

CELIER AVIATION

Mast Bulletin Service Introduction

Modification of mast fixation to the fuselage.

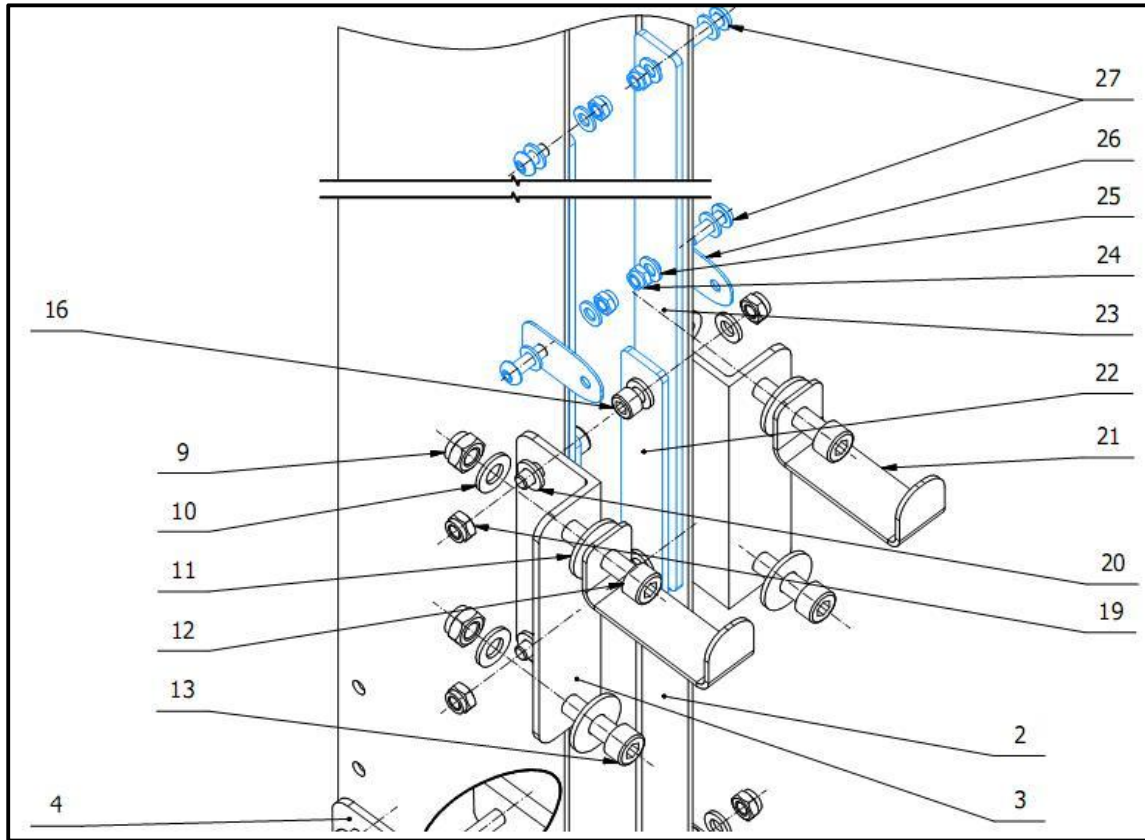
Due to have found masts showing an initial crack on external edges, we have decided to propose an upgrade and a reinforcement for the mast in the zone subjected to wear.

The original mounting is absolutely correct, and matches classic safety standards. The core of the mast being the most important part, it is not directly bolted, but only its flanges. The second inferior bolting zone is capable of holding full loads and stresses. This is called redundant safety. This is why masts do not brake in normal use despite a beginning crack on the edges. Still the last top fixation point was specifically designed to create a breaking point when a top shock is made, like in a severe blade flapping, rotor severe ground strike, crash situation. This is a very important feature on the Xenon to save occupants from flapping blades around the cabin, instead the rotor flies away. The mass inertia of a full motion rotor is around 2 tons, this energy has to dissipate somewhere, best not on hitting a cabin...

