NATIONAL CENTER FOR COMBUSTION RESEARCH AND DEVELOPMENT (NCCRD)
INDIAN INSTITUTE OF TECHNOLOGY MADRAS
CHENNAI – 600036, INDIA

Ref. No. ICS/11-12/013/DSTX/TSUN **Date: 7 Oct. 2016**

Due date: 28 Oct. 2016

Item name: FABRICATION OF DROP CAPSULES FOR MICROGRAVITY FACILITY (2 Sets)

1. Quotations are invited in a **two bid system** for the items shown overleaf (in Annexure I). The offers / bids should be submitted as Technical bid and Financial bid. The Technical bid should consist of all technical details / specifications only. The Financial bid should indicate item-wise price for each item and it should contain all Commercial Terms and Conditions including Taxes, transportation, packing & forwarding, installation, guarantee, payment terms, pricing terms etc. The Technical bid and Financial bid should be put in separate covers and sealed. Both the sealed covers should be put in a bigger cover. The Tender for supply of "_____" should be written on the left side of the Outer bigger cover and sealed.
2. The quotations should be valid for sixty days from the due date and the period of delivery required should also be clearly indicated.
3. The total cost of the equipment in terms of CIP Chennai should be clearly mentioned.
4. Terms of warranty and guarantee should be explicitly mentioned.
5. Packing and delivery charges, customs and clearance duty should be clearly stated.
6. Goods shall not be supplied without an official supply order.
7. Local firms : Quotations should be for free delivery to this institute. If quotations for ex-godown delivery charges should be indicated separately.
8. Firms outside Chennai: Quotations should be for F.O.R. Chennai. If F.O.R. consignor station, freight charges by passenger train / lorry transport must be indicated. If ex-godown, packing, forwarding and freight charges must be indicated.
9. The rate of sales / general taxes and the percentage of such other taxes legally leviable and intended to be claimed should be distinctly shown along with the price quoted. Where this is not done, no claim for sales / general taxes will be admitted at any stage and on any ground whatsoever. The taxes leviable should take into consideration that we are entitled to have Concessional Sales Tax (CST) applicable to non-government educational institutions run with no profit motive for which a concession sales tax certificate will be issued at the time of final settlement of the bill.
10. Payment : Specify the mode of payment and if advanced payment has to be made. Every attempt will be made to make payment within 30 days from the date of receipt of bill / acceptance of goods, whichever is later.
11. IIT Madras is exempt from payment of excise duty and is eligible for concessional rate of customs duty. Necessary certificate will be issued on demand.
12. IIT Madras has the right to accept the whole or any part of the tender or portion of the quantity offered or reject it in full without assigning any reason.
13. The sealed quotation may be sent to

    Prof. S. R. Chakravarthy
    NCCRD Office
    No. 201, Rarefied Gas Dynamics Lab (Behind Aerospace Engineering Dept.)
    Chennai – 600036, Ph. (O) +91-44-22575025

Project ref no.ICS/11-12/013/DSTX/TSUN

FABRICATION OF DROP CAPSULES FOR MICROGRAVITY FACILITY

QTY: 2 SETS.

Two units of drop capsule set for use in microgravity drop tower experiments are to be fabricated as per the technical specifications provided in this document. Each capsule set comprises of an outer capsule and an inner capsule. The capsules are rigid structures which will serve as framework forhousing sophisticated instruments for microgravity experiments. The capsule impacts a deflatable airbag at the end of each fall from a height of 32 m. The inner and the outer capsules should be strong enough to with-stand repeated impact load of about 40g from such fall. The total weight of the capsule with all instrumentation is estimated to be 600 kg, out of which the weight of outer plus innercapsule should not exceed 200 kg.Further details and drawings of inner and outer capsules are provided in the following sections of this document.

Eligibility Criteria

The vendor must satisfy the following criteria to get his offer selected for further evaluation.

1) Vendors must have at least 5 years of experience in design, manufacturing, inspection, testing, installation and commissioning of special purpose experimental setups, projects. They must produce job completion certificates of having successfully commissioned similar project works.

2) Vendors should provide contact information of previous customers along with technical details of the commissioned project. The feedback from the clients will be considered.

3) Vendors should furnish the details of technical capability. (of that of equipment and operating personnel)

4) Vendors should provide copies of test certification documents of the materials used. Wherever the material is not specified vendors shall choose the proper IS code for material selection.

5) 24 months guaranteed trouble free operation has to be given by the vendor.

6) The manufacturability, workability, maintenance feasibility shall be well checked before committing the project. No complaints at a later stage will be considered.

7) The bidder should attend the pre-bid meeting and also make a site visit to qualify for submitting the tender. Time and venue of meeting: (Friday) 21st October 2016; at 3:00 pm, Conference Hall, Aerospace Department, IIT Madras.

8) Modifications in the proposed design for the ease of fabrication are acceptable, but the same has to withstand the desired load capacities and safety concerns. Vendors can also give innovative suggestions on design and fabrication feasibility, cost control and optimization.

9) The vendor should produce a detailed scope of work, deliverables and project execution plan.

10) The successful bidder should maintain a complete manufacturing file, containing detailed information about the design, production and quality control.

11) The project should be completed and delivered with necessary testing within a span of 4 – 6 weeks from the date of purchase order release.

