TECHNICAL CONSTRUCTION REPORT

T 12-ING-02-1019

PORTABLE CRANE PPM 2.X WTG GEWE

GEWE

1. Aim

The aim of this Technical Construction is to define the characteristics of design and construction "PPM 2.X PORTABLE HOIST GEWE WTG" employed to lift a maximum load of 100 kg.

2. Background

The element has been designed and manufactured by TESICNOR S.L, who review the manufacturing along all phases. He has made the documentation to marking CE according to royal decree 1644/2008.

In this document are tool calculations to ensure safety on your application.

3. Scope

The tool is used as described in the instruction manual, respecting the given constraints, such that the load does not exceed the maximum handling cargo and load supporting each element in the indicated direction.

This Technical Construction File is valid provided that all such elements are described and as set forth in the accompanying drawings.

4. Definitions and acronyms

UNITS:
Length (m or mm)
Load/force (N)
Tension (MPa)

SYMBOLS:

Rm = Ftu	Admissible break point [Pa] or [MPa]
Fty	Admissible yield point [Pa] or [MPa]

ACRONYMS

WLL	Working load limit or maximum working load

DEFINITIONS:
Break security factor: is defined as the relation between the break point (R) and the applied load (F).

$$CS_{rotura} = \frac{R_{rotura}}{F}$$

Yield security factor:

$$CS_{fluencia} = \frac{R_{fluencia}}{F}$$

Tower section: each of the elements that compose a wind turbine tower.

Flange: on present document should be referred to the flange located at both ends on the tower section of the wind turbine.

Bots: should be referred to the connection bolts used on each connection between tower sections by its flanges.

5. Reference standards

EUROPEAN DIRECTIVES

Directive 2006/42/EC of the European Parliament and of the Council of 17 May 2006 on machinery.

Directive 89/654/EEC of 30 November 1989 concerning the minimum safety and health requirements for the workplace.

ROYAL DECREES

Royal Decree 1644/1992, of October 10, laying down the rules for the market and putting into service of machinery.

Royal Decree 1215/1997, of July 18, laying down minimum safety and health requirements for the use by workers of the teams.

Royal Decree 486/1997 concerning the minimum safety and health requirements for the workplace.

Royal Decree 1801/2003 general security of industrial products.

REFERENCE STANDARD

UNE-EN ISO 12100:2012 Safety of machinery. General principles for design. Risk assessment and risk reduction. (ISO 12100:2010).

UNE-ENV 1993-1-1:2006 Eurocode 3. Design of steel structures. EN 10025-1:2004 Hot rolled products of structural steels.

UNE-EN 10219- Cold formed welded structural hollow sections of non-alloy and fine grain steels - Part 1: Technical delivery conditions.

UNE-EN 10219-2 Cold formed welded structural hollow sections of non-alloy and fine grain steels - Part 2: Tolerances, dimensions and sectional properties.

UNE EN 1993-1-10 Eurocode 3: Design of steel structures - Part 1-10: Material toughness and through-thickness properties

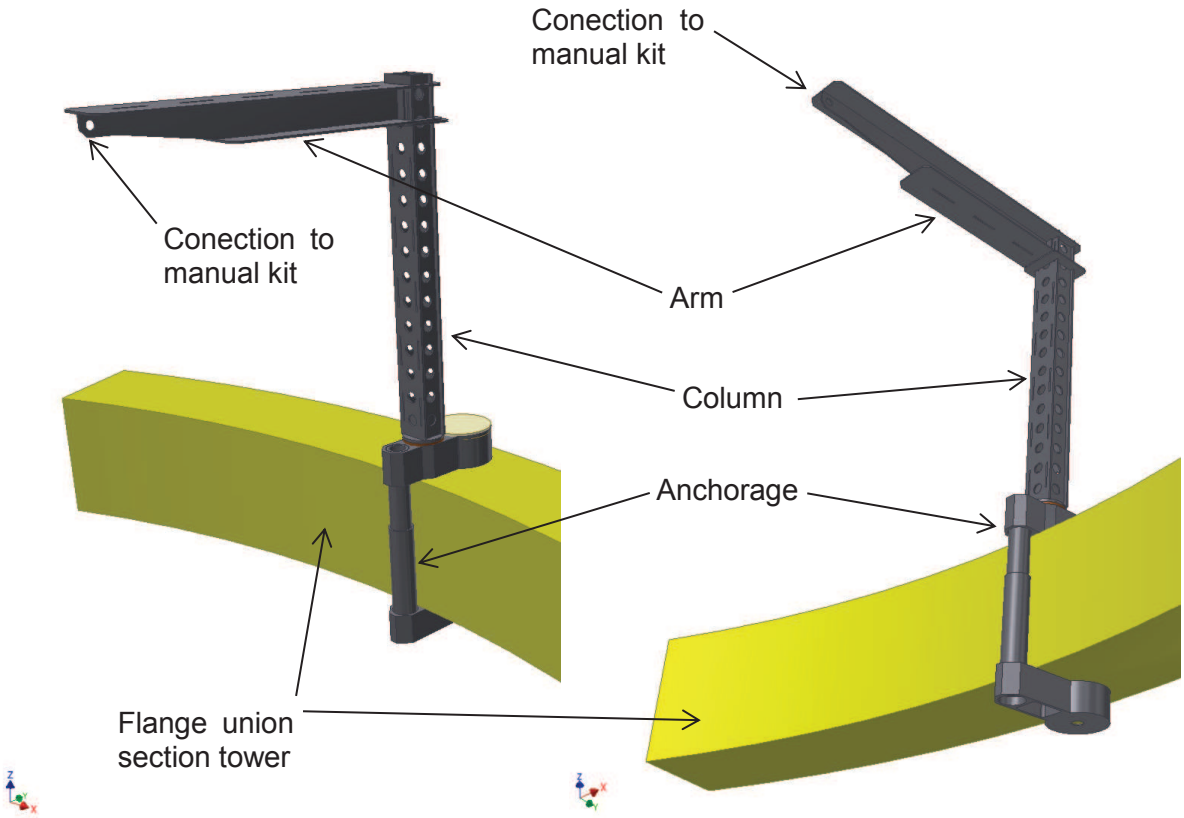
UNE-EN 50308. Wind turbines - Protective measures - Requirements for design, operation and maintenance.

UNE EN 1993-1-1 Eurocode 3: Design of steel structures - Part 1-1: General rules and rules for buildings.

UNE-EN 1993-1-10 Eurocode 3: Design of steel structures - Part 1-10: Material toughness and through-thickness properties.

6. Description

It is a portable structure to fixing in flange wind turbine, to connect a manual kit and use to lift maximum loads of 100 kg, according to directive 2006/42/EC transposed by Royal Decree 1644/2008.



The toolkit is composed by the next elements:

- Anchorage: It is assembled on the bolt of flange in section tower and tightening the flange. The clamping element against the flange is made by the action of a spindle.

- Column: The column is inserted into the anchor allowing relative rotation between both elements.

- Arm: It is inserted into the upper end of the post being prevented relative rotation between both elements. At the end of the arm has a hole for connecting the manual chain hoist for lifting loads.

The material employed in the manufacturing of the toolkit are the next:

- Steel S700MC in column and arm
- Steel F111 in anchorage

The calculations were made with steel S355JR.

7. Safety devices

They have employed the European directives and harmonized standards indicated to evaluate the list of significant hazards.

Have complied with the requirements set by these rules, indicating the particulars of each case by the work environment.

Following are details regarding the same.

Mechanical construction and stability:

Design in accordance with regulations, calculated to ensure stability. Calculate foreseeable forces and adequate structural material.

You must ensure proper connection between the flange and the clamping member; Mooring and carabiner with chain hoist.

Lighting devices:

None provided any means of lighting.

Because the intended use indoors, it depends on the lighting of the wind turbine, suspending the activities if there is not enough light to safely operate.

Check that will not cause glare or create annoying shadows, in which case it shall cease the use of the whole.

The device and its elements are painted and identified so that in the absence of light refract position. The tool is painted yellow and has luminescent bands on mastil and arm.

8. Evaluation risks

Based on the UNE EN ISO 12100 with the following parameters.

		Consequences (Cons.)		
		slightly harmful .D. (L.D.)	harmful (D.)	extremely harmful (E.D.)
Probability (Prob.)	Low (B)	Trivial risk	Tolerable risk	Moderate risk
	Medium (M)	Tolerable risk	Moderate risk	Important risk
	High (A)	Moderate risk	Important risk	Untolerable risk

Risk	Valoration
Trivial (TR)	No specific action is required.
Tolerable (TO)	No need to improve preventive action, however should be considered more cost-effective solutions or improvements that do not pose a significant economic burden. Regular checks are required to ensure that effective control measures are maintained.
Moderate (MO)	Efforts should be made to reduce the risk, determining the necessary investments. Measures to reduce the risk should be implemented in a given period. Where the moderate risk is associated with extremely harmful consequences, further action will be needed to establish more precisely the likelihood of harm as a basis for determining the need for improved control measures.
Important (IM)	Should not commence work until the risk is reduced. May require considerable resources you to control the risk.
Untolerable (IN)	You should not start or continue work until the risk, even with limited resources is reduced, the work should be prohibited.

If the dangerous situation is not indicated, shall be understood as continuous during use.

Identified hazards and hazardous situations	Prob	Cons	Risk	Actions
Mechanical risks Inadequate strength. Estability. Entrapment hazard. Risk of crushing. Danger shear. Anticipated or unanticipated movements	B	E.D.	MO	Ensure proper placement of the system. Under no circumstances stand under suspended loads.
Slipping, losing balance or falling. Environment work by machine	B	D	TO	Keep area clean transit of foreign elements.
Inadequate visibility from command post.	B	L.D.	TR	Training and information for operators.
Assembly errors	M	D	MO	Only perform maintenance and skilled installation. Simple and intuitive design.

Identified hazards and hazardous situations	Prob	Cons	Risk	Actions
Mechanical hazards and hazardous events. Collisions. Lack stability. Uncontrolled overload. Unexpected movement. Insufficient mechanical strength. Abnormal assembly / test / use / maintenance.	B	E.D.	MO	Inherently safe design.
Falling objects.	B	E.D.	MO	Lanyards shall bear the CE marking and shall withstand the maximum working capacity.
Loss or overturning stability.	B	E.D.	MO	Lanyards shall bear the CE marking and shall withstand the maximum working capacity.
Hazard to people exposed to uncontrolled movements.	B	D	TO	No person should be placed in the scan field except for the performance of maintenance by qualified personnel.

Identified hazards and hazardous situations	Prob	Cons	Risk	Actions
Hazards generated by not respecting ergonomic principles. Derivatives awkward postures or excessive efforts Incorrect postures. Inadequate hand-arm anatomy consideration. Inadequate Design manual controls.	B	L.D.	TR	Staff turnover based on the evaluation of ergonomic hazards.

CALCULATION

9. Introduction to F.E.M

In the finite element analysis involves the following properties of the material in its entirety:

- Lineal: The stress is directly proportional to the force.
- Continuous: no voids exist between particles and, therefore, interstitial voids.
- Homogeneous: the properties do not change in the entire volume of the piece.
- Isotropic: the material properties are identical in all directions.

These properties must be verified by an effective method.

The material properties are (S355JR steel):

Designación según		Límite elástico, mínimo, R_{eH} [a], en MPa [b] Espesor nominal, en milímetros									Resistencia a tracción R_m [a], en MPa [b] Espesor nominal en milímetros				
UNE EN 10027-1 y CR 10260	UNE EN 10027-2	≤ 16	> 16 ≤ 40	> 40 ≤ 63	> 63 ≤ 80	> 80 ≤ 100	> 100 ≤ 150	> 150 ≤ 200	> 200 ≤ 250	> 250 ≤ 400[c]	≤ 3	> 3 ≤ 100	> 100 ≤ 150	> 150 ≤ 250	> 250 ≤ 400[c]
S 235 JR S 235 JO S 235 J2	1.0038 1.0114 1.0117	235 235 235	225 225 225	215 215 215	215 215 215	215 215 215	195 195 195	185 185 185	175 175 175	- - 165	360 a 510 360 a 510 360 a 510	360 a 510 360 a 510 360 a 510	350 a 500 350 a 500 350 a 500	340 a 490 340 a 490 340 a 490	- - 330 a 480
S 275 JR S 275 JO S 275 J2	1.0044 1.0143 1.0145	275 275 275	265 265 265	255 255 255	245 245 245	235 235 235	225 225 225	215 215 215	205 205 205	- - 195	430 a 580 430 a 580 430 a 580	410 a 560 410 a 560 410 a 560	400 a 540 400 a 540 400 a 540	380 a 540 380 a 540 380 a 540	- - 380 a 540
S 355 JR S 355 JO S 355 J2 S 355 K2	1.0045 1.0553 1.0577 1.0596	355 355 355 355	345 345 345 345	335 335 335 335	325 325 325 325	315 315 315 315	295 295 295 295	285 285 285 285	275 275 275 275	- - 265 265	510 a 680 510 a 680 510 a 680 510 a 680	470 a 630 470 a 630 470 a 630 470 a 630	450 a 600 450 a 600 450 a 600 450 a 600	450 a 600 450 a 600 450 a 600 450 a 600	- - 450 a 600 450 a 600
S 450 J0[d]	1.0590	450	430	410	390	380	380	-	-	-	-	550 a 720	530 a 700	-	-

Modulus of Young	**210000 N/mm2**
Coeficient of Poisson	**0,3**
Density	**7850 Kg/m3**
Elastic limit	**355 N/mm2**
Breaking limit	**470 N/mm2**

The safety factor is calculated using the maximum equivalent stress failure theory for ductile materials. The yield strength of the material specified stress limit.

10. Initial data

They are based on all the data presented herein. With these data, a 3D model is made for further study by the finite element method.

Acceptance criteria shall be as follows:

Safety factor (CS) at least 1.5 on the elastic limit of the material to all provisions of load.

Using S355JR steel, the conditioning factors are:

On the elastic limit, the máximum stress Von Misses will be 355/1,5 = 236 MPa.

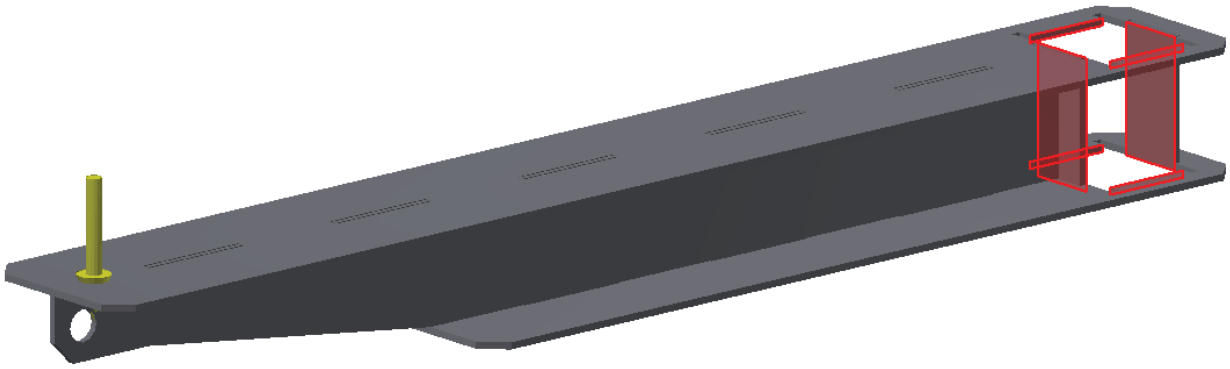
This also implies that On the breaking limit CS = 470/236 = 1,986

The static load calculation for PPM 2.X PORTABLE HOIST GEWE WTG is set to 100 kg = 1000 N = 1 kN

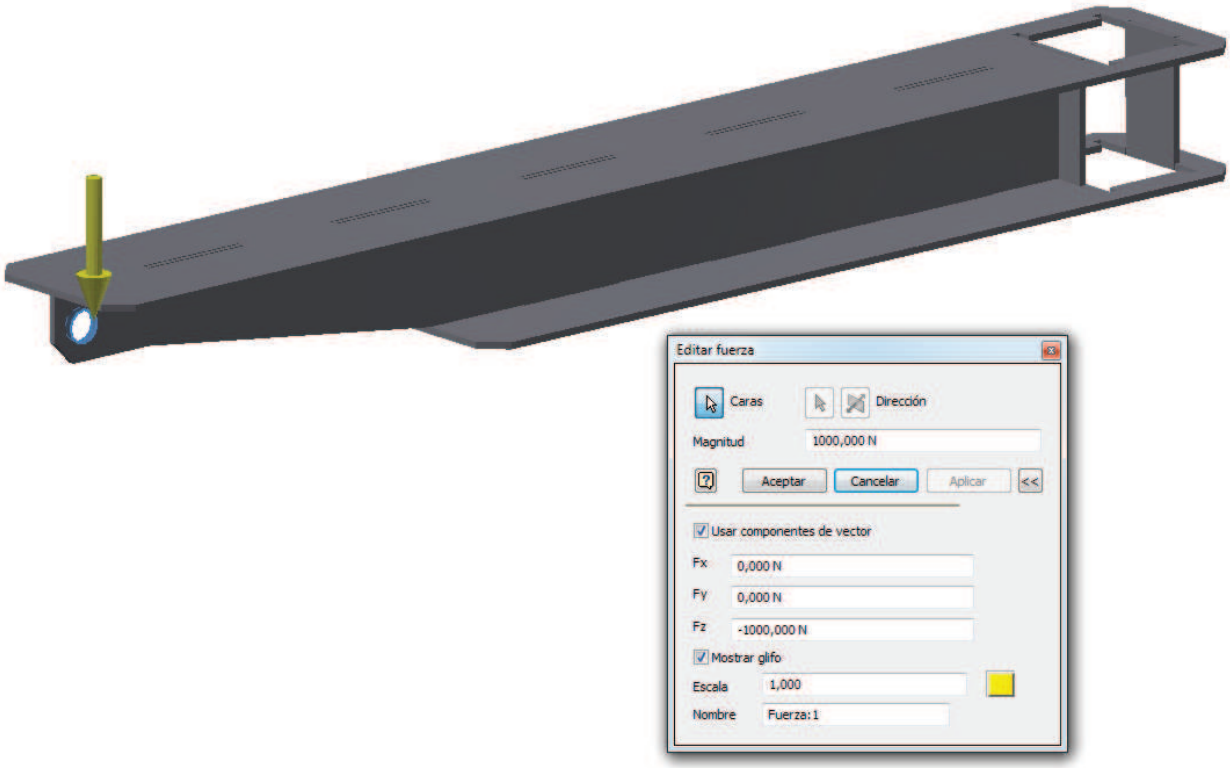
11. Analisys F.E.M

11.1. Analisys arm

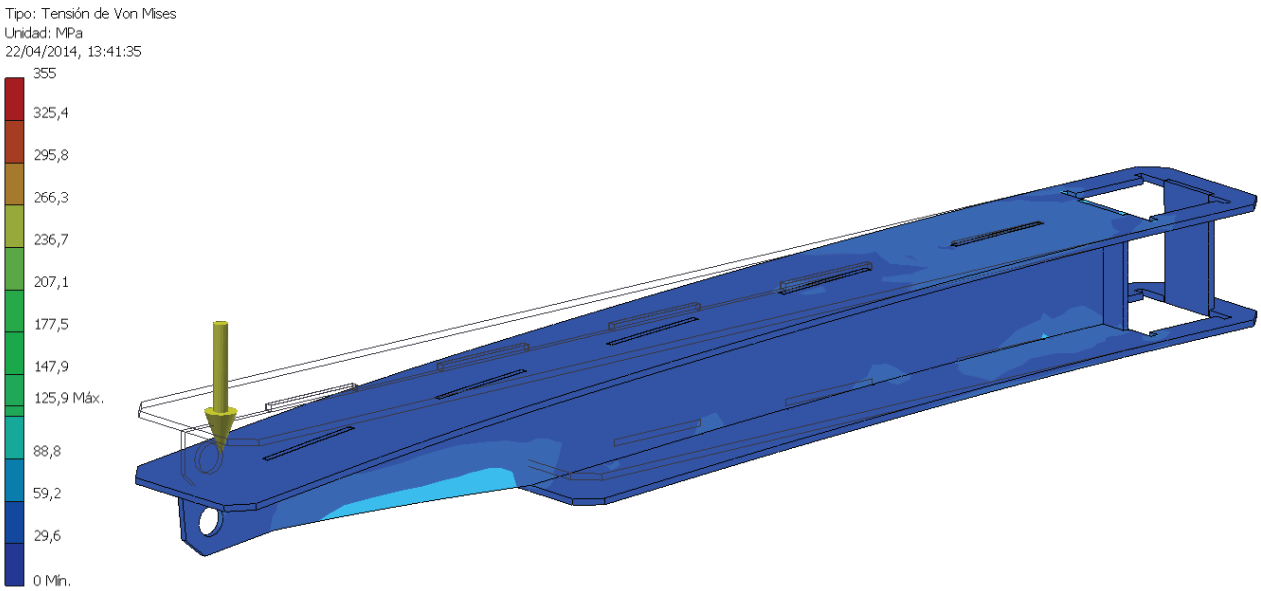
Restrictions



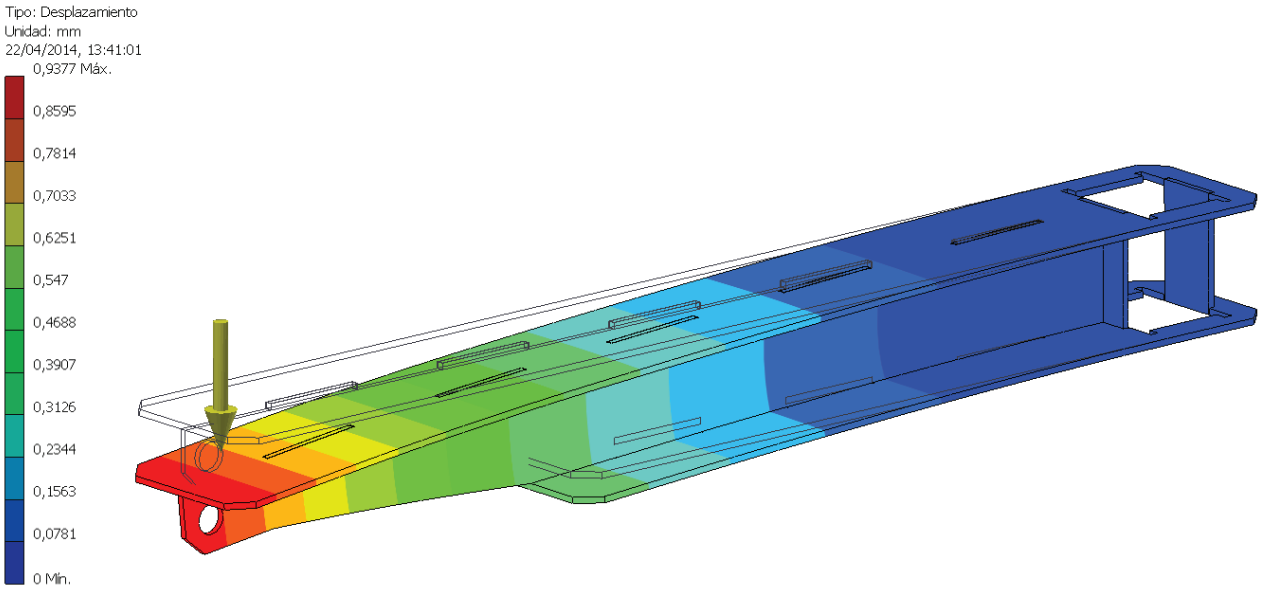
Load 1000 N



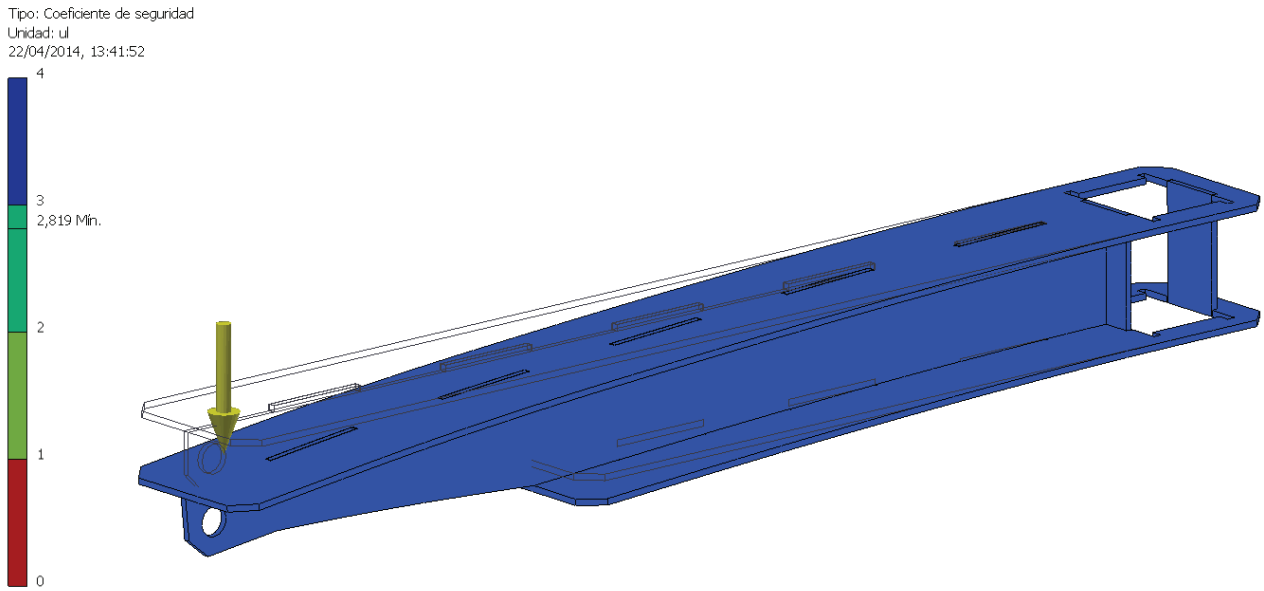
Stress Von Misses



Displacements



Safety coeficient

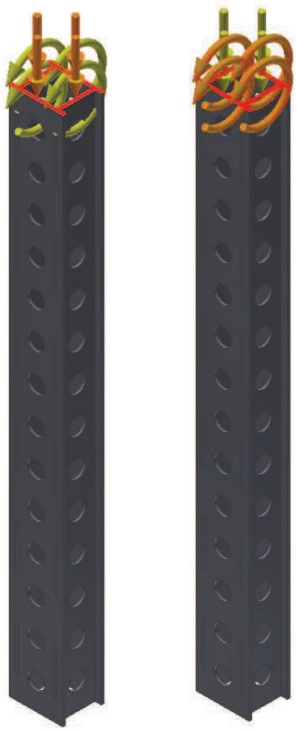


Analyzing the results is determined that the component satisfies the conditions of resistance.

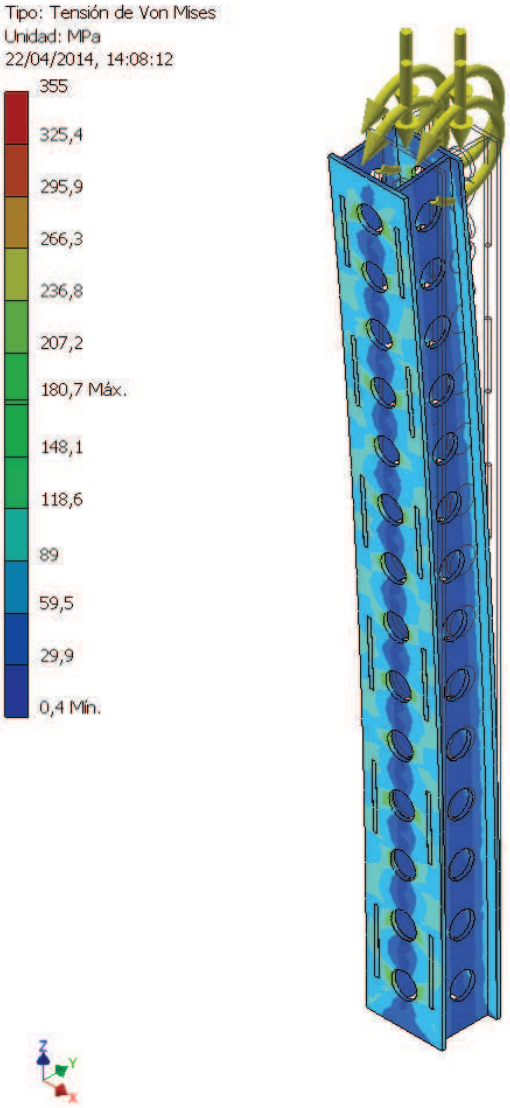
11.2. Analisys column

Restrictions

Load 1000 N to compresion + Flector 580000 Nmm



Stress Von Misses



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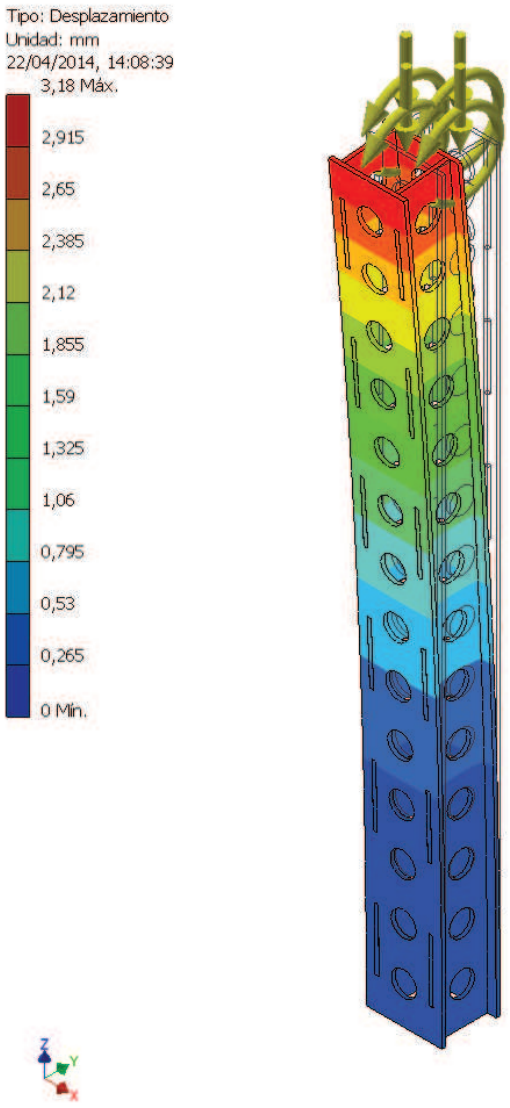
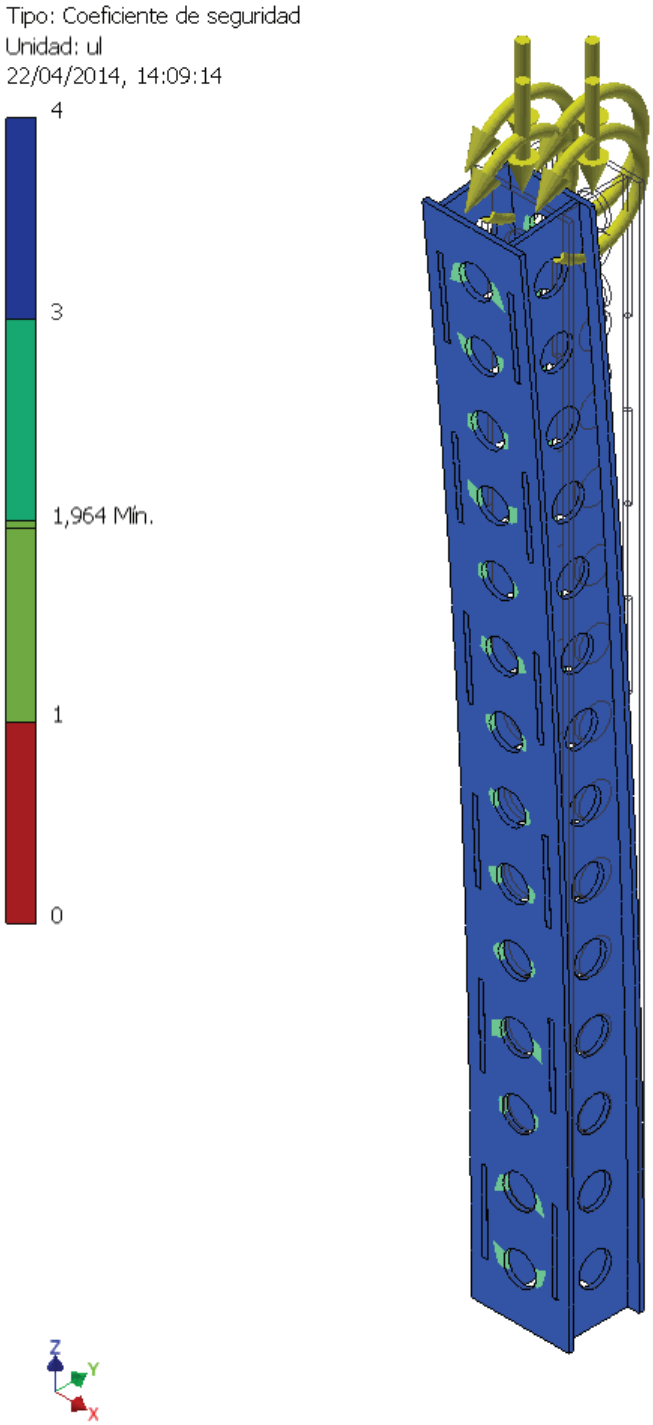


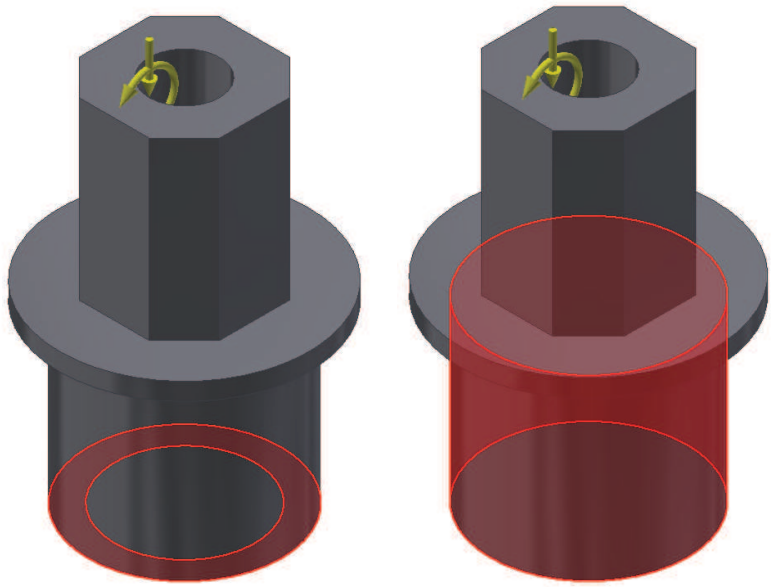
Safety coeficient



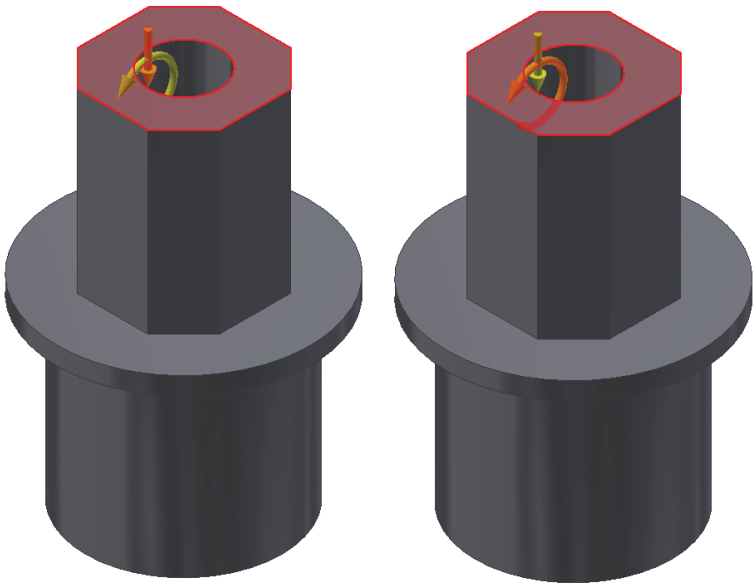
Analyzing the results is determined that the component satisfies the conditions of resistance.

11.3. Analisys anchorage nº1

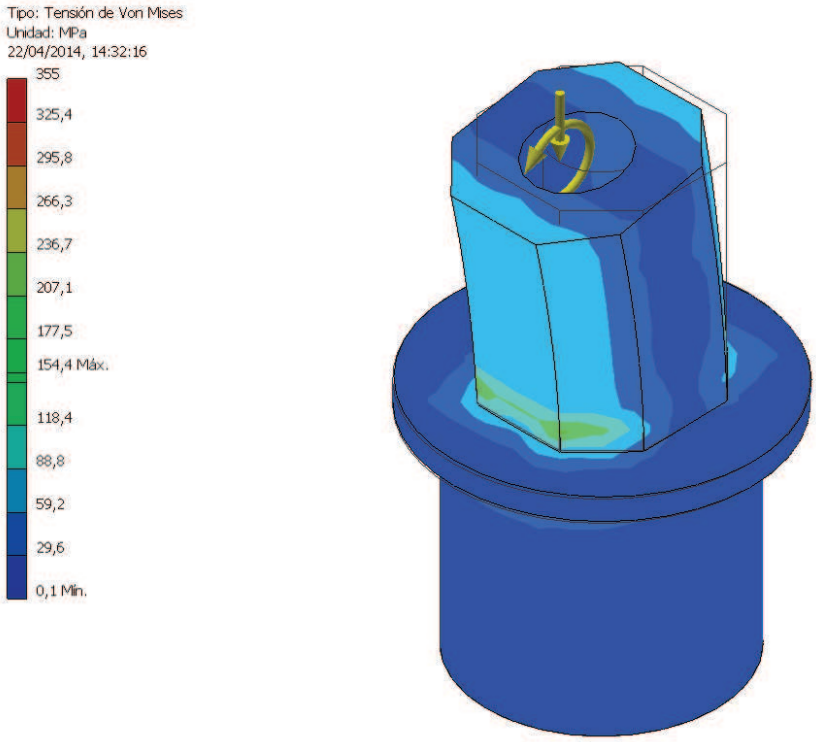
Restrictions



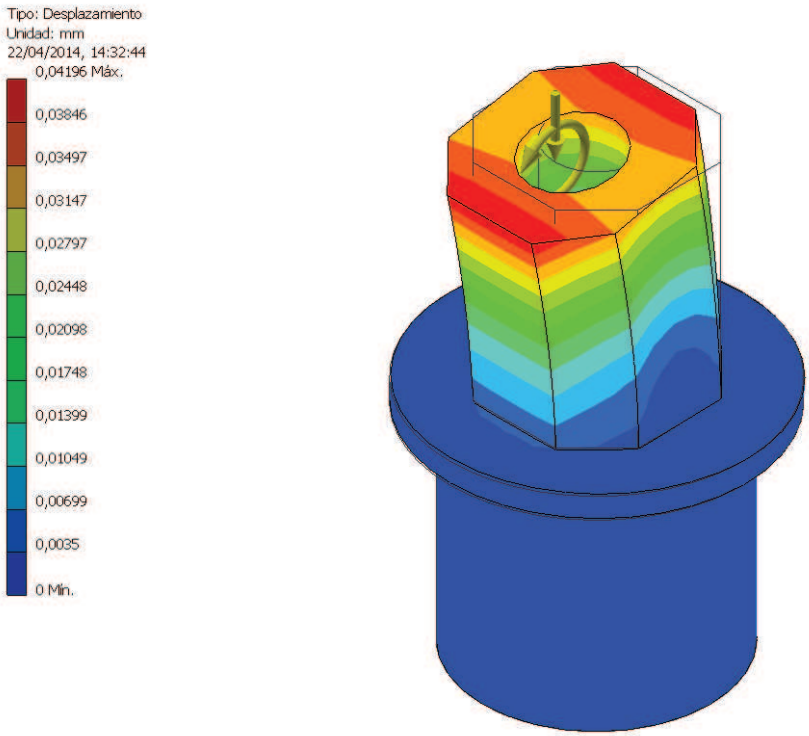
Loads 1000 N to compresion + Flector 580000 Nmm



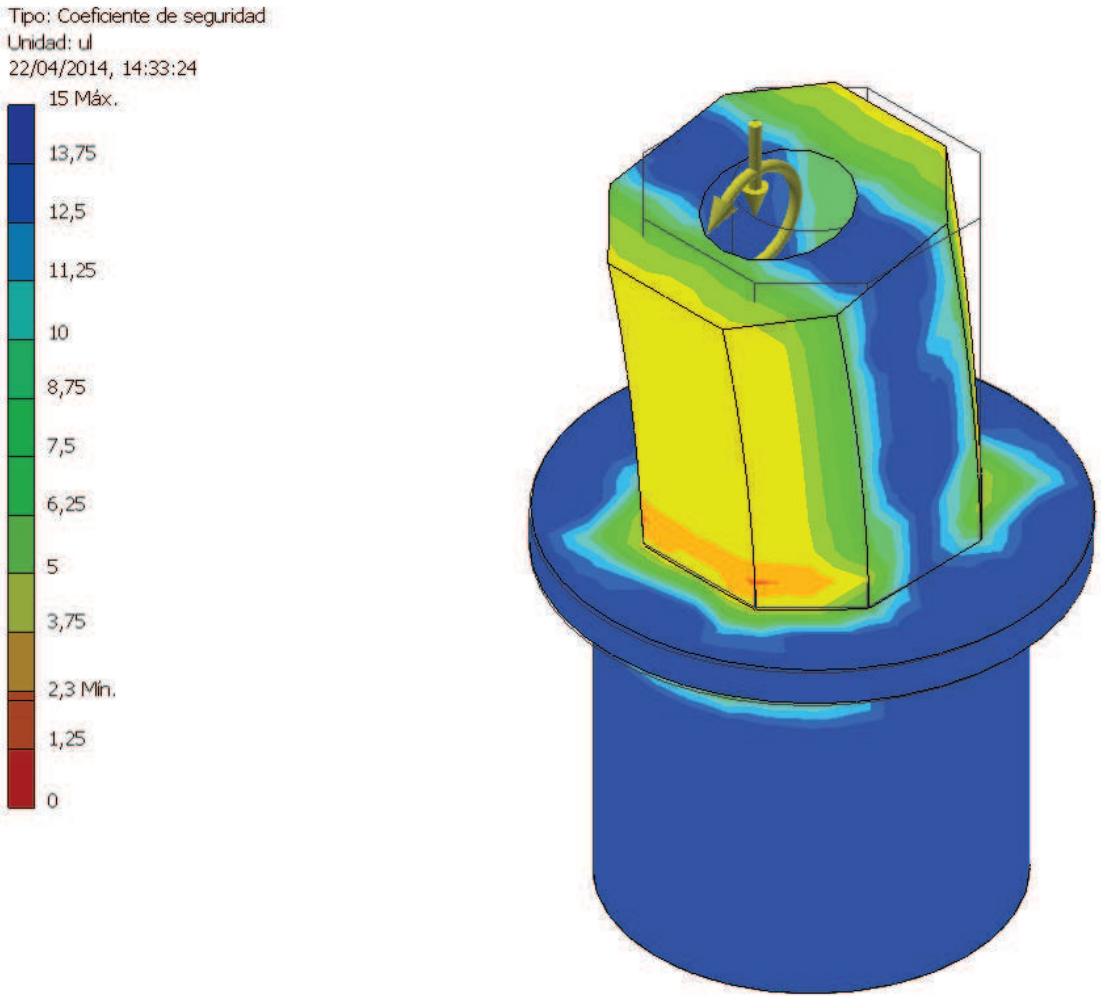
Stress Von Misses



Displacements



Safety coeficient



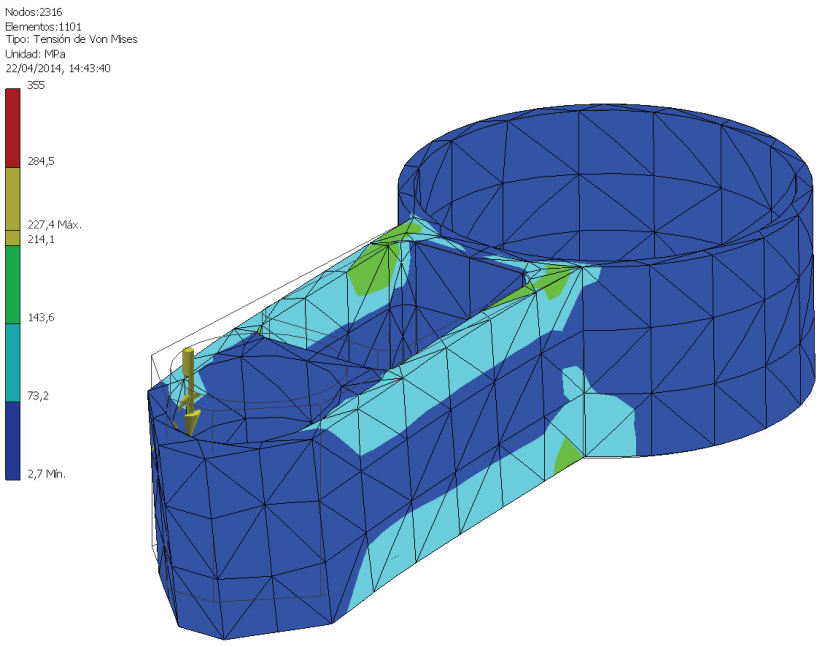
Analyzing the results is determined that the component satisfies the conditions of resistance.

11.4. Analisys anchorage nº2

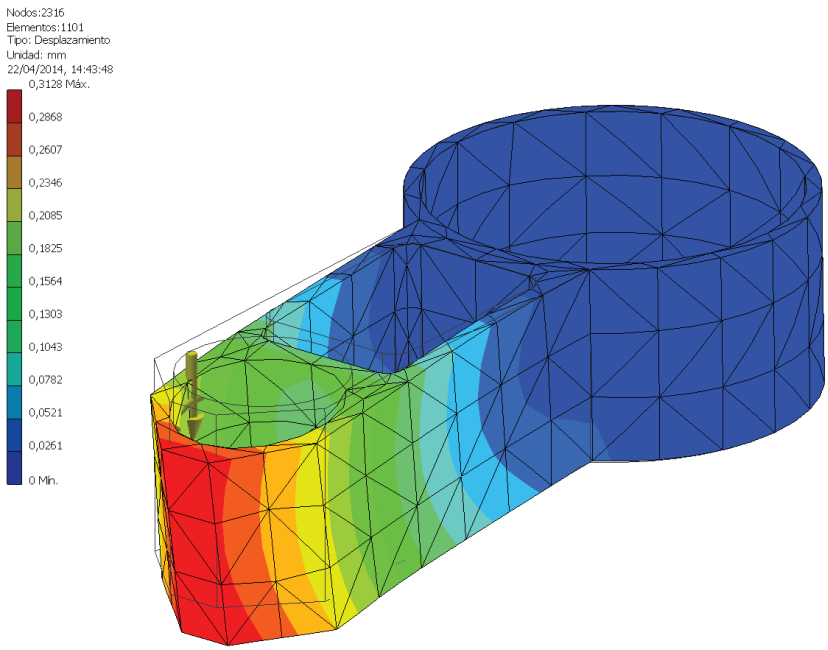
Is definied the next loads:

- Compresion 1000 N
- Flector 580000 Nmm

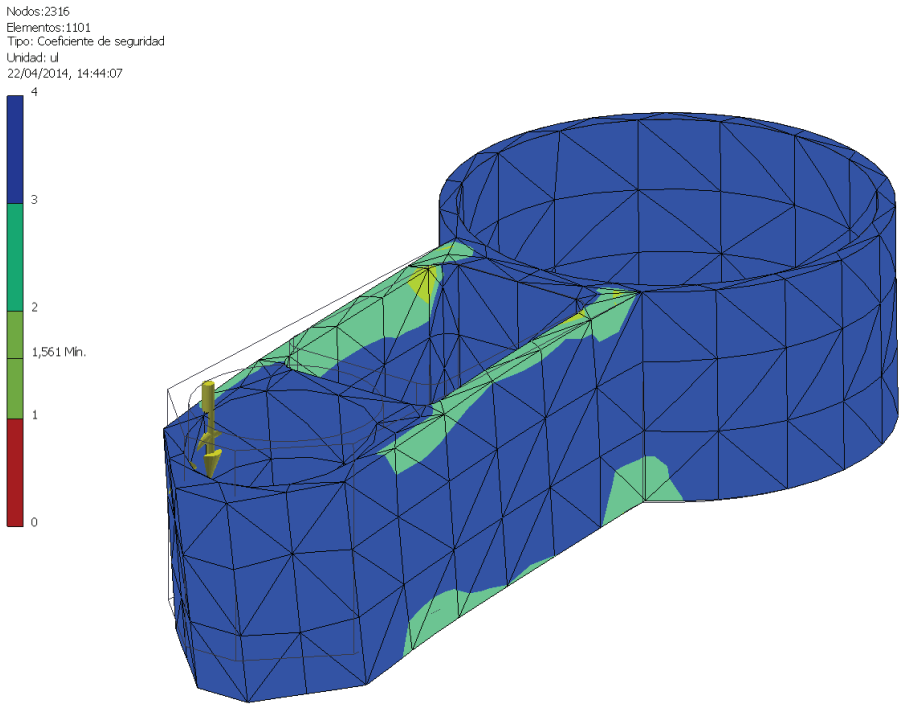
Stress Von Misses



Displacements



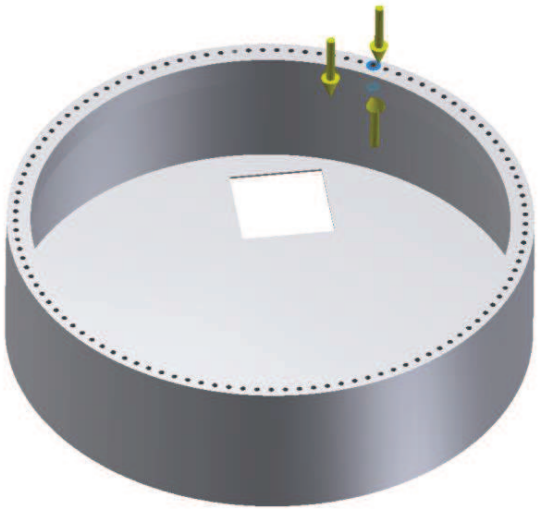
Safety coeficient



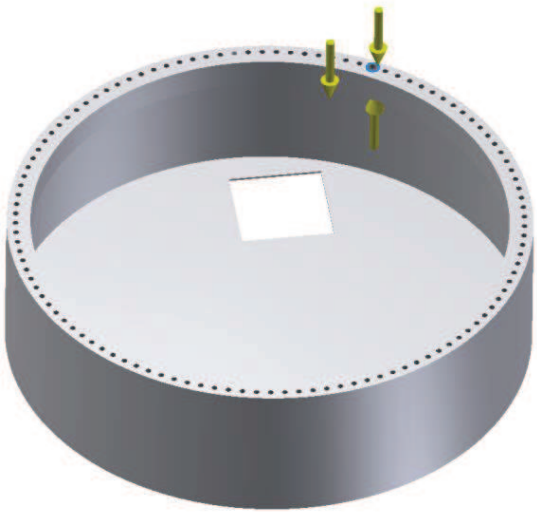
Analyzing the results is determined that the component satisfies the conditions of resistance.

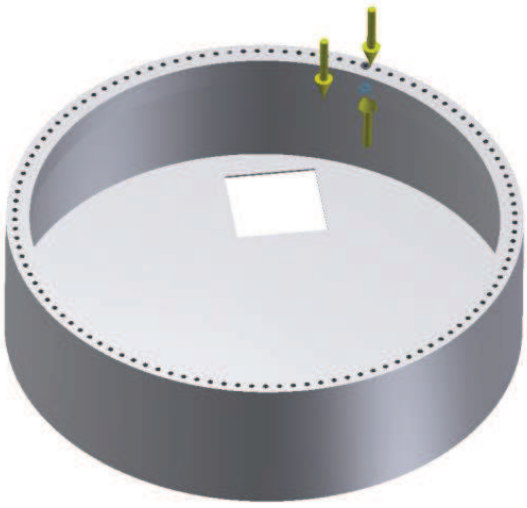
11.5. Checking reactions flange

The load 100 kg is applied on the most unfavorable position (on the end of the arm of 580 mm length).

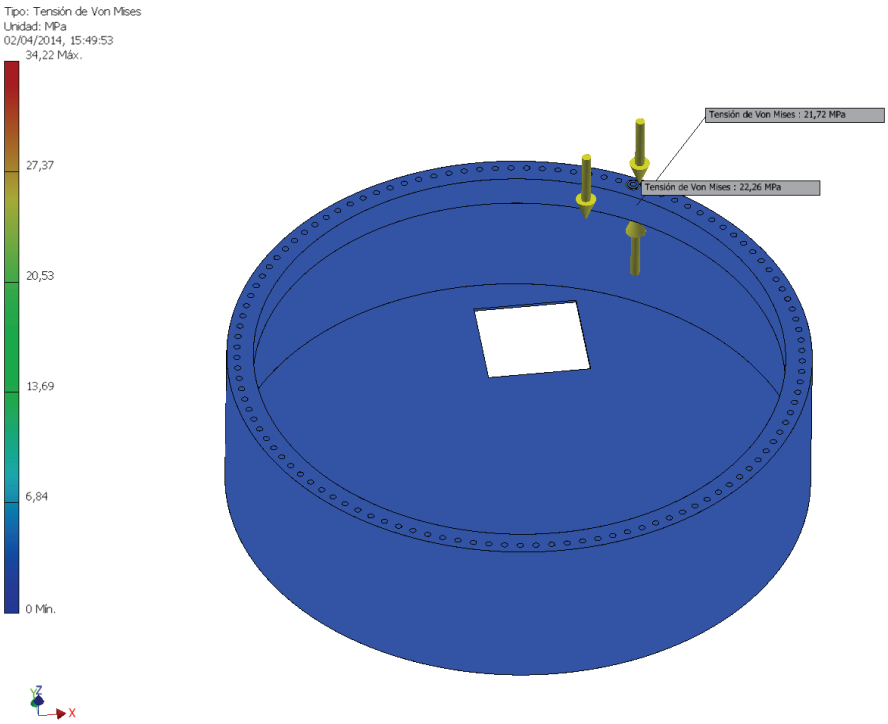


Preload is introduced on the bolt 16 tons.





Results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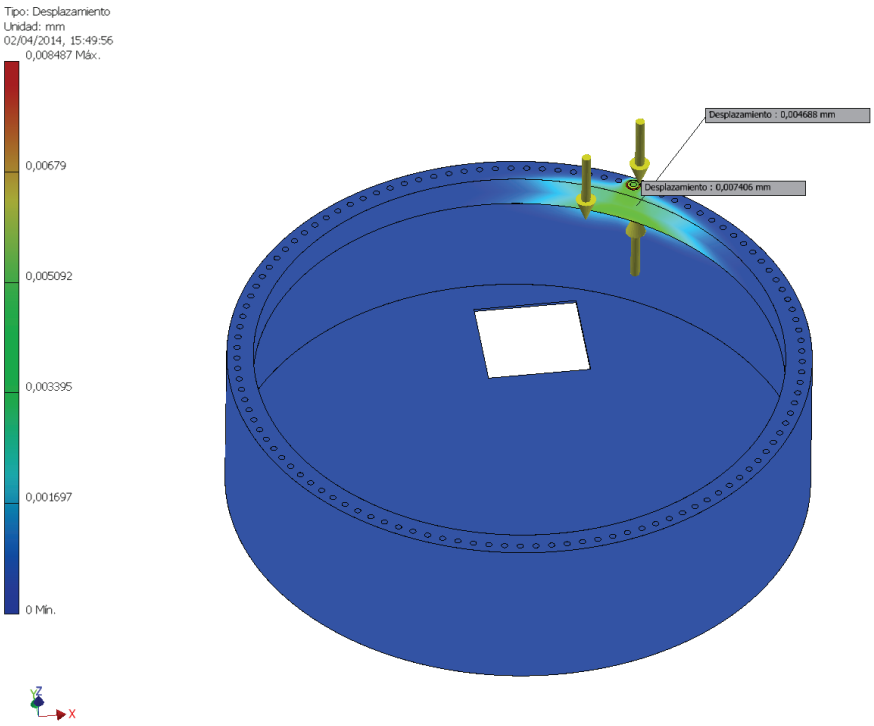
Unidad: MPa
02/04/2014, 15:49:53
34,22 Máx.
27,37
20,53
13,69
6,84
0 Mín.
Tensión de Von Mises : 21,72 MPa
Tensión de Von Mises : 22,26 MPa
Y
Z
X


Tipo: Desplazamiento
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0,00679
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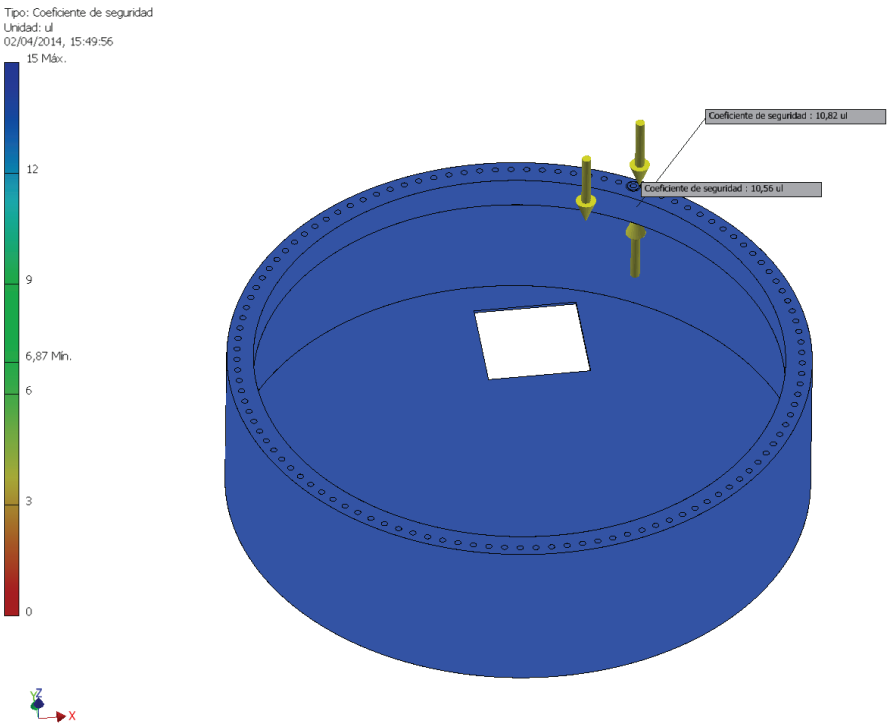
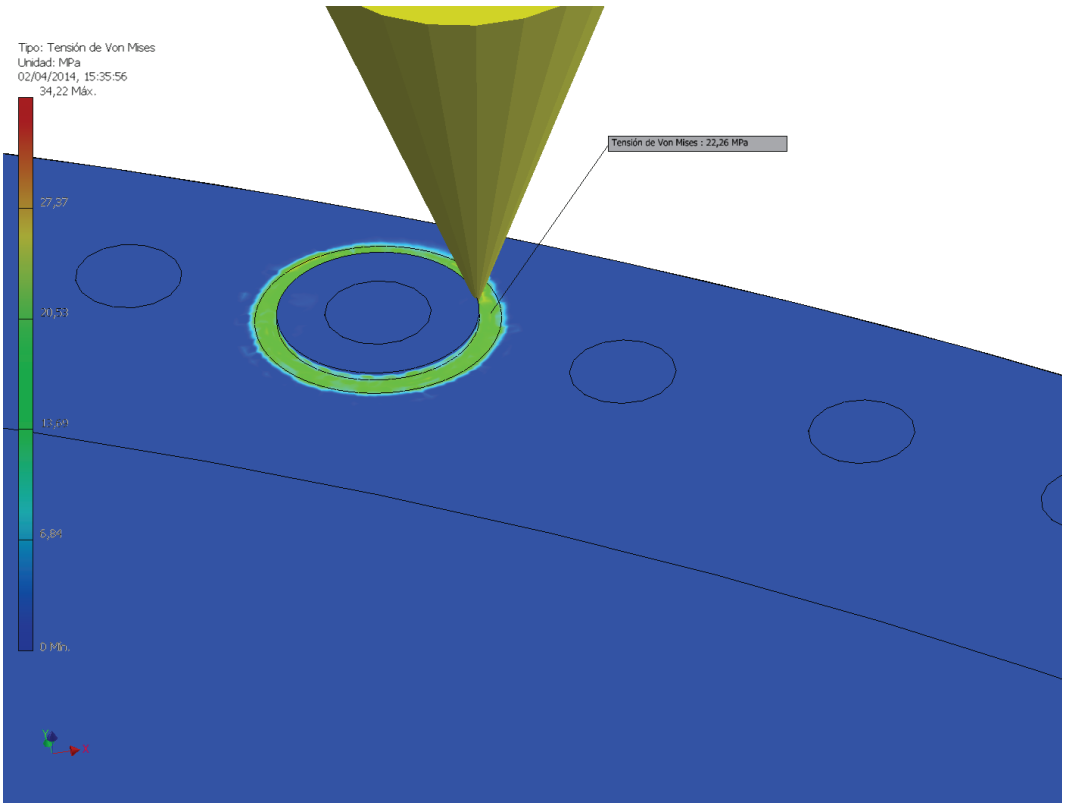
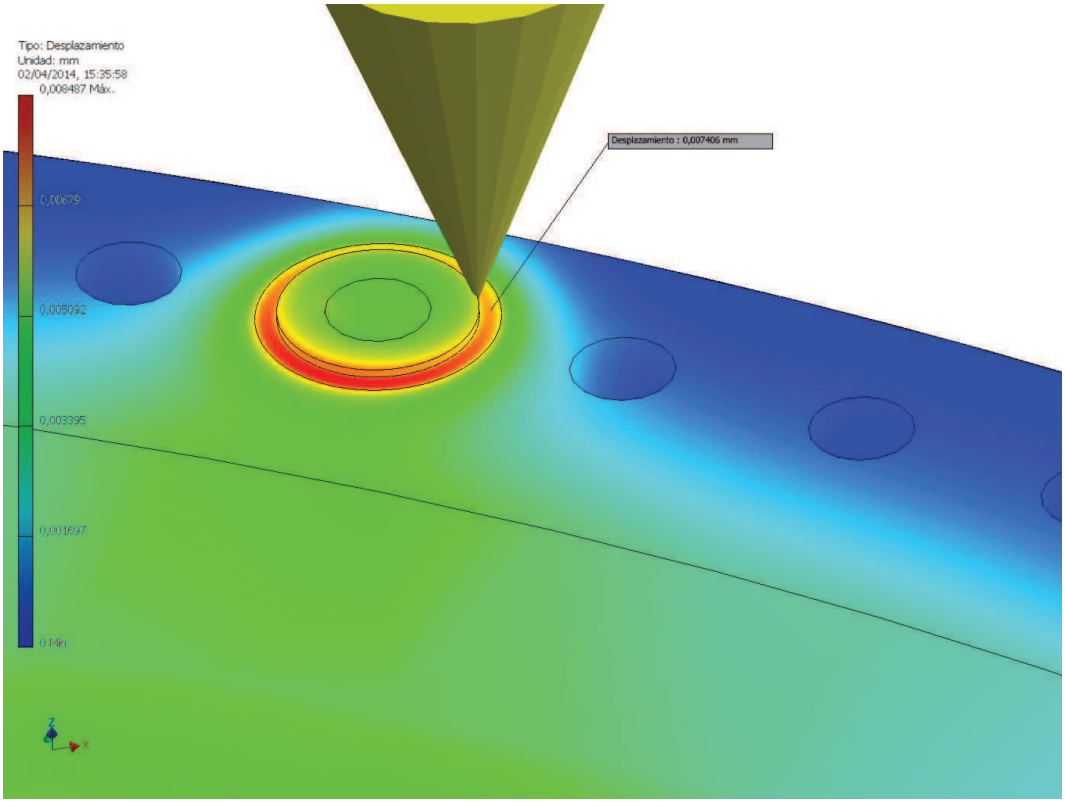
0,001697
0 Mín.
Desplazamiento : 0,004688 mm
Desplazamiento : 0,007406 mm
Y
Z
X



Below are details of the upper and lower part of the connection point.

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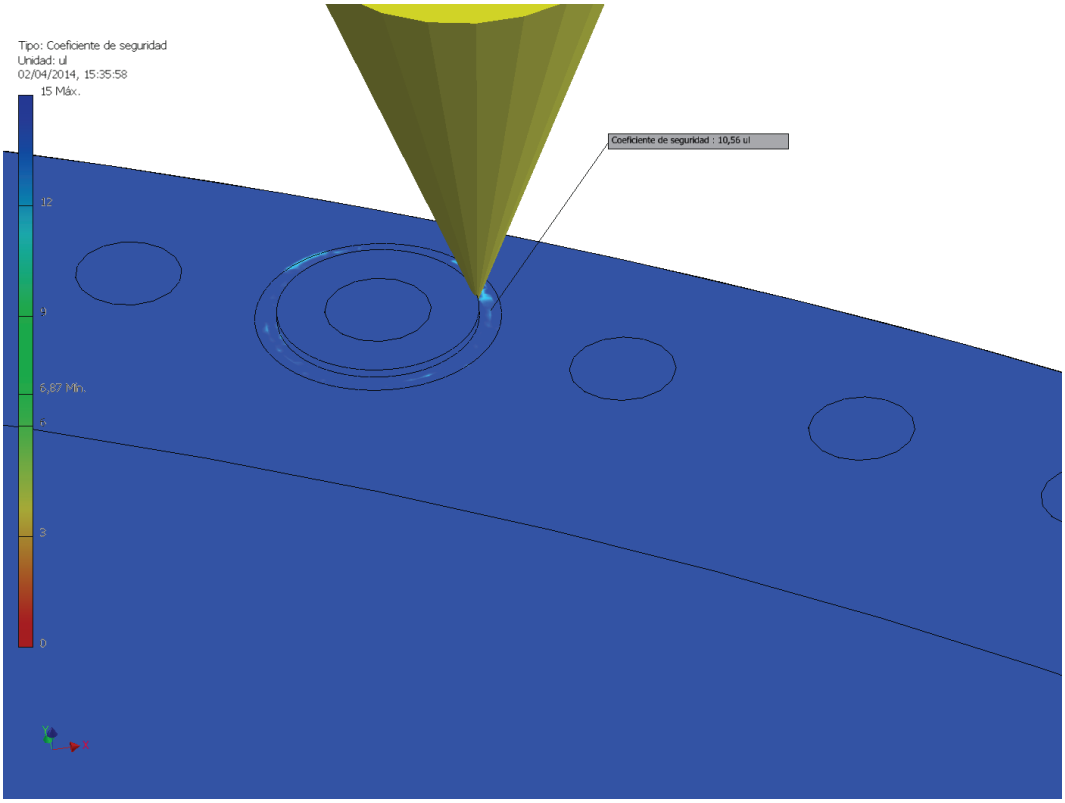
Tipo: Coeficiente de seguridad
Unidad: ul
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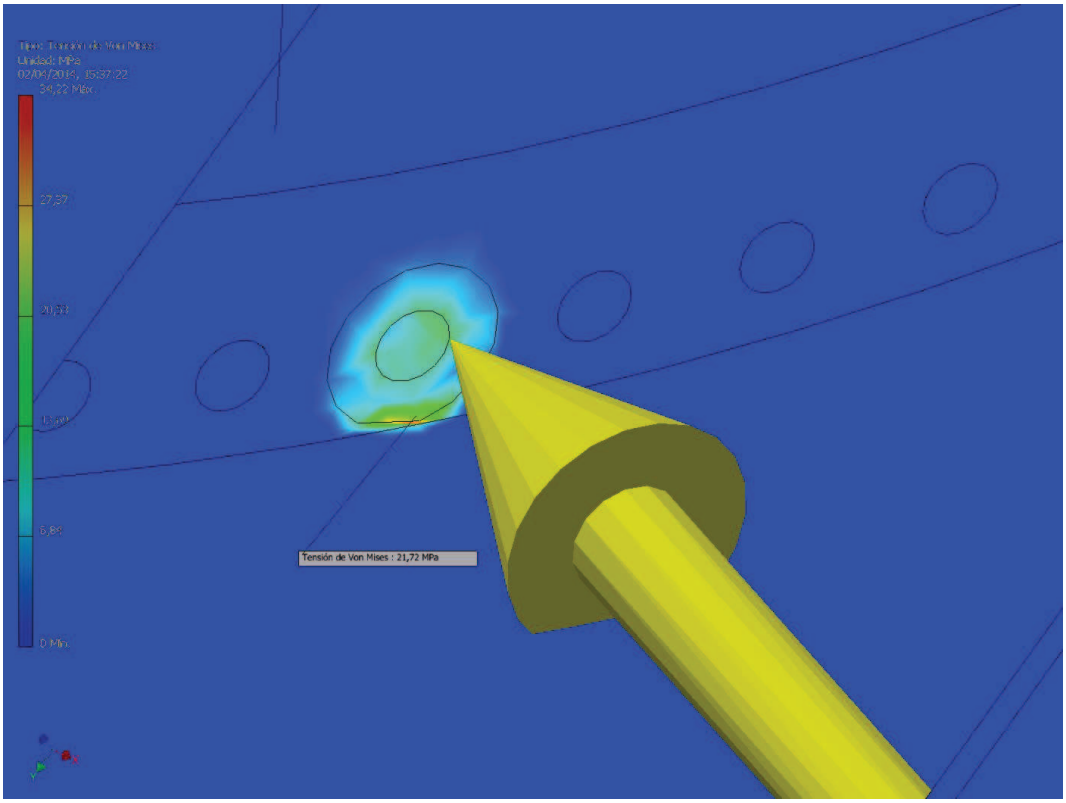
15 Máx.
12
9
6,87 Mín.
6
3
0
Coeficiente de seguridad : 10,56 ul


Unidad: MPa
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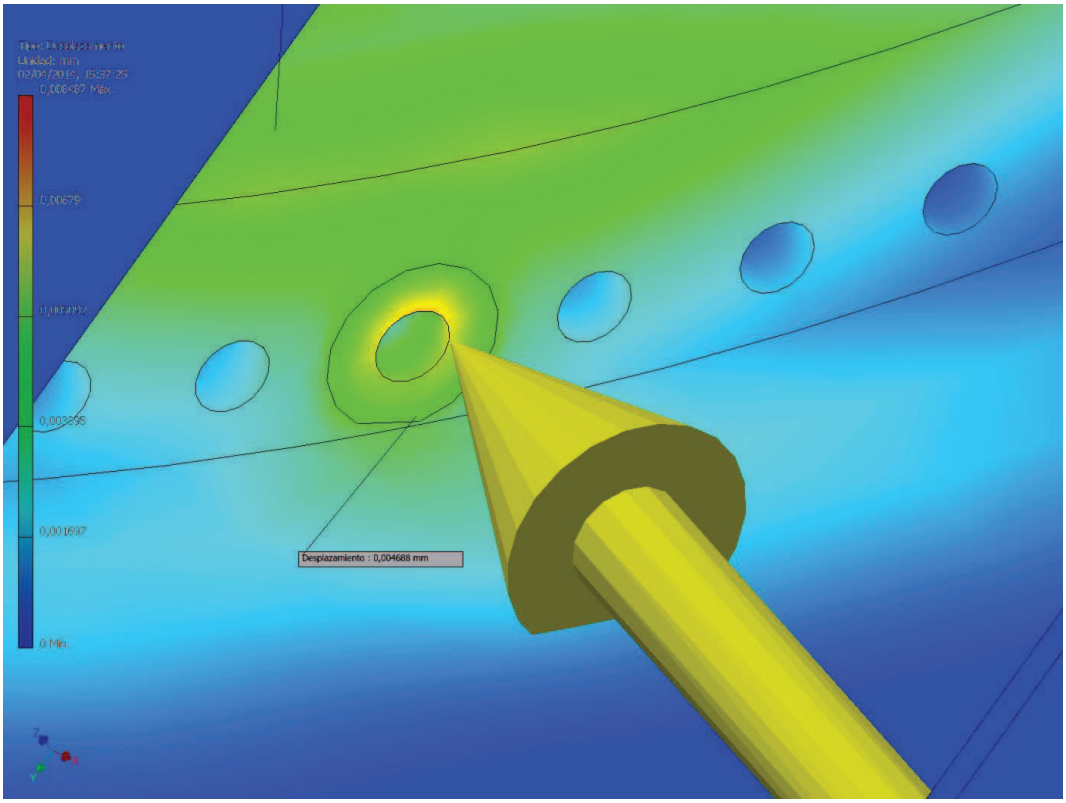
34,22 Máx.
27,37
20,53
13,68
6,84
0 Mín.
Tensión de Von Mises : 21,72 MPa


Unidad: mm
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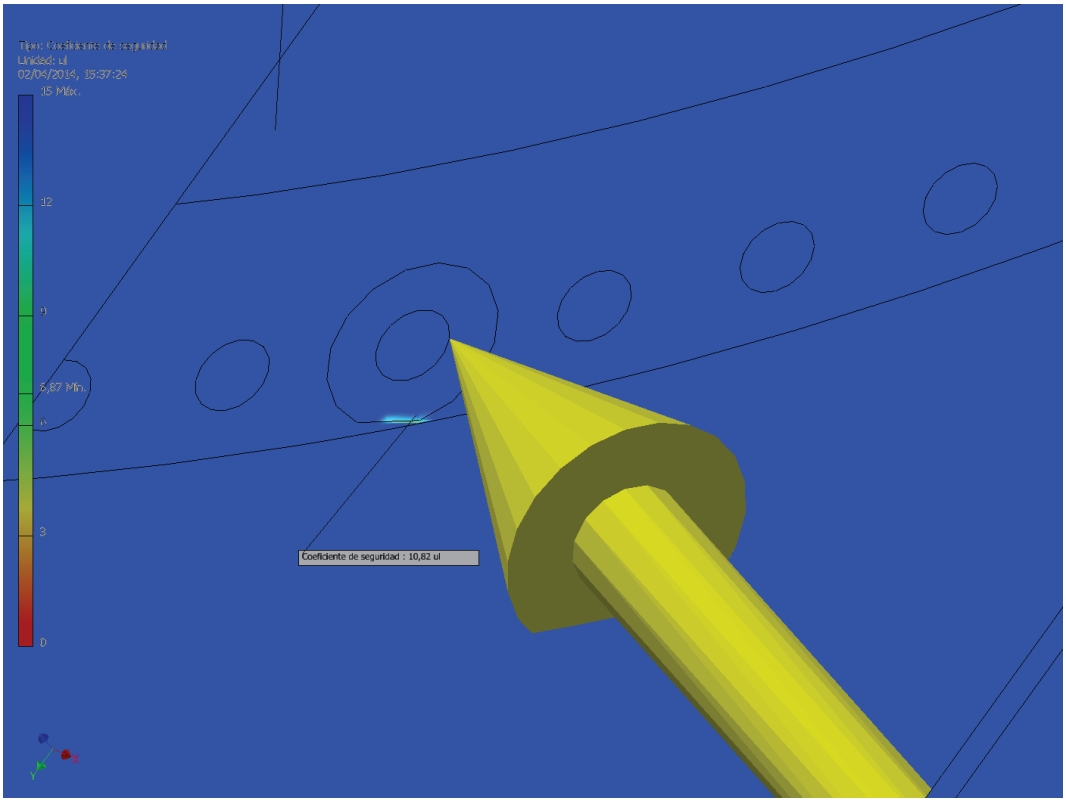
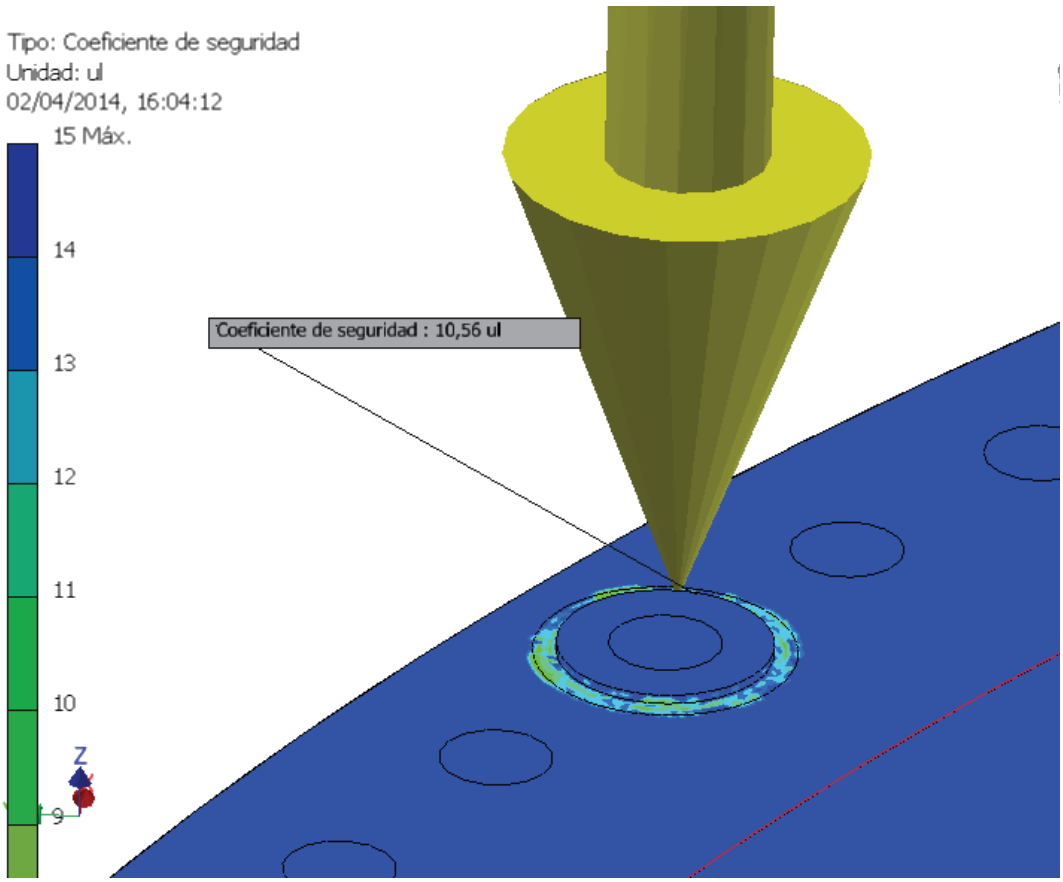
0 Mín.
Desplazamiento : 0,004688 mm


15 Máx.
12
9
6,87 Mín.
3
0
Coeficiente de seguridad : 10,82 ul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Unidad: ul
02/04/2014, 16:04:12
15 Máx.
14
13
12
11
10
9
Z
Coeficiente de seguridad : 10,56 ul

12. Welds

Welds along all the contact areas with a compatible welding throat thickness of the welded parts are used. Generally, the welding to be 0.7 times the minimum thickness of the sheets to be joined.

Welding a groove so that the members to be joined is not lowered is used, avoiding the creation of cracks or inclusions.

The mechanical characteristics of the input elements will in any case, higher than the base material

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