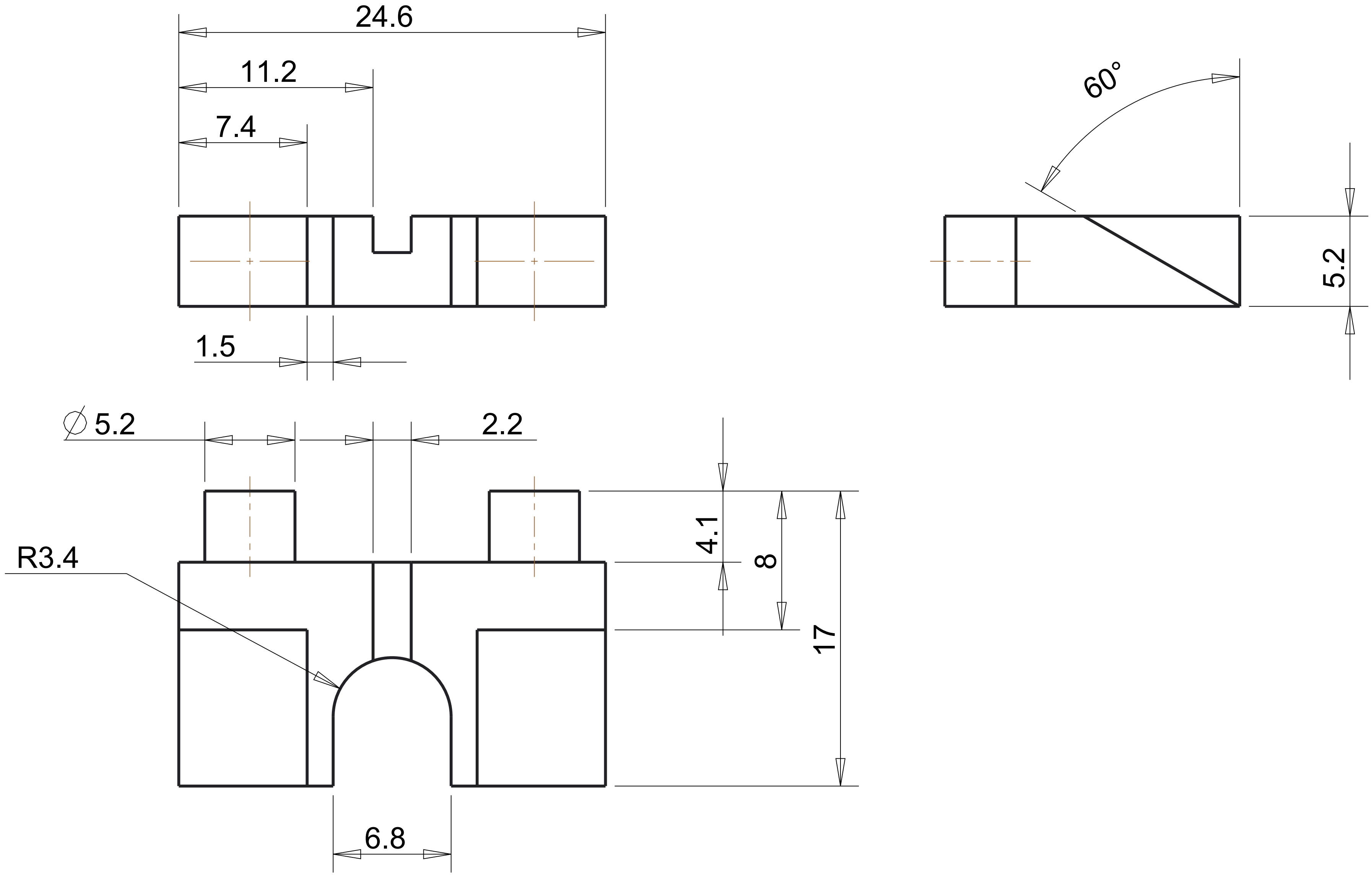
Department of Mechanical and Aerospace		All dimensions in mm	
		FIRST ANGLE	Scale 2:1



