ANNEXES

ANNEX 1 – FITXES TÈCNIQUES

En el següent annex hi han les fitxes tècniques dels materials que les diferents empreses de fabricació de globus aerostàtics, citades en el sub-apartat de l'*Estudi de mercat*, utilitzen per a la confecció dels diferents models de vela.

POLIAMIDA 6.6

POLIÈSTER KUBICEK®

HYPERLAST®

RIPSTOP NILÓ®

www.lorkindustrias.com

LORK INDUSTRIAS, S.L.
CARACAS, 11
08030—BARCELONA

Telefono: 93 346 82 12
Fax: 93 311 30 60
Email: lork@lorkindustrias.com

FICHA TÉCNICA

PA 6.6

Denominación química

Poliamida 6.6

Características técnicas

Densidad		ISO 1183	g/cm ³		1,15
Temperatura de Servicio			Cº		-80 +120
Temperatura máxima de servicio en periodos breves			Cº		≤ 200
Esfuerzo en el punto de fluencia		ISO 527	MPa	seco	80
		ISO 527	%	humedo	60
Elongación a la rotura		ISO 527	%	seco	50
		ISO 527	Mpa	húmedo	150
Modulo de elasticidad a la tensión		ISO 527	Mpa	seco	3200
		ISO 179/leU	kJ/m²	húmedo	1600
Resistencia al impacto		ISO 179/leU	kJ/m²	seco	No rompe
		ISO 179/leA	kJ/m²	seco	No rompe
Dureza		ISO 13000-2	Shore D		80
Tiempo limite de rendimiento δ 1/1000	23ºC/50%	ISO 899	Mpa	seco	6,0
	RH 100ºC	ISO 899	Mpa	húmedo	3,5
Temperatura de distorsión térmica	Método A	ISO 75	Cº	seco	100
	Método B	ISO 75	Cº	seco	>200
Punto de Fusión	Método A	ISO 3146	Cº		255
Coeficiente de expansión lineal térmica		DIN 53752	1/K 10^{-5}	seco	7-10
Conductividad térmica	Método A		W / m·K	seco	0,23
Calor específico		IEC 1006	J (g.K)		1,7
Constante dieléctrica	1 MHz	IEC 250		seco	3,2
		IEC 250		húmedo	5,0
Factor de disipación	1 MHz	IEC 250		seco	0.026
		IEC 250		húmedo	0,2
Resistencia dieléctrica		IEC 243	KV/mm	seco	120
		IEC 243	KV/mm	húmedo	80
Resistividad volumétrica		IEC 243	Ω·cm	seco	10^{15}
		IEC 243	Ω·cm	húmedo	10^{12}
Absorción de humedad a 23ºC, 50% RH		ISO 62	%		2,8 ±0,3
Absorción de Agua a 23ºC		ISO 62	%		8,0 ±0.5

Approved (US Food and Drug Aministration). Según Código Federal de Regulación , Título 21.

New level

www.kubicekballoons.cz

Fly the finest fabric – Fly Kubicek Polyester

WHY YOU SHOULD CONSIDER CHANGING TO A POLYESTER BALLOON

There are two basic fabrics from which balloon envelopes are manufactured. The choice is either nylon or polyester. In Europe we are most familiar with nylon because it is the material that both Carrington and Luckenhaus make and these two companies provide the fabric for most of the European balloon manufacturers. American balloonists are more familiar with the choice between nylon and polyester because at least two American manufacturers use polyester.

Now that you can chose to fly a Kubicek envelope that is made from polyester it is time to look at the advantages and disadvantages of the two fabrics. In our opinion polyester is the better balloon fabric, but you must make up your own mind. Let's look at some basic facts.

FABRIC PROPERTIES

Nylon was first made in 1938 and its technical name is polyamide. Nylon absorbs energy well and it is elastic and extensible and has a high resistance to tearing under shock loads. Because of these excellent properties it is used extensively in the production of ropes, tyre cords and parachutes.

When European balloons were first manufactured, in England in the seventies, this fabric, probably because it was already used extensively for parachutes, was used for the production of the first balloons. Unfortunately nylon has a number of disadvantage, the greatest of which is that it is easily damaged by hydrolysis – it tends to absorb water, attract micro-organisms and, as a result, decay. This decay often continues even when the envelope is stored in its bag. Although modern coatings have reduced this susceptibility they have not removed it. To disguise the poorer properties of some of these fabrics you may be offered a heavier nylon fabric for the top of a nylon balloon.

Polyester was developed in 1941 and one of the best known brand names is Dacron. Polyester, when compared with nylon, has a higher UV resistance, higher reversible deformation and it is less susceptible to damage by micro-organisms. Polyester offers higher durability (life cycle), higher heat resistance, higher stability to UV radiation and other weather conditions. Although Polyester is an ideal fabric for balloon envelopes it is more difficult to dye and this has tended to deter most balloon manufacturers.

Kubicek BALLOONS

BALÓNY KUBÍČEK spol. s r.o.
Francouzská 81, 602 00 Brno
Czech Republic
tel.: +420 545 211 917
sales@kubicekballoons.cz

Joint Aviation Requirements JAR 21 Approved

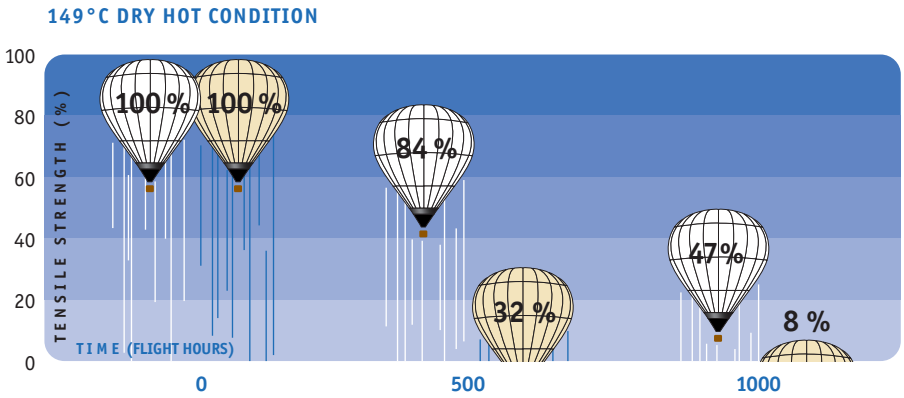
COATING

In addition to the chemical structure of the fibre the coatings applied to it and the way that the surface is finished will all effect the quality and the life of the fabric. Coatings can be used to fix the colours, to increase impermeability (air-tightness), to reduce microbiological action and to slow the decay of the fabric by reducing hydrolysis. The most frequently used coatings are polyurethane, acrylic and silicone. These coatings can be used individually or as a mixture on both nylon and polyester fabric.
Coating thickness can be varied and a number of different coatings may be applied.

We are often asked why Kubicek is the only balloon manufacturer to use white demonstrators. The answer is simple; our fabric is coated and finished in a way designed to throw off dirt. Kubicek Polyester is designed to stay brighter for longer.

HEAT DEGRADATION

Synthetic fabrics degrade gradually when they are exposed to heat. As an example of the difference between nylon and polyester, the Celanese Fibres company presented a comparison of fabric tensile strengths to the Industrial Fabric Association International. In this study it was shown that, after 500 hours of exposure to a continual 'dry temperature' of 149 °C, the fabric made from nylon had degraded to 32 % of its original strength, whereas the same fabric made from polyester retained 84 % of its initial strength. The same values measured over 1000 hours at the same temperature were even more dramatic: nylon was down to 8 % of its original strength whilst polyester had retained 47 % of the original strength.



The durability (life cycle) of the polyester fabric is significantly higher than the life of a nylon fabric at comparable temperatures.

Because polyester fabrics stand up well to high temperatures the manufacturers who uses this fabric have the option of asking for their balloons to be certified to fly at higher envelope temperatures than balloons made of nylon fabric. For example FireFly balloons are certified at to 149 °C against an 'European standard' of around 121°C. This is a road that Kubicek has chosen not to take, preferring instead to certify its envelopes for 124 °C, closer to the temperatures adopted by European balloon manufacturers. By accepting this lower temperature the fabric will last longer.

KUBICEK FABRIC

Since 1984 Kubicek has woven its own fabric. The looms that Kubicek own could produce either nylon or polyester fabric at similar costs, but the obvious choice was polyester. Kubicek's first fabric, called 'Urge' was used until 1997; it showed excellent laboratory results and lasted well. One of the oldest airworthiness envelope with 670 flight hours (autumn 2002) still flies in Vienna, Austria, pilot F-J. Rohrer. It's greate feature and tolerance of overheating was shown when 'Flower Power' balloon had set an altitude record during which it had been flown at a fairly constant 200 °C and the fabric remain airworthy for many following years. In 1997 the weave density of the fabric was increased and the tensile strength increased to give yet longer life. This new fabric 'Kubicek Polyester' is expected to give even longer life than the excellent fabric that it replaces.

BALLOON FABRICS – DATA COMPARISON

		KUBICEK POLYESTER	STANDARD BALLOON NYLON
weight (g/m²)		60	60–63
tensile	warp (N/5cm)	560	560–630
strength	weft (N/5cm)	540	510–620

We are often asked why we at Kubicek produce our own fabric. There are four simple reasons.

1. Kubicek can protect its own know how and maintain its own quality control.
2. In house production reduces dependence on suppliers.
3. New fabrics and coatings can be developed in house.
4. Kubicek cut out the middleman and pass the savings on to their customers.

Do not just take our word for it. Contact pilot Peter Flaggl in Stubenberg, Austria on *flagglen@aon.at* and ask his opinion of our fabric, as these words went to press the oldest of his six Kubicek balloons was passing 500 flight hours. Last stength fabric test on his Primagaz balloon BB60 (210000 cuft) shows that at 380 hrs (late 2002) the fabric retained 85 % of it's initial strength. Ask him how it's flying now !

BASIC COMPARISON – TECHNICAL FABRICS

PAD – polyamide, commercial name e.g. Nylon, the most famous fibre producer e.g. Du Pont

PES – polyester, commercial name e.g. Dacron, the most famous fibre producer e.g. Hoechst Co.

FIRST MADE

1938 | 1941

ADVANTAGES

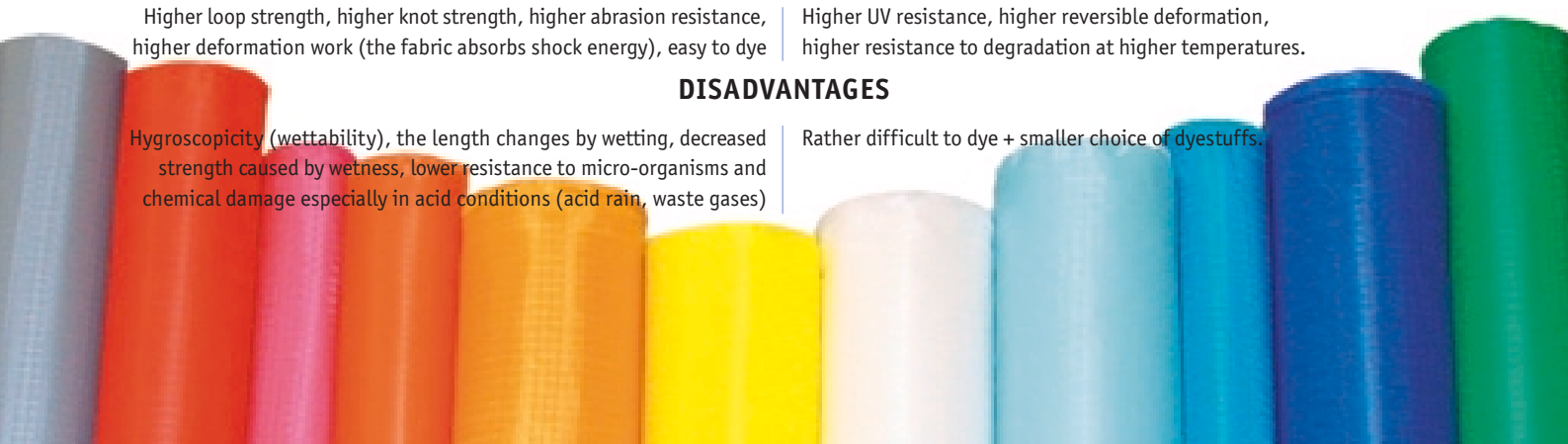
Higher loop strength, higher knot strength, higher abrasion resistance, higher deformation work (the fabric absorbs shock energy), easy to dye

Higher UV resistance, higher reversible deformation, higher resistance to degradation at higher temperatures.

DISADVANTAGES

Hygroscopicity (wettability), the length changes by wetting, decreased strength caused by wetness, lower resistance to micro-organisms and chemical damage especially in acid conditions (acid rain, waste gases)

Rather difficult to dye + smaller choice of dyestuffs.



HYPERLAST LU 7010 Poliol
HYPERLAST LE 7012 Isocianato

Descripción

HYPERLAST LU 7010 Poliol / HYPERLAST LE 7012 Isocianato consiste en un sistema 100% Poliurea Pura, bi componente, tecnológicamente desarrollado para la producción de elastómeros de alta densidad y alta performance, aplicado para el proceso spray, debido a las características intrínsecas del componente Poliurea (A) y la particular e innovadora composición de isocianato (B), presentan una membrana monolítica de alta reactividad formada en segundos y como consecuencia de esto, posee un alto nivel de resistencia a la temperatura y la humedad al momento de la aplicación. El polímero formado presenta excelentes propiedades físico-mecánicas, resistencia química y resistencia a la hidrólisis.

Principales Aplicaciones

El sistema HYPERLAST puede ser aplicado en diversas áreas de la industria y afines como:
Tanques de tratamiento de agua, protección anticorrosiva, cajas automotrices, canales de irrigación, impermeabilización, estadios de fútbol (gradas), pisos industriales o en lugares donde se requieran las características descriptas debajo:

- Amplio rango de temperatura de aplicación – Verano/Invierno;
- No inflamable;
- Libre de solventes;
- Resistencia química;
- Resistencia a la abrasión;
- Impermeable;
- Capa monolítica;
- Puede ser aplicado en una única o en múltiples capas;
- No requiere post curado;
- Puede ser retocado si se daña.

Propiedades Típicas de los Componentes

	Unidades	**HYPERLAST* LU 7010 Poliol**	**HYPERLAST * LE 7012** Isocianato	**Métodos**
Viscosidad @ 25/25°C (Spindle nº XX , YYY RPM)	cPs	200 – 400	550 - 950	ASTM D 445
Gravedad Específica 25/25ºC	g/cm^3	1.001	1.087	ASTM D 891
Color		Gris claro	Ambar	

Manejo y Almacenamiento

	Unidades	**HYPERLAST* LU 7010 Poliol**	**HYPERLAST * LE 7012** Isocianato
Temperatura de Almacenamiento	°C	15 - 35	15 - 35
Estabilidad de Almacenamiento / Validez (1)	meses	6	6

1 La estabilidad de almacenamiento indicada, se refiere a tambores originales, lacrados y almacenados en ambiente seco y a la temperatura recomendada.

Condiciones Recomendadas de Proceso

El HYPERLAST* LU 7010 Poliol debe ser homogeneizado previo a su utilización.
El HYPERLAST* LE 7012 Isocianato en reacción con agua genera dióxido de carbono pudiendo generar presión en los tambores. La formación de ureas sólidas también ocurre y afectará el desempeño del producto. Se la temperatura llega a ser menor que 15°C puede ocurrir una cristalización del producto.

	Unidades	Límites
HYPERLAST LU 7010 Poliol	pbv	1.00
HYPERLAST LE 7012 Iso	pbv	1.00
Equipos	Gusmer H20-35/H3500 Graco Reactor, Glascraft*	
Pistola de aplicación	Gusmer GX-7 DI/Glasscraft Probler/Graco Fusion	
Flujo	Gal/min	3-7
Cámara de mezcla		2929
Temperarura de los componentes	ºC	60 - 70
Temperarura de las mangueras	ºC	60 - 70
Presión de aplicación	psi	1800 - 2500

Características Típicas de Reacción

Usar máquina de spray de alta presión.

	Unidades	Límites
Tiempo de Gel	s	5 - 10
Tiempo de tacto libre	s	10 - 15
Densidad Libre	Kg/m3	1000 - 1050
Temperatura de Aplicación	ºC	12ºC a 40ºC
Temperatura de punto de rocío	ºC	> 5ºC de diferencia
Temperatura de Servicio	ºC	0ºC a 100ºC
Tempo para vuelta a servicio	Hrs	24

Propiedades Típicas del Polímero (1)

	Unidades	Límites	Métodos de Ensayo
Densidad Moldeada	Kg/m^3	1000 - 1050	DIN 53420
Tensión de Ruptura	psi	1900	DIN 53504
Alongamiento de ruptura	%	550 - 650	DIN 53504
Resistencia al desgarro	N/mm	64.3	DIN 53515
Dureza Shore A	A	80 - 85	DIN 53505
Resistencia a la Abrasión	mg	180	DIN 53510
% Sólidos	%	100 (0 g/l VOCs)	DIN 53510

Resistencia Química del Polímero

Polímero totalmente inmerso en el producto químico en condiciones de temperatura a 25°C por un período de 168 horas.

	Resistencia Química	Métodos de Ensayo
ÁCIDO SULFÚRICO 10%	R	ASTM D 543
ÁCIDO SULFÚRICO 25%	R	ASTM D 543
ÁCIDO ACETICO 5%	R	ASTM D 543
ÁCIDO CITRICO 10%	R	ASTM D 543
PERÓXIDO DE HIDRÓGENO 3%	R	ASTM D 543
HIDRÓXIDO DE SODIO 60%	R	ASTM D 543
HIDRÓXIDO DE SODIO 60% (60°C)	R	ASTM D 543
HIDRÓXIDO DE SODIO 60% (105°C) (Salpicaduras)	R	
CARBONATO DE SODIO 20%	R	ASTM D 543
CLORETO DE SODIO 10%	R	ASTM D 543
ACEITE MINERAL	R	ASTM D 543
ACEITE DE OLIVA	R	ASTM D 543
ACEITE DIESEL	R	ASTM D 543
ACETONA	R	ASTM D 543
ÉTER DE PETRÓLEO	R	ASTM D 543
ISOPROPANOL	R	ASTM D 543
AGUA	R	ASTM D 543
DETERGENTE	R	ASTM D 543
CLORETO DE METILENO	L	ASTM D 543
DIMETIL FORMAMIDA	NR	ASTM D 543
TOLUENO	NR	ASTM D 543
FENOL 5%	NR	ASTM D 543
ÁCIDO CLORHÍDRICO 36,5%	NR	ASTM D 543
ÁCIDO FOSFÓRICO 85%	NR	ASTM D 543
ÁCIDO SULFÚRICO 98%	NR	ASTM D 543

1. Esta información es considerada exacta y confiable hasta la fecha presente y proporcionada de buena fe. Una vez que las condiciones de uso y las regulaciones aplicables pueden diferir de lugar a lugar y pueden cambiar con el tiempo, es responsabilidad de quien está recibiendo esta información determinar si la misma es apropiada y aplicable al uso. Dado que Dow no tiene control sobre el uso de esta información, no asume obligaciones o responsabilidades. No se dan garantías expresas o implícitas y no está permitido que se den opiniones sobre cualquier patente de Dow o terceros.

2. (R) - RECOMENDADO: Aceptable para exposición o inmersión continua. Ningún aumento de peso o hinchazón y ninguna pérdida de resistencia a la tracción o dureza después de inmersión total por 30 días a 23º±2ºC. Temperaturas más altas o una combinación de solventes pueden reducir la resistencia química.

3. (L) - LIMITADO: Aceptable para exposición temporal a salpicaduras o derrames. Puede ser aceptable para exposición continua de gases o vapores. Menos del 10% de aumento de peso o hinchazón y correspondiente pérdida de resistencia a la tracción o dureza después de inmersión total por 7 días a 23º±2ºC. Temperaturas más altas o una combinación de solventes pueden reducir la resistencia química.

4. (NR) - NO RECOMENDADO: No aceptable para exposición temporaria o inmersión continua. Degradación química rápida con más de 10% de aumento de peso o hinchazón y correspondiente pérdida de resistencia a la tracción o dureza después de inmersión total por 7 días a 23º±2ºC.

Envejecimiento por calor 30 días a 185º F

	Unidades	Límites	Métodos de Ensayo
Densidad Moldeada	Kg/m^3	1000 - 1050	DIN 53420
Tensión de Ruptura	psi	1900	DIN 53504
Alargamiento de ruptura	%	550 - 650	DIN 53504
Resistencia al desgarro	N/mm	64.3	DIN 53515
Dureza Shore A	A	80 - 85	DIN 53505
Resistencia a la abrasión	mg	180	DIN 53510

Hidrólisis 7 días a 185º F

	Unidades	Límites	Métodos de Ensayo
Densidad Moldeada	Kg/m^3	1000 - 1050	DIN 53420
Tensión de Ruptura	psi	1900	DIN 53504
Alargamiento de ruptura	%	550 - 650	DIN 53504
Resistencia al desgarro	N/mm	64.3	DIN 53515
Dureza Shore A	A	80 - 85	DIN 53505
Resistencia a la abrasión	mg	180	DIN 53510

Resistencia UV del Polímero

Polímero expuesto a UV durante 3000hrs

	Unidades	Límites	Métodos de Ensayo
Densidad Moldeada	Kg/m^3	1000 - 1050	DIN 53420
Tensión de Ruptura	psi	1900	DIN 53504
Alargamiento de ruptura	%	550 - 650	DIN 53504
Resistencia al desgarro	N/mm	64.3	DIN 53515
Dureza Shore A	A	80 - 85	DIN 53505
Resistencia a la abrasión	mg	180	DIN 53510

Condiciones Recomendadas de Proceso

El sistema HYPERLAST* LU 7010 Poliol & HYPERLAST* LE 7012 Iso deberá siempre ser aplicado en sustratos secos y limpios. Remueva todo el aceite, polvo, grasa o cualquier otro tipo de suciedades que puedan afectar la aplicación de la membrana.
Considerar y observar las condiciones climáticas al momento de la aplicación, principalmente en el aspecto de temperatura del punto de rocío, la cual debe ser respetada. La recomendación internacional es de solamente aplicar el producto con la temperatura del sustrato 3°C por encima de la temperatura del punto de rocío del lugar. En la práctica, varios aplicadores solo aplican con 5°C por encima de la temperatura del punto de rocío.
La humedad del sustrato debe ser menor que 5%.

Concreto viejo

El concreto deberá estar exento de aceites o cualquier otro tipo de contaminante. Si el concreto estuviese contaminado con los productos citados, ellos deberán ser removidos con un detergente fuerte. Para la selección del mejor procedimiento para la limpieza del concreto, consultar la norma ASTM D4258 (Prácticas Padrones para la Limpieza de Concretos). Entretanto, generalmente para la remoción de contaminantes, hacer uso de hidrotratamiento con material abrasivo y cerciorarse que el concreto esté totalmente seco antes de continuar con el próximo paso.
Para la maximización de la adhesión/ cohesión, es imprescindible la utilización/ aplicación de un primer para concreto, antes de la aplicación del sistema HYPERLAST*. En algunos casos, si el concreto presenta deterioración en la superficie, como arañazos o rajaduras, las mismas deberán ser reparadas/ rellenadas para obtener el mismo nivel de superficie de un concreto nuevo. Después de esta reparación, se deberá realizar la aplicación del primer y en seguida el sistema HYPERLAST*.

Concreto Nuevo

El sistema HYPERLAST* no deberá ser aplicado antes del tiempo total de curado del concreto (30 – 60 días). Después de este período, la aplicación del chorro abrasivo o hidrotratamiento es imprescindible para la remoción de polvo y posibles componentes que son liberados con la cura del concreto. Aguardar o promover el secado completo del concreto, y entonces iniciar la aplicación del primer y en seguida el sistema HYPERLAST*.

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Metal

Antes de la aplicación del sistema HYPERLAST* en un sustrato metálico, asegurarse que las soldaduras sean continuas y exentas de imperfecciones. La preparación del metal deberá ser realizada con un chorro abrasivo y posteriormente con un solvente u otro producto capaz de remover trazas de aceite, grasa, humedad y contaminantes generados durante el proceso de abrasión que pueda comprometer la adhesión del primer y consecuentemente del sistema HYPERLAST *.

.

Consideraciones de Seguridad

Las Hojas de Datos de Seguridad de Materiales (MSDS) están disponibles en The Dow Chemical Company. Las MSDS son provistas para ayudar a los clientes a atender sus propias necesidades de manipulación, seguridad y disposición, más allá de aquellas exigidas por las reglamentaciones de seguridad y salud aplicables localmente, Las MSDS son actualizadas regularmente. Por lo tanto, solicite y evalúe la MSDS más reciente antes de manipular o utilizar cualquier producto. Están disponibles en las oficinas de ventas más próximas de Dow.

Aviso al Cliente

Dow incentiva a sus clientes a evaluar las aplicaciones que realizarán con los productos Dow desde el punto de vista de la salud humana y la calidad ambiental. Para garantizar que los productos de Dow no sean utilizados de maneras para las cuales ellos no fueron destinados o testeados, el personal de Dow estará listo para ayudar a los clientes para lidiar con las consideraciones ecológicas y de seguridad de producto. El representante de venas de Dow puede obtener los debidos contratos.

Informaciones para Contrato:
Para obtener más informaciones sobre los productos de Sistemas de Poliuretano, entre en contacto con The Dow Chemical. Company:
http://www.dow.com/pusystems/index.htm

Quality Management System certified by DQS against DIN EN ISO 9001
Reg. No. 055759 QM

ERTALON® 66 SA

theplasticshop.co.uk®

PRODUCT DATA SHEET

Material with a higher mechanical strength, stiffness, heat and wear resistance than Ertalon 6 SA. It also has a better creep resistance but its impact strength and mechanical damping ability is reduced. Well suited for machining on automatic lathes.

Please note that the **Ertalon 66 SA** natural rods over dia. 150 mm are made from a modified polyamide 66 resin (Ertalon 66 SA-C).

Physical properties (indicative values ▪)

PROPERTIES		Test methods	Units	VALUES
Colour		-	-	natural (cream)/ black
Density		ISO 1183-1	g/cm³	1.14
Water absorption:				
- after 24/96 h immersion in water of 23 °C (1)		ISO 62	mg	40 / 76
		ISO 62	%	0.60 / 1.13
- at saturation in air of 23 °C / 50 % RH		-	%	2.4
- at saturation in water of 23 °C		-	%	8
Thermal Properties (2)				
Melting temperature (DSC, 10 °C/min)		ISO 11357-1/-3	°C	260
Glass transition temperature (DSC, 20 °C/min) - (3)		ISO 11357-1/-2	°C	-
Thermal conductivity at 23 °C		-	W/(K.m)	0.28
Coefficient of linear thermal expansion:				
- average value between 23 and 60 °C		-	m/(m.K)	80 x 10^{-6}
- average value between 23 and 100 °C		-	m/(m.K)	95 x 10^{-6}
Temperature of deflection under load:				
- method A: 1.8 MPa	+	ISO 75-1/-2	°C	85
Max. allowable service temperature in air:				
- for short periods (4)		-	°C	180
- continuously : for 5,000 / 20,000 h (5)		-	°C	95 / 80
Min. service temperature (6)		-	°C	-30
Flammability (7):				
- "Oxygen Index"		ISO 4589-1/-2	%	26
- according to UL 94 (3 / 6 mm thickness)		-	-	HB / HB
Mechanical Properties at 23 °C (8)				
Tension test (9):				
- tensile stress at yield / tensile stress at break (10)	+	ISO 527-1/-2	MPa	90 / -
	++	ISO 527-1/-2	MPa	55 / -
- tensile strength (10)	+	ISO 527-1/-2	MPa	93
- tensile strain at yield (10)	+	ISO 527-1/-2	%	5
- tensile strain at break (10)	+	ISO 527-1/-2	%	50
	++	ISO 527-1/-2	%	> 100
- tensile modulus of elasticity (11)	+	ISO 527-1/-2	MPa	3550
	++	ISO 527-1/-2	MPa	1700
Compression test (12):				
- compressive stress at 1 / 2 / 5 % nominal strain (11)	+	ISO 604	MPa	32 / 62 / 100
Charpy impact strength - Unnotched (13)	+	ISO 179-1/1eU	kJ/m²	no break
Charpy impact strength - Notched	+	ISO 179-1/1eA	kJ/m²	4.5
Ball indentation hardness (14)	+	ISO 2039-1	N/mm²	160
Rockwell hardness (14)	+	ISO 2039-2	-	M 88
Electrical Properties at 23 °C				
Electric strength (15)	+	IEC 60243-1	kV/mm	27
	++	IEC 60243-1	kV/mm	18
Volume resistivity	+	IEC 60093	Ohm.cm	> 10^{14}
	++	IEC 60093	Ohm.cm	> 10^{12}
Surface resistivity	+	IEC 60093	Ohm	> 10^{13}
	++	IEC 60093	Ohm	> 10^{12}
Relative permittivity ε_r : - at 100 Hz	+	IEC 60250	-	3.8
	++	IEC 60250	-	7.4
- at 1 MHz	+	IEC 60250	-	3.3
	++	IEC 60250	-	3.8
Dielectric dissipation factor tan δ: - at 100 Hz	+	IEC 60250	-	0.013
	++	IEC 60250	-	0.13
- at 1 MHz	+	IEC 60250	-	0.020
	++	IEC 60250	-	0.06
Comparative tracking index (CTI)	+	IEC 60112	-	600
	++	IEC 60112	-	600

Note: 1 g/cm³ = 1,000 kg/m³ ; 1 MPa = 1 N/mm² ; 1 kV/mm = 1 MV/m.

Legend:

\+ : values referring to dry material

++ : values referring to material in equilibrium with the standard atmosphere 23 °C / 50 % RH (mostly derived from literature)

(1) According to method 1 of ISO 62 and done on discs ∅ 50 mm x 3 mm.

(2) The figures given for these properties are for the most part derived from raw material supplier data and other publications.

(3) Values for this property are only given here for amorphous materials and not for semi-crystalline ones.

(4) Only for short time exposure (a few hours) in applications where no or only a very low load is applied to the material.

(5) Temperature resistance over a period of 5,000/20,000 hours. After these periods of time, there is a decrease in tensile strength – measured at 23 °C – of about 50 % as compared with the original value. The temperature values given here are thus based on the thermal-oxidative degradation which takes place and causes a reduction in properties. Note, however, that the maximum allowable service temperature depends in many cases essentially on the duration and the magnitude of the mechanical stresses to which the material is subjected.

(6) Impact strength decreasing with decreasing temperature, the minimum allowable service temperature is practically mainly determined by the extent to which the material is subjected to impact. The value given here is based on unfavourable impact conditions and may consequently not be considered as being the absolute practical limit.

(7) These estimated ratings, derived from raw material supplier data and other publications, are not intended to reflect hazards presented by the material under actual fire conditions. There is no 'UL File Number' available for Ertalon 66 SA stock shapes.

(8) The figures given for the properties of dry material (+) are for the most part average values of tests run on test specimens machined out of rods Ø 40 - 60 mm. Except for the hardness tests, the test specimens were then taken from an area mid between centre and outside diameter, with their length in longitudinal direction of the rod (parallel to the extrusion direction).

(9) Test specimens: Type 1 B

(10) Test speed: 50 mm/min [chosen acc. to ISO 10350-1 as a function of the ductile behaviour of the material (tough or brittle)]

(11) Test speed: 1 mm/min

(12) Test specimens: cylinders ∅ 8 mm x 16 mm

(13) Pendulum used: 4 J

(14) Measured on 10 mm thick test specimens (discs), mid between centre and outside diameter.

(15) Electrode configuration: ∅ 25 / ∅ 75 mm coaxial cylinders ; in transformer oil according to IEC 60296 ; 1 mm thick test specimens.
Please note that the electric strength of Ertalon 66 SA black can be considerably lower than the figure listed in the table which refers to natural material.

▪ This table, mainly to be used for comparison purposes, is a valuable help in the choice of a material. The data listed here fall within the normal range of product properties. However, they are not guaranteed and they should not be used to establish material specification limits nor used alone as the basis of design.

Availablility: see "Guide to Diameter/Sheet Tolerances and Weights" or contact us

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ANNEX 2 – *REPORTS* DE ANSYS

Aquest altre annex recull tots els *reports* que el programa de simulació computacional Ansys, ha realitzat en l'execució de tots i cada un dels casos d'anàlisis d'estàtica estructural que es descriuen en la memòria.

CAS 1. Primer contacte i verificació del 3D.

CAS 2. Comprovació de les restriccions.

CAS 3. Variació de la vela sense paracaigudes.

CAS 4. Patent ES-2538595-B1.

CAS 5A. Millora dels contactes.

CAS 5B. Patent i grans desplaçaments.

CAS 5C. RÍGID. Patent i grans desplaçaments.

CAS 6A. Re-disseny amb més tubs a l'equador.

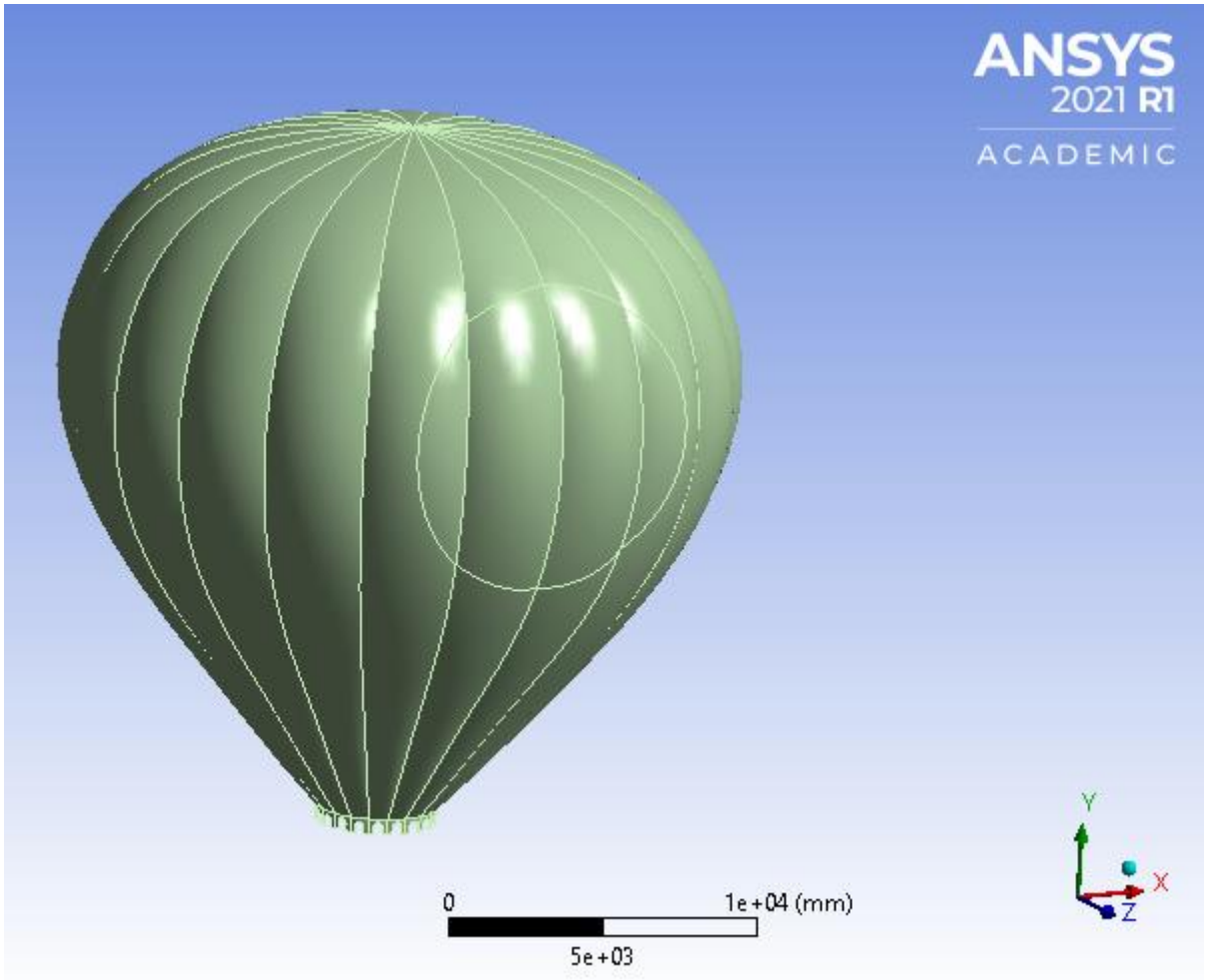
CAS 6B. RÍGID. Re-disseny amb més tubs a l'equador.

CAS 7A. Disseny final de xarxa.

CAS 7B. RÍGID. Disseny final de xarxa.

Project*

First Saved	Monday, March 15, 2021
Last Saved	Monday, June 14, 2021
Product Version	2021 R1
Save Project Before Solution	No
Save Project After Solution	No



Contents

Units

TABLE 1

Unit System	Metric (mm, kg, N, s, mV, mA) Degrees rad/s Celsius
Angle	Degrees
Rotational Velocity	rad/s
Temperature	Celsius

Model (A4)

Geometry

TABLE 2
Model (A4) > Geometry

Object Name	*Geometry*
State	Fully Defined
Definition	
Source	C:\Users\fvila\Desktop\1-PROVA_divisio-simple+ABS\1-PROVA\1-PROVA_divisio-simple+plastic\1-PROVA_divisio-simple+plastic_files\dp0\SYS\DM\SYS.scdoc
Type	SpaceClaim
Length Unit	Meters
Element Control	Program Controlled
Display Style	Body Color
Bounding Box	
Length X	21995 mm
Length Y	23200 mm
Length Z	21995 mm
Properties	

Volume	8,9386e+009 mm³
Mass	9206,7 kg
Surface Area(approx.)	1,4898e+009 mm²
Scale Factor Value	1,
2D Tolerance	Default (1,e-005)
Statistics	
Bodies	1
Active Bodies	1
Nodes	10537
Elements	10491
Mesh Metric	None
Update Options	
Assign Default Material	No
Basic Geometry Options	
Solid Bodies	Yes
Surface Bodies	Yes
Line Bodies	Yes
Parameters	Independent
Parameter Key	
Attributes	Yes
Attribute Key	
Named Selections	Yes
Named Selection Key	
Material Properties	Yes
Advanced Geometry Options	
Use Associativity	Yes
Coordinate Systems	Yes
Coordinate System Key	
Reader Mode Saves Updated File	No
Use Instances	Yes
Smart CAD Update	Yes
Compare Parts On Update	No
Analysis Type	3-D
Mixed Import Resolution	None
Import Facet Quality	Source
Clean Bodies On Import	No
Stitch Surfaces On Import	None
Decompose Disjoint Geometry	Yes
Enclosure and Symmetry Processing	Yes

TABLE 3
Model (A4) > Geometry > Parts

Object Name	*SYS\Surface1*
State	Meshed
Graphics Properties	
Visible	Yes
Transparency	1
Definition	
Suppressed	No
Dimension	3D
Stiffness Behavior	Flexible
Coordinate System	Default Coordinate System
Reference Temperature	By Environment
Thickness	6, mm
Thickness Mode	Manual
Offset Type	Middle
Treatment	None
Model Type	Shell
Material	
Assignment	Plastic, ABS (high-impact)
Nonlinear Effects	Yes
Thermal Strain Effects	Yes
Bounding Box	
Length X	21995 mm
Length Y	23200 mm
Length Z	21995 mm
Properties	
Volume	8,9386e+009 mm³
Mass	9206,7 kg
Centroid X	-1,3553e-004 mm
Centroid Y	4336,1 mm
Centroid Z	0,6686 mm
Moment of Inertia Ip1	7,0402e+011 kg·mm²
Moment of Inertia Ip2	7,0558e+011 kg·mm²
Moment of Inertia Ip3	7,0395e+011 kg·mm²
Surface Area(approx.)	1,4898e+009 mm²
Statistics	
Nodes	10537
Elements	10491
Mesh Metric	None
CAD Attributes	
PartTolerance:	0,00000001
Color:143.149.175	

TABLE 4
Model (A4) > Materials

Object Name	*Materials*
State	Fully Defined
Statistics	
Materials	3
Material Assignments	0

Coordinate Systems

TABLE 5
Model (A4) > Coordinate Systems > Coordinate System

Object Name	*Global Coordinate System*
State	Fully Defined
Definition	
Type	Cartesian
Coordinate System ID	0,
Origin	
Origin X	0, mm
Origin Y	0, mm
Origin Z	0, mm
Directional Vectors	
X Axis Data	[1, 0, 0,]
Y Axis Data	[0, 1, 0,]
Z Axis Data	[0, 0, 1,]

Connections

TABLE 6
Model (A4) > Connections

Object Name	*Connections*
State	Fully Defined
Auto Detection	
Generate Automatic Connection On Refresh	Yes
Transparency	
Enabled	Yes

Mesh

TABLE 7
Model (A4) > Mesh

Object Name	*Mesh*
State	Solved
Display	
Display Style	Use Geometry Setting
Defaults	
Physics Preference	Mechanical
Element Order	Program Controlled
Element Size	Default (703,2 mm)
Sizing	
Use Adaptive Sizing	No
Growth Rate	Default (1,2)
Mesh Defeaturing	Yes
Defeature Size	Default (3,516 mm)
Capture Curvature	Yes
Curvature Min Size	Default (7,032 mm)
Curvature Normal Angle	Default (30,°)
Capture Proximity	No
Bounding Box Diagonal	38805 mm
Average Surface Area	3,1647e+007 mm²

Minimum Edge Length	15,709 mm
Quality	
Check Mesh Quality	Yes, Errors
Error Limits	Aggressive Mechanical
Target Quality	Default (0.050000)
Smoothing	Medium
Mesh Metric	None
Inflation	
Use Automatic Inflation	None
Inflation Option	Smooth Transition
Transition Ratio	0,272
Maximum Layers	2
Growth Rate	1,2
Inflation Algorithm	Pre
View Advanced Options	No
Batch Connections	
Mesh Based Connection	No
Advanced	
Number of CPUs for Parallel Part Meshing	Program Controlled
Straight Sided Elements	No
Rigid Body Behavior	Dimensionally Reduced
Triangle Surface Mesher	Program Controlled
Topology Checking	Yes
Use Sheet Thickness for Pinch	No
Pinch Tolerance	Default (6,3288 mm)
Generate Pinch on Refresh	No
Sheet Loop Removal	No
Statistics	
Nodes	10537
Elements	10491

TABLE 8
Model (A4) > Mesh > Mesh Controls

Object Name	*Face Sizing*	*Face Sizing 2*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	26 Faces	20 Faces
Definition		
Suppressed	No	
Type	Element Size	
Element Size	400, mm	100, mm
Advanced		
Defeature Size	Default (3,516 mm)	
Behavior	Soft	
Growth Rate	Default (1,2)	
Capture Curvature	No	
Capture Proximity	No	

Static Structural (A5)

TABLE 9
Model (A4) > Analysis

Object Name	*Static Structural (A5)*
State	Solved
Definition	
Physics Type	Structural
Analysis Type	Static Structural
Solver Target	Mechanical APDL
Options	
Environment Temperature	22, °C
Generate Input Only	No

TABLE 10
Model (A4) > Static Structural (A5) > Analysis Settings

Object Name	*Analysis Settings*
State	Fully Defined
Step Controls	
Number Of Steps	1,
Current Step Number	1,
Step End Time	1, s
Auto Time Stepping	Program Controlled
Solver Controls	
Solver Type	Program Controlled
Weak Springs	Off
Solver Pivot Checking	Program Controlled
Large Deflection	Off
Inertia Relief	Off
Quasi-Static Solution	Off
Rotordynamics Controls	
Coriolis Effect	Off
Restart Controls	
Generate Restart Points	Program Controlled
Retain Files After Full Solve	No
Combine Restart Files	Program Controlled
Nonlinear Controls	
Newton-Raphson Option	Program Controlled
Force Convergence	Program Controlled
Moment Convergence	Program Controlled
Displacement Convergence	Program Controlled
Rotation Convergence	Program Controlled
Line Search	Program Controlled
Stabilization	Program Controlled

Advanced	
Inverse Option	No
Contact Split (DMP)	Off
Output Controls	
Stress	Yes
Surface Stress	No
Back Stress	No
Strain	Yes
Contact Data	Yes
Nonlinear Data	No
Nodal Forces	No
Volume and Energy	Yes
Euler Angles	Yes
General Miscellaneous	No
Contact Miscellaneous	No
Store Results At	All Time Points
Result File Compression	Program Controlled
Analysis Data Management	
Solver Files Directory	C:\Users\fvila\Desktop\1-PROVA_divisio-simple+ABS\1-PROVA\1-PROVA_divisio-simple+plastic\1-PROVA_divisio-simple+plastic_files\dp0\SYS\MECH\
Future Analysis	None
Scratch Solver Files Directory	
Save MAPDL db	No
Contact Summary	Program Controlled
Delete Unneeded Files	Yes
Nonlinear Solution	No
Solver Units	Active System
Solver Unit System	nmm

TABLE 11
Model (A4) > Static Structural (A5) > Loads

Object Name	*Displacement 2*	*Fixed Rotation*	*Pressure*
State	Fully Defined		
Scope			
Scoping Method	Geometry Selection		
Geometry	20 Faces		4 Faces
Definition			
Type	Displacement	Fixed Rotation	Pressure
Define By	Components		Normal To
Coordinate System	Global Coordinate System		
X Component	0, mm (ramped)		
Y Component	0, mm (ramped)		
Z Component	0, mm (ramped)		
Suppressed	No		
Rotation X		Fixed	
Rotation Y		Fixed	

Rotation Z		Fixed	
Applied By			Surface Effect
Loaded Area			Deformed
Magnitude			9,e-005 MPa (ramped)

Solution (A6)

TABLE 12
Model (A4) > Static Structural (A5) > Solution

Object Name	*Solution (A6)*
State	Solved
Adaptive Mesh Refinement	
Max Refinement Loops	1,
Refinement Depth	2,
Information	
Status	Done
MAPDL Elapsed Time	5, s
MAPDL Memory Used	577, MB
MAPDL Result File Size	10,813 MB
Post Processing	
Beam Section Results	No
On Demand Stress/Strain	No

TABLE 13
Model (A4) > Static Structural (A5) > Solution (A6) > Solution Information

Object Name	*Solution Information*
State	Solved
Solution Information	
Solution Output	Solver Output
Newton-Raphson Residuals	0
Identify Element Violations	0
Update Interval	2,5 s
Display Points	All
FE Connection Visibility	
Activate Visibility	Yes
Display	All FE Connectors
Draw Connections Attached To	All Nodes
Line Color	Connection Type
Visible on Results	No
Line Thickness	Single
Display Type	Lines

TABLE 14
Model (A4) > Static Structural (A5) > Solution (A6) > Results

Object Name	*Total Deformation*	*Equivalent Elastic Strain*	*Stress Intensity*
State	Solved		
Scope			
Scoping Method	Geometry Selection		
Geometry	All Bodies		
Position		Top/Bottom	
Definition			
Type	Total Deformation	Equivalent Elastic Strain	Stress Intensity
By	Time		

Display Time	Last		
Calculate Time History	Yes		
Identifier			
Suppressed	No		
Results			
Minimum	0, mm	0, mm/mm	0, MPa
Maximum	304,38 mm	2,6477e-003 mm/mm	4,7603 MPa
Average	70,422 mm	2,8061e-004 mm/mm	0,42588 MPa
Minimum Occurs On	SYS\Surface1		
Maximum Occurs On	SYS\Surface1		
Information			
Time	1, s		
Load Step	1		
Substep	1		
Iteration Number	1		
Integration Point Results			
Display Option		Averaged	
Average Across Bodies		No	

FIGURE 1
Model (A4) > Static Structural (A5) > Solution (A6) > Total Deformation

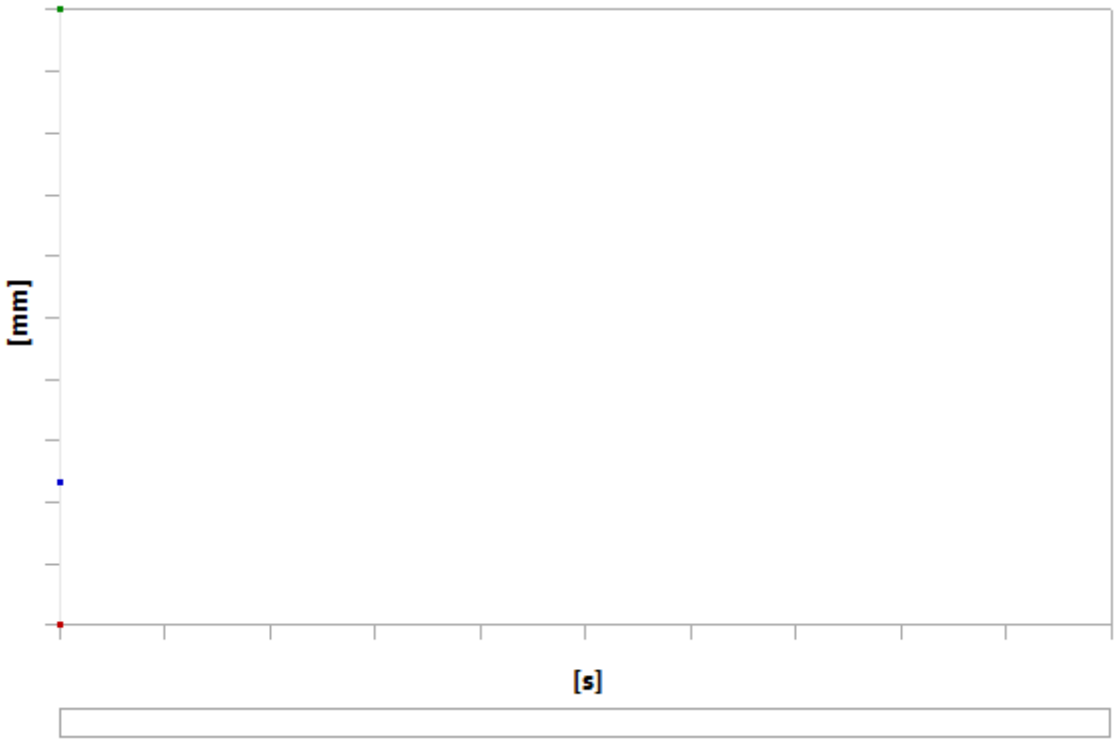


TABLE 15
Model (A4) > Static Structural (A5) > Solution (A6) > Total Deformation

Time [s]	Minimum [mm]	Maximum [mm]	Average [mm]
1,	0,	304,38	70,422

FIGURE 2
Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Elastic Strain

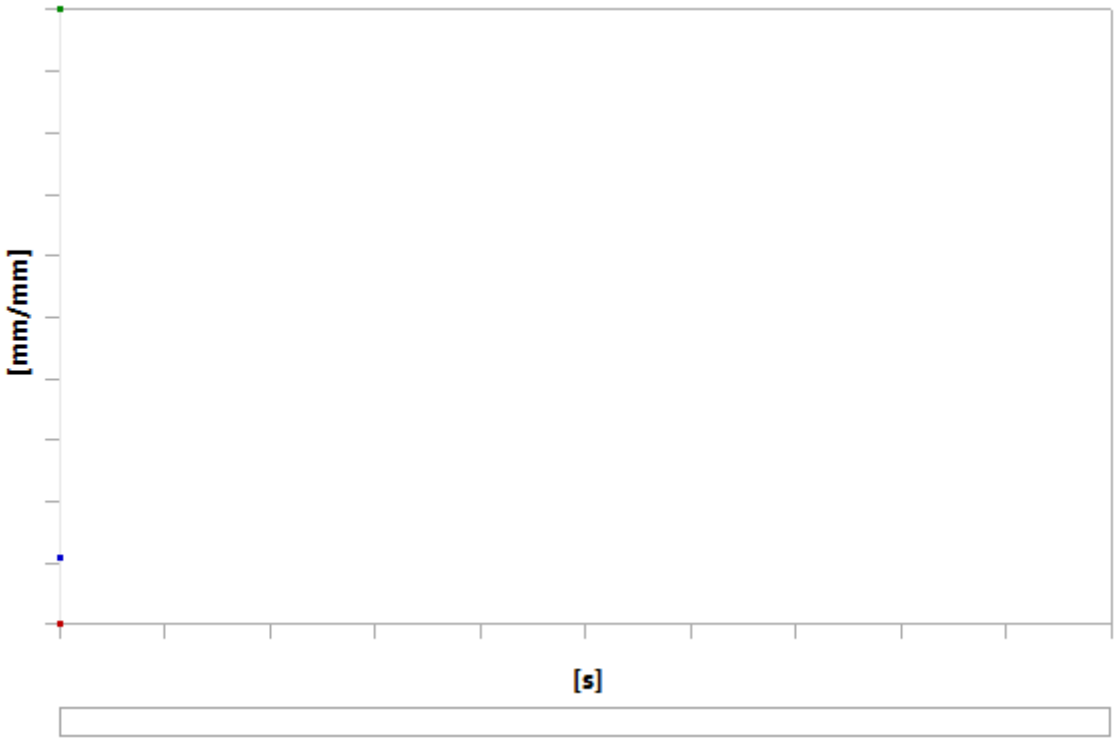


TABLE 16
Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Elastic Strain

Time [s]	Minimum [mm/mm]	Maximum [mm/mm]	Average [mm/mm]
1,	0,	2,6477e-003	2,8061e-004

FIGURE 3
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Intensity

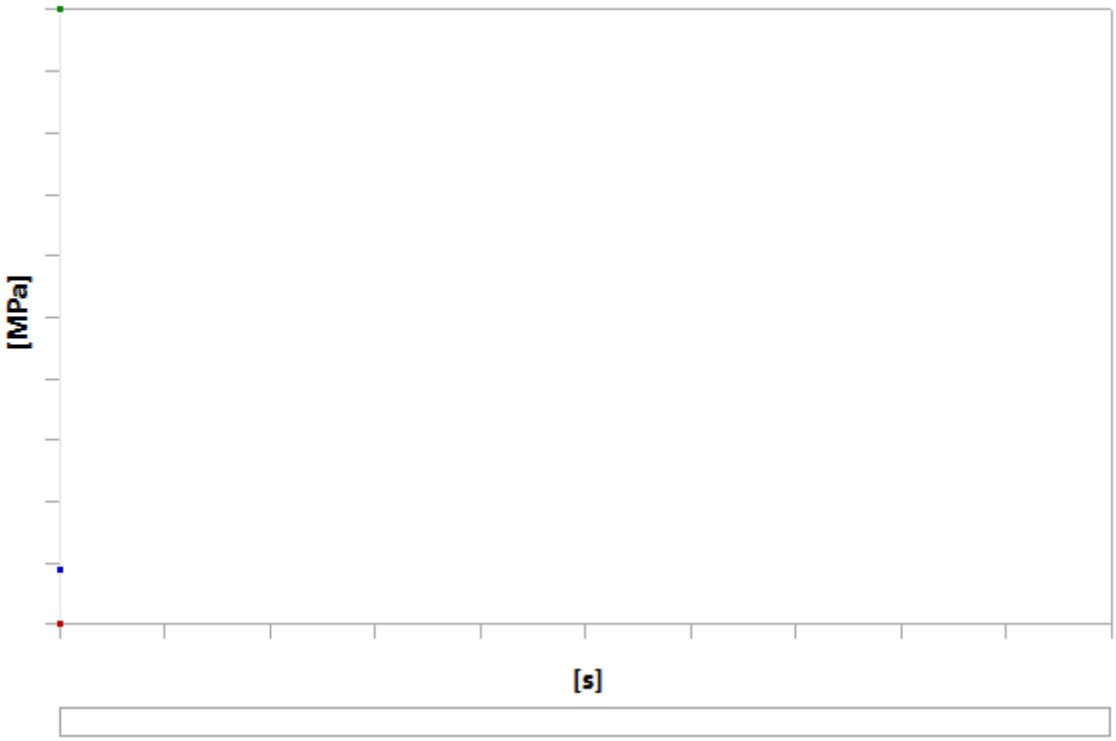


TABLE 17
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Intensity

Time [s]	Minimum [MPa]	Maximum [MPa]	Average [MPa]
1,	0,	4,7603	0,42588

TABLE 18
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Safety Tools

Object Name	*Stress Tool*
State	Solved
Definition	
Theory	Max Equivalent Stress
Stress Limit Type	Tensile Yield Per Material

TABLE 19
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Tool > Results

Object Name	*Safety Factor*
State	Solved
Scope	
Scoping Method	Geometry Selection
Geometry	All Bodies
Definition	
Type	Safety Factor
By	Time
Display Time	Last
Calculate Time History	Yes
Identifier	
Suppressed	No
Integration Point Results	
Display Option	Averaged

Average Across Bodies	No
Results	
Minimum	6,6392
Minimum Occurs On	SYS\Surface1
Information	
Time	1, s
Load Step	1
Substep	1
Iteration Number	1

FIGURE 4
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Tool > Safety Factor

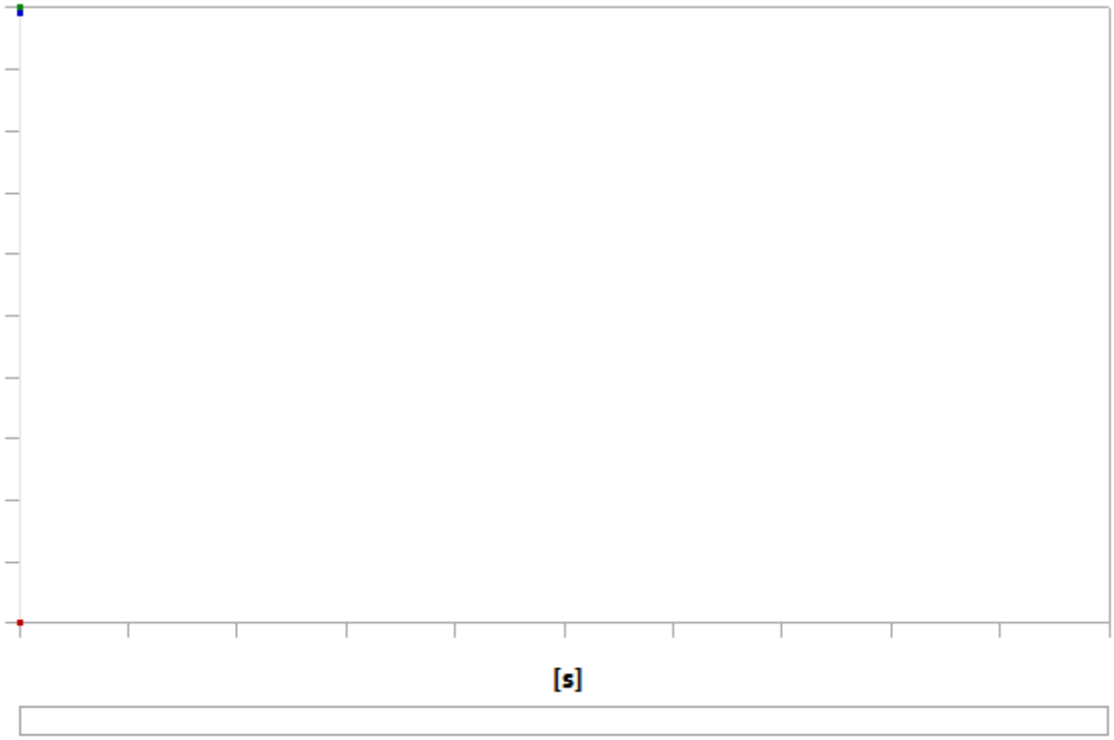


TABLE 20
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Tool > Safety Factor

Time [s]	Minimum	Maximum	Average
1,	6,6392	15,	14,916

Material Data

Plastic, ABS (high-impact)

TABLE 21
Plastic, ABS (high-impact) > Constants

Density	1,03e-006 kg mm^-3
Tensile Yield Strength	27,44 MPa
Tensile Ultimate Strength	36,26 MPa
Coefficient of Thermal Expansion	1,84e-004 C^-1
Thermal Conductivity	1,997e-004 W mm^-1 C^-1

Specific Heat	1,4e+006 mJ kg^-1 C^-1

TABLE 22
Plastic, ABS (high-impact) > Opacity

Red	Green	Blue
0,	153,	255,
Opacity		
0,9		
Metallic Finish		
0,		

TABLE 23
Plastic, ABS (high-impact) > Isotropic Elasticity

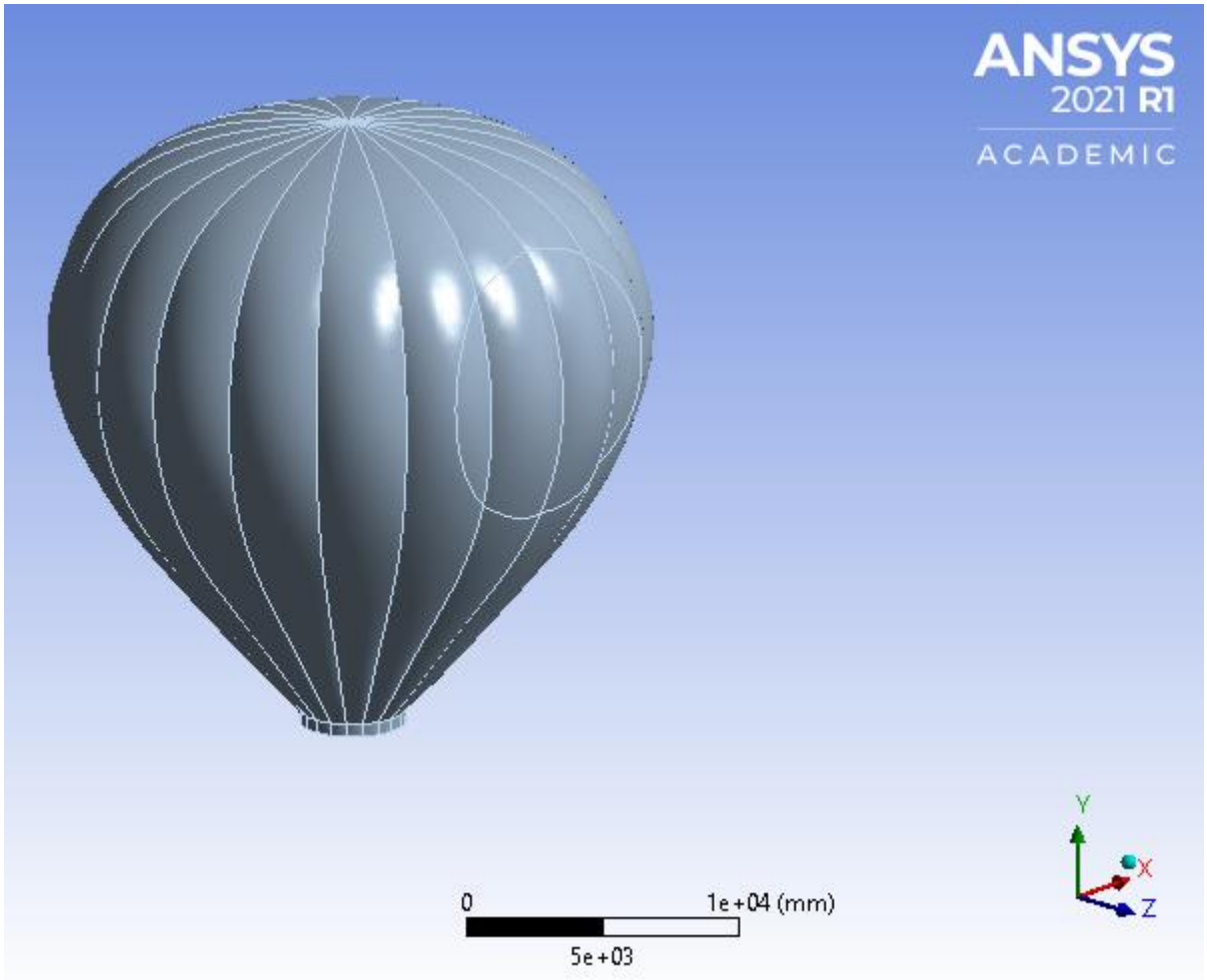
Young's Modulus MPa	Poisson's Ratio	Bulk Modulus MPa	Shear Modulus MPa	Temperature C
1628,	0,4089	2978,4	577,76	23,

TABLE 24
Plastic, ABS (high-impact) > Isotropic Secant Coefficient of Thermal Expansion

Zero-Thermal-Strain Reference Temperature C
23,

Project*

First Saved	Wednesday, April 14, 2021
Last Saved	Monday, June 14, 2021
Product Version	2021 R1
Save Project Before Solution	No
Save Project After Solution	No



Contents

Units

TABLE 1

Unit System	Metric (mm, kg, N, s, mV, mA) Degrees rad/s Celsius
Angle	Degrees
Rotational Velocity	rad/s
Temperature	Celsius

Model (A4)

Geometry

TABLE 2
Model (A4) > Geometry

Object Name	*Geometry*
State	Fully Defined
Definition	
Source	C:\Users\fvila\Desktop\2-PROVA-globusCLOSE_restriccions-PA\2-PROVA-globusCLOSE_restriccions-PA_files\dp0\SYS\DM\SYS.scdoc
Type	SpaceClaim
Length Unit	Meters
Element Control	Program Controlled
Display Style	Body Color
Bounding Box	
Length X	21995 mm
Length Y	23200 mm
Length Z	21995 mm
Properties	
Volume	7,4601e+008 mm³
Mass	850,45 kg

