Design of different elements of a pressurized capsule for stratospheric balloons

UNIVERSITAT POLITÈCNICA DE CATALUNYA
BARCELONATECH
Escola Tècnica Superior d'Enginyeries
Industrial i Aeronàutica de Terrassa

VOLUME IV:

DRAWINGS

STUDENT
David Lázaro Jiménez Higueras

DEGREE IN
Industrial engineering

PROJECT DIRECTOR
Rafael Weyler Pérez

CO-DIRECTOR
Montserrat Sánchez Romero

DATE
June 2014

Design of different elements of a pressurized capsule for stratospheric balloons

UNIVERSITAT POLITÈCNICA DE CATALUNYA
BARCELONATECH
Escola Tècnica Superior d'Enginyeries
Industrial i Aeronàutica de Terrassa

PRODUCT SPECIFICATIONS

INDEX

CHAPTER 1:
ELEMENTS SPECIFICATIONS

1.1. Regulation

As this is an experimental flight this project is not submitted to any specific regulation and a special governmental permission has to be requested. Although every single and commercial element acquired by purchase must accomplish with his sector regulation.

1.2. Manufactured elements

All the items manufactured by the different contractors must accomplish all the properties listed in the attached annexes to the product specifications and in the different drawings such as materials, tolerances, surface finish, etc.

1.3. Assets acquired through purchase

All the items acquired through purchase from a provider or commercial agent must satisfy the characteristics from the catalogue or agreed upon at the origin point and them won't be reduced or altered.

CHAPTER 2:

TRANSPORT

2. Transport

All the windows and the assets that can be transported individually must be protected with the necessary elements and packaged properly in order to keep off dust and dirt. If the window is transported assembled in the capsule a covering plastic has to cover the exposed surface and a terminal threat sha

ll be located in the argon intake in order to avoid any particle enter the mid-layer.

In case of breakage or deterioration it shall be replaced for the matching component.

CHAPTER 3: MATERIALS

The main frames of each window and entry are made in high strength aluminum and they must accomplish with the mechanical properties specified in the catalogue enduring in time with the same mechanical properties and working in the nominal conditions.

The materials used are: aluminum 7075 T6 for the entry frame, aluminum 6063 T6 for the windows frame and weldable aluminum parts. For the polycarbonate windows we will use Bayer makrolon UV and AXSON 400 for the adhesive.

The remaining employed steels are normalized type (UNE 36011, EN 10111 and EN 10025) and must accomplish with the established mechanical properties.

If any company doesn't accomplish those requirements the concerned company must replace the defective elements.

All the aluminum parts will receive a surface finish through 14-15 microns anodized.

CHAPTER 4: ASSEMBLY AND MOUNTING CONDITIONS

4.1. Assembly and mounting conditions

Unless there is a contraindication no specified tolerances in the final assembly will be assumed as +-0,3mm. Welded elements must be evaluated under +-0,5mm tolerance.

4.2. Screws tightening torque

During the assembly the operator must use a torque wrench to adjust all the screws located in a structural element guided by the following tightening torques:

Metric/ MATERIAL	5.6 5D	8.8 8G	10.9 10G	UNITS
M3	0.66	1,25	2,1	Nm
M4	2	2,9	4	Nm
M5	3.1	5,8	8,1	Nm
M6	5.2	9,6	13,5	Nm
M7	8.3	15,6	22	Nm
M8	12.6	24	33	Nm
M10	24	46	65	Nm
M12	42	78	110	Nm

Table 1: Tightening torque

If any element suffers damage during the assembly stage it must be replaced without considering instantaneous reparation as an option.

CHAPTER 5:
PRELAUNCH PROCEDURES

5. Prelaunch procedures.

Before the launch an operator should make a visual inspection and ensure that the whole routing system is correctly connected and away of the field of actuation of the inner crew. With a torque wrench should also verify that all the screws are correctly inserted in its nominal position.

Only the authorized personnel can enter inside the capsule once the pre-flight protocol has been activated. All the operators shall wear gloves and bracelets, rings or necklaces are forbidden intended to prevent the structure, wires or tubing from damage.

The entering process is explained below.

The whole operation is performed by 3 operators that assist the two travellers and prepares all the tools to the launch. The list below describes the operating protocol:

Three operators get into the elevator while one of them controls it. They will bring with them a ladder to allow travellers go downstairs and ship the pod. One of them will open

the hatch while the other holds it to prevent it from falling. Once the hatch is opened the ladder shall be placed in the floor of the capsule. The upper operator will introduce the ladder inside the capsule while the lower one holds it with his hands and blocking it with his feet. After the ladder is placed correctly the upper operator will help the traveller in all his movements holding his bag and arm. Once the first traveller is inside the capsule the lower operator will help him to seat and fasten the four point seat belt. The same sequence is repeated with the second traveller. When both travellers are secured to each seat the lower operator will give the hatch to the upper one and will raise the ladder and remove it from the inside. Finally the second operator will block the entry and ensure that the hatch and is perfectly sealed.

