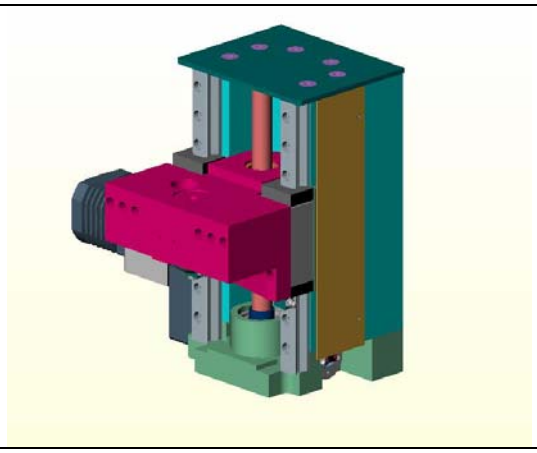
System Business Unit

MICRO CONTROLE
BP29
45340 BEAUNE LA ROLANDE
France

Base Jack design review

Written by:

Gilles Duplessy
System Business Unit Manager
Micro-Contrôle
45340 Beaune-La-Rolande
Tel. +33 (0) 238 40 51 68
Fax +33 (0) 238 40 50 05
gduplessy@newport-fr.com



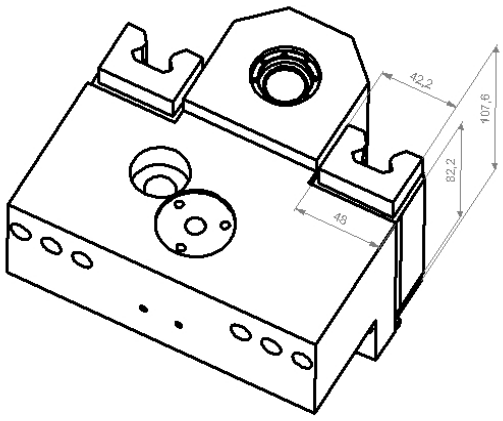
1. Rail and carriage

"In particular, Prof. Clarke noted that he is not happy with the quality of the drawings that came back from Alain. There appear to be inconsistencies and the dimensions are not legible on some of the drawings. For example, EX0000 1382010 (the critical pinion part) does not appear to be substantially improved beyond what we had. Also, the drawing of the part RUE 25 DHL FE and its corresponding rail is not accurate according to the manufacturer's literature (INA-Schaeffler KG). (It is 40 mm wide on the drawing but 48 mm wide on the manufacturer's spec sheet.) Is Micocontrole intending to modify the Scheffler design, and if so why? Or are the changes from the original design because of inaccuracies in the drawings? We must have a CONSISTENT set of drawings and part call-outs,

BEFORE this upgrade is approved, otherwise we are in the same situation as last time where the parts delivered were different than what were shown in the drawings. (On one of our drawing, the part called for is W1636 A0 but the installed parts are all EX 1382.)"

Answer :

We confirm that the rail reference is RUE 25 DHL FE. The carriage width is 48 mm. 42.2mm is the width of the end plate and the seal. We are not modifying the rails and carriage.



2. Safety plate

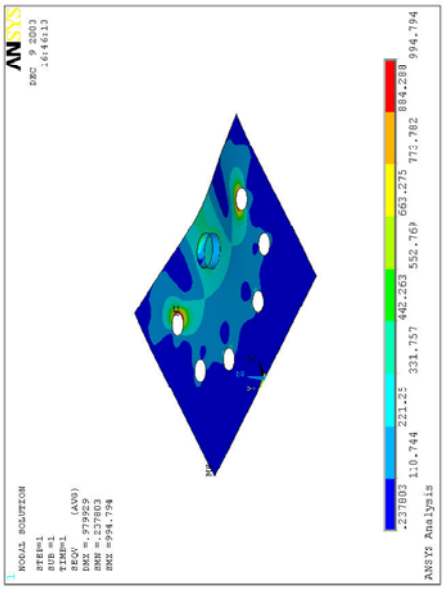
"Note the proposed plate also to replace the small thin Al plate at the end of the slide. I have proposed a plate like this a while ago (see drawing_safetyplate.pdf) and I would like your engineer to consider the addition of such a plate. This plate must be engineered carefully not to hinder the motion of the gonio(if to thick it would be hit). Is it possible to bolt a steel plate that would catch the lead screw if the retaining ring would break? If this were possible, then the instrument

would not fall down."

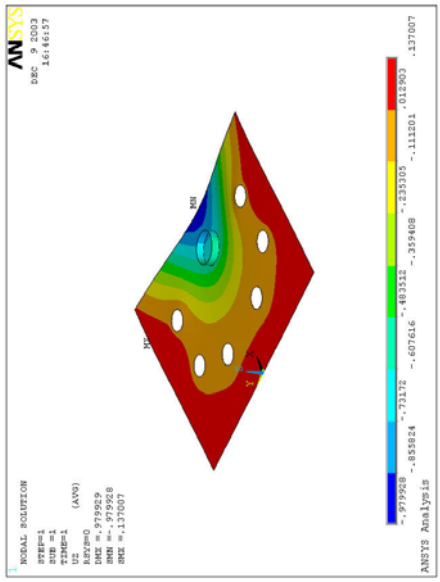
Answer :

We agree that this kind of plate brings additional safety to the system. We will include it in the modified jack.