Surface Area(approx.)	1,492e+009 mm²
Scale Factor Value	1,
2D Tolerance	Default (1,e-005)
Statistics	
Bodies	1
Active Bodies	1
Nodes	17768
Elements	17840
Mesh Metric	None
Update Options	
Assign Default Material	No
Basic Geometry Options	
Solid Bodies	Yes
Surface Bodies	Yes
Line Bodies	Yes
Parameters	Independent
Parameter Key	
Attributes	Yes
Attribute Key	
Named Selections	Yes
Named Selection Key	
Material Properties	Yes
Advanced Geometry Options	
Use Associativity	Yes
Coordinate Systems	Yes
Coordinate System Key	
Reader Mode Saves Updated File	No
Use Instances	Yes
Smart CAD Update	Yes
Compare Parts On Update	No
Analysis Type	3-D
Mixed Import Resolution	None
Import Facet Quality	Source
Clean Bodies On Import	No
Stitch Surfaces On Import	None
Decompose Disjoint Geometry	Yes
Enclosure and Symmetry Processing	Yes

TABLE 3
Model (A4) > Geometry > Parts

Object Name	*Ultramagic-T-180-PROVA2\Surface1*
State	Meshed
Graphics Properties	
Visible	Yes
Transparency	1

Definition	
Suppressed	No
Dimension	3D
Stiffness Behavior	Flexible
Coordinate System	Default Coordinate System
Reference Temperature	By Environment
Thickness	0,5 mm
Thickness Mode	Manual
Offset Type	Middle
Treatment	None
Model Type	Shell
Material	
Assignment	Plastic, PA6
Nonlinear Effects	Yes
Thermal Strain Effects	Yes
Bounding Box	
Length X	21995 mm
Length Y	23200 mm
Length Z	21995 mm
Properties	
Volume	7,4601e+008 mm³
Mass	850,45 kg
Centroid X	-1,3533e-004 mm
Centroid Y	4315,7 mm
Centroid Z	0,66758 mm
Moment of Inertia Ip1	6,5167e+010 kg·mm²
Moment of Inertia Ip2	6,5082e+010 kg·mm²
Moment of Inertia Ip3	6,516e+010 kg·mm²
Surface Area(approx.)	1,492e+009 mm²
Statistics	
Nodes	17768
Elements	17840
Mesh Metric	None
CAD Attributes	
PartTolerance:	0,00000001
Color:143.149.175	

TABLE 4
Model (A4) > Materials

Object Name	*Materials*
State	Fully Defined
Statistics	
Materials	2
Material Assignments	0

Coordinate Systems

TABLE 5
Model (A4) > Coordinate Systems > Coordinate System

Object Name	*Global Coordinate System*
State	Fully Defined
Definition	

Type	Cartesian
Coordinate System ID	0,
Origin	
Origin X	0, mm
Origin Y	0, mm
Origin Z	0, mm
Directional Vectors	
X Axis Data	[1, 0, 0,]
Y Axis Data	[0, 1, 0,]
Z Axis Data	[0, 0, 1,]

Mesh

TABLE 6
Model (A4) > Mesh

Object Name	*Mesh*
State	Solved
Display	
Display Style	Use Geometry Setting
Defaults	
Physics Preference	Mechanical
Element Order	Program Controlled
Element Size	Default (703,73 mm)
Sizing	
Use Adaptive Sizing	No
Growth Rate	Default (1,2)
Mesh Defeaturing	Yes
Defeature Size	Default (3,5187 mm)
Capture Curvature	Yes
Curvature Min Size	Default (7,0373 mm)
Curvature Normal Angle	Default (30,°)
Capture Proximity	No
Bounding Box Diagonal	38805 mm
Average Surface Area	3,1695e+007 mm²
Minimum Edge Length	15,709 mm
Quality	
Check Mesh Quality	Yes, Errors
Error Limits	Aggressive Mechanical
Target Quality	Default (0.050000)
Smoothing	Medium
Mesh Metric	None
Inflation	
Use Automatic Inflation	None
Inflation Option	Smooth Transition
Transition Ratio	0,272
Maximum Layers	2
Growth Rate	1,2
Inflation Algorithm	Pre
View Advanced Options	No
Batch Connections	
Mesh Based Connection	No
Advanced	

Number of CPUs for Parallel Part Meshing	Program Controlled
Straight Sided Elements	No
Rigid Body Behavior	Dimensionally Reduced
Triangle Surface Mesher	Program Controlled
Topology Checking	Yes
Use Sheet Thickness for Pinch	No
Pinch Tolerance	Default (6,3336 mm)
Generate Pinch on Refresh	No
Sheet Loop Removal	No
Statistics	
Nodes	17768
Elements	17840

TABLE 7
Model (A4) > Mesh > Mesh Controls

Object Name	*300mm*	*100mm*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	27 Faces	20 Faces
Definition		
Suppressed	No	
Type	Element Size	
Element Size	300, mm	100, mm
Advanced		
Defeature Size	Default (3,5187 mm)	
Behavior	Soft	
Growth Rate	Default (1,2)	
Capture Curvature	No	
Capture Proximity	No	

Static Structural (A5)

TABLE 8
Model (A4) > Analysis

Object Name	*Static Structural (A5)*
State	Solved
Definition	
Physics Type	Structural
Analysis Type	Static Structural
Solver Target	Mechanical APDL
Options	
Environment Temperature	22, °C
Generate Input Only	No

TABLE 9
Model (A4) > Static Structural (A5) > Analysis Settings

Object Name	*Analysis Settings*
State	Fully Defined
Step Controls	
Number Of Steps	1,

Current Step Number	1,
Step End Time	1, s
Auto Time Stepping	On
Define By	Substeps
Initial Substeps	500,
Minimum Substeps	100,
Maximum Substeps	10000
Solver Controls	
Solver Type	Program Controlled
Weak Springs	Off
Solver Pivot Checking	Program Controlled
Large Deflection	Off
Inertia Relief	Off
Quasi-Static Solution	Off
Rotordynamics Controls	
Coriolis Effect	Off
Restart Controls	
Generate Restart Points	Program Controlled
Retain Files After Full Solve	No
Combine Restart Files	Program Controlled
Nonlinear Controls	
Newton-Raphson Option	Program Controlled
Force Convergence	Program Controlled
Moment Convergence	Program Controlled
Displacement Convergence	Program Controlled
Rotation Convergence	Program Controlled
Line Search	Program Controlled
Stabilization	Program Controlled
Advanced	
Inverse Option	No
Contact Split (DMP)	Off
Output Controls	
Stress	Yes
Surface Stress	No
Back Stress	No
Strain	Yes
Contact Data	Yes
Nonlinear Data	No
Nodal Forces	No
Volume and Energy	Yes
Euler Angles	Yes
General Miscellaneous	No
Contact Miscellaneous	No

Store Results At	All Time Points
Result File Compression	Program Controlled
Analysis Data Management	
Solver Files Directory	C:\Users\fvila\Desktop\2-PROVA-globusCLOSE_restriccions-PA\2-PROVA-globusCLOSE_restriccions-PA_files\dp0\SYS\MECH\
Future Analysis	None
Scratch Solver Files Directory	
Save MAPDL db	No
Contact Summary	Program Controlled
Delete Unneeded Files	Yes
Nonlinear Solution	No
Solver Units	Active System
Solver Unit System	nmm

TABLE 10
Model (A4) > Static Structural (A5) > Loads

Object Name	*Displacement*	*Fixed Rotation*	*Pressure*	*Pressure 2*
State	Fully Defined			
Scope				
Scoping Method	Geometry Selection			
Geometry	21 Faces	10 Faces	4 Faces	27 Faces
Definition				
Type	Displacement	Fixed Rotation	Pressure	
Define By	Components		Normal To	
Coordinate System	Global Coordinate System			
X Component	0, mm (ramped)			
Y Component	0, mm (ramped)			
Z Component	0, mm (ramped)			
Suppressed	No			
Rotation X		Fixed		
Rotation Y		Fixed		
Rotation Z		Fixed		
Applied By			Surface Effect	
Loaded Area			Deformed	
Magnitude			0,15199 MPa (ramped)	-0,1 MPa (ramped)

Solution (A6)

TABLE 11
Model (A4) > Static Structural (A5) > Solution

Object Name	*Solution (A6)*
State	Solved
Adaptive Mesh Refinement	
Max Refinement Loops	1,

Refinement Depth	2,
Information	
Status	Done
MAPDL Elapsed Time	3 m 32 s
MAPDL Memory Used	711, MB
MAPDL Result File Size	1,7412 GB
Post Processing	
Beam Section Results	No
On Demand Stress/Strain	No

TABLE 12
Model (A4) > Static Structural (A5) > Solution (A6) > Solution Information

Object Name	*Solution Information*
State	Solved
Solution Information	
Solution Output	Solver Output
Newton-Raphson Residuals	0
Identify Element Violations	0
Update Interval	2,5 s
Display Points	All
FE Connection Visibility	
Activate Visibility	Yes
Display	All FE Connectors
Draw Connections Attached To	All Nodes
Line Color	Connection Type
Visible on Results	No
Line Thickness	Single
Display Type	Lines

TABLE 13
Model (A4) > Static Structural (A5) > Solution (A6) > Results

Object Name	*Total Deformation*	*Equivalent Elastic Strain*	*Stress Intensity*
State	Solved		
Scope			
Scoping Method	Geometry Selection		
Geometry	All Bodies		
Position		Top/Bottom	
Definition			
Type	Total Deformation	Equivalent Elastic Strain	Stress Intensity
By	Time		
Display Time	Last		
Calculate Time History	Yes		
Identifier			
Suppressed	No		
Results			
Minimum	0, mm	0, mm/mm	0, MPa
Maximum	6,5584e+007 mm	857,87 mm/mm	6,47e+005 MPa
Average	5,3403e+006 mm	20,327 mm/mm	19896 MPa
Minimum Occurs On	Ultramagic-T-180-PROVA2\Surface1		
Maximum Occurs On	Ultramagic-T-180-PROVA2\Surface1		
Minimum Value Over Time			
Minimum	0, mm	0, mm/mm	0, MPa
Maximum	0, mm	0, mm/mm	0, MPa

Maximum Value Over Time			
Minimum	1,3117e+005 mm	1,7157 mm/mm	1294, MPa
Maximum	6,5584e+007 mm	857,87 mm/mm	6,47e+005 MPa
Information			
Time	1, s		
Load Step	1		
Substep	102		
Iteration Number	102		
Integration Point Results			
Display Option		Averaged	
Average Across Bodies		No	

FIGURE 1
Model (A4) > Static Structural (A5) > Solution (A6) > Total Deformation

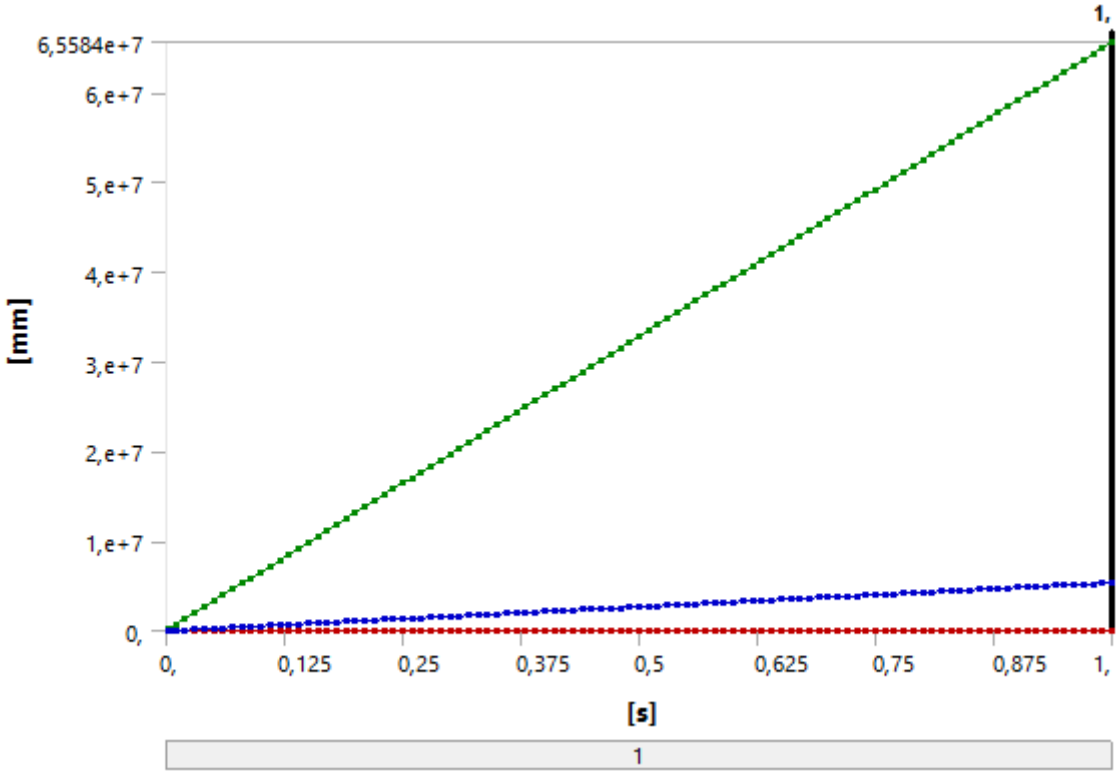


TABLE 14
Model (A4) > Static Structural (A5) > Solution (A6) > Total Deformation

Time [s]	Minimum [mm]	Maximum [mm]	Average [mm]
2,e-003	0,	1,3117e+005	10681
4,e-003		2,6234e+005	21361
1,e-002		6,5584e+005	53403
2,e-002		1,3117e+006	1,0681e+005
3,e-002		1,9675e+006	1,6021e+005
4,e-002		2,6234e+006	2,1361e+005
5,e-002		3,2792e+006	2,6702e+005
6,e-002		3,935e+006	3,2042e+005
7,e-002		4,5909e+006	3,7382e+005
8,e-002		5,2467e+006	4,2723e+005
9,e-002		5,9026e+006	4,8063e+005
1,e-001		6,5584e+006	5,3403e+005

0,11		7,2142e+006	5,8744e+005
0,12		7,8701e+006	6,4084e+005
0,13		8,5259e+006	6,9424e+005
0,14		9,1818e+006	7,4765e+005
0,15		9,8376e+006	8,0105e+005
0,16		1,0493e+007	8,5445e+005
0,17		1,1149e+007	9,0786e+005
0,18		1,1805e+007	9,6126e+005
0,19		1,2461e+007	1,0147e+006
0,2		1,3117e+007	1,0681e+006
0,21		1,3773e+007	1,1215e+006
0,22		1,4428e+007	1,1749e+006
0,23		1,5084e+007	1,2283e+006
0,24		1,574e+007	1,2817e+006
0,25		1,6396e+007	1,3351e+006
0,26		1,7052e+007	1,3885e+006
0,27		1,7708e+007	1,4419e+006
0,28		1,8364e+007	1,4953e+006
0,29		1,9019e+007	1,5487e+006
0,3		1,9675e+007	1,6021e+006
0,31		2,0331e+007	1,6555e+006
0,32		2,0987e+007	1,7089e+006
0,33		2,1643e+007	1,7623e+006
0,34		2,2299e+007	1,8157e+006
0,35		2,2954e+007	1,8691e+006
0,36		2,361e+007	1,9225e+006
0,37		2,4266e+007	1,9759e+006
0,38		2,4922e+007	2,0293e+006
0,39		2,5578e+007	2,0827e+006
0,4		2,6234e+007	2,1361e+006
0,41		2,6889e+007	2,1895e+006
0,42		2,7545e+007	2,2429e+006
0,43		2,8201e+007	2,2963e+006
0,44		2,8857e+007	2,3497e+006
0,45		2,9513e+007	2,4031e+006
0,46		3,0169e+007	2,4566e+006
0,47		3,0824e+007	2,51e+006
0,48		3,148e+007	2,5634e+006
0,49		3,2136e+007	2,6168e+006
0,5		3,2792e+007	2,6702e+006
0,51		3,3448e+007	2,7236e+006
0,52		3,4104e+007	2,777e+006
0,53		3,4759e+007	2,8304e+006
0,54		3,5415e+007	2,8838e+006
0,55		3,6071e+007	2,9372e+006
0,56		3,6727e+007	2,9906e+006
0,57		3,7383e+007	3,044e+006
0,58		3,8039e+007	3,0974e+006
0,59		3,8695e+007	3,1508e+006
0,6		3,935e+007	3,2042e+006
0,61		4,0006e+007	3,2576e+006
0,62		4,0662e+007	3,311e+006

0,63		4,1318e+007	3,3644e+006
0,64		4,1974e+007	3,4178e+006
0,65		4,263e+007	3,4712e+006
0,66		4,3285e+007	3,5246e+006
0,67		4,3941e+007	3,578e+006
0,68		4,4597e+007	3,6314e+006
0,69		4,5253e+007	3,6848e+006
0,7		4,5909e+007	3,7382e+006
0,71		4,6565e+007	3,7916e+006
0,72		4,722e+007	3,845e+006
0,73		4,7876e+007	3,8984e+006
0,74		4,8532e+007	3,9518e+006
0,75		4,9188e+007	4,0052e+006
0,76		4,9844e+007	4,0586e+006
0,77		5,05e+007	4,1121e+006
0,78		5,1155e+007	4,1655e+006
0,79		5,1811e+007	4,2189e+006
0,8		5,2467e+007	4,2723e+006
0,81		5,3123e+007	4,3257e+006
0,82		5,3779e+007	4,3791e+006
0,83		5,4435e+007	4,4325e+006
0,84		5,5091e+007	4,4859e+006
0,85		5,5746e+007	4,5393e+006
0,86		5,6402e+007	4,5927e+006
0,87		5,7058e+007	4,6461e+006
0,88		5,7714e+007	4,6995e+006
0,89		5,837e+007	4,7529e+006
0,9		5,9026e+007	4,8063e+006
0,91		5,9681e+007	4,8597e+006
0,92		6,0337e+007	4,9131e+006
0,93		6,0993e+007	4,9665e+006
0,94		6,1649e+007	5,0199e+006
0,95		6,2305e+007	5,0733e+006
0,96		6,2961e+007	5,1267e+006
0,97		6,3616e+007	5,1801e+006
0,98		6,4272e+007	5,2335e+006
0,99		6,4928e+007	5,2869e+006
1,		6,5584e+007	5,3403e+006

FIGURE 2
Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Elastic Strain

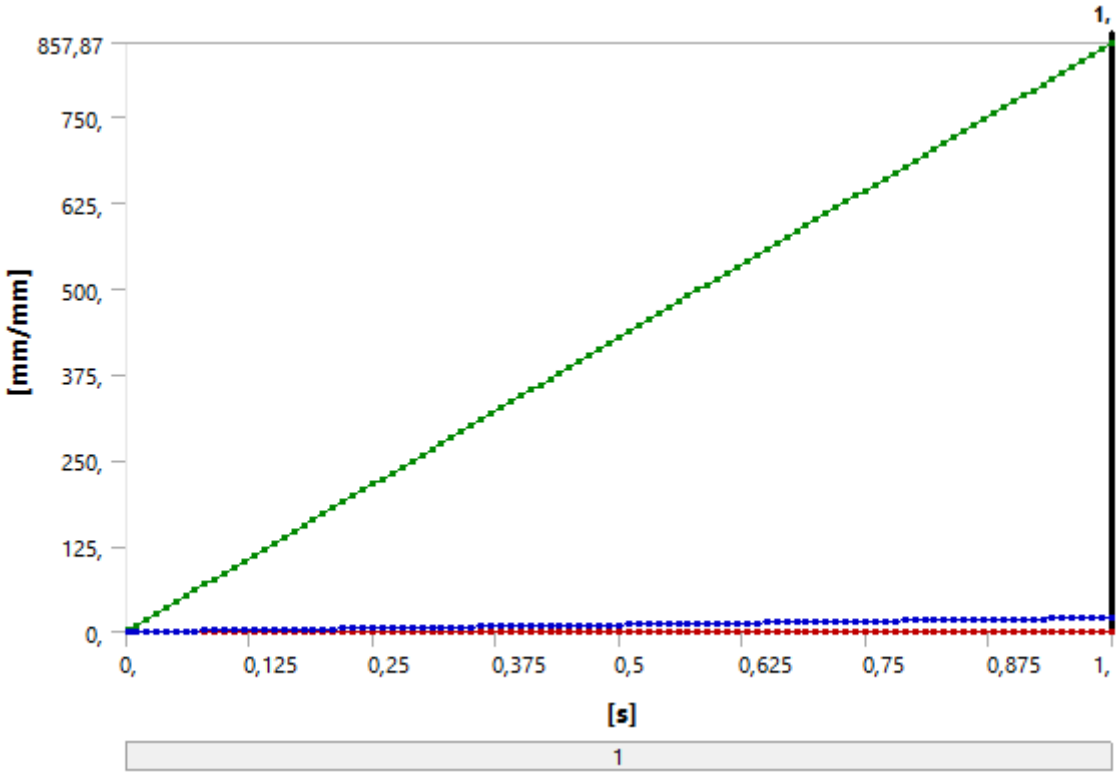


TABLE 15
Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Elastic Strain

Time [s]	Minimum [mm/mm]	Maximum [mm/mm]	Average [mm/mm]
2,e-003	0,	1,7157	4,0655e-002
4,e-003		3,4315	8,1309e-002
1,e-002		8,5787	0,20327
2,e-002		17,157	0,40655
3,e-002		25,736	0,60982
4,e-002		34,315	0,81309
5,e-002		42,894	1,0164
6,e-002		51,472	1,2196
7,e-002		60,051	1,4229
8,e-002		68,63	1,6262
9,e-002		77,209	1,8295
1,e-001		85,787	2,0327
0,11		94,366	2,236
0,12		102,94	2,4393
0,13		111,52	2,6426
0,14		120,1	2,8458
0,15		128,68	3,0491
0,16		137,26	3,2524
0,17		145,84	3,4557
0,18		154,42	3,6589
0,19		163,	3,8622
0,2		171,57	4,0655
0,21		180,15	4,2687
0,22		188,73	4,472
0,23		197,31	4,6753
0,24		205,89	4,8786

0,25		214,47	5,0818
0,26		223,05	5,2851
0,27		231,63	5,4884
0,28		240,2	5,6917
0,29		248,78	5,8949
0,3		257,36	6,0982
0,31		265,94	6,3015
0,32		274,52	6,5048
0,33		283,1	6,708
0,34		291,68	6,9113
0,35		300,26	7,1146
0,36		308,83	7,3178
0,37		317,41	7,5211
0,38		325,99	7,7244
0,39		334,57	7,9277
0,4		343,15	8,1309
0,41		351,73	8,3342
0,42		360,31	8,5375
0,43		368,89	8,7408
0,44		377,46	8,944
0,45		386,04	9,1473
0,46		394,62	9,3506
0,47		403,2	9,5539
0,48		411,78	9,7571
0,49		420,36	9,9604
0,5		428,94	10,164
0,51		437,51	10,367
0,52		446,09	10,57
0,53		454,67	10,773
0,54		463,25	10,977
0,55		471,83	11,18
0,56		480,41	11,383
0,57		488,99	11,587
0,58		497,57	11,79
0,59		506,14	11,993
0,6		514,72	12,196
0,61		523,3	12,4
0,62		531,88	12,603
0,63		540,46	12,806
0,64		549,04	13,01
0,65		557,62	13,213
0,66		566,2	13,416
0,67		574,77	13,619
0,68		583,35	13,823
0,69		591,93	14,026
0,7		600,51	14,229
0,71		609,09	14,432
0,72		617,67	14,636
0,73		626,25	14,839
0,74		634,83	15,042
0,75		643,4	15,246
0,76		651,98	15,449

0,77		660,56	15,652
0,78		669,14	15,855
0,79		677,72	16,059
0,8		686,3	16,262
0,81		694,88	16,465
0,82		703,46	16,668
0,83		712,03	16,872
0,84		720,61	17,075
0,85		729,19	17,278
0,86		737,77	17,482
0,87		746,35	17,685
0,88		754,93	17,888
0,89		763,51	18,091
0,9		772,09	18,295
0,91		780,66	18,498
0,92		789,24	18,701
0,93		797,82	18,904
0,94		806,4	19,108
0,95		814,98	19,311
0,96		823,56	19,514
0,97		832,14	19,718
0,98		840,72	19,921
0,99		849,29	20,124
1,		857,87	20,327

FIGURE 3
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Intensity

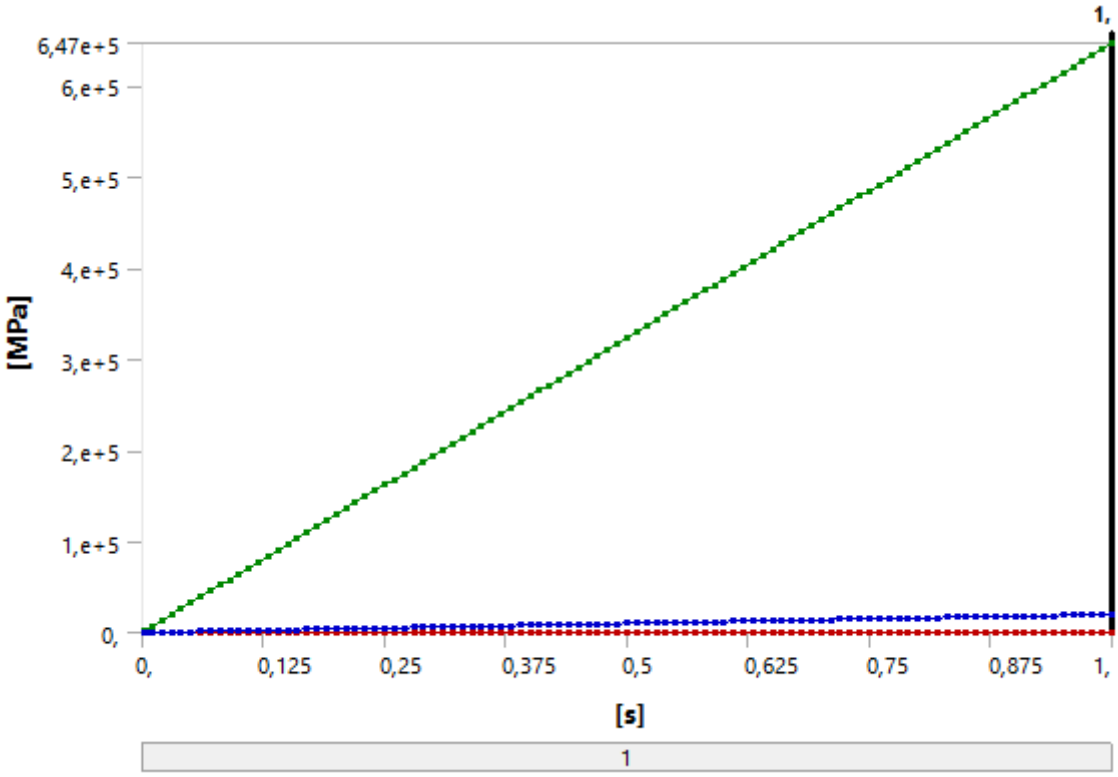


TABLE 16
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Intensity

Time [s]	Minimum [MPa]	Maximum [MPa]	Average [MPa]
2,e-003		1294,	39,791
4,e-003		2588,	79,583
1,e-002		6470,	198,96
2,e-002		12940	397,91
3,e-002		19410	596,87
4,e-002		25880	795,83
5,e-002		32350	994,78
6,e-002		38820	1193,7
7,e-002		45290	1392,7
8,e-002		51760	1591,7
9,e-002		58230	1790,6
1,e-001		64700	1989,6
0,11		71170	2188,5
0,12		77640	2387,5
0,13		84111	2586,4
0,14		90581	2785,4
0,15		97051	2984,4
0,16		1,0352e+005	3183,3
0,17		1,0999e+005	3382,3
0,18		1,1646e+005	3581,2
0,19		1,2293e+005	3780,2
0,2		1,294e+005	3979,1
0,21		1,3587e+005	4178,1
0,22		1,4234e+005	4377,
0,23		1,4881e+005	4576,
0,24	0,	1,5528e+005	4775,
0,25		1,6175e+005	4973,9
0,26		1,6822e+005	5172,9
0,27		1,7469e+005	5371,8
0,28		1,8116e+005	5570,8
0,29		1,8763e+005	5769,7
0,3		1,941e+005	5968,7
0,31		2,0057e+005	6167,7
0,32		2,0704e+005	6366,6
0,33		2,1351e+005	6565,6
0,34		2,1998e+005	6764,5
0,35		2,2645e+005	6963,5
0,36		2,3292e+005	7162,4
0,37		2,3939e+005	7361,4
0,38		2,4586e+005	7560,4
0,39		2,5233e+005	7759,3
0,4		2,588e+005	7958,3
0,41		2,6527e+005	8157,2
0,42		2,7174e+005	8356,2
0,43		2,7821e+005	8555,1
0,44		2,8468e+005	8754,1
0,45		2,9115e+005	8953,1
0,46		2,9762e+005	9152,
0,47		3,0409e+005	9351,
0,48		3,1056e+005	9549,9
0,49		3,1703e+005	9748,9

0,5		3,235e+005	9947,8
0,51		3,2997e+005	10147
0,52		3,3644e+005	10346
0,53		3,4291e+005	10545
0,54		3,4938e+005	10744
0,55		3,5585e+005	10943
0,56		3,6232e+005	11142
0,57		3,6879e+005	11341
0,58		3,7526e+005	11539
0,59		3,8173e+005	11738
0,6		3,882e+005	11937
0,61		3,9467e+005	12136
0,62		4,0114e+005	12335
0,63		4,0761e+005	12534
0,64		4,1408e+005	12733
0,65		4,2055e+005	12932
0,66		4,2702e+005	13131
0,67		4,3349e+005	13330
0,68		4,3996e+005	13529
0,69		4,4643e+005	13728
0,7		4,529e+005	13927
0,71		4,5937e+005	14126
0,72		4,6584e+005	14325
0,73		4,7231e+005	14524
0,74		4,7878e+005	14723
0,75		4,8525e+005	14922
0,76		4,9172e+005	15121
0,77		4,9819e+005	15320
0,78		5,0466e+005	15519
0,79		5,1113e+005	15718
0,8		5,176e+005	15917
0,81		5,2407e+005	16115
0,82		5,3054e+005	16314
0,83		5,3701e+005	16513
0,84		5,4348e+005	16712
0,85		5,4995e+005	16911
0,86		5,5642e+005	17110
0,87		5,6289e+005	17309
0,88		5,6936e+005	17508
0,89		5,7583e+005	17707
0,9		5,823e+005	17906
0,91		5,8877e+005	18105
0,92		5,9524e+005	18304
0,93		6,0171e+005	18503
0,94		6,0818e+005	18702
0,95		6,1465e+005	18901
0,96		6,2112e+005	19100
0,97		6,2759e+005	19299
0,98		6,3406e+005	19498
0,99		6,4053e+005	19697
1,		6,47e+005	19896

TABLE 17
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Safety Tools

Object Name	*Stress Tool*
State	Solved
Definition	
Theory	Max Equivalent Stress
Stress Limit Type	Tensile Yield Per Material

TABLE 18
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Tool > Results

Object Name	*Safety Factor*
State	Solved
Scope	
Scoping Method	Geometry Selection
Geometry	All Bodies
Definition	
Type	Safety Factor
By	Time
Display Time	Last
Calculate Time History	Yes
Identifier	
Suppressed	No
Integration Point Results	
Display Option	Averaged
Average Across Bodies	No
Results	
Minimum	7,3778e-005
Minimum Occurs On	Ultramagic-T-180-PROVA2\Surface1
Minimum Value Over Time	
Minimum	7,3778e-005
Maximum	3,6889e-002
Maximum Value Over Time	
Minimum	15,
Maximum	15,
Information	
Time	1, s
Load Step	1
Substep	102
Iteration Number	102

FIGURE 4
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Tool > Safety Factor

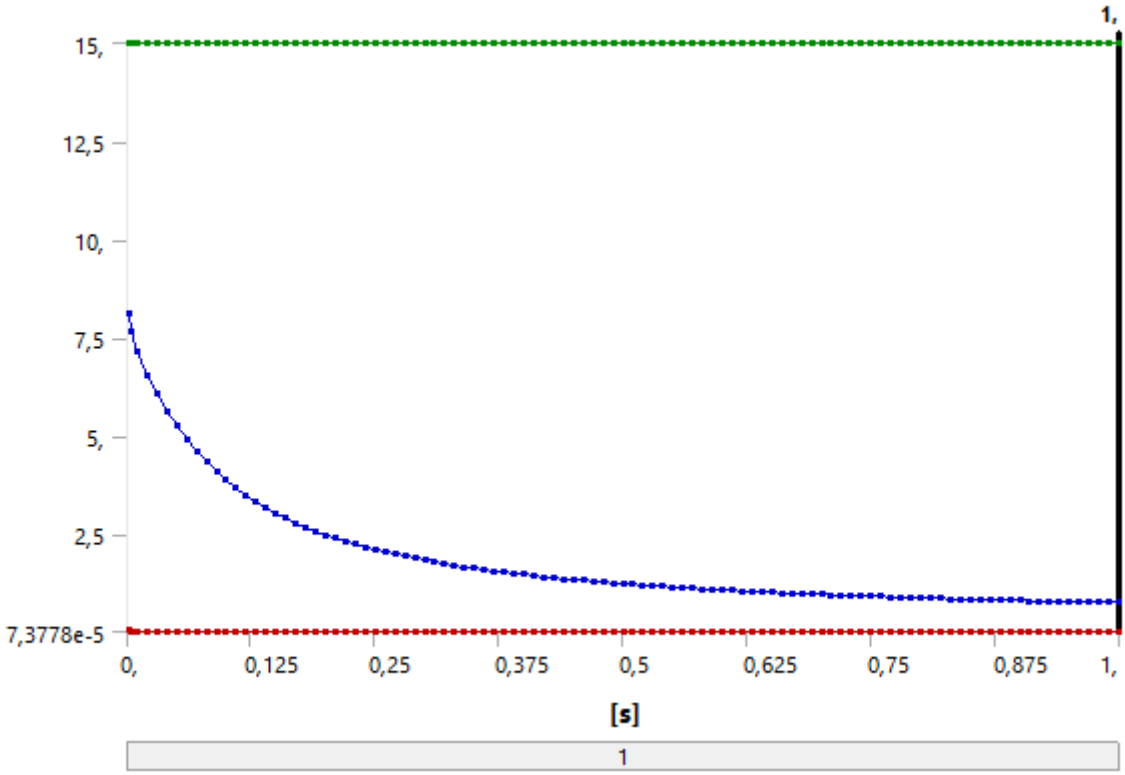


TABLE 19
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Tool > Safety Factor

Time [s]	Minimum	Maximum	Average
2,e-003	3,6889e-002	15,	8,1247
4,e-003	1,8444e-002		7,6664
1,e-002	7,3778e-003		7,1343
2,e-002	3,6889e-003		6,555
3,e-002	2,4593e-003		6,0642
4,e-002	1,8444e-003		5,6353
5,e-002	1,4756e-003		5,2529
6,e-002	1,2296e-003		4,9104
7,e-002	1,054e-003		4,605
8,e-002	9,2222e-004		4,3316
9,e-002	8,1975e-004		4,0843
1,e-001	7,3778e-004		3,8611
0,11	6,7071e-004		3,6584
0,12	6,1481e-004		3,4748
0,13	5,6752e-004		3,3079
0,14	5,2698e-004		3,1561
0,15	4,9185e-004		3,0174
0,16	4,6111e-004		2,8905
0,17	4,3399e-004		2,774
0,18	4,0988e-004		2,6664
0,19	3,883e-004		2,5667
0,2	3,6889e-004		2,474
0,21	3,5132e-004		2,3879
0,22	3,3535e-004		2,3078
0,23	3,2077e-004		2,233
0,24	3,0741e-004		2,163

0,25	2,9511e-004		2,0971
0,26	2,8376e-004		2,0354
0,27	2,7325e-004		1,9775
0,28	2,6349e-004		1,9228
0,29	2,5441e-004		1,8713
0,3	2,4593e-004		1,8227
0,31	2,3799e-004		1,7767
0,32	2,3056e-004		1,7333
0,33	2,2357e-004		1,6922
0,34	2,1699e-004		1,6531
0,35	2,1079e-004		1,6162
0,36	2,0494e-004		1,581
0,37	1,994e-004		1,5475
0,38	1,9415e-004		1,5157
0,39	1,8917e-004		1,4853
0,4	1,8444e-004		1,4562
0,41	1,7995e-004		1,4284
0,42	1,7566e-004		1,4018
0,43	1,7158e-004		1,3762
0,44	1,6768e-004		1,3518
0,45	1,6395e-004		1,3283
0,46	1,6039e-004		1,3059
0,47	1,5697e-004		1,2843
0,48	1,537e-004		1,2635
0,49	1,5057e-004		1,2436
0,5	1,4756e-004		1,2244
0,51	1,4466e-004		1,2059
0,52	1,4188e-004		1,188
0,53	1,392e-004		1,1708
0,54	1,3663e-004		1,1542
0,55	1,3414e-004		1,1382
0,56	1,3175e-004		1,1228
0,57	1,2943e-004		1,1078
0,58	1,272e-004		1,0933
0,59	1,2505e-004		1,0793
0,6	1,2296e-004		1,0657
0,61	1,2095e-004		1,0525
0,62	1,19e-004		1,0398
0,63	1,1711e-004		1,0275
0,64	1,1528e-004		1,0155
0,65	1,135e-004		1,0039
0,66	1,1178e-004		0,99263
0,67	1,1012e-004		0,98169
0,68	1,085e-004		0,97106
0,69	1,0692e-004		0,96072
0,7	1,054e-004		0,95067
0,71	1,0391e-004		0,94089
0,72	1,0247e-004		0,93138
0,73	1,0107e-004		0,92213
0,74	9,97e-005		0,91313
0,75	9,837e-005		0,90436
0,76	9,7076e-005		0,89581

0,77	9,5815e-005		0,88748
0,78	9,4587e-005		0,87937
0,79	9,3389e-005		0,87146
0,8	9,2222e-005		0,86374
0,81	9,1084e-005		0,85621
0,82	8,9973e-005		0,84886
0,83	8,8889e-005		0,84168
0,84	8,7831e-005		0,83467
0,85	8,6797e-005		0,82782
0,86	8,5788e-005		0,82113
0,87	8,4802e-005		0,81459
0,88	8,3838e-005		0,8082
0,89	8,2896e-005		0,80196
0,9	8,1975e-005		0,79585
0,91	8,1074e-005		0,78988
0,92	8,0193e-005		0,78404
0,93	7,9331e-005		0,77831
0,94	7,8487e-005		0,77272
0,95	7,7661e-005		0,76723
0,96	7,6852e-005		0,76187
0,97	7,6059e-005		0,75661
0,98	7,5283e-005		0,75146
0,99	7,4523e-005		0,7464
1,	7,3778e-005		0,74144

Material Data

Plastic, PA6

TABLE 20
Plastic, PA6 > Constants

Density	1,14e-006 kg mm^-3
Tensile Yield Strength	43,13 MPa
Tensile Ultimate Strength	71,89 MPa
Coefficient of Thermal Expansion	1,467e-004 C^-1
Thermal Conductivity	2,428e-004 W mm^-1 C^-1
Specific Heat	1,5e+006 mJ kg^-1 C^-1

TABLE 21
Plastic, PA6 > Opacity

Red	Green	Blue
0,	153,	255,
Opacity		
0,6		
Metallic Finish		
0,		

TABLE 22
Plastic, PA6 > Isotropic Elasticity

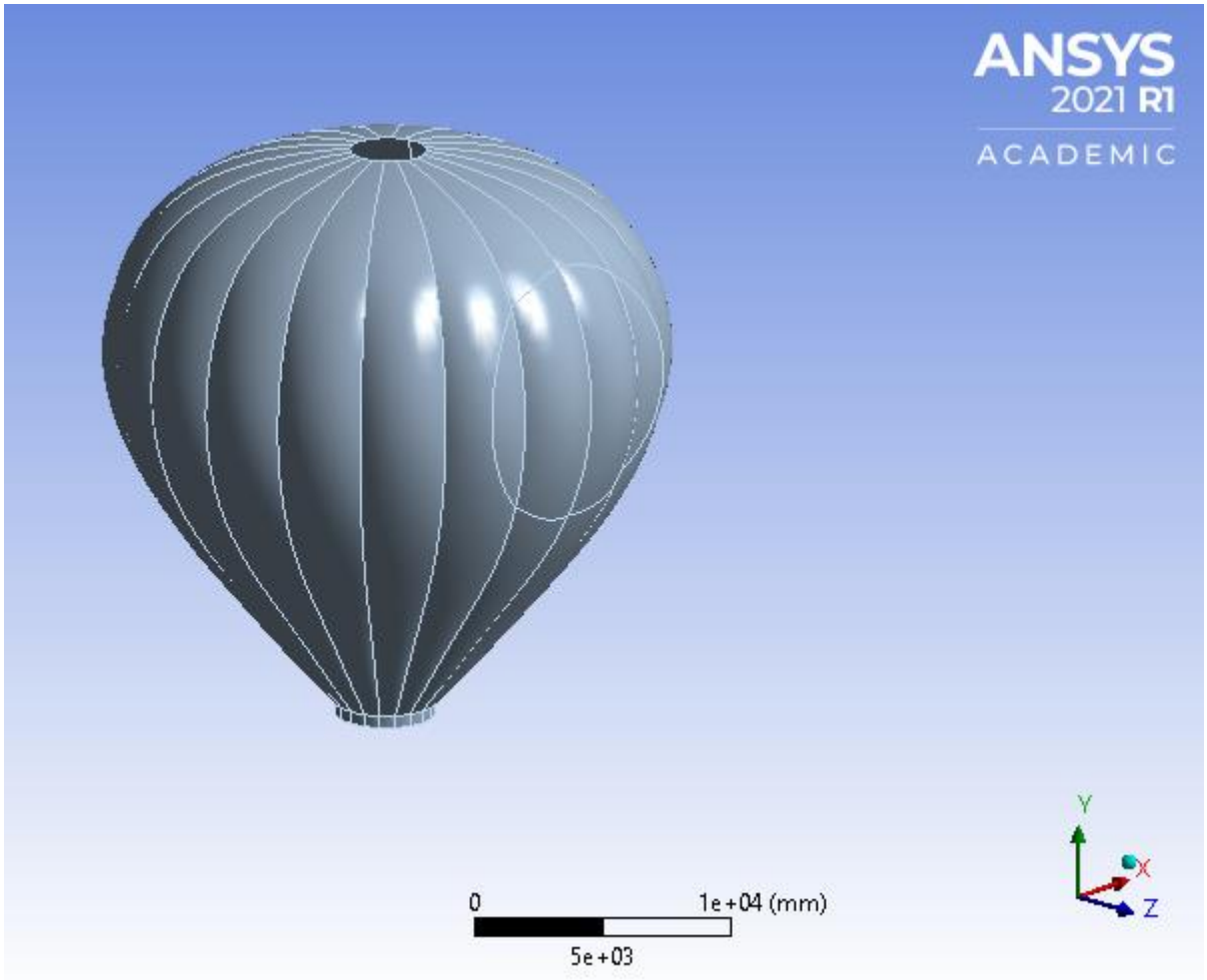
Young's Modulus MPa	Poisson's Ratio	Bulk Modulus MPa	Shear Modulus MPa	Temperature C
1111,	0,3499	1233,6	411,51	23,

TABLE 23
Plastic, PA6 > Isotropic Secant Coefficient of Thermal Expansion

Zero-Thermal-Strain Reference Temperature C
23,

Project*

First Saved	Wednesday, April 14, 2021
Last Saved	Monday, June 14, 2021
Product Version	2021 R1
Save Project Before Solution	No
Save Project After Solution	No



Contents

Units

TABLE 1

Unit System	Metric (mm, kg, N, s, mV, mA) Degrees rad/s Celsius
Angle	Degrees
Rotational Velocity	rad/s
Temperature	Celsius

Model (A4)

Geometry

TABLE 2
Model (A4) > Geometry

Object Name	*Geometry*
State	Fully Defined
Definition	
Source	C:\Users\fvila\Desktop\3-PROVA-globusOPEN_restriccions-PA\3-PROVA-globusOPEN_restriccions-PA_files\dp0\SYS-1\DM\SYS-1.scdoc
Type	SpaceClaim
Length Unit	Meters
Element Control	Program Controlled
Display Style	Body Color
Bounding Box	
Length X	21995 mm
Length Y	23052 mm
Length Z	21995 mm
Properties	
Volume	7,4248e+008 mm³

Mass	846,43 kg
Surface Area(approx.)	1,485e+009 mm²
Scale Factor Value	1,
2D Tolerance	Default (1,e-005)
Statistics	
Bodies	1
Active Bodies	1
Nodes	17460
Elements	17499
Mesh Metric	None
Update Options	
Assign Default Material	No
Basic Geometry Options	
Solid Bodies	Yes
Surface Bodies	Yes
Line Bodies	Yes
Parameters	Independent
Parameter Key	
Attributes	Yes
Attribute Key	
Named Selections	Yes
Named Selection Key	
Material Properties	Yes
Advanced Geometry Options	
Use Associativity	Yes
Coordinate Systems	Yes
Coordinate System Key	
Reader Mode Saves Updated File	No
Use Instances	Yes
Smart CAD Update	Yes
Compare Parts On Update	No
Analysis Type	3-D
Mixed Import Resolution	None
Import Facet Quality	Source
Clean Bodies On Import	No
Stitch Surfaces On Import	None
Decompose Disjoint Geometry	Yes
Enclosure and Symmetry Processing	Yes

TABLE 3
Model (A4) > Geometry > Parts

Object Name	*Ultramagic-T-180-PROVA3\Surface1*
State	Meshed
Graphics Properties	
Visible	Yes

Transparency	1
Definition	
Suppressed	No
Dimension	3D
Stiffness Behavior	Flexible
Coordinate System	Default Coordinate System
Reference Temperature	By Environment
Thickness	0,5 mm
Thickness Mode	Manual
Offset Type	Middle
Treatment	None
Model Type	Shell
Material	
Assignment	Plastic, PA6
Nonlinear Effects	Yes
Thermal Strain Effects	Yes
Bounding Box	
Length X	21995 mm
Length Y	23052 mm
Length Z	21995 mm
Properties	
Volume	7,4248e+008 mm³
Mass	846,43 kg
Centroid X	1,922e-005 mm
Centroid Y	4268,6 mm
Centroid Z	1,2917 mm
Moment of Inertia Ip1	6,4765e+010 kg·mm²
Moment of Inertia Ip2	6,5042e+010 kg·mm²
Moment of Inertia Ip3	6,4753e+010 kg·mm²
Surface Area(approx.)	1,485e+009 mm²
Statistics	
Nodes	17460
Elements	17499
Mesh Metric	None
CAD Attributes	
PartTolerance:	0,00000001
Color:143.149.175	

TABLE 4
Model (A4) > Materials

Object Name	*Materials*
State	Fully Defined
Statistics	
Materials	2
Material Assignments	0

Coordinate Systems

TABLE 5
Model (A4) > Coordinate Systems > Coordinate System

Object Name	*Global Coordinate System*
State	Fully Defined

Definition	
Type	Cartesian
Coordinate System ID	0,
Origin	
Origin X	0, mm
Origin Y	0, mm
Origin Z	0, mm
Directional Vectors	
X Axis Data	[1, 0, 0,]
Y Axis Data	[0, 1, 0,]
Z Axis Data	[0, 0, 1,]

Mesh

TABLE 6
Model (A4) > Mesh

Object Name	*Mesh*
State	Solved
Display	
Display Style	Use Geometry Setting
Defaults	
Physics Preference	Mechanical
Element Order	Program Controlled
Element Size	Default (709,53 mm)
Sizing	
Use Adaptive Sizing	No
Growth Rate	Default (1,2)
Mesh Defeaturing	Yes
Defeature Size	Default (3,5476 mm)
Capture Curvature	Yes
Curvature Min Size	Default (7,0953 mm)
Curvature Normal Angle	Default (30,°)
Capture Proximity	No
Bounding Box Diagonal	38717 mm
Average Surface Area	3,2219e+007 mm²
Minimum Edge Length	471,25 mm
Quality	
Check Mesh Quality	Yes, Errors
Error Limits	Aggressive Mechanical
Target Quality	Default (0.050000)
Smoothing	Medium
Mesh Metric	None
Inflation	
Use Automatic Inflation	None
Inflation Option	Smooth Transition
Transition Ratio	0,272
Maximum Layers	2
Growth Rate	1,2
Inflation Algorithm	Pre
View Advanced Options	No
Batch Connections	
Mesh Based Connection	No

Advanced	
Number of CPUs for Parallel Part Meshing	Program Controlled
Straight Sided Elements	No
Rigid Body Behavior	Dimensionally Reduced
Triangle Surface Mesher	Program Controlled
Topology Checking	Yes
Use Sheet Thickness for Pinch	No
Pinch Tolerance	Default (6,3857 mm)
Generate Pinch on Refresh	No
Sheet Loop Removal	No
Statistics	
Nodes	17460
Elements	17499

TABLE 7
Model (A4) > Mesh > Mesh Controls

Object Name	*300mm*	*100mm*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	26 Faces	20 Faces
Definition		
Suppressed	No	
Type	Element Size	
Element Size	300, mm	100, mm
Advanced		
Defeature Size	Default (3,5476 mm)	
Behavior	Soft	
Growth Rate	Default (1,2)	
Capture Curvature	No	
Capture Proximity	No	

Static Structural (A5)

TABLE 8
Model (A4) > Analysis

Object Name	*Static Structural (A5)*
State	Solved
Definition	
Physics Type	Structural
Analysis Type	Static Structural
Solver Target	Mechanical APDL
Options	
Environment Temperature	22, °C
Generate Input Only	No

TABLE 9
Model (A4) > Static Structural (A5) > Analysis Settings

Object Name	*Analysis Settings*
State	Fully Defined
Step Controls	
Number Of Steps	1,

Current Step Number	1,
Step End Time	1, s
Auto Time Stepping	On
Define By	Substeps
Initial Substeps	500,
Minimum Substeps	100,
Maximum Substeps	10000
Solver Controls	
Solver Type	Program Controlled
Weak Springs	Off
Solver Pivot Checking	Program Controlled
Large Deflection	Off
Inertia Relief	Off
Quasi-Static Solution	Off
Rotordynamics Controls	
Coriolis Effect	Off
Restart Controls	
Generate Restart Points	Program Controlled
Retain Files After Full Solve	No
Combine Restart Files	Program Controlled
Nonlinear Controls	
Newton-Raphson Option	Program Controlled
Force Convergence	Program Controlled
Moment Convergence	Program Controlled
Displacement Convergence	Program Controlled
Rotation Convergence	Program Controlled
Line Search	Program Controlled
Stabilization	Program Controlled
Advanced	
Inverse Option	No
Contact Split (DMP)	Off
Output Controls	
Stress	Yes
Surface Stress	No
Back Stress	No
Strain	Yes
Contact Data	Yes
Nonlinear Data	No
Nodal Forces	No
Volume and Energy	Yes
Euler Angles	Yes
General Miscellaneous	No
Contact Miscellaneous	No

Store Results At	All Time Points
Result File Compression	Program Controlled
Analysis Data Management	
Solver Files Directory	C:\Users\fvila\Desktop\3-PROVA-globusOPEN_restriccions-PA\3-PROVA-globusOPEN_restriccions-PA_files\dp0\SYS-1\MECH\
Future Analysis	None
Scratch Solver Files Directory	
Save MAPDL db	No
Contact Summary	Program Controlled
Delete Unneeded Files	Yes
Nonlinear Solution	No
Solver Units	Active System
Solver Unit System	nmm

TABLE 10
Model (A4) > Static Structural (A5) > Loads

Object Name	*Displacement*	*Fixed Rotation*	*Fixed Rotation 2*	*Pressure*	*Pressure 2*
State	Fully Defined				
Scope					
Scoping Method	Geometry Selection				
Geometry	20 Faces	10 Faces	10 Edges	4 Faces	26 Faces
Definition					
Type	Displacement	Fixed Rotation		Pressure	
Define By	Components			Normal To	
Coordinate System	Global Coordinate System				
X Component	0, mm (ramped)				
Y Component	0, mm (ramped)				
Z Component	0, mm (ramped)				
Suppressed	No				
Rotation X		Fixed			
Rotation Y		Fixed			
Rotation Z		Fixed			
Rotation X			Fixed		
Rotation Y			Fixed		
Rotation Z			Fixed		
Applied By				Surface Effect	
Loaded Area				Deformed	
Magnitude				0,15199 MPa (ramped)	-0,1 MPa (ramped)

Solution (A6)

TABLE 11
Model (A4) > Static Structural (A5) > Solution

Object Name	*Solution (A6)*

State	Solved
Adaptive Mesh Refinement	
Max Refinement Loops	1,
Refinement Depth	2,
Information	
Status	Done
MAPDL Elapsed Time	6 m 21 s
MAPDL Memory Used	702, MB
MAPDL Result File Size	1,7081 GB
Post Processing	
Beam Section Results	No
On Demand Stress/Strain	No

TABLE 12
Model (A4) > Static Structural (A5) > Solution (A6) > Solution Information

Object Name	*Solution Information*
State	Solved
Solution Information	
Solution Output	Solver Output
Newton-Raphson Residuals	0
Identify Element Violations	0
Update Interval	2,5 s
Display Points	All
FE Connection Visibility	
Activate Visibility	Yes
Display	All FE Connectors
Draw Connections Attached To	All Nodes
Line Color	Connection Type
Visible on Results	No
Line Thickness	Single
Display Type	Lines

TABLE 13
Model (A4) > Static Structural (A5) > Solution (A6) > Results

Object Name	*Total Deformation*	*Equivalent Elastic Strain*	*Stress Intensity*
State	Solved		
Scope			
Scoping Method	Geometry Selection		
Geometry	All Bodies		
Position		Top/Bottom	
Definition			
Type	Total Deformation	Equivalent Elastic Strain	Stress Intensity
By	Time		
Display Time	Last		
Calculate Time History	Yes		
Identifier			
Suppressed	No		
Results			
Minimum	0, mm	0, mm/mm	0, MPa
Maximum	6,9917e+007 mm	862,88 mm/mm	6,445e+005 MPa
Average	5,9093e+006 mm	21,018 mm/mm	20315 MPa
Minimum Occurs On	Ultramagic-T-180-PROVA3\Surface1		
Maximum Occurs On	Ultramagic-T-180-PROVA3\Surface1		

Minimum Value Over Time			
Minimum	0, mm	0, mm/mm	0, MPa
Maximum	0, mm	0, mm/mm	0, MPa
Maximum Value Over Time			
Minimum	1,3983e+005 mm	1,7258 mm/mm	1289, MPa
Maximum	6,9917e+007 mm	862,88 mm/mm	6,445e+005 MPa
Information			
Time	1, s		
Load Step	1		
Substep	102		
Iteration Number	102		
Integration Point Results			
Display Option		Averaged	
Average Across Bodies		No	

FIGURE 1
Model (A4) > Static Structural (A5) > Solution (A6) > Total Deformation

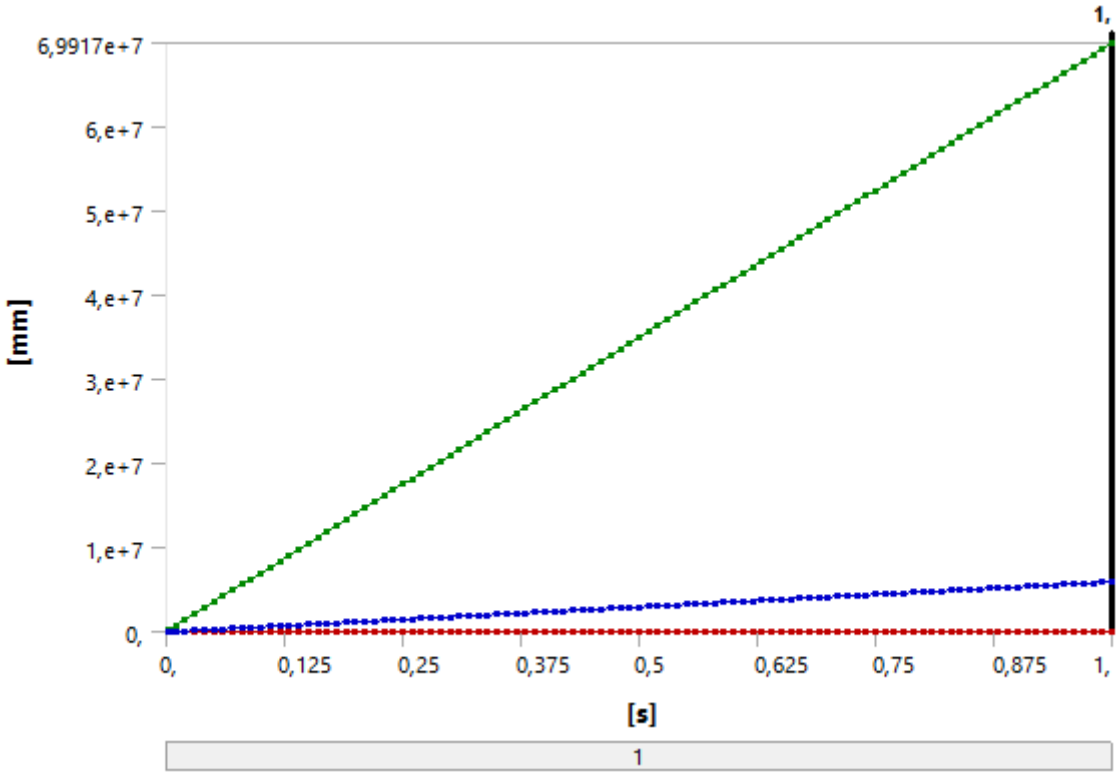


TABLE 14
Model (A4) > Static Structural (A5) > Solution (A6) > Total Deformation

Time [s]	Minimum [mm]	Maximum [mm]	Average [mm]
2,e-003	0,	1,3983e+005	11819
4,e-003		2,7967e+005	23637
1,e-002		6,9917e+005	59093
2,e-002		1,3983e+006	1,1819e+005
3,e-002		2,0975e+006	1,7728e+005
4,e-002		2,7967e+006	2,3637e+005
5,e-002		3,4959e+006	2,9546e+005
6,e-002		4,195e+006	3,5456e+005
7,e-002		4,8942e+006	4,1365e+005

8,e-002		5,5934e+006	4,7274e+005
9,e-002		6,2926e+006	5,3183e+005
1,e-001		6,9917e+006	5,9093e+005
0,11		7,6909e+006	6,5002e+005
0,12		8,3901e+006	7,0911e+005
0,13		9,0893e+006	7,682e+005
0,14		9,7884e+006	8,273e+005
0,15		1,0488e+007	8,8639e+005
0,16		1,1187e+007	9,4548e+005
0,17		1,1886e+007	1,0046e+006
0,18		1,2585e+007	1,0637e+006
0,19		1,3284e+007	1,1228e+006
0,2		1,3983e+007	1,1819e+006
0,21		1,4683e+007	1,2409e+006
0,22		1,5382e+007	1,3e+006
0,23		1,6081e+007	1,3591e+006
0,24		1,678e+007	1,4182e+006
0,25		1,7479e+007	1,4773e+006
0,26		1,8179e+007	1,5364e+006
0,27		1,8878e+007	1,5955e+006
0,28		1,9577e+007	1,6546e+006
0,29		2,0276e+007	1,7137e+006
0,3		2,0975e+007	1,7728e+006
0,31		2,1674e+007	1,8319e+006
0,32		2,2374e+007	1,891e+006
0,33		2,3073e+007	1,9501e+006
0,34		2,3772e+007	2,0091e+006
0,35		2,4471e+007	2,0682e+006
0,36		2,517e+007	2,1273e+006
0,37		2,5869e+007	2,1864e+006
0,38		2,6569e+007	2,2455e+006
0,39		2,7268e+007	2,3046e+006
0,4		2,7967e+007	2,3637e+006
0,41		2,8666e+007	2,4228e+006
0,42		2,9365e+007	2,4819e+006
0,43		3,0065e+007	2,541e+006
0,44		3,0764e+007	2,6001e+006
0,45		3,1463e+007	2,6592e+006
0,46		3,2162e+007	2,7183e+006
0,47		3,2861e+007	2,7774e+006
0,48		3,356e+007	2,8364e+006
0,49		3,426e+007	2,8955e+006
0,5		3,4959e+007	2,9546e+006
0,51		3,5658e+007	3,0137e+006
0,52		3,6357e+007	3,0728e+006
0,53		3,7056e+007	3,1319e+006
0,54		3,7755e+007	3,191e+006
0,55		3,8455e+007	3,2501e+006
0,56		3,9154e+007	3,3092e+006
0,57		3,9853e+007	3,3683e+006
0,58		4,0552e+007	3,4274e+006
0,59		4,1251e+007	3,4865e+006

0,6		4,195e+007	3,5456e+006
0,61		4,265e+007	3,6046e+006
0,62		4,3349e+007	3,6637e+006
0,63		4,4048e+007	3,7228e+006
0,64		4,4747e+007	3,7819e+006
0,65		4,5446e+007	3,841e+006
0,66		4,6146e+007	3,9001e+006
0,67		4,6845e+007	3,9592e+006
0,68		4,7544e+007	4,0183e+006
0,69		4,8243e+007	4,0774e+006
0,7		4,8942e+007	4,1365e+006
0,71		4,9641e+007	4,1956e+006
0,72		5,0341e+007	4,2547e+006
0,73		5,104e+007	4,3138e+006
0,74		5,1739e+007	4,3729e+006
0,75		5,2438e+007	4,4319e+006
0,76		5,3137e+007	4,491e+006
0,77		5,3836e+007	4,5501e+006
0,78		5,4536e+007	4,6092e+006
0,79		5,5235e+007	4,6683e+006
0,8		5,5934e+007	4,7274e+006
0,81		5,6633e+007	4,7865e+006
0,82		5,7332e+007	4,8456e+006
0,83		5,8032e+007	4,9047e+006
0,84		5,8731e+007	4,9638e+006
0,85		5,943e+007	5,0229e+006
0,86		6,0129e+007	5,082e+006
0,87		6,0828e+007	5,1411e+006
0,88		6,1527e+007	5,2001e+006
0,89		6,2227e+007	5,2592e+006
0,9		6,2926e+007	5,3183e+006
0,91		6,3625e+007	5,3774e+006
0,92		6,4324e+007	5,4365e+006
0,93		6,5023e+007	5,4956e+006
0,94		6,5722e+007	5,5547e+006
0,95		6,6422e+007	5,6138e+006
0,96		6,7121e+007	5,6729e+006
0,97		6,782e+007	5,732e+006
0,98		6,8519e+007	5,7911e+006
0,99		6,9218e+007	5,8502e+006
1,		6,9917e+007	5,9093e+006

FIGURE 2
Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Elastic Strain

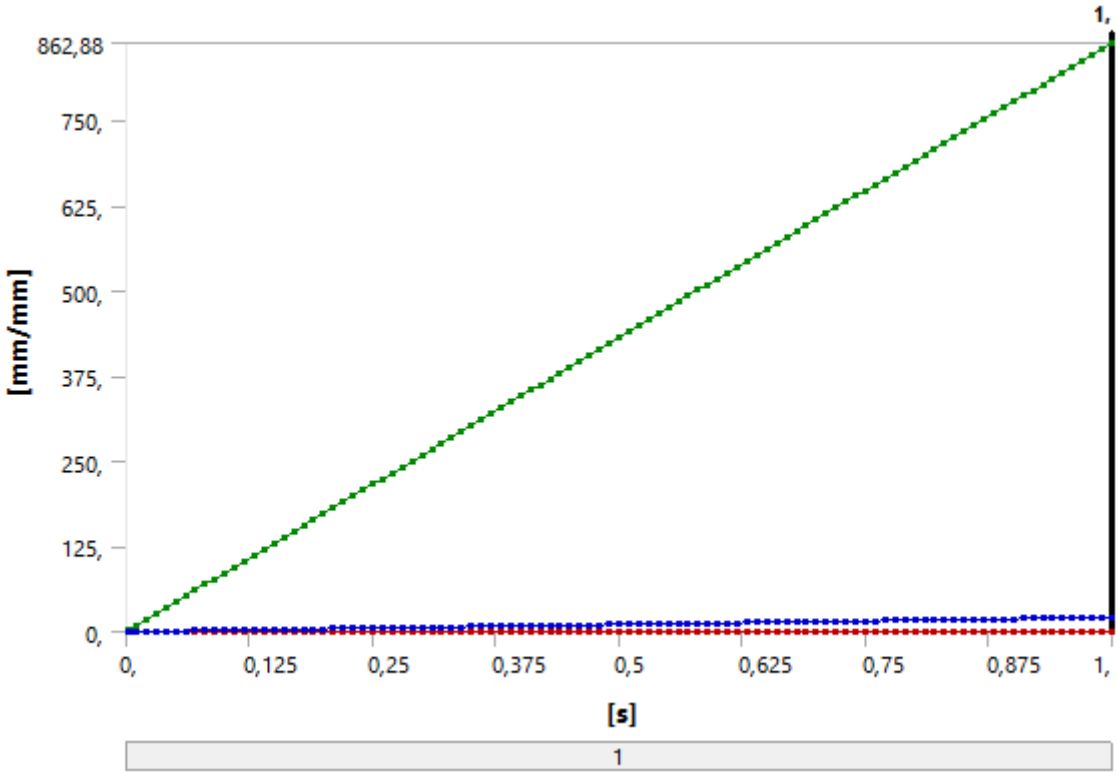


TABLE 15
Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Elastic Strain

Time [s]	Minimum [mm/mm]	Maximum [mm/mm]	Average [mm/mm]
2,e-003	0,	1,7258	4,2036e-002
4,e-003		3,4515	8,4072e-002
1,e-002		8,6288	0,21018
2,e-002		17,258	0,42036
3,e-002		25,886	0,63054
4,e-002		34,515	0,84072
5,e-002		43,144	1,0509
6,e-002		51,773	1,2611
7,e-002		60,401	1,4713
8,e-002		69,03	1,6814
9,e-002		77,659	1,8916
1,e-001		86,288	2,1018
0,11		94,917	2,312
0,12		103,55	2,5222
0,13		112,17	2,7323
0,14		120,8	2,9425
0,15		129,43	3,1527
0,16		138,06	3,3629
0,17		146,69	3,5731
0,18		155,32	3,7832
0,19		163,95	3,9934
0,2		172,58	4,2036
0,21		181,2	4,4138
0,22		189,83	4,624
0,23		198,46	4,8342
0,24		207,09	5,0443