CHAPTER 6:

TESTING AND VALIDATION

The product validation will pass through different stages. Some has been treated in this project and other doesn't. This consists in testing the different windows and the entry in the designed pressurized boil. Before getting started it is important to try the measuring equipment individually in order to ensure that the conditions are performing in the desired conditions.

It is mandatory to perform the test with distilled water in order to avoid the introduction of particles, minerals or scale formations. Before beginning, all the outer elements must be dry and clean.

The first element to test will be the little window as explained in the memory document. Each window test will pass through two stages: the first one consists in blocking the argon intake in order to verify the inner window layer. The second stage has to allow

distilled water pass through this intake to provoke a pressure differential between the outer window and the exterior. This procedure has to be reiterated with the average window and the entry. In the case of the entry there is only one layer so one step is only required.

Every test shall be repeated to form a cyclic stress applying pressure during 5 minutes at 2.1 bar (absolute pressure) few seconds without pressure and repeating again the same cycle 5 times.

Once these tests have been performed the windows and the entry shall pass through an almost real conditions test (cooled to -60ºC and zero pressure atmosphere). If this test cannot be performed a zero2infinity shall execute.

Design of different elements of a pressurized capsule for stratospheric balloons

UNIVERSITAT POLITÈCNICA DE CATALUNYA
BARCELONATECH
Escola Tècnica Superior d'Enginyeries
Industrial i Aeronàutica de Terrassa

BUDGET

This project develops the design of a single system of the capsule. It doesn't make sense to make a full company budget because at the end it won't be sold for the industry or the public with a retail price. The only thing that really matters is the manufacturing cost of each part of the project.

The general budget presented in this project has into account the manufacturing costs and the material needed for the first testing stage so no design, company maintenance, redesign or remanufacturing costs are contemplated. If it is needed during the testing phase to remake a new model or modification we would have to add the associated costs of mechanizing, conforming and manipulation.

The main costs come from manufacturing so all the required budget must be available before beginning the project.

The overall budget amount is 8947,9 € VAT included valid until the 1st of September of 2014.

The following table resumes real budgets provided by the listed above manufacturers:

Total budget	8947,9	€
Window 1	1122,73	€
Window 2	1122,73	€
Window 3	1463,57	€
Window 4	1122,73	€
Entry	1949,86	€
Argon system	1595	€
Boil test	571,27	€

Table 2: Budget resume

Detailed budget:

Assembly	Part code	Description	Price/unit [€]	Quantity	Final price [€]
0002-E-0002	**-**	**Little window**	**1122,73**	**3**	**1122,73**
	0002-P-0004	Inner frame	474,6	1	474,6
	0002-P-0020	Outer window	273,54	1	273,54
	0002-P-0007	Inner window	246,82	1	246,82
	0002-P-0006	protection plate	63,27	1	63,27
	0002-P-0020	spacer	37,5	1	37,5
	0002-P-0077	Argon insert	23	1	23
	-	Screws	0,2	20	4
0002-E-0004	**-**	**Entry**	**1949,86**	**1**	**1949,86**
	0002-P-0016	Entry dome	520,46	1	520,46
	0002-P-0015	Outer frame	573,6	1	573,6
	0002-P-0060	Upper handle	32	4	128
	0002-P-0059	Lower handle	35	4	140
	0002-P-0057	Sealing insert	20	4	80
	0002-P-0056	Joint housing	27,5	4	110
	0002-P-0083	Joint	35,3	1	35,3
	0002-P-0017	Inner frame	362,5	1	362,5
0002-E-0006	**-**	**Average window**	**1463,57**	**1**	**1463,57**
	0002-P-0038	Inner frame	672,4	1	672,4
	0002-P-0041	Outer window	331,82	1	331,82
	0002-P-0040	Inner window	322,4	1	322,4
	0002-P-0043	spacer	38,5	1	38,5
	0002-P-0046	Joint	22	1	22
	0002-P-0044	protection plate	72,45	1	72,45
	-	Screws	0,2	20	4
Argon System	**-**	**-**	**-**	**-**	**759**
	0002-P-0081	Differential valve	670	1	670
	-	Air tubes	20	1	20
	-	Overpressure valve	14	4	56
	-	Adaptor racor	12	5	60
	-	Electronics+sensors	836	1	836
		Filter	43.7	1	43.7

Test boil	**-**	**-**	**-**	**-**	**571,27**
	0002-P-0049	Main boil body	434,2	1	434,2
	0002-P-0050	Removable insert	53,5	1	53,5
	0002-P-0053	Back cover	68,57	1	68,57
	-	Screws	15	1	15

Table 3: Detailed budget