Drawn by Guillaume Picard	Title: Plug Guard Orthographic View		
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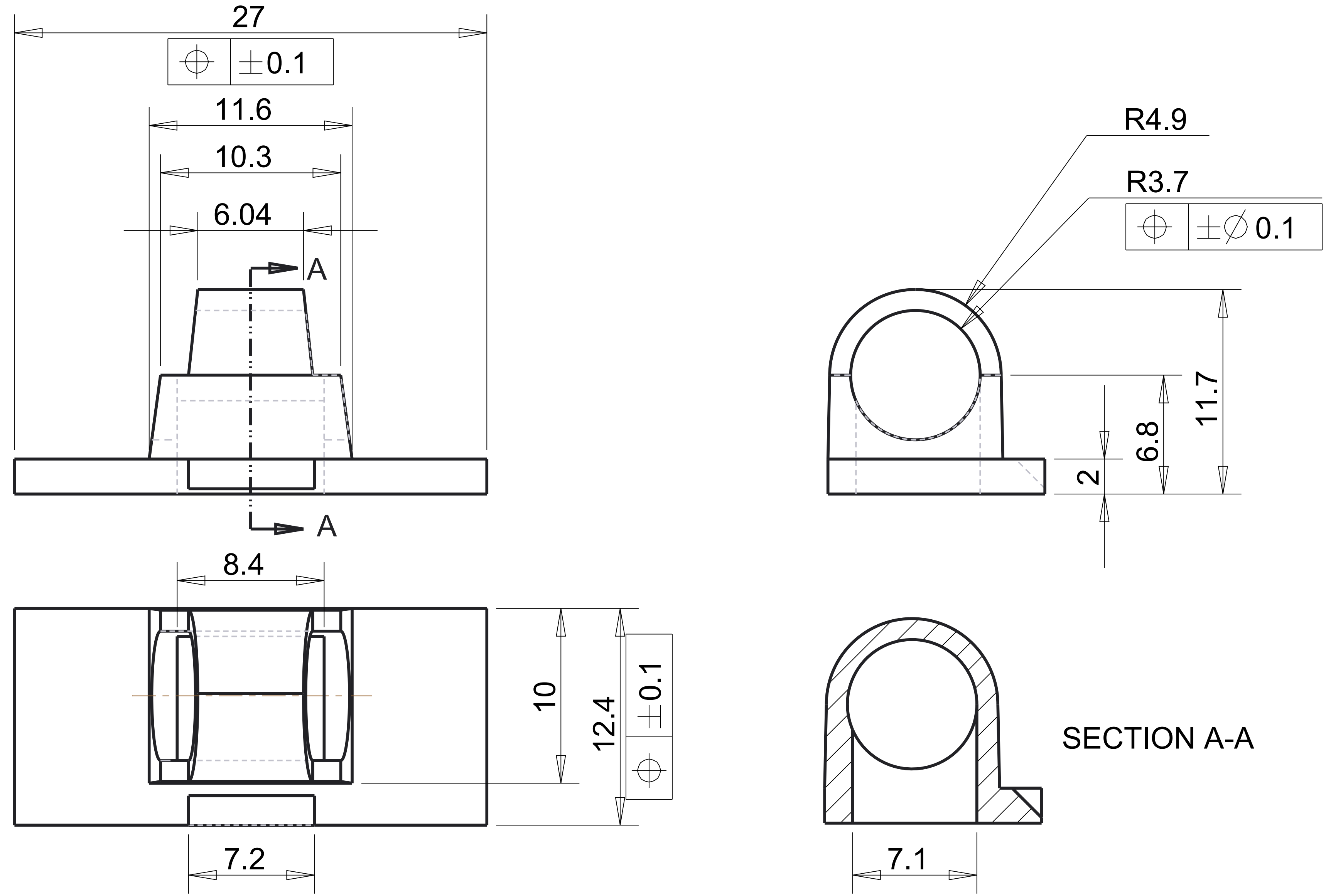
Department of Mechanical and Aerospace		All dimensions in mm	
		FIRST ANGLE	Scale 3:1