0,25		215,72	5,2545
0,26		224,35	5,4647
0,27		232,98	5,6749
0,28		241,61	5,8851
0,29		250,23	6,0952
0,3		258,86	6,3054
0,31		267,49	6,5156
0,32		276,12	6,7258
0,33		284,75	6,936
0,34		293,38	7,1461
0,35		302,01	7,3563
0,36		310,64	7,5665
0,37		319,26	7,7767
0,38		327,89	7,9869
0,39		336,52	8,197
0,4		345,15	8,4072
0,41		353,78	8,6174
0,42		362,41	8,8276
0,43		371,04	9,0378
0,44		379,67	9,2479
0,45		388,29	9,4581
0,46		396,92	9,6683
0,47		405,55	9,8785
0,48		414,18	10,089
0,49		422,81	10,299
0,5		431,44	10,509
0,51		440,07	10,719
0,52		448,7	10,929
0,53		457,33	11,14
0,54		465,95	11,35
0,55		474,58	11,56
0,56		483,21	11,77
0,57		491,84	11,98
0,58		500,47	12,19
0,59		509,1	12,401
0,6		517,73	12,611
0,61		526,36	12,821
0,62		534,98	13,031
0,63		543,61	13,241
0,64		552,24	13,452
0,65		560,87	13,662
0,66		569,5	13,872
0,67		578,13	14,082
0,68		586,76	14,292
0,69		595,39	14,502
0,7		604,01	14,713
0,71		612,64	14,923
0,72		621,27	15,133
0,73		629,9	15,343
0,74		638,53	15,553
0,75		647,16	15,764
0,76		655,79	15,974

0,77		664,42	16,184
0,78		673,04	16,394
0,79		681,67	16,604
0,8		690,3	16,814
0,81		698,93	17,025
0,82		707,56	17,235
0,83		716,19	17,445
0,84		724,82	17,655
0,85		733,45	17,865
0,86		742,07	18,076
0,87		750,7	18,286
0,88		759,33	18,496
0,89		767,96	18,706
0,9		776,59	18,916
0,91		785,22	19,126
0,92		793,85	19,337
0,93		802,48	19,547
0,94		811,1	19,757
0,95		819,73	19,967
0,96		828,36	20,177
0,97		836,99	20,388
0,98		845,62	20,598
0,99		854,25	20,808
1,		862,88	21,018

FIGURE 3
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Intensity

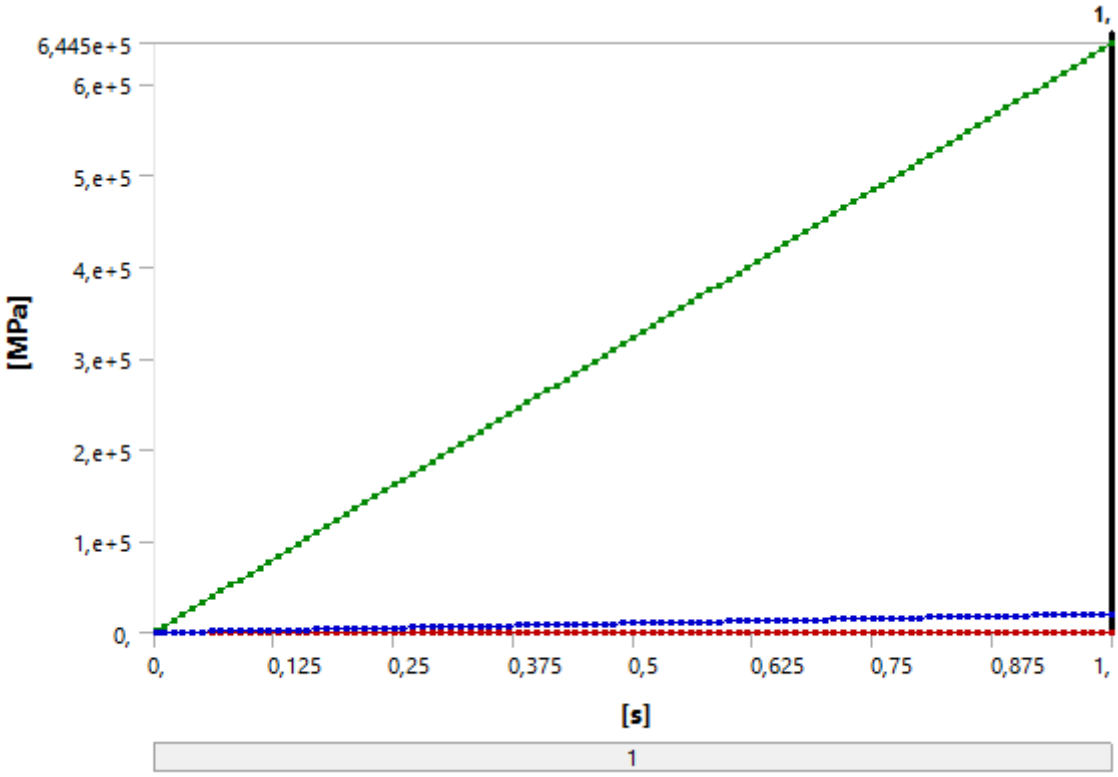


TABLE 16
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Intensity

Time [s]	Minimum [MPa]	Maximum [MPa]	Average [MPa]
2,e-003		1289,	40,63
4,e-003		2578,	81,261
1,e-002		6445,	203,15
2,e-002		12890	406,3
3,e-002		19335	609,46
4,e-002		25780	812,61
5,e-002		32225	1015,8
6,e-002		38670	1218,9
7,e-002		45115	1422,1
8,e-002		51560	1625,2
9,e-002		58005	1828,4
1,e-001		64450	2031,5
0,11		70895	2234,7
0,12		77340	2437,8
0,13		83785	2641,
0,14		90230	2844,1
0,15		96675	3047,3
0,16		1,0312e+005	3250,4
0,17		1,0956e+005	3453,6
0,18		1,1601e+005	3656,7
0,19		1,2245e+005	3859,9
0,2		1,289e+005	4063,
0,21		1,3534e+005	4266,2
0,22		1,4179e+005	4469,3
0,23		1,4823e+005	4672,5
0,24	0,	1,5468e+005	4875,7
0,25		1,6112e+005	5078,8
0,26		1,6757e+005	5282,
0,27		1,7401e+005	5485,1
0,28		1,8046e+005	5688,3
0,29		1,869e+005	5891,4
0,3		1,9335e+005	6094,6
0,31		1,9979e+005	6297,7
0,32		2,0624e+005	6500,9
0,33		2,1268e+005	6704,
0,34		2,1913e+005	6907,2
0,35		2,2557e+005	7110,3
0,36		2,3202e+005	7313,5
0,37		2,3846e+005	7516,6
0,38		2,4491e+005	7719,8
0,39		2,5135e+005	7922,9
0,4		2,578e+005	8126,1
0,41		2,6424e+005	8329,2
0,42		2,7069e+005	8532,4
0,43		2,7713e+005	8735,5
0,44		2,8358e+005	8938,7
0,45		2,9002e+005	9141,9
0,46		2,9647e+005	9345,
0,47		3,0291e+005	9548,2
0,48		3,0936e+005	9751,3
0,49		3,158e+005	9954,5

0,5		3,2225e+005	10158
0,51		3,2869e+005	10361
0,52		3,3514e+005	10564
0,53		3,4158e+005	10767
0,54		3,4803e+005	10970
0,55		3,5447e+005	11173
0,56		3,6092e+005	11377
0,57		3,6736e+005	11580
0,58		3,7381e+005	11783
0,59		3,8025e+005	11986
0,6		3,867e+005	12189
0,61		3,9314e+005	12392
0,62		3,9959e+005	12595
0,63		4,0603e+005	12799
0,64		4,1248e+005	13002
0,65		4,1892e+005	13205
0,66		4,2537e+005	13408
0,67		4,3181e+005	13611
0,68		4,3826e+005	13814
0,69		4,447e+005	14018
0,7		4,5115e+005	14221
0,71		4,5759e+005	14424
0,72		4,6404e+005	14627
0,73		4,7048e+005	14830
0,74		4,7693e+005	15033
0,75		4,8337e+005	15236
0,76		4,8982e+005	15440
0,77		4,9626e+005	15643
0,78		5,0271e+005	15846
0,79		5,0915e+005	16049
0,8		5,156e+005	16252
0,81		5,2204e+005	16455
0,82		5,2849e+005	16658
0,83		5,3493e+005	16862
0,84		5,4138e+005	17065
0,85		5,4782e+005	17268
0,86		5,5427e+005	17471
0,87		5,6071e+005	17674
0,88		5,6716e+005	17877
0,89		5,736e+005	18081
0,9		5,8005e+005	18284
0,91		5,8649e+005	18487
0,92		5,9294e+005	18690
0,93		5,9938e+005	18893
0,94		6,0583e+005	19096
0,95		6,1227e+005	19299
0,96		6,1872e+005	19503
0,97		6,2516e+005	19706
0,98		6,3161e+005	19909
0,99		6,3805e+005	20112
1,		6,445e+005	20315

TABLE 17
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Safety Tools

Object Name	*Stress Tool*
State	Solved
Definition	
Theory	Max Equivalent Stress
Stress Limit Type	Tensile Yield Per Material

TABLE 18
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Tool > Results

Object Name	*Safety Factor*
State	Solved
Scope	
Scoping Method	Geometry Selection
Geometry	All Bodies
Definition	
Type	Safety Factor
By	Time
Display Time	Last
Calculate Time History	Yes
Identifier	
Suppressed	No
Integration Point Results	
Display Option	Averaged
Average Across Bodies	No
Results	
Minimum	7,3927e-005
Minimum Occurs On	Ultramagic-T-180-PROVA3\Surface1
Minimum Value Over Time	
Minimum	7,3927e-005
Maximum	3,6963e-002
Maximum Value Over Time	
Minimum	15,
Maximum	15,
Information	
Time	1, s
Load Step	1
Substep	102
Iteration Number	102

FIGURE 4
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Tool > Safety Factor

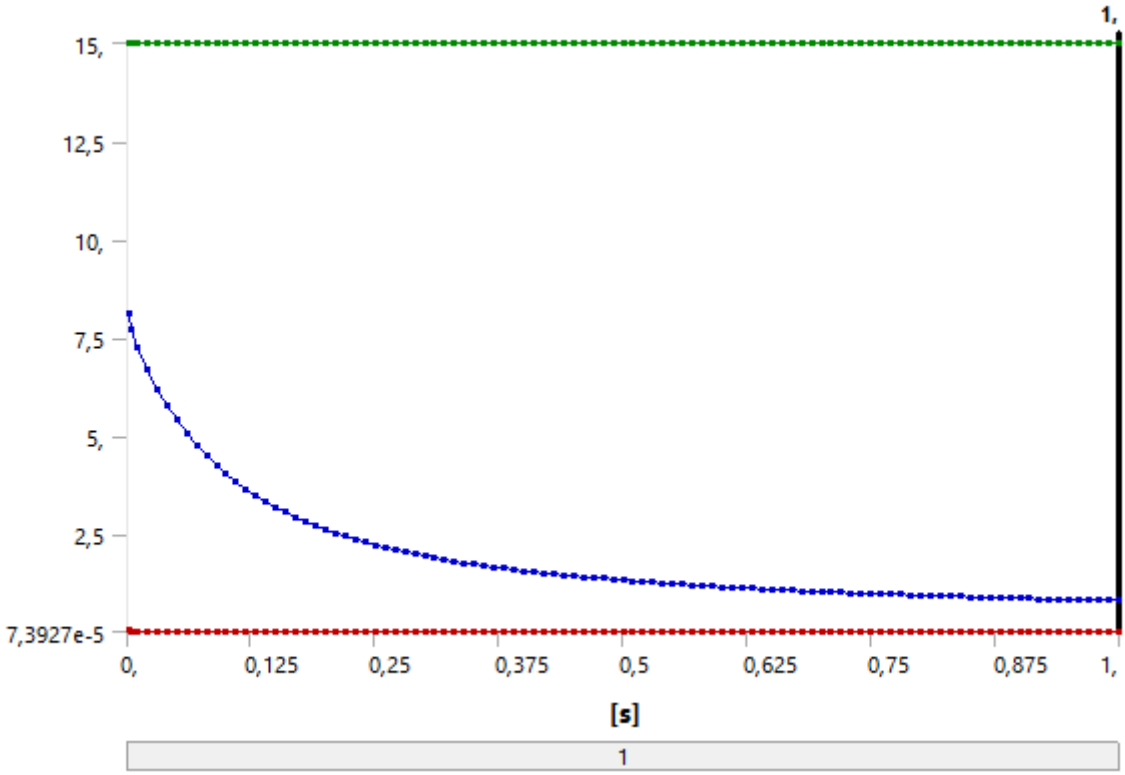


TABLE 19
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Tool > Safety Factor

Time [s]	Minimum	Maximum	Average
2,e-003	3,6963e-002	15,	8,1175
4,e-003	1,8482e-002		7,721
1,e-002	7,3927e-003		7,2638
2,e-002	3,6963e-003		6,685
3,e-002	2,4642e-003		6,1952
4,e-002	1,8482e-003		5,7724
5,e-002	1,4785e-003		5,3994
6,e-002	1,2321e-003		5,0678
7,e-002	1,0561e-003		4,7682
8,e-002	9,2409e-004		4,4987
9,e-002	8,2141e-004		4,2539
1,e-001	7,3927e-004		4,0311
0,11	6,7206e-004		3,8283
0,12	6,1606e-004		3,6431
0,13	5,6867e-004		3,4741
0,14	5,2805e-004		3,3185
0,15	4,9285e-004		3,1754
0,16	4,6204e-004		3,0432
0,17	4,3486e-004		2,9217
0,18	4,107e-004		2,8096
0,19	3,8909e-004		2,7061
0,2	3,6963e-004		2,6102
0,21	3,5203e-004		2,5208
0,22	3,3603e-004		2,4377
0,23	3,2142e-004		2,3599
0,24	3,0803e-004		2,2871

0,25	2,9571e-004		2,2189
0,26	2,8433e-004		2,1551
0,27	2,738e-004		2,0953
0,28	2,6402e-004		2,0391
0,29	2,5492e-004		1,986
0,3	2,4642e-004		1,9357
0,31	2,3847e-004		1,8881
0,32	2,3102e-004		1,8431
0,33	2,2402e-004		1,8004
0,34	2,1743e-004		1,7599
0,35	2,1122e-004		1,7214
0,36	2,0535e-004		1,6848
0,37	1,998e-004		1,6499
0,38	1,9454e-004		1,6167
0,39	1,8956e-004		1,585
0,4	1,8482e-004		1,5546
0,41	1,8031e-004		1,5255
0,42	1,7602e-004		1,4976
0,43	1,7192e-004		1,4709
0,44	1,6802e-004		1,4453
0,45	1,6428e-004		1,4206
0,46	1,6071e-004		1,3969
0,47	1,5729e-004		1,3741
0,48	1,5401e-004		1,3522
0,49	1,5087e-004		1,3312
0,5	1,4785e-004		1,3109
0,51	1,4495e-004		1,2914
0,52	1,4217e-004		1,2726
0,53	1,3948e-004		1,2545
0,54	1,369e-004		1,237
0,55	1,3441e-004		1,2201
0,56	1,3201e-004		1,2037
0,57	1,297e-004		1,1879
0,58	1,2746e-004		1,1725
0,59	1,253e-004		1,1577
0,6	1,2321e-004		1,1433
0,61	1,2119e-004		1,1293
0,62	1,1924e-004		1,1158
0,63	1,1734e-004		1,1027
0,64	1,1551e-004		1,0899
0,65	1,1373e-004		1,0776
0,66	1,1201e-004		1,0655
0,67	1,1034e-004		1,0539
0,68	1,0872e-004		1,0425
0,69	1,0714e-004		1,0315
0,7	1,0561e-004		1,0207
0,71	1,0412e-004		1,0102
0,72	1,0268e-004		1,
0,73	1,0127e-004		0,99011
0,74	9,9901e-005		0,98044
0,75	9,8569e-005		0,971
0,76	9,7272e-005		0,96179

0,77	9,6009e-005		0,95281
0,78	9,4778e-005		0,94404
0,79	9,3578e-005		0,9355
0,8	9,2409e-005		0,92716
0,81	9,1268e-005		0,91903
0,82	9,0155e-005		0,91108
0,83	8,9068e-005		0,90331
0,84	8,8008e-005		0,89573
0,85	8,6973e-005		0,88832
0,86	8,5961e-005		0,88107
0,87	8,4973e-005		0,87398
0,88	8,4008e-005		0,86705
0,89	8,3064e-005		0,86027
0,9	8,2141e-005		0,85364
0,91	8,1238e-005		0,84714
0,92	8,0355e-005		0,84078
0,93	7,9491e-005		0,83456
0,94	7,8646e-005		0,82847
0,95	7,7818e-005		0,82251
0,96	7,7007e-005		0,81666
0,97	7,6213e-005		0,81094
0,98	7,5436e-005		0,80533
0,99	7,4674e-005		0,79982
1,	7,3927e-005		0,79443

Material Data

Plastic, PA6

TABLE 20
Plastic, PA6 > Constants

Density	1,14e-006 kg mm^-3
Tensile Yield Strength	43,13 MPa
Tensile Ultimate Strength	71,89 MPa
Coefficient of Thermal Expansion	1,467e-004 C^-1
Thermal Conductivity	2,428e-004 W mm^-1 C^-1
Specific Heat	1,5e+006 mJ kg^-1 C^-1

TABLE 21
Plastic, PA6 > Opacity

Red	Green	Blue
0,	153,	255,
Opacity		
0,6		
Metallic Finish		
0,		

TABLE 22
Plastic, PA6 > Isotropic Elasticity

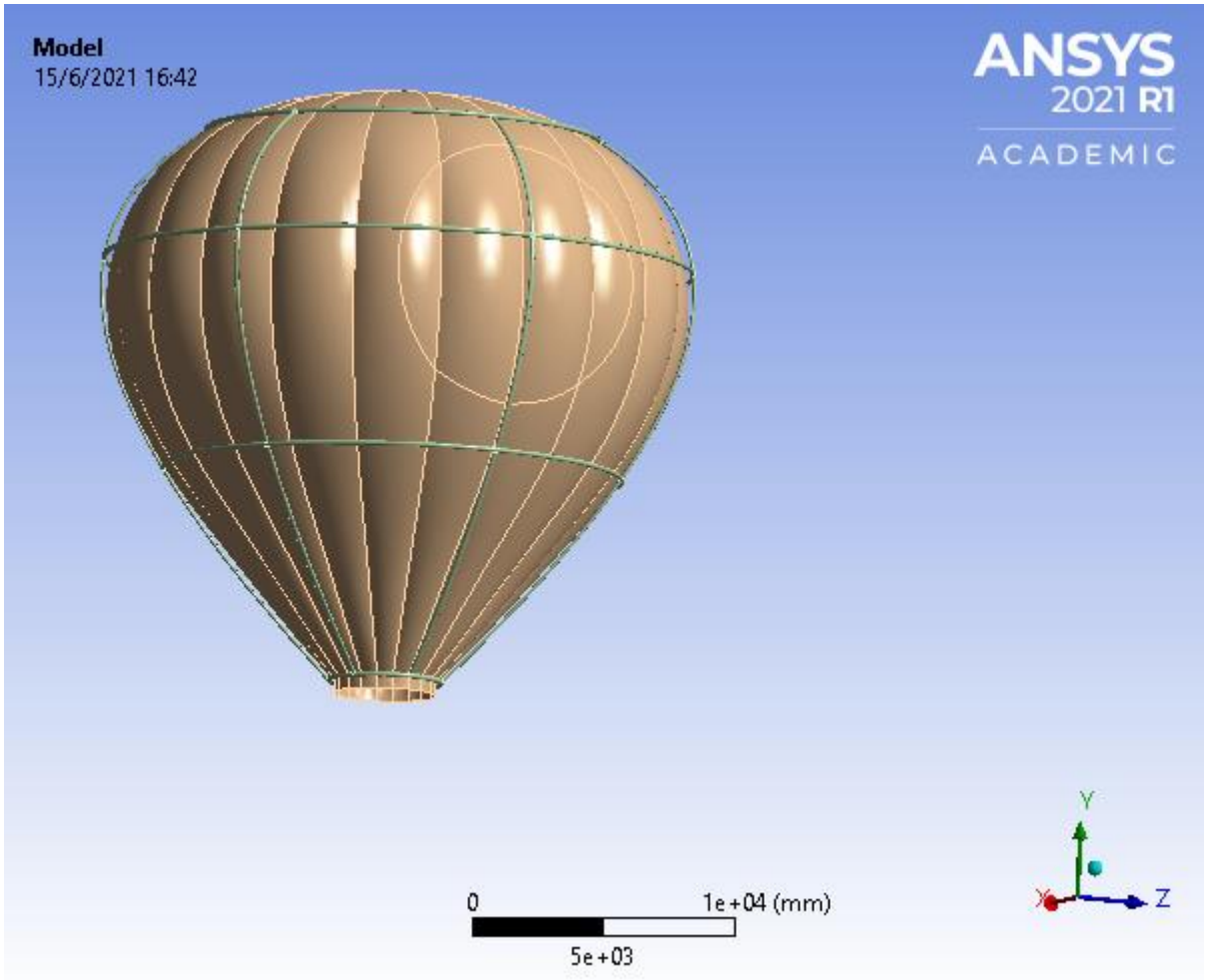
Young's Modulus MPa	Poisson's Ratio	Bulk Modulus MPa	Shear Modulus MPa	Temperature C
1111,	0,3499	1233,6	411,51	23,

TABLE 23
Plastic, PA6 > Isotropic Secant Coefficient of Thermal Expansion

Zero-Thermal-Strain Reference Temperature C
23,

Project*

First Saved	Sunday, April 25, 2021
Last Saved	Monday, June 14, 2021
Product Version	2021 R1
Save Project Before Solution	No
Save Project After Solution	No



Contents

Units

TABLE 1

Unit System	Metric (mm, kg, N, s, mV, mA) Degrees rad/s Celsius
Angle	Degrees
Rotational Velocity	rad/s
Temperature	Celsius

Model (A4)

Geometry

TABLE 2
Model (A4) > Geometry

Object Name	*Geometry*
State	Fully Defined
Definition	
Source	C:\Users\fvila\Desktop\4-PROVA-NO FUNCIONA-tubs-patent\4-PROVA-tubs-patent_files\dp0\SYS\DM\SYS.scdoc
Type	SpaceClaim
Length Unit	Meters
Element Control	Program Controlled
Display Style	Body Color
Bounding Box	
Length X	22770 mm
Length Y	23200 mm
Length Z	22700 mm

Properties	
Volume	7,9441e+008 mm³
Mass	905,63 kg
Surface Area(approx.)	1,6896e+009 mm²
Scale Factor Value	1,
2D Tolerance	Default (1,e-005)
Statistics	
Bodies	2
Active Bodies	2
Nodes	33992
Elements	39613
Mesh Metric	None
Update Options	
Assign Default Material	No
Basic Geometry Options	
Solid Bodies	Yes
Surface Bodies	Yes
Line Bodies	Yes
Parameters	Independent
Parameter Key	
Attributes	Yes
Attribute Key	
Named Selections	Yes
Named Selection Key	
Material Properties	Yes
Advanced Geometry Options	
Use Associativity	Yes
Coordinate Systems	Yes
Coordinate System Key	
Reader Mode Saves Updated File	No
Use Instances	Yes
Smart CAD Update	Yes
Compare Parts On Update	No
Analysis Type	3-D
Mixed Import Resolution	None
Import Facet Quality	Source
Clean Bodies On Import	No
Stitch Surfaces On Import	None
Decompose Disjoint Geometry	Yes
Enclosure and Symmetry Processing	Yes

TABLE 3
Model (A4) > Geometry > Parts

Object Name	*TUBS-SENZILL-PROVA4\Surface1*	*TUBS-PROVA4-PROVA4\Surface1*
State	Meshed	

Graphics Properties		
Visible	Yes	
Transparency	1	
Definition		
Suppressed	No	
Dimension	3D	
Stiffness Behavior	Flexible	
Coordinate System	Default Coordinate System	
Reference Temperature	By Environment	
Thickness	1, mm	0,4 mm
Thickness Mode	Manual	
Offset Type	Middle	
Treatment	None	
Model Type	Shell	
Material		
Assignment	Plastic, PA6	
Nonlinear Effects	Yes	
Thermal Strain Effects	Yes	
Bounding Box		
Length X	22770 mm	22001 mm
Length Y	21200 mm	23200 mm
Length Z	22700 mm	22001 mm
Properties		
Volume	1,976e+008 mm³	5,9681e+008 mm³
Mass	225,26 kg	680,36 kg
Centroid X	9110,3 mm	9110,5 mm
Centroid Y	16821 mm	17515 mm
Centroid Z	21649 mm	
Moment of Inertia Ip1	1,8571e+010 kg·mm²	5,2134e+010 kg·mm²
Moment of Inertia Ip2	1,8252e+010 kg·mm²	5,2066e+010 kg·mm²
Moment of Inertia Ip3	1,8572e+010 kg·mm²	5,2128e+010 kg·mm²
Surface Area(approx.)	1,976e+008 mm²	1,492e+009 mm²
Statistics		
Nodes	20499	13493
Elements	26073	13540
Mesh Metric	None	
CAD Attributes		
PartTolerance:	0,00000001	
Color:175.143.143		
Color:154.175.143		

TABLE 4
Model (A4) > Materials

Object Name	*Materials*
State	Fully Defined
Statistics	
Materials	3
Material Assignments	0

Coordinate Systems

TABLE 5
Model (A4) > Coordinate Systems > Coordinate System

Object Name	*Global Coordinate System*
State	Fully Defined
Definition	
Type	Cartesian
Coordinate System ID	0,
Origin	
Origin X	0, mm
Origin Y	0, mm
Origin Z	0, mm
Directional Vectors	
X Axis Data	[1, 0, 0,]
Y Axis Data	[0, 1, 0,]
Z Axis Data	[0, 0, 1,]

Connections

TABLE 6
Model (A4) > Connections

Object Name	*Connections*
State	Fully Defined
Auto Detection	
Generate Automatic Connection On Refresh	Yes
Transparency	
Enabled	Yes

TABLE 7
Model (A4) > Connections > Contacts

Object Name	*Contacts*
State	Fully Defined
Definition	
Connection Type	Contact
Scope	
Scoping Method	Geometry Selection
Geometry	All Bodies
Auto Detection	
Tolerance Type	Slider
Tolerance Slider	0,
Tolerance Value	99,121 mm
Use Range	No
Face/Face	Yes
Face-Face Angle Tolerance	75, °
Face Overlap Tolerance	Off
Cylindrical Faces	Include
Face/Edge	No
Edge/Edge	No
Priority	Include All
Group By	Bodies
Search Across	Bodies
Statistics	
Connections	1
Active Connections	1

TABLE 8
Model (A4) > Connections > Contacts > Contact Regions

Object Name	*Contact Region*
State	Fully Defined
Scope	
Scoping Method	Geometry Selection
Contact	19 Faces
Target	42 Faces
Contact Bodies	TUBS-SENZILL-PROVA4\Surface1
Target Bodies	TUBS-PROVA4-PROVA4\Surface1
Contact Shell Face	Program Controlled
Target Shell Face	Program Controlled
Shell Thickness Effect	No
Protected	No
Definition	
Type	Bonded
Scope Mode	Automatic
Behavior	Program Controlled
Trim Contact	Program Controlled
Trim Tolerance	99,121 mm
Suppressed	No
Advanced	
Formulation	Program Controlled
Small Sliding	Program Controlled
Detection Method	Program Controlled
Penetration Tolerance	Program Controlled
Elastic Slip Tolerance	Program Controlled
Normal Stiffness	Program Controlled
Update Stiffness	Program Controlled
Pinball Region	Program Controlled
Geometric Modification	
Contact Geometry Correction	None
Target Geometry Correction	None

Mesh

TABLE 9
Model (A4) > Mesh

Object Name	*Mesh*
State	Solved
Display	
Display Style	Use Geometry Setting
Defaults	
Physics Preference	Mechanical
Element Order	Program Controlled
Element Size	Default (618, mm)
Sizing	
Use Adaptive Sizing	No
Growth Rate	Default (1,2)
Mesh Defeaturing	Yes
Defeature Size	Default (3,09 mm)
Capture Curvature	Yes

Curvature Min Size	Default (6,18 mm)
Curvature Normal Angle	Default (30,°)
Capture Proximity	No
Bounding Box Diagonal	39648 mm
Average Surface Area	2,4443e+007 mm²
Minimum Edge Length	15,709 mm
Quality	
Check Mesh Quality	Yes, Errors
Error Limits	Aggressive Mechanical
Target Quality	Default (0.050000)
Smoothing	Medium
Mesh Metric	None
Inflation	
Use Automatic Inflation	None
Inflation Option	Smooth Transition
Transition Ratio	0,272
Maximum Layers	2
Growth Rate	1,2
Inflation Algorithm	Pre
View Advanced Options	No
Batch Connections	
Mesh Based Connection	No
Advanced	
Number of CPUs for Parallel Part Meshing	Program Controlled
Straight Sided Elements	No
Rigid Body Behavior	Dimensionally Reduced
Triangle Surface Mesher	Program Controlled
Topology Checking	Yes
Use Sheet Thickness for Pinch	No
Pinch Tolerance	Default (5,562 mm)
Generate Pinch on Refresh	No
Sheet Loop Removal	No
Statistics	
Nodes	33992
Elements	39613

TABLE 10
Model (A4) > Mesh > Mesh Controls

Object Name	*100mm*	*100mm*	*400mm*
State	Fully Defined		
Scope			
Scoping Method	Geometry Selection		
Geometry	20 Faces	1 Body	28 Faces
Definition			
Suppressed	No		
Type	Element Size		
Element Size	100, mm		350, mm
Advanced			
Defeature Size	Default (3,09 mm)		
Behavior	Soft		
Growth Rate	Default (1,2)		
Capture Curvature	No		

Capture Proximity	No

Static Structural (A5)

TABLE 11
Model (A4) > Analysis

Object Name	*Static Structural (A5)*
State	Solved
Definition	
Physics Type	Structural
Analysis Type	Static Structural
Solver Target	Mechanical APDL
Options	
Environment Temperature	22, °C
Generate Input Only	No

TABLE 12
Model (A4) > Static Structural (A5) > Analysis Settings

Object Name	*Analysis Settings*
State	Fully Defined
Step Controls	
Number Of Steps	1,
Current Step Number	1,
Step End Time	1, s
Auto Time Stepping	On
Define By	Substeps
Initial Substeps	250,
Minimum Substeps	50,
Maximum Substeps	5000,
Solver Controls	
Solver Type	Program Controlled
Weak Springs	Off
Solver Pivot Checking	Program Controlled
Large Deflection	Off
Inertia Relief	Off
Quasi-Static Solution	Off
Rotordynamics Controls	
Coriolis Effect	Off
Restart Controls	
Generate Restart Points	Program Controlled
Retain Files After Full Solve	No
Combine Restart Files	Program Controlled
Nonlinear Controls	
Newton-Raphson Option	Program Controlled
Force Convergence	Program Controlled
Moment Convergence	Program Controlled
Displacement Convergence	Program Controlled
Rotation Convergence	Program Controlled
Line Search	Program Controlled

Stabilization	Program Controlled
Advanced	
Inverse Option	No
Contact Split (DMP)	Off
Output Controls	
Stress	Yes
Surface Stress	No
Back Stress	No
Strain	Yes
Contact Data	Yes
Nonlinear Data	No
Nodal Forces	No
Volume and Energy	Yes
Euler Angles	Yes
General Miscellaneous	No
Contact Miscellaneous	No
Store Results At	All Time Points
Result File Compression	Program Controlled
Analysis Data Management	
Solver Files Directory	C:\Users\fvila\Desktop\4-PROVA-NO FUNCIONA-tubs-patent\4-PROVA-tubs-patent_files\dp0\SYS\MECH\
Future Analysis	None
Scratch Solver Files Directory	
Save MAPDL db	No
Contact Summary	Program Controlled
Delete Unneeded Files	Yes
Nonlinear Solution	No
Solver Units	Active System
Solver Unit System	nmm

TABLE 13
Model (A4) > Static Structural (A5) > Loads

Object Name	*Displacement*	*Fixed Rotation*	*xoc vent 1,5 atm*	*interior globus 0,1 MPa*	*tubs 0,2 MPa*
State	Fully Defined				
Scope					
Scoping Method	Geometry Selection				
Geometry	21 Faces	10 Faces	4 Faces	27 Faces	22 Faces
Definition					
Type	Displacement	Fixed Rotation	Pressure		
Define By	Components		Normal To		
Coordinate System	Global Coordinate System				
X Component	0, mm (ramped)				
Y Component	0, mm (ramped)				

Z Component	0, mm (ramped)				
Suppressed	No				
Rotation X		Fixed			
Rotation Y		Fixed			
Rotation Z		Fixed			
Applied By			Surface Effect		
Loaded Area			Deformed		
Magnitude			0,15199 MPa (ramped)	-0,1 MPa (ramped)	-0,2 MPa (ramped)

Solution (A6)

TABLE 14
Model (A4) > Static Structural (A5) > Solution

Object Name	*Solution (A6)*
State	Solved
Adaptive Mesh Refinement	
Max Refinement Loops	1,
Refinement Depth	2,
Information	
Status	Done
MAPDL Elapsed Time	8 m 15 s
MAPDL Memory Used	1,3916 GB
MAPDL Result File Size	2,0743 GB
Post Processing	
Beam Section Results	No
On Demand Stress/Strain	No

TABLE 15
Model (A4) > Static Structural (A5) > Solution (A6) > Solution Information

Object Name	*Solution Information*
State	Solved
Solution Information	
Solution Output	Solver Output
Newton-Raphson Residuals	0
Identify Element Violations	0
Update Interval	2,5 s
Display Points	All
FE Connection Visibility	
Activate Visibility	Yes
Display	All FE Connectors
Draw Connections Attached To	All Nodes
Line Color	Connection Type
Visible on Results	No
Line Thickness	Single
Display Type	Lines

TABLE 16
Model (A4) > Static Structural (A5) > Solution (A6) > Results

Object Name	*Total Deformation*	*Equivalent Elastic Strain*	*Stress Intensity*
State	Solved		
Scope			

Scoping Method	Geometry Selection		
Geometry	All Bodies		
Position		Top/Bottom	
Definition			
Type	Total Deformation	Equivalent Elastic Strain	Stress Intensity
By	Time		
Display Time	Last		
Calculate Time History	Yes		
Identifier			
Suppressed	No		
Results			
Minimum	0, mm	0, mm/mm	0, MPa
Maximum	5,1152e+006 mm	116,11 mm/mm	1,252e+005 MPa
Average	98931 mm	2,0544 mm/mm	2107,2 MPa
Minimum Occurs On	TUBS-PROVA4-PROVA4\Surface1		
Maximum Occurs On	TUBS-PROVA4-PROVA4\Surface1		
Minimum Value Over Time			
Minimum	0, mm	0, mm/mm	0, MPa
Maximum	0, mm	0, mm/mm	0, MPa
Maximum Value Over Time			
Minimum	20461 mm	0,46443 mm/mm	500,82 MPa
Maximum	5,1152e+006 mm	116,11 mm/mm	1,252e+005 MPa
Information			
Time	1, s		
Load Step	1		
Substep	52		
Iteration Number	52		
Integration Point Results			
Display Option		Averaged	
Average Across Bodies		No	

FIGURE 1
Model (A4) > Static Structural (A5) > Solution (A6) > Total Deformation

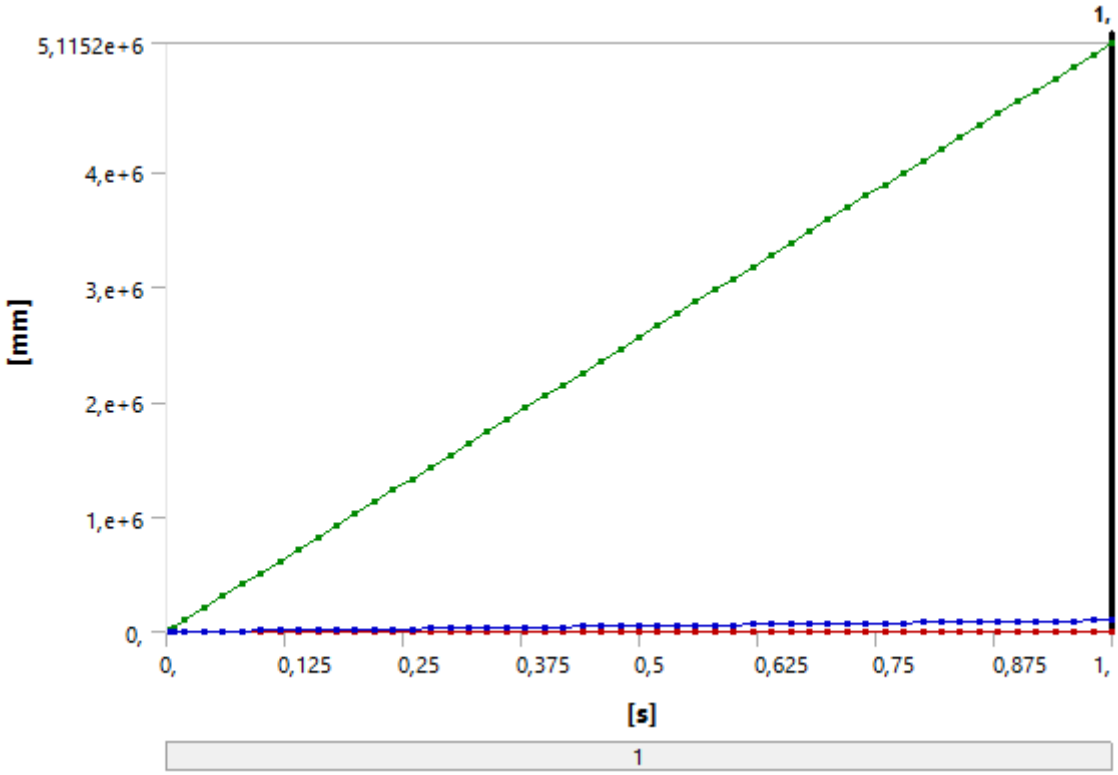


TABLE 17
Model (A4) > Static Structural (A5) > Solution (A6) > Total Deformation

Time [s]	Minimum [mm]	Maximum [mm]	Average [mm]
4,e-003	0,	20461	395,72
8,e-003		40921	791,45
2,e-002		1,023e+005	1978,6
4,e-002		2,0461e+005	3957,2
6,e-002		3,0691e+005	5935,9
8,e-002		4,0921e+005	7914,5
0,1		5,1152e+005	9893,1
0,12		6,1382e+005	11872
0,14		7,1613e+005	13850
0,16		8,1843e+005	15829
0,18		9,2073e+005	17808
0,2		1,023e+006	19786
0,22		1,1253e+006	21765
0,24		1,2276e+006	23743
0,26		1,3299e+006	25722
0,28		1,4323e+006	27701
0,3		1,5346e+006	29679
0,32		1,6369e+006	31658
0,34		1,7392e+006	33637
0,36		1,8415e+006	35615
0,38		1,9438e+006	37594
0,4		2,0461e+006	39572
0,42		2,1484e+006	41551
0,44		2,2507e+006	43530
0,46		2,353e+006	45508
0,48		2,4553e+006	47487

0,5		2,5576e+006	49466
0,52		2,6599e+006	51444
0,54		2,7622e+006	53423
0,56		2,8645e+006	55401
0,58		2,9668e+006	57380
0,6		3,0691e+006	59359
0,62		3,1714e+006	61337
0,64		3,2737e+006	63316
0,66		3,376e+006	65295
0,68		3,4783e+006	67273
0,7		3,5806e+006	69252
0,72		3,6829e+006	71230
0,74		3,7852e+006	73209
0,76		3,8875e+006	75188
0,78		3,9898e+006	77166
0,8		4,0921e+006	79145
0,82		4,1944e+006	81124
0,84		4,2968e+006	83102
0,86		4,3991e+006	85081
0,88		4,5014e+006	87059
0,9		4,6037e+006	89038
0,92		4,706e+006	91017
0,94		4,8083e+006	92995
0,96		4,9106e+006	94974
0,98		5,0129e+006	96953
1,		5,1152e+006	98931

FIGURE 2
Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Elastic Strain

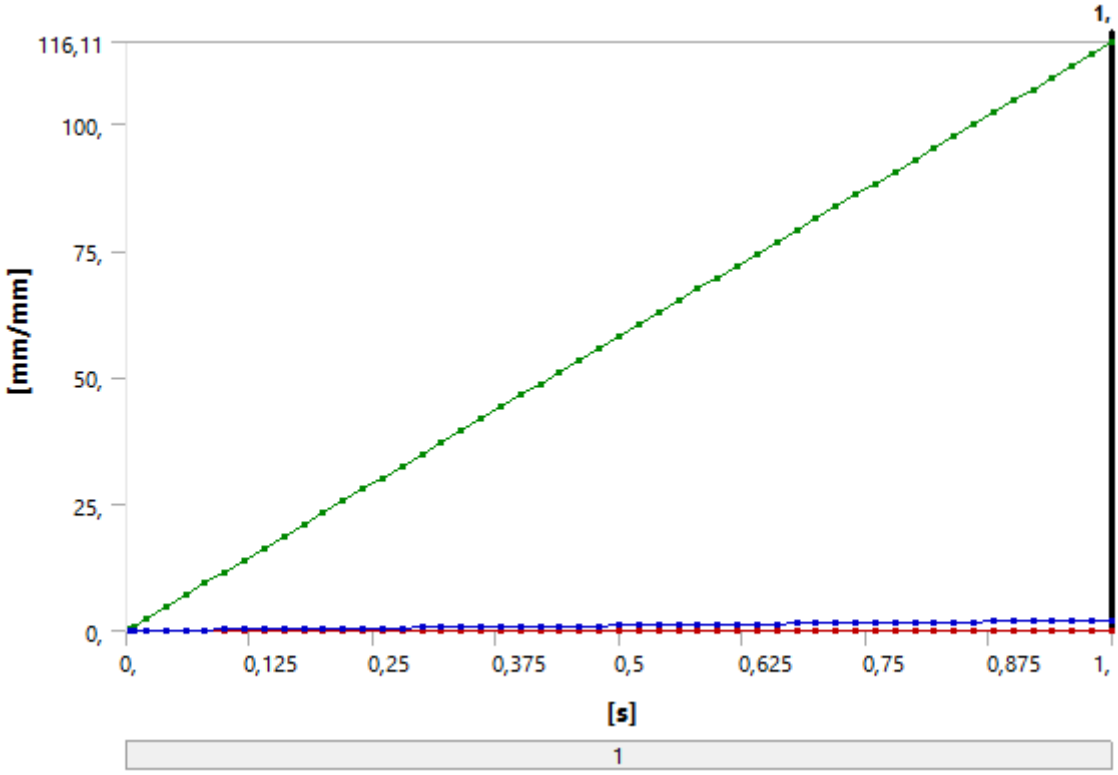


TABLE 18
Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Elastic Strain

Time [s]	Minimum [mm/mm]	Maximum [mm/mm]	Average [mm/mm]
4,e-003		0,46443	8,2177e-003
8,e-003		0,92886	1,6435e-002
2,e-002		2,3222	4,1088e-002
4,e-002		4,6443	8,2177e-002
6,e-002		6,9665	0,12327
8,e-002		9,2886	0,16435
0,1		11,611	0,20544
0,12		13,933	0,24653
0,14		16,255	0,28762
0,16		18,577	0,32871
0,18		20,899	0,3698
0,2		23,222	0,41088
0,22		25,544	0,45197
0,24		27,866	0,49306
0,26		30,188	0,53415
0,28		32,51	0,57524
0,3		34,832	0,61633
0,32		37,154	0,65742
0,34		39,477	0,6985
0,36		41,799	0,73959
0,38		44,121	0,78068
0,4		46,443	0,82177
0,42		48,765	0,86286
0,44		51,087	0,90395
0,46	0,	53,409	0,94503
0,48		55,732	0,98612
0,5		58,054	1,0272
0,52		60,376	1,0683
0,54		62,698	1,1094
0,56		65,02	1,1505
0,58		67,342	1,1916
0,6		69,665	1,2327
0,62		71,987	1,2737
0,64		74,309	1,3148
0,66		76,631	1,3559
0,68		78,953	1,397
0,7		81,275	1,4381
0,72		83,597	1,4792
0,74		85,92	1,5203
0,76		88,242	1,5614
0,78		90,564	1,6025
0,8		92,886	1,6435
0,82		95,208	1,6846
0,84		97,53	1,7257
0,86		99,853	1,7668
0,88		102,17	1,8079
0,9		104,5	1,849
0,92		106,82	1,8901
0,94		109,14	1,9312
0,96		111,46	1,9722

0,98		113,79	2,0133
1,		116,11	2,0544

FIGURE 3
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Intensity

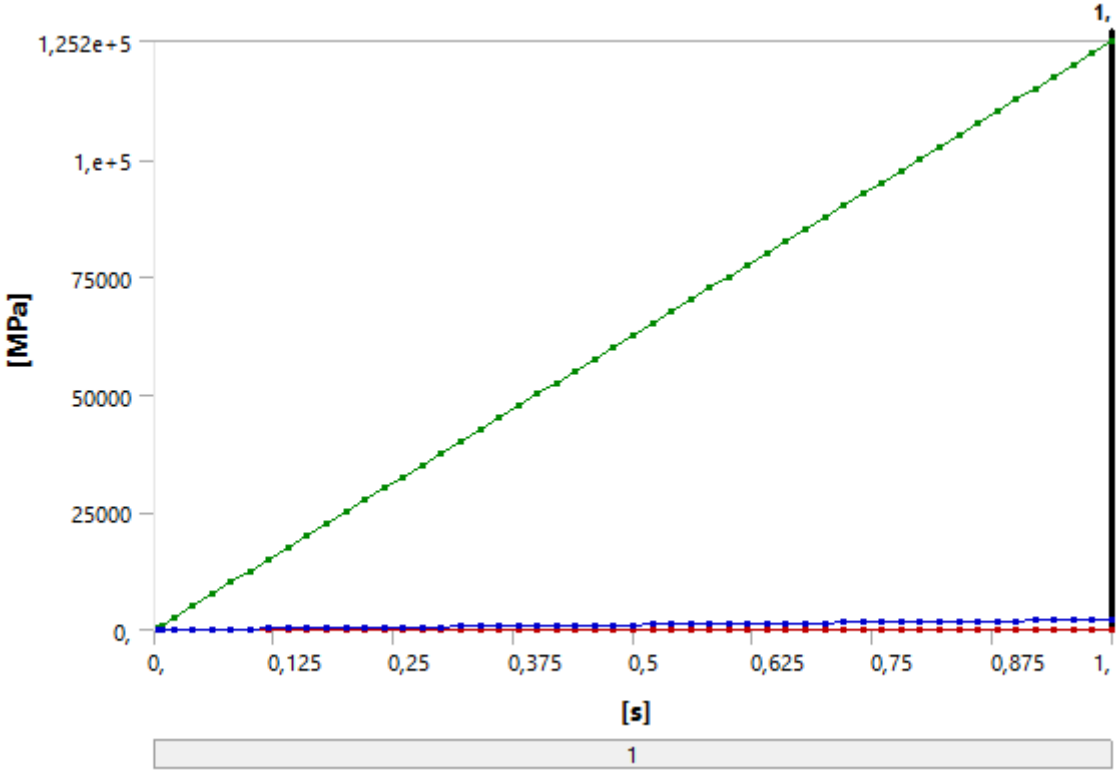


TABLE 19
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Intensity

Time [s]	Minimum [MPa]	Maximum [MPa]	Average [MPa]
4,e-003	0,	500,82	8,4288
8,e-003		1001,6	16,858
2,e-002		2504,1	42,144
4,e-002		5008,2	84,288
6,e-002		7512,2	126,43
8,e-002		10016	168,58
0,1		12520	210,72
0,12		15024	252,86
0,14		17529	295,01
0,16		20033	337,15
0,18		22537	379,29
0,2		25041	421,44
0,22		27545	463,58
0,24		30049	505,73
0,26		32553	547,87
0,28		35057	590,01
0,3		37561	632,16
0,32		40065	674,3
0,34		42569	716,45
0,36		45073	758,59
0,38		47578	800,73

0,4		50082	842,88
0,42		52586	885,02
0,44		55090	927,17
0,46		57594	969,31
0,48		60098	1011,5
0,5		62602	1053,6
0,52		65106	1095,7
0,54		67610	1137,9
0,56		70114	1180,
0,58		72618	1222,2
0,6		75122	1264,3
0,62		77626	1306,5
0,64		80131	1348,6
0,66		82635	1390,7
0,68		85139	1432,9
0,7		87643	1475,
0,72		90147	1517,2
0,74		92651	1559,3
0,76		95155	1601,5
0,78		97659	1643,6
0,8		1,0016e+005	1685,8
0,82		1,0267e+005	1727,9
0,84		1,0517e+005	1770,
0,86		1,0768e+005	1812,2
0,88		1,1018e+005	1854,3
0,9		1,1268e+005	1896,5
0,92		1,1519e+005	1938,6
0,94		1,1769e+005	1980,8
0,96		1,202e+005	2022,9
0,98		1,227e+005	2065,1
1,		1,252e+005	2107,2

TABLE 20
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Safety Tools

Object Name	*Stress Tool*
State	Solved
Definition	
Theory	Max Equivalent Stress
Stress Limit Type	Tensile Yield Per Material

TABLE 21
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Tool > Results

Object Name	*Safety Factor*
State	Solved
Scope	
Scoping Method	Geometry Selection
Geometry	All Bodies
Definition	
Type	Safety Factor
By	Time
Display Time	Last
Calculate Time History	Yes
Identifier	

Suppressed	No
Integration Point Results	
Display Option	Averaged
Average Across Bodies	No
Results	
Minimum	3,4666e-004
Minimum Occurs On	TUBS-PROVA4-PROVA4\Surface1
Minimum Value Over Time	
Minimum	3,4666e-004
Maximum	8,6665e-002
Maximum Value Over Time	
Minimum	15,
Maximum	15,
Information	
Time	1, s
Load Step	1
Substep	52
Iteration Number	52

FIGURE 4
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Tool > Safety Factor

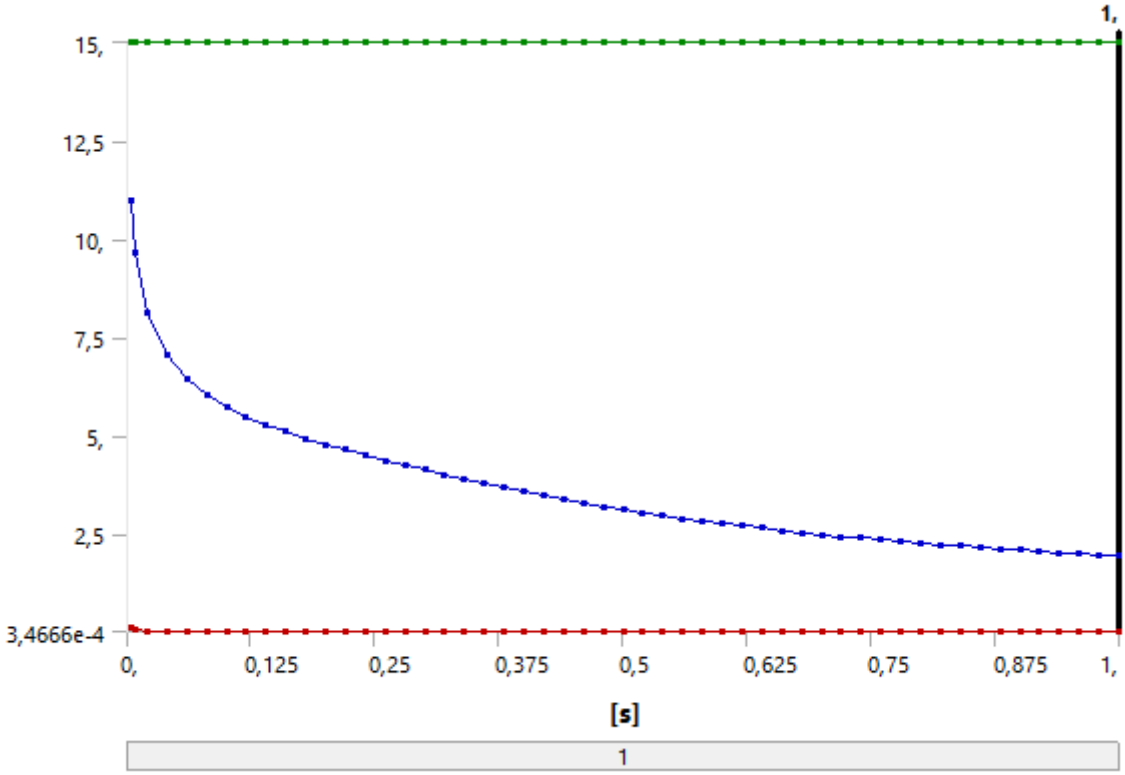


TABLE 22
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Tool > Safety Factor

Time [s]	Minimum	Maximum	Average
4,e-003	8,6665e-002	15,	10,955
8,e-003	4,3333e-002		9,6253
2,e-002	1,7333e-002		8,1054
4,e-002	8,6665e-003		7,035
6,e-002	5,7777e-003		6,4316

8,e-002	4,3333e-003		6,0287
0,1	3,4666e-003		5,7258
0,12	2,8888e-003		5,4827
0,14	2,4761e-003		5,274
0,16	2,1666e-003		5,089
0,18	1,9259e-003		4,9211
0,2	1,7333e-003		4,7662
0,22	1,5757e-003		4,6205
0,24	1,4444e-003		4,4824
0,26	1,3333e-003		4,3513
0,28	1,2381e-003		4,2265
0,3	1,1555e-003		4,1078
0,32	1,0833e-003		3,9944
0,34	1,0196e-003		3,8856
0,36	9,6295e-004		3,7798
0,38	9,1226e-004		3,6728
0,4	8,6665e-004		3,5659
0,42	8,2538e-004		3,4629
0,44	7,8787e-004		3,3646
0,46	7,5361e-004		3,2715
0,48	7,2221e-004		3,1837
0,5	6,9332e-004		3,1007
0,52	6,6666e-004		3,0222
0,54	6,4196e-004		2,9478
0,56	6,1904e-004		2,8772
0,58	5,9769e-004		2,8101
0,6	5,7777e-004		2,7463
0,62	5,5913e-004		2,6857
0,64	5,4166e-004		2,628
0,66	5,2524e-004		2,5731
0,68	5,098e-004		2,5208
0,7	4,9523e-004		2,471
0,72	4,8147e-004		2,4232
0,74	4,6846e-004		2,3777
0,76	4,5613e-004		2,3342
0,78	4,4444e-004		2,2924
0,8	4,3333e-004		2,2523
0,82	4,2276e-004		2,2138
0,84	4,1269e-004		2,1767
0,86	4,0309e-004		2,141
0,88	3,9393e-004		2,1067
0,9	3,8518e-004		2,0735
0,92	3,7681e-004		2,0415
0,94	3,6879e-004		2,0106
0,96	3,611e-004		1,9808
0,98	3,5374e-004		1,952
1,	3,4666e-004		1,9242

Material Data

Plastic, PA6

TABLE 23
Plastic, PA6 > Constants

Density	1,14e-006 kg mm^-3
Tensile Yield Strength	43,13 MPa
Tensile Ultimate Strength	71,89 MPa
Coefficient of Thermal Expansion	1,467e-004 C^-1
Thermal Conductivity	2,428e-004 W mm^-1 C^-1
Specific Heat	1,5e+006 mJ kg^-1 C^-1

TABLE 24
Plastic, PA6 > Opacity

Red	Green	Blue
0,	153,	255,

Opacity
0,6

Metallic Finish
0,

TABLE 25
Plastic, PA6 > Isotropic Elasticity

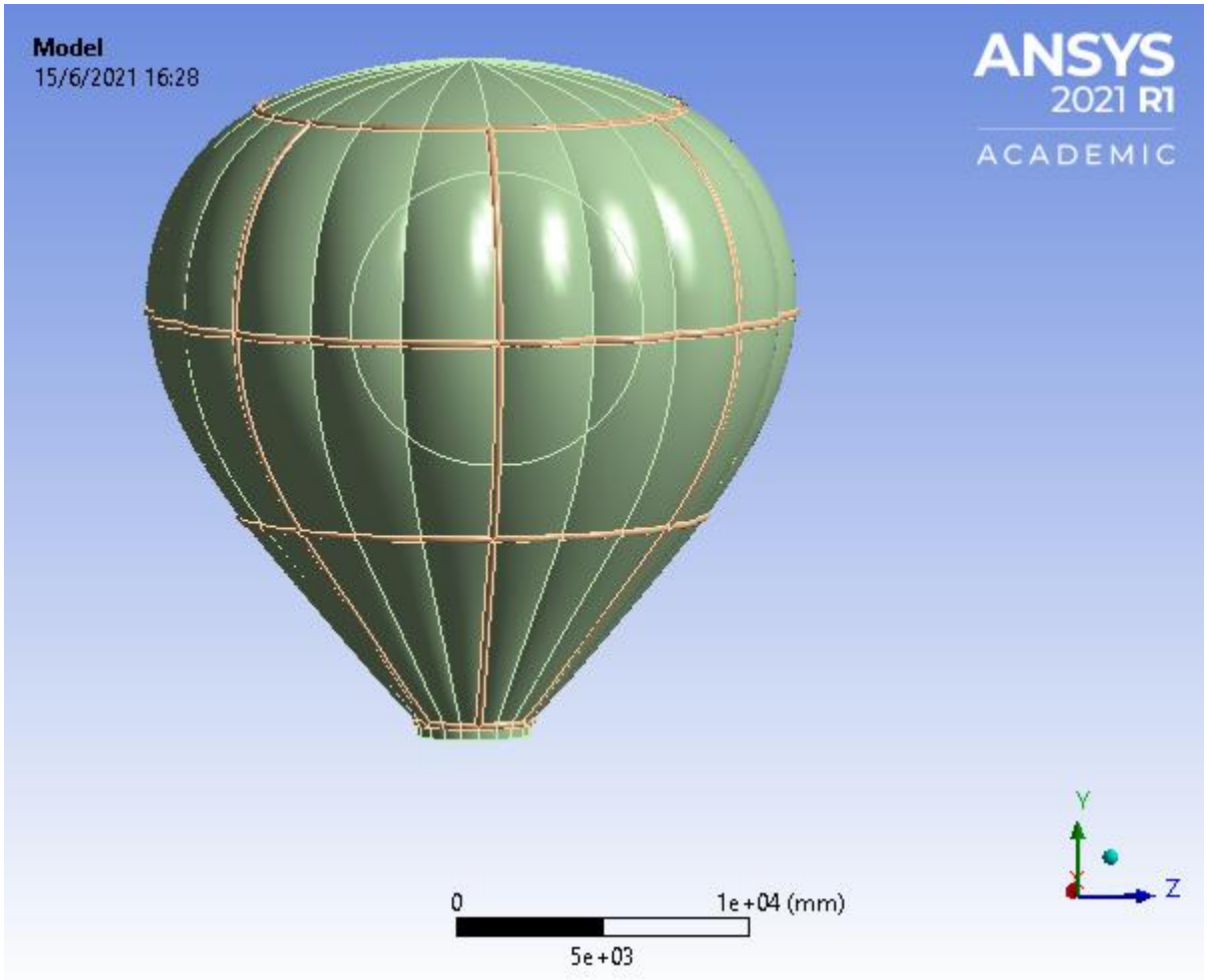
Young's Modulus MPa	Poisson's Ratio	Bulk Modulus MPa	Shear Modulus MPa	Temperature C
1111,	0,3499	1233,6	411,51	23,

TABLE 26
Plastic, PA6 > Isotropic Secant Coefficient of Thermal Expansion

Zero-Thermal-Strain Reference Temperature C
23,

Project*

First Saved	Monday, May 10, 2021
Last Saved	Tuesday, June 15, 2021
Product Version	2021 R1
Save Project Before Solution	No
Save Project After Solution	No



Contents

Units

TABLE 1

Unit System	Metric (mm, kg, N, s, mV, mA) Degrees rad/s Celsius
Angle	Degrees
Rotational Velocity	rad/s
Temperature	Celsius

Model (B4)

Geometry

TABLE 2
Model (B4) > Geometry

Object Name	*Geometry*
State	Fully Defined
Definition	
Source	C:\Users\fvila\Desktop\5-PROVA-tubs+contacte\5-PROVA-tubs-contacte_files\dp0\SYS-1\DM\SYS-1.scdoc
Type	SpaceClaim
Length Unit	Meters
Element Control	Program Controlled
Display Style	Body Color
Bounding Box	
Length X	22184 mm
Length Y	23200 mm
Length Z	22184 mm

Properties	
Volume	6,7491e+008 mm³
Mass	769,4 kg
Surface Area(approx.)	1,6873e+009 mm²
Scale Factor Value	1,
2D Tolerance	Default (1,e-005)
Statistics	
Bodies	2
Active Bodies	2
Nodes	9908
Elements	10285
Mesh Metric	None
Update Options	
Assign Default Material	No
Basic Geometry Options	
Solid Bodies	Yes
Surface Bodies	Yes
Line Bodies	Yes
Parameters	Independent
Parameter Key	
Attributes	Yes
Attribute Key	
Named Selections	Yes
Named Selection Key	
Material Properties	Yes
Advanced Geometry Options	
Use Associativity	Yes
Coordinate Systems	Yes
Coordinate System Key	
Reader Mode Saves Updated File	No
Use Instances	Yes
Smart CAD Update	Yes
Compare Parts On Update	No
Analysis Type	3-D
Mixed Import Resolution	None
Import Facet Quality	Source
Clean Bodies On Import	No
Stitch Surfaces On Import	None
Decompose Disjoint Geometry	Yes
Enclosure and Symmetry Processing	Yes

TABLE 3
Model (B4) > Geometry > Parts

Object Name	*TUBS-PROVA5-PROVA5\Surface1*	*TUBS-CONTACT-PROVA5\Surface1*
State	Meshed	
Graphics Properties		
Visible	Yes	
Transparency	1	

Definition		
Suppressed	No	
Dimension	3D	
Stiffness Behavior	Flexible	
Coordinate System	Default Coordinate System	
Reference Temperature	By Environment	
Thickness	0,4 mm	
Thickness Mode	Manual	
Offset Type	Middle	
Treatment	None	
Model Type	Shell	
Material		
Assignment	Plastic, PA6	
Nonlinear Effects	Yes	
Thermal Strain Effects	Yes	
Bounding Box		
Length X	22001 mm	22184 mm
Length Y	23200 mm	21250 mm
Length Z	22001 mm	22184 mm
Properties		
Volume	5,9681e+008 mm³	7,8103e+007 mm³
Mass	680,36 kg	89,037 kg
Centroid X	9110,5 mm	9111,1 mm
Centroid Y	17515 mm	16351 mm
Centroid Z	21649 mm	
Moment of Inertia Ip1	5,2134e+010 kg·mm²	7,0692e+009 kg·mm²
Moment of Inertia Ip2	5,2066e+010 kg·mm²	6,637e+009 kg·mm²
Moment of Inertia Ip3	5,2128e+010 kg·mm²	6,7394e+009 kg·mm²
Surface Area(approx.)	1,492e+009 mm²	1,9526e+008 mm²
Statistics		
Nodes	4115	5793
Elements	4182	6103
Mesh Metric	None	
CAD Attributes		
PartTolerance:	0,00000001	
Color:154.175.143		
Color:175.143.143		

TABLE 4
Model (B4) > Materials

Object Name	*Materials*
State	Fully Defined
Statistics	
Materials	2
Material Assignments	0

Coordinate Systems

TABLE 5
Model (B4) > Coordinate Systems > Coordinate System

Object Name	*Global Coordinate System*

State	Fully Defined
Definition	
Type	Cartesian
Coordinate System ID	0,
Origin	
Origin X	0, mm
Origin Y	0, mm
Origin Z	0, mm
Directional Vectors	
X Axis Data	[1, 0, 0,]
Y Axis Data	[0, 1, 0,]
Z Axis Data	[0, 0, 1,]

Connections

TABLE 6
Model (B4) > Connections

Object Name	*Connections*
State	Fully Defined
Auto Detection	
Generate Automatic Connection On Refresh	Yes
Transparency	
Enabled	Yes