We have simulated the resistance of this plates by FEA and design it to avoid any interference and Z-travel reduction.



Stress plot (MPA)

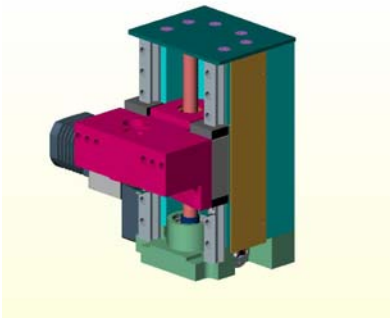


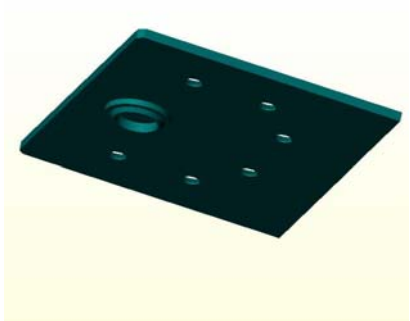
Deformation plot(mm)

We propose to use a plate made of steel Z20C13 with a maximum stress limit of 800 Mpa.
The FEA model gives a stress concentration with a maximum stress of 995 Mpa, but in fact this model is not realistic as it assumes that the contact between the plate and the tip of the screw will be limited to one point; so this analysis should be used only to look at the relative distribution of the stress. When we calculate the maximum stress taking into account the plasticity of the metal the maximum stress could be estimated to 33 MPA and the plate will support the diffractometer. We have limited the thickness of this plate to make sure that we are not limiting the travel of the jack.

It will be fixed with 6 milled cap screws M8.
Each screw have a load capacity of 1283 Kg.

The elastic limit for one screw is 1925 kg. So the plate will support the diffractometer.





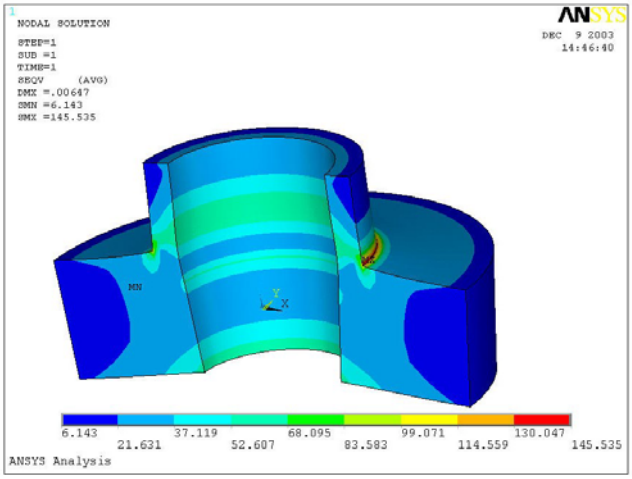
3. Retaining ring

"Scanp2.pdf shows the drawing you sent us on the retaining ring. Please replace it with a stiffer ring made of steel and following drawing W1636 A0 that is installed on P. Eng's gonio. Scanp3.pdf shows you one of our drawing where this part was called for but not installed."

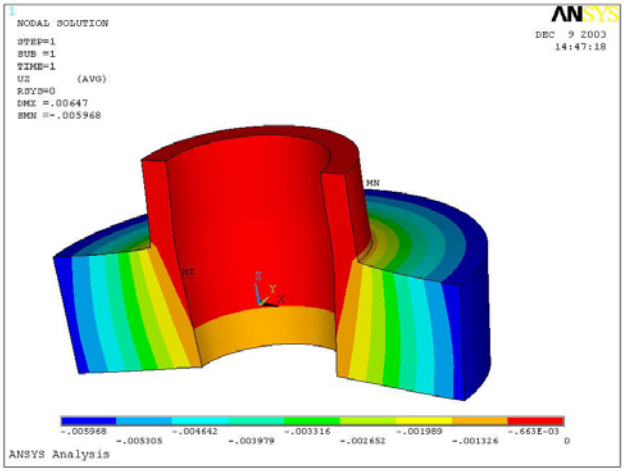
Answer : A 5 mm thick nut was strong enough to support the instrument but we have decided to further increase the thickness of the nut to further improve the stress ratio.
The table hereunder summarizes the maximum deformation and the maximum stress for 5mm thickness and 11mm thickness. The maximum stress should be compared to 500Mpa for the yield stress and 800Mpa for the ultimate tensile strength of the steel we choose (Z20C13)

Ring thickness	Max deformation	Max stress
Steel, 11 mm thickness	5,9 µm	145 Mpa
Steel, 5 mm thickness	27 µm	298 Mpa

The attached FEA analysis shows the stress distribution and the deformation of the nut when loaded by the mass of the goniometer.