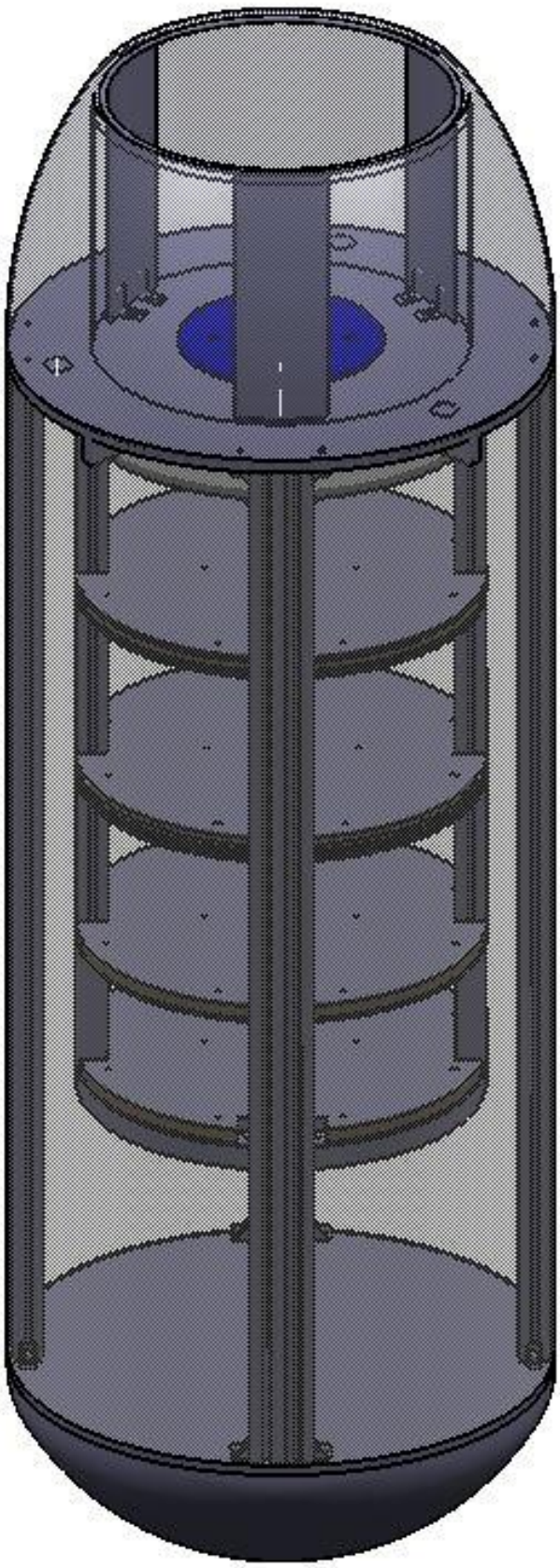

Figure 1: Drop Capsule

The figure no: 1 shows the isometric view of the experiment drop capsule. The skin of theouter capsule and the fairing are made transparent in the diagram, so that the arrangement of inner capsule is visible.

I) **Outer Capsule**

The outer capsule acts as a drag shield for the inner capsule. It is given an aerodynamic shape to minimize the drag forces. The outer capsule should also withstand the deceleration forces upon impacting the airbag. The total mass of the outer capsule should not exceed 100 kg.

The outer capsule consists of three main components.

1. The cylindrical section
2. The top fairing
3. The nose cone

1. The cylindrical section

The skeletal structure of the middle cylindrical section consists of a top plate and a bottom plate supported with four stringers. The cylindrical sectionis covered with a 3 mm thinsheet. The top and bottom plates are circular discs with provision for bolts for attaching the strut elements. The top plate additionally has a central hole of 36 mm diameter.The handling of the capsule is done using electromagnets, so an appropriate rust-free ferromagnetic plate should be attached on the outer side of the top plate. This will be used for retrieving the capsule after every drop.

The stringers are aluminium alloy channel struts, chosen such that it can withstand the impact load as well as facilitate easy assembling and disassembling. The stringers come with standard connectors and can be connected to the top and bottom plates. These connectors shall be used in the capsule to avoid further welding and machining. The bottom plate should have a rodwith threaded endwelded with it, to which the nose portion is fastened. The top plate should be supported with rib structures so as to prevent buckling or bending of the plate.

2. The top fairing

The fairing approximatesa standard streamline profile for the outer capsule.The diameter and height of the cylindrical space within the fairing is such that it can accommodate the pressure vessel and the holding mechanism within it, before the drop. The bottom plate of the fairing is attached to the top plate of the middle cylindrical section through bolts. These are radially locking mechanisms that can be engaged and disengaged easily.The support ring structure serves to protect the fairing from any load during retrieval of the capsule.

3. The nose profile

The nose profile is the major element that helps in reducing the drag force acting on the capsule. The nose shape is selected such that the aerodynamic drag is minimum for the height given. This is an easily removable assembly that can be fastened to the bottom plate of the middle section. The nose profile is made by attaching a 3 mm metal sheet (6061) over a skeletal structure. The bottom portion is made solid using 6082 aluminium alloy.

II) **The Inner Capsule**

The inner capsule is similar to outer capsule, except that it is more rugged than the outer capsule because it will be carrying the instruments and the experiment setup. The inner capsule consists of a top plate and bottom plate supported with four stringers. The base structure is used for housing the batteries and the experiments are arranged on composite platforms, arranged inside the capsule, attached to the stringers. The total mass of the inner capsule with the experiment platforms should not exceed 100 kg.

1. Top plate

The top plate of the capsule will have a provision for attaching a 32 mm threaded bolt. The top plate should be made in such a way so that it will not distort under the self-weight of the capsule.

2. The Base Structure

The base portion of the inner capsule is made as a different section for housing the batteries. The base support clamp is bolted to the bottom plate and stringers attached to it.

3. Experiment Platforms

Experiment platforms in the inner capsule are specially designed sandwich platforms made of aluminium and plywood. The sandwich platform should be made by gluing with appropriate rubber based adhesives. The platform should withstand the deceleration forces and help in dampening the induced oscillations. The platforms should have the provision of attaching it to the stringers from the bottom side so that the top surface of the platform is fully available for setting up the experiments. The maximum load on the platform can be assumed to be a point load of 100 kg hanging from the centre.**Six experiment platforms should be provided for each inner capsule.**

III) **Maintenance free latch and lock mechanism at the base of outer capsule**

The inner capsule falls relative to the outer capsule during the experiment. A locking mechanism is desired such that the inner capsule gets locked with the outer capsule upon impact. The mechanism should facilitate an easy disengagement so that the inner capsule can be quickly retrieved after each experiment. A proposed design is given in figure 34. A minimum of four locks has to be used so as to ensure proper locking of the inner capsule with outer capsule.

N.B.

i. The dimensional accuracies should be maintained for the proper alignment.

ii. Number of weldments to manufacture the parts should be minimized.

iii. The vendor should do a weight estimate of each component of the experiment capsule and should ensure that the centre of gravity of both inner and outer capsule lies on their respective line of symmetry. Weight estimate for components has to be given in a table along with their respective part numbers.

iv. The final fabricated outer capsule assembly should be aerodynamically smooth, free of any protrusions, or steps resulting from assembling.

v. The assembled capsule should be given a uniform surface coating on the outside. Appropriate paints or stickers should be used so that drag is minimized. The choice of colour and design on stickers will be provided at a later stage.

Table No: 1 Material specification and reference drawing numbers for parts

Item No:	Description	Material	Drawing Reference No:
100	Support Ring for fairing	SS 304	Fig 4
101	Outer capsule Top fairing	Aluminium alloy 6061	Fig. 5,6
102	Plate made of magnetic material	Rust-free ferromagnetic Clamping plate	Fig. 7,8
103	Outer Capsule Top plate with support rib structures	Aluminium alloy 6082	Fig. 9,10,11
104	Cylindrical Skin	Aluminium alloy 6061	Fig. 4
105	Stringers and connection accessories for Outer capsule	Anodized aluminium alloy channel struts Material – 6063 T5, 6063 T66	Fig. 12
105	Outer capsule bottom plate with a threaded rod	Aluminium alloy 6082	Fig. 13,14
107	Nose profile	Aluminium alloy 6061, 6082 for bottom part	Fig. 15,16
200	Inner Capsule Top plate	Al alloy 6082	Fig: 22,23
201	Composite Experiment Platform	Plywood (BWR) sandwiched between Aluminium plates	Fig: 24,25,26,27,28
202	Stringers and connection accessories for outer capsule	Anodized Aluminium alloy channel struts - 6063 T5, 6063 T66	Fig. 29
203	Base support clamp	Al Alloy 6082	Fig. 30, 31
204	Inner Capsule Bottom plate	Al Alloy 6082	Fig. 32, 33

Design Diagrams

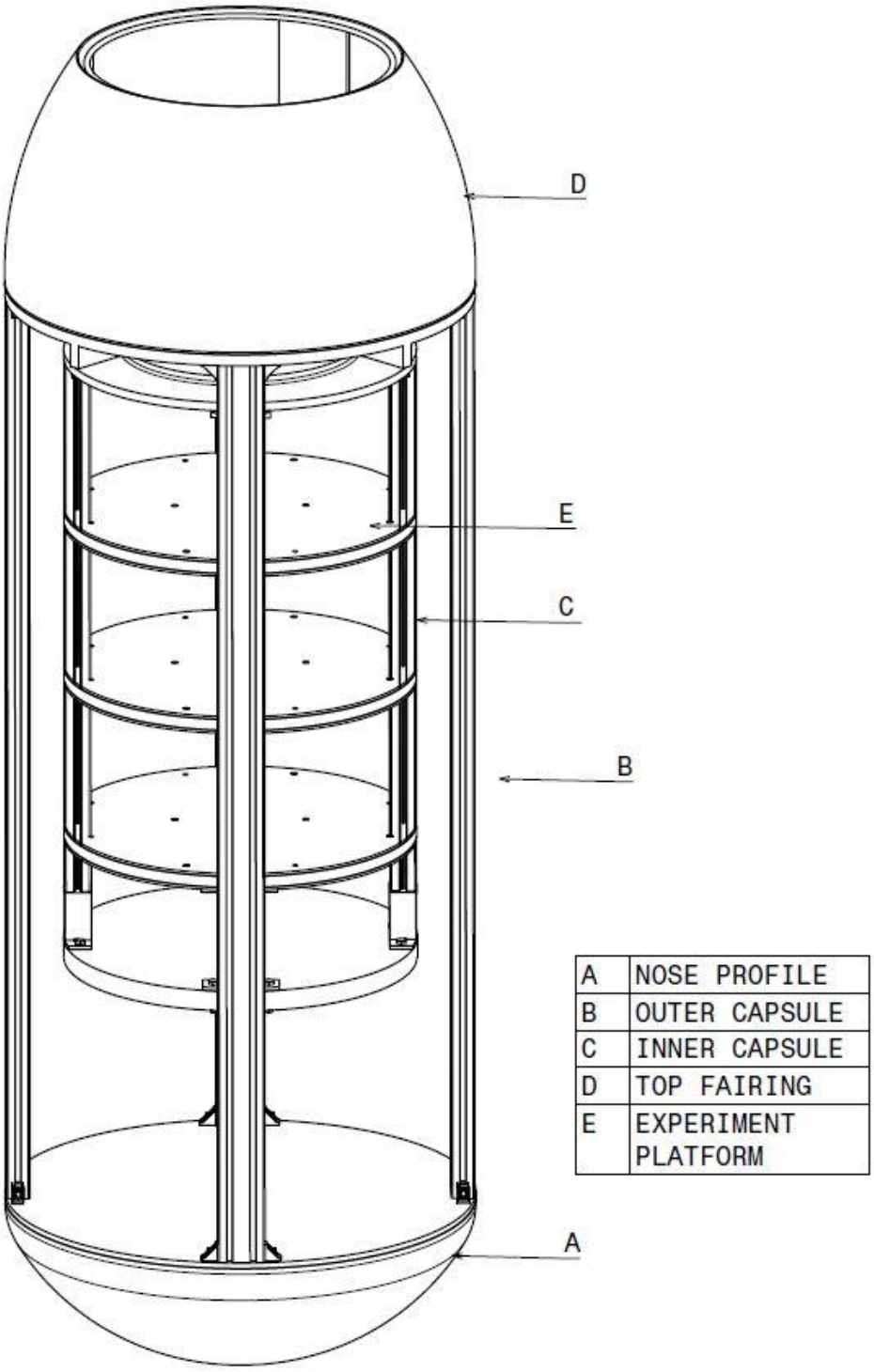

Figure 2: Isometric View of Drop Capsule

Outer Capsule

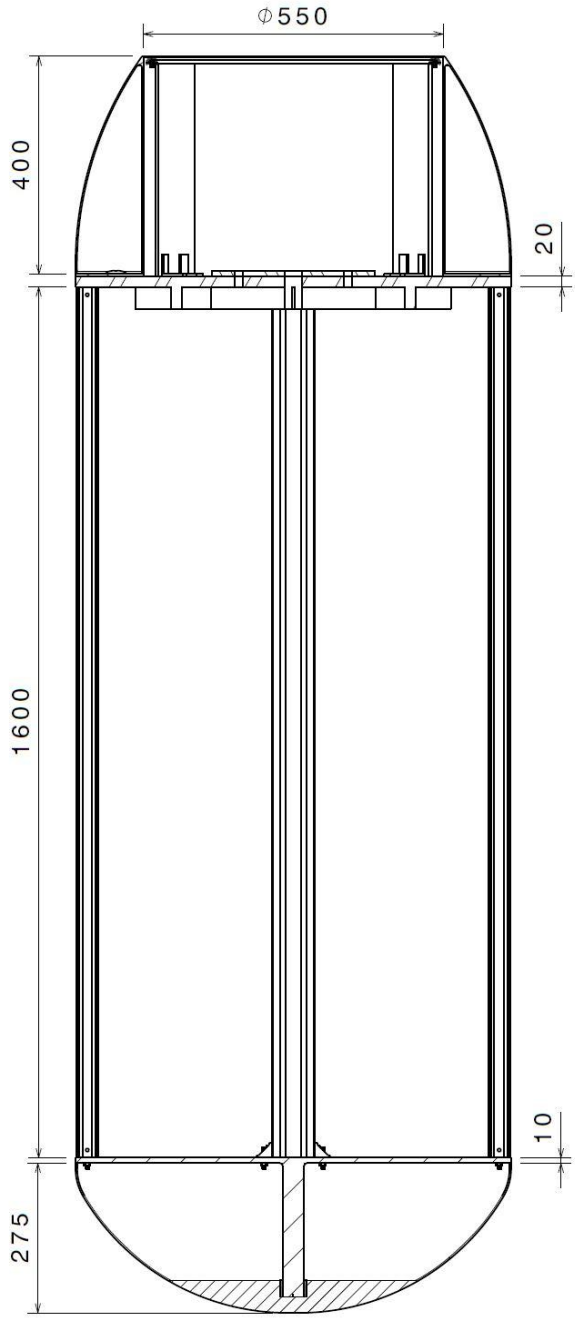

Figure 3: Sectional View of Outer Capsule

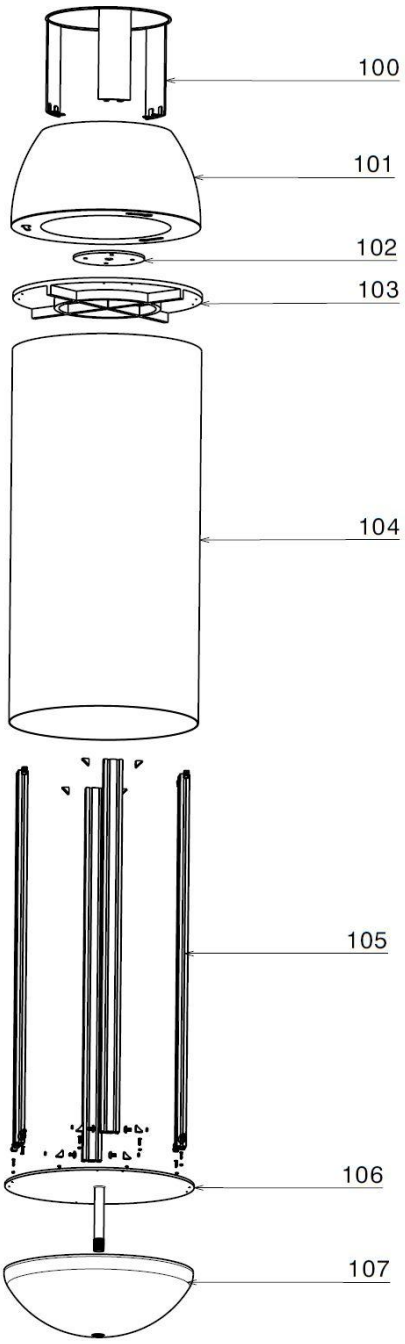

Figure 4: Outer Capsule - Exploded View

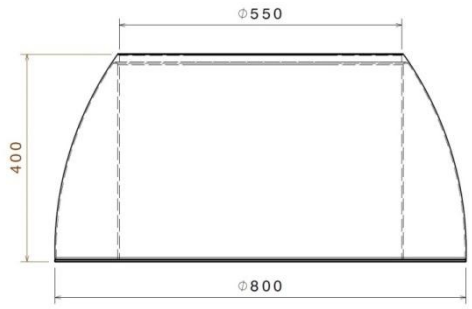

Figure 5: Fairing - Front View

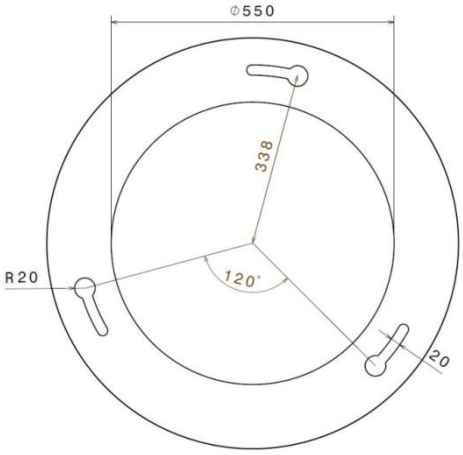

Figure 6: Fairing - Top View

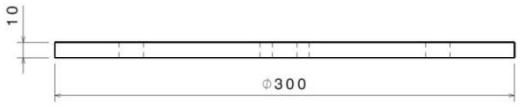

Figure 7: Ferromagnetic plate - Front View

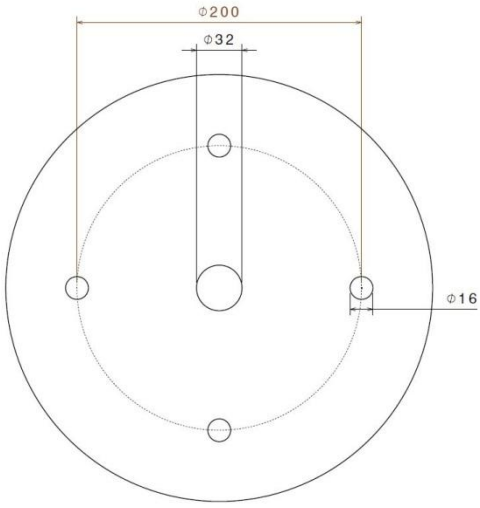

Figure 8: Ferromagnetic plate- Top View

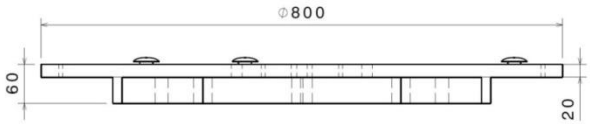

Figure 9: Top plate Front View

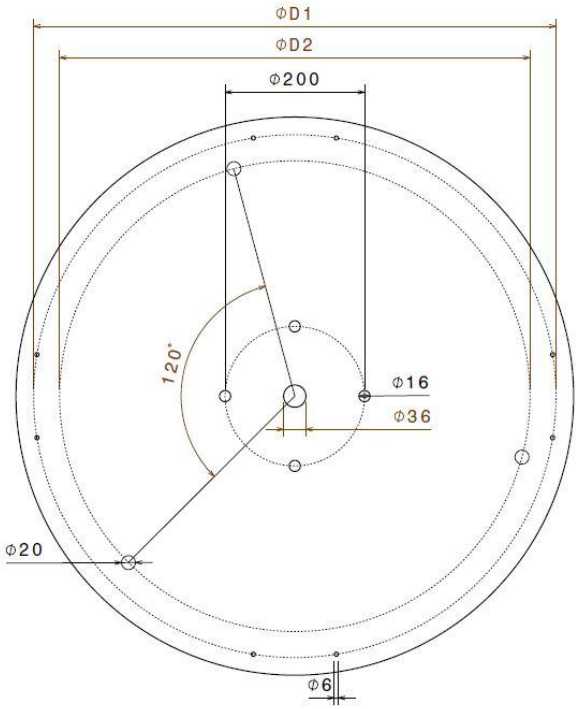

Figure 10: Top plate Top View

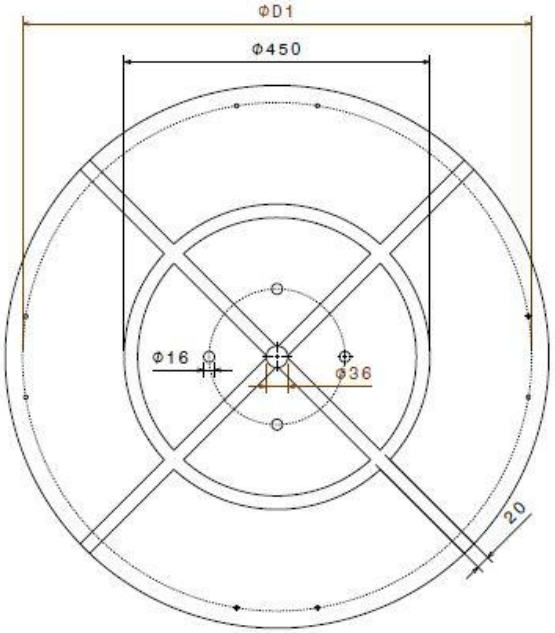

Figure 11: Top plate bottom view

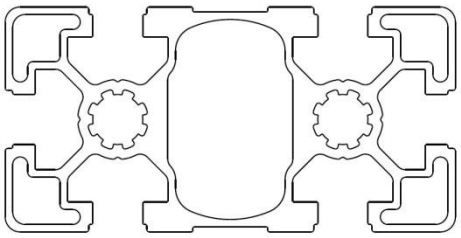

Figure 12: Stringer profile of outer capsule 90 x 45 mm

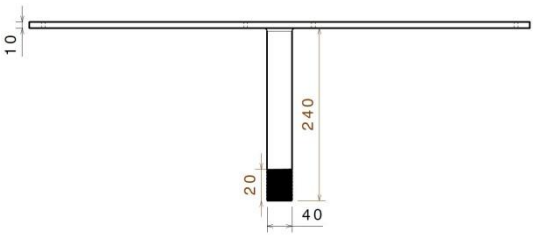

Figure 13: Bottom plate Front View

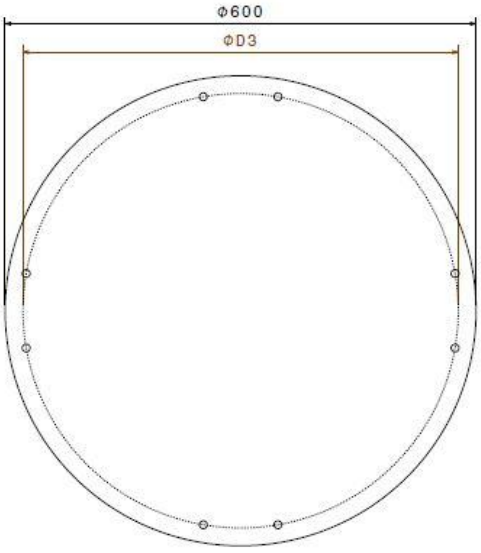

Figure 14: Bottom plate- Top View

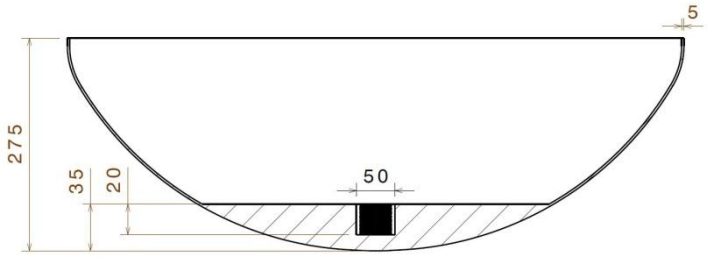

Figure 15: Nose profile - Front View

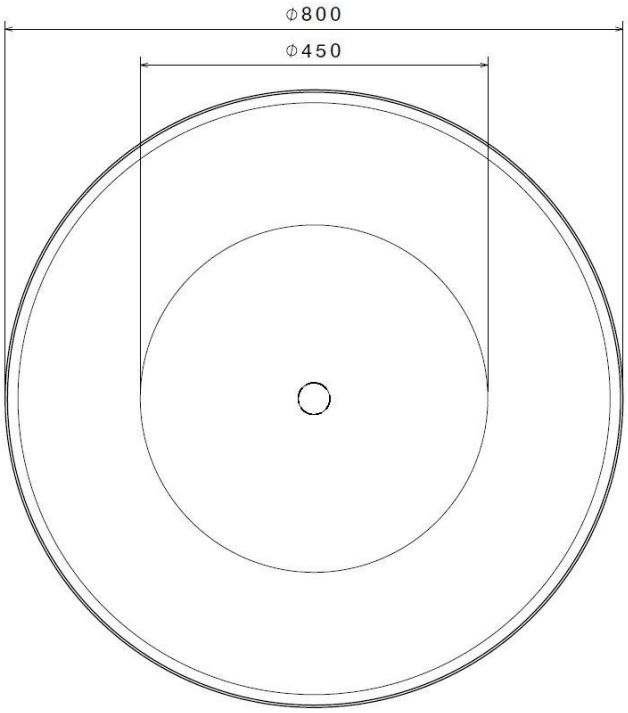

Figure 16: Nose Profile - Top View

Inner Capsule

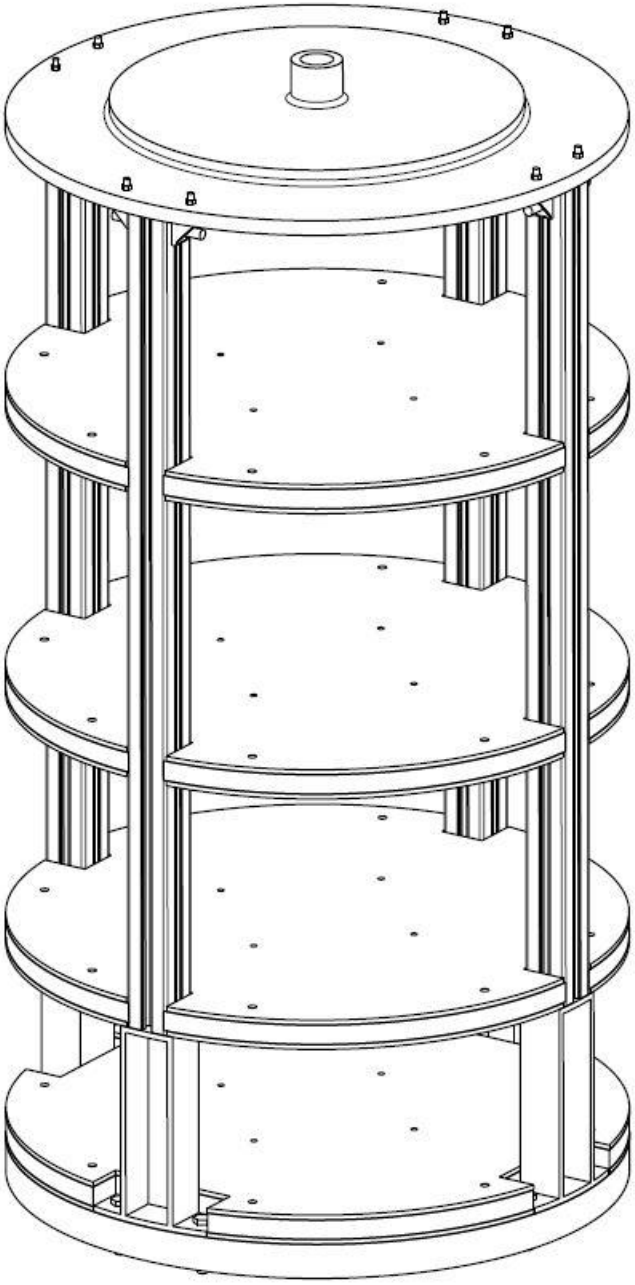

Figure 17: Inner capsule Isometric View

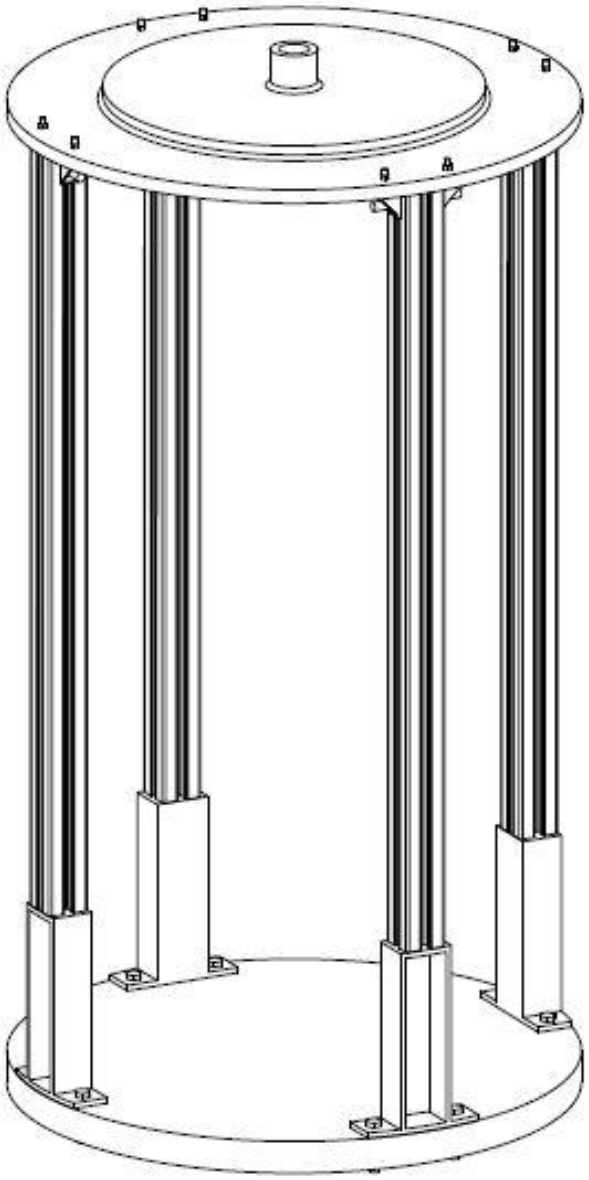

Figure 18: Inner Capsule without experiment platforms Isometric View

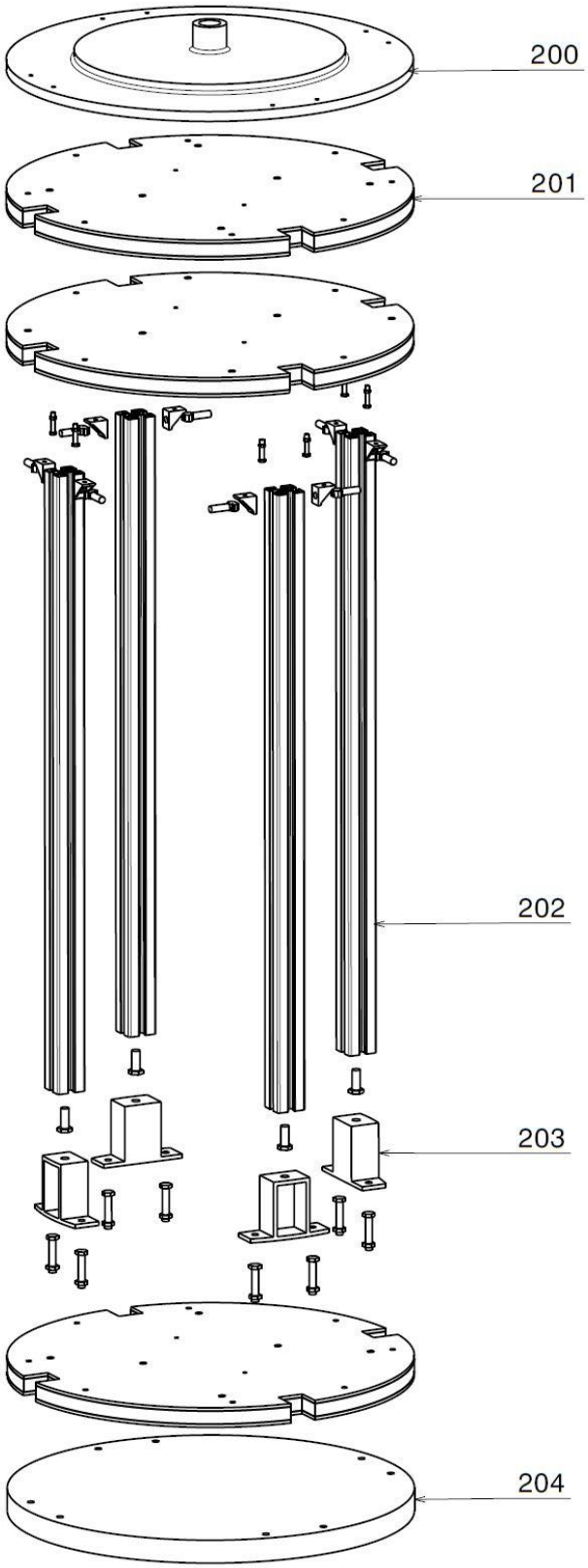