TABLE 7
Model (B4) > Connections > Contacts

Object Name	*Contacts*
State	Fully Defined
Definition	
Connection Type	Contact
Scope	
Scoping Method	Geometry Selection
Geometry	All Bodies
Auto Detection	
Tolerance Type	Slider
Tolerance Slider	0,
Tolerance Value	97,548 mm
Use Range	No
Face/Face	Yes
Face-Face Angle Tolerance	75, °
Face Overlap Tolerance	Off
Cylindrical Faces	Include
Face/Edge	No
Edge/Edge	No
Priority	Include All
Group By	Bodies
Search Across	Bodies
Statistics	
Connections	1
Active Connections	1

TABLE 8
Model (B4) > Connections > Contacts > Contact Regions

Object Name	*Contact Region*
State	Fully Defined
Scope	
Scoping Method	Geometry Selection
Contact	46 Faces
Target	95 Faces
Contact Bodies	TUBS-PROVA5-PROVA5\Surface1
Target Bodies	TUBS-CONTACT-PROVA5\Surface1
Contact Shell Face	Program Controlled
Target Shell Face	Program Controlled
Shell Thickness Effect	No
Protected	No
Definition	
Type	Bonded
Scope Mode	Automatic
Behavior	Program Controlled
Trim Contact	Program Controlled
Trim Tolerance	97,548 mm
Suppressed	No
Advanced	
Formulation	Program Controlled
Small Sliding	Program Controlled
Detection Method	Program Controlled
Penetration Tolerance	Program Controlled
Elastic Slip Tolerance	Program Controlled
Normal Stiffness	Program Controlled
Update Stiffness	Program Controlled
Pinball Region	Program Controlled
Geometric Modification	
Contact Geometry Correction	None
Target Geometry Correction	None

Mesh

TABLE 9
Model (B4) > Mesh

Object Name	*Mesh*
State	Solved
Display	
Display Style	Use Geometry Setting
Defaults	
Physics Preference	Mechanical
Element Order	Program Controlled
Element Size	Default (354,79 mm)
Sizing	
Use Adaptive Sizing	No
Growth Rate	Default (1,2)
Mesh Defeaturing	Yes
Defeature Size	Default (1,7739 mm)
Capture Curvature	Yes
Curvature Min Size	Default (3,5479 mm)
Curvature Normal Angle	Default (30,°)

Capture Proximity	No
Bounding Box Diagonal	39019 mm
Average Surface Area	8,0559e+006 mm²
Minimum Edge Length	6,6365e-003 mm
Quality	
Check Mesh Quality	Yes, Errors
Error Limits	Aggressive Mechanical
Target Quality	Default (0.050000)
Smoothing	Medium
Mesh Metric	None
Inflation	
Use Automatic Inflation	None
Inflation Option	Smooth Transition
Transition Ratio	0,272
Maximum Layers	2
Growth Rate	1,2
Inflation Algorithm	Pre
View Advanced Options	No
Batch Connections	
Mesh Based Connection	No
Advanced	
Number of CPUs for Parallel Part Meshing	Program Controlled
Straight Sided Elements	No
Rigid Body Behavior	Dimensionally Reduced
Triangle Surface Mesher	Program Controlled
Topology Checking	Yes
Use Sheet Thickness for Pinch	No
Pinch Tolerance	Default (3,1931 mm)
Generate Pinch on Refresh	No
Sheet Loop Removal	No
Statistics	
Nodes	9908
Elements	10285

TABLE 10
Model (B4) > Mesh > Mesh Controls

Object Name	*Body Sizing*	*Body Sizing 2*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	1 Body	
Definition		
Suppressed	No	
Type	Element Size	
Element Size	600, mm	200, mm
Advanced		
Defeature Size	Default (1,7739 mm)	
Behavior	Soft	
Growth Rate	Default (1,2)	
Capture Curvature	No	
Capture Proximity	No	

Static Structural (B5)

TABLE 11
Model (B4) > Analysis

Object Name	*Static Structural (B5)*
State	Solved
Definition	
Physics Type	Structural
Analysis Type	Static Structural
Solver Target	Mechanical APDL
Options	
Environment Temperature	22, °C
Generate Input Only	No

TABLE 12
Model (B4) > Static Structural (B5) > Analysis Settings

Object Name	*Analysis Settings*
State	Fully Defined
Step Controls	
Number Of Steps	1,
Current Step Number	1,
Step End Time	1, s
Auto Time Stepping	On
Define By	Substeps
Initial Substeps	500,
Minimum Substeps	100,
Maximum Substeps	10000
Solver Controls	
Solver Type	Program Controlled
Weak Springs	Off
Solver Pivot Checking	Program Controlled
Large Deflection	Off
Inertia Relief	Off
Quasi-Static Solution	Off
Rotordynamics Controls	
Coriolis Effect	Off
Restart Controls	
Generate Restart Points	Program Controlled
Retain Files After Full Solve	No
Combine Restart Files	Program Controlled
Nonlinear Controls	
Newton-Raphson Option	Program Controlled
Force Convergence	Program Controlled
Moment Convergence	Program Controlled
Displacement Convergence	Program Controlled
Rotation Convergence	Program Controlled
Line Search	Program Controlled
Stabilization	Program Controlled
Advanced	

Inverse Option	No
Contact Split (DMP)	Off
Output Controls	
Stress	Yes
Surface Stress	No
Back Stress	No
Strain	Yes
Contact Data	Yes
Nonlinear Data	No
Nodal Forces	No
Volume and Energy	Yes
Euler Angles	Yes
General Miscellaneous	No
Contact Miscellaneous	No
Store Results At	All Time Points
Result File Compression	Program Controlled
Analysis Data Management	
Solver Files Directory	C:\Users\fvila\Desktop\5-PROVA-tubs+contacte\5-PROVA-tubs-contacte_files\dp0\SYS-1\MECH\
Future Analysis	None
Scratch Solver Files Directory	
Save MAPDL db	No
Contact Summary	Program Controlled
Delete Unneeded Files	Yes
Nonlinear Solution	No
Solver Units	Active System
Solver Unit System	nmm

TABLE 13
Model (B4) > Static Structural (B5) > Loads

Object Name	*Displacement*	*Fixed Rotation*	*P.int_vela - 0,1MPA*	*P.vent 1,5 atm*	*P.tubs - 0,2MPA*
State	Fully Defined				
Scope					
Scoping Method	Geometry Selection				
Geometry	21 Faces	10 Faces	47 Faces	4 Faces	86 Faces
Definition					
Type	Displacement	Fixed Rotation	Pressure		
Define By	Components		Normal To		
Coordinate System	Global Coordinate System				
X Component	0, mm (ramped)				
Y Component	0, mm (ramped)				
Z Component	0, mm (ramped)				
Suppressed	No				
Rotation X		Fixed			
Rotation Y		Fixed			

Rotation Z		Fixed			
Applied By			Surface Effect		
Loaded Area			Deformed		
Magnitude			-0,1 MPa (ramped)	0,15199 MPa (ramped)	-0,2 MPa (ramped)

Solution (B6)

TABLE 14
Model (B4) > Static Structural (B5) > Solution

Object Name	*Solution (B6)*
State	Solved
Adaptive Mesh Refinement	
Max Refinement Loops	1,
Refinement Depth	2,
Information	
Status	Done
MAPDL Elapsed Time	37 m 23 s
MAPDL Memory Used	660, MB
MAPDL Result File Size	1,0696 GB
Post Processing	
Beam Section Results	No
On Demand Stress/Strain	No

TABLE 15
Model (B4) > Static Structural (B5) > Solution (B6) > Solution Information

Object Name	*Solution Information*
State	Solved
Solution Information	
Solution Output	Solver Output
Newton-Raphson Residuals	0
Identify Element Violations	0
Update Interval	2,5 s
Display Points	All
FE Connection Visibility	
Activate Visibility	Yes
Display	All FE Connectors
Draw Connections Attached To	All Nodes
Line Color	Connection Type
Visible on Results	No
Line Thickness	Single
Display Type	Lines

TABLE 16
Model (B4) > Static Structural (B5) > Solution (B6) > Results

Object Name	*Elastic Strain Intensity*	*Total Deformation*	*Stress Intensity*
State	Solved		
Scope			
Scoping Method	Geometry Selection		
Geometry	All Bodies		
Position	Top/Bottom		Top/Bottom
Definition			
Type	Elastic Strain Intensity	Total Deformation	Stress Intensity

By	Time		
Display Time	Last		
Calculate Time History	Yes		
Identifier			
Suppressed	No		
Integration Point Results			
Display Option	Averaged		Averaged
Average Across Bodies	No		No
Results			
Minimum	0, mm/mm	0, mm	0, MPa
Maximum	27,129 mm/mm	9,063e+005 mm	22328 MPa
Average	1,8325 mm/mm	27869 mm	1508,2 MPa
Minimum Occurs On	TUBS-PROVA5-PROVA5\Surface1		
Maximum Occurs On	TUBS-PROVA5-PROVA5\Surface1		
Minimum Value Over Time			
Minimum	0, mm/mm	0, mm	0, MPa
Maximum	0, mm/mm	0, mm	0, MPa
Maximum Value Over Time			
Minimum	5,4258e-002 mm/mm	1812,6 mm	44,655 MPa
Maximum	27,129 mm/mm	9,063e+005 mm	22328 MPa
Information			
Time	1, s		
Load Step	1		
Substep	102		
Iteration Number	102		

FIGURE 1
Model (B4) > Static Structural (B5) > Solution (B6) > Elastic Strain Intensity

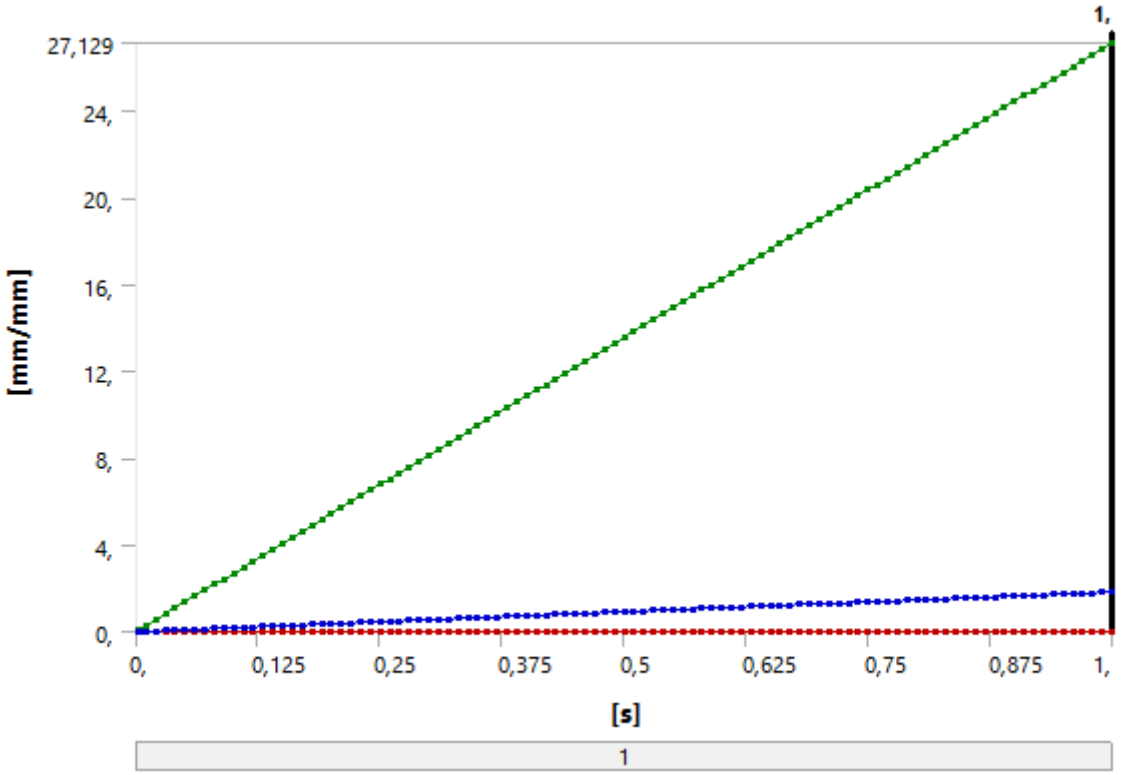


TABLE 17
Model (B4) > Static Structural (B5) > Solution (B6) > Elastic Strain Intensity

Time [s]	Minimum [mm/mm]	Maximum [mm/mm]	Average [mm/mm]
2,e-003		5,4258e-002	3,665e-003
4,e-003		0,10852	7,3299e-003
1,e-002		0,27129	1,8325e-002
2,e-002		0,54258	3,665e-002
3,e-002		0,81386	5,4975e-002
4,e-002		1,0852	7,3299e-002
5,e-002		1,3564	9,1624e-002
6,e-002		1,6277	0,10995
7,e-002		1,899	0,12827
8,e-002		2,1703	0,1466
9,e-002		2,4416	0,16492
1,e-001		2,7129	0,18325
0,11		2,9842	0,20157
0,12		3,2555	0,2199
0,13		3,5267	0,23822
0,14		3,798	0,25655
0,15		4,0693	0,27487
0,16		4,3406	0,2932
0,17		4,6119	0,31152
0,18		4,8832	0,32985
0,19		5,1545	0,34817
0,2		5,4258	0,3665
0,21		5,6971	0,38482
0,22		5,9683	0,40315
0,23	0,	6,2396	0,42147
0,24		6,5109	0,4398
0,25		6,7822	0,45812
0,26		7,0535	0,47645
0,27		7,3248	0,49477
0,28		7,5961	0,5131
0,29		7,8674	0,53142
0,3		8,1386	0,54975
0,31		8,4099	0,56807
0,32		8,6812	0,58639
0,33		8,9525	0,60472
0,34		9,2238	0,62304
0,35		9,4951	0,64137
0,36		9,7664	0,65969
0,37		10,038	0,67802
0,38		10,309	0,69634
0,39		10,58	0,71467
0,4		10,852	0,73299
0,41		11,123	0,75132
0,42		11,394	0,76964
0,43		11,665	0,78797
0,44		11,937	0,80629
0,45		12,208	0,82462
0,46		12,479	0,84294
0,47		12,751	0,86127
0,48		13,022	0,87959

0,49		13,293	0,89792
0,5		13,564	0,91624
0,51		13,836	0,93457
0,52		14,107	0,95289
0,53		14,378	0,97122
0,54		14,65	0,98954
0,55		14,921	1,0079
0,56		15,192	1,0262
0,57		15,463	1,0445
0,58		15,735	1,0628
0,59		16,006	1,0812
0,6		16,277	1,0995
0,61		16,549	1,1178
0,62		16,82	1,1361
0,63		17,091	1,1545
0,64		17,362	1,1728
0,65		17,634	1,1911
0,66		17,905	1,2094
0,67		18,176	1,2278
0,68		18,448	1,2461
0,69		18,719	1,2644
0,7		18,99	1,2827
0,71		19,261	1,3011
0,72		19,533	1,3194
0,73		19,804	1,3377
0,74		20,075	1,356
0,75		20,347	1,3744
0,76		20,618	1,3927
0,77		20,889	1,411
0,78		21,16	1,4293
0,79		21,432	1,4477
0,8		21,703	1,466
0,81		21,974	1,4843
0,82		22,246	1,5026
0,83		22,517	1,521
0,84		22,788	1,5393
0,85		23,06	1,5576
0,86		23,331	1,5759
0,87		23,602	1,5943
0,88		23,873	1,6126
0,89		24,145	1,6309
0,9		24,416	1,6492
0,91		24,687	1,6676
0,92		24,959	1,6859
0,93		25,23	1,7042
0,94		25,501	1,7225
0,95		25,772	1,7409
0,96		26,044	1,7592
0,97		26,315	1,7775
0,98		26,586	1,7958
0,99		26,858	1,8142
1,		27,129	1,8325

FIGURE 2
Model (B4) > Static Structural (B5) > Solution (B6) > Total Deformation

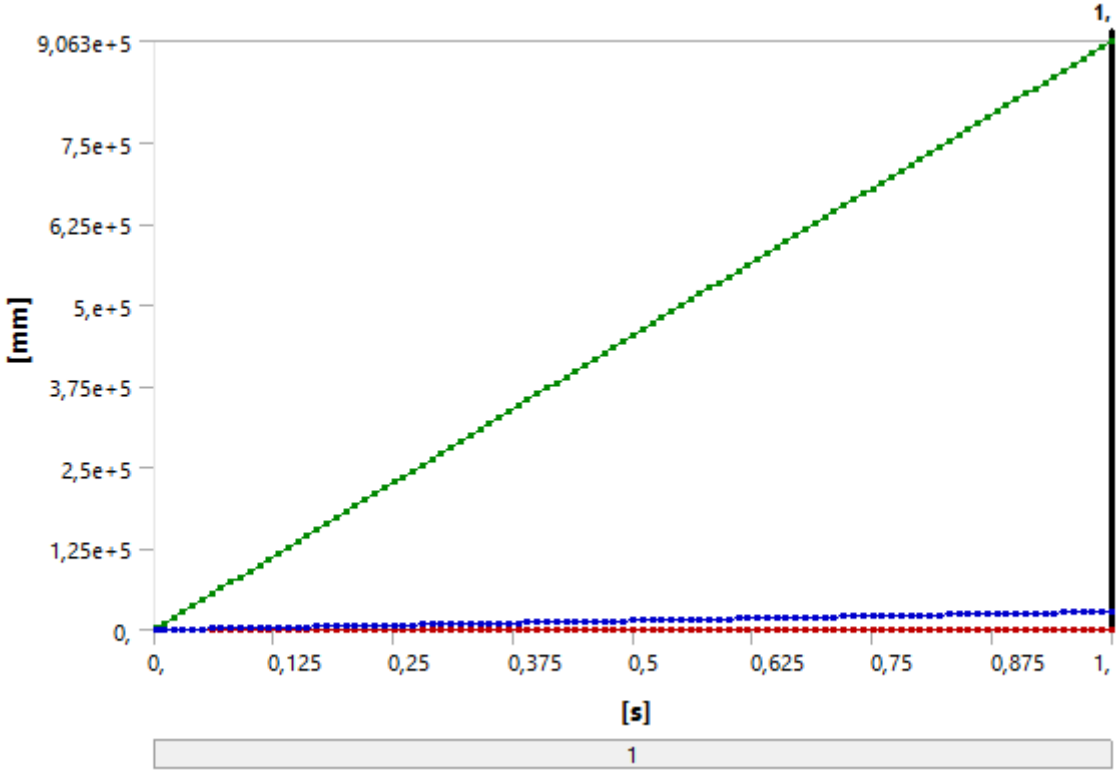


TABLE 18
Model (B4) > Static Structural (B5) > Solution (B6) > Total Deformation

Time [s]	Minimum [mm]	Maximum [mm]	Average [mm]
2,e-003	0,	1812,6	55,739
4,e-003		3625,2	111,48
1,e-002		9063,	278,69
2,e-002		18126	557,39
3,e-002		27189	836,08
4,e-002		36252	1114,8
5,e-002		45315	1393,5
6,e-002		54378	1672,2
7,e-002		63441	1950,8
8,e-002		72504	2229,5
9,e-002		81567	2508,2
1,e-001		90630	2786,9
0,11		99693	3065,6
0,12		1,0876e+005	3344,3
0,13		1,1782e+005	3623,
0,14		1,2688e+005	3901,7
0,15		1,3595e+005	4180,4
0,16		1,4501e+005	4459,1
0,17		1,5407e+005	4737,8
0,18		1,6313e+005	5016,5
0,19		1,722e+005	5295,2
0,2		1,8126e+005	5573,9
0,21		1,9032e+005	5852,5
0,22		1,9939e+005	6131,2

0,23		2,0845e+005	6409,9
0,24		2,1751e+005	6688,6
0,25		2,2658e+005	6967,3
0,26		2,3564e+005	7246,
0,27		2,447e+005	7524,7
0,28		2,5376e+005	7803,4
0,29		2,6283e+005	8082,1
0,3		2,7189e+005	8360,8
0,31		2,8095e+005	8639,5
0,32		2,9002e+005	8918,2
0,33		2,9908e+005	9196,9
0,34		3,0814e+005	9475,6
0,35		3,1721e+005	9754,2
0,36		3,2627e+005	10033
0,37		3,3533e+005	10312
0,38		3,4439e+005	10590
0,39		3,5346e+005	10869
0,4		3,6252e+005	11148
0,41		3,7158e+005	11426
0,42		3,8065e+005	11705
0,43		3,8971e+005	11984
0,44		3,9877e+005	12262
0,45		4,0784e+005	12541
0,46		4,169e+005	12820
0,47		4,2596e+005	13099
0,48		4,3502e+005	13377
0,49		4,4409e+005	13656
0,5		4,5315e+005	13935
0,51		4,6221e+005	14213
0,52		4,7128e+005	14492
0,53		4,8034e+005	14771
0,54		4,894e+005	15049
0,55		4,9847e+005	15328
0,56		5,0753e+005	15607
0,57		5,1659e+005	15885
0,58		5,2565e+005	16164
0,59		5,3472e+005	16443
0,6		5,4378e+005	16722
0,61		5,5284e+005	17000
0,62		5,6191e+005	17279
0,63		5,7097e+005	17558
0,64		5,8003e+005	17836
0,65		5,891e+005	18115
0,66		5,9816e+005	18394
0,67		6,0722e+005	18672
0,68		6,1628e+005	18951
0,69		6,2535e+005	19230
0,7		6,3441e+005	19508
0,71		6,4347e+005	19787
0,72		6,5254e+005	20066
0,73		6,616e+005	20345
0,74		6,7066e+005	20623

0,75		6,7973e+005	20902
0,76		6,8879e+005	21181
0,77		6,9785e+005	21459
0,78		7,0691e+005	21738
0,79		7,1598e+005	22017
0,8		7,2504e+005	22295
0,81		7,341e+005	22574
0,82		7,4317e+005	22853
0,83		7,5223e+005	23132
0,84		7,6129e+005	23410
0,85		7,7036e+005	23689
0,86		7,7942e+005	23968
0,87		7,8848e+005	24246
0,88		7,9754e+005	24525
0,89		8,0661e+005	24804
0,9		8,1567e+005	25082
0,91		8,2473e+005	25361
0,92		8,338e+005	25640
0,93		8,4286e+005	25918
0,94		8,5192e+005	26197
0,95		8,6099e+005	26476
0,96		8,7005e+005	26755
0,97		8,7911e+005	27033
0,98		8,8817e+005	27312
0,99		8,9724e+005	27591
1,		9,063e+005	27869

FIGURE 3
Model (B4) > Static Structural (B5) > Solution (B6) > Stress Intensity

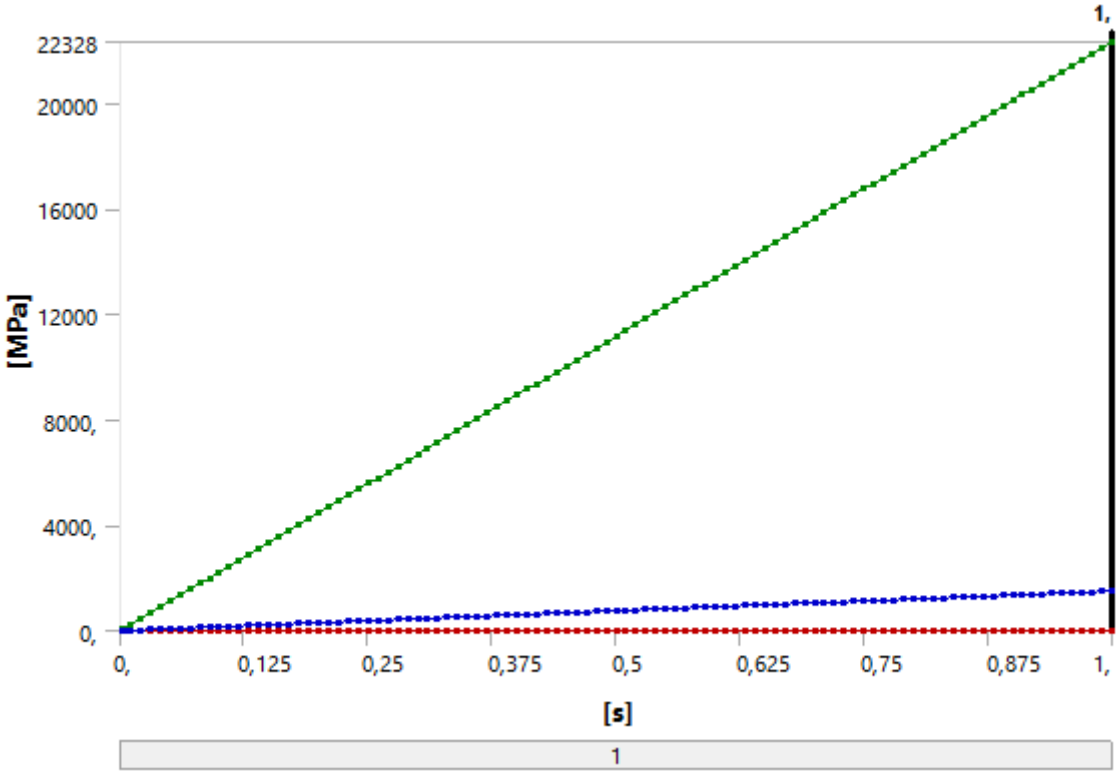


TABLE 19
Model (B4) > Static Structural (B5) > Solution (B6) > Stress Intensity

Time [s]	Minimum [MPa]	Maximum [MPa]	Average [MPa]
2,e-003	0,	44,655	3,0164
4,e-003		89,311	6,0327
1,e-002		223,28	15,082
2,e-002		446,55	30,164
3,e-002		669,83	45,245
4,e-002		893,11	60,327
5,e-002		1116,4	75,409
6,e-002		1339,7	90,491
7,e-002		1562,9	105,57
8,e-002		1786,2	120,65
9,e-002		2009,5	135,74
1,e-001		2232,8	150,82
0,11		2456,	165,9
0,12		2679,3	180,98
0,13		2902,6	196,06
0,14		3125,9	211,14
0,15		3349,2	226,23
0,16		3572,4	241,31
0,17		3795,7	256,39
0,18		4019,	271,47
0,19		4242,3	286,55
0,2		4465,5	301,64
0,21		4688,8	316,72
0,22		4912,1	331,8
0,23		5135,4	346,88
0,24		5358,6	361,96
0,25		5581,9	377,04
0,26		5805,2	392,13
0,27		6028,5	407,21
0,28		6251,8	422,29
0,29		6475,	437,37
0,3		6698,3	452,45
0,31		6921,6	467,54
0,32		7144,9	482,62
0,33		7368,1	497,7
0,34		7591,4	512,78
0,35		7814,7	527,86
0,36		8038,	542,94
0,37		8261,2	558,03
0,38		8484,5	573,11
0,39		8707,8	588,19
0,4		8931,1	603,27
0,41		9154,3	618,35
0,42		9377,6	633,43
0,43		9600,9	648,52
0,44		9824,2	663,6
0,45		10047	678,68
0,46		10271	693,76
0,47		10494	708,84
0,48		10717	723,93

0,49		10941	739,01
0,5		11164	754,09
0,51		11387	769,17
0,52		11610	784,25
0,53		11834	799,33
0,54		12057	814,42
0,55		12280	829,5
0,56		12504	844,58
0,57		12727	859,66
0,58		12950	874,74
0,59		13173	889,83
0,6		13397	904,91
0,61		13620	919,99
0,62		13843	935,07
0,63		14066	950,15
0,64		14290	965,23
0,65		14513	980,32
0,66		14736	995,4
0,67		14960	1010,5
0,68		15183	1025,6
0,69		15406	1040,6
0,7		15629	1055,7
0,71		15853	1070,8
0,72		16076	1085,9
0,73		16299	1101,
0,74		16522	1116,1
0,75		16746	1131,1
0,76		16969	1146,2
0,77		17192	1161,3
0,78		17416	1176,4
0,79		17639	1191,5
0,8		17862	1206,5
0,81		18085	1221,6
0,82		18309	1236,7
0,83		18532	1251,8
0,84		18755	1266,9
0,85		18979	1282,
0,86		19202	1297,
0,87		19425	1312,1
0,88		19648	1327,2
0,89		19872	1342,3
0,9		20095	1357,4
0,91		20318	1372,4
0,92		20541	1387,5
0,93		20765	1402,6
0,94		20988	1417,7
0,95		21211	1432,8
0,96		21435	1447,9
0,97		21658	1462,9
0,98		21881	1478,
0,99		22104	1493,1
1,		22328	1508,2

TABLE 20
Model (B4) > Static Structural (B5) > Solution (B6) > Stress Safety Tools

Object Name	*Stress Tool*
State	Solved
Definition	
Theory	Max Equivalent Stress
Stress Limit Type	Tensile Yield Per Material

TABLE 21
Model (B4) > Static Structural (B5) > Solution (B6) > Stress Tool > Results

Object Name	*Safety Factor*
State	Solved
Scope	
Scoping Method	Geometry Selection
Geometry	All Bodies
Definition	
Type	Safety Factor
By	Time
Display Time	Last
Calculate Time History	Yes
Identifier	
Suppressed	No
Integration Point Results	
Display Option	Averaged
Average Across Bodies	No
Results	
Minimum	2,0967e-003
Minimum Occurs On	TUBS-PROVA5-PROVA5\Surface1
Minimum Value Over Time	
Minimum	2,0967e-003
Maximum	1,0484
Maximum Value Over Time	
Minimum	15,
Maximum	15,
Information	
Time	1, s
Load Step	1
Substep	102
Iteration Number	102

FIGURE 4
Model (B4) > Static Structural (B5) > Solution (B6) > Stress Tool > Safety Factor

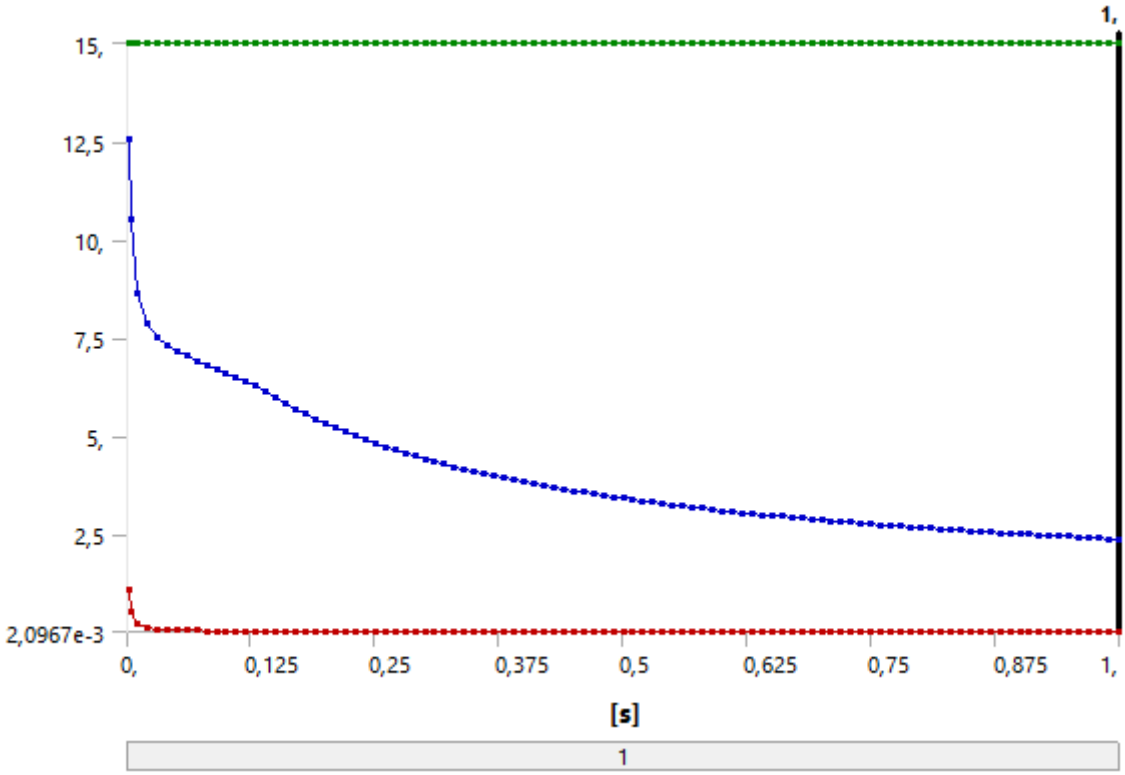


TABLE 22
Model (B4) > Static Structural (B5) > Solution (B6) > Stress Tool > Safety Factor

Time [s]	Minimum	Maximum	Average
2,e-003	1,0484	15,	12,562
4,e-003	0,52418		10,488
1,e-002	0,20967		8,6404
2,e-002	0,10484		7,8559
3,e-002	6,9891e-002		7,5227
4,e-002	5,2418e-002		7,3149
5,e-002	4,1934e-002		7,1587
6,e-002	3,4945e-002		7,0263
7,e-002	2,9953e-002		6,9068
8,e-002	2,6209e-002		6,7952
9,e-002	2,3297e-002		6,6893
1,e-001	2,0967e-002		6,5852
0,11	1,9061e-002		6,4806
0,12	1,7473e-002		6,3721
0,13	1,6129e-002		6,2545
0,14	1,4977e-002		6,1232
0,15	1,3978e-002		5,9754
0,16	1,3104e-002		5,827
0,17	1,2334e-002		5,6855
0,18	1,1648e-002		5,5519
0,19	1,1035e-002		5,4253
0,2	1,0484e-002		5,3049
0,21	9,9844e-003		5,1909
0,22	9,5305e-003		5,0836
0,23	9,1162e-003		4,9816
0,24	8,7363e-003		4,8846

0,25	8,3869e-003		4,7926
0,26	8,0643e-003		4,7052
0,27	7,7656e-003		4,6221
0,28	7,4883e-003		4,5433
0,29	7,2301e-003		4,4683
0,3	6,9891e-003		4,3968
0,31	6,7636e-003		4,3287
0,32	6,5522e-003		4,2633
0,33	6,3537e-003		4,2007
0,34	6,1668e-003		4,1408
0,35	5,9906e-003		4,0832
0,36	5,8242e-003		4,0276
0,37	5,6668e-003		3,9739
0,38	5,5177e-003		3,9219
0,39	5,3762e-003		3,8714
0,4	5,2418e-003		3,8226
0,41	5,1139e-003		3,7752
0,42	4,9922e-003		3,7292
0,43	4,8761e-003		3,6843
0,44	4,7653e-003		3,6404
0,45	4,6594e-003		3,5975
0,46	4,5581e-003		3,5558
0,47	4,4611e-003		3,5153
0,48	4,3682e-003		3,476
0,49	4,279e-003		3,4379
0,5	4,1934e-003		3,401
0,51	4,1112e-003		3,3651
0,52	4,0321e-003		3,3305
0,53	3,9561e-003		3,2968
0,54	3,8828e-003		3,2642
0,55	3,8122e-003		3,2325
0,56	3,7441e-003		3,2018
0,57	3,6784e-003		3,172
0,58	3,615e-003		3,143
0,59	3,5538e-003		3,1148
0,6	3,4945e-003		3,0873
0,61	3,4372e-003		3,0606
0,62	3,3818e-003		3,0345
0,63	3,3281e-003		3,0092
0,64	3,2761e-003		2,9845
0,65	3,2257e-003		2,9603
0,66	3,1768e-003		2,9367
0,67	3,1294e-003		2,9136
0,68	3,0834e-003		2,891
0,69	3,0387e-003		2,8689
0,7	2,9953e-003		2,8474
0,71	2,9531e-003		2,8263
0,72	2,9121e-003		2,8057
0,73	2,8722e-003		2,7855
0,74	2,8334e-003		2,7657
0,75	2,7956e-003		2,7464
0,76	2,7588e-003		2,7273

0,77	2,723e-003		2,7087
0,78	2,6881e-003		2,6904
0,79	2,6541e-003		2,6724
0,8	2,6209e-003		2,6548
0,81	2,5885e-003		2,6376
0,82	2,557e-003		2,6207
0,83	2,5262e-003		2,6041
0,84	2,4961e-003		2,5877
0,85	2,4667e-003		2,5717
0,86	2,438e-003		2,556
0,87	2,41e-003		2,5405
0,88	2,3826e-003		2,5253
0,89	2,3559e-003		2,5104
0,9	2,3297e-003		2,4957
0,91	2,3041e-003		2,4813
0,92	2,279e-003		2,4671
0,93	2,2545e-003		2,4532
0,94	2,2305e-003		2,4396
0,95	2,2071e-003		2,4261
0,96	2,1841e-003		2,4129
0,97	2,1616e-003		2,3998
0,98	2,1395e-003		2,3869
0,99	2,1179e-003		2,3742
1,	2,0967e-003		2,3617

Material Data

Plastic, PA6

TABLE 23
Plastic, PA6 > Constants

Density	1,14e-006 kg mm^-3
Tensile Yield Strength	43,13 MPa
Tensile Ultimate Strength	71,89 MPa
Coefficient of Thermal Expansion	1,467e-004 C^-1
Thermal Conductivity	2,428e-004 W mm^-1 C^-1
Specific Heat	1,5e+006 mJ kg^-1 C^-1

TABLE 24
Plastic, PA6 > Opacity

Red	Green	Blue
0,	153,	255,
Opacity		
0,6		
Metallic Finish		
0,		

TABLE 25
Plastic, PA6 > Isotropic Elasticity

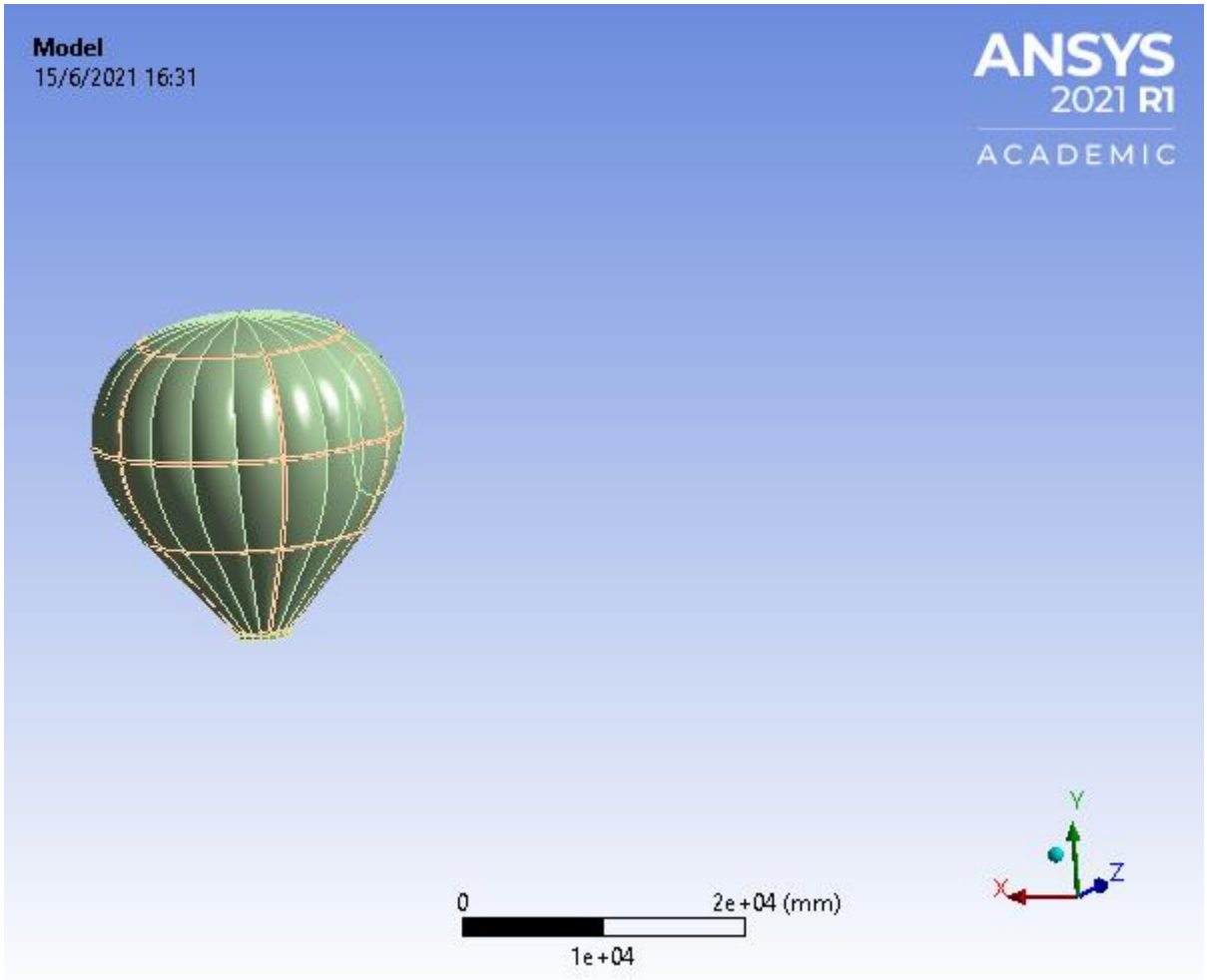
Young's Modulus MPa	Poisson's Ratio	Bulk Modulus MPa	Shear Modulus MPa	Temperature C
1111,	0,3499	1233,6	411,51	23,

TABLE 26
Plastic, PA6 > Isotropic Secant Coefficient of Thermal Expansion

Zero-Thermal-Strain Reference Temperature C
23,

Project*

First Saved	Monday, May 10, 2021
Last Saved	Tuesday, June 15, 2021
Product Version	2021 R1
Save Project Before Solution	No
Save Project After Solution	No



Contents

Units

TABLE 1

Unit System	Metric (mm, kg, N, s, mV, mA) Degrees rad/s Celsius
Angle	Degrees
Rotational Velocity	rad/s
Temperature	Celsius

Model (C4)

Geometry

TABLE 2
Model (C4) > Geometry

Object Name	*Geometry*
State	Fully Defined
Definition	
Source	C:\Users\fvila\Desktop\5-PROVA-tubs+contacte\5-PROVA-tubs-contacte_files\dp0\SYS-2\DM\SYS-2.scdoc
Type	SpaceClaim
Length Unit	Meters
Element Control	Program Controlled
Display Style	Body Color
Bounding Box	
Length X	22184 mm
Length Y	23200 mm
Length Z	22184 mm

Properties	
Volume	6,7491e+008 mm³
Mass	769,4 kg
Surface Area(approx.)	1,6873e+009 mm²
Scale Factor Value	1,
2D Tolerance	Default (1,e-005)
Statistics	
Bodies	2
Active Bodies	2
Nodes	13755
Elements	14290
Mesh Metric	None
Update Options	
Assign Default Material	No
Basic Geometry Options	
Solid Bodies	Yes
Surface Bodies	Yes
Line Bodies	Yes
Parameters	Independent
Parameter Key	
Attributes	Yes
Attribute Key	
Named Selections	Yes
Named Selection Key	
Material Properties	Yes
Advanced Geometry Options	
Use Associativity	Yes
Coordinate Systems	Yes
Coordinate System Key	
Reader Mode Saves Updated File	No
Use Instances	Yes
Smart CAD Update	Yes
Compare Parts On Update	No
Analysis Type	3-D
Mixed Import Resolution	None
Import Facet Quality	Source
Clean Bodies On Import	No
Stitch Surfaces On Import	None
Decompose Disjoint Geometry	Yes
Enclosure and Symmetry Processing	Yes

TABLE 3
Model (C4) > Geometry > Parts

Object Name	*TUBS-PROVA5-PROVA5\Surface1*	*TUBS-CONTACT-PROVA5\Surface1*
State	Meshed	
Graphics Properties		
Visible	Yes	
Transparency	1	

Definition		
Suppressed	No	
Dimension	3D	
Stiffness Behavior	Flexible	
Coordinate System	Default Coordinate System	
Reference Temperature	By Environment	
Thickness	0,4 mm	
Thickness Mode	Manual	
Offset Type	Middle	
Treatment	None	
Model Type	Shell	
Material		
Assignment	Plastic, PA6	
Nonlinear Effects	Yes	
Thermal Strain Effects	Yes	
Bounding Box		
Length X	22001 mm	22184 mm
Length Y	23200 mm	21250 mm
Length Z	22001 mm	22184 mm
Properties		
Volume	5,9681e+008 mm³	7,8103e+007 mm³
Mass	680,36 kg	89,037 kg
Centroid X	9110,5 mm	9111,1 mm
Centroid Y	17515 mm	16351 mm
Centroid Z	21649 mm	
Moment of Inertia Ip1	5,2134e+010 kg·mm²	7,0692e+009 kg·mm²
Moment of Inertia Ip2	5,2066e+010 kg·mm²	6,637e+009 kg·mm²
Moment of Inertia Ip3	5,2128e+010 kg·mm²	6,7394e+009 kg·mm²
Surface Area(approx.)	1,492e+009 mm²	1,9526e+008 mm²
Statistics		
Nodes	9482	4273
Elements	9562	4728
Mesh Metric	None	
CAD Attributes		
PartTolerance:	0,00000001	
Color:154.175.143		
Color:175.143.143		

TABLE 4
Model (C4) > Materials

Object Name	*Materials*
State	Fully Defined
Statistics	
Materials	2
Material Assignments	0

Coordinate Systems

TABLE 5
Model (C4) > Coordinate Systems > Coordinate System

Object Name	*Global Coordinate System*

State	Fully Defined
Definition	
Type	Cartesian
Coordinate System ID	0,
Origin	
Origin X	0, mm
Origin Y	0, mm
Origin Z	0, mm
Directional Vectors	
X Axis Data	[1, 0, 0,]
Y Axis Data	[0, 1, 0,]
Z Axis Data	[0, 0, 1,]

Connections

TABLE 6
Model (C4) > Connections

Object Name	*Connections*
State	Fully Defined
Auto Detection	
Generate Automatic Connection On Refresh	Yes
Transparency	
Enabled	Yes

TABLE 7
Model (C4) > Connections > Contacts

Object Name	*Contacts*
State	Fully Defined
Definition	
Connection Type	Contact
Scope	
Scoping Method	Geometry Selection
Geometry	All Bodies
Auto Detection	
Tolerance Type	Slider
Tolerance Slider	0,
Tolerance Value	97,548 mm
Use Range	No
Face/Face	Yes
Face-Face Angle Tolerance	75, °
Face Overlap Tolerance	Off
Cylindrical Faces	Include
Face/Edge	No
Edge/Edge	No
Priority	Include All
Group By	Bodies
Search Across	Bodies
Statistics	
Connections	2
Active Connections	1

TABLE 8
Model (C4) > Connections > Contacts > Contact Regions

Object Name	*Bounded-Faces*	*No Separation-Faces*
State	Fully Defined	Suppressed
Scope		
Scoping Method	Geometry Selection	
Contact	46 Faces	
Target	64 Faces	
Contact Bodies	TUBS-PROVA5-PROVA5\Surface1	
Target Bodies	TUBS-CONTACT-PROVA5\Surface1	
Contact Shell Face	Program Controlled	
Target Shell Face	Program Controlled	
Shell Thickness Effect	No	
Protected	No	
Definition		
Type	Bonded	No Separation
Scope Mode	Manual	
Behavior	Program Controlled	
Trim Contact	Program Controlled	
Suppressed	No	Yes
Advanced		
Formulation	Program Controlled	
Small Sliding	Program Controlled	
Detection Method	Program Controlled	
Penetration Tolerance	Program Controlled	
Elastic Slip Tolerance	Program Controlled	
Normal Stiffness	Program Controlled	
Update Stiffness	Program Controlled	
Pinball Region	Program Controlled	
Geometric Modification		
Contact Geometry Correction	None	
Target Geometry Correction	None	

Mesh

TABLE 9
Model (C4) > Mesh

Object Name	*Mesh*
State	Solved
Display	
Display Style	Use Geometry Setting
Defaults	
Physics Preference	Mechanical
Element Order	Program Controlled
Element Size	Default (354,79 mm)
Sizing	
Use Adaptive Sizing	No
Growth Rate	Default (1,2)
Mesh Defeaturing	Yes
Defeature Size	Default (1,7739 mm)
Capture Curvature	Yes
Curvature Min Size	Default (3,5479 mm)
Curvature Normal Angle	Default (30,°)
Capture Proximity	No

Bounding Box Diagonal	39019 mm
Average Surface Area	8,0559e+006 mm²
Minimum Edge Length	6,6365e-003 mm
Quality	
Check Mesh Quality	Yes, Errors
Error Limits	Aggressive Mechanical
Target Quality	Default (0.050000)
Smoothing	Medium
Mesh Metric	None
Inflation	
Use Automatic Inflation	None
Inflation Option	Smooth Transition
Transition Ratio	0,272
Maximum Layers	2
Growth Rate	1,2
Inflation Algorithm	Pre
View Advanced Options	No
Batch Connections	
Mesh Based Connection	No
Advanced	
Number of CPUs for Parallel Part Meshing	Program Controlled
Straight Sided Elements	No
Rigid Body Behavior	Dimensionally Reduced
Triangle Surface Mesher	Program Controlled
Topology Checking	Yes
Use Sheet Thickness for Pinch	No
Pinch Tolerance	Default (3,1931 mm)
Generate Pinch on Refresh	No
Sheet Loop Removal	No
Statistics	
Nodes	13755
Elements	14290

TABLE 10
Model (C4) > Mesh > Mesh Controls

Object Name	*Body Sizing*	*Body Sizing 2*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	1 Body	
Definition		
Suppressed	No	
Type	Element Size	
Element Size	400, mm	300, mm
Advanced		
Defeature Size	Default (1,7739 mm)	
Behavior	Soft	
Growth Rate	Default (1,2)	
Capture Curvature	No	
Capture Proximity	No	

Static Structural (C5)

TABLE 11
Model (C4) > Analysis

Object Name	*Static Structural (C5)*
State	Solved
Definition	
Physics Type	Structural
Analysis Type	Static Structural
Solver Target	Mechanical APDL
Options	
Environment Temperature	22, °C
Generate Input Only	No

TABLE 12
Model (C4) > Static Structural (C5) > Analysis Settings

Object Name	*Analysis Settings*
State	Fully Defined
Step Controls	
Number Of Steps	1,
Current Step Number	1,
Step End Time	1, s
Auto Time Stepping	On
Define By	Substeps
Initial Substeps	250,
Minimum Substeps	50,
Maximum Substeps	5000,
Solver Controls	
Solver Type	Program Controlled
Weak Springs	Off
Solver Pivot Checking	Program Controlled
Large Deflection	Off
Inertia Relief	Off
Quasi-Static Solution	Off
Rotordynamics Controls	
Coriolis Effect	Off
Restart Controls	
Generate Restart Points	Program Controlled
Retain Files After Full Solve	No
Combine Restart Files	Program Controlled
Nonlinear Controls	
Newton-Raphson Option	Program Controlled
Force Convergence	Program Controlled
Moment Convergence	Program Controlled
Displacement Convergence	Program Controlled
Rotation Convergence	Program Controlled
Line Search	Program Controlled
Stabilization	Program Controlled
Advanced	
Inverse Option	No
Contact Split (DMP)	Off

Output Controls	
Stress	Yes
Surface Stress	No
Back Stress	No
Strain	Yes
Contact Data	Yes
Nonlinear Data	No
Nodal Forces	No
Volume and Energy	Yes
Euler Angles	Yes
General Miscellaneous	No
Contact Miscellaneous	No
Store Results At	All Time Points
Result File Compression	Program Controlled
Analysis Data Management	
Solver Files Directory	C:\Users\fvila\Desktop\5-PROVA-tubs+contacte\5-PROVA-tubs-contacte_files\dp0\SYS-2\MECH\
Future Analysis	None
Scratch Solver Files Directory	
Save MAPDL db	No
Contact Summary	Program Controlled
Delete Unneeded Files	Yes
Nonlinear Solution	No
Solver Units	Active System
Solver Unit System	nmm

TABLE 13
Model (C4) > Static Structural (C5) > Loads

Object Name	*Displacement*	*Fixed Rotation*	*P.int_vela - 0,000734MPA*	*P.vent 21m/s*	*P.tubs -2bar*
State	Fully Defined				
Scope					
Scoping Method	Geometry Selection				
Geometry	48 Faces	38 Faces	47 Faces	4 Faces	86 Faces
Definition					
Type	Displacement	Fixed Rotation	Pressure		
Define By	Components		Normal To		
Coordinate System	Global Coordinate System				
X Component	0, mm (ramped)				
Y Component	0, mm (ramped)				
Z Component	0, mm (ramped)				
Suppressed	No				
Rotation X		Fixed			
Rotation Y		Fixed			
Rotation Z		Fixed			
Applied By			Surface Effect		

Loaded Area		Deformed		
Magnitude		-7,34e-004 MPa (ramped)	2,756e-004 MPa (ramped)	-0,2 MPa (ramped)

Solution (C6)

TABLE 14
Model (C4) > Static Structural (C5) > Solution

Object Name	*Solution (C6)*
State	Solved
Adaptive Mesh Refinement	
Max Refinement Loops	1,
Refinement Depth	2,
Information	
Status	Done
MAPDL Elapsed Time	3 m 25 s
MAPDL Memory Used	805, MB
MAPDL Result File Size	751,81 MB
Post Processing	
Beam Section Results	No
On Demand Stress/Strain	No

TABLE 15
Model (C4) > Static Structural (C5) > Solution (C6) > Solution Information

Object Name	*Solution Information*
State	Solved
Solution Information	
Solution Output	Solver Output
Newton-Raphson Residuals	0
Identify Element Violations	0
Update Interval	2,5 s
Display Points	All
FE Connection Visibility	
Activate Visibility	Yes
Display	All FE Connectors
Draw Connections Attached To	All Nodes
Line Color	Connection Type
Visible on Results	No
Line Thickness	Single
Display Type	Lines

TABLE 16
Model (C4) > Static Structural (C5) > Solution (C6) > Results

Object Name	*Total Deformation*	*Equivalent Elastic Strain*	*Stress Intensity*
State	Solved		
Scope			
Scoping Method	Geometry Selection		
Geometry	All Bodies		
Position		Top/Bottom	
Definition			
Type	Total Deformation	Equivalent Elastic Strain	Stress Intensity

By	Time		
Display Time	Last		
Calculate Time History	Yes		
Identifier			
Suppressed	No		
Results			
Minimum	0, mm	0, mm/mm	0, MPa
Maximum	38841 mm	3,7916 mm/mm	4318,2 MPa
Average	4761,9 mm	0,22602 mm/mm	243,37 MPa
Minimum Occurs On	TUBS-PROVA5-PROVA5\Surface1		
Maximum Occurs On	TUBS-PROVA5-PROVA5\Surface1	TUBS-CONTACT-PROVA5\Surface1	
Minimum Value Over Time			
Minimum	0, mm	0, mm/mm	0, MPa
Maximum	0, mm	0, mm/mm	0, MPa
Maximum Value Over Time			
Minimum	155,36 mm	1,5166e-002 mm/mm	17,273 MPa
Maximum	38841 mm	3,7916 mm/mm	4318,2 MPa
Information			
Time	1, s		
Load Step	1		
Substep	52		
Iteration Number	52		
Integration Point Results			
Display Option		Averaged	
Average Across Bodies		No	

FIGURE 1
Model (C4) > Static Structural (C5) > Solution (C6) > Total Deformation

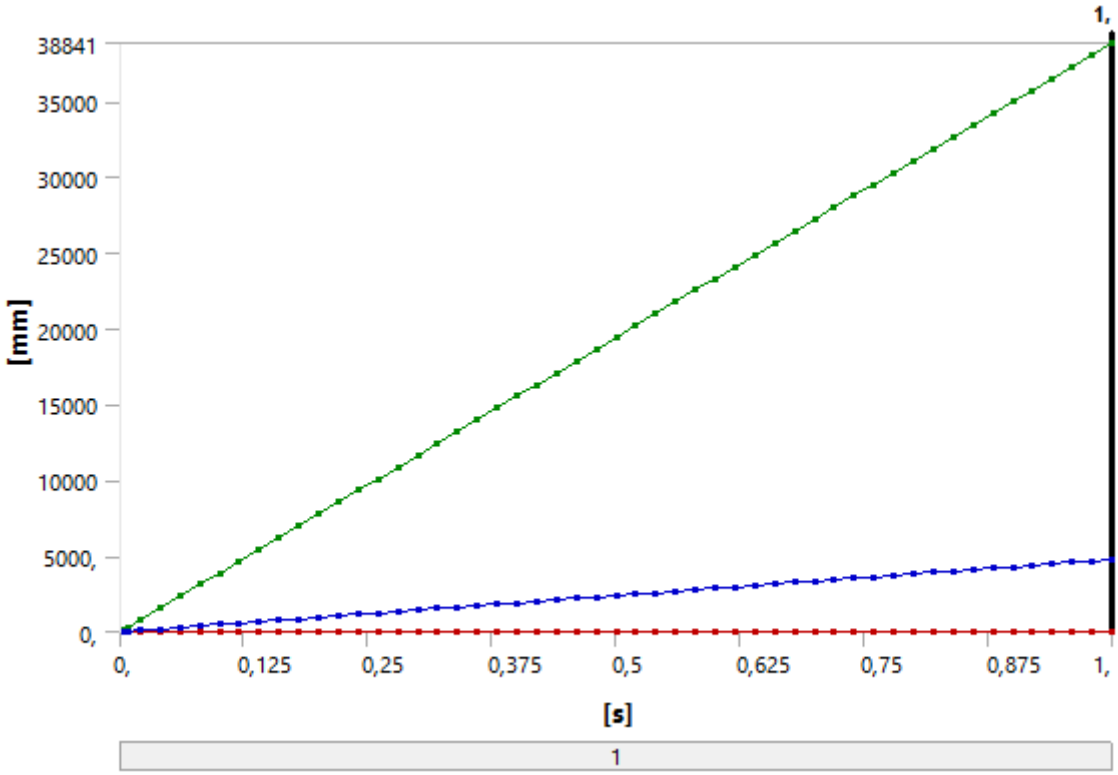


TABLE 17
Model (C4) > Static Structural (C5) > Solution (C6) > Total Deformation

Time [s]	Minimum [mm]	Maximum [mm]	Average [mm]
4,e-003	0,	155,36	19,047
8,e-003		310,73	38,095
2,e-002		776,81	95,237
4,e-002		1553,6	190,47
6,e-002		2330,4	285,71
8,e-002		3107,3	380,95
0,1		3884,1	476,19
0,12		4660,9	571,42
0,14		5437,7	666,66
0,16		6214,5	761,9
0,18		6991,3	857,14
0,2		7768,1	952,37
0,22		8545,	1047,6
0,24		9321,8	1142,8
0,26		10099	1238,1
0,28		10875	1333,3
0,3		11652	1428,6
0,32		12429	1523,8
0,34		13206	1619,
0,36		13983	1714,3
0,38		14759	1809,5
0,4		15536	1904,7
0,42		16313	2000,
0,44		17090	2095,2
0,46		17867	2190,5
0,48		18644	2285,7

0,5		19420	2380,9
0,52		20197	2476,2
0,54		20974	2571,4
0,56		21751	2666,6
0,58		22528	2761,9
0,6		23304	2857,1
0,62		24081	2952,4
0,64		24858	3047,6
0,66		25635	3142,8
0,68		26412	3238,1
0,7		27189	3333,3
0,72		27965	3428,5
0,74		28742	3523,8
0,76		29519	3619,
0,78		30296	3714,3
0,8		31073	3809,5
0,82		31849	3904,7
0,84		32626	4000,
0,86		33403	4095,2
0,88		34180	4190,4
0,9		34957	4285,7
0,92		35733	4380,9
0,94		36510	4476,2
0,96		37287	4571,4
0,98		38064	4666,6
1,		38841	4761,9

FIGURE 2
Model (C4) > Static Structural (C5) > Solution (C6) > Equivalent Elastic Strain

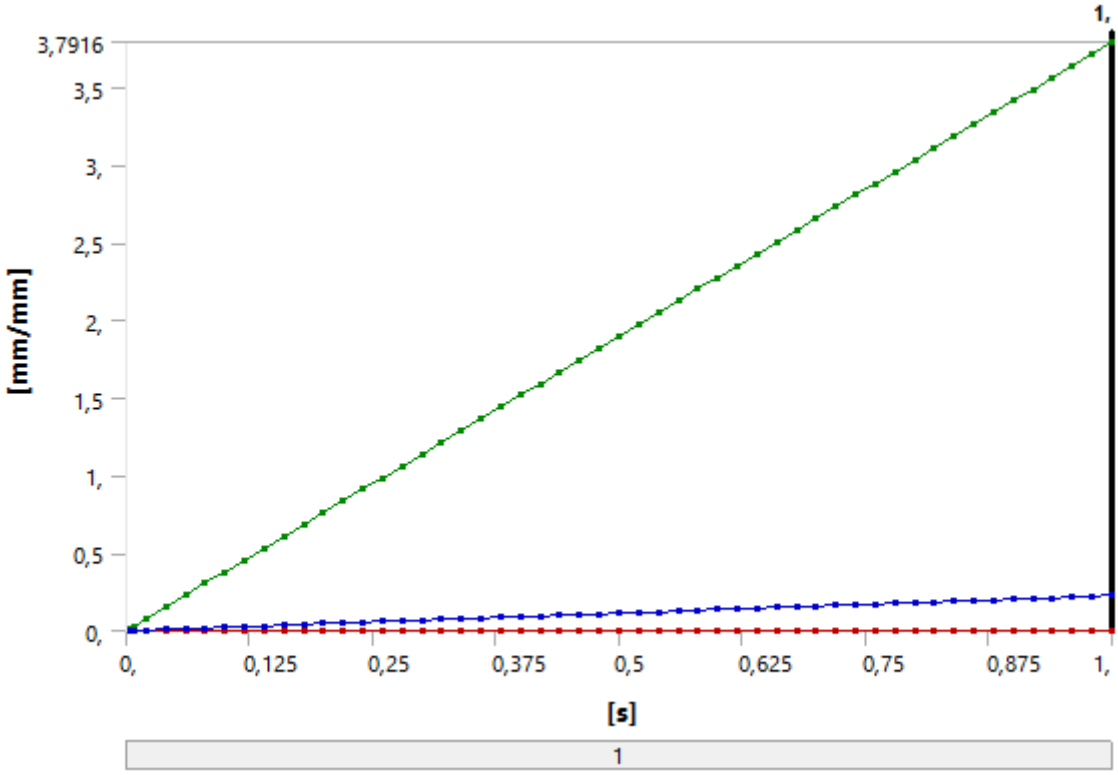


TABLE 18
Model (C4) > Static Structural (C5) > Solution (C6) > Equivalent Elastic Strain

Time [s]	Minimum [mm/mm]	Maximum [mm/mm]	Average [mm/mm]
4,e-003		1,5166e-002	9,0408e-004
8,e-003		3,0333e-002	1,8082e-003
2,e-002		7,5832e-002	4,5204e-003
4,e-002		0,15166	9,0408e-003
6,e-002		0,22749	1,3561e-002
8,e-002		0,30333	1,8082e-002
0,1		0,37916	2,2602e-002
0,12		0,45499	2,7123e-002
0,14		0,53082	3,1643e-002
0,16		0,60665	3,6163e-002
0,18		0,68248	4,0684e-002
0,2		0,75832	4,5204e-002
0,22		0,83415	4,9725e-002
0,24		0,90998	5,4245e-002
0,26		0,98581	5,8765e-002
0,28		1,0616	6,3286e-002
0,3		1,1375	6,7806e-002
0,32		1,2133	7,2327e-002
0,34		1,2891	7,6847e-002
0,36		1,365	8,1368e-002
0,38		1,4408	8,5888e-002
0,4		1,5166	9,0408e-002
0,42		1,5925	9,4929e-002
0,44		1,6683	9,9449e-002
0,46	0,	1,7441	0,10397
0,48		1,82	0,10849
0,5		1,8958	0,11301
0,52		1,9716	0,11753
0,54		2,0475	0,12205
0,56		2,1233	0,12657
0,58		2,1991	0,13109
0,6		2,2749	0,13561
0,62		2,3508	0,14013
0,64		2,4266	0,14465
0,66		2,5024	0,14917
0,68		2,5783	0,15369
0,7		2,6541	0,15821
0,72		2,7299	0,16274
0,74		2,8058	0,16726
0,76		2,8816	0,17178
0,78		2,9574	0,1763
0,8		3,0333	0,18082
0,82		3,1091	0,18534
0,84		3,1849	0,18986
0,86		3,2608	0,19438
0,88		3,3366	0,1989
0,9		3,4124	0,20342
0,92		3,4883	0,20794
0,94		3,5641	0,21246
0,96		3,6399	0,21698