Drawn by Guillaume Picard	Title: Fuse Holder Orthographic View		
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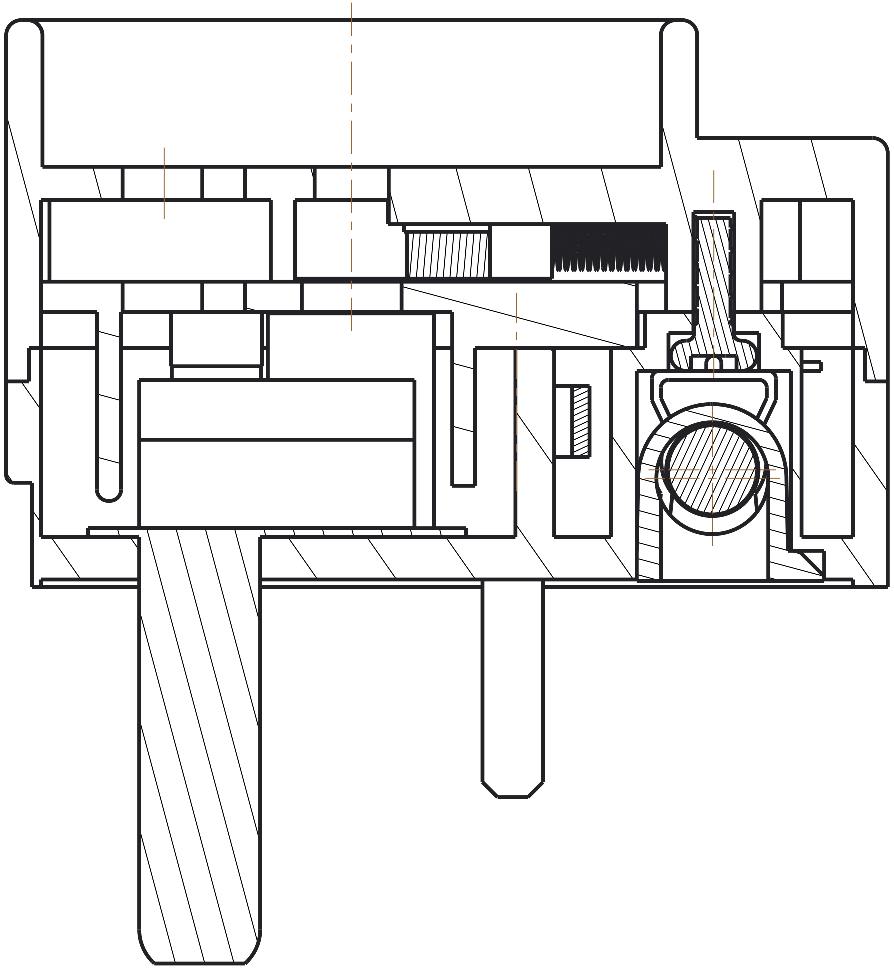
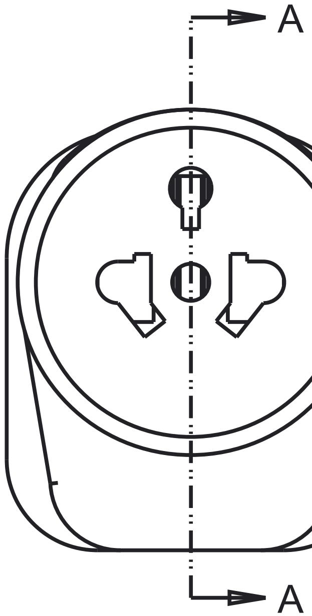
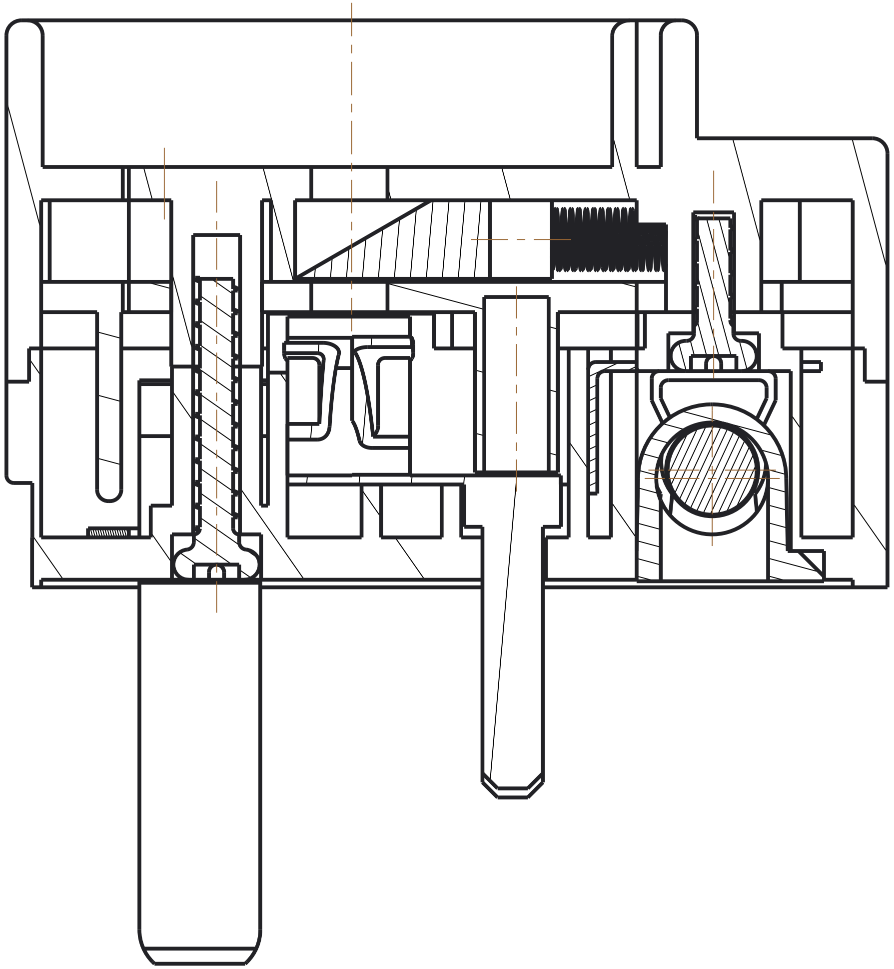
Department of Mechanical and Aerospace	All dimensions in mm		
	FIRST ANGLE		Scale 3:1



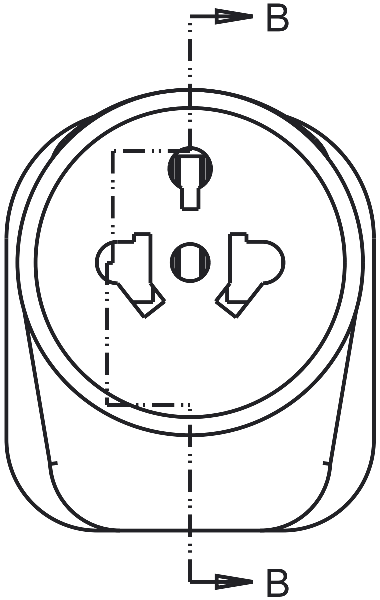
SECTION A-A
SCALE 2.000



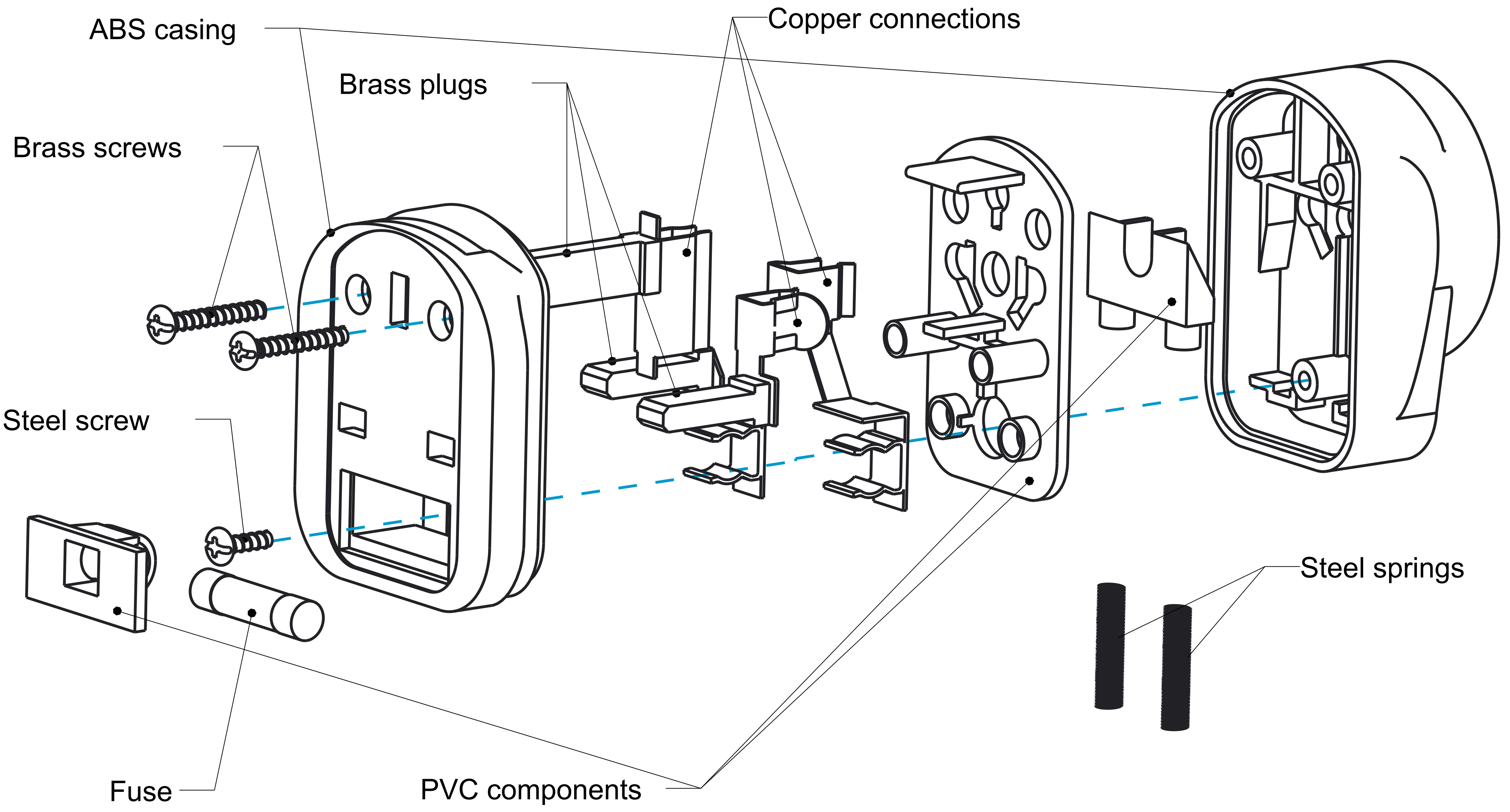
Drawn by Guillaume Picard	Title Assembly Section View 1		
	Class 16165	Course Aero-Mechanical Eng	Date 06/12/13
Department of Mechanical and Aerospace	All dimensions in mm		
	FIRST ANGLE		Scale 1:1



SECTION B-B
SCALE 2.000



Drawn by Guillaume Picard	Title Assembly Section View 2		
	Class 16165	Course Aero-Mechanical Eng	Date 06/12/13
Department of Mechanical and Aerospace		All dimensions in mm	
		FIRST ANGLE	Scale 1:1



Drawn by	Title		
Guillaume Picard	Exploded View with Materials Detailing		
	Class 16165	Course Aero-Mechanical Eng	Date 06/12/13
Department of Mechanical and Aerospace	All dimensions in mm		
	FIRST ANGLE		Scale Not to scale

Manufacturing Tolerances

Although a majority of our parts have been detailed to a precision of ±0.1, not all of our components required a strict manufacturing tolerance. Without a doubt, the essential measurements are those which affect boundary intersections and interconnecting parts. Indeed, the casing surface dimensions and flatness must be within a certain tolerance otherwise the parts will not be able to fit together. Screws and screw-hole diameters do not depend on such strict tolerances as the screw will still be able to fit within a manufactured screw hole whose tolerance is dependant upon the moulding process whose precision falls below the ±0.1 scale. The most essential tolerance in this object is with regards to the 3-pin plug dimensions, as these must satisfy the BS 1363 standard. The plug must comply with the BS 1363 standards otherwise it will not fit within the casing or into British Sockets.

EXPLODED ASSEMBLY VIEW

MANUFACTURING PROCESSES

Casing

The casing is manufactured from ABS (Acrylonitrile butadiene styrene) plastic. ABS is a popular thermoplastic known for its toughness and durability, thus why it is often used in the consumer and household industries. Casings for wall plugs are sometimes manufactured from urea-formaldehyde, another thermosetting plastic; however this material is more commonly used for seldom-used plugs (i.e. refrigerator, heavy appliances) as its impact resistance is much lower than ABS. In order to produce the casing required for the adapter plug, the ABS is manufactured using an injection moulding technique. A precision injection moulding technique may also be used if the additional precision is required by the manufacturer. Once the ABS reaches its melting point, it is injected into a pre-defined mould generally made of pre-hardened steel using a heated screw, and the ABS is then allowed to cool down until the mould is opened and the final part is removed. The casing can then be polished and cleaned depending on the requirements of the producer.

Inner Plastic Components

A variety of additional plastic components can be found within the adapter plug itself; the plug guard, the separator plate which separates the front components from the rear casing to prevent short-circuiting, and the fuse holder. All of these components are manufactured from PVC (Polyvinyl chloride). PVC is another popular thermoplastic, mostly due to its adaptability to a mixture of applications, either in rigid or flexible states. With the addition of heat stabilizers, PVC is particularly useful as its durability and electrical insulation properties make it perfect for use in a travel adapter. The stabilised PVC can then be processed through an injection moulding technique to achieve the desired end shape.

Plug components

The peculiarity of the plug components arises from their duality of both copper and brass. Brass is in fact a copper alloy composed primarily of copper and zinc. Brass is more resistive than copper in nature due to its mixed nature, which makes it ideal from use in plugs as these need to be resistant to regular strain and stress due to continued use. The inner connector sections however are made from copper, which are necessarily more flexible as they need to fit within pre-manufactured slots within the ABS casing. These components are most likely manufactured using casting which exists in a variety of forms (investment casting, sand casting, shell moulding…) depending desired economic use of the materials as defined by the manufacturer. Indeed, casting can be undertaken using expendable moulds (either permanent or expendable patterns) or permanent moulds. Once these parts have been manufactured, they are simply joined together using a welded pin attachment which solidifies upon cooling and keeps the two sections rigidly fastened together.

Springs

Made from steel, the springs are initially made into long, thin wires produced using an extrusion technique. Once the steel wire has been produced, the wire is then coiled using a spring winding machine, most likely at room temperature given the small dimensions of the spring. The springs then go through a variety of post-manufacturing processes following a heat treating method (to preserve resilience), which can include grinding, shot peening, setting and finally coating to prevent corrosion.

Screws

Both the brass and steel screws are manufactured using threading techniques which involves rolling the pre-manufactured screw cylinder of required diameter (called a screw blank) into a thread forming machine which digs groves into the screw blank of required pitch and size.

Fuse

The fuse is of course an acquired part as it is manufactured by a third-party adhering to BS1362 standards. The ends of the fuse are usually made from aluminium and the middle section is either produced from thermosetting plastics such as ABS, or ceramic which both have good thermal properties essential to a fuse's capacity to cut a circuit which is in danger of short-circuiting and thus exploding. The inner plate or wire connecting both ends of the fuse is usually manufactured from copper and its diameter varies depending on the amp value rating of the fuse.

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