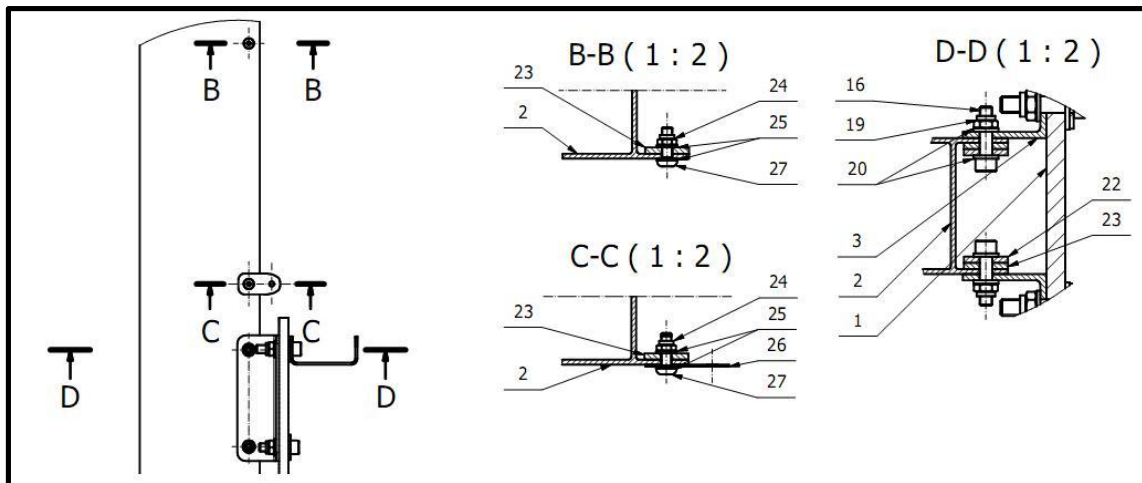
The upgrade, retains the possibility of this safety point, while offering more solidity in severe uses.

We have found, that most Xenon users, DO NOT inspect deeply their machine after a hard landing. Thus it is mandatory as per the Maintenance Manual. Machines with bent rear wheel axles, bent aluminium landing gears, abused / forced pre-rotation sequences, very bumpy runways, should definitely inspect more often the structure. We also observe very hard handlings, and acrobatic manoeuvres. Let's remember gyroplanes are not acrobatic airplanes. The Xenon is known for its extreme solidity / strength, very forgiving machine, handling schooling perfectly. Still it is not a reason to forget about the discipline of controlling / inspecting, as it should be done on any aircraft. Let's be more respectful to the technology.

The upgrade kit is available immediately, please contact our spare part service to order it. Cost is 35€ plus transport.