0,98		3,7157	0,2215
1,		3,7916	0,22602

FIGURE 3
Model (C4) > Static Structural (C5) > Solution (C6) > Stress Intensity

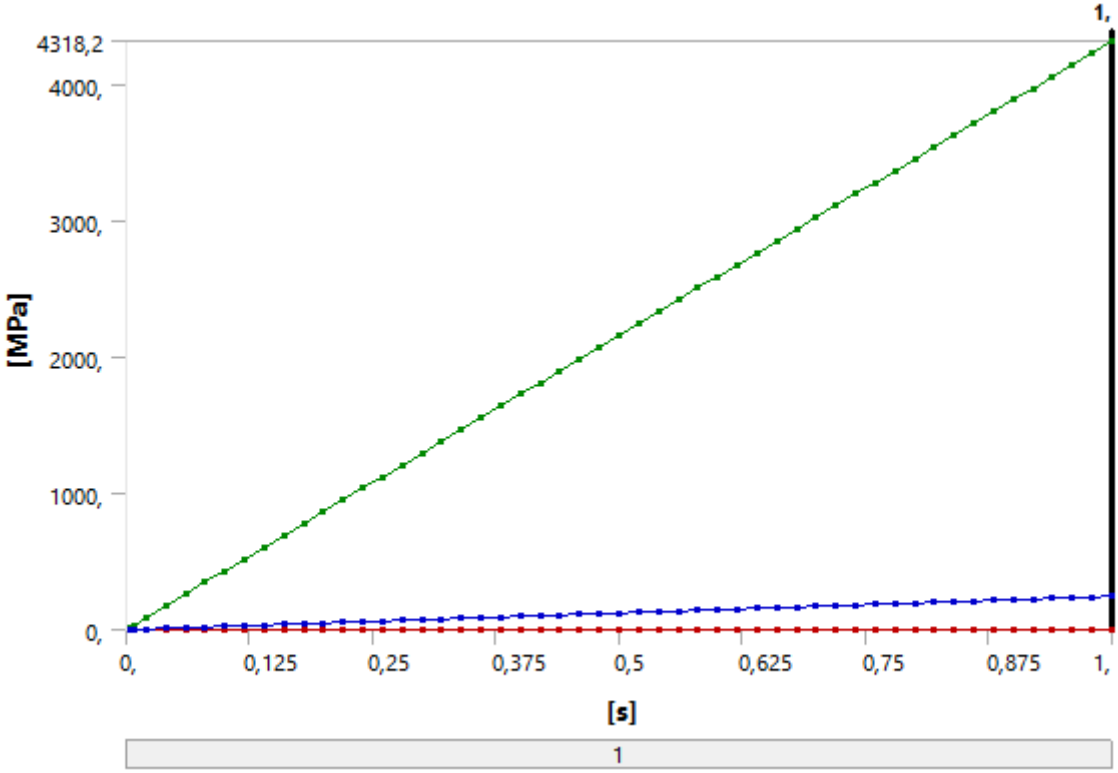


TABLE 19
Model (C4) > Static Structural (C5) > Solution (C6) > Stress Intensity

Time [s]	Minimum [MPa]	Maximum [MPa]	Average [MPa]
4,e-003		17,273	0,97349
8,e-003		34,546	1,947
2,e-002		86,365	4,8674
4,e-002		172,73	9,7349
6,e-002		259,09	14,602
8,e-002		345,46	19,47
0,1		431,82	24,337
0,12		518,19	29,205
0,14		604,55	34,072
0,16		690,92	38,94
0,18	0,	777,28	43,807
0,2		863,65	48,674
0,22		950,01	53,542
0,24		1036,4	58,409
0,26		1122,7	63,277
0,28		1209,1	68,144
0,3		1295,5	73,012
0,32		1381,8	77,879
0,34		1468,2	82,747
0,36		1554,6	87,614
0,38		1640,9	92,481

0,4		1727,3	97,349
0,42		1813,7	102,22
0,44		1900,	107,08
0,46		1986,4	111,95
0,48		2072,8	116,82
0,5		2159,1	121,69
0,52		2245,5	126,55
0,54		2331,8	131,42
0,56		2418,2	136,29
0,58		2504,6	141,16
0,6		2590,9	146,02
0,62		2677,3	150,89
0,64		2763,7	155,76
0,66		2850,	160,63
0,68		2936,4	165,49
0,7		3022,8	170,36
0,72		3109,1	175,23
0,74		3195,5	180,1
0,76		3281,9	184,96
0,78		3368,2	189,83
0,8		3454,6	194,7
0,82		3540,9	199,57
0,84		3627,3	204,43
0,86		3713,7	209,3
0,88		3800,	214,17
0,9		3886,4	219,04
0,92		3972,8	223,9
0,94		4059,1	228,77
0,96		4145,5	233,64
0,98		4231,9	238,5
1,		4318,2	243,37

TABLE 20
Model (C4) > Static Structural (C5) > Solution (C6) > Stress Safety Tools

Object Name	*Stress Tool*
State	Solved
Definition	
Theory	Max Equivalent Stress
Stress Limit Type	Tensile Yield Per Material

TABLE 21
Model (C4) > Static Structural (C5) > Solution (C6) > Stress Tool > Results

Object Name	*Safety Factor*
State	Solved
Scope	
Scoping Method	Geometry Selection
Geometry	All Bodies
Definition	
Type	Safety Factor
By	Time
Display Time	Last
Calculate Time History	Yes
Identifier	

Suppressed	No
Integration Point Results	
Display Option	Averaged
Average Across Bodies	No
Results	
Minimum	1,1405e-002
Minimum Occurs On	TUBS-CONTACT-PROVA5\Surface1
Minimum Value Over Time	
Minimum	1,1405e-002
Maximum	2,8513
Maximum Value Over Time	
Minimum	15,
Maximum	15,
Information	
Time	1, s
Load Step	1
Substep	52
Iteration Number	52

FIGURE 4
Model (C4) > Static Structural (C5) > Solution (C6) > Stress Tool > Safety Factor

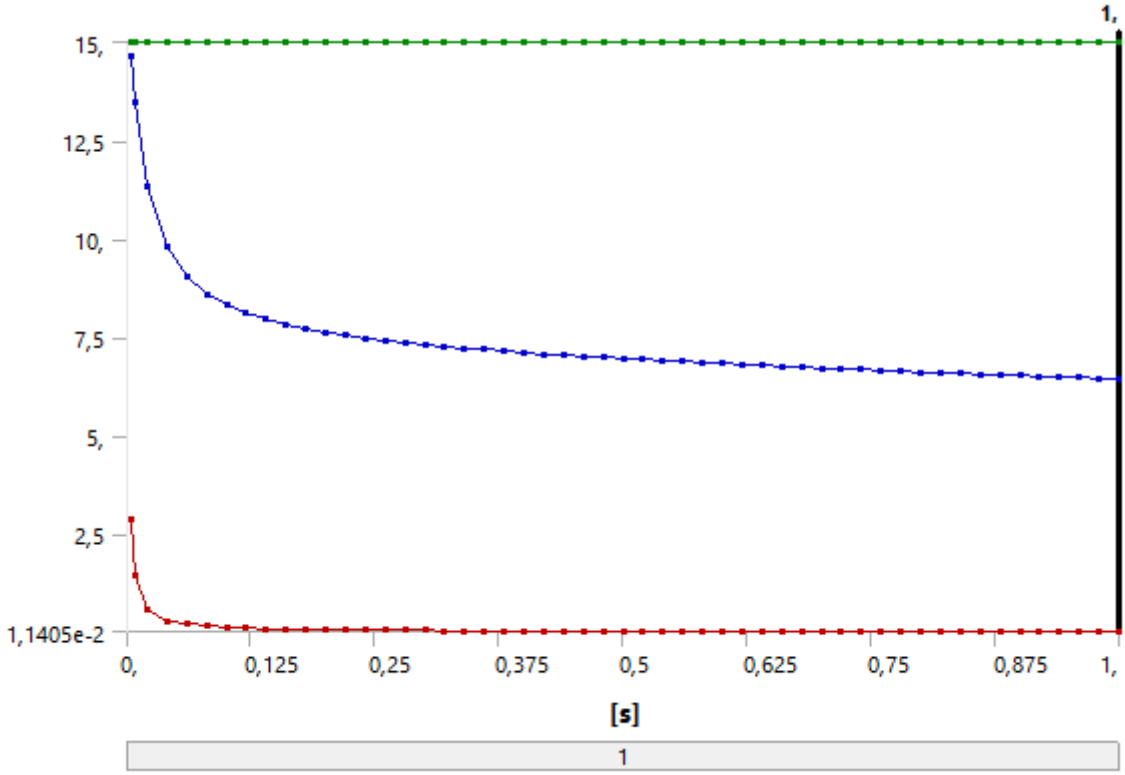


TABLE 22
Model (C4) > Static Structural (C5) > Solution (C6) > Stress Tool > Safety Factor

Time [s]	Minimum	Maximum	Average
4,e-003	2,8513	15,	14,623
8,e-003	1,4256		13,494
2,e-002	0,57026		11,354
4,e-002	0,28513		9,7818
6,e-002	0,19009		9,0324

8,e-002	0,14256		8,5988
0,1	0,11405		8,3163
0,12	9,5043e-002		8,107
0,14	8,1465e-002		7,9425
0,16	7,1282e-002		7,8106
0,18	6,3362e-002		7,7023
0,2	5,7026e-002		7,6121
0,22	5,1842e-002		7,5344
0,24	4,7522e-002		7,4666
0,26	4,3866e-002		7,4072
0,28	4,0733e-002		7,3536
0,3	3,8017e-002		7,3044
0,32	3,5641e-002		7,2589
0,34	3,3545e-002		7,2169
0,36	3,1681e-002		7,1774
0,38	3,0014e-002		7,1402
0,4	2,8513e-002		7,105
0,42	2,7155e-002		7,0711
0,44	2,5921e-002		7,0387
0,46	2,4794e-002		7,0076
0,48	2,3761e-002		6,9777
0,5	2,281e-002		6,9489
0,52	2,1933e-002		6,9213
0,54	2,1121e-002		6,8946
0,56	2,0366e-002		6,8687
0,58	1,9664e-002		6,8436
0,6	1,9009e-002		6,8193
0,62	1,8395e-002		6,7955
0,64	1,7821e-002		6,7724
0,66	1,7281e-002		6,7499
0,68	1,6772e-002		6,728
0,7	1,6293e-002		6,7067
0,72	1,5841e-002		6,686
0,74	1,5412e-002		6,6656
0,76	1,5007e-002		6,6455
0,78	1,4622e-002		6,6259
0,8	1,4256e-002		6,6065
0,82	1,3909e-002		6,5875
0,84	1,3578e-002		6,569
0,86	1,3262e-002		6,5508
0,88	1,296e-002		6,533
0,9	1,2672e-002		6,5154
0,92	1,2397e-002		6,498
0,94	1,2133e-002		6,4808
0,96	1,188e-002		6,4639
0,98	1,1638e-002		6,4472
1,	1,1405e-002		6,4309

Material Data

Plastic, PA6

TABLE 23
Plastic, PA6 > Constants

Density	1,14e-006 kg mm^-3
Tensile Yield Strength	43,13 MPa
Tensile Ultimate Strength	71,89 MPa
Coefficient of Thermal Expansion	1,467e-004 C^-1
Thermal Conductivity	2,428e-004 W mm^-1 C^-1
Specific Heat	1,5e+006 mJ kg^-1 C^-1

TABLE 24
Plastic, PA6 > Opacity

Red	Green	Blue
0,	153,	255,

Opacity
0,6

Metallic Finish
0,

TABLE 25
Plastic, PA6 > Isotropic Elasticity

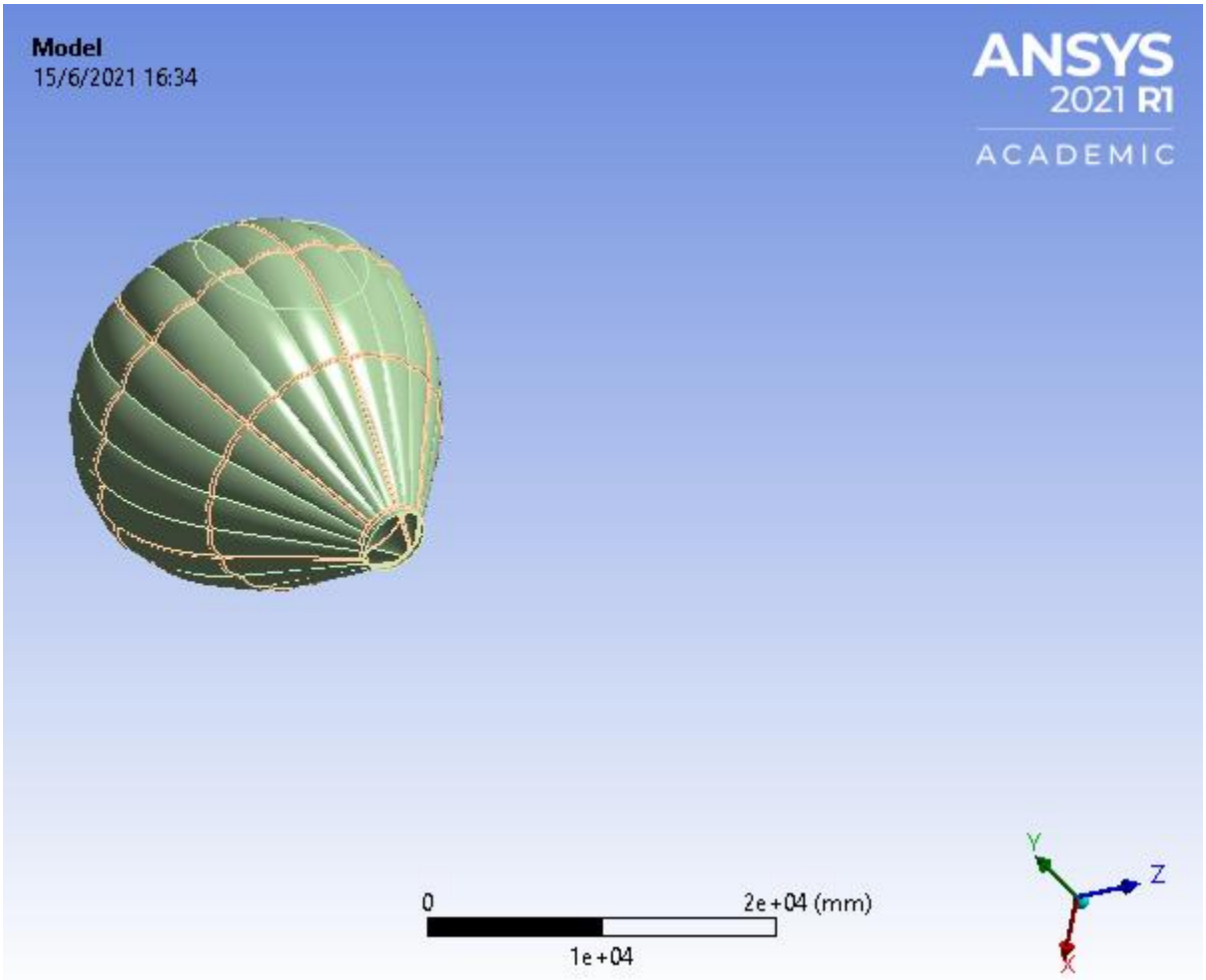
Young's Modulus MPa	Poisson's Ratio	Bulk Modulus MPa	Shear Modulus MPa	Temperature C
1111,	0,3499	1233,6	411,51	23,

TABLE 26
Plastic, PA6 > Isotropic Secant Coefficient of Thermal Expansion

Zero-Thermal-Strain Reference Temperature C
23,

Project*

First Saved	Monday, May 10, 2021
Last Saved	Tuesday, June 15, 2021
Product Version	2021 R1
Save Project Before Solution	No
Save Project After Solution	No



Contents

Units

TABLE 1

Unit System	Metric (mm, kg, N, s, mV, mA) Degrees rad/s Celsius
Angle	Degrees
Rotational Velocity	rad/s
Temperature	Celsius

Model (D4)

Geometry

TABLE 2
Model (D4) > Geometry

Object Name	*Geometry*
State	Fully Defined
Definition	
Source	C:\Users\fvila\Desktop\5-PROVA-tubs+contacte\5-PROVA-tubs-contacte_files\dp0\SYS-3\DM\SYS-3.scdoc
Type	SpaceClaim
Length Unit	Meters
Element Control	Program Controlled
Display Style	Body Color
Bounding Box	
Length X	22184 mm
Length Y	23200 mm

Length Z	22184 mm
Properties	
Volume	1,1826e+009 mm³
Mass	5278,7 kg
Surface Area(approx.)	1,6873e+009 mm²
Scale Factor Value	1,
2D Tolerance	Default (1,e-005)
Statistics	
Bodies	2
Active Bodies	2
Nodes	20452
Elements	21202
Mesh Metric	None
Update Options	
Assign Default Material	No
Basic Geometry Options	
Solid Bodies	Yes
Surface Bodies	Yes
Line Bodies	Yes
Parameters	Independent
Parameter Key	
Attributes	Yes
Attribute Key	
Named Selections	Yes
Named Selection Key	
Material Properties	Yes
Advanced Geometry Options	
Use Associativity	Yes
Coordinate Systems	Yes
Coordinate System Key	
Reader Mode Saves Updated File	No
Use Instances	Yes
Smart CAD Update	Yes
Compare Parts On Update	No
Analysis Type	3-D
Mixed Import Resolution	None
Import Facet Quality	Source
Clean Bodies On Import	No
Stitch Surfaces On Import	None
Decompose Disjoint Geometry	Yes
Enclosure and Symmetry Processing	Yes

TABLE 3
Model (D4) > Geometry > Parts

Object Name	*TUBS-PROVA5-PROVA5\Surface1*	*TUBS-CONTACT-PROVA5\Surface1*
State	Meshed	
Graphics Properties		
Visible	Yes	

Transparency	1	
Definition		
Suppressed	No	
Dimension	3D	
Stiffness Behavior	Flexible	
Coordinate System	Default Coordinate System	
Reference Temperature	By Environment	
Thickness	0,4 mm	3, mm
Thickness Mode	Manual	
Offset Type	Middle	
Treatment	None	
Model Type	Shell	
Material		
Assignment	Plastic, PA6	Structural Steel
Nonlinear Effects	Yes	
Thermal Strain Effects	Yes	
Bounding Box		
Length X	22001 mm	22184 mm
Length Y	23200 mm	21250 mm
Length Z	22001 mm	22184 mm
Properties		
Volume	5,9681e+008 mm³	5,8577e+008 mm³
Mass	680,36 kg	4598,3 kg
Centroid X	9110,5 mm	9111,1 mm
Centroid Y	17515 mm	16351 mm
Centroid Z	21649 mm	
Moment of Inertia Ip1	5,2134e+010 kg·mm²	3,6508e+011 kg·mm²
Moment of Inertia Ip2	5,2066e+010 kg·mm²	3,4277e+011 kg·mm²
Moment of Inertia Ip3	5,2128e+010 kg·mm²	3,4806e+011 kg·mm²
Surface Area(approx.)	1,492e+009 mm²	1,9526e+008 mm²
Statistics		
Nodes	16620	3832
Elements	16737	4465
Mesh Metric	None	
CAD Attributes		
PartTolerance:	0,00000001	
Color:154.175.143		
Color:175.143.143		

TABLE 4
Model (D4) > Materials

Object Name	*Materials*
State	Fully Defined
Statistics	
Materials	2
Material Assignments	0

Coordinate Systems

TABLE 5
Model (D4) > Coordinate Systems > Coordinate System

Object Name	*Global Coordinate System*
State	Fully Defined
Definition	
Type	Cartesian
Coordinate System ID	0,
Origin	
Origin X	0, mm
Origin Y	0, mm
Origin Z	0, mm
Directional Vectors	
X Axis Data	[1, 0, 0,]
Y Axis Data	[0, 1, 0,]
Z Axis Data	[0, 0, 1,]

Connections

TABLE 6
Model (D4) > Connections

Object Name	*Connections*
State	Fully Defined
Auto Detection	
Generate Automatic Connection On Refresh	Yes
Transparency	
Enabled	Yes

TABLE 7
Model (D4) > Connections > Contacts

Object Name	*Contacts*
State	Fully Defined
Definition	
Connection Type	Contact
Scope	
Scoping Method	Geometry Selection
Geometry	All Bodies
Auto Detection	
Tolerance Type	Slider
Tolerance Slider	0,
Tolerance Value	97,548 mm
Use Range	No
Face/Face	Yes
Face-Face Angle Tolerance	75, °
Face Overlap Tolerance	Off
Cylindrical Faces	Include
Face/Edge	No
Edge/Edge	No
Priority	Include All
Group By	Bodies
Search Across	Bodies
Statistics	
Connections	2
Active Connections	1

TABLE 8
Model (D4) > Connections > Contacts > Contact Regions

Object Name	*Bounded-Faces*	*No Separation-Faces*
State	Fully Defined	Suppressed
Scope		
Scoping Method	Geometry Selection	
Contact	46 Faces	
Target	64 Faces	
Contact Bodies	TUBS-PROVA5-PROVA5\Surface1	
Target Bodies	TUBS-CONTACT-PROVA5\Surface1	
Contact Shell Face	Program Controlled	
Target Shell Face	Program Controlled	
Shell Thickness Effect	No	
Protected	No	
Definition		
Type	Bonded	No Separation
Scope Mode	Manual	
Behavior	Program Controlled	
Trim Contact	Program Controlled	
Suppressed	No	Yes
Advanced		
Formulation	Program Controlled	
Small Sliding	Program Controlled	
Detection Method	Program Controlled	
Penetration Tolerance	Program Controlled	
Elastic Slip Tolerance	Program Controlled	
Normal Stiffness	Program Controlled	
Update Stiffness	Program Controlled	
Pinball Region	Program Controlled	
Geometric Modification		
Contact Geometry Correction	None	
Target Geometry Correction	None	

Mesh

TABLE 9
Model (D4) > Mesh

Object Name	*Mesh*
State	Solved
Display	
Display Style	Use Geometry Setting
Defaults	
Physics Preference	Mechanical
Element Order	Program Controlled
Element Size	Default (354,79 mm)
Sizing	
Use Adaptive Sizing	No
Growth Rate	Default (1,2)
Mesh Defeaturing	Yes
Defeature Size	Default (1,7739 mm)
Capture Curvature	Yes
Curvature Min Size	Default (3,5479 mm)

Curvature Normal Angle	Default (30,°)
Capture Proximity	No
Bounding Box Diagonal	39019 mm
Average Surface Area	8,0559e+006 mm²
Minimum Edge Length	6,6365e-003 mm
Quality	
Check Mesh Quality	Yes, Errors
Error Limits	Aggressive Mechanical
Target Quality	Default (0.050000)
Smoothing	Medium
Mesh Metric	None
Inflation	
Use Automatic Inflation	None
Inflation Option	Smooth Transition
Transition Ratio	0,272
Maximum Layers	2
Growth Rate	1,2
Inflation Algorithm	Pre
View Advanced Options	No
Batch Connections	
Mesh Based Connection	No
Advanced	
Number of CPUs for Parallel Part Meshing	Program Controlled
Straight Sided Elements	No
Rigid Body Behavior	Dimensionally Reduced
Triangle Surface Mesher	Program Controlled
Topology Checking	Yes
Use Sheet Thickness for Pinch	No
Pinch Tolerance	Default (3,1931 mm)
Generate Pinch on Refresh	No
Sheet Loop Removal	No
Statistics	
Nodes	20452
Elements	21202

TABLE 10
Model (D4) > Mesh > Mesh Controls

Object Name	*Body Sizing*	*Body Sizing 2*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	1 Body	
Definition		
Suppressed	No	
Type	Element Size	
Element Size	300, mm	350, mm
Advanced		
Defeature Size	Default (1,7739 mm)	
Behavior	Soft	
Growth Rate	Default (1,2)	
Capture Curvature	No	
Capture Proximity	No	

Static Structural (D5)

TABLE 11
Model (D4) > Analysis

Object Name	*Static Structural (D5)*
State	Solved
Definition	
Physics Type	Structural
Analysis Type	Static Structural
Solver Target	Mechanical APDL
Options	
Environment Temperature	22, °C
Generate Input Only	No

TABLE 12
Model (D4) > Static Structural (D5) > Analysis Settings

Object Name	*Analysis Settings*
State	Fully Defined
Step Controls	
Number Of Steps	1,
Current Step Number	1,
Step End Time	1, s
Auto Time Stepping	On
Define By	Substeps
Initial Substeps	250,
Minimum Substeps	50,
Maximum Substeps	5000,
Solver Controls	
Solver Type	Program Controlled
Weak Springs	Off
Solver Pivot Checking	Program Controlled
Large Deflection	Off
Inertia Relief	Off
Quasi-Static Solution	Off
Rotordynamics Controls	
Coriolis Effect	Off
Restart Controls	
Generate Restart Points	Program Controlled
Retain Files After Full Solve	No
Combine Restart Files	Program Controlled
Nonlinear Controls	
Newton-Raphson Option	Program Controlled
Force Convergence	Program Controlled
Moment Convergence	Program Controlled
Displacement Convergence	Program Controlled
Rotation Convergence	Program Controlled
Line Search	Program Controlled
Stabilization	Program Controlled
Advanced	

Inverse Option	No
Contact Split (DMP)	Off
Output Controls	
Stress	Yes
Surface Stress	No
Back Stress	No
Strain	Yes
Contact Data	Yes
Nonlinear Data	No
Nodal Forces	No
Volume and Energy	Yes
Euler Angles	Yes
General Miscellaneous	No
Contact Miscellaneous	No
Store Results At	All Time Points
Result File Compression	Program Controlled
Analysis Data Management	
Solver Files Directory	C:\Users\fvila\Desktop\5-PROVA-tubs+contacte\5-PROVA-tubs-contacte_files\dp0\SYS-3\MECH\
Future Analysis	None
Scratch Solver Files Directory	
Save MAPDL db	No
Contact Summary	Program Controlled
Delete Unneeded Files	Yes
Nonlinear Solution	No
Solver Units	Active System
Solver Unit System	nmm

TABLE 13
Model (D4) > Static Structural (D5) > Loads

Object Name	*Displacement*	*Fixed Rotation*	*P.int_vela - 0,000734MPA*	*P.vent 21m/s*	*P.tubs -2bar*
State	Fully Defined				
Scope					
Scoping Method	Geometry Selection				
Geometry	48 Faces	38 Faces	47 Faces	4 Faces	86 Faces
Definition					
Type	Displacement	Fixed Rotation	Pressure		
Define By	Components		Normal To		
Coordinate System	Global Coordinate System				
X Component	0, mm (ramped)				
Y Component	0, mm (ramped)				
Z Component	0, mm (ramped)				
Suppressed	No				
Rotation X		Fixed			
Rotation Y		Fixed			

Rotation Z		Fixed			
Applied By			Surface Effect		
Loaded Area			Deformed		
Magnitude			-7,34e-004 MPa (ramped)	2,756e-004 MPa (ramped)	-0,2 MPa (ramped)

Solution (D6)

TABLE 14
Model (D4) > Static Structural (D5) > Solution

Object Name	*Solution (D6)*
State	Solved
Adaptive Mesh Refinement	
Max Refinement Loops	1,
Refinement Depth	2,
Information	
Status	Done
MAPDL Elapsed Time	4 m 1 s
MAPDL Memory Used	999, MB
MAPDL Result File Size	1,1154 GB
Post Processing	
Beam Section Results	No
On Demand Stress/Strain	No

TABLE 15
Model (D4) > Static Structural (D5) > Solution (D6) > Solution Information

Object Name	*Solution Information*
State	Solved
Solution Information	
Solution Output	Solver Output
Newton-Raphson Residuals	0
Identify Element Violations	0
Update Interval	2,5 s
Display Points	All
FE Connection Visibility	
Activate Visibility	Yes
Display	All FE Connectors
Draw Connections Attached To	All Nodes
Line Color	Connection Type
Visible on Results	No
Line Thickness	Single
Display Type	Lines

TABLE 16
Model (D4) > Static Structural (D5) > Solution (D6) > Results

Object Name	*Total Deformation*	*Equivalent Elastic Strain*	*Stress Intensity*
State	Solved		
Scope			
Scoping Method	Geometry Selection		
Geometry	All Bodies		
Position		Top/Bottom	
Definition			

Type	Total Deformation	Equivalent Elastic Strain	Stress Intensity
By	Time		
Display Time	Last		
Calculate Time History	Yes		
Identifier			
Suppressed	No		
Results			
Minimum	0, mm	0, mm/mm	0, MPa
Maximum	30039 mm	0,47901 mm/mm	13870 MPa
Average	631,34 mm	1,5445e-002 mm/mm	116,62 MPa
Minimum Occurs On	TUBS-PROVA5-PROVA5\Surface1		
Maximum Occurs On	TUBS-PROVA5-PROVA5\Surface1		TUBS-CONTACT-PROVA5\Surface1
Minimum Value Over Time			
Minimum	0, mm	0, mm/mm	0, MPa
Maximum	0, mm	0, mm/mm	0, MPa
Maximum Value Over Time			
Minimum	120,15 mm	1,916e-003 mm/mm	55,479 MPa
Maximum	30039 mm	0,47901 mm/mm	13870 MPa
Information			
Time	1, s		
Load Step	1		
Substep	52		
Iteration Number	52		
Integration Point Results			
Display Option		Averaged	
Average Across Bodies		No	

FIGURE 1
Model (D4) > Static Structural (D5) > Solution (D6) > Total Deformation

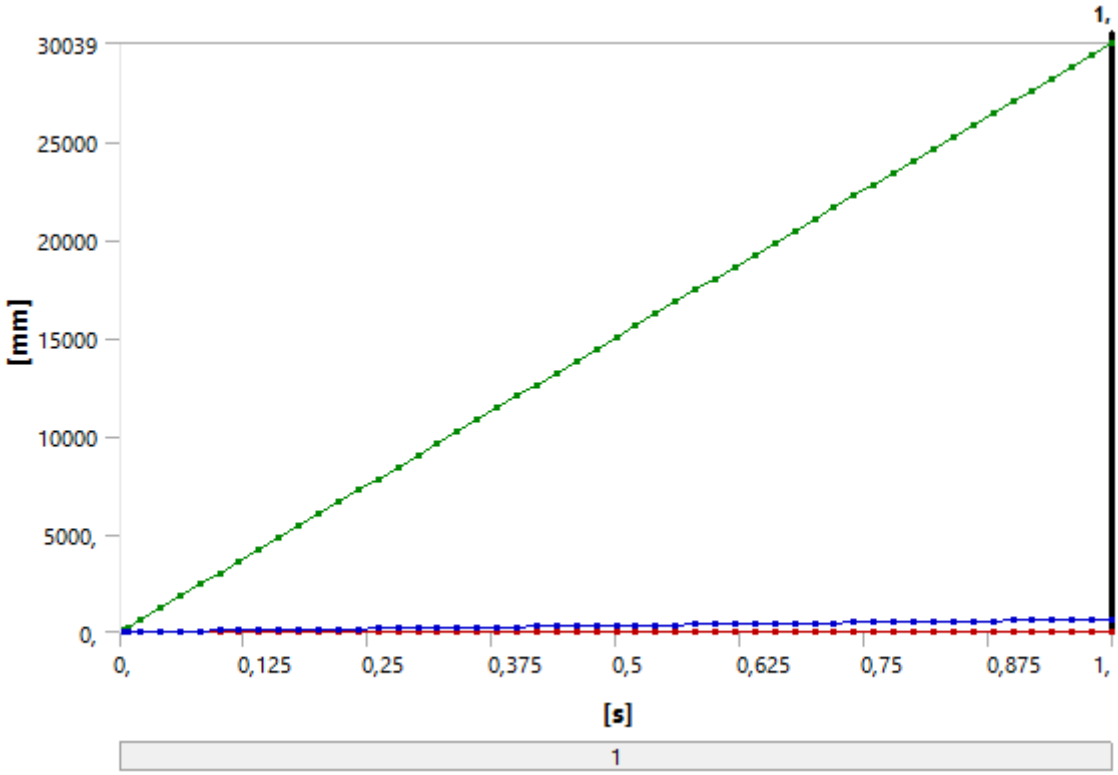


TABLE 17
Model (D4) > Static Structural (D5) > Solution (D6) > Total Deformation

Time [s]	Minimum [mm]	Maximum [mm]	Average [mm]
4,e-003	0,	120,15	2,5253
8,e-003		240,31	5,0507
2,e-002		600,77	12,627
4,e-002		1201,5	25,253
6,e-002		1802,3	37,88
8,e-002		2403,1	50,507
0,1		3003,9	63,134
0,12		3604,6	75,76
0,14		4205,4	88,387
0,16		4806,2	101,01
0,18		5406,9	113,64
0,2		6007,7	126,27
0,22		6608,5	138,89
0,24		7209,2	151,52
0,26		7810,	164,15
0,28		8410,8	176,77
0,3		9011,6	189,4
0,32		9612,3	202,03
0,34		10213	214,65
0,36		10814	227,28
0,38		11415	239,91
0,4		12015	252,53
0,42		12616	265,16
0,44		13217	277,79
0,46		13818	290,41
0,48		14418	303,04

0,5		15019	315,67
0,52		15620	328,29
0,54		16221	340,92
0,56		16822	353,55
0,58		17422	366,17
0,6		18023	378,8
0,62		18624	391,43
0,64		19225	404,05
0,66		19825	416,68
0,68		20426	429,31
0,7		21027	441,93
0,72		21628	454,56
0,74		22229	467,19
0,76		22829	479,81
0,78		23430	492,44
0,8		24031	505,07
0,82		24632	517,69
0,84		25232	530,32
0,86		25833	542,95
0,88		26434	555,57
0,9		27035	568,2
0,92		27635	580,83
0,94		28236	593,45
0,96		28837	606,08
0,98		29438	618,71
1,		30039	631,34

FIGURE 2
Model (D4) > Static Structural (D5) > Solution (D6) > Equivalent Elastic Strain

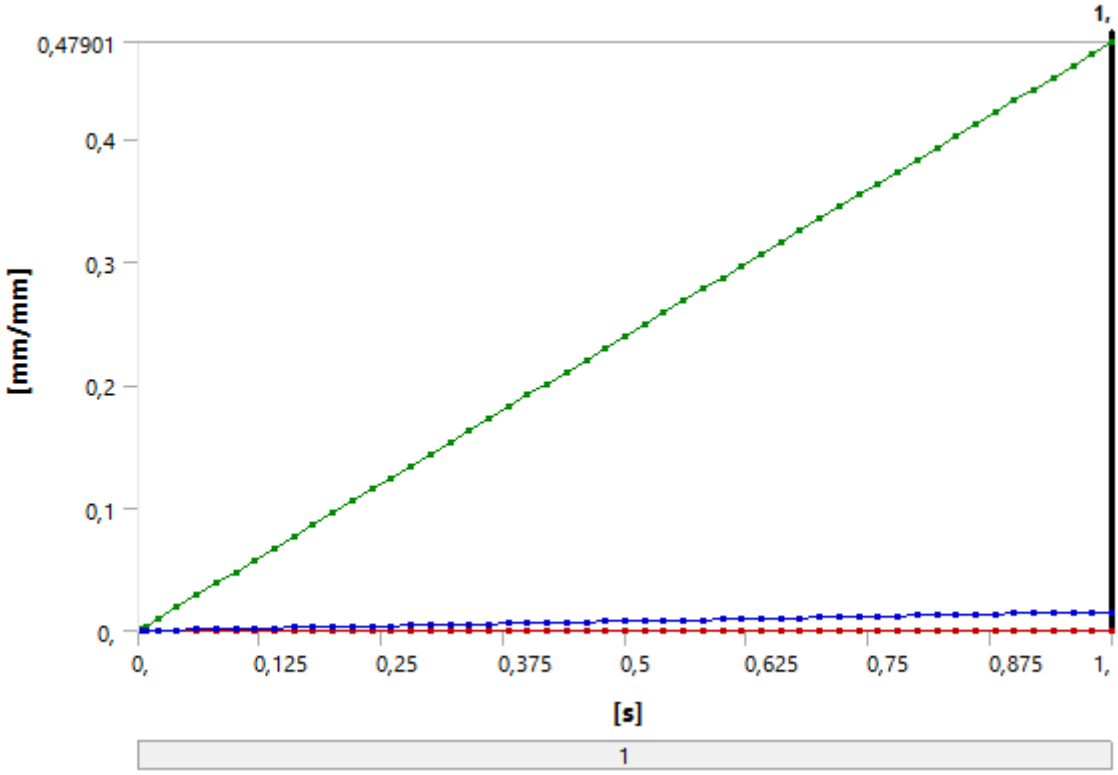


TABLE 18
Model (D4) > Static Structural (D5) > Solution (D6) > Equivalent Elastic Strain

Time [s]	Minimum [mm/mm]	Maximum [mm/mm]	Average [mm/mm]
4,e-003	0,	1,916e-003	6,1782e-005
8,e-003		3,8321e-003	1,2356e-004
2,e-002		9,5801e-003	3,0891e-004
4,e-002		1,916e-002	6,1782e-004
6,e-002		2,874e-002	9,2673e-004
8,e-002		3,8321e-002	1,2356e-003
0,1		4,7901e-002	1,5445e-003
0,12		5,7481e-002	1,8535e-003
0,14		6,7061e-002	2,1624e-003
0,16		7,6641e-002	2,4713e-003
0,18		8,6221e-002	2,7802e-003
0,2		9,5801e-002	3,0891e-003
0,22		0,10538	3,398e-003
0,24		0,11496	3,7069e-003
0,26		0,12454	4,0158e-003
0,28		0,13412	4,3247e-003
0,3		0,1437	4,6336e-003
0,32		0,15328	4,9426e-003
0,34		0,16286	5,2515e-003
0,36		0,17244	5,5604e-003
0,38		0,18202	5,8693e-003
0,4		0,1916	6,1782e-003
0,42		0,20118	6,4871e-003
0,44		0,21076	6,796e-003
0,46		0,22034	7,1049e-003
0,48		0,22992	7,4138e-003
0,5		0,2395	7,7227e-003
0,52		0,24908	8,0317e-003
0,54		0,25866	8,3406e-003
0,56		0,26824	8,6495e-003
0,58		0,27782	8,9584e-003
0,6		0,2874	9,2673e-003
0,62		0,29698	9,5762e-003
0,64		0,30656	9,8851e-003
0,66		0,31614	1,0194e-002
0,68		0,32572	1,0503e-002
0,7		0,3353	1,0812e-002
0,72		0,34488	1,1121e-002
0,74		0,35447	1,143e-002
0,76		0,36405	1,1739e-002
0,78		0,37363	1,2047e-002
0,8		0,38321	1,2356e-002
0,82		0,39279	1,2665e-002
0,84		0,40237	1,2974e-002
0,86		0,41195	1,3283e-002
0,88		0,42153	1,3592e-002
0,9		0,43111	1,3901e-002
0,92		0,44069	1,421e-002
0,94		0,45027	1,4519e-002
0,96		0,45985	1,4828e-002

0,98		0,46943	1,5137e-002
1,		0,47901	1,5445e-002

FIGURE 3
Model (D4) > Static Structural (D5) > Solution (D6) > Stress Intensity

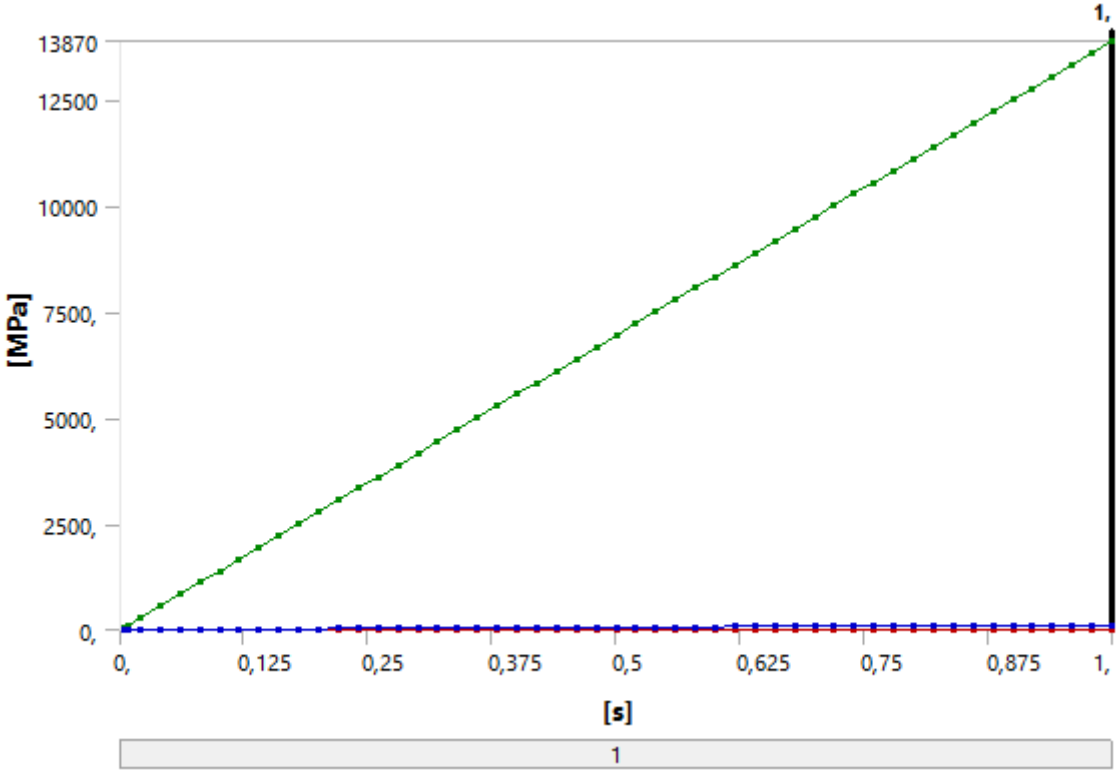


TABLE 19
Model (D4) > Static Structural (D5) > Solution (D6) > Stress Intensity

Time [s]	Minimum [MPa]	Maximum [MPa]	Average [MPa]
4,e-003	0,	55,479	0,46646
8,e-003		110,96	0,93292
2,e-002		277,39	2,3323
4,e-002		554,79	4,6646
6,e-002		832,18	6,9969
8,e-002		1109,6	9,3292
0,1		1387,	11,662
0,12		1664,4	13,994
0,14		1941,8	16,326
0,16		2219,2	18,658
0,18		2496,6	20,991
0,2		2773,9	23,323
0,22		3051,3	25,655
0,24		3328,7	27,988
0,26		3606,1	30,32
0,28		3883,5	32,652
0,3		4160,9	34,985
0,32		4438,3	37,317
0,34		4715,7	39,649
0,36		4993,1	41,981
0,38		5270,5	44,314

0,4		5547,9	46,646
0,42		5825,3	48,978
0,44		6102,7	51,311
0,46		6380,1	53,643
0,48		6657,5	55,975
0,5		6934,9	58,308
0,52		7212,3	60,64
0,54		7489,7	62,972
0,56		7767,1	65,304
0,58		8044,5	67,637
0,6		8321,8	69,969
0,62		8599,2	72,301
0,64		8876,6	74,634
0,66		9154,	76,966
0,68		9431,4	79,298
0,7		9708,8	81,631
0,72		9986,2	83,963
0,74		10264	86,295
0,76		10541	88,627
0,78		10818	90,96
0,8		11096	93,292
0,82		11373	95,624
0,84		11651	97,957
0,86		11928	100,29
0,88		12205	102,62
0,9		12483	104,95
0,92		12760	107,29
0,94		13038	109,62
0,96		13315	111,95
0,98		13592	114,28
1,		13870	116,62

TABLE 20
Model (D4) > Static Structural (D5) > Solution (D6) > Stress Safety Tools

Object Name	*Stress Tool*
State	Solved
Definition	
Theory	Max Equivalent Stress
Stress Limit Type	Tensile Yield Per Material

TABLE 21
Model (D4) > Static Structural (D5) > Solution (D6) > Stress Tool > Results

Object Name	*Safety Factor*
State	Solved
Scope	
Scoping Method	Geometry Selection
Geometry	All Bodies
Definition	
Type	Safety Factor
By	Time
Display Time	Last
Calculate Time History	Yes
Identifier	

Suppressed	No
Integration Point Results	
Display Option	Averaged
Average Across Bodies	No
Results	
Minimum	1,9509e-002
Minimum Occurs On	TUBS-CONTACT-PROVA5\Surface1
Minimum Value Over Time	
Minimum	1,9509e-002
Maximum	4,8773
Maximum Value Over Time	
Minimum	15,
Maximum	15,
Information	
Time	1, s
Load Step	1
Substep	52
Iteration Number	52

FIGURE 4
Model (D4) > Static Structural (D5) > Solution (D6) > Stress Tool > Safety Factor

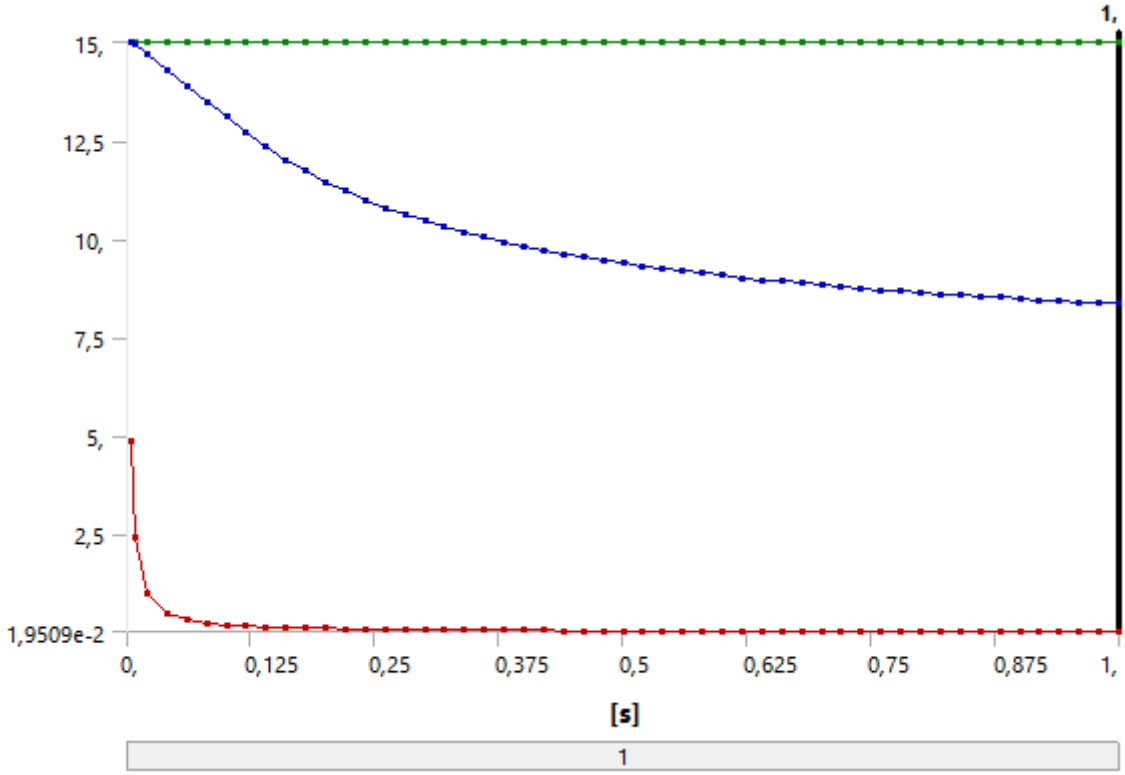


TABLE 22
Model (D4) > Static Structural (D5) > Solution (D6) > Stress Tool > Safety Factor

Time [s]	Minimum	Maximum	Average
4,e-003	4,8773	15,	14,997
8,e-003	2,4386		14,96
2,e-002	0,97545		14,719
4,e-002	0,48773		14,277
6,e-002	0,32515		13,874

8,e-002	0,24386		13,495
0,1	0,19509		13,095
0,12	0,16258		12,697
0,14	0,13935		12,333
0,16	0,12193		12,007
0,18	0,10838		11,714
0,2	9,7545e-002		11,448
0,22	8,8678e-002		11,208
0,24	8,1288e-002		10,99
0,26	7,5035e-002		10,793
0,28	6,9675e-002		10,615
0,3	6,503e-002		10,452
0,32	6,0966e-002		10,304
0,34	5,738e-002		10,167
0,36	5,4192e-002		10,041
0,38	5,134e-002		9,9242
0,4	4,8773e-002		9,8167
0,42	4,645e-002		9,717
0,44	4,4339e-002		9,6241
0,46	4,2411e-002		9,5373
0,48	4,0644e-002		9,4562
0,5	3,9018e-002		9,3806
0,52	3,7517e-002		9,3095
0,54	3,6128e-002		9,2427
0,56	3,4838e-002		9,1797
0,58	3,3636e-002		9,1203
0,6	3,2515e-002		9,0642
0,62	3,1466e-002		9,0111
0,64	3,0483e-002		8,9606
0,66	2,9559e-002		8,9126
0,68	2,869e-002		8,8668
0,7	2,787e-002		8,8233
0,72	2,7096e-002		8,7817
0,74	2,6364e-002		8,742
0,76	2,567e-002		8,704
0,78	2,5012e-002		8,6677
0,8	2,4386e-002		8,6329
0,82	2,3792e-002		8,5996
0,84	2,3225e-002		8,5677
0,86	2,2685e-002		8,5372
0,88	2,2169e-002		8,5077
0,9	2,1677e-002		8,4794
0,92	2,1206e-002		8,452
0,94	2,0754e-002		8,4256
0,96	2,0322e-002		8,4002
0,98	1,9907e-002		8,3756
1,	1,9509e-002		8,3519

Material Data

Plastic, PA6

TABLE 23
Plastic, PA6 > Constants

Density	1,14e-006 kg mm^-3
Tensile Yield Strength	43,13 MPa
Tensile Ultimate Strength	71,89 MPa
Coefficient of Thermal Expansion	1,467e-004 C^-1
Thermal Conductivity	2,428e-004 W mm^-1 C^-1
Specific Heat	1,5e+006 mJ kg^-1 C^-1

TABLE 24
Plastic, PA6 > Opacity

Red	Green	Blue
0,	153,	255,

Opacity
0,6

Metallic Finish
0,

TABLE 25
Plastic, PA6 > Isotropic Elasticity

Young's Modulus MPa	Poisson's Ratio	Bulk Modulus MPa	Shear Modulus MPa	Temperature C
1111,	0,3499	1233,6	411,51	23,

TABLE 26
Plastic, PA6 > Isotropic Secant Coefficient of Thermal Expansion

Zero-Thermal-Strain Reference Temperature C
23,

Structural Steel

TABLE 27
Structural Steel > Constants

Density	7,85e-006 kg mm^-3
Coefficient of Thermal Expansion	1,2e-005 C^-1
Specific Heat	4,34e+005 mJ kg^-1 C^-1
Thermal Conductivity	6,05e-002 W mm^-1 C^-1
Resistivity	1,7e-004 ohm mm

TABLE 28
Structural Steel > Color

Red	Green	Blue
132,	139,	179,

TABLE 29
Structural Steel > Compressive Ultimate Strength

Compressive Ultimate Strength MPa
0,

TABLE 30
Structural Steel > Compressive Yield Strength

Compressive Yield Strength MPa
250,

TABLE 31
Structural Steel > Tensile Yield Strength

Tensile Yield Strength MPa
250,

TABLE 32
Structural Steel > Tensile Ultimate Strength

Tensile Ultimate Strength MPa
460,

TABLE 33
Structural Steel > Isotropic Secant Coefficient of Thermal Expansion

Zero-Thermal-Strain Reference Temperature C
22,

TABLE 34
Structural Steel > S-N Curve

Alternating Stress MPa	Cycles	Mean Stress MPa
3999,	10,	0,
2827,	20,	0,
1896,	50,	0,
1413,	100,	0,
1069,	200,	0,
441,	2000,	0,
262,	10000	0,
214,	20000	0,
138,	1,e+005	0,
114,	2,e+005	0,
86,2	1,e+006	0,

TABLE 35
Structural Steel > Strain-Life Parameters

Strength Coefficient MPa	Strength Exponent	Ductility Coefficient	Ductility Exponent	Cyclic Strength Coefficient MPa	Cyclic Strain Hardening Exponent
920,	-0,106	0,213	-0,47	1000,	0,2

TABLE 36
Structural Steel > Isotropic Elasticity

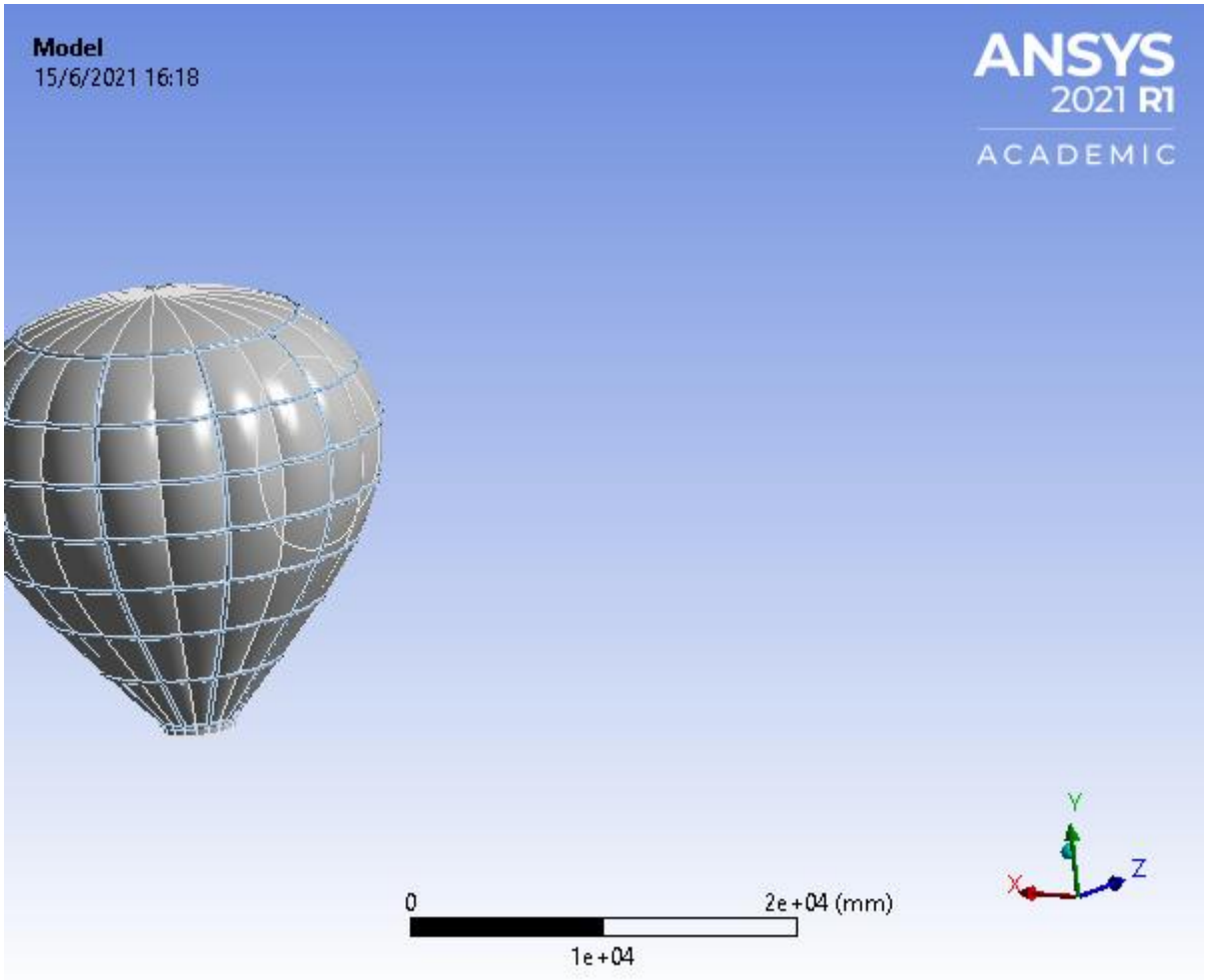
Young's Modulus MPa	Poisson's Ratio	Bulk Modulus MPa	Shear Modulus MPa	Temperature C
2,e+005	0,3	1,6667e+005	76923	

TABLE 37
Structural Steel > Isotropic Relative Permeability

Relative Permeability
10000

Project

First Saved	Sunday, June 6, 2021
Last Saved	Tuesday, June 15, 2021
Product Version	2021 R1
Save Project Before Solution	No
Save Project After Solution	No



Contents

Units

TABLE 1

Unit System	Metric (mm, kg, N, s, mV, mA) Degrees rad/s Celsius
Angle	Degrees
Rotational Velocity	rad/s
Temperature	Celsius

Model (A4)

Geometry

TABLE 2
Model (A4) > Geometry

Object Name	*Geometry*
State	Fully Defined
Definition	
Source	C:\Users\fvila\Desktop\6-PROVA-redisseny_+tubs\REDISSENY+TUBS+OPEN-PROVA6_files\dp0\SYS\DM\SYS.scdoc
Type	SpaceClaim
Length Unit	Meters
Element Control	Program Controlled
Display Style	Body Color
Bounding Box	
Length X	22213 mm

Length Y	23200 mm
Length Z	22213 mm
Properties	
Volume	7,555e+008 mm³
Mass	861,27 kg
Surface Area(approx.)	1,8888e+009 mm²
Scale Factor Value	1,
2D Tolerance	Default (1,e-005)
Statistics	
Bodies	2
Active Bodies	2
Nodes	20537
Elements	21861
Mesh Metric	None
Update Options	
Assign Default Material	No
Basic Geometry Options	
Solid Bodies	Yes
Surface Bodies	Yes
Line Bodies	Yes
Parameters	Independent
Parameter Key	
Attributes	Yes
Attribute Key	
Named Selections	Yes
Named Selection Key	
Material Properties	Yes
Advanced Geometry Options	
Use Associativity	Yes
Coordinate Systems	Yes
Coordinate System Key	
Reader Mode Saves Updated File	No
Use Instances	Yes
Smart CAD Update	Yes
Compare Parts On Update	No
Analysis Type	3-D
Mixed Import Resolution	None
Import Facet Quality	Source
Clean Bodies On Import	No
Stitch Surfaces On Import	None
Decompose Disjoint Geometry	Yes
Enclosure and Symmetry Processing	Yes

TABLE 3
Model (A4) > Geometry > Parts

Object Name	*REDISSENY-VELA-PROVA6\Surface1*	*REDISSENY-CONTACT-PROVA6\Surface1*
State	Meshed	
Graphics Properties		
Visible	Yes	
Transparency	1	
Definition		
Suppressed	No	
Dimension	3D	
Stiffness Behavior	Flexible	
Coordinate System	Default Coordinate System	
Reference Temperature	By Environment	
Thickness	0,4 mm	
Thickness Mode	Manual	
Offset Type	Middle	
Treatment	None	
Model Type	Shell	
Material		
Assignment	Plastic, PA6	
Nonlinear Effects	Yes	
Thermal Strain Effects	Yes	
Bounding Box		
Length X	22001 mm	22213 mm
Length Y	23200 mm	21300 mm
Length Z	22001 mm	22213 mm
Properties		
Volume	5,9681e+008 mm³	1,5869e+008 mm³
Mass	680,36 kg	180,91 kg
Centroid X	9110,5 mm	9111,7 mm
Centroid Y	17515 mm	16286 mm
Centroid Z	21649 mm	21650 mm
Moment of Inertia Ip1	5,2134e+010 kg·mm²	1,3773e+010 kg·mm²
Moment of Inertia Ip2	5,2066e+010 kg·mm²	1,4121e+010 kg·mm²
Moment of Inertia Ip3	5,2128e+010 kg·mm²	1,3772e+010 kg·mm²
Surface Area(approx.)	1,492e+009 mm²	3,9673e+008 mm²
Statistics		
Nodes	9482	11055
Elements	9562	12299
Mesh Metric	None	
CAD Attributes		
PartTolerance:	0,00000001	
Color:154.175.143		
Color:175.143.143		

TABLE 4
Model (A4) > Materials

Object Name	*Materials*
State	Fully Defined
Statistics	
Materials	2

Material Assignments	0

Coordinate Systems

TABLE 5
Model (A4) > Coordinate Systems > Coordinate System

Object Name	*Global Coordinate System*
State	Fully Defined
Definition	
Type	Cartesian
Coordinate System ID	0,
Origin	
Origin X	0, mm
Origin Y	0, mm
Origin Z	0, mm
Directional Vectors	
X Axis Data	[1, 0, 0,]
Y Axis Data	[0, 1, 0,]
Z Axis Data	[0, 0, 1,]

Connections

TABLE 6
Model (A4) > Connections

Object Name	*Connections*
State	Fully Defined
Auto Detection	
Generate Automatic Connection On Refresh	Yes
Transparency	
Enabled	Yes

TABLE 7
Model (A4) > Connections > Contacts

Object Name	*Contacts*
State	Fully Defined
Definition	
Connection Type	Contact
Scope	
Scoping Method	Geometry Selection
Geometry	All Bodies
Auto Detection	
Tolerance Type	Slider
Tolerance Slider	0,
Tolerance Value	97,63 mm
Use Range	No
Face/Face	Yes
Face-Face Angle Tolerance	75, °
Face Overlap Tolerance	Off
Cylindrical Faces	Include
Face/Edge	No
Edge/Edge	No
Priority	Include All

Group By	Bodies
Search Across	Bodies
Statistics	
Connections	1
Active Connections	1

TABLE 8
Model (A4) > Connections > Contacts > Contact Regions

Object Name	*Bonded - REDISSENY-VELA-PROVA6\Surface1 To REDISSENY-CONTACT-PROVA6\Surface1*
State	Fully Defined
Scope	
Scoping Method	Geometry Selection
Contact	46 Faces
Target	40 Faces
Contact Bodies	REDISSENY-VELA-PROVA6\Surface1
Target Bodies	REDISSENY-CONTACT-PROVA6\Surface1
Contact Shell Face	Program Controlled
Target Shell Face	Program Controlled
Shell Thickness Effect	No
Protected	No
Definition	
Type	Bonded
Scope Mode	Manual
Behavior	Program Controlled
Trim Contact	Program Controlled
Suppressed	No
Advanced	
Formulation	Program Controlled
Small Sliding	Program Controlled
Detection Method	Program Controlled
Penetration Tolerance	Program Controlled
Elastic Slip Tolerance	Program Controlled
Normal Stiffness	Program Controlled
Update Stiffness	Program Controlled
Pinball Region	Program Controlled
Geometric Modification	
Contact Geometry Correction	None
Target Geometry Correction	None

Mesh

TABLE 9
Model (A4) > Mesh

Object Name	*Mesh*
State	Solved
Display	
Display Style	Use Geometry Setting
Defaults	
Physics Preference	Mechanical
Element Order	Program Controlled

Element Size	Default (376,18 mm)
Sizing	
Use Adaptive Sizing	No
Growth Rate	Default (1,2)
Mesh Defeaturing	Yes
Defeature Size	Default (1,8809 mm)
Capture Curvature	Yes
Curvature Min Size	Default (3,7618 mm)
Curvature Normal Angle	Default (30,°)
Capture Proximity	No
Bounding Box Diagonal	39052 mm
Average Surface Area	9,0566e+006 mm²
Minimum Edge Length	15,709 mm
Quality	
Check Mesh Quality	Yes, Errors
Error Limits	Aggressive Mechanical
Target Quality	Default (0.050000)
Smoothing	Medium
Mesh Metric	None
Inflation	
Use Automatic Inflation	None
Inflation Option	Smooth Transition
Transition Ratio	0,272
Maximum Layers	2
Growth Rate	1,2
Inflation Algorithm	Pre
View Advanced Options	No
Batch Connections	
Mesh Based Connection	No
Advanced	
Number of CPUs for Parallel Part Meshing	Program Controlled
Straight Sided Elements	No
Rigid Body Behavior	Dimensionally Reduced
Triangle Surface Mesher	Program Controlled
Topology Checking	Yes
Use Sheet Thickness for Pinch	No
Pinch Tolerance	Default (3,3856 mm)
Generate Pinch on Refresh	No
Sheet Loop Removal	No
Statistics	
Nodes	20537
Elements	21861

TABLE 10
Model (A4) > Mesh > Mesh Controls

Object Name	*400mm vela*	*200mm tubs*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	1 Body	
Definition		
Suppressed	No	

Type	Element Size	
Element Size	400, mm	200, mm
Advanced		
Defeature Size	Default (1,8809 mm)	
Behavior	Soft	
Growth Rate	Default (1,2)	
Capture Curvature	No	
Capture Proximity	No	

Static Structural (A5)

TABLE 11
Model (A4) > Analysis

Object Name	*Static Structural (A5)*
State	Solved
Definition	
Physics Type	Structural
Analysis Type	Static Structural
Solver Target	Mechanical APDL
Options	
Environment Temperature	22, °C
Generate Input Only	No

TABLE 12
Model (A4) > Static Structural (A5) > Analysis Settings

Object Name	*Analysis Settings*
State	Fully Defined
Step Controls	
Number Of Steps	1,
Current Step Number	1,
Step End Time	1, s
Auto Time Stepping	On
Define By	Substeps
Initial Substeps	250,
Minimum Substeps	50,
Maximum Substeps	5000,
Solver Controls	
Solver Type	Program Controlled
Weak Springs	Off
Solver Pivot Checking	Program Controlled
Large Deflection	Off
Inertia Relief	Off
Quasi-Static Solution	Off
Rotordynamics Controls	
Coriolis Effect	Off
Restart Controls	
Generate Restart Points	Program Controlled
Retain Files After Full Solve	No

Combine Restart Files	Program Controlled
Nonlinear Controls	
Newton-Raphson Option	Program Controlled
Force Convergence	Program Controlled
Moment Convergence	Program Controlled
Displacement Convergence	Program Controlled
Rotation Convergence	Program Controlled
Line Search	Program Controlled
Stabilization	Program Controlled
Advanced	
Inverse Option	No
Contact Split (DMP)	Off
Output Controls	
Stress	Yes
Surface Stress	No
Back Stress	No
Strain	Yes
Contact Data	Yes
Nonlinear Data	No
Nodal Forces	No
Volume and Energy	Yes
Euler Angles	Yes
General Miscellaneous	No
Contact Miscellaneous	No
Store Results At	All Time Points
Result File Compression	Program Controlled
Analysis Data Management	
Solver Files Directory	C:\Users\fvila\Desktop\6-PROVA-redisseny_+tubs\REDISSENY+TUBS+OPEN-PROVA6_files\dp0\SYS\MECH\
Future Analysis	None
Scratch Solver Files Directory	
Save MAPDL db	No
Contact Summary	Program Controlled
Delete Unneeded Files	Yes
Nonlinear Solution	No
Solver Units	Active System
Solver Unit System	nmm