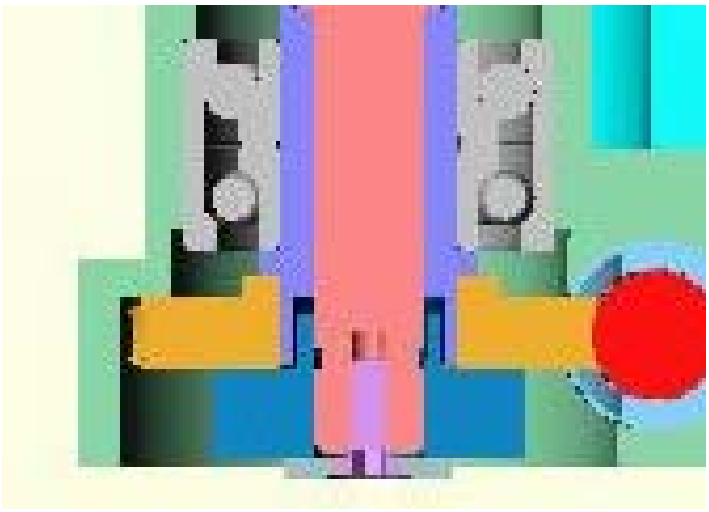


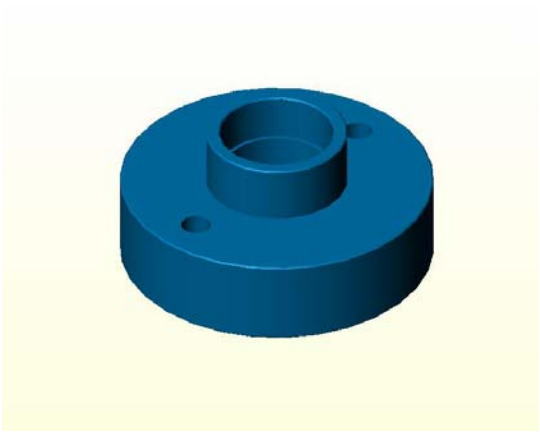
Stress plot (Mpa)



Deformation plot (mm)

We have also improve the way the nut is assembled and fixed. The nut is pressed against the wheel with two screws after being tightened. A third screw will be fitted on-site to fix the ring and the wheel together. A washer is fixed at the end of the drive screw to tighten the nut on this screw adding a third security.





4. Moments calculation

"In addition, after reading the ball bearing specs, did you perform calculations of the moments on the gonio table jacks when the gonio angles are moved by large angles, creating large mass shifts? How close to the specs Mox, Moy, Moz moments are these? What are the limits of the table tilts with this new design? The old design had a maximum tilt of +/- 1 degree. What is the difference between C and C0 on the RUE 25 DHL ... specs?"

Answer : We have made some new simulations with the following data.

Mass = 3 003 203 Kg
Gravity center height = 624 ± 85 mm ,roughly centered
height/ rotating joint = 225 mm
Carriage length = 107 mm
Distance rails plane/rotating joint = 70 mm
Max distance rotating joint/ Cg in plane = 859 mm

1)Torque due to the load (diffractometer is horizontal)
Maximum torque (Moz)= 345 Nm (on the 2 slides on one jack)

2) Additional torque and effort due to the tip/tilt angle
Maximum angle is ± 1°
Torque (Moy or Moz)= 85 Nm
Co = 3,2 kN

Note : Mox is equal to zero

The attached table compares the guiding system specifications with the calculated values for the goniometer.

	Mox	Moy	Moz	Co/C
specification	440 Nm	1200 Nm	1080 Nm	82/33,5 kN
Max value	0	85 Nm	430 Nm	3,2 kN

(*) C is dynamic load capacity and Co is the static one.

5. Lubrication

"Will these slides need lubrication periodically, and if so how often? I would like to receive the contact information of people who have this design installed to query them on its performance. Please send me their email addresses."

Answer :

The slides are provided with end seal and with grease.
If the duty cycle of the jacks is very low no lubrication is needed.
The duty cycle and the time between re-lubrication is depending upon the environment.
In a clean environment, the manufacture give a number of 10 000 Km. That's meaning $30x10^6$ cycles for a travel of +/-170 mm.

If you have a more demanding duty cycle, the guiding system should be lubricated once a year.

This type of jack have been installed (with a 5mm nut)on the machine we delivered to:

- Dr Jens Birch at IFM in Sweden jbh@ifm.liu.se phone + 46 13 28 12 28
- Dr Bruce Patterson at PSI in Switzerland bruce.patterson.@psi.ch phone + 41 56 310 45 24

6. Conclusion

We hope the review of the technology of this modified jack will convince your specialists that they can operate safely.

We confirm the choice of the slides.

We propose a ring as thick as possible.

We add the safety plate