Pic.1. Mast modification



Pic.2. Mast modification

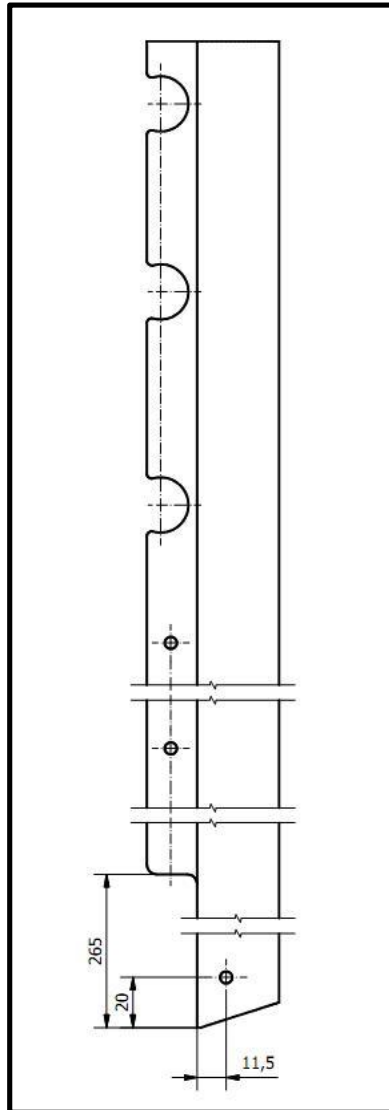
27	Hex socket button head cap screw	4	Steel	ISO 7380 - M5 x 16	
26	Mast spoiler fixation plate	2	Stainless Steel	CAXen-K-M-6032	
25	Washer	8	Steel, Mild	DIN 125 - A 5,3	
24	Hex nut Nylon-stop	4	Steel, Mild	DIN 985 - M5	
23	Alu reinforcement bar long	2	PA7 (AW2024)	CAXen-K-M-6031	
22	Alu reinforcement bar short	2	PA7 (AW2024)	CAXen-K-M-6030	
21	Headphones holders	2	PA6 (AW2017A)	CAXen-K-A-1012	
20	Washer	44	Steel, Mild	DIN 125 - A 6,4	
19	Hex nut Nylon-stop	22	Steel, Mild	DIN 985 - M6	
18	Hex socket head cap screw	2	Steel, Mild	ANSI B18.3.1M - M6x1 x 90	
17	Cap special screw M6x40/30	4	Steel, Mild	CAXen-K-M-6036	
16	Cap special screw M6x40/25	8	Steel, Mild	CAXen-K-M-6035	
15	Cap special screw M6x35/20	4	Steel, Mild	CAXen-K-M-6034	
14	Cap special screw M6x35/16	4	Steel, Mild	CAXen-K-M-6033	
13	Cap special screw M8x40/30	2	Steel, Mild	CAXen-K-M-6037	
12	Cap special screw M8x45/35	2	Steel, Mild	CAXen-K-M-6038	
11	Washer	4	Steel, Mild	DIN 9021 - 8,4	
10	Washer	4	Steel, Mild	DIN 125 - A 8,4	
9	Hex nut Nylon-stop	4	Steel, Mild	DIN 985 - M8	
8	Bottom front alu angle	1	PA7 (AW2024)	CAXen-K-M-6001	
7	Bottom back alu angle	1	PA7 (AW2024)	CAXen-K-M-6001A	
6	Bottom steel angle	2	Steel	CAXen-K-M-6003C	
5	Top steel angle	2	Steel	CAXen-K-M-6003B	
4	Horiz. alu angle- mast to fuselage 115x30x3	2	PA7 (AW2024)	CAXen-K-M-6003	
3	Vert. alu angle- mast to fuselage 120x40x3	2	PA7 (AW2024)	CAXen-K-M-6003A	
2	Mast	1	Al AW-6106	CAXen-K-M-6000	
1	Part of the Cabin	1	-	-	
No.	Part title	Qty	Material	Part No / Standard	Comments

Pic. 3. Mast montage Part List

Upgrade kit consist of:

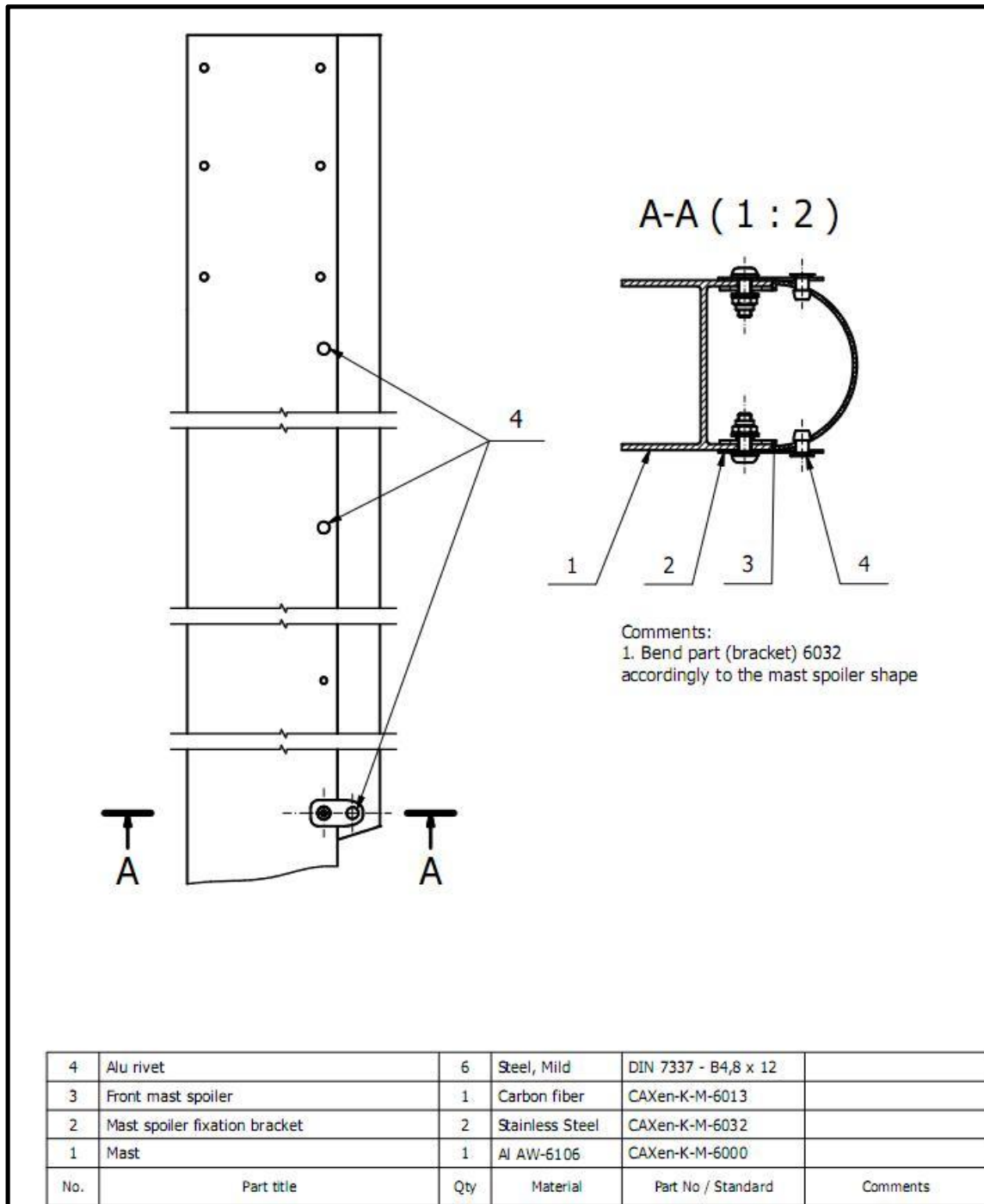
Part	Quantity	Part No / Standard
Alu reinforcement bar long	2	6031
Alu reinforcement bar short	2	6030
Mast spoiler fixation plate	2	6032
Hex socket button head cap screw	4	ISO 7380 ó M5x16
Cap special screw M6x40/30	4	6036
Cap special screw M6x40/25	8	6035
Cap special screw M6x35/20	4	6034
Cap special screw M6x35/16	4	6033
Cap special screw M8x40/30	2	6037
Cap special screw M8x40/35	2	6038
Washer M6	22	DIN 125-A 6,4
Washer M5	8	DIN 125-A 5,3
Hex nut Nylon-stop M5	4	DIN 985 ó M5
Extra alu rivets	6	6016

Modification of mast spoiler fixation to the mast.



Pic.4.Mast spoiler cut

To fix front mast spoiler to the mast, cut it in accordance to Pic.4.
Then attach it to the mast and rivet it in accordance to Pic.5



Pic.5.Mast spoiler fixation



Pic.6. Example of crack – it makes mast change mandatory

The core of the mast is the main holding surfaces, and is attached through 2 extra points, to the back and down the cabin. The safety margin is very high, as per the stress analysis shows, at 525 kg x 3.5 G x 2.1 safety factor. Total usable strength is 3858 kg.

Stress Analysis Report



Summary:	<p><i>Analiza wytrzymałościowa wzmocnionego masztu wiatrakowca Xenon 2 dla MTOW= 450kg oraz MTOW = 560kg.</i></p> <p>Strength analysis of reinforced mast of Xenon 2 autogyro for MTOW= 450kg and MTOW = 560kg</p>
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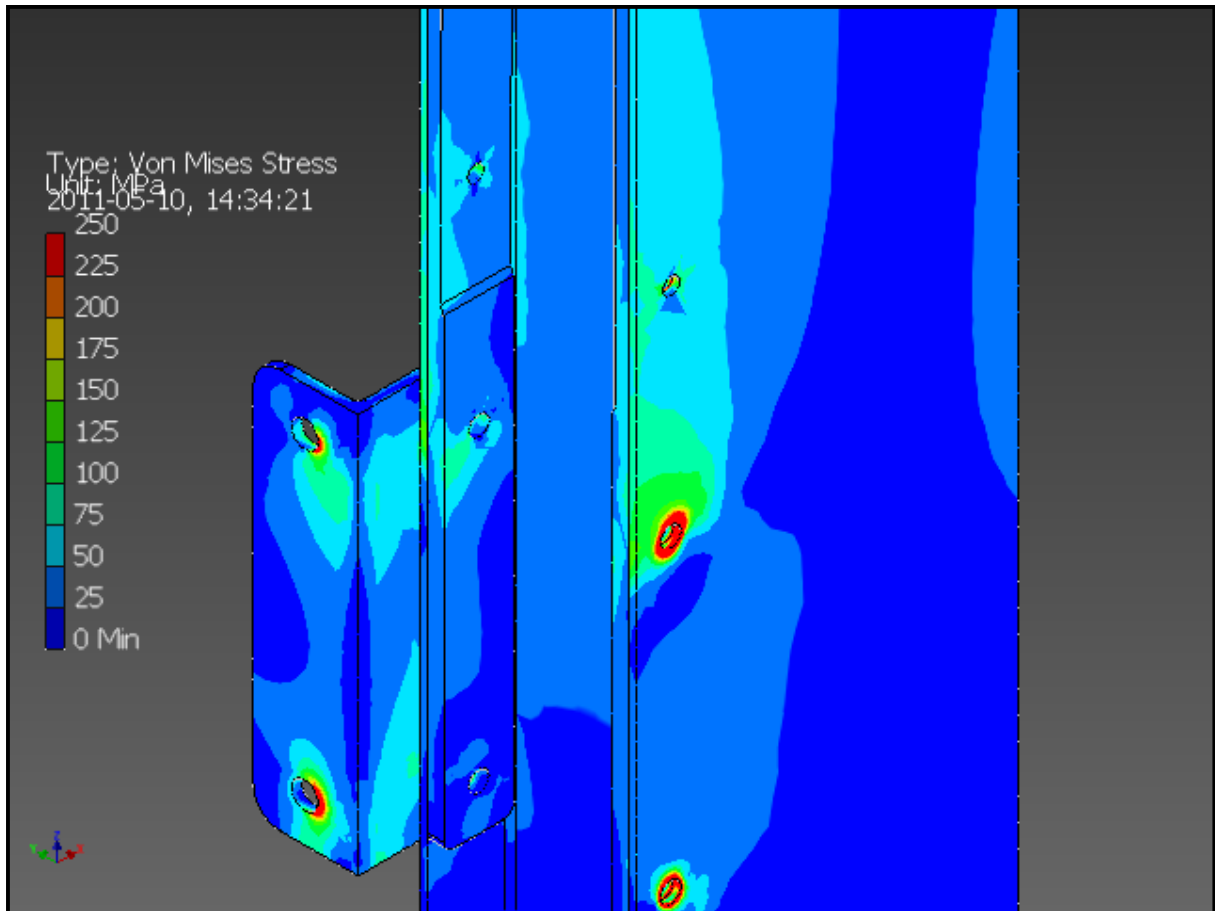
Two stress analysis were performed for new mast fixation and reinforcement.

First one considered Xenon gyroplane with MTOW= 450kg and the second one with MTOW= 560kg (Typical results presented below). In both cases simulation showed better results than without mast upgrade:

- Each simulation was performed for the load factor of 3,5 and safety factor of 1,5;
- Simulations were performed without the participation of additional parts that helps in load/vibrations distribution and stress concentration (such as cabin structure);
- The Ultimate Tensile Strength of the weakest material used is 250MPa and the stress do not exceed this value (*in a region that is to be taken into account- not in very close distance to the holes- influence of phenomena that are NOT perfectly described with the stress analysis*). Obtained values of stress give the margin of 30-10% above limit required by airworthiness rules and legislation.
- The original mast without reinforcement is still reliable structure.
- The proposed modification makes the mast structure stronger for: repetitive impacts, out of scale vibrations, overloaded gyroplane, usage of prerotator beyond its limitations. Reinforced version still retains the capacity for the mast to break upon strong blade flapping and/or ground strike protecting the occupants.

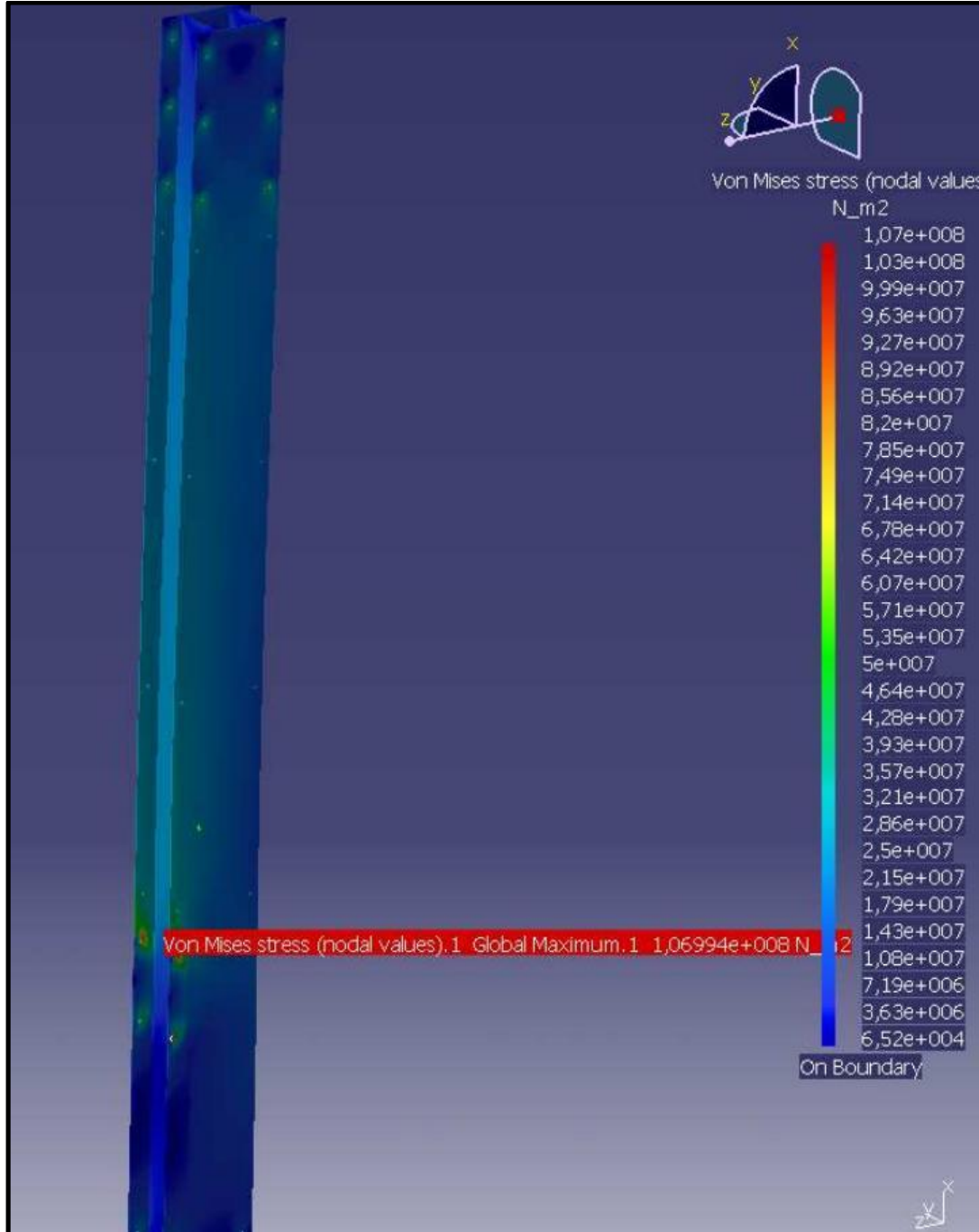
Typical result

Von Mises Stress:



Pic.7. Typical diagram of Von Mises Stress obtained in simulation.

Original tested mounting of the Mast was done with a limit load of 525kg and load factor 3,5 multiplied by safety factor 2,1. Results have shown adequate strength in normal conditions of use (Pic.7).



Pic.7. Original stress analysis of mast fixation.