TABLE 13
Model (A4) > Static Structural (A5) > Loads

Object Name	*Displacement*	*Fixed Rotation*	*Pint_vela - 0,000734MPA*	*Pvent 21m/s*	*Ptubs -2bar - 1atm aire ext*
State	Fully Defined				

Scope					
Scoping Method	Geometry Selection				
Geometry	21 Faces	11 Faces	47 Faces	4 Faces	83 Faces
Definition					
Type	Displacement	Fixed Rotation	Pressure		
Define By	Components		Normal To		
Coordinate System	Global Coordinate System				
X Component	0, mm (ramped)				
Y Component	0, mm (ramped)				
Z Component	0, mm (ramped)				
Suppressed	No				
Rotation X		Fixed			
Rotation Y		Fixed			
Rotation Z		Fixed			
Applied By			Surface Effect		
Loaded Area			Deformed		
Magnitude			-7,34e-004 MPa (ramped)	2,756e-004 MPa (ramped)	-0,1 MPa (ramped)

FIGURE 1
Model (A4) > Static Structural (A5) > Displacement

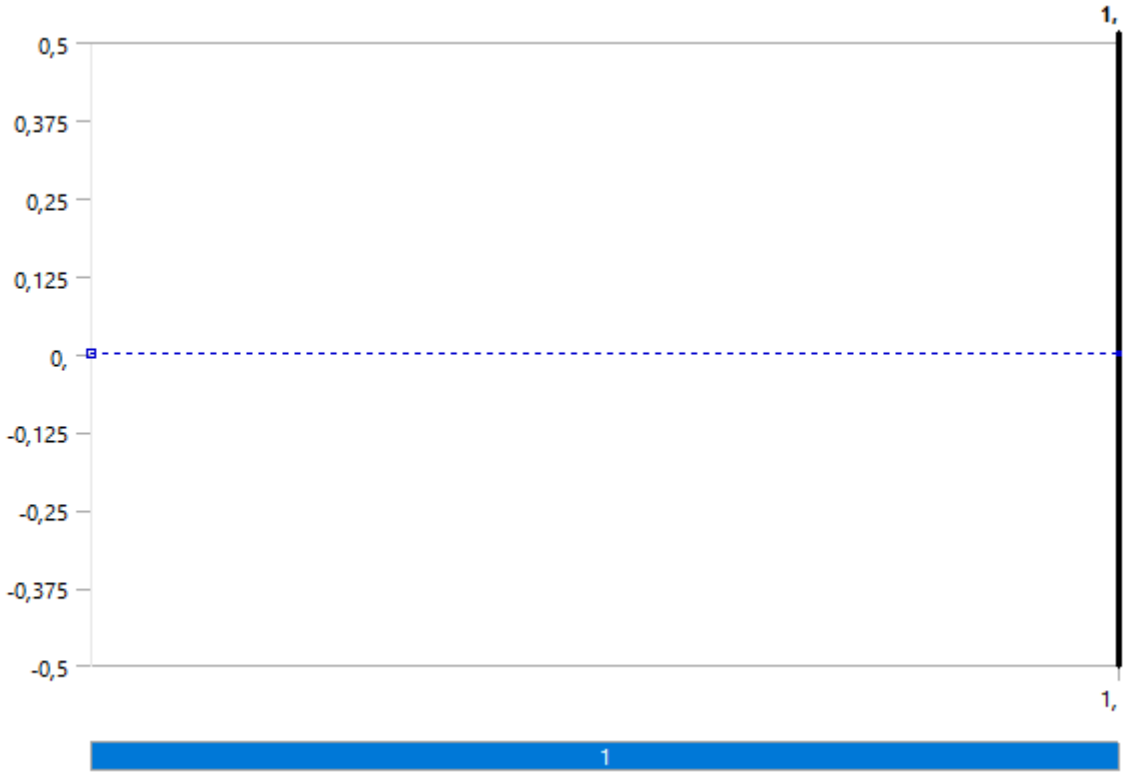


FIGURE 2
Model (A4) > Static Structural (A5) > Pint_vela -0,000734MPA

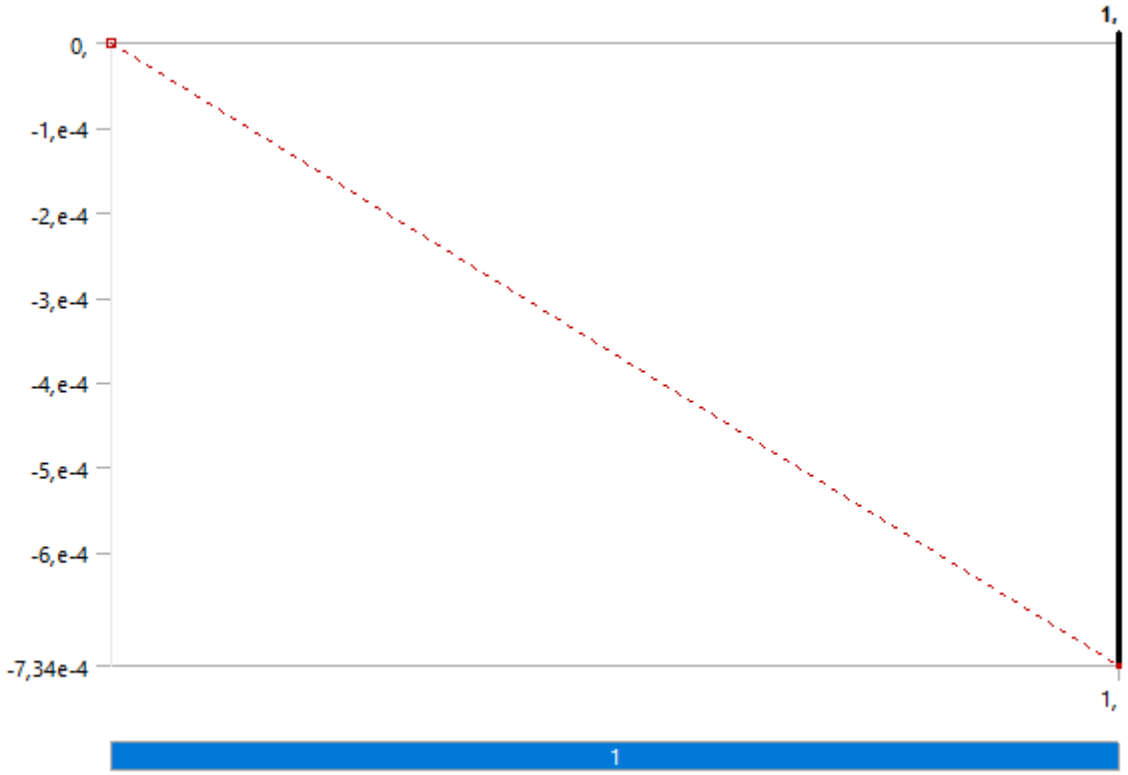


FIGURE 3
Model (A4) > Static Structural (A5) > Pvent 21m/s

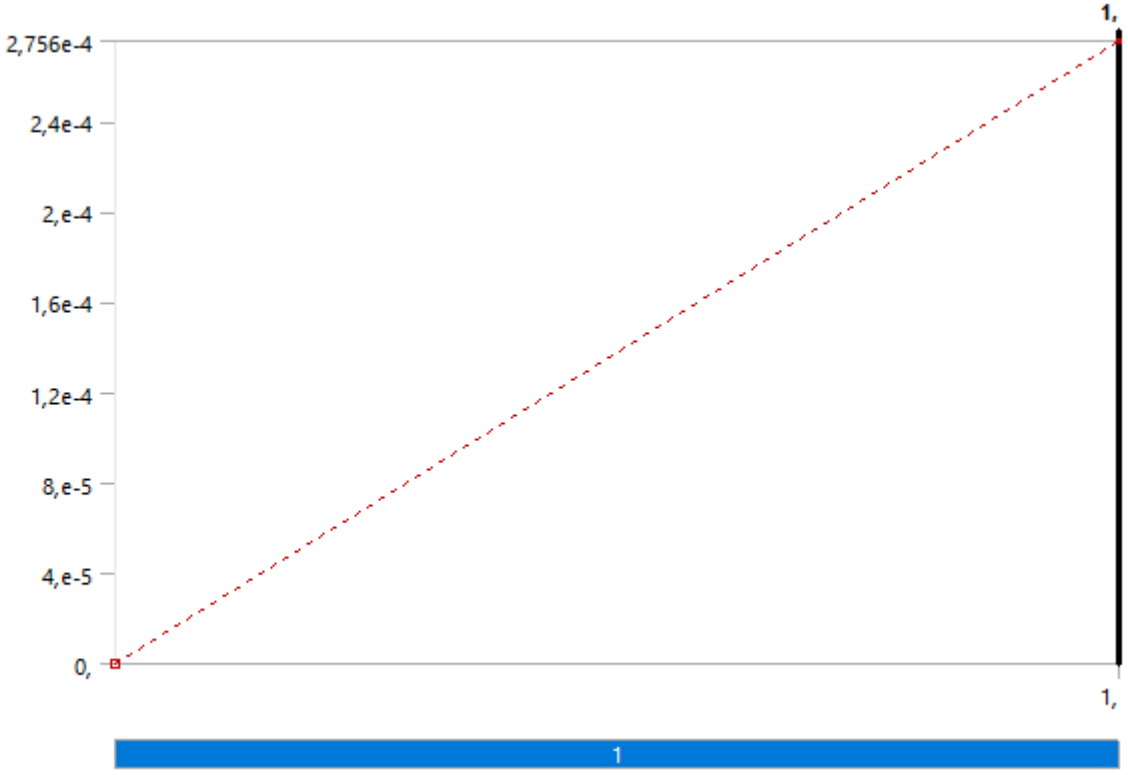
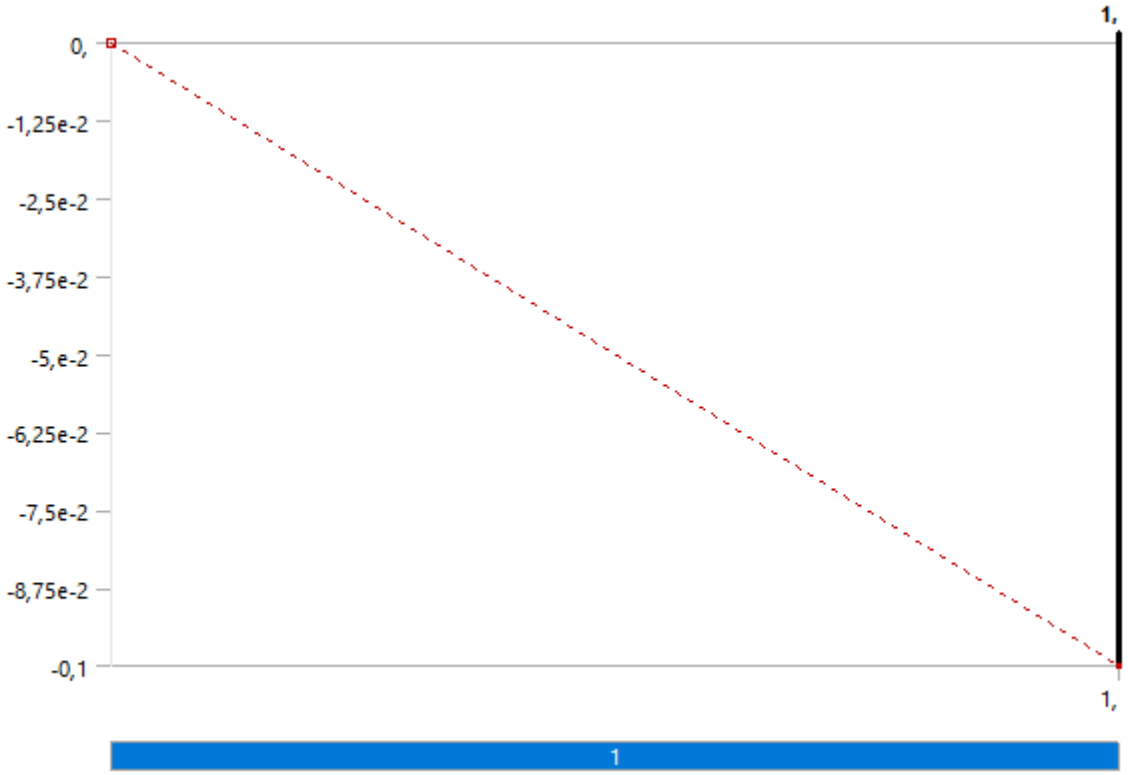


FIGURE 4
Model (A4) > Static Structural (A5) > Ptubs -2bar -1atm aire ext



Solution (A6)

TABLE 14
Model (A4) > Static Structural (A5) > Solution

Object Name	*Solution (A6)*
State	Solved
Adaptive Mesh Refinement	
Max Refinement Loops	1,
Refinement Depth	2,
Information	
Status	Done
MAPDL Elapsed Time	4 m 46 s
MAPDL Memory Used	985, MB
MAPDL Result File Size	1,1687 GB
Post Processing	
Beam Section Results	No
On Demand Stress/Strain	No

TABLE 15
Model (A4) > Static Structural (A5) > Solution (A6) > Solution Information

Object Name	*Solution Information*
State	Solved
Solution Information	
Solution Output	Solver Output
Newton-Raphson Residuals	0
Identify Element Violations	0
Update Interval	2,5 s
Display Points	All
FE Connection Visibility	

Activate Visibility	Yes
Display	All FE Connectors
Draw Connections Attached To	All Nodes
Line Color	Connection Type
Visible on Results	No
Line Thickness	Single
Display Type	Lines

TABLE 16
Model (A4) > Static Structural (A5) > Solution (A6) > Results

Object Name	*Total Deformation*	*Stress Intensity*	*Equivalent Elastic Strain*
State	Solved		
Scope			
Scoping Method	Geometry Selection		
Geometry	All Bodies		
Position		Top/Bottom	
Definition			
Type	Total Deformation	Stress Intensity	Equivalent Elastic Strain
By	Time		
Display Time	Last		
Calculate Time History	Yes		
Identifier			
Suppressed	No		
Results			
Minimum	0, mm	0, MPa	0, mm/mm
Maximum	28739 mm	1749,3 MPa	1,6157 mm/mm
Average	2104,4 mm	147,91 MPa	0,13598 mm/mm
Minimum Occurs On	REDISSENY-VELA-PROVA6\Surface1		
Maximum Occurs On	REDISSENY-VELA-PROVA6\Surface1	REDISSENY-CONTACT-PROVA6\Surface1	
Minimum Value Over Time			
Minimum	0, mm	0, MPa	0, mm/mm
Maximum	0, mm	0, MPa	0, mm/mm
Maximum Value Over Time			
Minimum	114,96 mm	6,9971 MPa	6,4627e-003 mm/mm
Maximum	28739 mm	1749,3 MPa	1,6157 mm/mm
Information			
Time	1, s		
Load Step	1		
Substep	52		
Iteration Number	52		
Integration Point Results			
Display Option		Averaged	
Average Across Bodies		No	

FIGURE 5
Model (A4) > Static Structural (A5) > Solution (A6) > Total Deformation

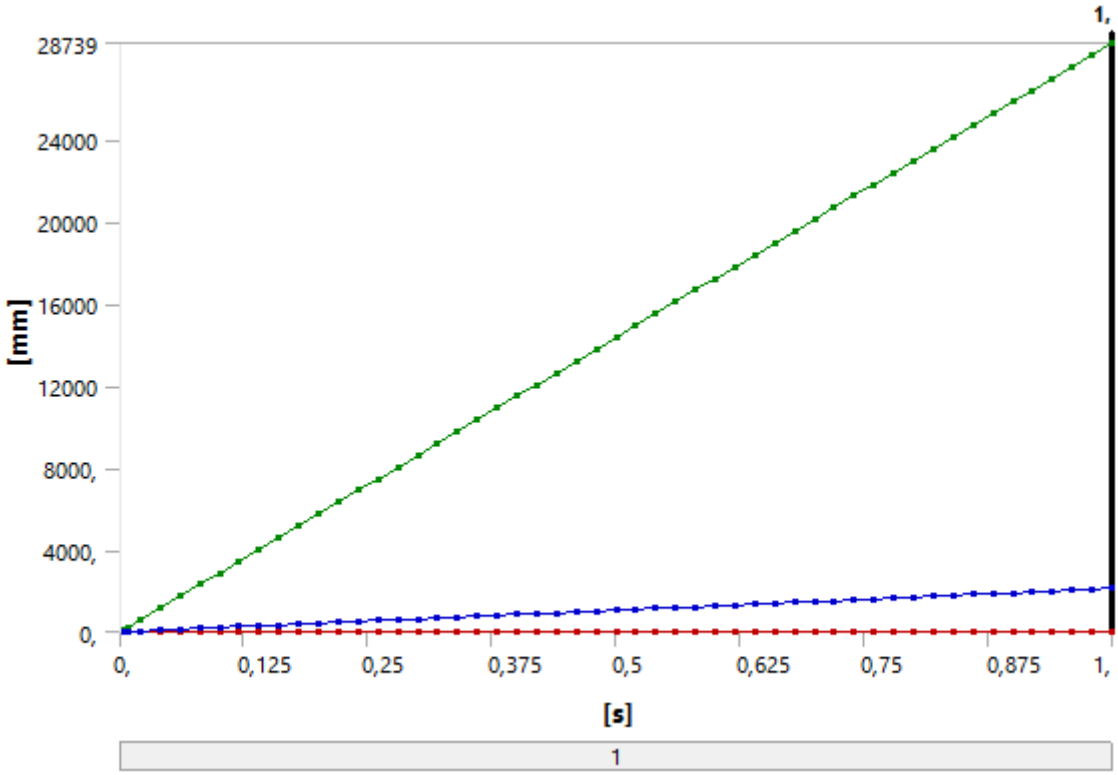


TABLE 17
Model (A4) > Static Structural (A5) > Solution (A6) > Total Deformation

Time [s]	Minimum [mm]	Maximum [mm]	Average [mm]
4,e-003	0,	114,96	8,4174
8,e-003		229,91	16,835
2,e-002		574,79	42,087
4,e-002		1149,6	84,174
6,e-002		1724,4	126,26
8,e-002		2299,1	168,35
0,1		2873,9	210,44
0,12		3448,7	252,52
0,14		4023,5	294,61
0,16		4598,3	336,7
0,18		5173,1	378,78
0,2		5747,9	420,87
0,22		6322,7	462,96
0,24		6897,4	505,05
0,26		7472,2	547,13
0,28		8047,	589,22
0,3		8621,8	631,31
0,32		9196,6	673,39
0,34		9771,4	715,48
0,36		10346	757,57
0,38		10921	799,66
0,4		11496	841,74
0,42		12071	883,83
0,44		12645	925,92
0,46		13220	968,01
0,48		13795	1010,1

0,5		14370	1052,2
0,52		14944	1094,3
0,54		15519	1136,4
0,56		16094	1178,4
0,58		16669	1220,5
0,6		17244	1262,6
0,62		17818	1304,7
0,64		18393	1346,8
0,66		18968	1388,9
0,68		19543	1431,
0,7		20118	1473,1
0,72		20692	1515,1
0,74		21267	1557,2
0,76		21842	1599,3
0,78		22417	1641,4
0,8		22991	1683,5
0,82		23566	1725,6
0,84		24141	1767,7
0,86		24716	1809,7
0,88		25291	1851,8
0,9		25865	1893,9
0,92		26440	1936,
0,94		27015	1978,1
0,96		27590	2020,2
0,98		28165	2062,3
1,		28739	2104,4

FIGURE 6
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Intensity

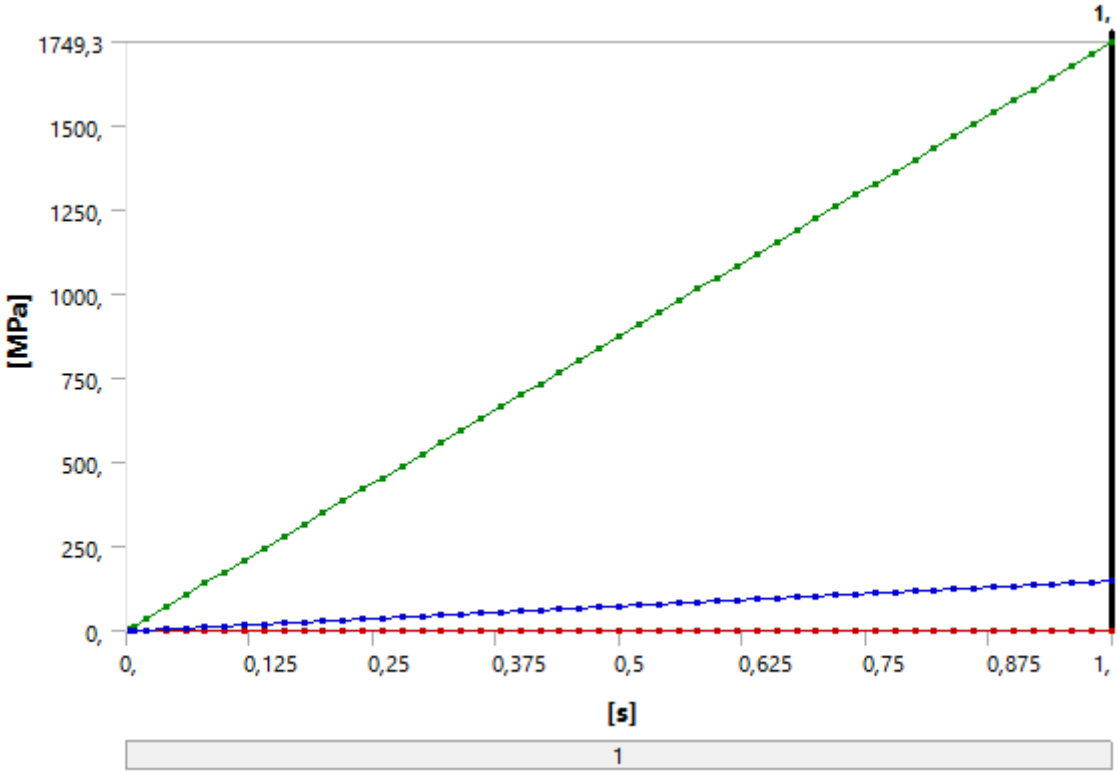


TABLE 18
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Intensity

Time [s]	Minimum [MPa]	Maximum [MPa]	Average [MPa]
4,e-003		6,9971	0,59162
8,e-003		13,994	1,1832
2,e-002		34,985	2,9581
4,e-002		69,971	5,9162
6,e-002		104,96	8,8743
8,e-002		139,94	11,832
0,1		174,93	14,791
0,12		209,91	17,749
0,14		244,9	20,707
0,16		279,88	23,665
0,18		314,87	26,623
0,2		349,85	29,581
0,22		384,84	32,539
0,24		419,83	35,497
0,26		454,81	38,456
0,28		489,8	41,414
0,3		524,78	44,372
0,32		559,77	47,33
0,34		594,75	50,288
0,36		629,74	53,246
0,38		664,72	56,204
0,4		699,71	59,162
0,42		734,69	62,12
0,44		769,68	65,079
0,46	0,	804,67	68,037
0,48		839,65	70,995
0,5		874,64	73,953
0,52		909,62	76,911
0,54		944,61	79,869
0,56		979,59	82,827
0,58		1014,6	85,785
0,6		1049,6	88,743
0,62		1084,5	91,702
0,64		1119,5	94,66
0,66		1154,5	97,618
0,68		1189,5	100,58
0,7		1224,5	103,53
0,72		1259,5	106,49
0,74		1294,5	109,45
0,76		1329,4	112,41
0,78		1364,4	115,37
0,8		1399,4	118,32
0,82		1434,4	121,28
0,84		1469,4	124,24
0,86		1504,4	127,2
0,88		1539,4	130,16
0,9		1574,3	133,12
0,92		1609,3	136,07
0,94		1644,3	139,03
0,96		1679,3	141,99

0,98		1714,3	144,95
1,		1749,3	147,91

FIGURE 7
Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Elastic Strain

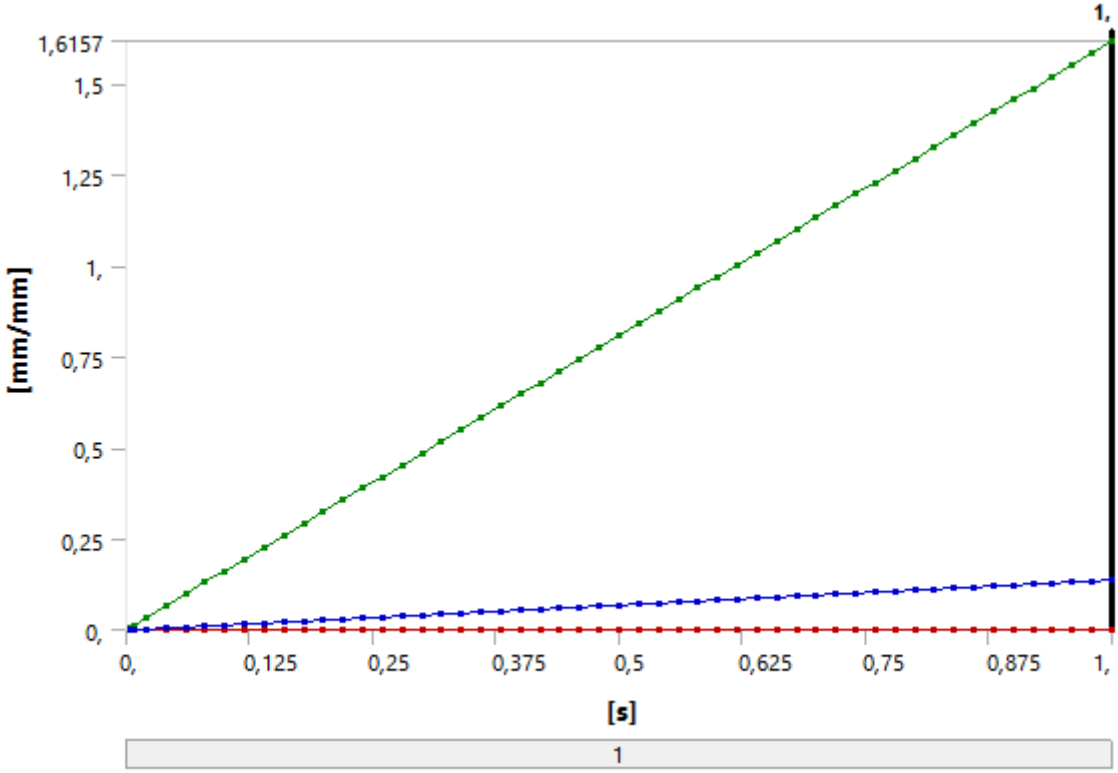


TABLE 19
Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Elastic Strain

Time [s]	Minimum [mm/mm]	Maximum [mm/mm]	Average [mm/mm]
4,e-003	0,	6,4627e-003	5,4392e-004
8,e-003		1,2925e-002	1,0878e-003
2,e-002		3,2313e-002	2,7196e-003
4,e-002		6,4627e-002	5,4392e-003
6,e-002		9,694e-002	8,1588e-003
8,e-002		0,12925	1,0878e-002
0,1		0,16157	1,3598e-002
0,12		0,19388	1,6318e-002
0,14		0,22619	1,9037e-002
0,16		0,25851	2,1757e-002
0,18		0,29082	2,4477e-002
0,2		0,32313	2,7196e-002
0,22		0,35545	2,9916e-002
0,24		0,38776	3,2635e-002
0,26		0,42007	3,5355e-002
0,28		0,45239	3,8075e-002
0,3		0,4847	4,0794e-002
0,32		0,51701	4,3514e-002
0,34		0,54933	4,6233e-002
0,36		0,58164	4,8953e-002
0,38		0,61395	5,1673e-002

0,4		0,64627	5,4392e-002
0,42		0,67858	5,7112e-002
0,44		0,71089	5,9831e-002
0,46		0,74321	6,2551e-002
0,48		0,77552	6,5271e-002
0,5		0,80783	6,799e-002
0,52		0,84014	7,071e-002
0,54		0,87246	7,343e-002
0,56		0,90477	7,6149e-002
0,58		0,93708	7,8869e-002
0,6		0,9694	8,1588e-002
0,62		1,0017	8,4308e-002
0,64		1,034	8,7028e-002
0,66		1,0663	8,9747e-002
0,68		1,0987	9,2467e-002
0,7		1,131	9,5186e-002
0,72		1,1633	9,7906e-002
0,74		1,1956	0,10063
0,76		1,2279	0,10335
0,78		1,2602	0,10606
0,8		1,2925	0,10878
0,82		1,3248	0,1115
0,84		1,3572	0,11422
0,86		1,3895	0,11694
0,88		1,4218	0,11966
0,9		1,4541	0,12238
0,92		1,4864	0,1251
0,94		1,5187	0,12782
0,96		1,551	0,13054
0,98		1,5833	0,13326
1,		1,6157	0,13598

TABLE 20
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Safety Tools

Object Name	*Stress Tool*
State	Solved
Definition	
Theory	Max Equivalent Stress
Stress Limit Type	Tensile Yield Per Material

TABLE 21
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Tool > Results

Object Name	*Safety Factor*
State	Solved
Scope	
Scoping Method	Geometry Selection
Geometry	All Bodies
Definition	
Type	Safety Factor
By	Time
Display Time	Last
Calculate Time History	Yes
Identifier	

Suppressed	No
Integration Point Results	
Display Option	Averaged
Average Across Bodies	No
Results	
Minimum	2,5701e-002
Minimum Occurs On	REDISSENY-CONTACT-PROVA6\Surface1
Minimum Value Over Time	
Minimum	2,5701e-002
Maximum	6,4252
Maximum Value Over Time	
Minimum	15,
Maximum	15,
Information	
Time	1, s
Load Step	1
Substep	52
Iteration Number	52

FIGURE 8
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Tool > Safety Factor

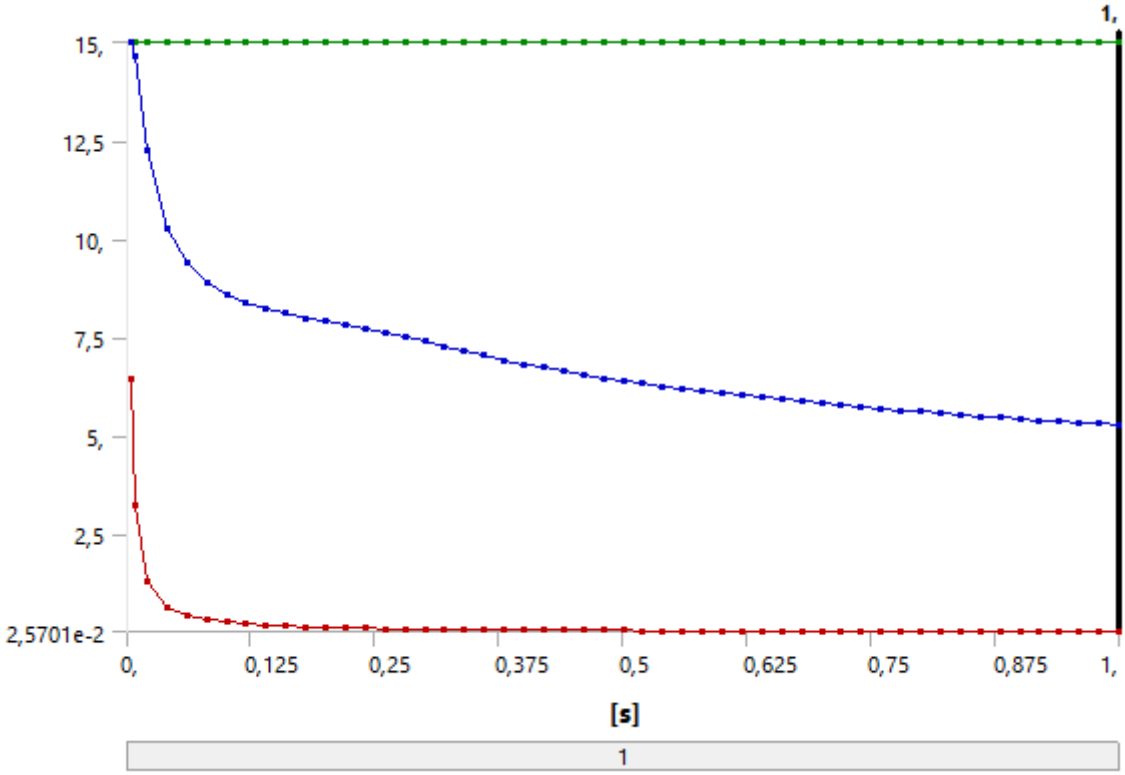


TABLE 22
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Tool > Safety Factor

Time [s]	Minimum	Maximum	Average
4,e-003	6,4252	15,	14,991
8,e-003	3,2126		14,627
2,e-002	1,285		12,247
4,e-002	0,64252		10,251
6,e-002	0,42835		9,3732

8,e-002	0,32126		8,8946
0,1	0,25701		8,5936
0,12	0,21417		8,384
0,14	0,18358		8,2273
0,16	0,16063		8,1026
0,18	0,14278		7,9966
0,2	0,1285		7,9041
0,22	0,11682		7,8172
0,24	0,10709		7,7284
0,26	9,8849e-002		7,6336
0,28	9,1788e-002		7,5242
0,3	8,5669e-002		7,399
0,32	8,0315e-002		7,2736
0,34	7,559e-002		7,1524
0,36	7,1391e-002		7,0351
0,38	6,7633e-002		6,9241
0,4	6,4252e-002		6,8205
0,42	6,1192e-002		6,7237
0,44	5,8411e-002		6,6328
0,46	5,5871e-002		6,5469
0,48	5,3543e-002		6,4661
0,5	5,1401e-002		6,3901
0,52	4,9424e-002		6,3185
0,54	4,7594e-002		6,2509
0,56	4,5894e-002		6,1868
0,58	4,4312e-002		6,1259
0,6	4,2835e-002		6,0681
0,62	4,1453e-002		6,0128
0,64	4,0157e-002		5,96
0,66	3,894e-002		5,9093
0,68	3,7795e-002		5,8607
0,7	3,6715e-002		5,814
0,72	3,5695e-002		5,7692
0,74	3,4731e-002		5,7261
0,76	3,3817e-002		5,6846
0,78	3,295e-002		5,6448
0,8	3,2126e-002		5,6063
0,82	3,1342e-002		5,5691
0,84	3,0596e-002		5,533
0,86	2,9885e-002		5,4981
0,88	2,9205e-002		5,4641
0,9	2,8556e-002		5,4311
0,92	2,7936e-002		5,3989
0,94	2,7341e-002		5,3676
0,96	2,6772e-002		5,337
0,98	2,6225e-002		5,307
1,	2,5701e-002		5,2777

Material Data

Plastic, PA6

TABLE 23
Plastic, PA6 > Constants

Density	1,14e-006 kg mm^-3
Tensile Yield Strength	43,13 MPa
Tensile Ultimate Strength	71,89 MPa
Coefficient of Thermal Expansion	1,467e-004 C^-1
Thermal Conductivity	2,428e-004 W mm^-1 C^-1
Specific Heat	1,5e+006 mJ kg^-1 C^-1

TABLE 24
Plastic, PA6 > Opacity

Red	Green	Blue
0,	153,	255,

Opacity
0,6

Metallic Finish
0,

TABLE 25
Plastic, PA6 > Isotropic Elasticity

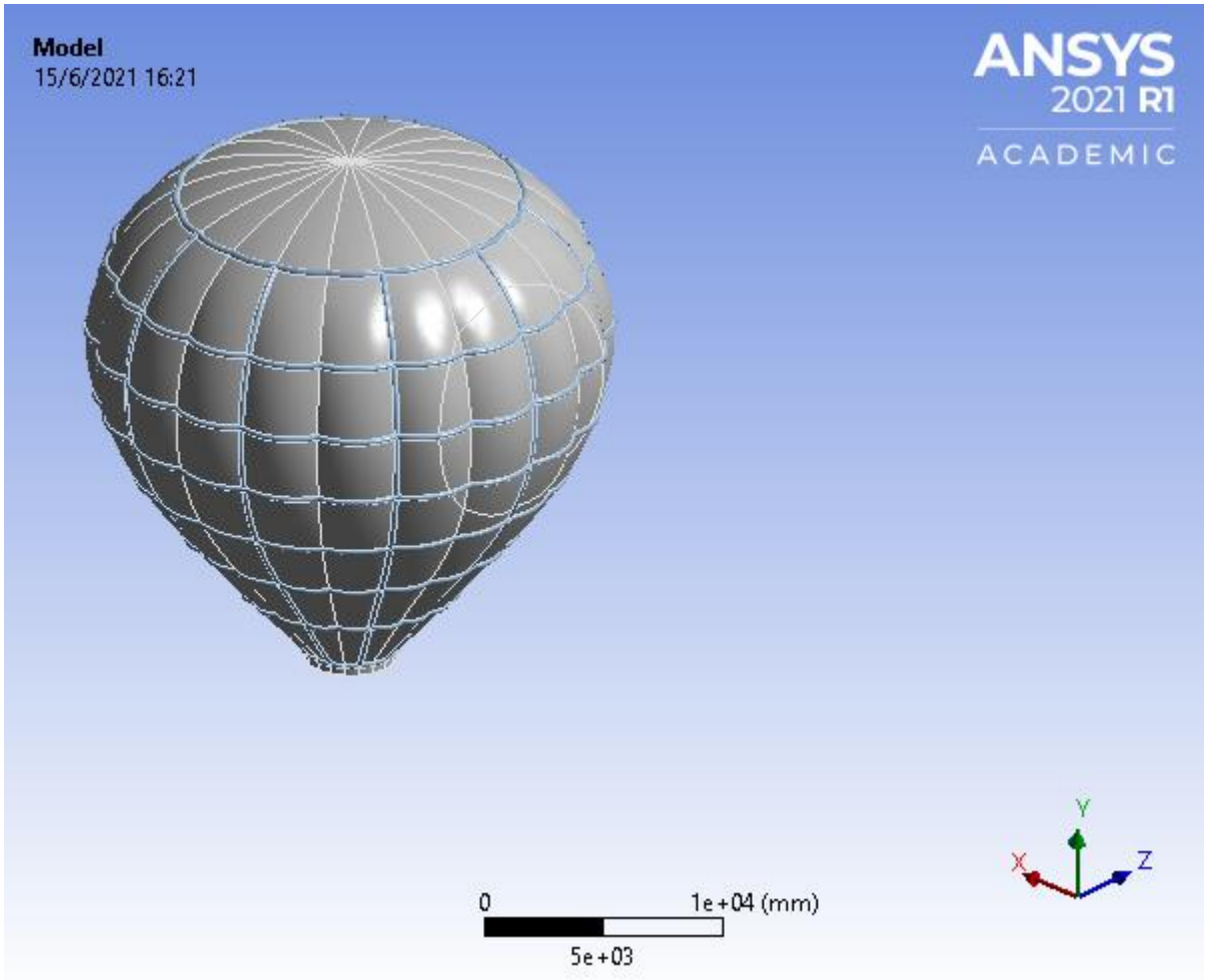
Young's Modulus MPa	Poisson's Ratio	Bulk Modulus MPa	Shear Modulus MPa	Temperature C
1111,	0,3499	1233,6	411,51	23,

TABLE 26
Plastic, PA6 > Isotropic Secant Coefficient of Thermal Expansion

Zero-Thermal-Strain Reference Temperature C
23,

Project

First Saved	Sunday, June 6, 2021
Last Saved	Tuesday, June 15, 2021
Product Version	2021 R1
Save Project Before Solution	No
Save Project After Solution	No



Contents

Units

TABLE 1

Unit System	Metric (mm, kg, N, s, mV, mA) Degrees rad/s Celsius
Angle	Degrees
Rotational Velocity	rad/s
Temperature	Celsius

Model (B4)

Geometry

TABLE 2
Model (B4) > Geometry

Object Name	*Geometry*
State	Fully Defined
Definition	
Source	C:\Users\fvila\Desktop\6-PROVA-redisseny_+tubs\REDISSENY+TUBS+OPEN-PROVA6_files\dp0\SYS-1\DM\SYS-1.scdoc
Type	SpaceClaim
Length Unit	Meters
Element Control	Program Controlled
Display Style	Body Color
Bounding Box	

Length X	22213 mm
Length Y	23200 mm
Length Z	22213 mm
Properties	
Volume	7,555e+008 mm³
Mass	1926,1 kg
Surface Area(approx.)	1,8888e+009 mm²
Scale Factor Value	1,
2D Tolerance	Default (1,e-005)
Statistics	
Bodies	2
Active Bodies	2
Nodes	20537
Elements	21861
Mesh Metric	None
Update Options	
Assign Default Material	No
Basic Geometry Options	
Solid Bodies	Yes
Surface Bodies	Yes
Line Bodies	Yes
Parameters	Independent
Parameter Key	
Attributes	Yes
Attribute Key	
Named Selections	Yes
Named Selection Key	
Material Properties	Yes
Advanced Geometry Options	
Use Associativity	Yes
Coordinate Systems	Yes
Coordinate System Key	
Reader Mode Saves Updated File	No
Use Instances	Yes
Smart CAD Update	Yes
Compare Parts On Update	No
Analysis Type	3-D
Mixed Import Resolution	None
Import Facet Quality	Source
Clean Bodies On Import	No
Stitch Surfaces On Import	None
Decompose Disjoint Geometry	Yes

Enclosure and Symmetry Processing	Yes

TABLE 3
Model (B4) > Geometry > Parts

Object Name	*REDISSENY-VELA-PROVA6\Surface1*	*REDISSENY-CONTACT-PROVA6\Surface1*
State	Meshed	
Graphics Properties		
Visible	Yes	
Transparency	1	
Definition		
Suppressed	No	
Dimension	3D	
Stiffness Behavior	Flexible	
Coordinate System	Default Coordinate System	
Reference Temperature	By Environment	
Thickness	0,4 mm	
Thickness Mode	Manual	
Offset Type	Middle	
Treatment	None	
Model Type	Shell	
Material		
Assignment	Plastic, PA6	Structural Steel
Nonlinear Effects	Yes	
Thermal Strain Effects	Yes	
Bounding Box		
Length X	22001 mm	22213 mm
Length Y	23200 mm	21300 mm
Length Z	22001 mm	22213 mm
Properties		
Volume	5,9681e+008 mm³	1,5869e+008 mm³
Mass	680,36 kg	1245,7 kg
Centroid X	9110,5 mm	9111,7 mm
Centroid Y	17515 mm	16286 mm
Centroid Z	21649 mm	21650 mm
Moment of Inertia Ip1	5,2134e+010 kg·mm²	9,4837e+010 kg·mm²
Moment of Inertia Ip2	5,2066e+010 kg·mm²	9,7234e+010 kg·mm²
Moment of Inertia Ip3	5,2128e+010 kg·mm²	9,4832e+010 kg·mm²
Surface Area(approx.)	1,492e+009 mm²	3,9673e+008 mm²
Statistics		
Nodes	9482	11055
Elements	9562	12299
Mesh Metric	None	
CAD Attributes		
PartTolerance:	0,00000001	
Color:154.175.143		
Color:175.143.143		

TABLE 4
Model (B4) > Materials

Object Name	*Materials*
State	Fully Defined
Statistics	
Materials	2
Material Assignments	0

Coordinate Systems

TABLE 5
Model (B4) > Coordinate Systems > Coordinate System

Object Name	*Global Coordinate System*
State	Fully Defined
Definition	
Type	Cartesian
Coordinate System ID	0,
Origin	
Origin X	0, mm
Origin Y	0, mm
Origin Z	0, mm
Directional Vectors	
X Axis Data	[1, 0, 0,]
Y Axis Data	[0, 1, 0,]
Z Axis Data	[0, 0, 1,]

Connections

TABLE 6
Model (B4) > Connections

Object Name	*Connections*
State	Fully Defined
Auto Detection	
Generate Automatic Connection On Refresh	Yes
Transparency	
Enabled	Yes

TABLE 7
Model (B4) > Connections > Contacts

Object Name	*Contacts*
State	Fully Defined
Definition	
Connection Type	Contact
Scope	
Scoping Method	Geometry Selection
Geometry	All Bodies
Auto Detection	
Tolerance Type	Slider
Tolerance Slider	0,
Tolerance Value	97,63 mm
Use Range	No
Face/Face	Yes
Face-Face Angle Tolerance	75, °
Face Overlap Tolerance	Off

Cylindrical Faces	Include
Face/Edge	No
Edge/Edge	No
Priority	Include All
Group By	Bodies
Search Across	Bodies
Statistics	
Connections	1
Active Connections	1

TABLE 8
Model (B4) > Connections > Contacts > Contact Regions

Object Name	*Bonded - REDISSENY-VELA-PROVA6\Surface1 To REDISSENY-CONTACT-PROVA6\Surface1*
State	Fully Defined
Scope	
Scoping Method	Geometry Selection
Contact	46 Faces
Target	40 Faces
Contact Bodies	REDISSENY-VELA-PROVA6\Surface1
Target Bodies	REDISSENY-CONTACT-PROVA6\Surface1
Contact Shell Face	Program Controlled
Target Shell Face	Program Controlled
Shell Thickness Effect	No
Protected	No
Definition	
Type	Bonded
Scope Mode	Manual
Behavior	Program Controlled
Trim Contact	Program Controlled
Suppressed	No
Advanced	
Formulation	Program Controlled
Small Sliding	Program Controlled
Detection Method	Program Controlled
Penetration Tolerance	Program Controlled
Elastic Slip Tolerance	Program Controlled
Normal Stiffness	Program Controlled
Update Stiffness	Program Controlled
Pinball Region	Program Controlled
Geometric Modification	
Contact Geometry Correction	None
Target Geometry Correction	None

Mesh

TABLE 9
Model (B4) > Mesh

Object Name	*Mesh*
State	Solved
Display	

Display Style	Use Geometry Setting
Defaults	
Physics Preference	Mechanical
Element Order	Program Controlled
Element Size	Default (376,18 mm)
Sizing	
Use Adaptive Sizing	No
Growth Rate	Default (1,2)
Mesh Defeaturing	Yes
Defeature Size	Default (1,8809 mm)
Capture Curvature	Yes
Curvature Min Size	Default (3,7618 mm)
Curvature Normal Angle	Default (30,°)
Capture Proximity	No
Bounding Box Diagonal	39052 mm
Average Surface Area	9,0566e+006 mm²
Minimum Edge Length	15,709 mm
Quality	
Check Mesh Quality	Yes, Errors
Error Limits	Aggressive Mechanical
Target Quality	Default (0.050000)
Smoothing	Medium
Mesh Metric	None
Inflation	
Use Automatic Inflation	None
Inflation Option	Smooth Transition
Transition Ratio	0,272
Maximum Layers	2
Growth Rate	1,2
Inflation Algorithm	Pre
View Advanced Options	No
Batch Connections	
Mesh Based Connection	No
Advanced	
Number of CPUs for Parallel Part Meshing	Program Controlled
Straight Sided Elements	No
Rigid Body Behavior	Dimensionally Reduced
Triangle Surface Mesher	Program Controlled
Topology Checking	Yes
Use Sheet Thickness for Pinch	No
Pinch Tolerance	Default (3,3856 mm)
Generate Pinch on Refresh	No
Sheet Loop Removal	No
Statistics	
Nodes	20537
Elements	21861

TABLE 10
Model (B4) > Mesh > Mesh Controls

Object Name	*400mm vela*	*200mm tubs*
State	Fully Defined	
Scope		

Scoping Method	Geometry Selection	
Geometry	1 Body	
Definition		
Suppressed	No	
Type	Element Size	
Element Size	400, mm	200, mm
Advanced		
Defeature Size	Default (1,8809 mm)	
Behavior	Soft	
Growth Rate	Default (1,2)	
Capture Curvature	No	
Capture Proximity	No	

Static Structural (B5)

TABLE 11
Model (B4) > Analysis

Object Name	*Static Structural (B5)*
State	Solved
Definition	
Physics Type	Structural
Analysis Type	Static Structural
Solver Target	Mechanical APDL
Options	
Environment Temperature	22, °C
Generate Input Only	No

TABLE 12
Model (B4) > Static Structural (B5) > Analysis Settings

Object Name	*Analysis Settings*
State	Fully Defined
Step Controls	
Number Of Steps	1,
Current Step Number	1,
Step End Time	1, s
Auto Time Stepping	On
Define By	Substeps
Initial Substeps	250,
Minimum Substeps	50,
Maximum Substeps	5000,
Solver Controls	
Solver Type	Program Controlled
Weak Springs	Off
Solver Pivot Checking	Program Controlled
Large Deflection	Off
Inertia Relief	Off
Quasi-Static Solution	Off
Rotordynamics Controls	
Coriolis Effect	Off

Restart Controls	
Generate Restart Points	Program Controlled
Retain Files After Full Solve	No
Combine Restart Files	Program Controlled
Nonlinear Controls	
Newton-Raphson Option	Program Controlled
Force Convergence	Program Controlled
Moment Convergence	Program Controlled
Displacement Convergence	Program Controlled
Rotation Convergence	Program Controlled
Line Search	Program Controlled
Stabilization	Program Controlled
Advanced	
Inverse Option	No
Contact Split (DMP)	Off
Output Controls	
Stress	Yes
Surface Stress	No
Back Stress	No
Strain	Yes
Contact Data	Yes
Nonlinear Data	No
Nodal Forces	No
Volume and Energy	Yes
Euler Angles	Yes
General Miscellaneous	No
Contact Miscellaneous	No
Store Results At	All Time Points
Result File Compression	Program Controlled
Analysis Data Management	
Solver Files Directory	C:\Users\fvila\Desktop\6-PROVA-redisseny_+tubs\REDISSENY+TUBS+OPEN-PROVA6_files\dp0\SYS-1\MECH\
Future Analysis	None
Scratch Solver Files Directory	
Save MAPDL db	No
Contact Summary	Program Controlled
Delete Unneeded Files	Yes
Nonlinear Solution	No
Solver Units	Active System
Solver Unit System	nmm

TABLE 13
Model (B4) > Static Structural (B5) > Loads

Object Name	*Displacement*	*Fixed Rotation*	*Pint_vela - 0,000734MPA*	*Pvent 21m/s*	*Ptubs -2bar - 1atm aire ext*
State	Fully Defined				
Scope					
Scoping Method	Geometry Selection				
Geometry	21 Faces	11 Faces	47 Faces	4 Faces	83 Faces
Definition					
Type	Displacement	Fixed Rotation	Pressure		
Define By	Components		Normal To		
Coordinate System	Global Coordinate System				
X Component	0, mm (ramped)				
Y Component	0, mm (ramped)				
Z Component	0, mm (ramped)				
Suppressed	No				
Rotation X		Fixed			
Rotation Y		Fixed			
Rotation Z		Fixed			
Applied By			Surface Effect		
Loaded Area			Deformed		
Magnitude			-7,34e-004 MPa (ramped)	2,756e-004 MPa (ramped)	-0,1 MPa (ramped)

FIGURE 1
Model (B4) > Static Structural (B5) > Displacement

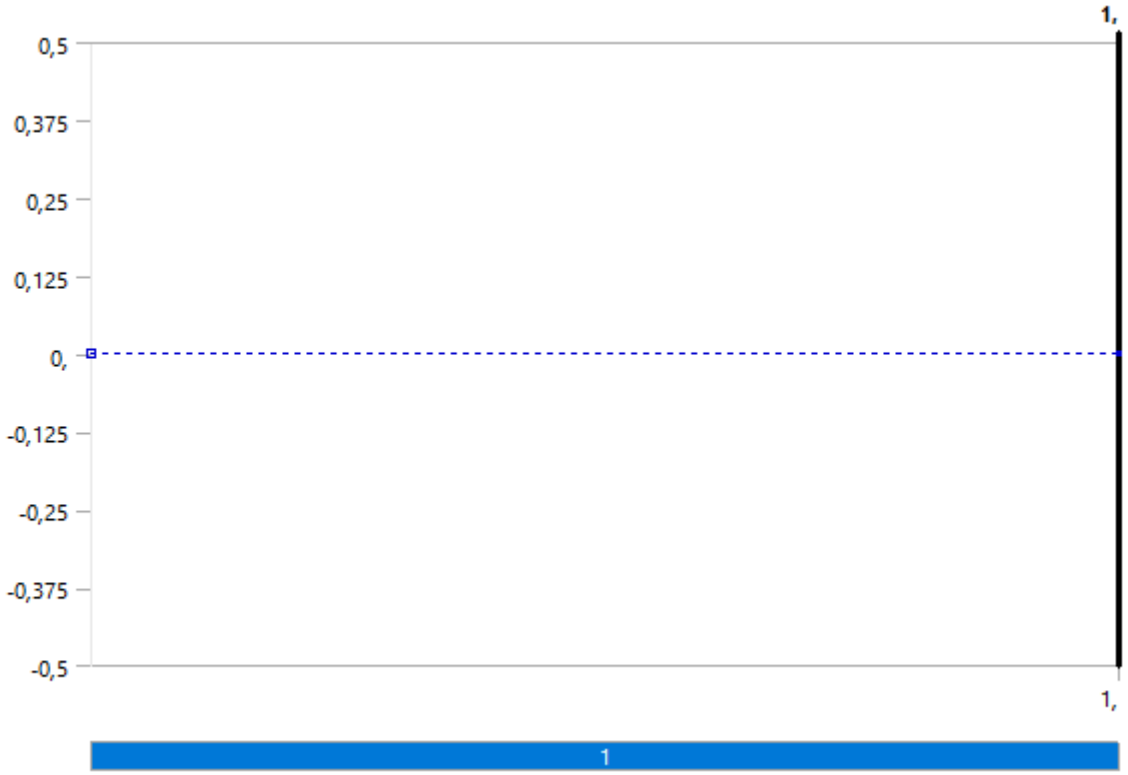


FIGURE 2
Model (B4) > Static Structural (B5) > Pint_vela -0,000734MPA

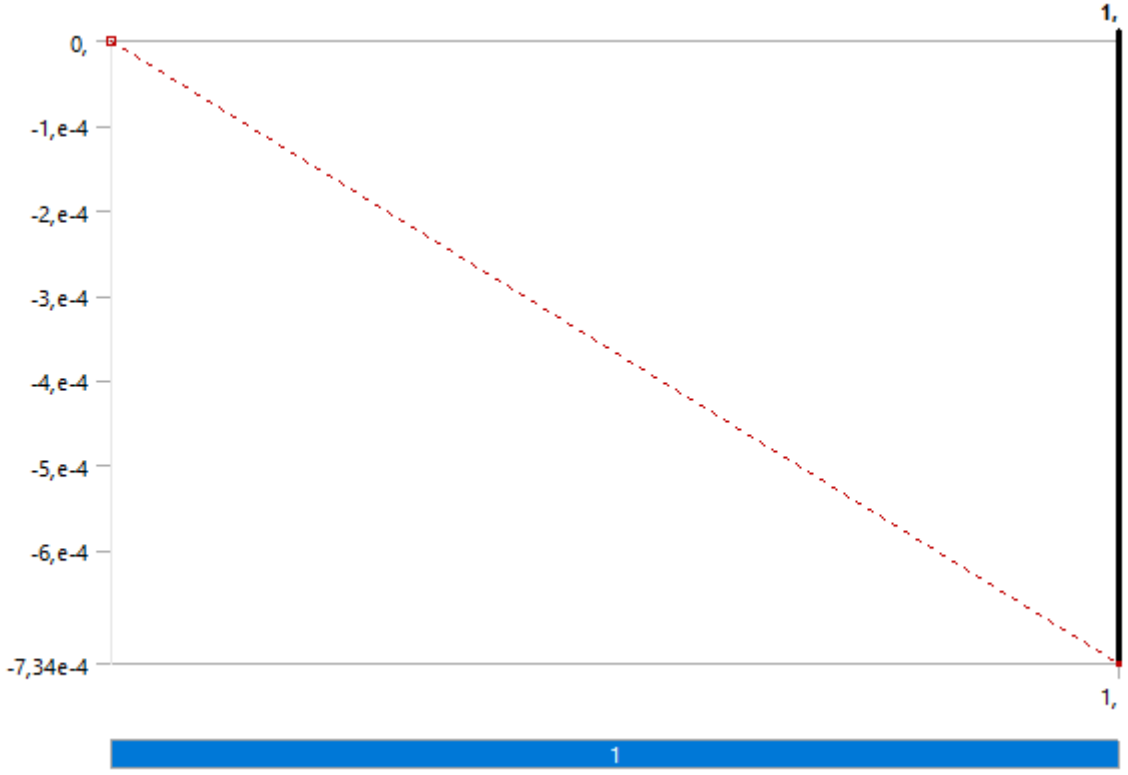


FIGURE 3
Model (B4) > Static Structural (B5) > Pvent 21m/s

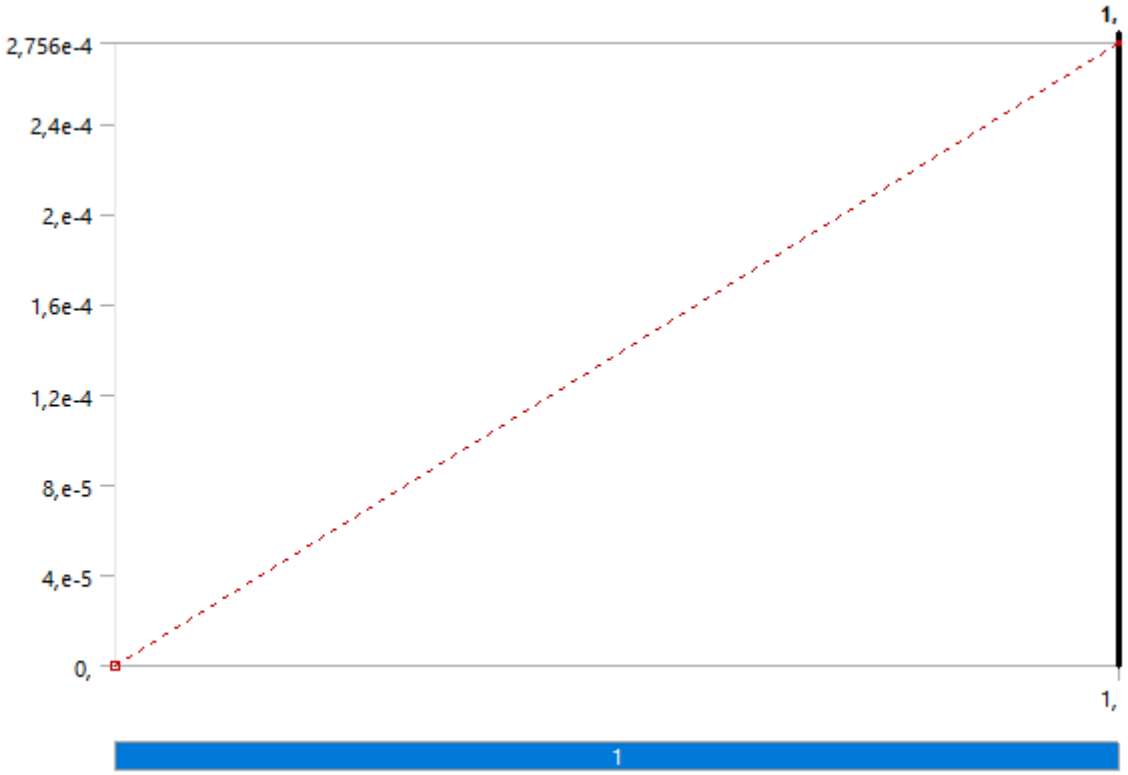
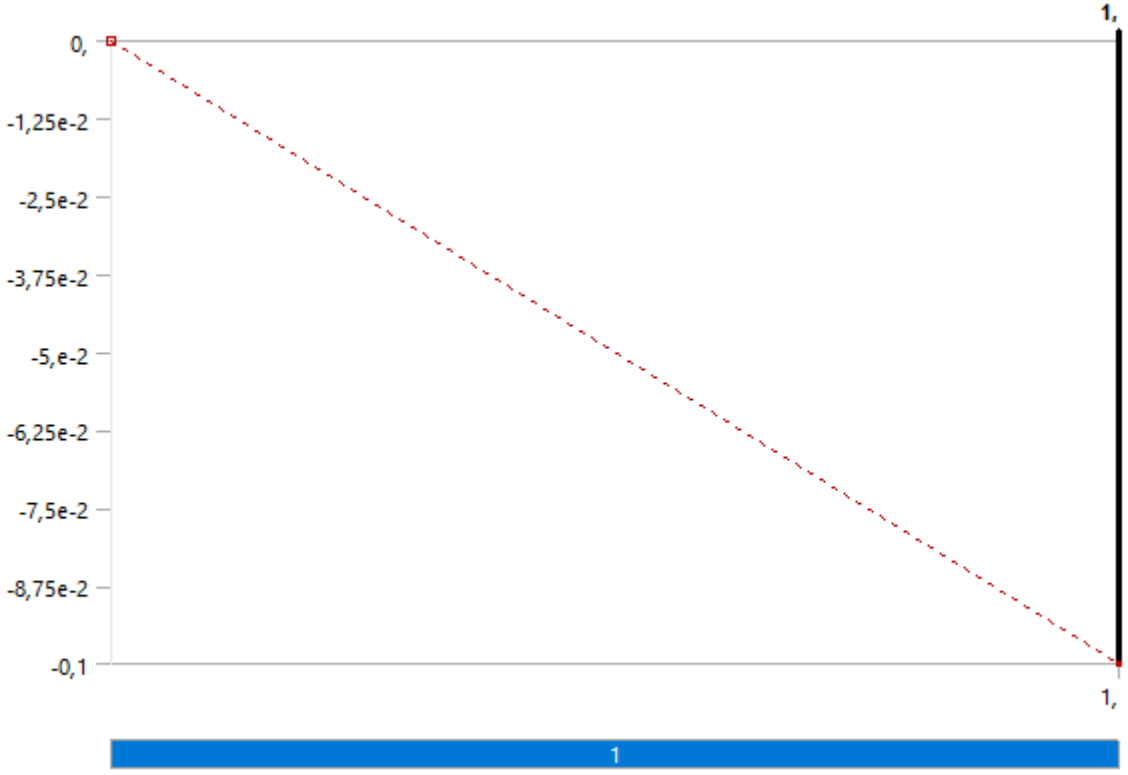


FIGURE 4
Model (B4) > Static Structural (B5) > Ptubs -2bar -1atm aire ext



Solution (B6)

TABLE 14
Model (B4) > Static Structural (B5) > Solution

Object Name	*Solution (B6)*
State	Solved
Adaptive Mesh Refinement	
Max Refinement Loops	1,
Refinement Depth	2,
Information	
Status	Done
MAPDL Elapsed Time	4 m 41 s
MAPDL Memory Used	963, MB
MAPDL Result File Size	1,1687 GB
Post Processing	
Beam Section Results	No
On Demand Stress/Strain	No

TABLE 15
Model (B4) > Static Structural (B5) > Solution (B6) > Solution Information

Object Name	*Solution Information*
State	Solved
Solution Information	
Solution Output	Solver Output
Newton-Raphson Residuals	0
Identify Element Violations	0
Update Interval	2,5 s
Display Points	All
FE Connection Visibility	
Activate Visibility	Yes
Display	All FE Connectors
Draw Connections Attached To	All Nodes
Line Color	Connection Type
Visible on Results	No
Line Thickness	Single
Display Type	Lines

TABLE 16
Model (B4) > Static Structural (B5) > Solution (B6) > Results

Object Name	*Total Deformation*	*Stress Intensity*	*Equivalent Elastic Strain*
State	Solved		
Scope			
Scoping Method	Geometry Selection		
Geometry	All Bodies		
Position		Top/Bottom	
Definition			
Type	Total Deformation	Stress Intensity	Equivalent Elastic Strain
By	Time		
Display Time	Last		
Calculate Time History	Yes		
Identifier			
Suppressed	No		
Results			

Minimum	0, mm	0, MPa	0, mm/mm
Maximum	3367,2 mm	6293,2 MPa	8,4612e-002 mm/mm
Average	137,75 mm	353,08 MPa	6,5997e-003 mm/mm
Minimum Occurs On	REDISSENY-VELA-PROVA6\Surface1		
Maximum Occurs On	REDISSENY-VELA-PROVA6\Surface1	REDISSENY-CONTACT-PROVA6\Surface1	REDISSENY-VELA-PROVA6\Surface1
Minimum Value Over Time			
Minimum	0, mm	0, MPa	0, mm/mm
Maximum	0, mm	0, MPa	0, mm/mm
Maximum Value Over Time			
Minimum	13,469 mm	25,173 MPa	3,3845e-004 mm/mm
Maximum	3367,2 mm	6293,2 MPa	8,4612e-002 mm/mm
Information			
Time	1, s		
Load Step	1		
Substep	52		
Iteration Number	52		
Integration Point Results			
Display Option		Averaged	
Average Across Bodies		No	

