TEST REPORT

Concerning the approval of Lateral protection devices (LPD) as a separate technical unit (Part II) in accordance with Regulation 73.01

Test report number		:	**RDW-73R-0094514**
0.1.	Make of the lateral protection device	:	Tilbox
0.2.	Type of the lateral protection device	:	Toolbox Tilbox, Toolbox Europa
0.4.	Intended category of the vehicle	:	O3, O4 And N2, N3
0.5.	Name and address of the manufacturer	:	F. Tilburgs Metaal B.V. John F. Kennedylaan 5 5555XC Valkenswaard, The Netherlands

General : The Lateral protection devices complies with the requirements laid down in:
- Part II of above-mentioned Regulation.
See documentation: E4*73R01/02*0071*02

Tests : The tests/calculations have been carried out in accordance with Part II of the above-mentioned Regulation.
See page 2 to 4.

Conclusion : The type of Lateral protection devices complies with the requirements and there are no objections to granting the approval under the above-mentioned Regulation.

Tests conducted on : 29 June 2020

By : E. Meisner

Zoetermeer, 04 November 2020,
The test engineer,

E. Meisner

Test Department

P.O. Box 777
2700 AT Zoetermeer
The Netherlands

Tel. + 31 79 345 83 02
E-mail VRTtesten@rdw.nl
www.rdw.nl

Test Centre
Talingweg 76
8218 NX Lelystad
The Netherlands

List of contents

List of attached documentation

Subject	Number of pages
R73 Quality mark	23

Reason for testing

New worst-case test to cover all possible configurations in the Tilsmart configurator

Used test equipment/calculation program

Item	Identification number (make and type)	Calibration papers available
		yes/not checked
		yes/not checked
		yes/not checked
		yes/not checked
		yes/not checked

Remarks

Physical tests have been performed on all supports and some of the boxes, larger and smaller, they show that the calculation is reliable to use on all sizes of boxes. See attached R73 Quality mark

General information

Make and type of the LPD	Tilbox Toolbox Europe
Intended Vehicle category	O3, O4 And N2, N3
Test conducted by	E. Meisner
Place	Valkenswaard, The Netherlands
Date	29 June 2020

Part II Approval of lateral protection devices (LPD)

14. Requirements

14.1. The outer surface of the LPD shall be smooth, and so far as possible continuous from front to rear; : pass/~~fail~~

Adjacent parts may however overlap provided that the overlapping edge faces rearwards or downwards, or a gap of not more than 25 mm measured longitudinally may be left, provided that the rearward part does not protrude outboard of the forward part; : pass/~~fail/N/A~~

Domed heads of bolts or rivets may protrude beyond the surface to a distance not exceeding 10 mm and other parts may protrude to the same extent provided that they are smooth and similarly rounded; : ~~pass/fail~~/N/A

All external edges and corners that may be contacted by a sphere of 100 mm diameter shall be rounded with a radius not less than 2.5 mm; : pass/~~fail~~

those protruding less than 5 mm shall have blunted outward facing edges. : ~~pass/fail~~/N/A

14.2. LPD may consist of a continuous flat surface, or of one or more horizontal rails, or a combination of surface and rails; when rails are used they shall be not more than 300 mm apart and not less than: : pass/~~fail~~ the surface is flat, always higher than 100 mm

a) 50 mm high in the case of LPD for vehicles of categories N2 and O3; : pass/~~fail/N/A~~

b) 100 mm high and essentially flat in the case of LPD for vehicles of categories for N3 and O4. : pass/~~fail/N/A~~

Combinations of surfaces and rails shall form a practically continuous LPD subject, however, to the provisions of paragraph 14.1. : ~~pass/fail~~/N/A

14.3. The forward edge shall consist of a continuous vertical member extending over the whole height of the device; : ~~pass/fail~~ the LPD shall not be used as a forward edge

the outer and forward faces of this member shall measure at least 50 mm rearwards and be turned 100 mm inwards or have a minimum radius of 50 mm in the case of vehicles of categories N2 and O3 : ~~pass/fail~~/N/A

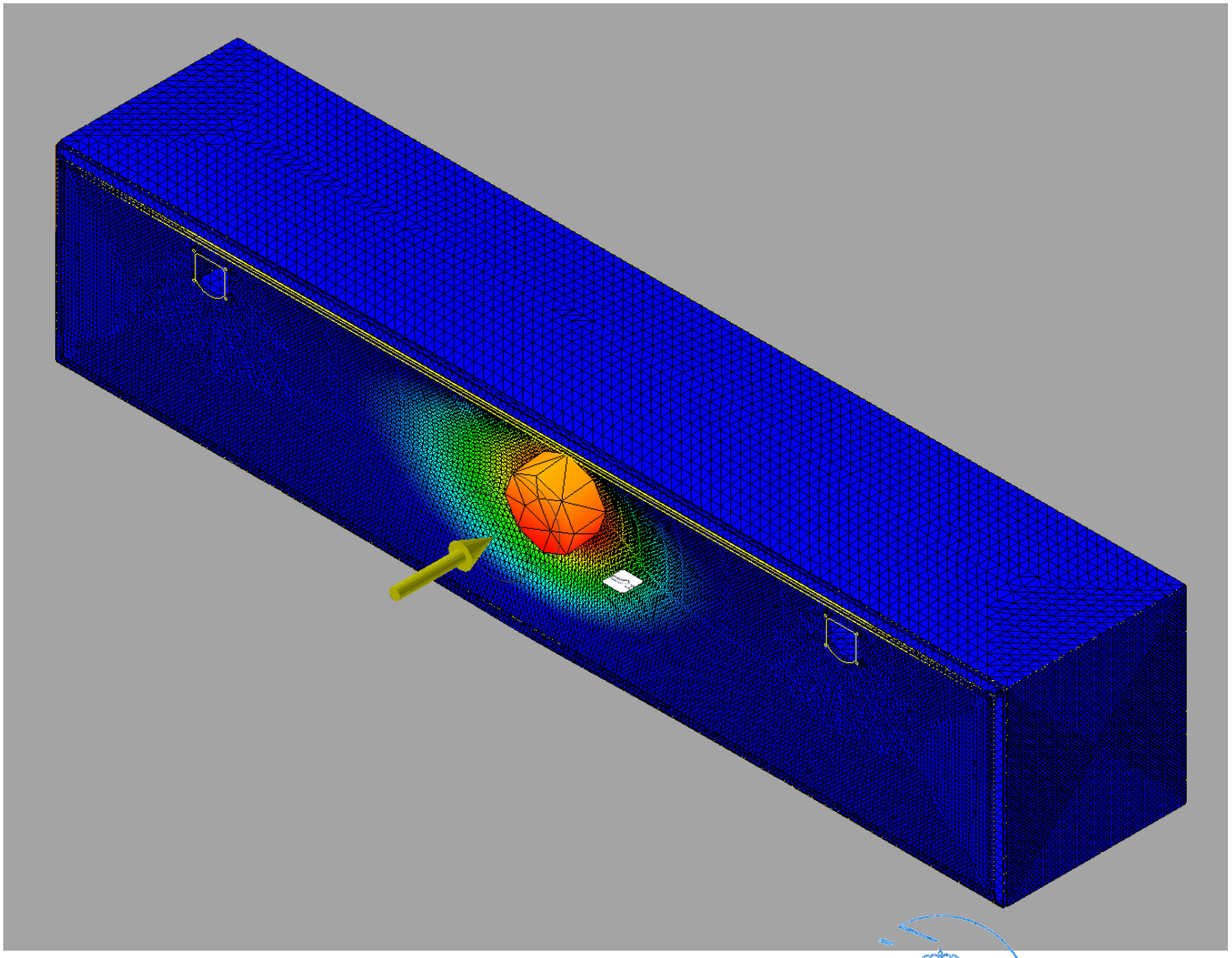
and at least 100 mm rearwards and be turned 100 mm inwards or a minimum radius of 100 mm in the case of vehicles of categories N3 and O4. : ~~pass/fail~~/N/A

JE MAINTIENDRAI
RDW

14.4.	LPD shall be essentially rigid and, except as regards the parts listed in paragraph 14.5., made of metal or any other suitable material.	: pass/~~fail~~
	LPD shall be considered suitable if they are capable of withstanding a horizontal static force of 1 kN applied perpendicularly to any part of their external surface by the centre of a ram the face of which is circular and flat, with a diameter of 220 mm ± 10 mm,	: pass/~~fail~~
	If the deflection of the device under load measured at the centre of the ram is then not more than:	
	a) 30 mm over the rearmost 250 mm of the device; and	: pass/~~fail~~ 6,55 mm Calculated Worst case, with supports in the middle. See page 14
	b) 150 mm over the remainder of the device	: pass/~~fail~~ 20,18 mm 18,18 + 2,00 mm Worst case box with worst case supports, See page 11 t/m 15
	At the request of the manufacturer, compliance with this requirement may be demonstrated by calculation. The validity of the calculation method shall be established to the satisfaction of the Technical Service.	: Combination of calculation and test to prove the calculation
14.5.	Components permanently fixed to the vehicle, e.g. spare wheels, battery box, air tanks, fuel tanks, lamps, reflectors and tool boxes may be incorporated in a device, provided that they meet the dimensional requirements of this part.	: pass/~~fail/N/A~~ at all times the surface is smooth and continuous
14.6.	LPD may be so designed to have several positions at the side of the vehicle. In this event, there must be a guaranteed method of securing them in their normal operating position so that any unintentional change of position is precluded. The force applied by the operator to vary the position of the device shall not exceed 40 daN.	: ~~pass/fail~~/N/A

TILBOX
TOOLBOXES FOR TRUCKS & TRAILERS

R73 Quality mark



JE MAINTIENDRAI
RDW

Title: R73 Quality mark for boxes
Author: Tilbox
Date: 22-8-2020

Table of contents

1. Introduction

The R73 quality mark is requested for a wide range of Tilbox boxes. This report indicates why it complies with the R73 quality mark and which boxes will be able to get this quality mark. It will first be shown that the FEM calculation is reliable compared to reality. Then the different types are described. When the types have been described, the worst case is described and calculated. Finally, the results of the worst case are compared to the requirements of the quality mark. The supports with which the boxes are attached have been tested and this can be read in appendix A, B and C.

2. Validation

To validate that the reality is comparable with the calculation, a box of 2600 mm wide, 500 mm high and 400 mm deep was pressed. The box was pressed with 1000 N on a 220 mm diameter disc. The disc is not deformable. The box consists of stainless steel 304 1.5 mm thick. The box is fixed at the bottom. This is done because these are also mounted on the truck. The box has a relatively small thickness compared to its dimensions. This makes it safe to work with a shell element. The midplane surface is used for the shell element. The following properties are used for the material properties.

property	value	unit
Young's modulus	190	Gpa
Poission's ratio	0,29	-
Schear modulus	86	Gpa
Density	8	g/cm^3
Yield strength	215	MPa
Tensile strength	510	MPa

Table 1: Properties stainless steel 304

When this situation is run it can be seen that the indentation on the lid is 8.279 mm.

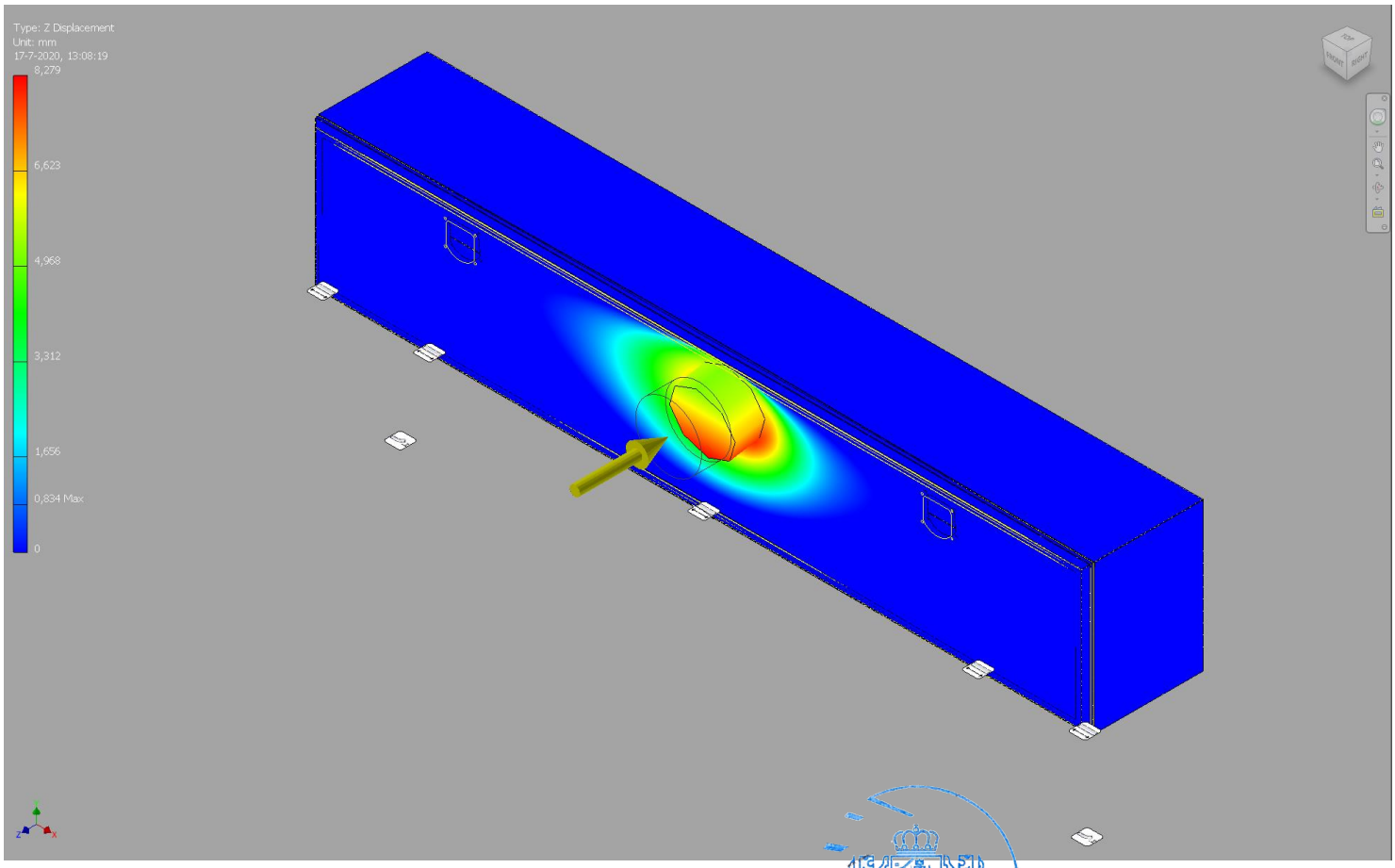


Figure 1: Calculation validation

It can be seen that at the real test, the box dents 9 mm.

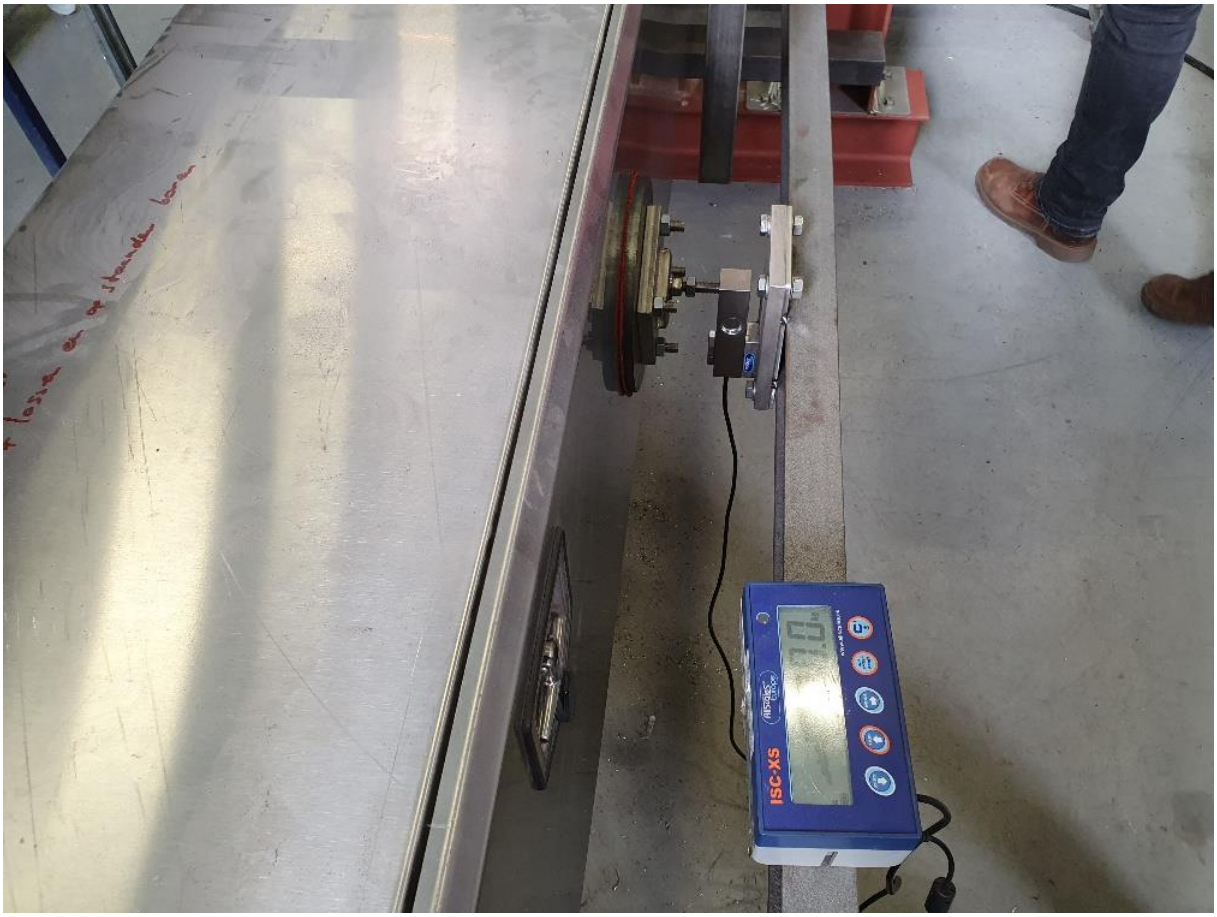


Figure 2: Impression test

It can therefore be concluded that the calculated data provide a realistic picture of the actual situation.

JE MAINTIENDRAI
RDW

3. Materials and components

There are different materials and parts for the approval of the boxes. This chapter explains the different materials and parts in the box. The design of the box is also briefly discussed.

3.1 Materials

Different materials are used in the box. The different materials are now highlighted one by one. Stainless steel, aluminum, steel and zincor are used for the boxes.

3.1.1 Stainless steel 304 2B/polished cold rolled EN10088-2

As can be seen earlier, it was stainless steel 304. The properties of stainless steel 304 can be found in chapter 2.

3.1.2 Aluminum EN AW-5754 H111/H114/H12/H22 / EN AW-1050A H14/H24

The aluminum used for the boxes has the following properties.

property	value	unit
Young's modulus	69	Gpa
Poission's ratio	0,33	-
Schear modulus	27	Gpa
Density	2,7	g/cm^3
Yield strength	80	MPa
Tensile strength	190	MPa

Table 2: Properties Aluminum

3.1.3 Steel S235JR EN10025-2 / Zincor EN 10152-DC01+ZE25/25-APC / Sendzimir DX51D+Z275-M-A-C

The steel used for the boxes has the following properties.

property	value	unit
Young's modulus	210	Gpa
Poission's ratio	0,3	-
Schear modulus	81	Gpa
Density	7,85	g/cm^3
Yield strength	235	MPa
Tensile strength	360	MPa

Table 3: Properties Steel

3.2 Components

There are various components in the boxes. There are various locks, hinges and a rubber and aeration caps. The parts do not influence the deformation of the box when 1000 N is applied.

3.2.1 Bevola lock (300.006.001.000)

The bevola lock looks like this.

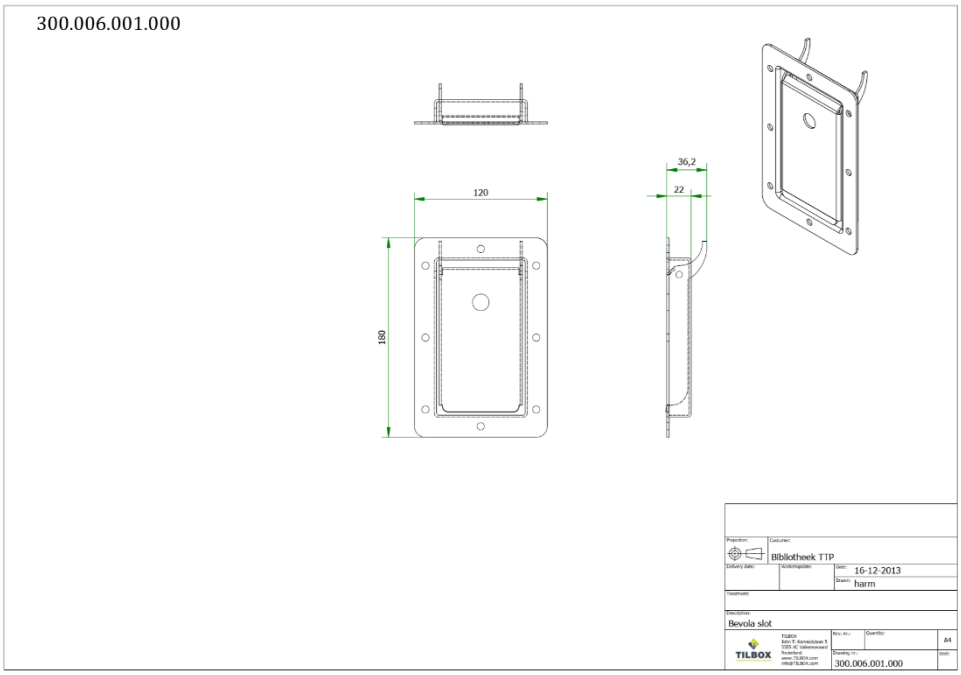


Figure 3: Bevola lock

3.2.2 Square 7 lock (300.006.021)

The square 7 lock looks like this.

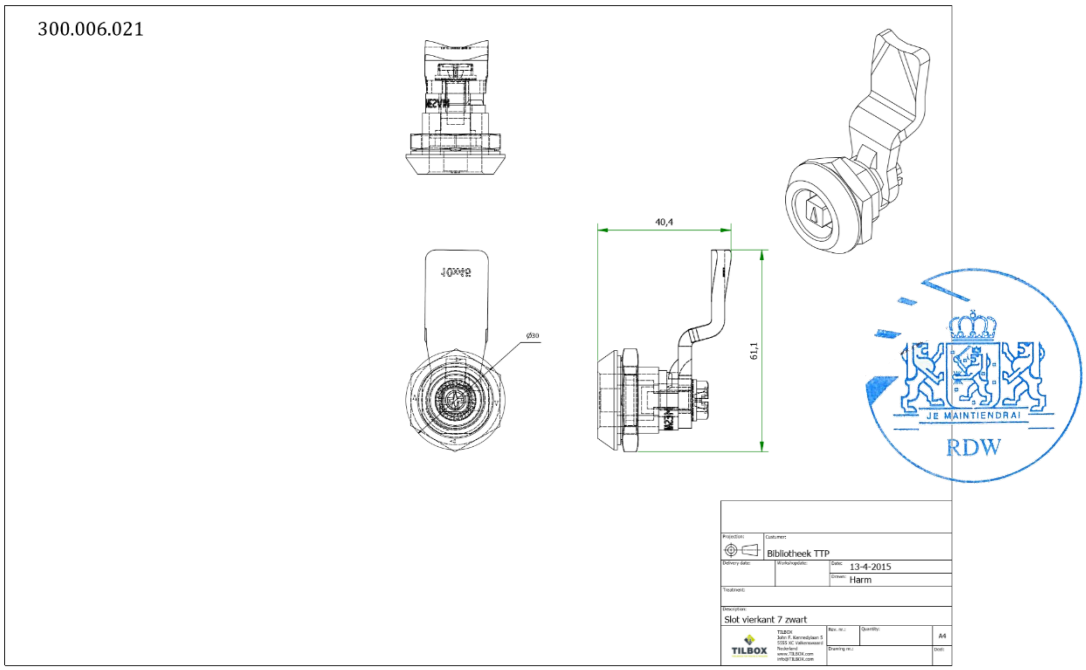


Figure 4: Square 7 lock

3.2.3 Tilbox T-drop lock (300.006.007.006 / 300.006.007.007)

The Tilbox T-drop lock looks like this.

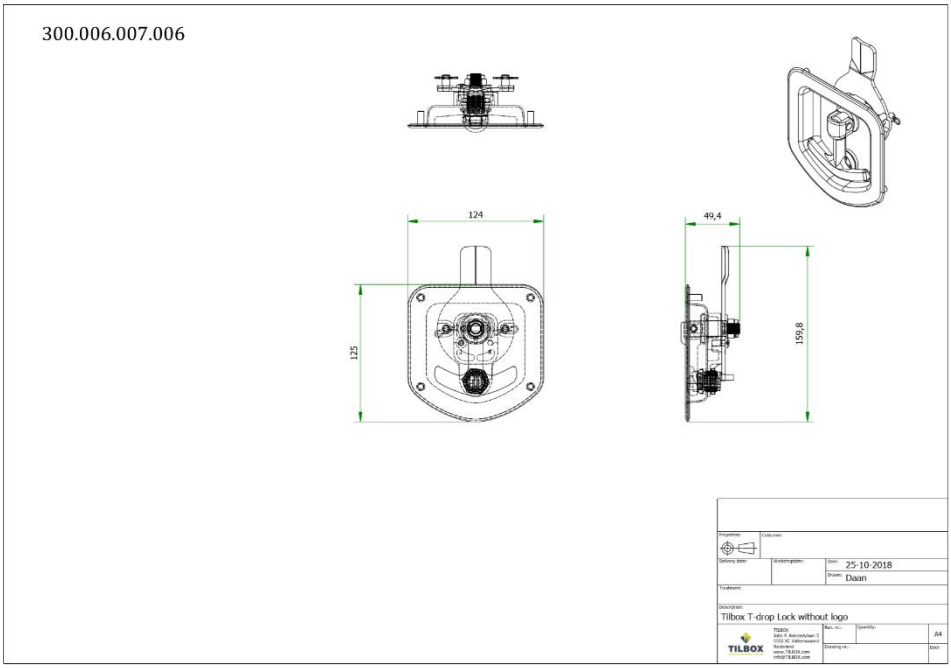


Figure 5: T-drop lock

3.2.4 Hinge Europa (300.004.002)

The hinge Europa looks like this.

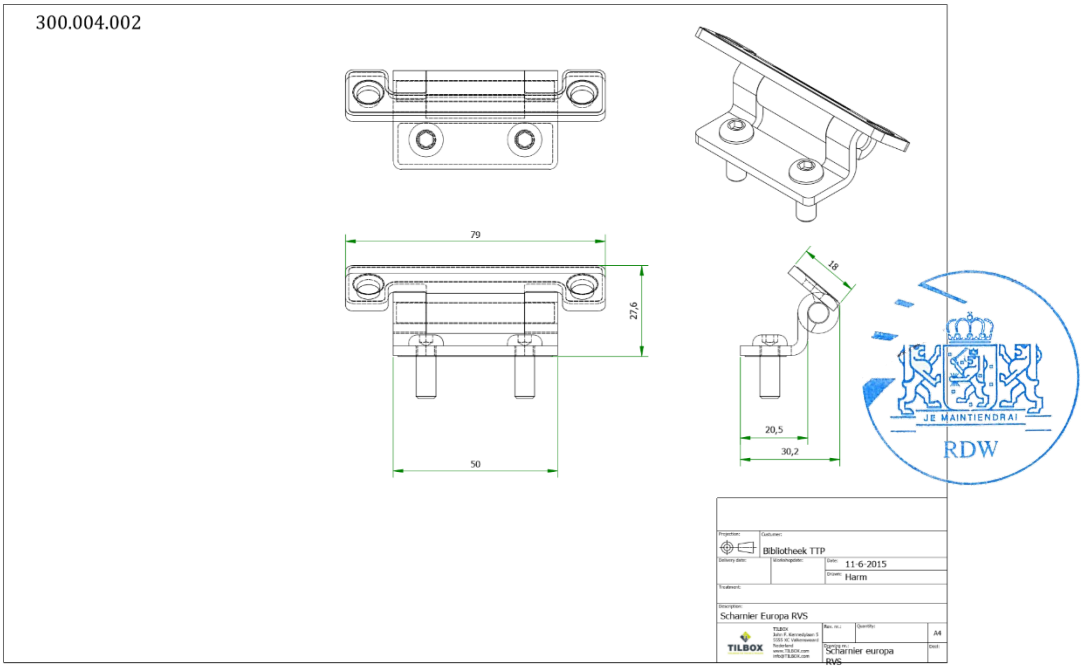


Figure 6: Hinge Europa

3.2.5 Screwable hinge TTP (300.004.003)

The screwable hinge TTP looks like this.

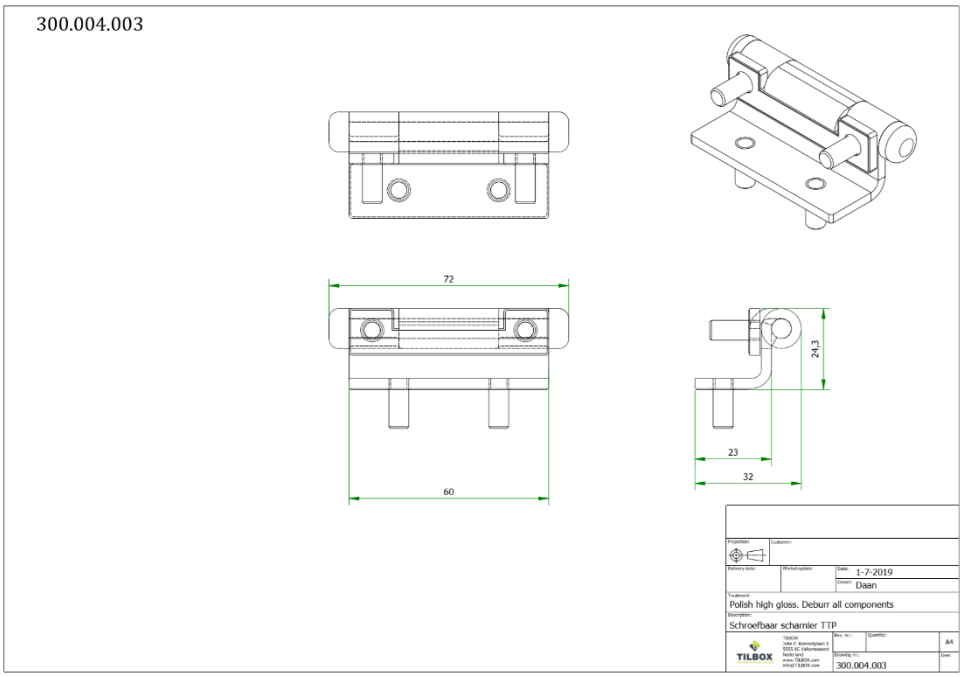


Figure 7: screwable hinge TTP

3.2.6 Rubber (300.010.025)

The rubber looks like this.

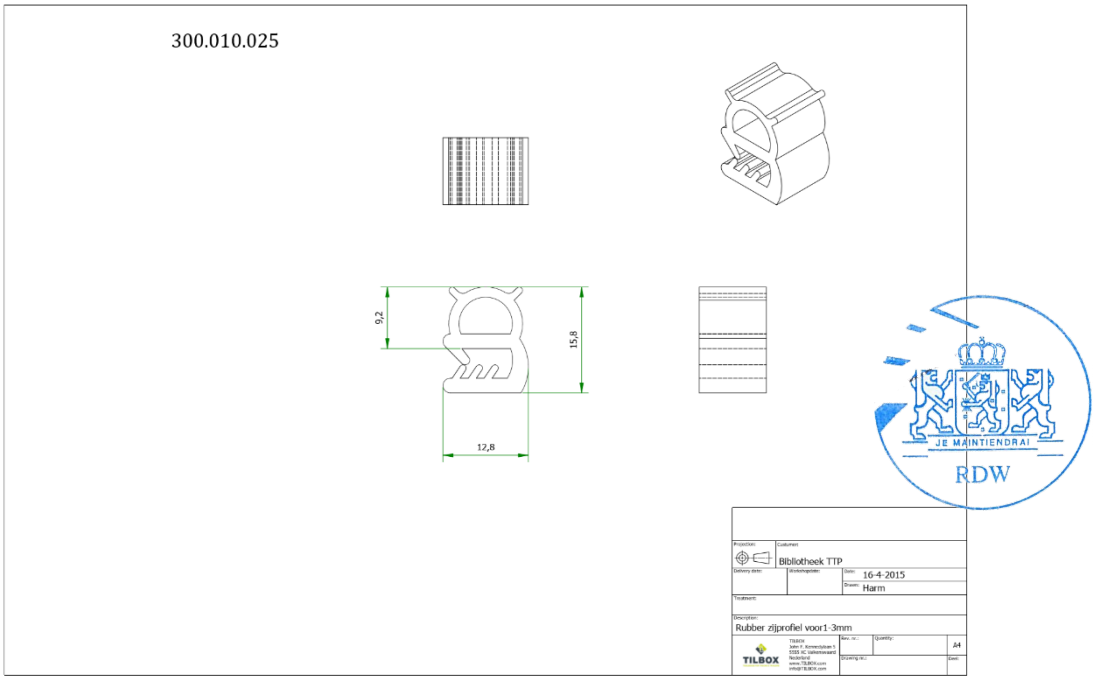


Figure 8: Rubber

3.2.7 Aeration cap round 90 mm (300.010.001.090)

The aeration cap round 90 mm looks like this.

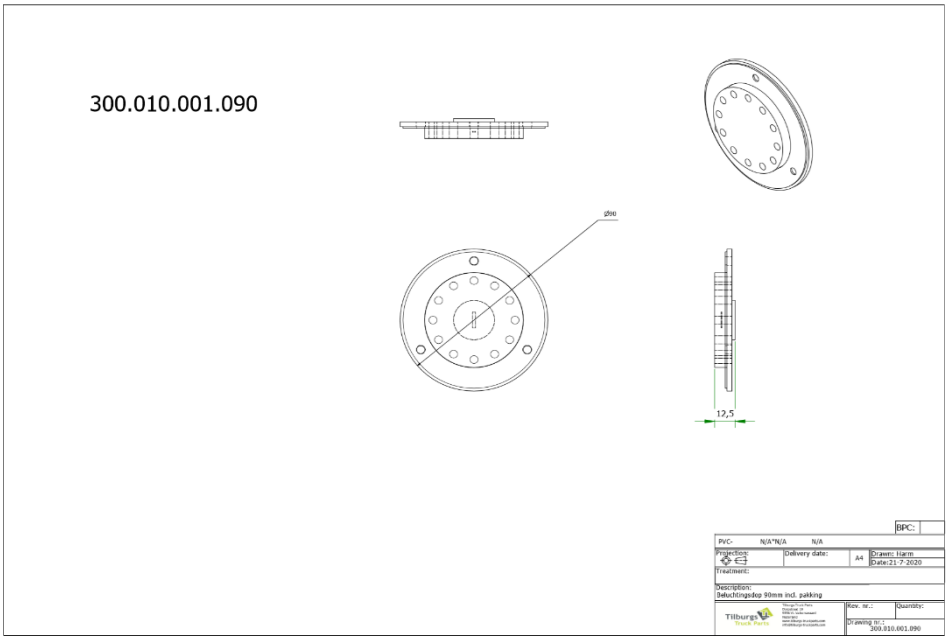


Figure 9: Aeration cap round 90 mm

3.2.8 Aeration cap round 160 mm (300.010.001.160)

The aeration cap round 160 mm looks like this.

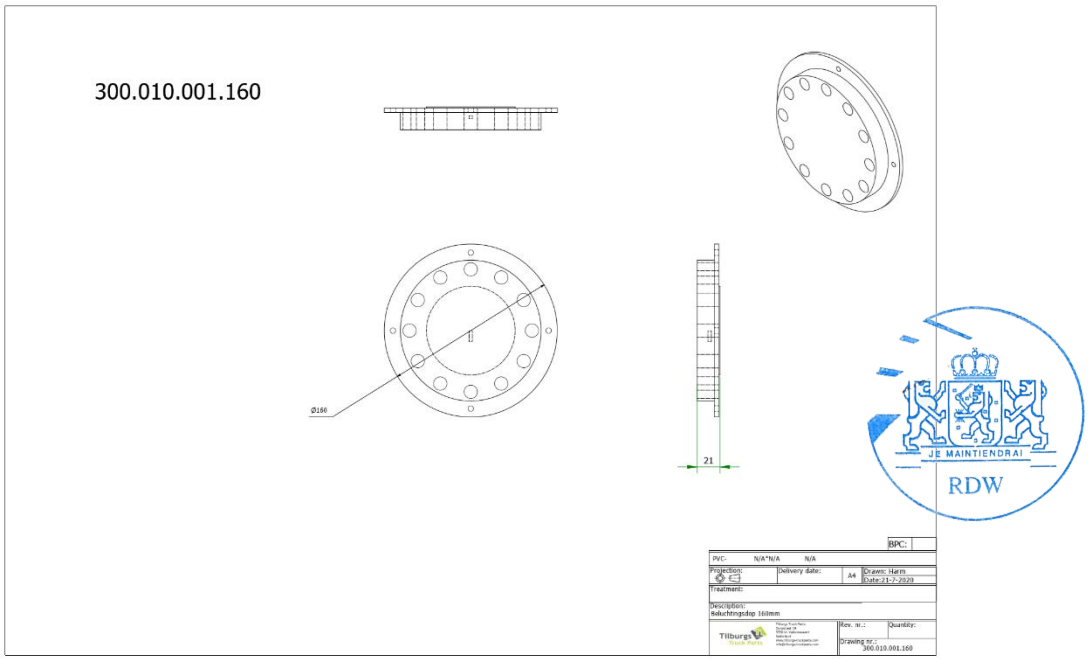


Figure 10: Aeration cap round 160 mm

4. Design

There are two different versions of a box, the Europe model and the Tilbox model. The difference between the two boxes is in the shape of the lid. The Europe model has two bendings and the Tilbox model only one. It is clarified in the images below. The Europe model is less stiff than the Tilbox model due to the 2 bendings instead of 1, as with the Tilbox model. The Europa model includes the Europa hinges (300.004.002). The Tilbox Model includes the screwable TTP hinge (300.004.003). The other options such as locks and rubber are available in both models.

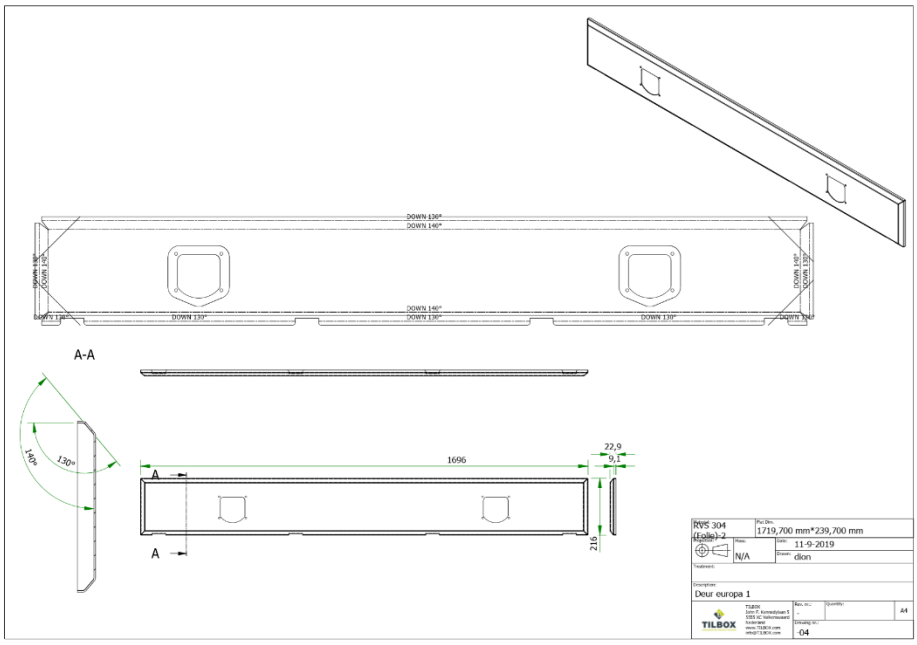


Figure 11: Europa-model

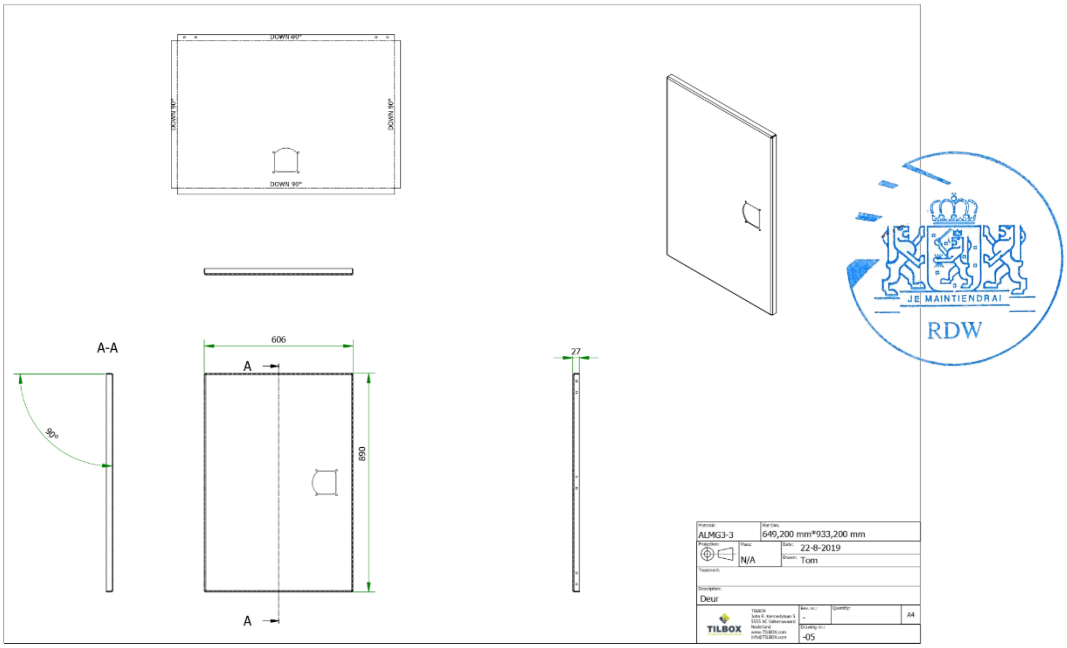


Figure 12: Tilbox-model

5. Worstcase

To ensure that all boxes can receive the quality mark, the least favorable box is looked at. A Europe model was chosen instead of a Tilbox model because it is less stiff. It is less stiff because the angle is larger in the European version and therefore the neutral line moves less when bending. The more the neutral line moves, the more rigidity the design gains as the material becomes stronger due to internal stresses. In the image below you can see that the neutral line shifts more as the corner gets sharper. Because plastic deformation occurs due to the stresses, the design becomes stiffer. The higher the stresses, the stiffer the design becomes. The stresses must remain below the maximum tensile strength. The maximum tensile strength is never reached when bending plates. The dimensions of the box are 3000 mm wide, 600 mm high and 600 mm deep. This is the largest size that can hang under a truck. The load of 1000 N acts in the middle. This is the position where the box can dent the most because that point is furthest from the rabbet. The box is calculated in both stainless steel 1.5 mm thick and 2 mm aluminum. This is done because 1.5 mm is the thinnest plate that Tilbox works with. Aluminum is the material with the least favorable properties that Tilbox works with. However, aluminum is only used from 2mm. The above situation has therefore been chosen in stainless steel 1.5mm thick and the above situation in aluminum 2mm thick.

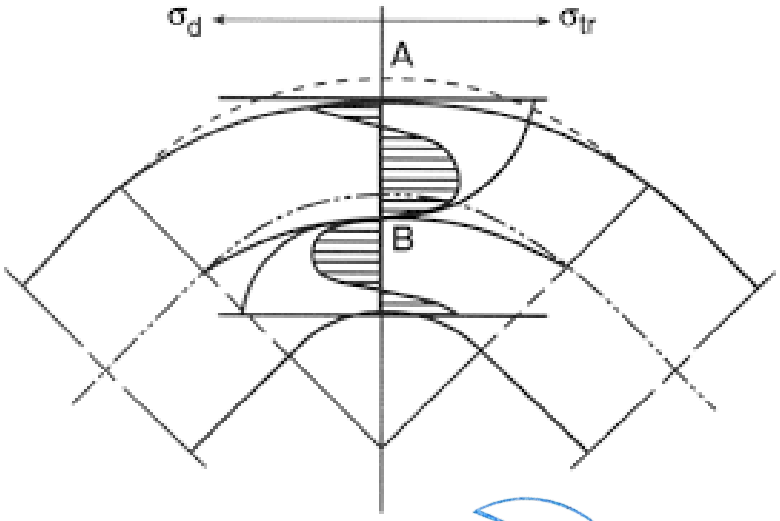


Figure 13: neutral-line displacement

5.1 Stainless steel 304 1,5 thick

If the following simulation is run, there will be a maximum indentation of 16.04 mm.

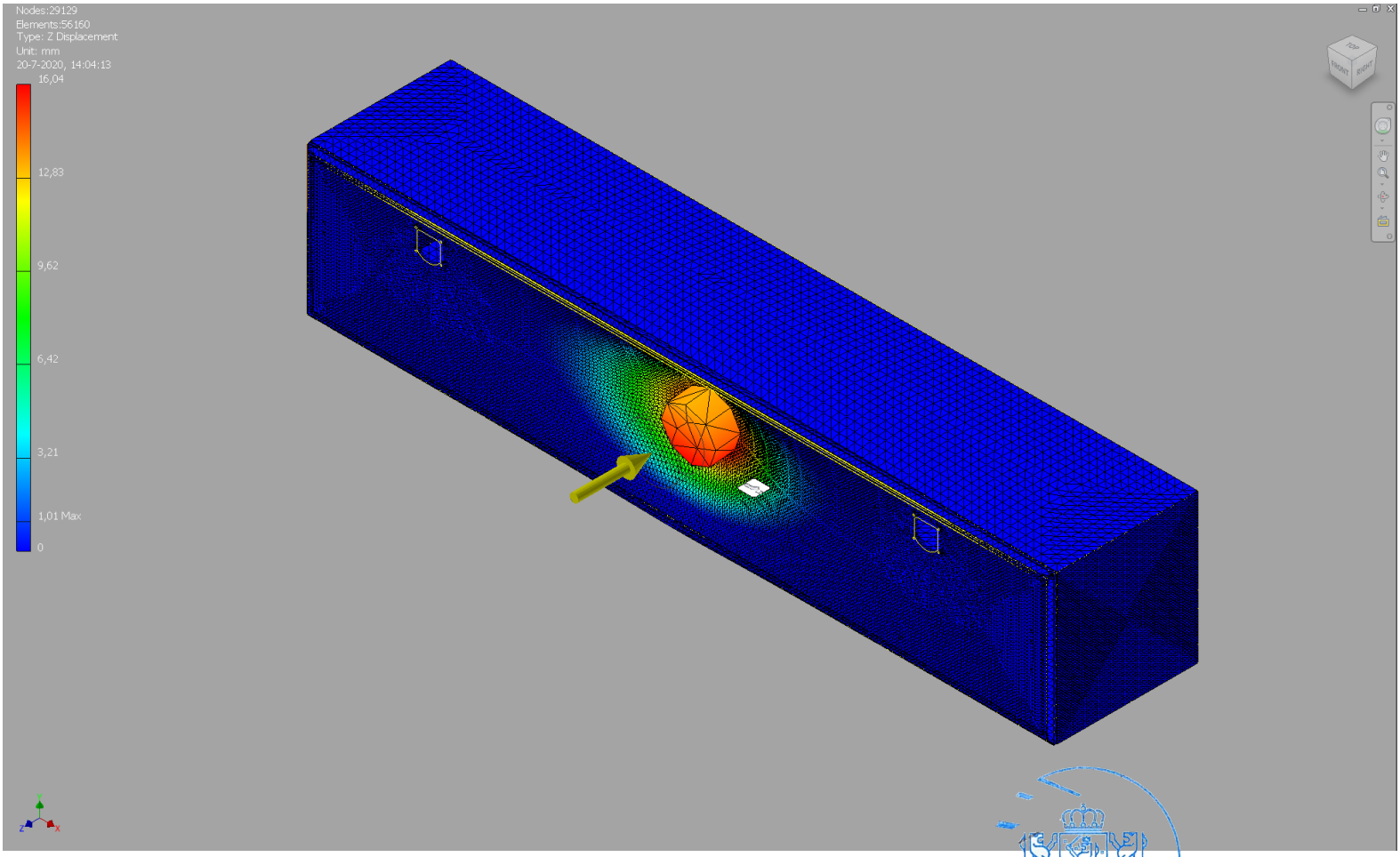


*Figure 14: Indentation box stainless steel 3000*600*600 mm*

5.2 Aluminum 2mm thick

If the following simulation is run, there will be a maximum indentation of 18.18 mm.

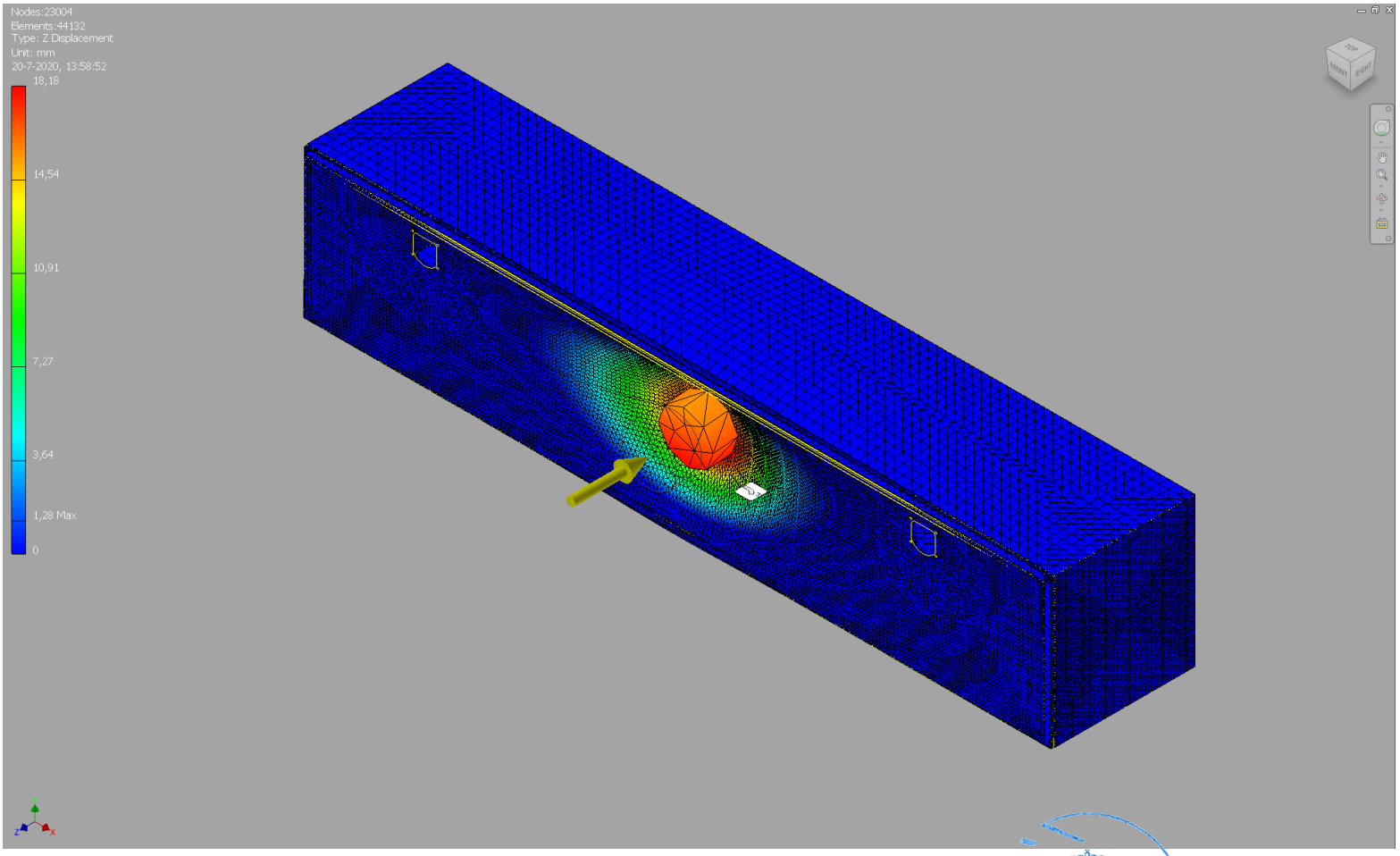


*Figure 15: Indentation box aluminum 3000*600*600 mm*

6. Support positioning

The positioning of the supports will be determined. This is the distance from the side of the box to the side of the support. These are the supports from appendixes A and C. The other supports from appendix B are always mounted on the sides and are therefore not applicable. However, all supports must be properly mounted. 1000N is used again on the worst-case box (3000 * 600 * 600) on the front. This time, however, it is positioned on the left instead of in the middle. The box may not protrude further than 30 mm on the right side. The box is tested on aluminum 2 thick. Since this one had the most indentation in the worst-case test. For the test, the supports are placed in the middle against each other. This is the worst case because it produces the greatest moment.

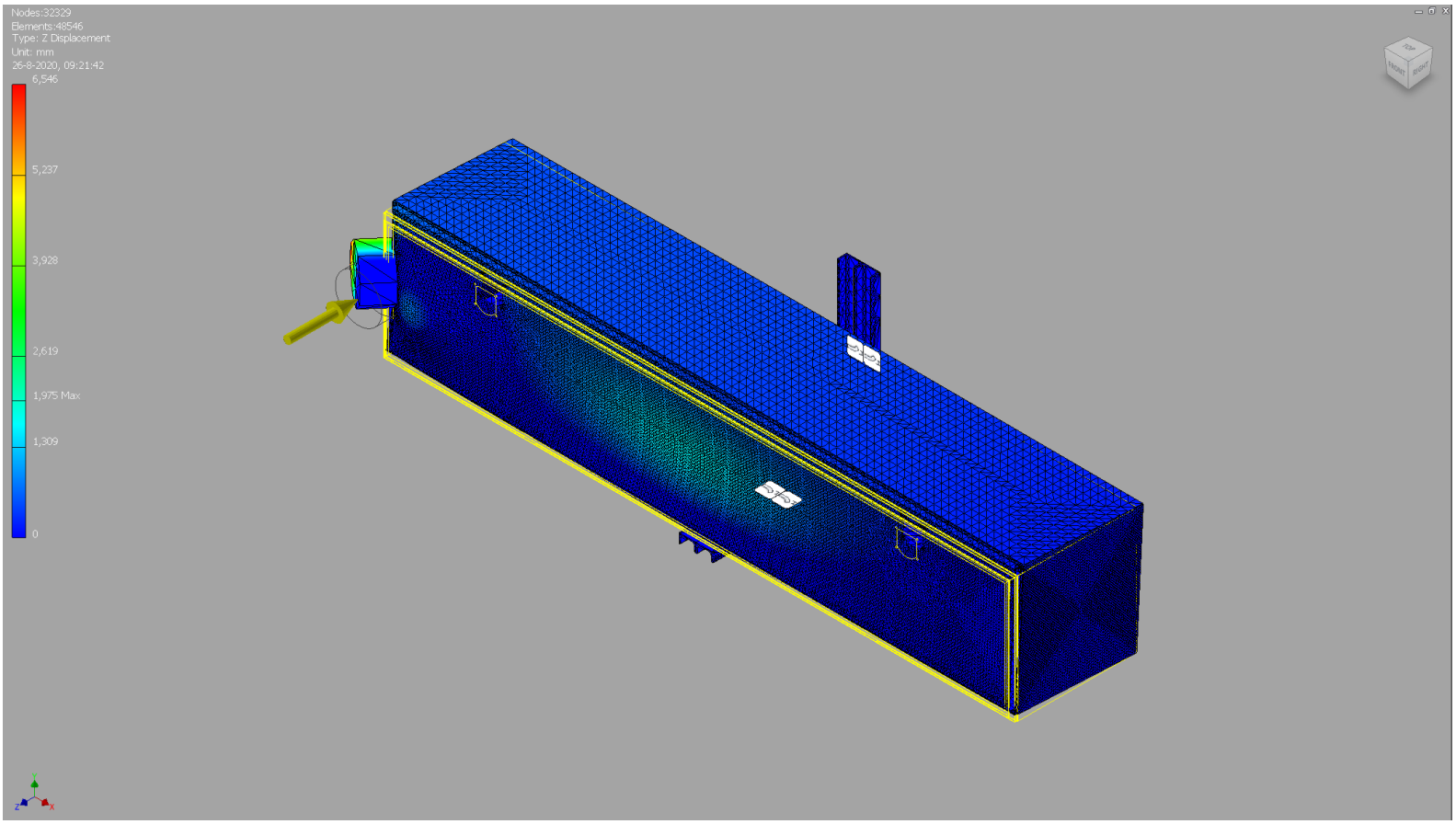


Figure 16: Support Positioning

It can be seen that the maximum displacement is 6,546 mm. The box will not slide forward when it is properly mounted to the support. The chest is more likely to deform itself. For the quality mark it is therefore not important what the distance is. In reality, however, a mutual distance will be recommended, but that is due to the weight distribution in the box that creates a force in the y-direction. However, this is not covered by the quality mark, so it will not be discussed further.

7. Conclusion

To receive the R73 quality mark, a box may indent 30 mm in the first 250 mm when 1000 Newton is pressed on it. This report has shown that the Tilbox boxes within a range of 3000 mm wide, 600 mm high and 600 mm deep do not dent further than 30 mm. This applies to aluminum from 2 mm thick and for stainless steel and steel from 1.5 thick in both Tilbox and Europe version. All other parts in the boxes also meet the quality mark because they have no influence on the indentation.

The table on the next page lists all versions that get the R73 quality mark. The supports that also meet the quality mark have been left outside the table. The supports that come in combination with the box never have an indentation greater than 30 mm. This can be read in the appendices. The box suffices with this, both with and without supports.

Material	Minimal thickness	Maximum W*H*D	Model	Options
Aluminum	2	3000*600*600	Europa	Europa-hinge Tilbox T-drop lock Bevola lock Square 7 lock aeration cap round 90 aeration cap round 160 rubber
Aluminum	2	3000*600*600	Tilbox	Screwable hinge TTP Tilbox T-drop lock Bevola lock Square 7 lock aeration cap round 90 aeration cap round 160 rubber
Stainless steel	1,5	3000*600*600	Europa	Europa-hinge Tilbox T-drop lock Bevola lock Square 7 lock aeration cap round 90 aeration cap round 160 rubber
Stainless steel	1,5	3000*600*600	Tilbox	Screwable hinge TTP Tilbox T-drop lock Bevola lock Square 7 lock aeration cap round 90 aeration cap round 160 rubber
Steel	1,5	3000*600*600	Europa	Europa-hinge Tilbox T-drop lock Bevola lock Square 7 lock aeration cap round 90 aeration cap round 160 rubber
Steel	1,5	3000*600*600	Tilbox	Screwable hinge TTP Tilbox T-drop lock Bevola lock Square 7 lock aeration cap round 90 aeration cap round 160 rubber
Zincor	1,5	3000*600*600	Europa	Europa-hinge Tilbox T-drop lock Bevola lock Square 7 lock aeration cap round 90 aeration cap round 160 rubber
Zincor	1,5	3000*600*600	Tilbox	Screwable hinge TTP Tilbox T-drop lock Bevola lock Square 7 lock aeration cap round 90 aeration cap round 160 rubber

Table 4: boxes with quality mark R73

Appendix A: UNP Support

In this test, 2 UNP 100 supports are used to mount a box of 600x400x400 mm (width x height x depth). This concerns a test for article 280.080.075.075, 280.100.075.075, 280.120.070.060, 280.065.060.060, 280.080.060.060 and 280.100.070.070.

From the field test can be seen in Figure 17 shows that the indentation 3mm is at a compression force of 1000 N.

Figuur 117: Practice impression

To validate this practice depression, a FEM calculation is made. This calculation is shown in Figure 18. This calculation shows that the indentation is 2.84 mm when indented with the disc.

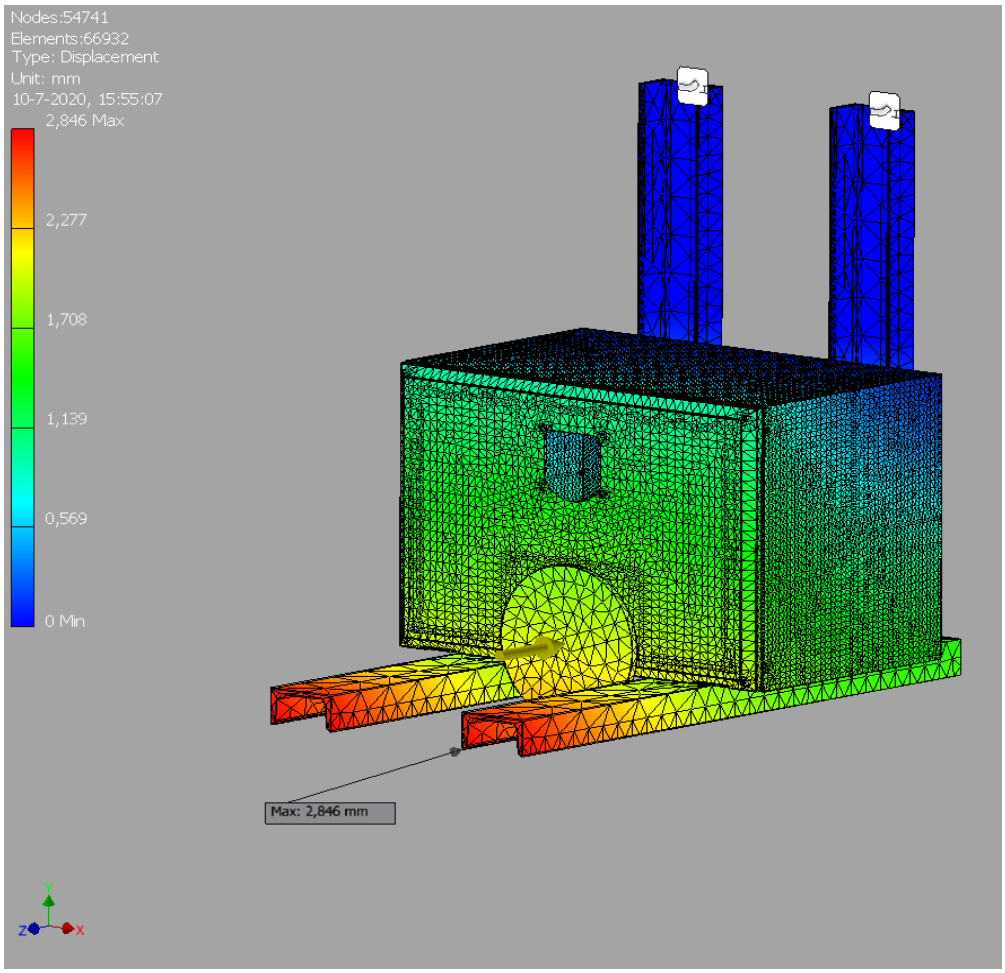


Figure 18 FEM Calculation UNP

Data Calculation:

Constrains: The 2 UNP100 beams are fixed on the back, so that there is no possibility of movement. This is to simulate the practical situation in which the UNP beams are welded to the chassis.

Load: The force indicated by the yellow arrow in the figure is 1000N. This force pushes the disc into the box, working perpendicularly.

The supports are located 50 mm inwards from the side of the box. The disc is located with the center at 85mm height on the box and in the middle of the width of the box this is 300 mm.

Data parts:

The disc has a diameter of 220 mm. The box is 1.5 mm thick sheet material with dimensions (600 x 400 x 400) made of stainless steel 304. The supports have a height of 750mm and a forward length of 750mm and are made of S235.

Appendix B: Support of bended plate

In this test, 2 bent supports are used to mount a 600x400x400 box (width x height x depth). This is a test for article 280.001.001, 280.001.002 and 280.001.003.

The practical test shown in Figure 19 shows that the indentation is 0 mm at the bottom left at an indentation force of 1000 N.

Figure 19: Practical set-up Supports from bended plate

To validate this practice depression, a FEM calculation is made. This calculation is shown in Figure 20. This calculation shows that the indentation at the bottom left is 0.051 mm for an indentation with the disc in the Z direction.

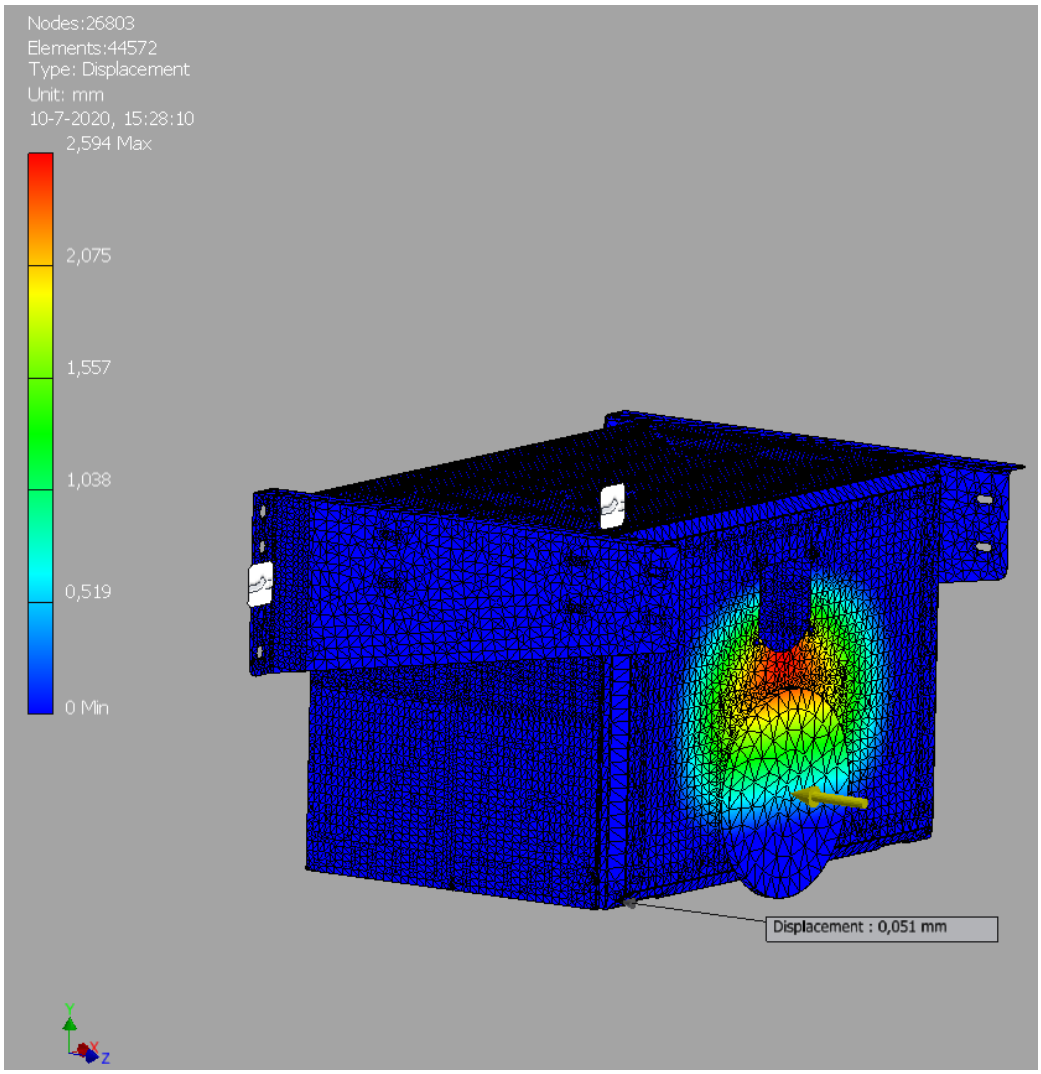


Figure 20: FEM calculation bended plate

Data Calculation:
Constrains: The 2 set supports are fixed on the back, so that there is no possibility of movement. This is to simulate the practical situation where the supports are bolted to the chassis.
Load: The force indicated by the yellow arrow in the figure is 1000N. This force pushes the disc into the box, working perpendicularly.

The supports are located on the side walls of the box by means of bolt connections to the box. The top of the brackets and the box are the same, and at the rear the box is 50 mm inwards from the support.

Data parts:
The disc has a diameter of 220 mm. The box is 1.5 mm thick sheet material with dimensions (600 x 400 x 400) made of stainless steel 304. The supports have a height of 180 mm and a length to the front of 520 mm and are made of stainless steel 304.

Appendix C: Supports from omega profile

In this test, 2 omega profile supports are used to mount a beam of 140 x 140 x 4 (width x height x thickness in mm). This concerns a test for article 280.120.070.060.V.

The practical test shown in figure 20 shows that the indentation is 2mm at a pushing force of 1000 N.

Figure 21: Indentation omega profile supports

To validate this practice depression, a FEM calculation is made. This calculation is shown in Figure 22. This calculation shows that the indentation is 1.8 mm in the Y-direction when indented with the disc

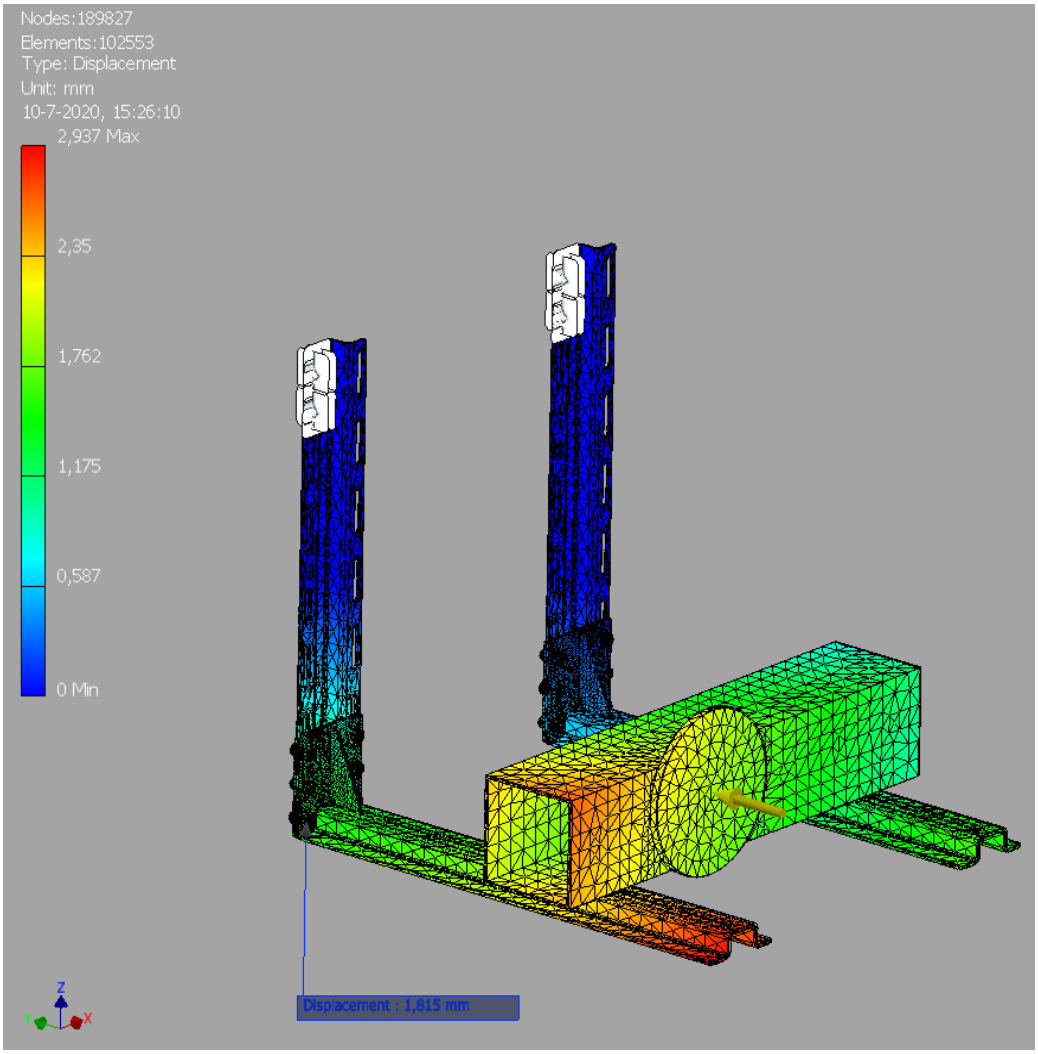


Figure 22: FEM calculation support omega profile

Data Calculation:

Constrains: The 2 UNP100 beams are fixed on the back, so that there is no possibility of movement. This is to simulate the practical situation in which the UNP beams are welded to the chassis.

Load: The force indicated by the yellow arrow in the figure is 1000N. This force pushes the disc into the box, working perpendicularly.

The beam is located 450 mm from the supports. The disc is located to the left of center at 190mm from the left support and at the center height of the beam.

Data parts:

The disc has a diameter of 220 mm. The beam is 140 by 140 and 5mm thick from S235. The supports have a height of 750mm and a forward length of 750mm and are made of S235.