Figure 19: Inner Capsule Exploded View

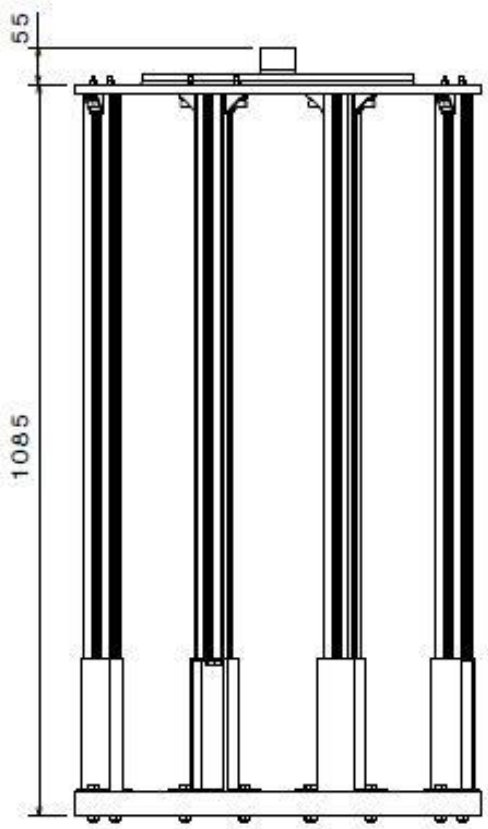

Figure 20: Inner Capsule Front View

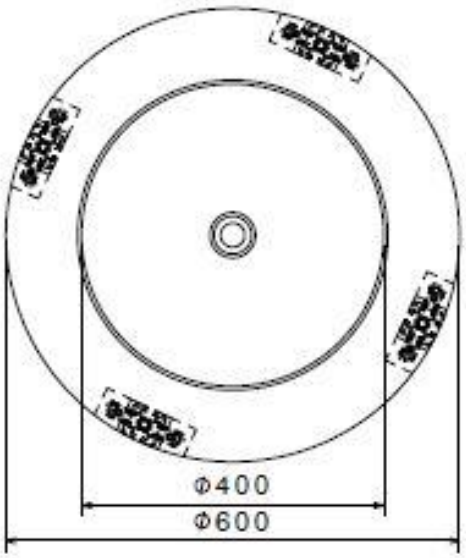

Figure 21: Inner Capsule Top View

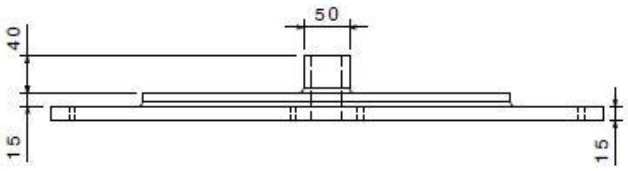

Figure 22: Top plate - Front view

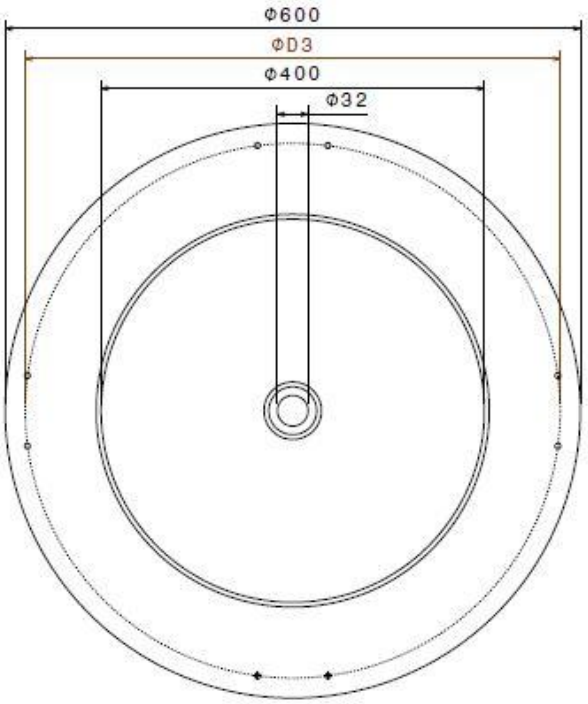

Figure 23: Top plate - Top view

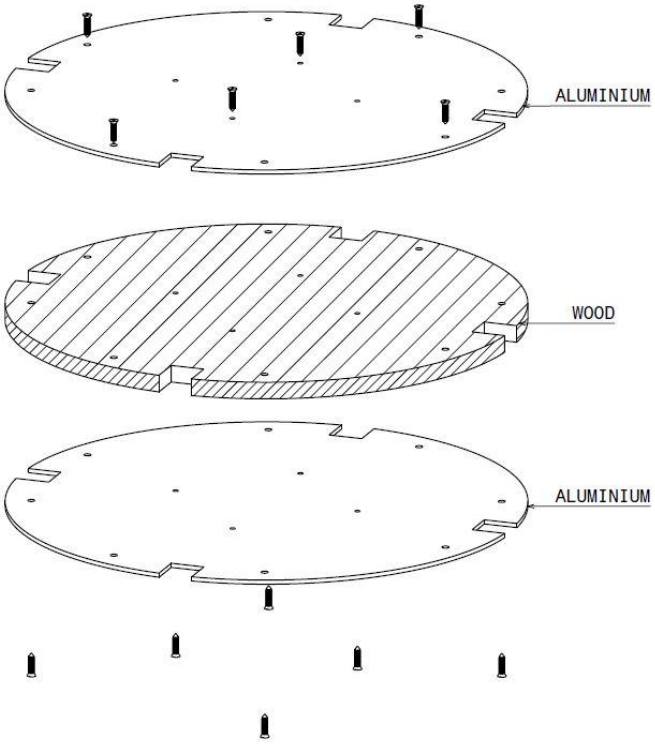

Figure 24: Exploded view of experiment platform

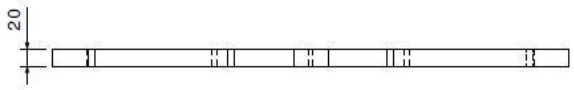

Figure 25: Wood section - Front View

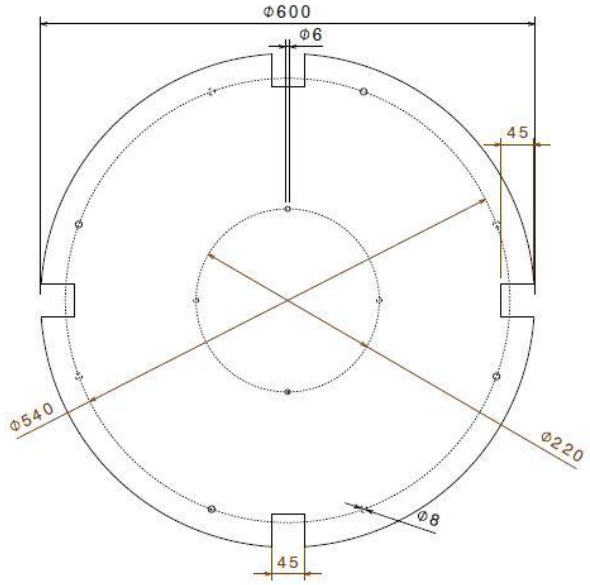

Figure 26: Wood section - Top view

Figure 27: Metal section - Front view

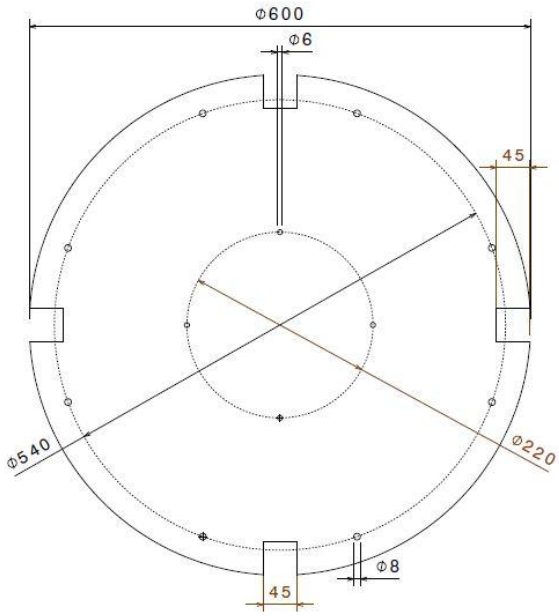

Figure 28: Metal section - Top View

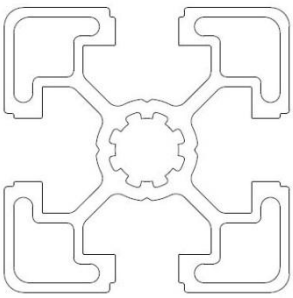

Figure 29: Stringer profile of inner capsule 45 x 45 mm

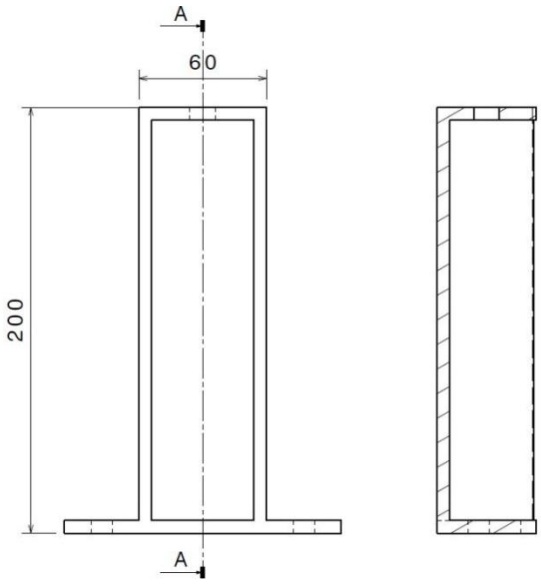

Figure 30: Base support plate Front View

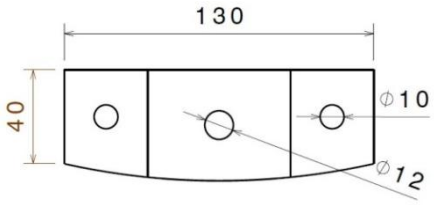

Figure 31: Base support plate bottom view

Figure 32: Bottom plate front view

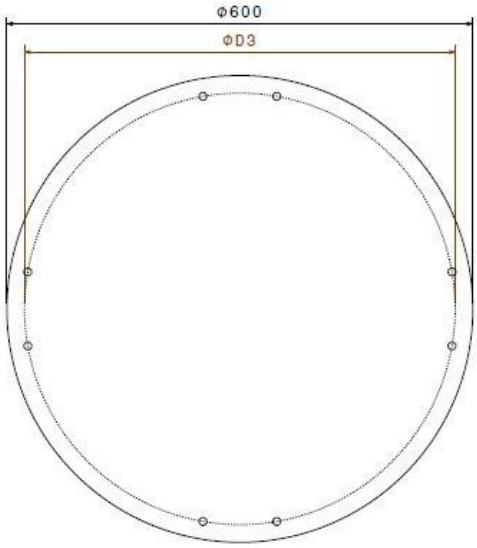

Figure 33: Bottom plate bottom view

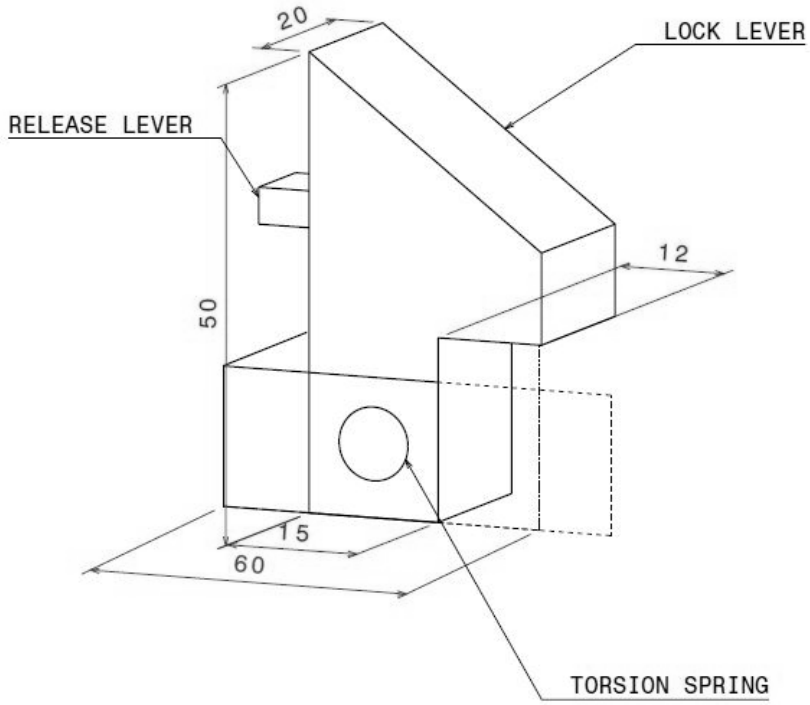

Figure 34: Proposed design for latch and lock mechanism

For any clarifications, kindly contact Mr. Nikhil V V , cell no: 9447320498

E-mail : nikhilzerog@gmail.com

MICROGRAVITY DROP CAPSULE – CHECK LIST

Vendor has to fill up the following checklist and enclose the same along with the technical specifications and necessary support documents while submitting the tender proposal.

Sl No	**Requirement**	**Compliance (Yes/No)**	**Remarks**
1	Bidder should have submitted all the certificate copies related to work experience, material testing etc.		
2	Details and contact of previous customers with job description		
3	Whether the bidder has attended the pre-bid meeting and made a site visit		
4	Conformance to the design and specifications as proposed in the tender notification.		
	i) Outer Capsule		
	Dimensions as mentioned in tender specification.		
	Mass of the Outer capsule as specified in tender		
	Assembled outer capsule has a smooth aerodynamic profile without any protrusions.		
	Material selection as per table no. 1 or better		
	ii) Inner Capsule		
	Dimensions as mentioned in tender specification		
	Mass of the inner capsule as specified in the tender		
	Six experiment platforms per inner capsule with design and strength as specified in the tender or better		
	Material selection as per table no. 1 or better		
	iii) Maintenance free latch and lock mechanism.		
	Latch and lock mechanisms should be provided around the periphery of the bottom plate of outer capsule to capture inner capsule.		
5	Whether the vendor has submitted the project execution plan		

6	The project should be completed and capsules delivered after necessary testing within a span of 4 to 6 weeks from the date of purchase order release.		
7	24 months guaranteed trouble free operation		