FIGURE 5
Model (B4) > Static Structural (B5) > Solution (B6) > Total Deformation

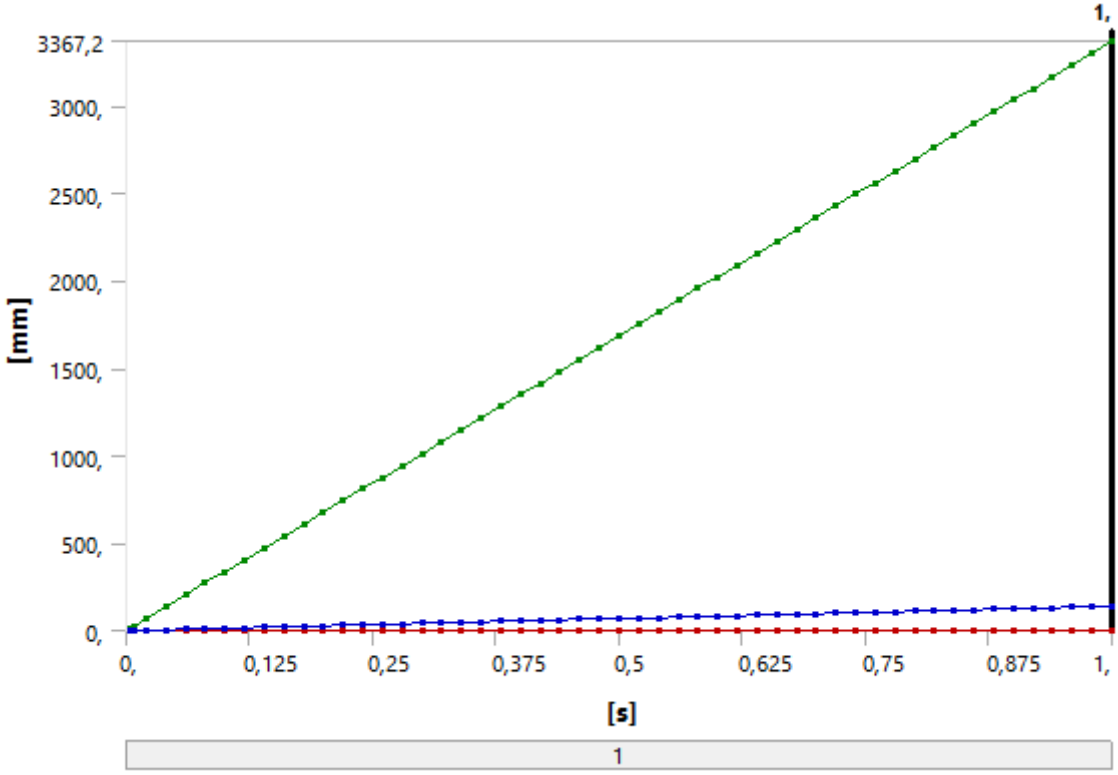


TABLE 17
Model (B4) > Static Structural (B5) > Solution (B6) > Total Deformation

Time [s]	Minimum [mm]	Maximum [mm]	Average [mm]
4,e-003	0,	13,469	0,55101

8,e-003		26,938	1,102
2,e-002		67,344	2,755
4,e-002		134,69	5,5101
6,e-002		202,03	8,2651
8,e-002		269,38	11,02
0,1		336,72	13,775
0,12		404,07	16,53
0,14		471,41	19,285
0,16		538,75	22,04
0,18		606,1	24,795
0,2		673,44	27,55
0,22		740,79	30,305
0,24		808,13	33,06
0,26		875,47	35,816
0,28		942,82	38,571
0,3		1010,2	41,326
0,32		1077,5	44,081
0,34		1144,9	46,836
0,36		1212,2	49,591
0,38		1279,5	52,346
0,4		1346,9	55,101
0,42		1414,2	57,856
0,44		1481,6	60,611
0,46		1548,9	63,366
0,48		1616,3	66,121
0,5		1683,6	68,876
0,52		1750,9	71,631
0,54		1818,3	74,386
0,56		1885,6	77,141
0,58		1953,	79,896
0,6		2020,3	82,651
0,62		2087,7	85,406
0,64		2155,	88,161
0,66		2222,4	90,916
0,68		2289,7	93,671
0,7		2357,	96,426
0,72		2424,4	99,181
0,74		2491,7	101,94
0,76		2559,1	104,69
0,78		2626,4	107,45
0,8		2693,8	110,2
0,82		2761,1	112,96
0,84		2828,5	115,71
0,86		2895,8	118,47
0,88		2963,1	121,22
0,9		3030,5	123,98
0,92		3097,8	126,73
0,94		3165,2	129,49
0,96		3232,5	132,24
0,98		3299,9	135,
1,		3367,2	137,75

FIGURE 6
Model (B4) > Static Structural (B5) > Solution (B6) > Stress Intensity

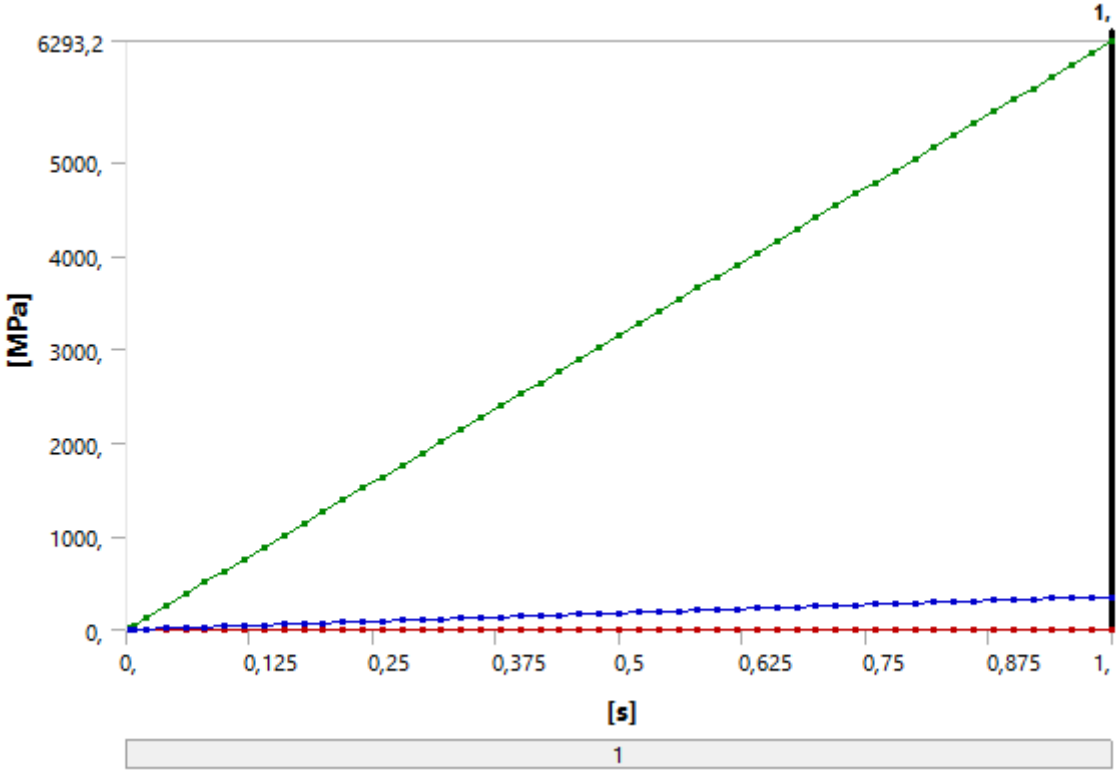


TABLE 18
Model (B4) > Static Structural (B5) > Solution (B6) > Stress Intensity

Time [s]	Minimum [MPa]	Maximum [MPa]	Average [MPa]
4,e-003	0,	25,173	1,4123
8,e-003		50,346	2,8246
2,e-002		125,86	7,0615
4,e-002		251,73	14,123
6,e-002		377,59	21,185
8,e-002		503,46	28,246
0,1		629,32	35,308
0,12		755,19	42,369
0,14		881,05	49,431
0,16		1006,9	56,492
0,18		1132,8	63,554
0,2		1258,6	70,615
0,22		1384,5	77,677
0,24		1510,4	84,738
0,26		1636,2	91,8
0,28		1762,1	98,861
0,3		1888,	105,92
0,32		2013,8	112,98
0,34		2139,7	120,05
0,36		2265,6	127,11
0,38		2391,4	134,17
0,4		2517,3	141,23
0,42		2643,2	148,29
0,44		2769,	155,35

0,46		2894,9	162,41
0,48		3020,8	169,48
0,5		3146,6	176,54
0,52		3272,5	183,6
0,54		3398,4	190,66
0,56		3524,2	197,72
0,58		3650,1	204,78
0,6		3775,9	211,85
0,62		3901,8	218,91
0,64		4027,7	225,97
0,66		4153,5	233,03
0,68		4279,4	240,09
0,7		4405,3	247,15
0,72		4531,1	254,21
0,74		4657,	261,28
0,76		4782,9	268,34
0,78		4908,7	275,4
0,8		5034,6	282,46
0,82		5160,5	289,52
0,84		5286,3	296,58
0,86		5412,2	303,65
0,88		5538,1	310,71
0,9		5663,9	317,77
0,92		5789,8	324,83
0,94		5915,7	331,89
0,96		6041,5	338,95
0,98		6167,4	346,01
1,		6293,2	353,08

FIGURE 7
Model (B4) > Static Structural (B5) > Solution (B6) > Equivalent Elastic Strain

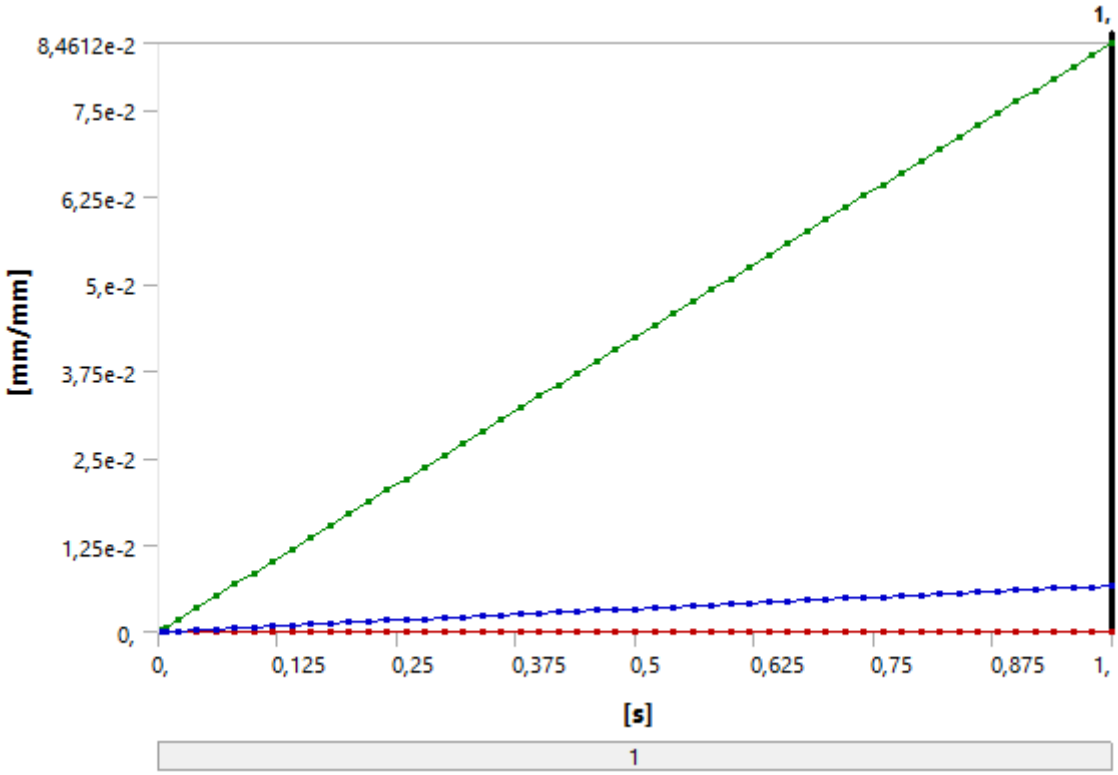


TABLE 19
Model (B4) > Static Structural (B5) > Solution (B6) > Equivalent Elastic Strain

Time [s]	Minimum [mm/mm]	Maximum [mm/mm]	Average [mm/mm]
4,e-003	0,	3,3845e-004	2,6399e-005
8,e-003		6,769e-004	5,2798e-005
2,e-002		1,6922e-003	1,3199e-004
4,e-002		3,3845e-003	2,6399e-004
6,e-002		5,0767e-003	3,9598e-004
8,e-002		6,769e-003	5,2798e-004
0,1		8,4612e-003	6,5997e-004
0,12		1,0153e-002	7,9197e-004
0,14		1,1846e-002	9,2396e-004
0,16		1,3538e-002	1,056e-003
0,18		1,523e-002	1,188e-003
0,2		1,6922e-002	1,3199e-003
0,22		1,8615e-002	1,4519e-003
0,24		2,0307e-002	1,5839e-003
0,26		2,1999e-002	1,7159e-003
0,28		2,3691e-002	1,8479e-003
0,3		2,5384e-002	1,9799e-003
0,32		2,7076e-002	2,1119e-003
0,34		2,8768e-002	2,2439e-003
0,36		3,046e-002	2,3759e-003
0,38		3,2153e-002	2,5079e-003
0,4		3,3845e-002	2,6399e-003
0,42		3,5537e-002	2,7719e-003
0,44		3,7229e-002	2,9039e-003
0,46		3,8921e-002	3,0359e-003
0,48		4,0614e-002	3,1679e-003

0,5		4,2306e-002	3,2999e-003
0,52		4,3998e-002	3,4319e-003
0,54		4,569e-002	3,5639e-003
0,56		4,7383e-002	3,6958e-003
0,58		4,9075e-002	3,8278e-003
0,6		5,0767e-002	3,9598e-003
0,62		5,2459e-002	4,0918e-003
0,64		5,4152e-002	4,2238e-003
0,66		5,5844e-002	4,3558e-003
0,68		5,7536e-002	4,4878e-003
0,7		5,9228e-002	4,6198e-003
0,72		6,0921e-002	4,7518e-003
0,74		6,2613e-002	4,8838e-003
0,76		6,4305e-002	5,0158e-003
0,78		6,5997e-002	5,1478e-003
0,8		6,769e-002	5,2798e-003
0,82		6,9382e-002	5,4118e-003
0,84		7,1074e-002	5,5438e-003
0,86		7,2766e-002	5,6758e-003
0,88		7,4458e-002	5,8078e-003
0,9		7,6151e-002	5,9398e-003
0,92		7,7843e-002	6,0718e-003
0,94		7,9535e-002	6,2037e-003
0,96		8,1227e-002	6,3357e-003
0,98		8,292e-002	6,4677e-003
1,		8,4612e-002	6,5997e-003

TABLE 20
Model (B4) > Static Structural (B5) > Solution (B6) > Stress Safety Tools

Object Name	*Stress Tool*
State	Solved
Definition	
Theory	Max Equivalent Stress
Stress Limit Type	Tensile Yield Per Material

TABLE 21
Model (B4) > Static Structural (B5) > Solution (B6) > Stress Tool > Results

Object Name	*Safety Factor*
State	Solved
Scope	
Scoping Method	Geometry Selection
Geometry	All Bodies
Definition	
Type	Safety Factor
By	Time
Display Time	Last
Calculate Time History	Yes
Identifier	
Suppressed	No
Integration Point Results	
Display Option	Averaged
Average Across Bodies	No
Results	

Minimum	4,2259e-002
Minimum Occurs On	REDISSENY-CONTACT-PROVA6\Surface1
Minimum Value Over Time	
Minimum	4,2259e-002
Maximum	10,565
Maximum Value Over Time	
Minimum	15,
Maximum	15,
Information	
Time	1, s
Load Step	1
Substep	52
Iteration Number	52

FIGURE 8
Model (B4) > Static Structural (B5) > Solution (B6) > Stress Tool > Safety Factor

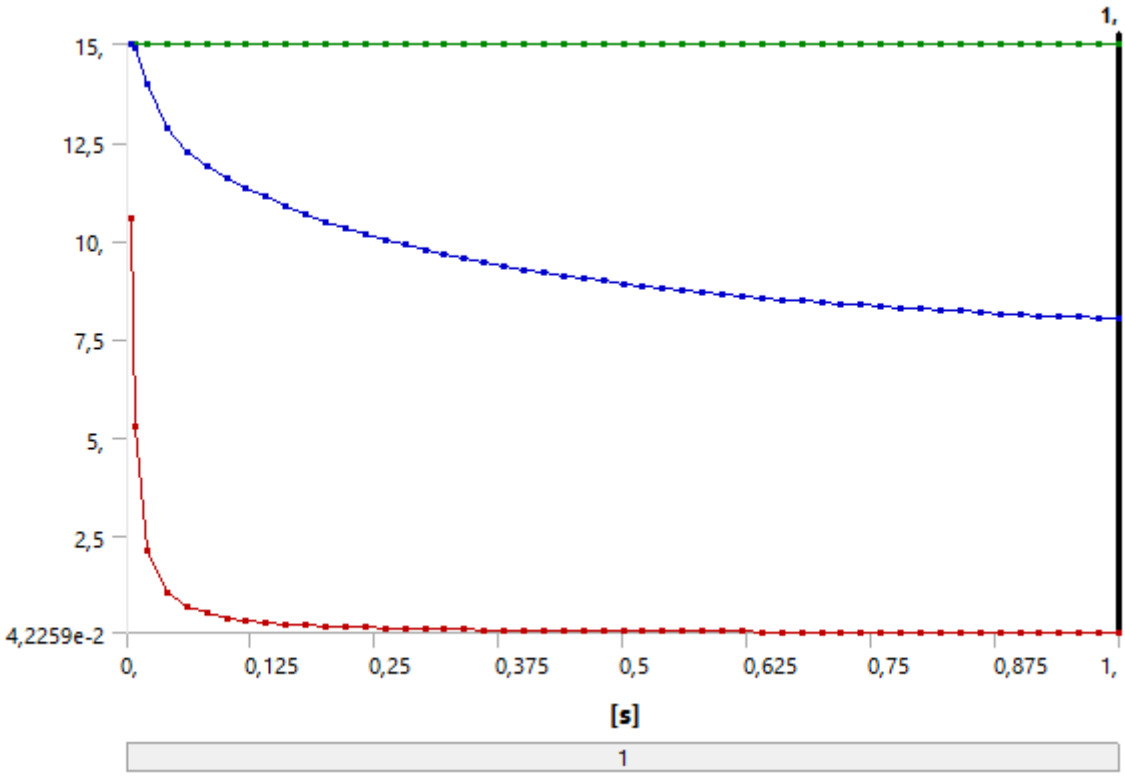


TABLE 22
Model (B4) > Static Structural (B5) > Solution (B6) > Stress Tool > Safety Factor

Time [s]	Minimum	Maximum	Average
4,e-003	10,565	15,	14,998
8,e-003	5,2824		14,903
2,e-002	2,113		13,993
4,e-002	1,0565		12,847
6,e-002	0,70432		12,273
8,e-002	0,52824		11,903
0,1	0,42259		11,608
0,12	0,35216		11,348
0,14	0,30185		11,108
0,16	0,26412		10,886

0,18	0,23477		10,681
0,2	0,2113		10,495
0,22	0,19209		10,324
0,24	0,17608		10,168
0,26	0,16254		10,026
0,28	0,15093		9,8948
0,3	0,14086		9,7724
0,32	0,13206		9,6588
0,34	0,12429		9,553
0,36	0,11739		9,4543
0,38	0,11121		9,3616
0,4	0,10565		9,2747
0,42	0,10062		9,1931
0,44	9,6044e-002		9,1164
0,46	9,1868e-002		9,0442
0,48	8,804e-002		8,9763
0,5	8,4519e-002		8,9123
0,52	8,1268e-002		8,852
0,54	7,8258e-002		8,7952
0,56	7,5463e-002		8,7414
0,58	7,2861e-002		8,6905
0,6	7,0432e-002		8,6423
0,62	6,816e-002		8,5967
0,64	6,603e-002		8,5533
0,66	6,4029e-002		8,5121
0,68	6,2146e-002		8,4728
0,7	6,037e-002		8,4352
0,72	5,8693e-002		8,3991
0,74	5,7107e-002		8,3645
0,76	5,5604e-002		8,3313
0,78	5,4179e-002		8,2994
0,8	5,2824e-002		8,2686
0,82	5,1536e-002		8,2389
0,84	5,0309e-002		8,2103
0,86	4,9139e-002		8,1826
0,88	4,8022e-002		8,1559
0,9	4,6955e-002		8,13
0,92	4,5934e-002		8,1048
0,94	4,4957e-002		8,0803
0,96	4,402e-002		8,0565
0,98	4,3122e-002		8,0333
1,	4,2259e-002		8,0108

Material Data

Plastic, PA6

TABLE 23
Plastic, PA6 > Constants

Density	1,14e-006 kg mm^-3
Tensile Yield Strength	43,13 MPa
Tensile Ultimate Strength	71,89 MPa

Coefficient of Thermal Expansion	1,467e-004 C^-1
Thermal Conductivity	2,428e-004 W mm^-1 C^-1
Specific Heat	1,5e+006 mJ kg^-1 C^-1

TABLE 24
Plastic, PA6 > Opacity

Red	Green	Blue
0,	153,	255,

Opacity
0,6

Metallic Finish
0,

TABLE 25
Plastic, PA6 > Isotropic Elasticity

Young's Modulus MPa	Poisson's Ratio	Bulk Modulus MPa	Shear Modulus MPa	Temperature C
1111,	0,3499	1233,6	411,51	23,

TABLE 26
Plastic, PA6 > Isotropic Secant Coefficient of Thermal Expansion

Zero-Thermal-Strain Reference Temperature C
23,

Structural Steel

TABLE 27
Structural Steel > Constants

Density	7,85e-006 kg mm^-3
Coefficient of Thermal Expansion	1,2e-005 C^-1
Specific Heat	4,34e+005 mJ kg^-1 C^-1
Thermal Conductivity	6,05e-002 W mm^-1 C^-1
Resistivity	1,7e-004 ohm mm

TABLE 28
Structural Steel > Color

Red	Green	Blue
132,	139,	179,

TABLE 29
Structural Steel > Compressive Ultimate Strength

Compressive Ultimate Strength MPa
0,

TABLE 30
Structural Steel > Compressive Yield Strength

Compressive Yield Strength MPa
250,

TABLE 31
Structural Steel > Tensile Yield Strength

Tensile Yield Strength MPa
250,

TABLE 32
Structural Steel > Tensile Ultimate Strength

Tensile Ultimate Strength MPa
460,

TABLE 33
Structural Steel > Isotropic Secant Coefficient of Thermal Expansion

Zero-Thermal-Strain Reference Temperature C
22,

TABLE 34
Structural Steel > S-N Curve

Alternating Stress MPa	Cycles	Mean Stress MPa
3999,	10,	0,
2827,	20,	0,
1896,	50,	0,
1413,	100,	0,
1069,	200,	0,
441,	2000,	0,
262,	10000	0,
214,	20000	0,
138,	1,e+005	0,
114,	2,e+005	0,
86,2	1,e+006	0,

TABLE 35
Structural Steel > Strain-Life Parameters

Strength Coefficient MPa	Strength Exponent	Ductility Coefficient	Ductility Exponent	Cyclic Strength Coefficient MPa	Cyclic Strain Hardening Exponent
920,	-0,106	0,213	-0,47	1000,	0,2

TABLE 36
Structural Steel > Isotropic Elasticity

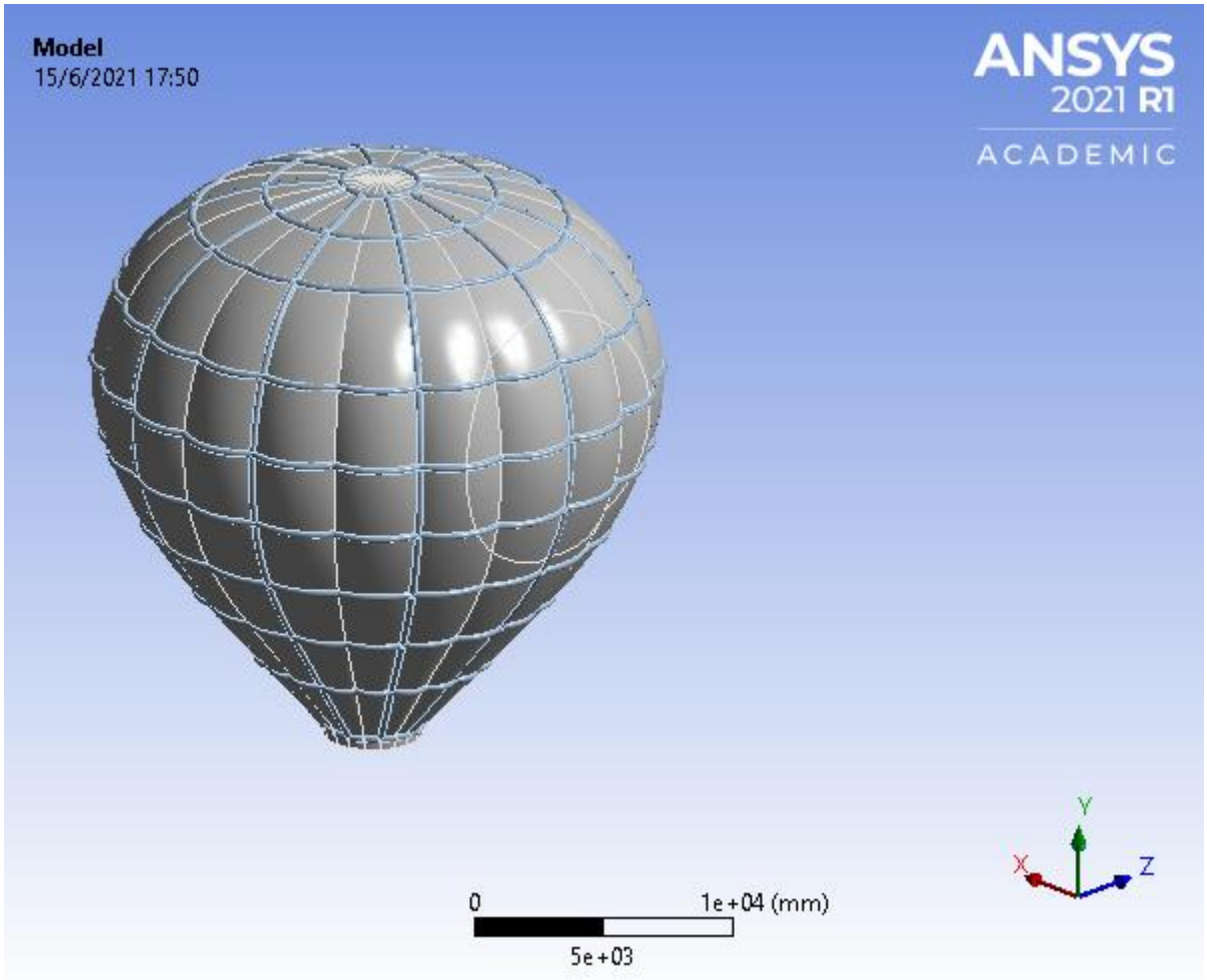
Young's Modulus MPa	Poisson's Ratio	Bulk Modulus MPa	Shear Modulus MPa	Temperature C
2,e+005	0,3	1,6667e+005	76923	

TABLE 37
Structural Steel > Isotropic Relative Permeability

Relative Permeability
10000

Project*

First Saved	Sunday, June 6, 2021
Last Saved	Tuesday, June 15, 2021
Product Version	2021 R1
Save Project Before Solution	No
Save Project After Solution	No



Contents

Units

TABLE 1

Unit System	Metric (mm, kg, N, s, mV, mA) Degrees rad/s Celsius
Angle	Degrees
Rotational Velocity	rad/s
Temperature	Celsius

Model (A4)

Geometry

TABLE 2
Model (A4) > Geometry

Object Name	*Geometry*
State	Fully Defined
Definition	
Source	C:\Users\fvila\Desktop\7-PROVA-redisseny_+xarxa-tubular\REDISSENY+XARXA+OPEN-PROVA7_files\dp0\SYS\DM\SYS.scdoc
Type	SpaceClaim
Length Unit	Meters
Element Control	Program Controlled
Display Style	Body Color
Bounding Box	
Length X	22233 mm
Length Y	23211 mm

Length Z	22233 mm
Properties	
Volume	8,2265e+008 mm³
Mass	937,82 kg
Surface Area(approx.)	2,0566e+009 mm²
Scale Factor Value	1,
2D Tolerance	Default (1,e-005)
Statistics	
Bodies	2
Active Bodies	2
Nodes	26182
Elements	27496
Mesh Metric	None
Update Options	
Assign Default Material	No
Basic Geometry Options	
Solid Bodies	Yes
Surface Bodies	Yes
Line Bodies	Yes
Parameters	Independent
Parameter Key	
Attributes	Yes
Attribute Key	
Named Selections	Yes
Named Selection Key	
Material Properties	Yes
Advanced Geometry Options	
Use Associativity	Yes
Coordinate Systems	Yes
Coordinate System Key	
Reader Mode Saves Updated File	No
Use Instances	Yes
Smart CAD Update	Yes
Compare Parts On Update	No
Analysis Type	3-D
Mixed Import Resolution	None
Import Facet Quality	Source
Clean Bodies On Import	No
Stitch Surfaces On Import	None
Decompose Disjoint Geometry	Yes
Enclosure and Symmetry Processing	Yes

TABLE 3
Model (A4) > Geometry > Parts

Object Name	*REDISSENY+OPEN-PROVA7\Surface1*	*REDISSENY+XARXA+OPEN-PROVA7\Surface1*
State	Meshed	
Graphics Properties		
Visible	Yes	
Transparency	1	
Definition		
Suppressed	No	
Dimension	3D	
Stiffness Behavior	Flexible	
Coordinate System	Default Coordinate System	
Reference Temperature	By Environment	
Thickness	0,4 mm	
Thickness Mode	Manual	
Offset Type	Middle	
Treatment	None	
Model Type	Shell	
Material		
Assignment	Ripstop nylon 66	
Nonlinear Effects	Yes	
Thermal Strain Effects	Yes	
Bounding Box		
Length X	22001 mm	22233 mm
Length Y	23200 mm	22871 mm
Length Z	22001 mm	22233 mm
Properties		
Volume	5,9681e+008 mm³	2,2584e+008 mm³
Mass	680,36 kg	257,46 kg
Centroid X	9110,5 mm	9110, mm
Centroid Y	17515 mm	17527 mm
Centroid Z	21649 mm	21645 mm
Moment of Inertia Ip1	5,2134e+010 kg·mm²	1,8135e+010 kg·mm²
Moment of Inertia Ip2	5,2066e+010 kg·mm²	1,611e+010 kg·mm²
Moment of Inertia Ip3	5,2128e+010 kg·mm²	1,814e+010 kg·mm²
Surface Area(approx.)	1,492e+009 mm²	5,6461e+008 mm²
Statistics		
Nodes	9516	16666
Elements	9606	17890
Mesh Metric	None	
CAD Attributes		
PartTolerance:	0,00000001	
Color:154.175.143		
Color:175.143.143		

TABLE 4
Model (A4) > Materials

Object Name	*Materials*

State	Fully Defined
Statistics	
Materials	3
Material Assignments	0

Coordinate Systems

TABLE 5
Model (A4) > Coordinate Systems > Coordinate System

Object Name	*Global Coordinate System*
State	Fully Defined
Definition	
Type	Cartesian
Coordinate System ID	0,
Origin	
Origin X	0, mm
Origin Y	0, mm
Origin Z	0, mm
Directional Vectors	
X Axis Data	[1, 0, 0,]
Y Axis Data	[0, 1, 0,]
Z Axis Data	[0, 0, 1,]

Connections

TABLE 6
Model (A4) > Connections

Object Name	*Connections*
State	Fully Defined
Auto Detection	
Generate Automatic Connection On Refresh	Yes
Transparency	
Enabled	Yes

TABLE 7
Model (A4) > Connections > Contacts

Object Name	*Contacts*
State	Fully Defined
Definition	
Connection Type	Contact
Scope	
Scoping Method	Geometry Selection
Geometry	All Bodies
Auto Detection	
Tolerance Type	Slider
Tolerance Slider	0,
Tolerance Value	97,702 mm
Use Range	No
Face/Face	Yes
Face-Face Angle Tolerance	75, °
Face Overlap Tolerance	Off
Cylindrical Faces	Include

Face/Edge	No
Edge/Edge	No
Priority	Include All
Group By	Bodies
Search Across	Bodies
Statistics	
Connections	2
Active Connections	2

TABLE 8
Model (A4) > Connections > Contacts > Contact Regions

Object Name	*Bonded - REDISSENY+OPEN-PROVA7\Surface1 To REDISSENY+XARXA+OPEN-PROVA7\Surface1*	*Contact Region*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Contact	46 Faces	
Target	40 Faces	49 Faces
Contact Bodies	REDISSENY+OPEN-PROVA7\Surface1	
Target Bodies	REDISSENY+XARXA+OPEN-PROVA7\Surface1	
Contact Shell Face	Program Controlled	
Target Shell Face	Program Controlled	
Shell Thickness Effect	No	
Protected	No	
Definition		
Type	Bonded	
Scope Mode	Manual	Automatic
Behavior	Program Controlled	
Trim Contact	Program Controlled	
Suppressed	No	
Trim Tolerance		97,702 mm
Advanced		
Formulation	Program Controlled	
Small Sliding	Program Controlled	
Detection Method	Program Controlled	
Penetration Tolerance	Program Controlled	
Elastic Slip Tolerance	Program Controlled	
Normal Stiffness	Program Controlled	
Update Stiffness	Program Controlled	
Pinball Region	Program Controlled	
Geometric Modification		
Contact Geometry Correction	None	
Target Geometry Correction	None	

Mesh

TABLE 9
Model (A4) > Mesh

Object Name	*Mesh*
State	Solved
Display	
Display Style	Use Geometry Setting
Defaults	
Physics Preference	Mechanical
Element Order	Program Controlled
Element Size	Default
Sizing	
Use Adaptive Sizing	Yes
Resolution	Default (2)
Mesh Defeaturing	Yes
Defeature Size	Default
Transition	Fast
Span Angle Center	Coarse
Initial Size Seed	Assembly
Bounding Box Diagonal	39081 mm
Average Surface Area	8,7192e+006 mm²
Minimum Edge Length	10,247 mm
Quality	
Check Mesh Quality	Yes, Errors
Error Limits	Aggressive Mechanical
Target Quality	Default (0.050000)
Smoothing	Medium
Mesh Metric	None
Inflation	
Use Automatic Inflation	None
Inflation Option	Smooth Transition
Transition Ratio	0,272
Maximum Layers	2
Growth Rate	1,2
Inflation Algorithm	Pre
View Advanced Options	No
Advanced	
Number of CPUs for Parallel Part Meshing	Program Controlled
Straight Sided Elements	No
Rigid Body Behavior	Dimensionally Reduced
Triangle Surface Mesher	Program Controlled
Topology Checking	Yes
Use Sheet Thickness for Pinch	No
Pinch Tolerance	Please Define
Generate Pinch on Refresh	No
Sheet Loop Removal	No
Statistics	
Nodes	26182
Elements	27496

TABLE 10
Model (A4) > Mesh > Mesh Controls

Object Name	*vela 400mm*	*tubs 200mm*
State	Fully Defined	
Scope		

Scoping Method	Geometry Selection	
Geometry	1 Body	
Definition		
Suppressed	No	
Type	Element Size	
Element Size	400, mm	200, mm
Advanced		
Defeature Size	Default	
Behavior	Soft	

Static Structural (A5)

TABLE 11
Model (A4) > Analysis

Object Name	*Static Structural (A5)*
State	Solved
Definition	
Physics Type	Structural
Analysis Type	Static Structural
Solver Target	Mechanical APDL
Options	
Environment Temperature	22, °C
Generate Input Only	No

TABLE 12
Model (A4) > Static Structural (A5) > Analysis Settings

Object Name	*Analysis Settings*
State	Fully Defined
Step Controls	
Number Of Steps	1,
Current Step Number	1,
Step End Time	1, s
Auto Time Stepping	On
Define By	Substeps
Initial Substeps	250,
Minimum Substeps	50,
Maximum Substeps	5000,
Solver Controls	
Solver Type	Program Controlled
Weak Springs	Off
Solver Pivot Checking	Program Controlled
Large Deflection	Off
Inertia Relief	Off
Quasi-Static Solution	Off
Rotordynamics Controls	
Coriolis Effect	Off
Restart Controls	
Generate Restart Points	Program Controlled

Retain Files After Full Solve	No
Combine Restart Files	Program Controlled
Nonlinear Controls	
Newton-Raphson Option	Program Controlled
Force Convergence	Program Controlled
Moment Convergence	Program Controlled
Displacement Convergence	Program Controlled
Rotation Convergence	Program Controlled
Line Search	Program Controlled
Stabilization	Program Controlled
Advanced	
Inverse Option	No
Contact Split (DMP)	Off
Output Controls	
Stress	Yes
Surface Stress	No
Back Stress	No
Strain	Yes
Contact Data	Yes
Nonlinear Data	No
Nodal Forces	No
Volume and Energy	Yes
Euler Angles	Yes
General Miscellaneous	No
Contact Miscellaneous	No
Store Results At	All Time Points
Result File Compression	Program Controlled
Analysis Data Management	
Solver Files Directory	C:\Users\fvila\Desktop\7-PROVA-redisseny_+xarxa-tubular\REDISSENY+XARXA+OPEN-PROVA7_files\dp0\SYS\MECH\
Future Analysis	None
Scratch Solver Files Directory	
Save MAPDL db	No
Contact Summary	Program Controlled
Delete Unneeded Files	Yes
Nonlinear Solution	No
Solver Units	Active System
Solver Unit System	nmm

TABLE 13
Model (A4) > Static Structural (A5) > Loads

Object Name	*Displacement*	*Fixed Rotation*	*Pint_vela - 0,000734Mpa*	*Pvent 21m/s*	*Ptubs -2bar - 1atm aire ext*

State	Fully Defined				
Scope					
Scoping Method	Geometry Selection				
Geometry	21 Faces	11 Faces	47 Faces	4 Faces	141 Faces
Definition					
Type	Displacement	Fixed Rotation	Pressure		
Define By	Components		Normal To		
Coordinate System	Global Coordinate System				
X Component	0, mm (ramped)				
Y Component	0, mm (ramped)				
Z Component	0, mm (ramped)				
Suppressed	No				
Rotation X		Fixed			
Rotation Y		Fixed			
Rotation Z		Fixed			
Applied By			Surface Effect		
Loaded Area			Deformed		
Magnitude			-7,34e-004 MPa (ramped)	2,756e-004 MPa (ramped)	-0,1 MPa (ramped)

FIGURE 1
Model (A4) > Static Structural (A5) > Displacement

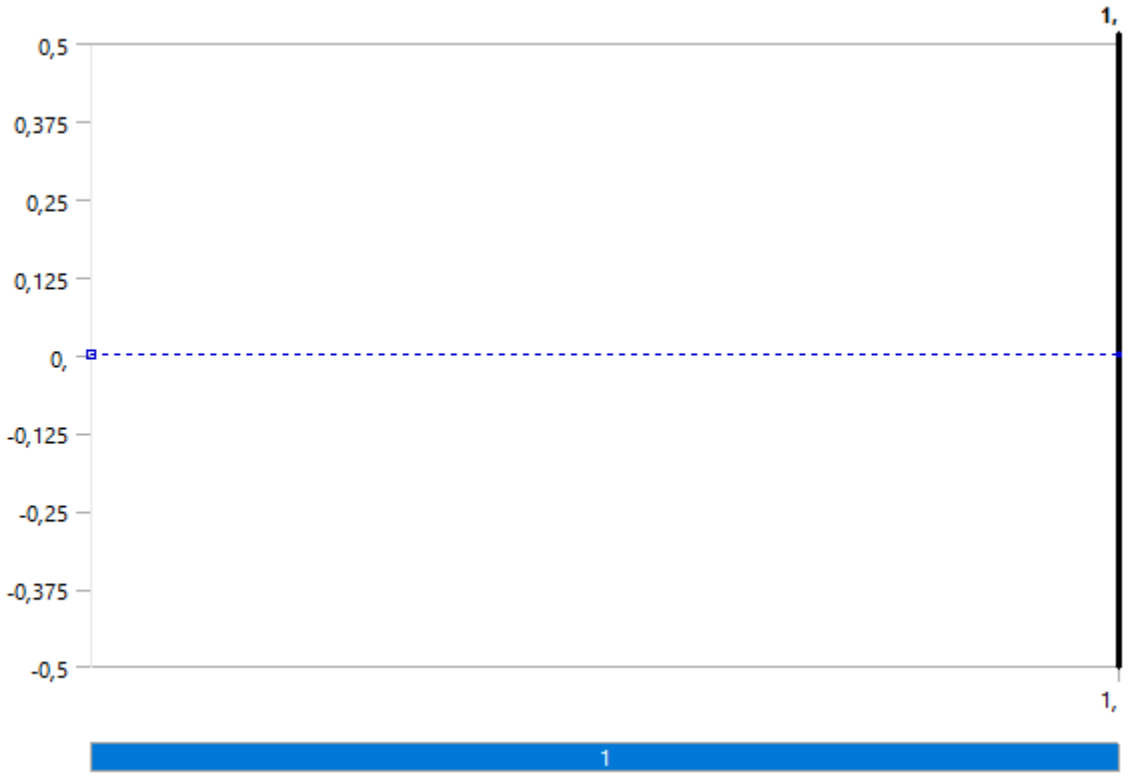


FIGURE 2
Model (A4) > Static Structural (A5) > Pint_vela -0,000734Mpa

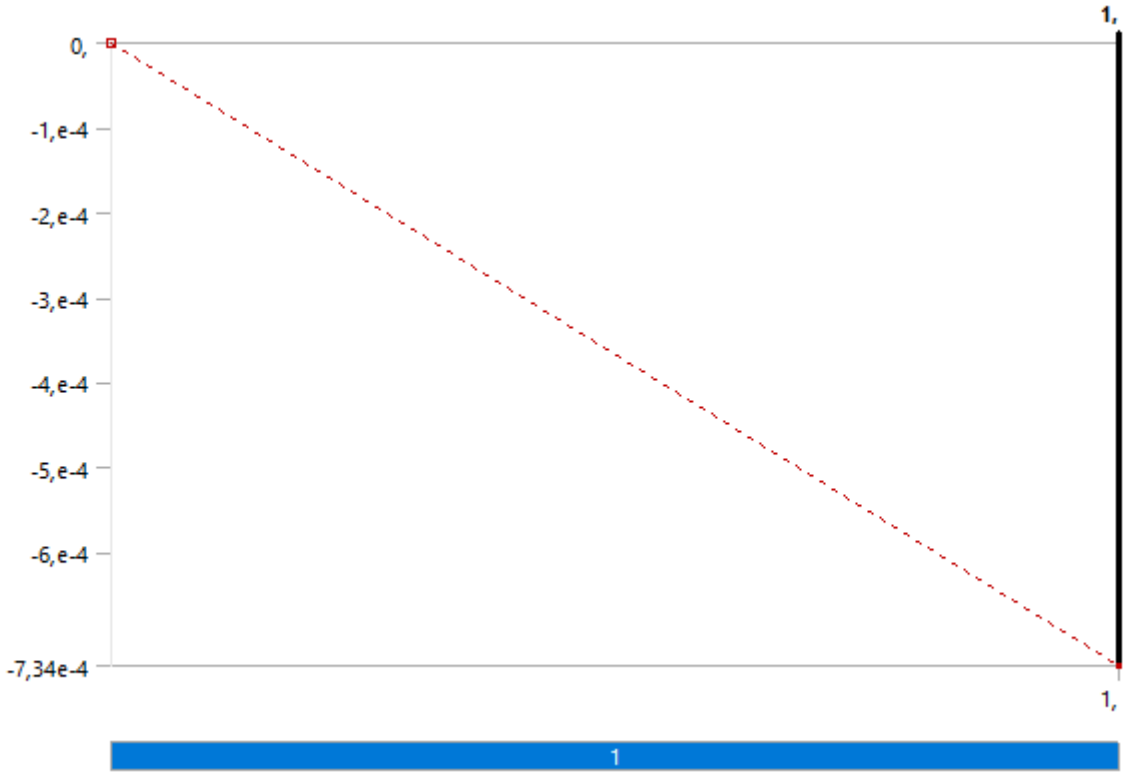


FIGURE 3
Model (A4) > Static Structural (A5) > Pvent 21m/s

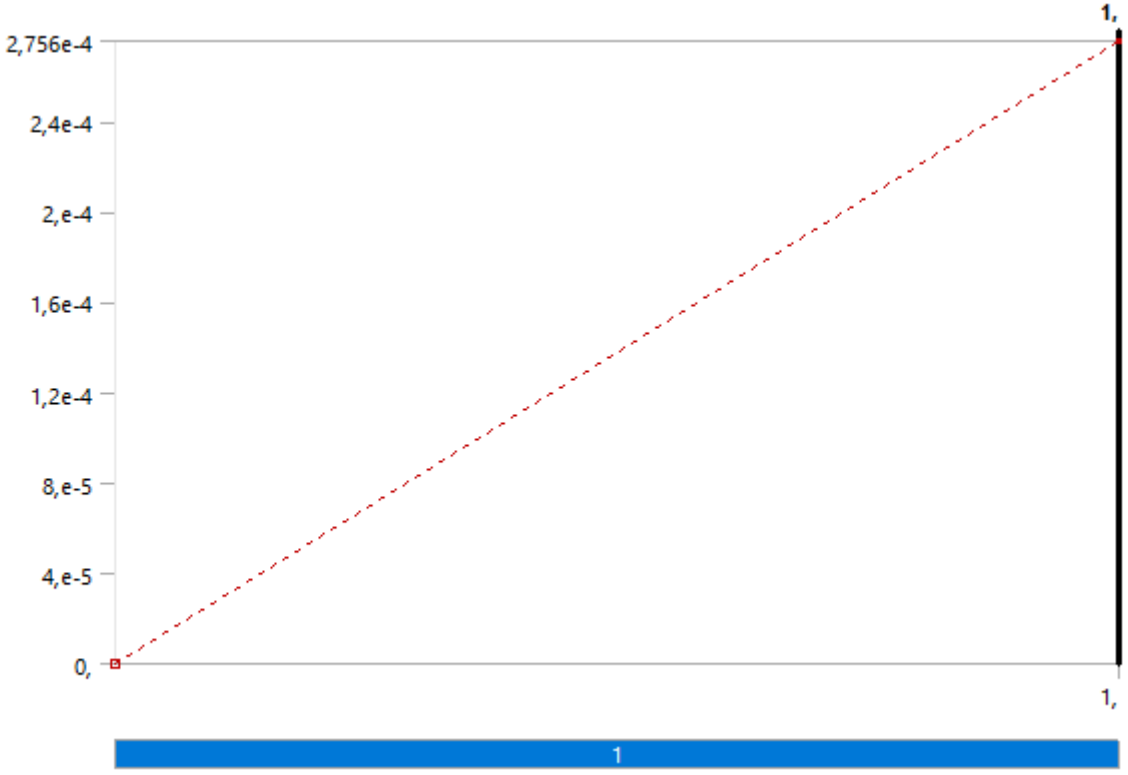
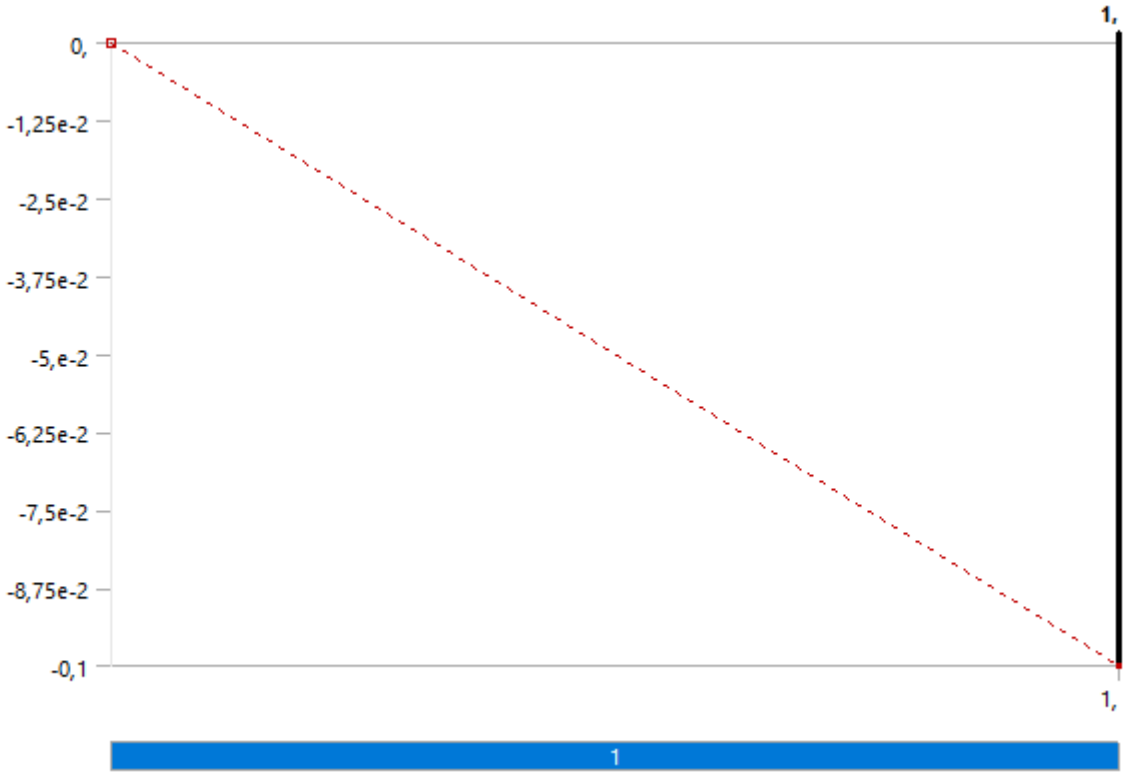


FIGURE 4
Model (A4) > Static Structural (A5) > Ptubs -2bar -1atm aire ext



Solution (A6)

TABLE 14
Model (A4) > Static Structural (A5) > Solution

Object Name	*Solution (A6)*
State	Solved
Adaptive Mesh Refinement	
Max Refinement Loops	1,
Refinement Depth	2,
Information	
Status	Done
MAPDL Elapsed Time	8 m 0 s
MAPDL Memory Used	1,333 GB
MAPDL Result File Size	1,6179 GB
Post Processing	
Beam Section Results	No
On Demand Stress/Strain	No

TABLE 15
Model (A4) > Static Structural (A5) > Solution (A6) > Solution Information

Object Name	*Solution Information*
State	Solved
Solution Information	
Solution Output	Solver Output
Newton-Raphson Residuals	0
Identify Element Violations	0
Update Interval	2,5 s
Display Points	All
FE Connection Visibility	

Activate Visibility	Yes
Display	All FE Connectors
Draw Connections Attached To	All Nodes
Line Color	Connection Type
Visible on Results	No
Line Thickness	Single
Display Type	Lines

TABLE 16
Model (A4) > Static Structural (A5) > Solution (A6) > Results

Object Name	*Total Deformation*	*Stress Intensity*	*Equivalent Elastic Strain*
State	Solved		
Scope			
Scoping Method	Geometry Selection		
Geometry	All Bodies		
Position		Top/Bottom	
Definition			
Type	Total Deformation	Stress Intensity	Equivalent Elastic Strain
By	Time		
Display Time	Last		
Calculate Time History	Yes		
Identifier			
Suppressed	No		
Results			
Minimum	0, mm	0, MPa	0, mm/mm
Maximum	5391,8 mm	1479,6 MPa	0,41909 mm/mm
Average	410,61 mm	130,23 MPa	3,6724e-002 mm/mm
Minimum Occurs On	REDISSENY+OPEN-PROVA7\Surface1		
Maximum Occurs On	REDISSENY+OPEN-PROVA7\Surface1	REDISSENY+XARXA+OPEN-PROVA7\Surface1	
Minimum Value Over Time			
Minimum	0, mm	0, MPa	0, mm/mm
Maximum	0, mm	0, MPa	0, mm/mm
Maximum Value Over Time			
Minimum	21,567 mm	5,9183 MPa	1,6764e-003 mm/mm
Maximum	5391,8 mm	1479,6 MPa	0,41909 mm/mm
Information			
Time	1, s		
Load Step	1		
Substep	52		
Iteration Number	52		
Integration Point Results			
Display Option		Averaged	
Average Across Bodies		No	

FIGURE 5
Model (A4) > Static Structural (A5) > Solution (A6) > Total Deformation

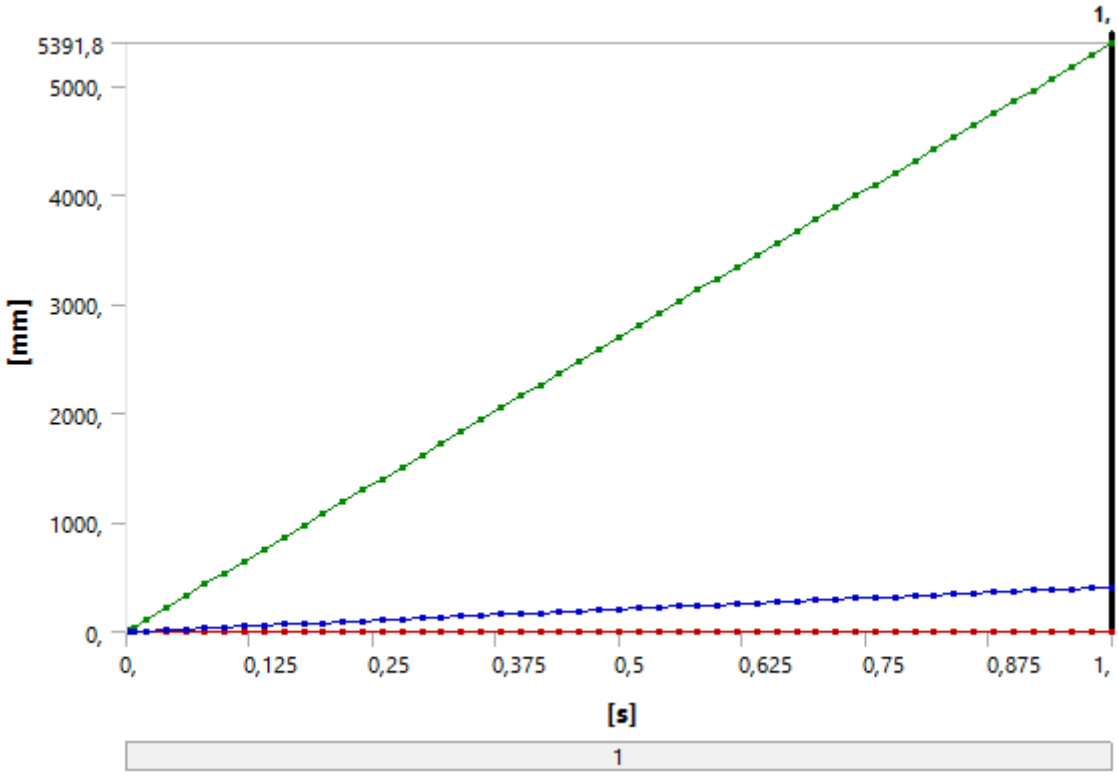


TABLE 17
Model (A4) > Static Structural (A5) > Solution (A6) > Total Deformation

Time [s]	Minimum [mm]	Maximum [mm]	Average [mm]
4,e-003	0,	21,567	1,6424
8,e-003		43,134	3,2849
2,e-002		107,84	8,2121
4,e-002		215,67	16,424
6,e-002		323,51	24,636
8,e-002		431,34	32,849
0,1		539,18	41,061
0,12		647,02	49,273
0,14		754,85	57,485
0,16		862,69	65,697
0,18		970,53	73,909
0,2		1078,4	82,121
0,22		1186,2	90,334
0,24		1294,	98,546
0,26		1401,9	106,76
0,28		1509,7	114,97
0,3		1617,5	123,18
0,32		1725,4	131,39
0,34		1833,2	139,61
0,36		1941,1	147,82
0,38		2048,9	156,03
0,4		2156,7	164,24
0,42		2264,6	172,46
0,44		2372,4	180,67
0,46		2480,2	188,88
0,48		2588,1	197,09

0,5		2695,9	205,3
0,52		2803,7	213,52
0,54		2911,6	221,73
0,56		3019,4	229,94
0,58		3127,2	238,15
0,6		3235,1	246,36
0,62		3342,9	254,58
0,64		3450,8	262,79
0,66		3558,6	271,
0,68		3666,4	279,21
0,7		3774,3	287,43
0,72		3882,1	295,64
0,74		3989,9	303,85
0,76		4097,8	312,06
0,78		4205,6	320,27
0,8		4313,4	328,49
0,82		4421,3	336,7
0,84		4529,1	344,91
0,86		4637,	353,12
0,88		4744,8	361,33
0,9		4852,6	369,55
0,92		4960,5	377,76
0,94		5068,3	385,97
0,96		5176,1	394,18
0,98		5284,	402,4
1,		5391,8	410,61

FIGURE 6
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Intensity

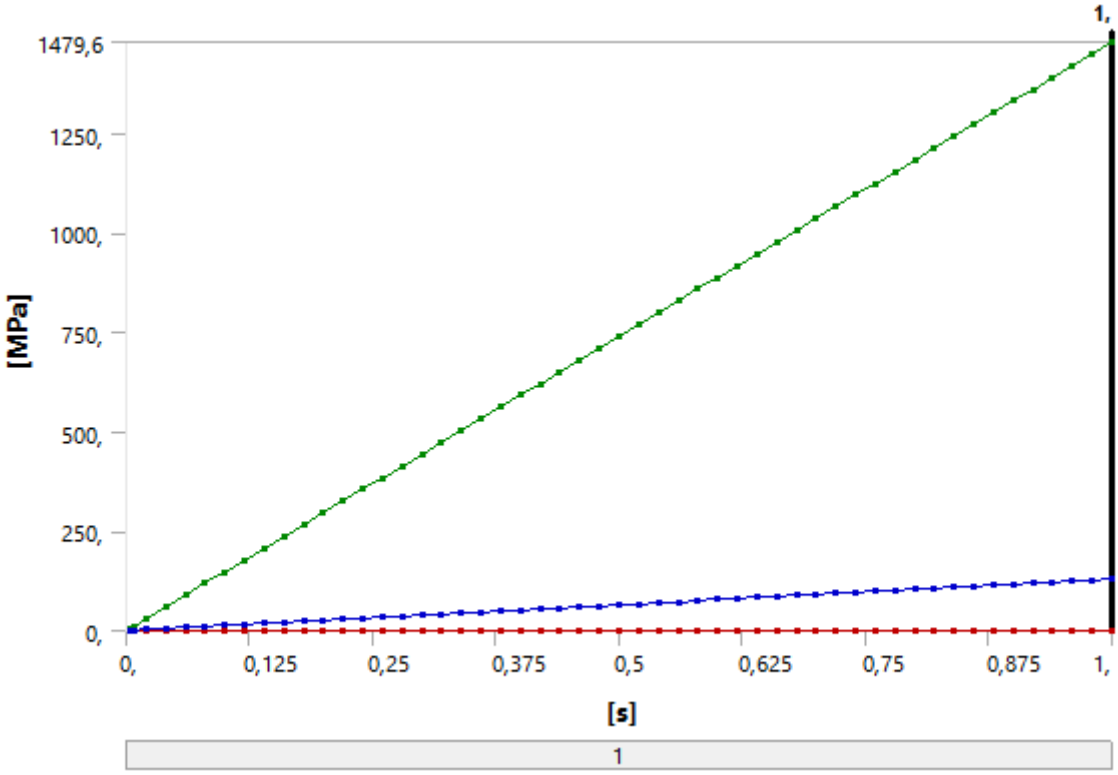


TABLE 18
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Intensity

Time [s]	Minimum [MPa]	Maximum [MPa]	Average [MPa]
4,e-003		5,9183	0,52091
8,e-003		11,837	1,0418
2,e-002		29,592	2,6045
4,e-002		59,183	5,2091
6,e-002		88,775	7,8136
8,e-002		118,37	10,418
0,1		147,96	13,023
0,12		177,55	15,627
0,14		207,14	18,232
0,16		236,73	20,836
0,18		266,32	23,441
0,2		295,92	26,045
0,22		325,51	28,65
0,24		355,1	31,254
0,26		384,69	33,859
0,28		414,28	36,463
0,3		443,87	39,068
0,32		473,46	41,672
0,34		503,06	44,277
0,36		532,65	46,882
0,38		562,24	49,486
0,4		591,83	52,091
0,42		621,42	54,695
0,44		651,01	57,3
0,46	0,	680,61	59,904
0,48		710,2	62,509
0,5		739,79	65,113
0,52		769,38	67,718
0,54		798,97	70,322
0,56		828,56	72,927
0,58		858,16	75,531
0,6		887,75	78,136
0,62		917,34	80,74
0,64		946,93	83,345
0,66		976,52	85,95
0,68		1006,1	88,554
0,7		1035,7	91,159
0,72		1065,3	93,763
0,74		1094,9	96,368
0,76		1124,5	98,972
0,78		1154,1	101,58
0,8		1183,7	104,18
0,82		1213,3	106,79
0,84		1242,8	109,39
0,86		1272,4	111,99
0,88		1302,	114,6
0,9		1331,6	117,2
0,92		1361,2	119,81
0,94		1390,8	122,41
0,96		1420,4	125,02

0,98		1450,	127,62
1,		1479,6	130,23

FIGURE 7
Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Elastic Strain

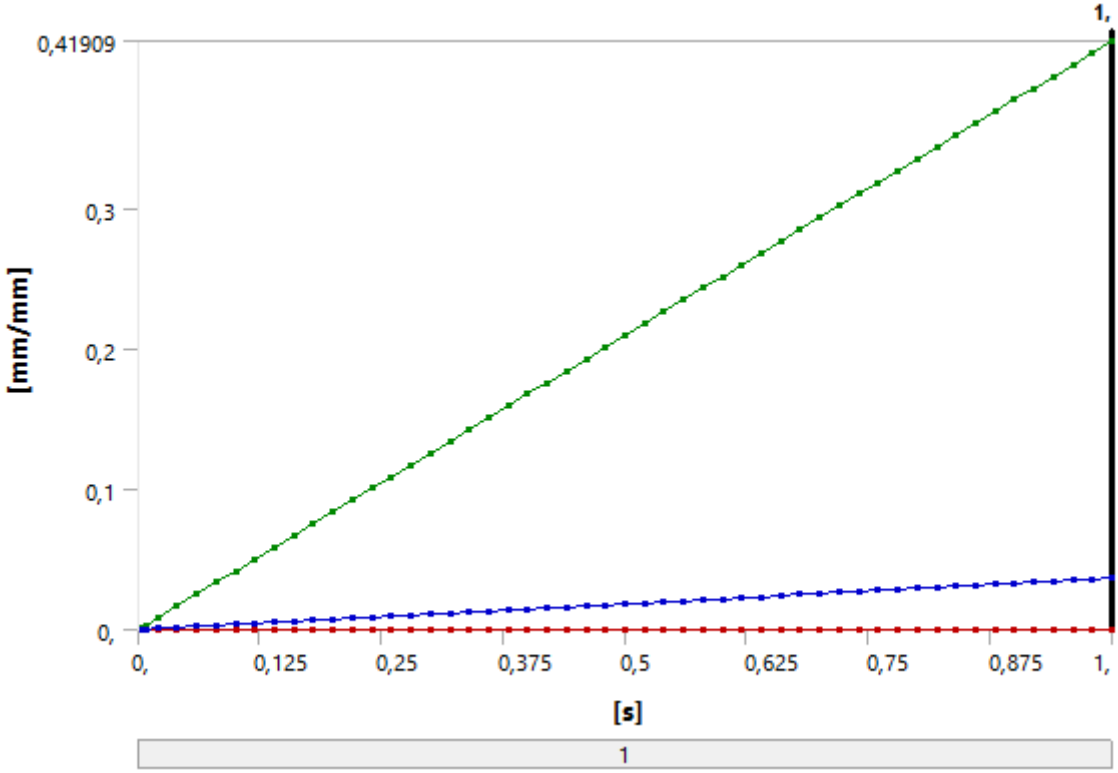


TABLE 19
Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Elastic Strain

Time [s]	Minimum [mm/mm]	Maximum [mm/mm]	Average [mm/mm]
4,e-003	0,	1,6764e-003	1,469e-004
8,e-003		3,3527e-003	2,9379e-004
2,e-002		8,3818e-003	7,3449e-004
4,e-002		1,6764e-002	1,469e-003
6,e-002		2,5145e-002	2,2035e-003
8,e-002		3,3527e-002	2,9379e-003
0,1		4,1909e-002	3,6724e-003
0,12		5,0291e-002	4,4069e-003
0,14		5,8673e-002	5,1414e-003
0,16		6,7055e-002	5,8759e-003
0,18		7,5436e-002	6,6104e-003
0,2		8,3818e-002	7,3449e-003
0,22		9,22e-002	8,0794e-003
0,24		0,10058	8,8138e-003
0,26		0,10896	9,5483e-003
0,28		0,11735	1,0283e-002
0,3		0,12573	1,1017e-002
0,32		0,13411	1,1752e-002
0,34		0,14249	1,2486e-002
0,36		0,15087	1,3221e-002
0,38		0,15925	1,3955e-002

0,4		0,16764	1,469e-002
0,42		0,17602	1,5424e-002
0,44		0,1844	1,6159e-002
0,46		0,19278	1,6893e-002
0,48		0,20116	1,7628e-002
0,5		0,20955	1,8362e-002
0,52		0,21793	1,9097e-002
0,54		0,22631	1,9831e-002
0,56		0,23469	2,0566e-002
0,58		0,24307	2,13e-002
0,6		0,25145	2,2035e-002
0,62		0,25984	2,2769e-002
0,64		0,26822	2,3504e-002
0,66		0,2766	2,4238e-002
0,68		0,28498	2,4973e-002
0,7		0,29336	2,5707e-002
0,72		0,30175	2,6442e-002
0,74		0,31013	2,7176e-002
0,76		0,31851	2,7911e-002
0,78		0,32689	2,8645e-002
0,8		0,33527	2,9379e-002
0,82		0,34365	3,0114e-002
0,84		0,35204	3,0848e-002
0,86		0,36042	3,1583e-002
0,88		0,3688	3,2317e-002
0,9		0,37718	3,3052e-002
0,92		0,38556	3,3786e-002
0,94		0,39395	3,4521e-002
0,96		0,40233	3,5255e-002
0,98		0,41071	3,599e-002
1,		0,41909	3,6724e-002

TABLE 20
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Safety Tools

Object Name	*Stress Tool*
State	Solved
Definition	
Theory	Max Equivalent Stress
Stress Limit Type	Tensile Yield Per Material

TABLE 21
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Tool > Results

Object Name	*Safety Factor*
State	Solved
Scope	
Scoping Method	Geometry Selection
Geometry	All Bodies
Definition	
Type	Safety Factor
By	Time
Display Time	Last
Calculate Time History	Yes
Identifier	

Suppressed	No
Integration Point Results	
Display Option	Averaged
Average Across Bodies	No
Results	
Minimum	7,1807e-002
Minimum Occurs On	REDISSENY+XARXA+OPEN-PROVA7\Surface1
Minimum Value Over Time	
Minimum	7,1807e-002
Maximum	15,
Maximum Value Over Time	
Minimum	15,
Maximum	15,
Information	
Time	1, s
Load Step	1
Substep	52
Iteration Number	52

FIGURE 8
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Tool > Safety Factor

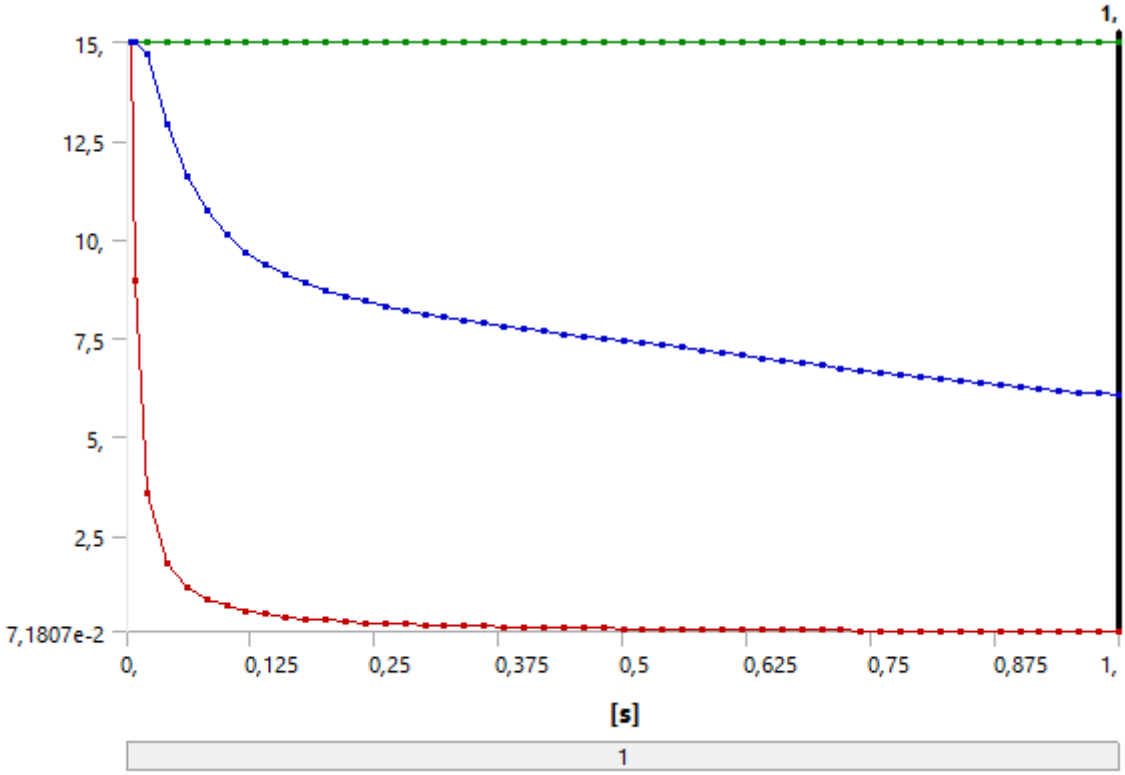


TABLE 22
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Tool > Safety Factor

Time [s]	Minimum	Maximum	Average
4,e-003	15,	15,	15,
8,e-003	8,9759		14,999
2,e-002	3,5904		14,679
4,e-002	1,7952		12,932
6,e-002	1,1968		11,591

8,e-002	0,89759		10,717
0,1	0,71807		10,123
0,12	0,59839		9,691
0,14	0,51291		9,3629
0,16	0,4488		9,1043
0,18	0,39893		8,8942
0,2	0,35904		8,7189
0,22	0,3264		8,5689
0,24	0,2992		8,4377
0,26	0,27618		8,3206
0,28	0,25645		8,2153
0,3	0,23936		8,1193
0,32	0,2244		8,0312
0,34	0,2112		7,9495
0,36	0,19946		7,8734
0,38	0,18897		7,802
0,4	0,17952		7,7352
0,42	0,17097		7,6719
0,44	0,1632		7,6111
0,46	0,1561		7,5522
0,48	0,1496		7,4943
0,5	0,14361		7,4362
0,52	0,13809		7,378
0,54	0,13298		7,3191
0,56	0,12823		7,2581
0,58	0,12381		7,1952
0,6	0,11968		7,1308
0,62	0,11582		7,0656
0,64	0,1122		7,0004
0,66	0,1088		6,9358
0,68	0,1056		6,872
0,7	0,10258		6,8096
0,72	9,9732e-002		6,7483
0,74	9,7037e-002		6,6887
0,76	9,4483e-002		6,6304
0,78	9,2061e-002		6,5736
0,8	8,9759e-002		6,5183
0,82	8,757e-002		6,4647
0,84	8,5485e-002		6,4129
0,86	8,3497e-002		6,3629
0,88	8,1599e-002		6,3146
0,9	7,9786e-002		6,2679
0,92	7,8051e-002		6,2227
0,94	7,6391e-002		6,1789
0,96	7,4799e-002		6,1364
0,98	7,3273e-002		6,0954
1,	7,1807e-002		6,0557

Material Data

Ripstop nylon 66

TABLE 23
Ripstop nylon 66 > Constants

Density	1,14e-006 kg mm^-3

TABLE 24
Ripstop nylon 66 > Color

Red	Green	Blue
181,	168,	168,

TABLE 25
Ripstop nylon 66 > Melting Temperature

Melting Temperature C
260,

TABLE 26
Ripstop nylon 66 > Isotropic Elasticity

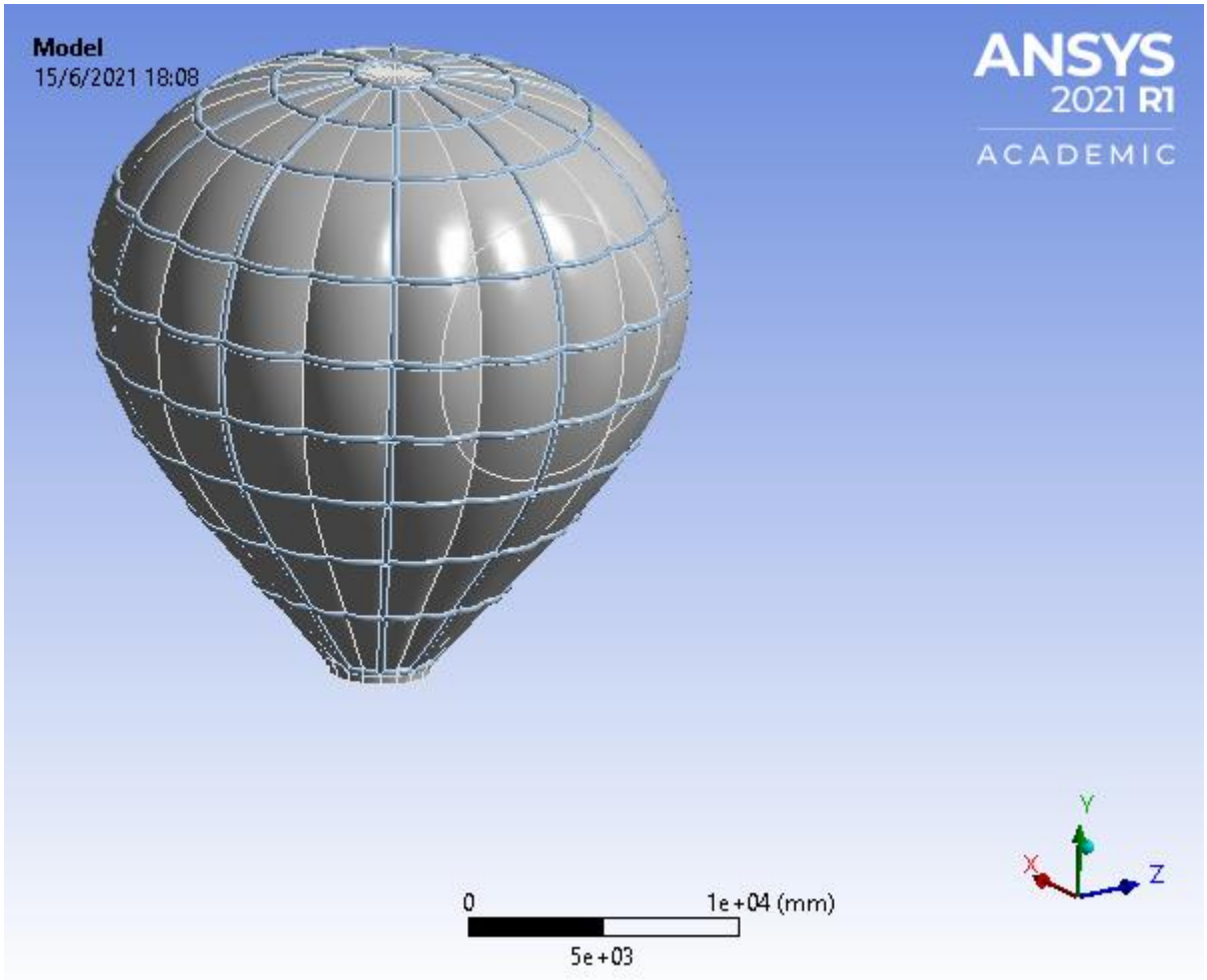
Young's Modulus MPa	Poisson's Ratio	Bulk Modulus MPa	Shear Modulus MPa	Temperature C
3550,	0,4	5916,7	1267,9	

TABLE 27
Ripstop nylon 66 > Tensile Yield Strength

Tensile Yield Strength MPa
93,

Project

First Saved	Sunday, June 6, 2021
Last Saved	Tuesday, June 15, 2021
Product Version	2021 R1
Save Project Before Solution	No
Save Project After Solution	No



Contents

Units

TABLE 1

Unit System	Metric (mm, kg, N, s, mV, mA) Degrees rad/s Celsius
Angle	Degrees
Rotational Velocity	rad/s
Temperature	Celsius

Model (B4)

Geometry

TABLE 2
Model (B4) > Geometry

Object Name	*Geometry*
State	Fully Defined
Definition	
Source	C:\Users\fvila\Desktop\7-PROVA-redisseny_+xarxa-tubular\REDISSENY+XARXA+OPEN-PROVA7_files\dp0\SYS-2\DM\SYS-2.scdoc
Type	SpaceClaim
Length Unit	Meters
Element Control	Program Controlled
Display Style	Body Color
Bounding Box	
Length X	22233 mm

Length Y	23211 mm
Length Z	22233 mm
Properties	
Volume	2,2906e+009 mm³
Mass	13977 kg
Surface Area(approx.)	2,0566e+009 mm²
Scale Factor Value	1,
2D Tolerance	Default (1,e-005)
Statistics	
Bodies	2
Active Bodies	2
Nodes	26182
Elements	27496
Mesh Metric	None
Update Options	
Assign Default Material	No
Basic Geometry Options	
Solid Bodies	Yes
Surface Bodies	Yes
Line Bodies	Yes
Parameters	Independent
Parameter Key	
Attributes	Yes
Attribute Key	
Named Selections	Yes
Named Selection Key	
Material Properties	Yes
Advanced Geometry Options	
Use Associativity	Yes
Coordinate Systems	Yes
Coordinate System Key	
Reader Mode Saves Updated File	No
Use Instances	Yes
Smart CAD Update	Yes
Compare Parts On Update	No
Analysis Type	3-D
Mixed Import Resolution	None
Import Facet Quality	Source
Clean Bodies On Import	No
Stitch Surfaces On Import	None
Decompose Disjoint Geometry	Yes
Enclosure and Symmetry Processing	Yes

TABLE 3
Model (B4) > Geometry > Parts

Object Name	*REDISSENY+OPEN-PROVA7\Surface1*	*REDISSENY+XARXA+OPEN-PROVA7\Surface1*
State	Meshed	
Graphics Properties		
Visible	Yes	
Transparency	1	
Definition		
Suppressed	No	
Dimension	3D	
Stiffness Behavior	Flexible	
Coordinate System	Default Coordinate System	
Reference Temperature	By Environment	
Thickness	0,4 mm	3, mm
Thickness Mode	Manual	
Offset Type	Middle	
Treatment	None	
Model Type	Shell	
Material		
Assignment	Ripstop nylon 66	Structural Steel
Nonlinear Effects	Yes	
Thermal Strain Effects	Yes	
Bounding Box		
Length X	22001 mm	22233 mm
Length Y	23200 mm	22871 mm
Length Z	22001 mm	22233 mm
Properties		
Volume	5,9681e+008 mm³	1,6938e+009 mm³
Mass	680,36 kg	13296 kg
Centroid X	9110,5 mm	9110, mm
Centroid Y	17515 mm	17527 mm
Centroid Z	21649 mm	21645 mm
Moment of Inertia Ip1	5,2134e+010 kg·mm²	9,3659e+011 kg·mm²
Moment of Inertia Ip2	5,2066e+010 kg·mm²	8,32e+011 kg·mm²
Moment of Inertia Ip3	5,2128e+010 kg·mm²	9,3681e+011 kg·mm²
Surface Area(approx.)	1,492e+009 mm²	5,6461e+008 mm²
Statistics		
Nodes	9516	16666
Elements	9606	17890
Mesh Metric	None	
CAD Attributes		
PartTolerance:	0,00000001	
Color:154.175.143		
Color:175.143.143		

TABLE 4
Model (B4) > Materials

Object Name	*Materials*
State	Fully Defined
Statistics	
Materials	3
Material Assignments	0

Coordinate Systems

TABLE 5
Model (B4) > Coordinate Systems > Coordinate System

Object Name	*Global Coordinate System*
State	Fully Defined
Definition	
Type	Cartesian
Coordinate System ID	0,
Origin	
Origin X	0, mm
Origin Y	0, mm
Origin Z	0, mm
Directional Vectors	
X Axis Data	[1, 0, 0,]
Y Axis Data	[0, 1, 0,]
Z Axis Data	[0, 0, 1,]

Connections

TABLE 6
Model (B4) > Connections

Object Name	*Connections*
State	Fully Defined
Auto Detection	
Generate Automatic Connection On Refresh	Yes
Transparency	
Enabled	Yes

TABLE 7
Model (B4) > Connections > Contacts

Object Name	*Contacts*
State	Fully Defined
Definition	
Connection Type	Contact
Scope	
Scoping Method	Geometry Selection
Geometry	All Bodies
Auto Detection	
Tolerance Type	Slider
Tolerance Slider	0,
Tolerance Value	97,702 mm
Use Range	No
Face/Face	Yes
Face-Face Angle Tolerance	75, °
Face Overlap Tolerance	Off

Cylindrical Faces	Include
Face/Edge	No
Edge/Edge	No
Priority	Include All
Group By	Bodies
Search Across	Bodies
Statistics	
Connections	2
Active Connections	2

TABLE 8
Model (B4) > Connections > Contacts > Contact Regions

Object Name	*Bonded - REDISSENY+OPEN-PROVA7\Surface1 To REDISSENY+XARXA+OPEN-PROVA7\Surface1*	*Contact Region*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Contact	46 Faces	
Target	40 Faces	49 Faces
Contact Bodies	REDISSENY+OPEN-PROVA7\Surface1	
Target Bodies	REDISSENY+XARXA+OPEN-PROVA7\Surface1	
Contact Shell Face	Program Controlled	
Target Shell Face	Program Controlled	
Shell Thickness Effect	No	
Protected	No	
Definition		
Type	Bonded	
Scope Mode	Manual	Automatic
Behavior	Program Controlled	
Trim Contact	Program Controlled	
Suppressed	No	
Trim Tolerance		97,702 mm
Advanced		
Formulation	Program Controlled	
Small Sliding	Program Controlled	
Detection Method	Program Controlled	
Penetration Tolerance	Program Controlled	
Elastic Slip Tolerance	Program Controlled	
Normal Stiffness	Program Controlled	
Update Stiffness	Program Controlled	
Pinball Region	Program Controlled	
Geometric Modification		
Contact Geometry Correction	None	
Target Geometry Correction	None	

Mesh

TABLE 9
Model (B4) > Mesh

Object Name	*Mesh*
State	Solved
Display	
Display Style	Use Geometry Setting
Defaults	
Physics Preference	Mechanical
Element Order	Program Controlled
Element Size	Default
Sizing	
Use Adaptive Sizing	Yes
Resolution	Default (2)
Mesh Defeaturing	Yes
Defeature Size	Default
Transition	Fast
Span Angle Center	Coarse
Initial Size Seed	Assembly
Bounding Box Diagonal	39081 mm
Average Surface Area	8,7192e+006 mm²
Minimum Edge Length	10,247 mm
Quality	
Check Mesh Quality	Yes, Errors
Error Limits	Aggressive Mechanical
Target Quality	Default (0.050000)
Smoothing	Medium
Mesh Metric	None
Inflation	
Use Automatic Inflation	None
Inflation Option	Smooth Transition
Transition Ratio	0,272
Maximum Layers	2
Growth Rate	1,2
Inflation Algorithm	Pre
View Advanced Options	No
Advanced	
Number of CPUs for Parallel Part Meshing	Program Controlled
Straight Sided Elements	No
Rigid Body Behavior	Dimensionally Reduced
Triangle Surface Mesher	Program Controlled
Topology Checking	Yes
Use Sheet Thickness for Pinch	No
Pinch Tolerance	Please Define
Generate Pinch on Refresh	No
Sheet Loop Removal	No
Statistics	
Nodes	26182
Elements	27496

TABLE 10
Model (B4) > Mesh > Mesh Controls

Object Name	*vela 400mm*	*tubs 200mm*
State	Fully Defined	

Scope		
Scoping Method	Geometry Selection	
Geometry	1 Body	
Definition		
Suppressed	No	
Type	Element Size	
Element Size	400, mm	200, mm
Advanced		
Defeature Size	Default	
Behavior	Soft	

Static Structural (B5)

TABLE 11
Model (B4) > Analysis

Object Name	*Static Structural (B5)*
State	Solved
Definition	
Physics Type	Structural
Analysis Type	Static Structural
Solver Target	Mechanical APDL
Options	
Environment Temperature	22, °C
Generate Input Only	No

TABLE 12
Model (B4) > Static Structural (B5) > Analysis Settings

Object Name	*Analysis Settings*
State	Fully Defined
Step Controls	
Number Of Steps	1,
Current Step Number	1,
Step End Time	1, s
Auto Time Stepping	On
Define By	Substeps
Initial Substeps	250,
Minimum Substeps	50,
Maximum Substeps	5000,
Solver Controls	
Solver Type	Program Controlled
Weak Springs	Off
Solver Pivot Checking	Program Controlled
Large Deflection	Off
Inertia Relief	Off
Quasi-Static Solution	Off
Rotordynamics Controls	
Coriolis Effect	Off
Restart Controls	
Generate Restart Points	Program Controlled

Retain Files After Full Solve	No
Combine Restart Files	Program Controlled
Nonlinear Controls	
Newton-Raphson Option	Program Controlled
Force Convergence	Program Controlled
Moment Convergence	Program Controlled
Displacement Convergence	Program Controlled
Rotation Convergence	Program Controlled
Line Search	Program Controlled
Stabilization	Program Controlled
Advanced	
Inverse Option	No
Contact Split (DMP)	Off
Output Controls	
Stress	Yes
Surface Stress	No
Back Stress	No
Strain	Yes
Contact Data	Yes
Nonlinear Data	No
Nodal Forces	No
Volume and Energy	Yes
Euler Angles	Yes
General Miscellaneous	No
Contact Miscellaneous	No
Store Results At	All Time Points
Result File Compression	Program Controlled
Analysis Data Management	
Solver Files Directory	C:\Users\fvila\Desktop\7-PROVA-redisseny_+xarxa-tubular\REDISSENY+XARXA+OPEN-PROVA7_files\dp0\SYS-2\MECH\
Future Analysis	None
Scratch Solver Files Directory	
Save MAPDL db	No
Contact Summary	Program Controlled
Delete Unneeded Files	Yes
Nonlinear Solution	No
Solver Units	Active System
Solver Unit System	nmm

TABLE 13
Model (B4) > Static Structural (B5) > Loads

Object Name	*Displacement*	*Fixed Rotation*	*Pint_vela - 0,000734Mpa*	*Pvent 21m/s*	*Ptubs -2bar - 1atm aire ext*

State	Fully Defined				
Scope					
Scoping Method	Geometry Selection				
Geometry	21 Faces	11 Faces	47 Faces	4 Faces	141 Faces
Definition					
Type	Displacement	Fixed Rotation	Pressure		
Define By	Components		Normal To		
Coordinate System	Global Coordinate System				
X Component	0, mm (ramped)				
Y Component	0, mm (ramped)				
Z Component	0, mm (ramped)				
Suppressed	No				
Rotation X		Fixed			
Rotation Y		Fixed			
Rotation Z		Fixed			
Applied By			Surface Effect		
Loaded Area			Deformed		
Magnitude			-7,34e-004 MPa (ramped)	2,756e-004 MPa (ramped)	-0,1 MPa (ramped)

Solution (B6)

TABLE 14
Model (B4) > Static Structural (B5) > Solution

Object Name	*Solution (B6)*
State	Solved
Adaptive Mesh Refinement	
Max Refinement Loops	1,
Refinement Depth	2,
Information	
Status	Done
MAPDL Elapsed Time	9 m 3 s
MAPDL Memory Used	1,332 GB
MAPDL Result File Size	1,6183 GB
Post Processing	
Beam Section Results	No
On Demand Stress/Strain	No

TABLE 15
Model (B4) > Static Structural (B5) > Solution (B6) > Solution Information

Object Name	*Solution Information*
State	Solved
Solution Information	
Solution Output	Solver Output
Newton-Raphson Residuals	0
Identify Element Violations	0
Update Interval	2,5 s

Display Points	All
FE Connection Visibility	
Activate Visibility	Yes
Display	All FE Connectors
Draw Connections Attached To	All Nodes
Line Color	Connection Type
Visible on Results	No
Line Thickness	Single
Display Type	Lines

TABLE 16
Model (B4) > Static Structural (B5) > Solution (B6) > Results

Object Name	*Total Deformation*	*Stress Intensity*	*Equivalent Elastic Strain*
State	Solved		
Scope			
Scoping Method	Geometry Selection		
Geometry	All Bodies		
Position		Top/Bottom	
Definition			
Type	Total Deformation	Stress Intensity	Equivalent Elastic Strain
By	Time		
Display Time	Last		
Calculate Time History	Yes		
Identifier			
Suppressed	No		
Results			
Minimum	0, mm	0, MPa	0, mm/mm
Maximum	739,26 mm	1064,8 MPa	1,6406e-002 mm/mm
Average	10,668 mm	58,69 MPa	7,9615e-004 mm/mm
Minimum Occurs On	REDISSENY+OPEN-PROVA7\Surface1		
Maximum Occurs On	REDISSENY+OPEN-PROVA7\Surface1	REDISSENY+XARXA+OPEN-PROVA7\Surface1	REDISSENY+OPEN-PROVA7\Surface1
Minimum Value Over Time			
Minimum	0, mm	0, MPa	0, mm/mm
Maximum	0, mm	0, MPa	0, mm/mm
Maximum Value Over Time			
Minimum	2,957 mm	4,2593 MPa	6,5626e-005 mm/mm
Maximum	739,26 mm	1064,8 MPa	1,6406e-002 mm/mm
Information			
Time	1, s		
Load Step	1		
Substep	52		
Iteration Number	52		
Integration Point Results			
Display Option		Averaged	

Average Across Bodies		No

FIGURE 1
Model (B4) > Static Structural (B5) > Solution (B6) > Total Deformation

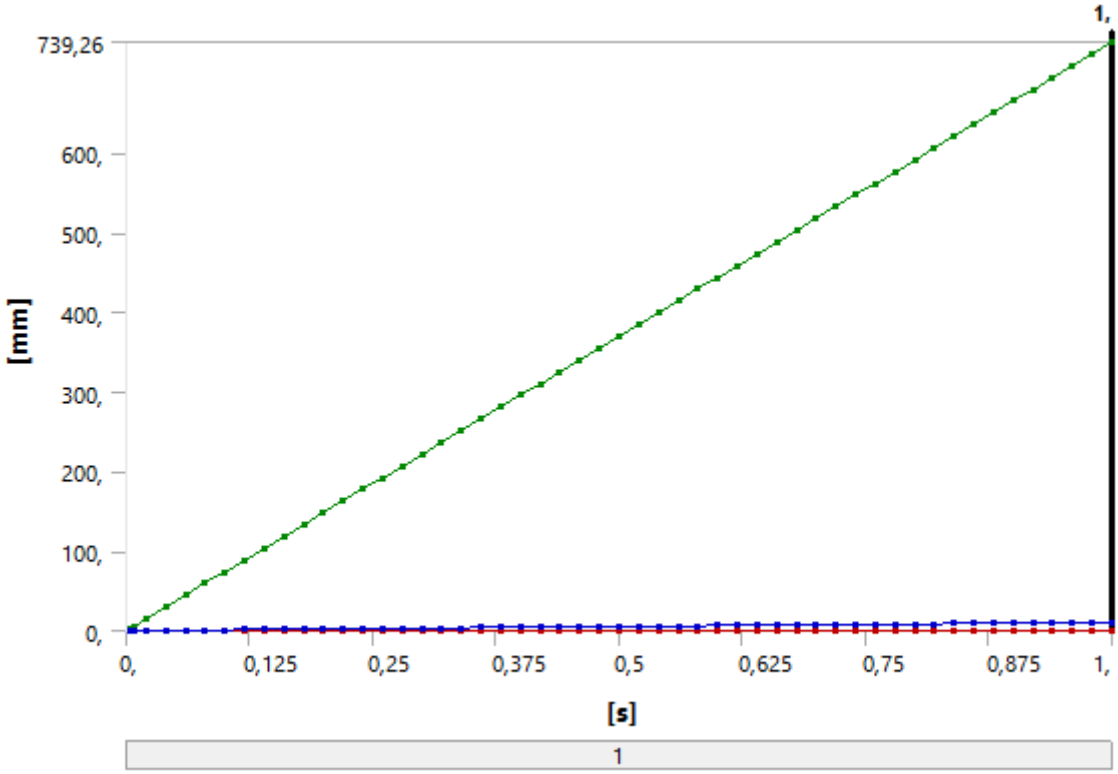


TABLE 17
Model (B4) > Static Structural (B5) > Solution (B6) > Total Deformation

Time [s]	Minimum [mm]	Maximum [mm]	Average [mm]
4,e-003	0,	2,957	4,2674e-002
8,e-003		5,9141	8,5347e-002
2,e-002		14,785	0,21337
4,e-002		29,57	0,42674
6,e-002		44,356	0,6401
8,e-002		59,141	0,85347
0,1		73,926	1,0668
0,12		88,711	1,2802
0,14		103,5	1,4936
0,16		118,28	1,7069
0,18		133,07	1,9203
0,2		147,85	2,1337
0,22		162,64	2,347
0,24		177,42	2,5604
0,26		192,21	2,7738
0,28		206,99	2,9871
0,3		221,78	3,2005
0,32		236,56	3,4139
0,34		251,35	3,6273
0,36		266,13	3,8406

0,38		280,92	4,054
0,4		295,7	4,2674
0,42		310,49	4,4807
0,44		325,28	4,6941
0,46		340,06	4,9075
0,48		354,85	5,1208
0,5		369,63	5,3342
0,52		384,42	5,5476
0,54		399,2	5,7609
0,56		413,99	5,9743
0,58		428,77	6,1877
0,6		443,56	6,401
0,62		458,34	6,6144
0,64		473,13	6,8278
0,66		487,91	7,0411
0,68		502,7	7,2545
0,7		517,48	7,4679
0,72		532,27	7,6812
0,74		547,05	7,8946
0,76		561,84	8,108
0,78		576,62	8,3213
0,8		591,41	8,5347
0,82		606,19	8,7481
0,84		620,98	8,9614
0,86		635,77	9,1748
0,88		650,55	9,3882
0,9		665,34	9,6015
0,92		680,12	9,8149
0,94		694,91	10,028
0,96		709,69	10,242
0,98		724,48	10,455
1,		739,26	10,668

FIGURE 2
Model (B4) > Static Structural (B5) > Solution (B6) > Stress Intensity

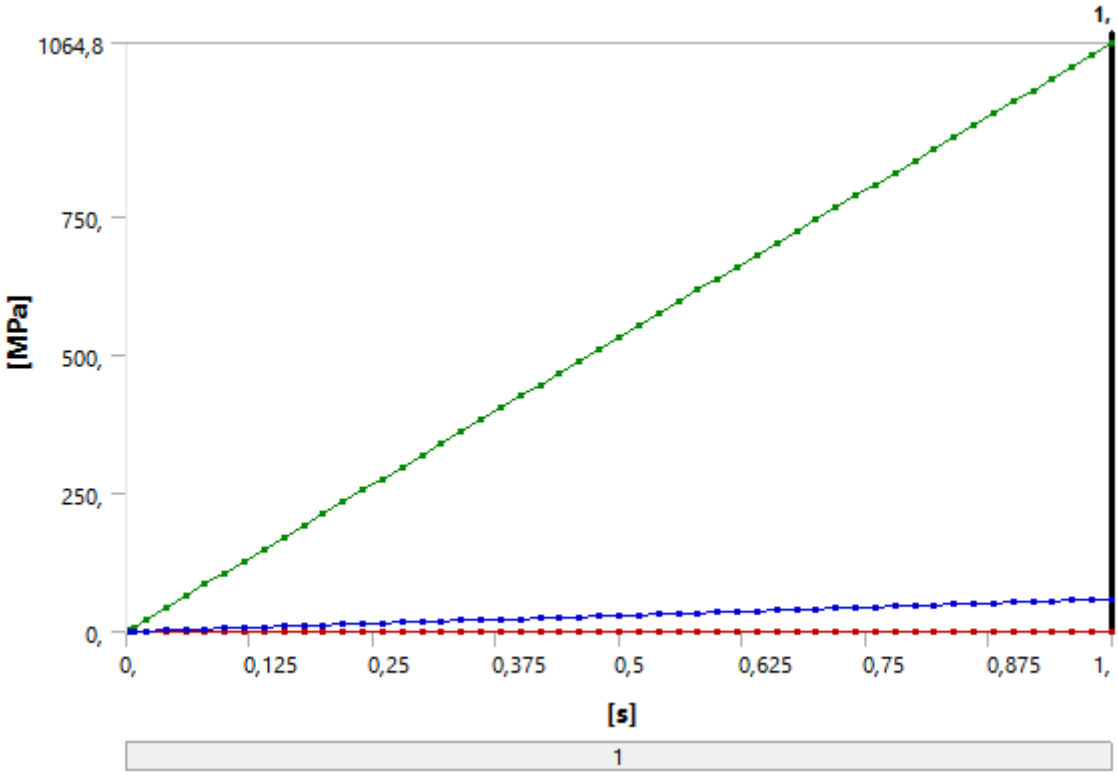


TABLE 18
Model (B4) > Static Structural (B5) > Solution (B6) > Stress Intensity

Time [s]	Minimum [MPa]	Maximum [MPa]	Average [MPa]
4,e-003	0,	4,2593	0,23476
8,e-003		8,5186	0,46952
2,e-002		21,296	1,1738
4,e-002		42,593	2,3476
6,e-002		63,889	3,5214
8,e-002		85,186	4,6952
0,1		106,48	5,869
0,12		127,78	7,0428
0,14		149,08	8,2165
0,16		170,37	9,3903
0,18		191,67	10,564
0,2		212,96	11,738
0,22		234,26	12,912
0,24		255,56	14,086
0,26		276,85	15,259
0,28		298,15	16,433
0,3		319,45	17,607
0,32		340,74	18,781
0,34		362,04	19,954
0,36		383,34	21,128
0,38		404,63	22,302
0,4		425,93	23,476
0,42		447,23	24,65
0,44		468,52	25,823
0,46		489,82	26,997
0,48		511,11	28,171

0,5		532,41	29,345
0,52		553,71	30,519
0,54		575,	31,692
0,56		596,3	32,866
0,58		617,6	34,04
0,6		638,89	35,214
0,62		660,19	36,388
0,64		681,49	37,561
0,66		702,78	38,735
0,68		724,08	39,909
0,7		745,38	41,083
0,72		766,67	42,257
0,74		787,97	43,43
0,76		809,26	44,604
0,78		830,56	45,778
0,8		851,86	46,952
0,82		873,15	48,125
0,84		894,45	49,299
0,86		915,75	50,473
0,88		937,04	51,647
0,9		958,34	52,821
0,92		979,64	53,994
0,94		1000,9	55,168
0,96		1022,2	56,342
0,98		1043,5	57,516
1,		1064,8	58,69

FIGURE 3
Model (B4) > Static Structural (B5) > Solution (B6) > Equivalent Elastic Strain

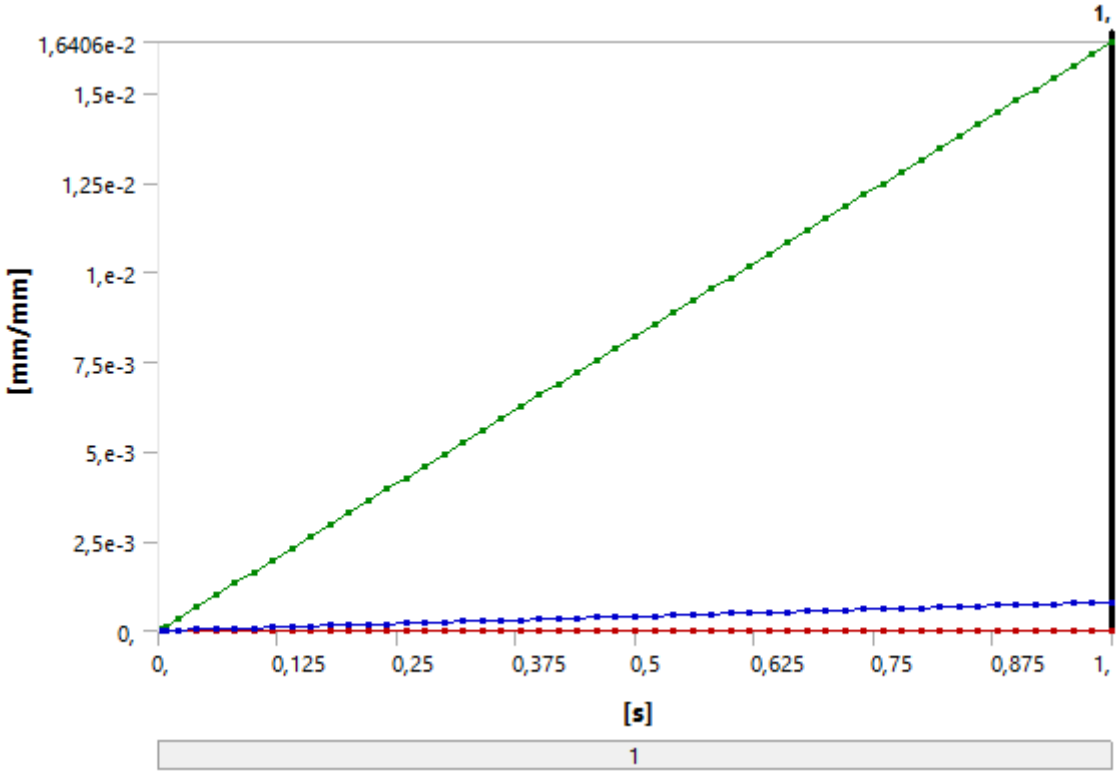


TABLE 19
Model (B4) > Static Structural (B5) > Solution (B6) > Equivalent Elastic Strain

Time [s]	Minimum [mm/mm]	Maximum [mm/mm]	Average [mm/mm]
4,e-003	0,	6,5626e-005	3,1846e-006
8,e-003		1,3125e-004	6,3692e-006
2,e-002		3,2813e-004	1,5923e-005
4,e-002		6,5626e-004	3,1846e-005
6,e-002		9,8438e-004	4,7769e-005
8,e-002		1,3125e-003	6,3692e-005
0,1		1,6406e-003	7,9615e-005
0,12		1,9688e-003	9,5538e-005
0,14		2,2969e-003	1,1146e-004
0,16		2,625e-003	1,2738e-004
0,18		2,9532e-003	1,4331e-004
0,2		3,2813e-003	1,5923e-004
0,22		3,6094e-003	1,7515e-004
0,24		3,9375e-003	1,9108e-004
0,26		4,2657e-003	2,07e-004
0,28		4,5938e-003	2,2292e-004
0,3		4,9219e-003	2,3885e-004
0,32		5,25e-003	2,5477e-004
0,34		5,5782e-003	2,7069e-004
0,36		5,9063e-003	2,8661e-004
0,38		6,2344e-003	3,0254e-004
0,4		6,5626e-003	3,1846e-004
0,42		6,8907e-003	3,3438e-004
0,44		7,2188e-003	3,5031e-004
0,46		7,5469e-003	3,6623e-004
0,48		7,8751e-003	3,8215e-004
0,5		8,2032e-003	3,9808e-004
0,52		8,5313e-003	4,14e-004
0,54		8,8595e-003	4,2992e-004
0,56		9,1876e-003	4,4584e-004
0,58		9,5157e-003	4,6177e-004
0,6		9,8438e-003	4,7769e-004
0,62		1,0172e-002	4,9361e-004
0,64		1,05e-002	5,0954e-004
0,66		1,0828e-002	5,2546e-004
0,68		1,1156e-002	5,4138e-004
0,7		1,1484e-002	5,5731e-004
0,72		1,1813e-002	5,7323e-004
0,74		1,2141e-002	5,8915e-004
0,76		1,2469e-002	6,0507e-004
0,78		1,2797e-002	6,21e-004
0,8		1,3125e-002	6,3692e-004
0,82		1,3453e-002	6,5284e-004
0,84		1,3781e-002	6,6877e-004
0,86		1,411e-002	6,8469e-004
0,88		1,4438e-002	7,0061e-004
0,9		1,4766e-002	7,1654e-004
0,92		1,5094e-002	7,3246e-004
0,94		1,5422e-002	7,4838e-004
0,96		1,575e-002	7,643e-004

0,98		1,6078e-002	7,8023e-004
1,		1,6406e-002	7,9615e-004

TABLE 20
Model (B4) > Static Structural (B5) > Solution (B6) > Stress Safety Tools

Object Name	*Stress Tool*
State	Solved
Definition	
Theory	Max Equivalent Stress
Stress Limit Type	Tensile Yield Per Material

TABLE 21
Model (B4) > Static Structural (B5) > Solution (B6) > Stress Tool > Results

Object Name	*Safety Factor*
State	Solved
Scope	
Scoping Method	Geometry Selection
Geometry	All Bodies
Definition	
Type	Safety Factor
By	Time
Display Time	Last
Calculate Time History	Yes
Identifier	
Suppressed	No
Integration Point Results	
Display Option	Averaged
Average Across Bodies	No
Results	
Minimum	0,2576
Minimum Occurs On	REDISSENY+XARXA+OPEN-PROVA7\Surface1
Minimum Value Over Time	
Minimum	0,2576
Maximum	15,
Maximum Value Over Time	
Minimum	15,
Maximum	15,
Information	
Time	1, s
Load Step	1
Substep	52
Iteration Number	52

FIGURE 4
Model (B4) > Static Structural (B5) > Solution (B6) > Stress Tool > Safety Factor

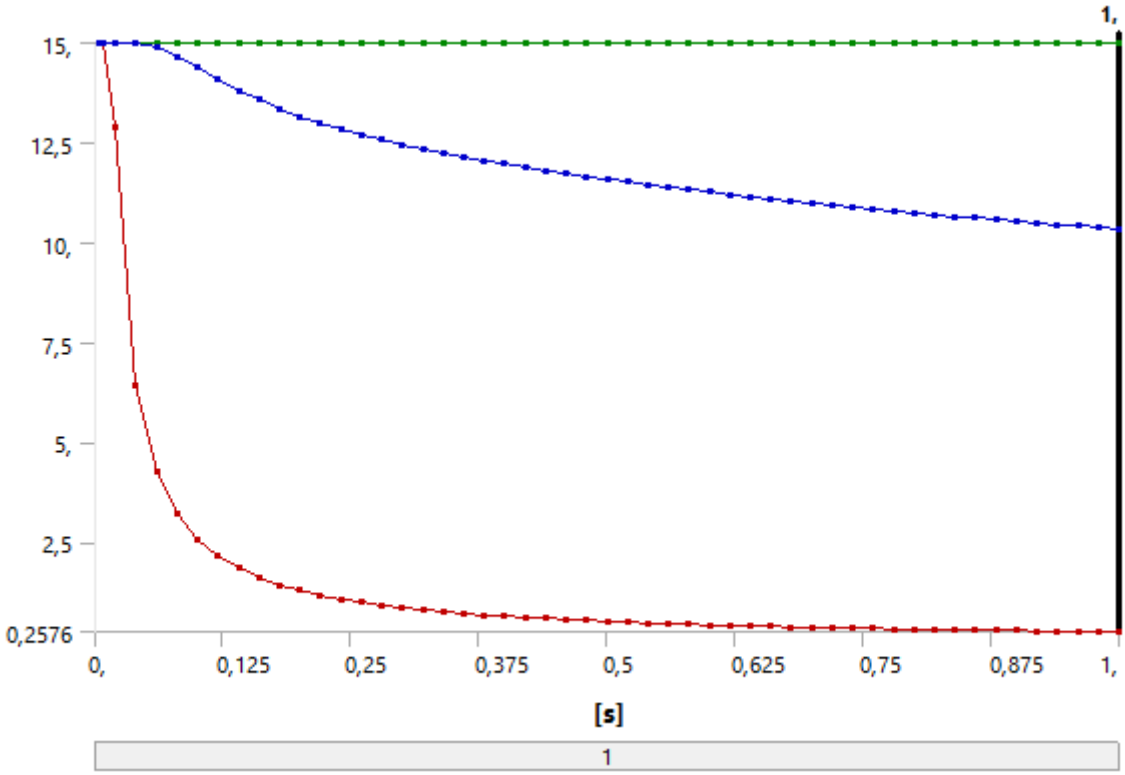


TABLE 22
Model (B4) > Static Structural (B5) > Solution (B6) > Stress Tool > Safety Factor

Time [s]	Minimum	Maximum	Average
4,e-003	15,	15,	15,
8,e-003			
2,e-002	12,88		
4,e-002	6,44		14,983
6,e-002	4,2933		14,896
8,e-002	3,22		14,671
0,1	2,576		14,38
0,12	2,1467		14,089
0,14	1,84		13,821
0,16	1,61		13,579
0,18	1,4311		13,362
0,2	1,288		13,169
0,22	1,1709		12,996
0,24	1,0733		12,841
0,26	0,99077		12,701
0,28	0,92		12,572
0,3	0,85867		12,455
0,32	0,805		12,345
0,34	0,75765		12,243
0,36	0,71556		12,147
0,38	0,6779		12,055
0,4	0,644		11,968
0,42	0,61334		11,885
0,44	0,58546		11,806
0,46	0,56		11,73
0,48	0,53667		11,656

0,5	0,5152		11,586
0,52	0,49539		11,518
0,54	0,47704		11,452
0,56	0,46		11,388
0,58	0,44414		11,326
0,6	0,42933		11,265
0,62	0,41549		11,207
0,64	0,4025		11,151
0,66	0,3903		11,095
0,68	0,37882		11,041
0,7	0,368		10,989
0,72	0,35778		10,938
0,74	0,34811		10,889
0,76	0,33895		10,84
0,78	0,33026		10,793
0,8	0,322		10,748
0,82	0,31415		10,703
0,84	0,30667		10,66
0,86	0,29954		10,618
0,88	0,29273		10,577
0,9	0,28622		10,537
0,92	0,28		10,498
0,94	0,27404		10,459
0,96	0,26833		10,422
0,98	0,26286		10,385
1,	0,2576		10,349

Material Data

Ripstop nylon 66

TABLE 23
Ripstop nylon 66 > Constants

Density	1,14e-006 kg mm^-3

TABLE 24
Ripstop nylon 66 > Color

Red	Green	Blue
181,	168,	168,

TABLE 25
Ripstop nylon 66 > Melting Temperature

Melting Temperature C
260,

TABLE 26
Ripstop nylon 66 > Isotropic Elasticity

Young's Modulus MPa	Poisson's Ratio	Bulk Modulus MPa	Shear Modulus MPa	Temperature C
3550,	0,4	5916,7	1267,9	

TABLE 27
Ripstop nylon 66 > Tensile Yield Strength

Tensile Yield Strength MPa
93,

Structural Steel

TABLE 28
Structural Steel > Constants

Density	7,85e-006 kg mm^-3
Coefficient of Thermal Expansion	1,2e-005 C^-1
Specific Heat	4,34e+005 mJ kg^-1 C^-1
Thermal Conductivity	6,05e-002 W mm^-1 C^-1
Resistivity	1,7e-004 ohm mm

TABLE 29
Structural Steel > Color

Red	Green	Blue
132,	139,	179,

TABLE 30
Structural Steel > Compressive Ultimate Strength

Compressive Ultimate Strength MPa
0,

TABLE 31
Structural Steel > Compressive Yield Strength

Compressive Yield Strength MPa
250,

TABLE 32
Structural Steel > Tensile Yield Strength

Tensile Yield Strength MPa
250,

TABLE 33
Structural Steel > Tensile Ultimate Strength

Tensile Ultimate Strength MPa
460,

TABLE 34
Structural Steel > Isotropic Secant Coefficient of Thermal Expansion

Zero-Thermal-Strain Reference Temperature C
22,

TABLE 35
Structural Steel > S-N Curve

Alternating Stress MPa	Cycles	Mean Stress MPa
3999,	10,	0,
2827,	20,	0,
1896,	50,	0,
1413,	100,	0,
1069,	200,	0,
441,	2000,	0,

262,	10000	0,
214,	20000	0,
138,	1,e+005	0,
114,	2,e+005	0,
86,2	1,e+006	0,

TABLE 36
Structural Steel > Strain-Life Parameters

Strength Coefficient MPa	Strength Exponent	Ductility Coefficient	Ductility Exponent	Cyclic Strength Coefficient MPa	Cyclic Strain Hardening Exponent
920,	-0,106	0,213	-0,47	1000,	0,2

TABLE 37
Structural Steel > Isotropic Elasticity

Young's Modulus MPa	Poisson's Ratio	Bulk Modulus MPa	Shear Modulus MPa	Temperature C
2,e+005	0,3	1,6667e+005	76923	

TABLE 38
Structural Steel > Isotropic Relative Permeability

Relative Permeability
10000

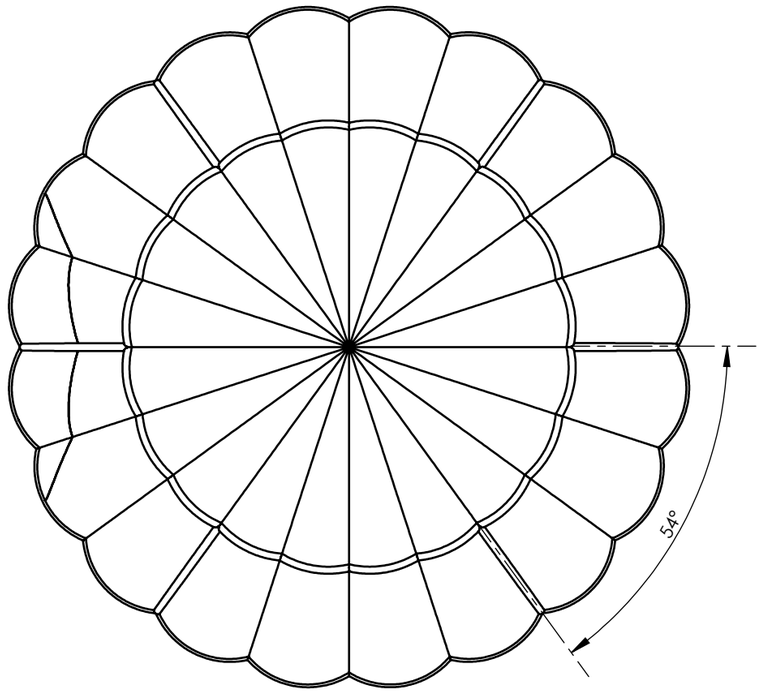
ANNEX 3 – PLÀNOLS DELS DISSENYS

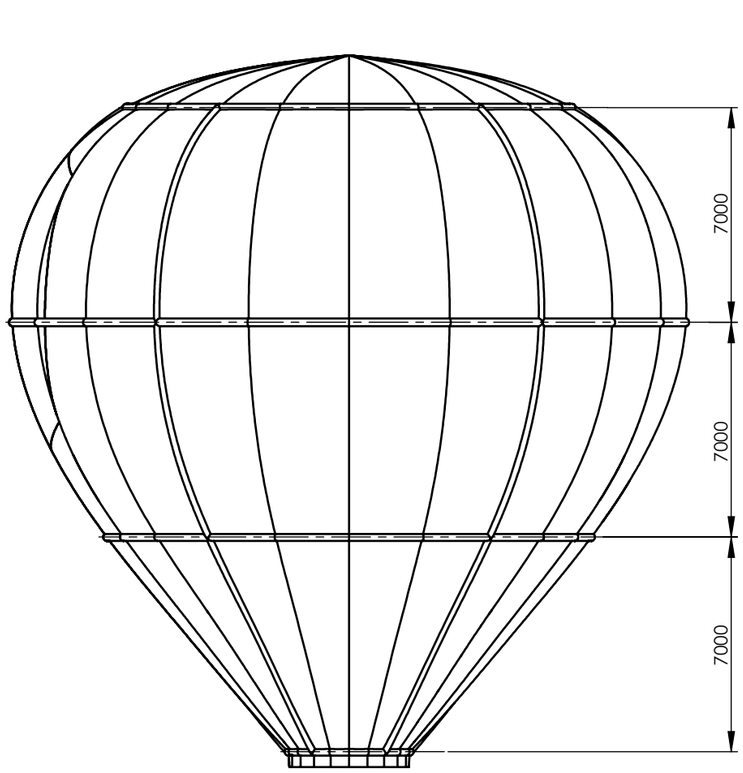
Tot seguit, s'adjunten en aquest annex els plànols del conjunt de vela i estructura dels casos més rellevants, ens ells només s'hi indiquen unes mesures generals sobre els cossos.

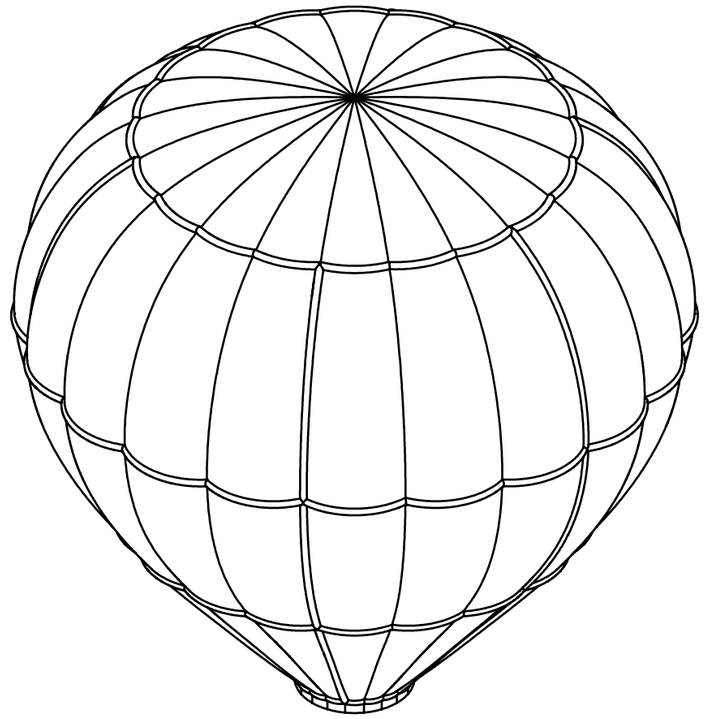
Plànol segons la patent: ES-2538595-B1.

Plànol del re-disseny, amb més tubs a l'equador.

Plànol del disseny final de xarxa.

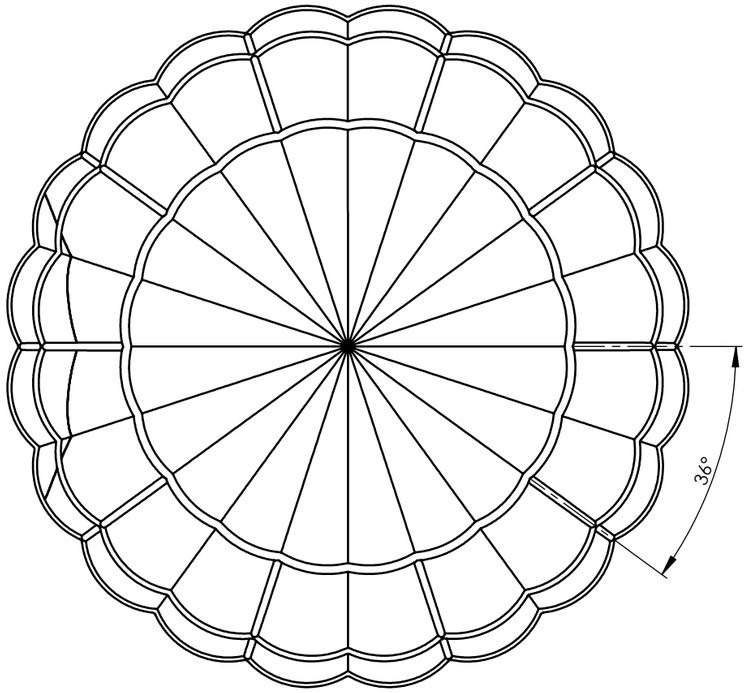


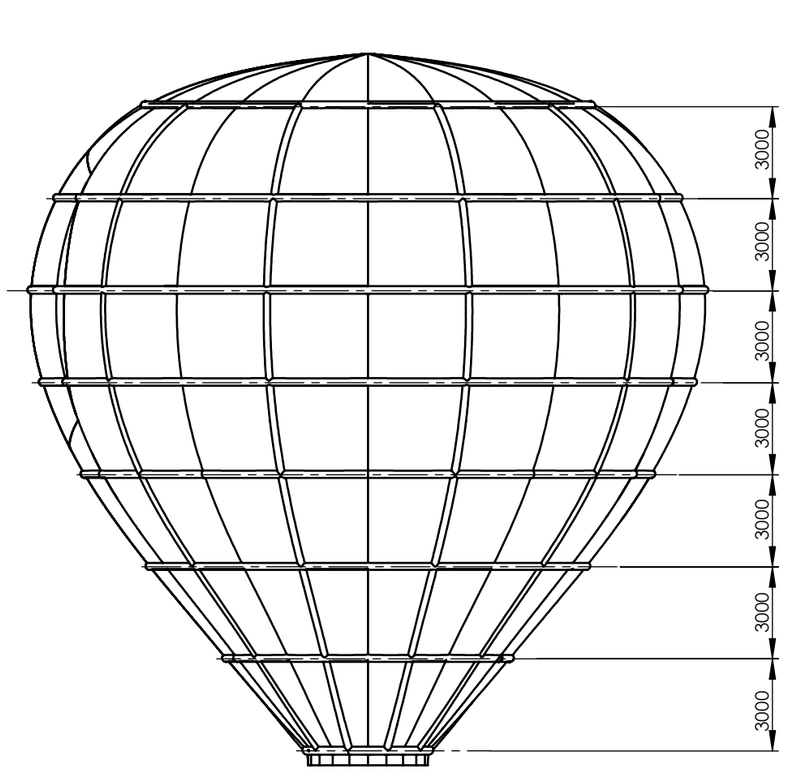


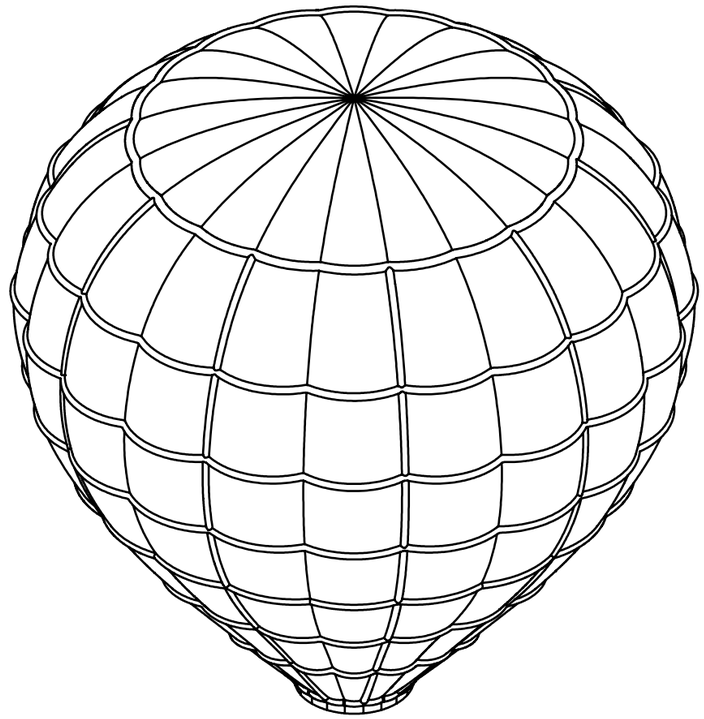


Tubs de 20 cm de diàmetre

Escola d'Enginyeria de Terrassa - E E T	Denominación proyecto: TFE	A3	Apellidos y nombre: VILÀ GAY, FERRAN
Ingeniería Gráfica Area de Expresión Gráfica en la Ingeniería	Denominación plano: PATENT ES-2538595-B1		Est.sup.UNE 1037/Tol.gral.ISO 2778-K/Tol.geom.ISO 2778-m
	Código plano:		Escala: 1:200 / Fecha: / Calificación:

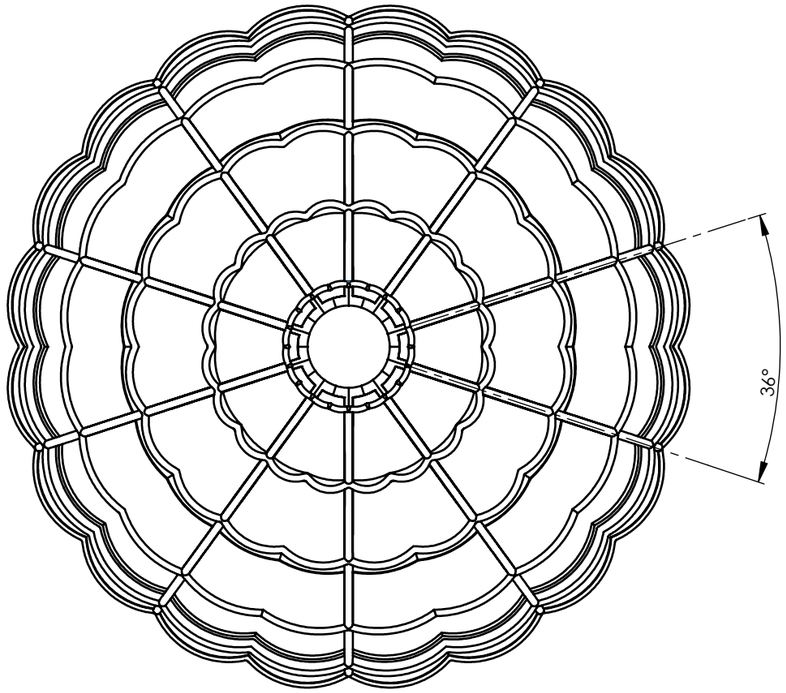


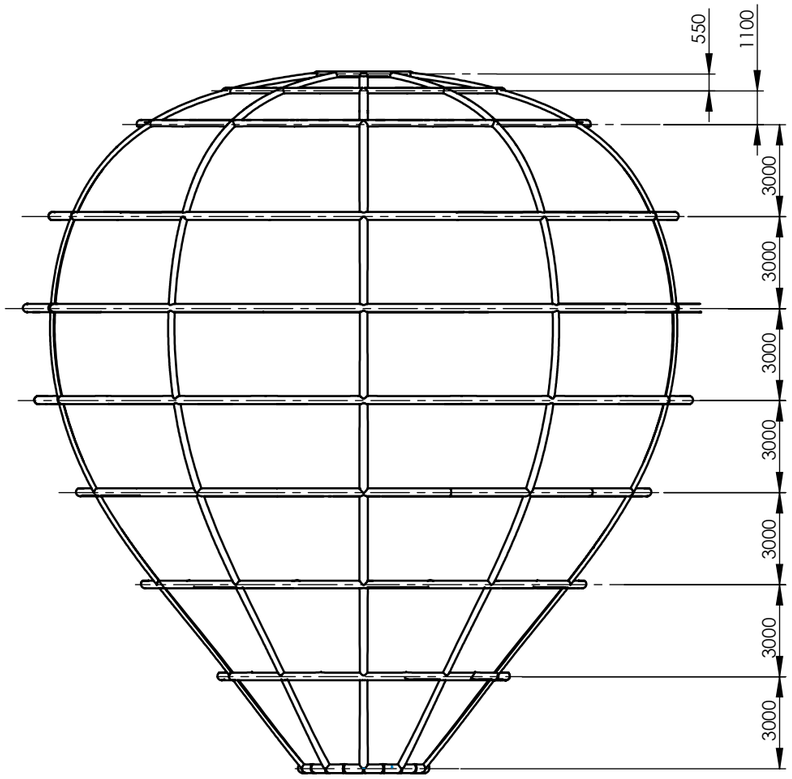


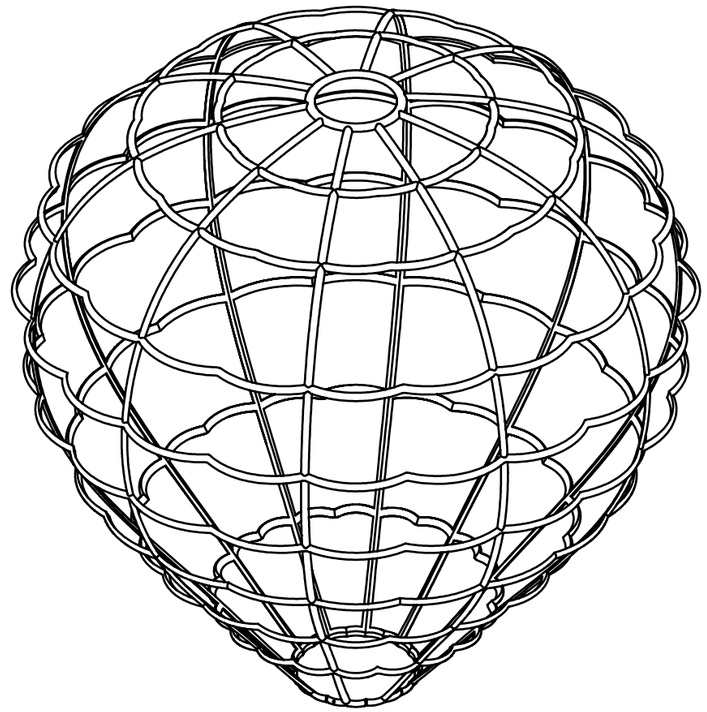


Tubs de 20 cm de diàmetre

Escola d'Enginyeria de Terrassa - E E T	Denominación proyecto: TFE	A3	Apellidos y nombre: VILÀ GAY, FERRAN
Ingeniería Gráfica Area de Expresión Gráfica en la Ingeniería	Denominación plano: Re-disseny més tubs		Est.sup.UNE 1037/Tol.gral.ISO 2778-K/Tol.geom.ISO 2778-m
	Código plano:		Escala: 1:200 / Fecha: / Calificación:







Tubs de 20 cm de diàmetre

Escola d'Enginyeria de Terrassa - E E T	Denominación proyecto: TFE	A3	Apellidos y nombre: VILÀ GAY, FERRAN
Ingeniería Gráfica Area de Expresión Gráfica en la Ingeniería	Denominación plano: Disseny final de xarxa		Est.sup.UNE 1037/Tol.gral.ISO 2778-K/Tol.geom.ISO 2778-m
	Código plano:		Escala: 1:200 / Fecha: / Calificación: