

Floating device

Jan Spoormaker

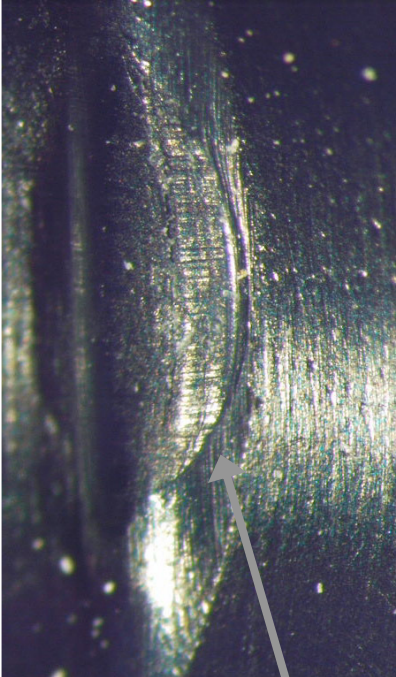
Spoormaker Consultancy

Kirill Kavelin

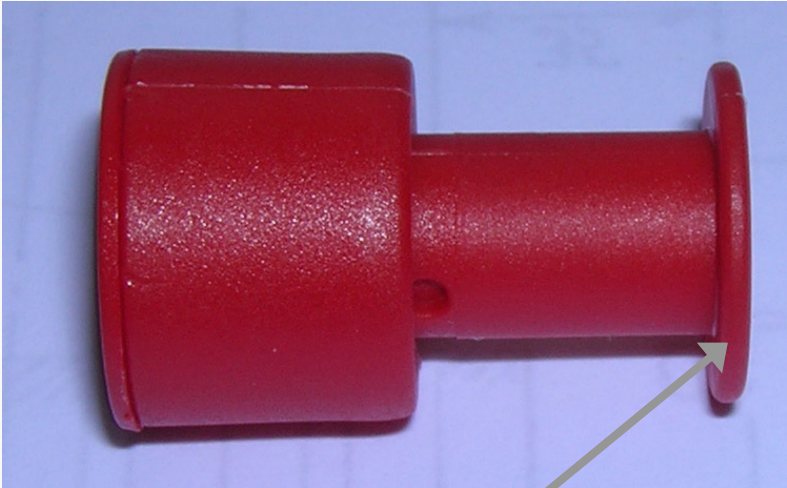
Delft University of Technology

The Netherlands

Detail of click boss



bobber with spool



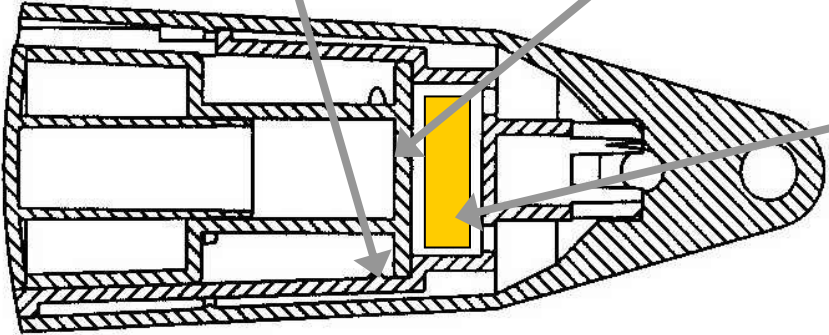
Keysaver in transparant ABS



boss

Click disk

Parts of Keysaver with keys to be saved



A-A



sponge

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Working Principle -1



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Working principle -2



Development of Keysaver

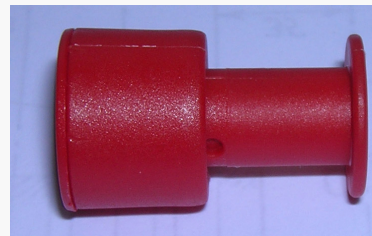
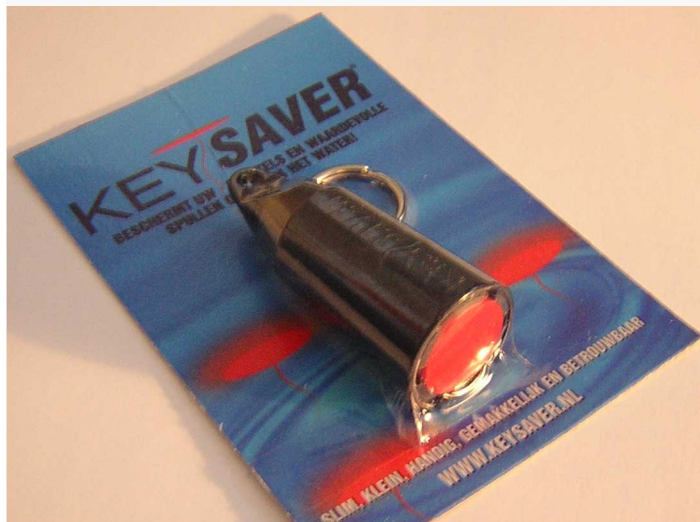
- 2 businessmen “invent” the Keysaver using “trial and error methods”
- Instead of making engineering design drawings the **“design” is given to mold makers to built a mold.**
- The mold maker suggested to make the bobber of POM or Nylon; **Nylon is selected.**
- The height of the bosses is a serious problem; **endless trials have been made.**
- Just before a water sport’s exhibition “HISWA” in 2002 the Keysaver “works”.
- During the HISWA 2002 in February 6000 Keysavers have been sold.
- At that time already some keys were lost during demonstrations
- Keysaver is awarded as an innovative product.

Court Case -1

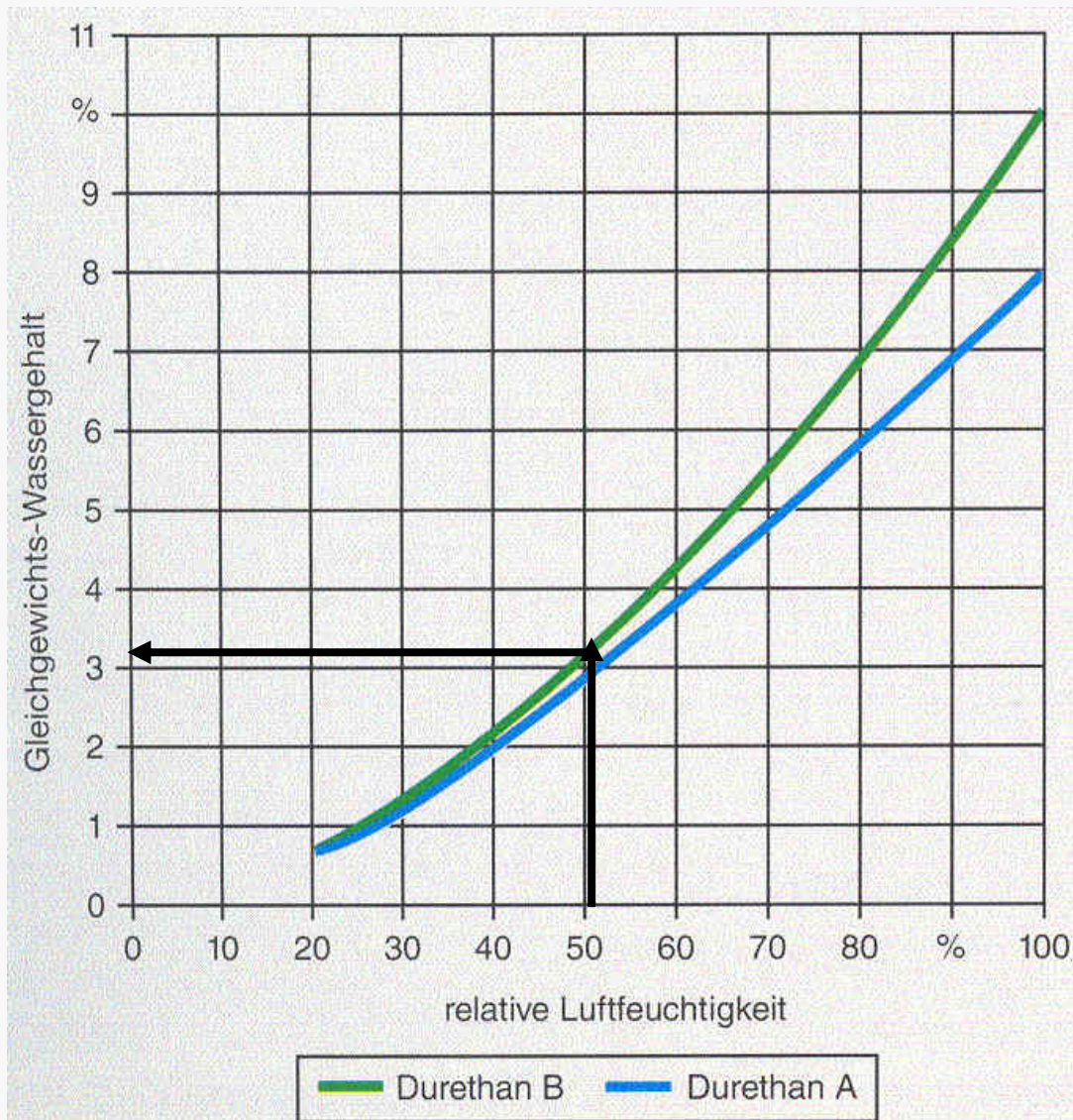
- In May 2002 the “inventors” sell the KEYSAVER business for € 300 000 + € 75 000.
- The sellers have told the new owner that the idea/product works perfectly well, but perhaps **some modifications might be necessary.**
- August 2002 is very warm and humid.
- The new owner carried out a test and 80 % fail. **Keysaver becomes Keyloser.**
- The new owner starts a civil court case in September 2002 and claims the house of the buyers.
- The judge has many problems with the technical matters and arranges an expert witness.
- *His task is to assemble two ore more KEYSAVERS and to determine whether the KEYSAVERS are faulty or not.*

Court Case-2

- In September 2004 I had to carry out experiments.
- Parties are not on speaking terms.
- The former owners have a few KEYSAVERS in a blister package.
- The new owner has parts, which have been exposed to ambient conditions during two years.
- The lawyer of the sellers of the Keysaver tells me that I have an “Idee fixe” about water absorption of PA



Equilibrium of water uptake in air



3 % water uptake

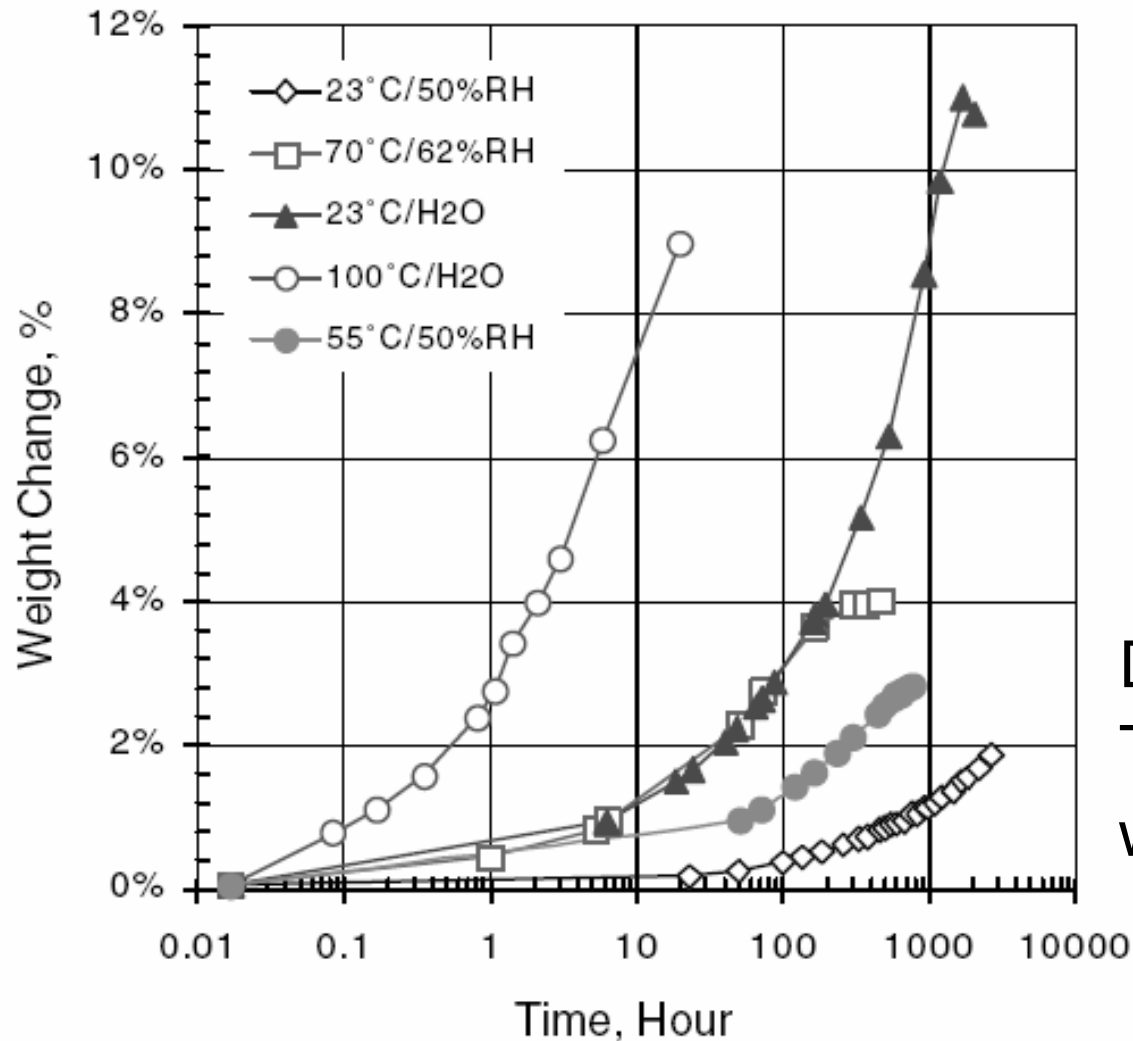
Dimensional stability

Information from Dupont about water uptake is found in their design brochures about “Dimensional stability”

Dimensional stability

Boiling in water is probably the only practical conditioning method for most of the applications that require conditioning. Parts can also be conditioned at temperatures less than boiling.

Water uptake in air and H₂O



Diffusion is dependent on T_g , which is dependent on water content.

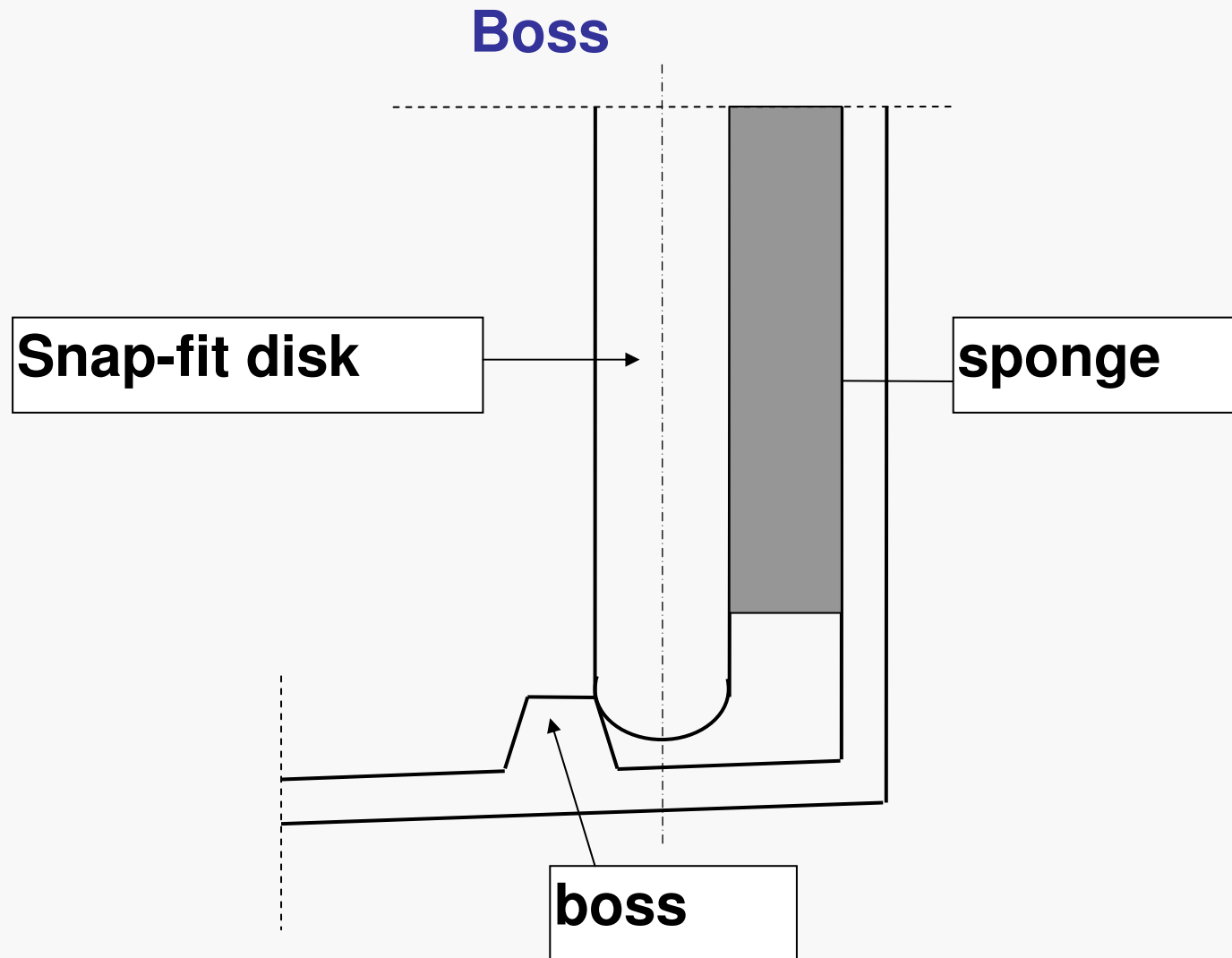
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Test set-up

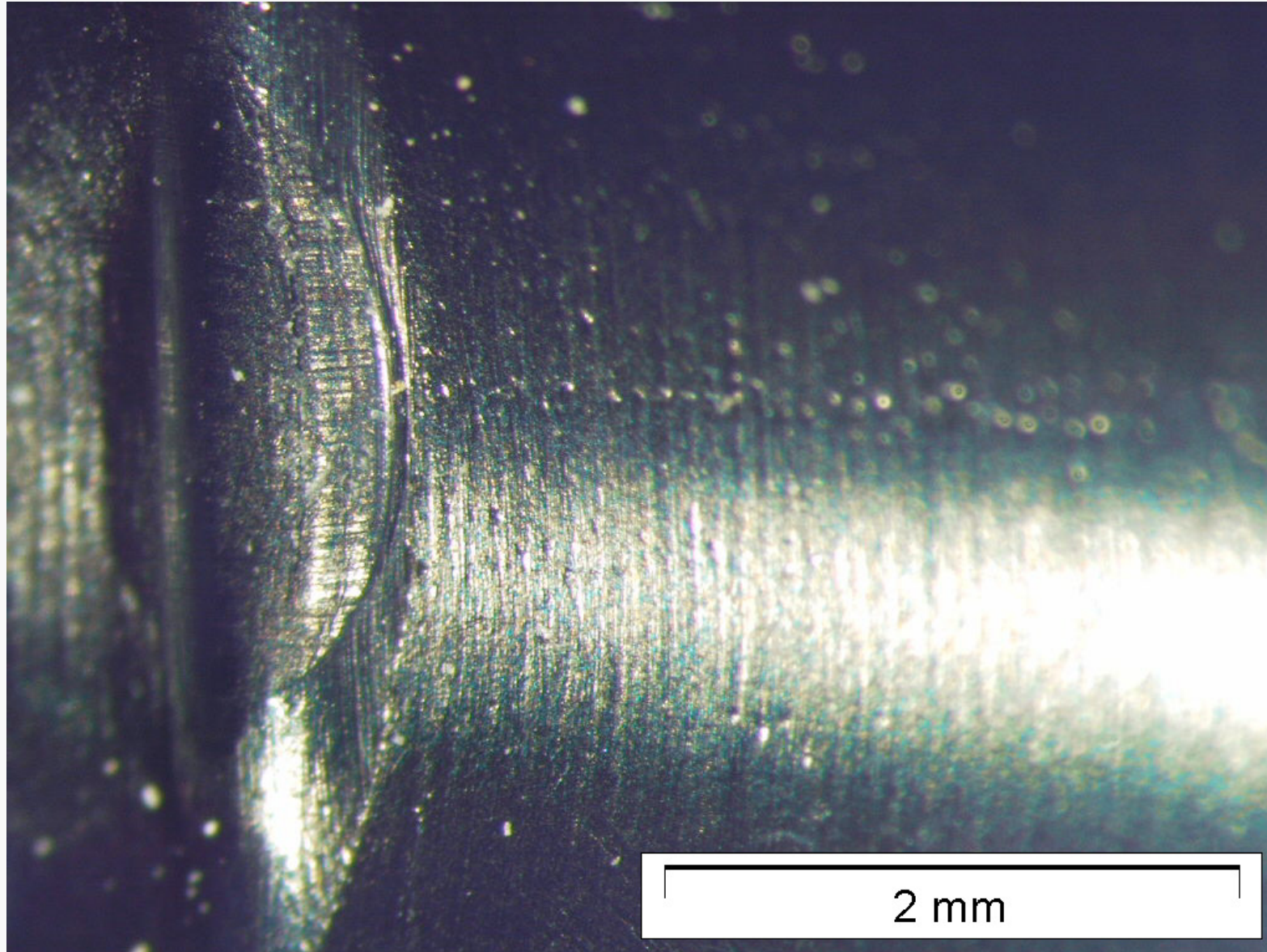
Conditioning	Number of Keysavers
> 2 years exposed to ambient air (buyer)	
Assemble separate parts	4
0 hour in boiling water	2
1/2 hour in boiling water	1
1 hour in boiling water	1

Conditioning	Number of Keysavers
> 2 years in a barrier packaging (seller)	
Disassemble and assemble keysaver	4
0 hour in boiling water	2
1/2 hour in boiling water	1
1 hour in boiling water	2

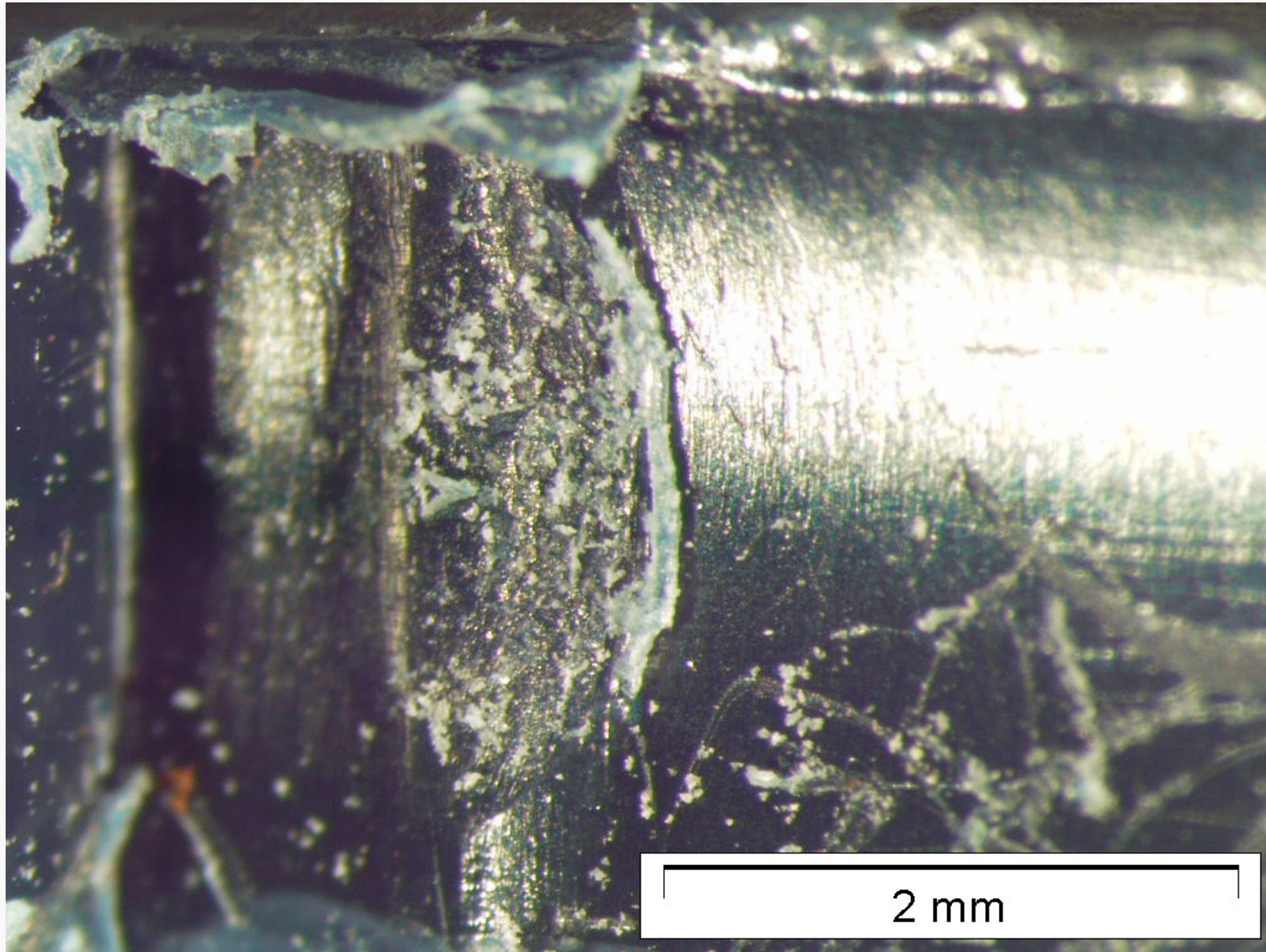
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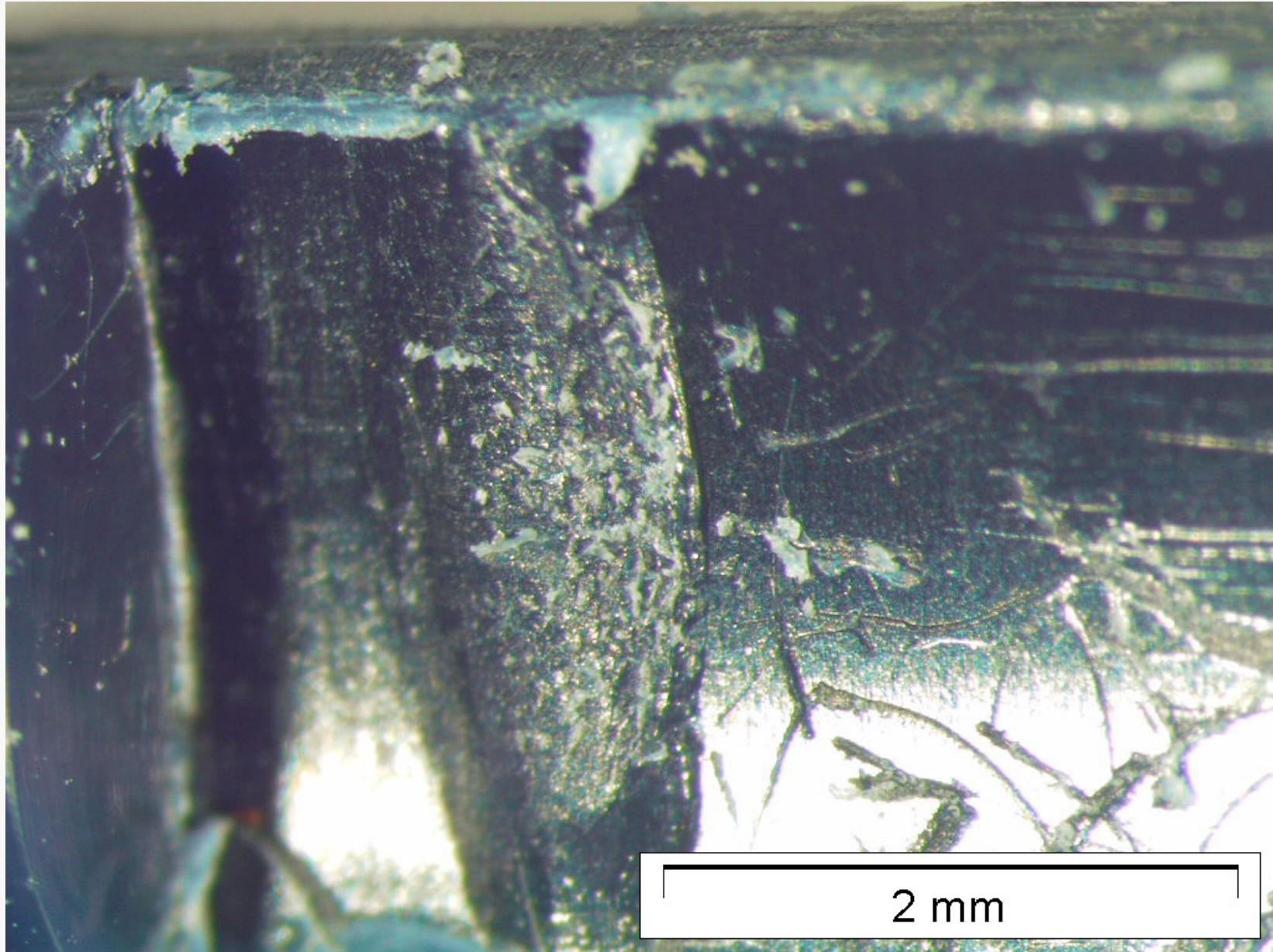
Boss -1



Boss - 2



Boss - 3



Carry out of test - boiling



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Carry out of test – spooling



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Carry out of test – drop in water



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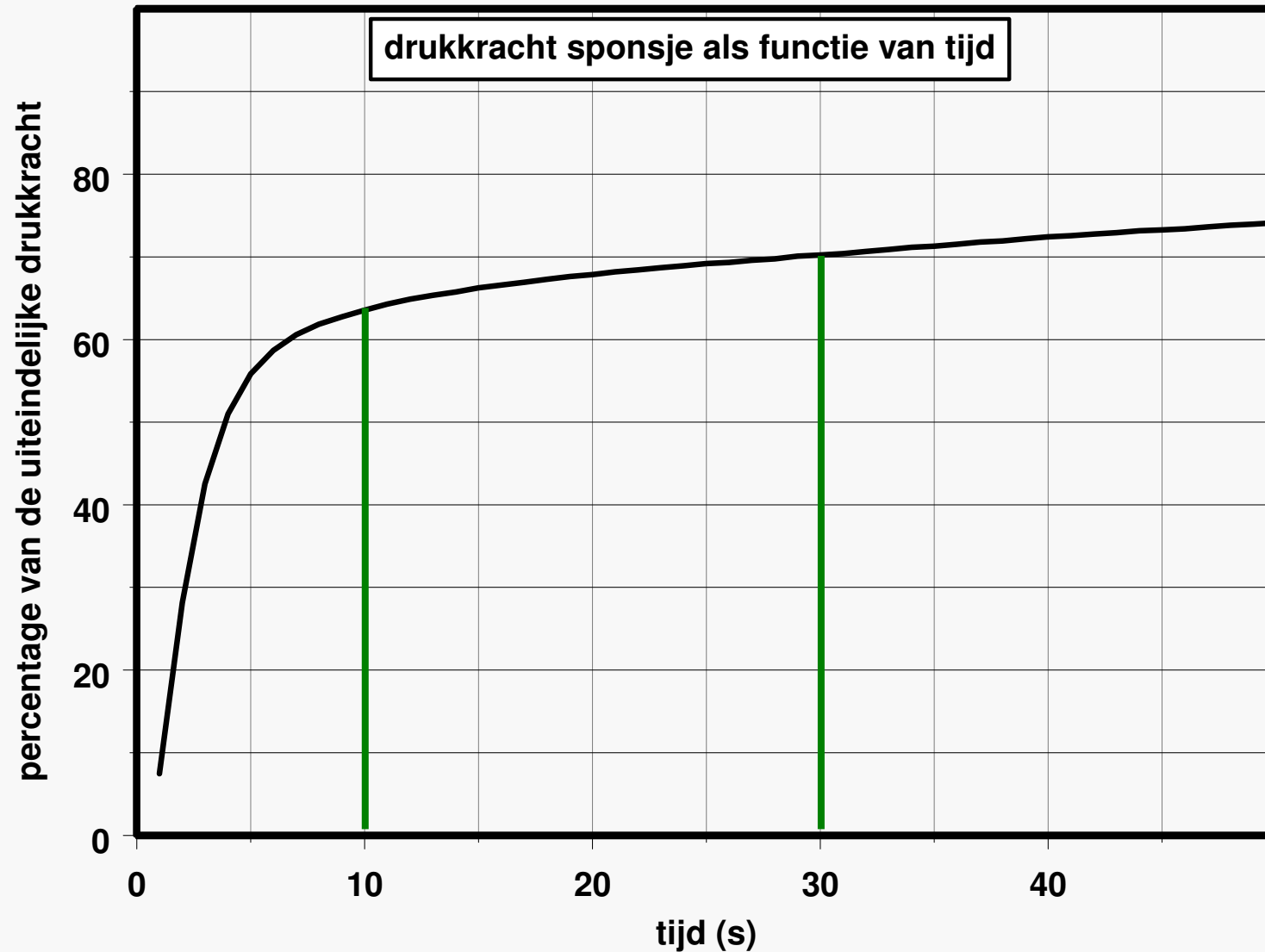
Test results

Conditioning	Time to unclick
> 2 years exposed to ambient air (buyer)	
0 hour in boiling water	4 minutes 12 seconds
0 hour in boiling water	4 minutes 52 seconds
½ hour in boiling water	No unclick
1 hour in boiling water	No unclick

Conditioning	Time to unclick
> 2 years in a barrier packaging (seller)	
0 hour in boiling water	10 seconds
0 hour in boiling water	30 seconds
½ hour in boiling water	6 minutes 50 seconds
1 hour in boiling water	No unclick

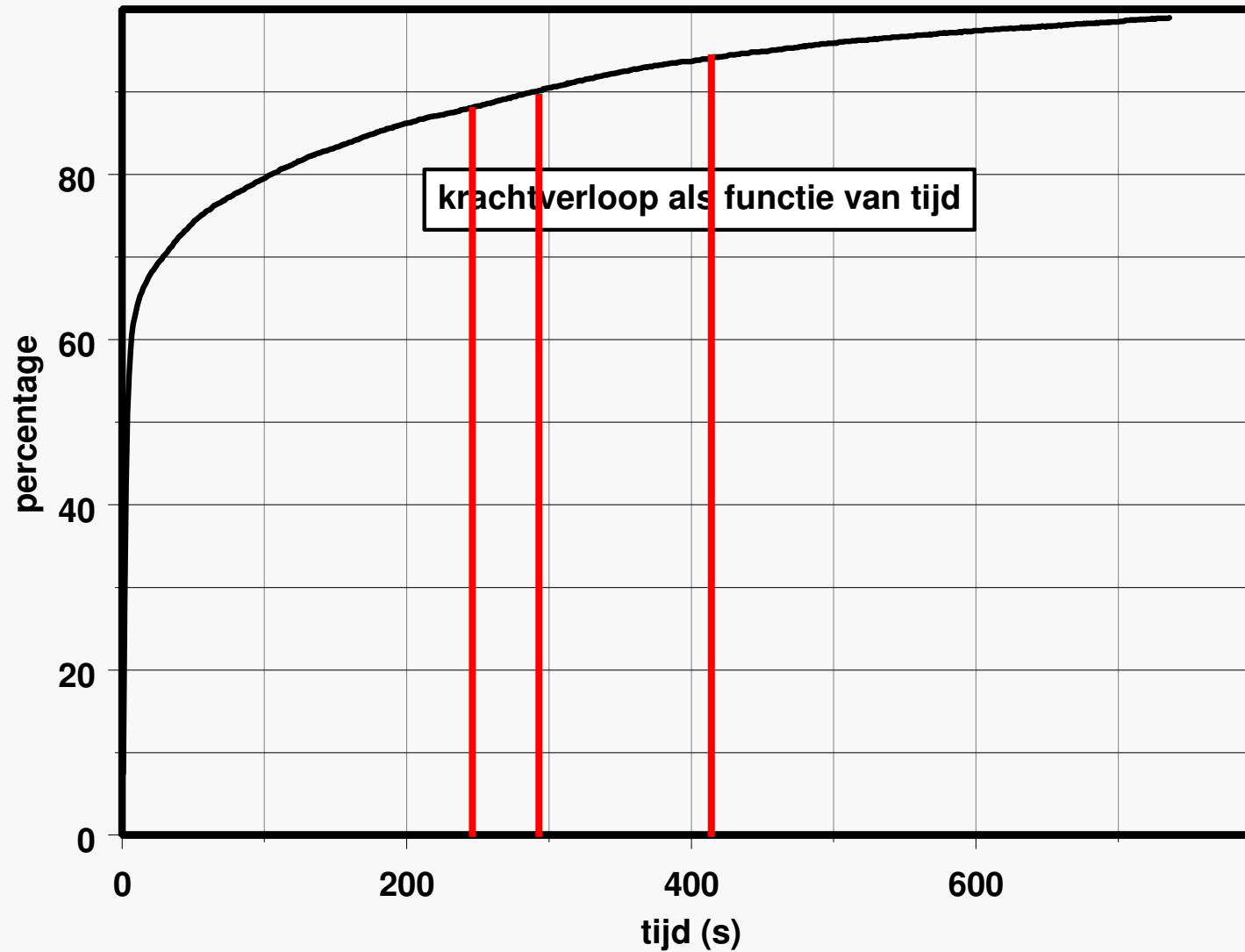
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Course with time of the force exerted by the sponge



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Course with time of the force exerted by the sponge



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Deformation of the inner house after 1 hour in water of 100 C

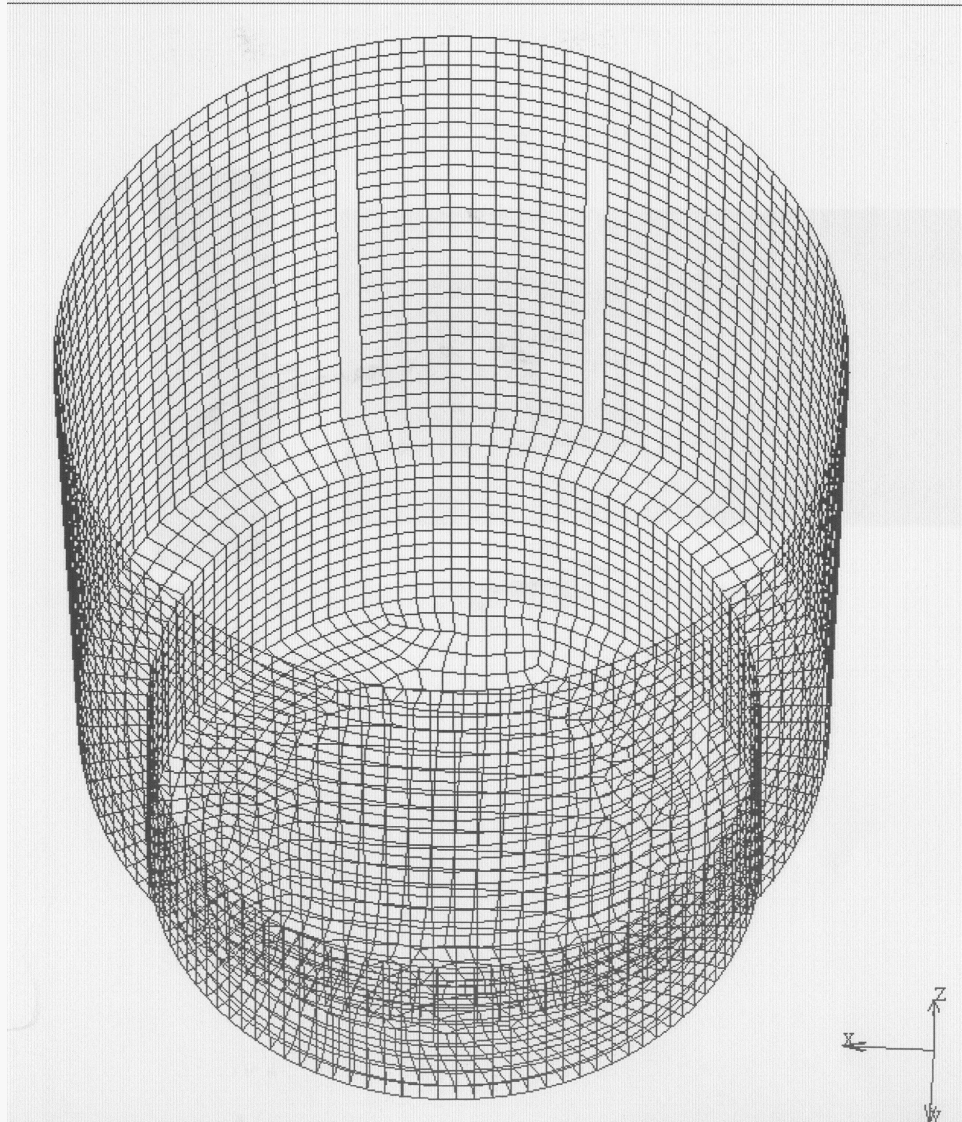


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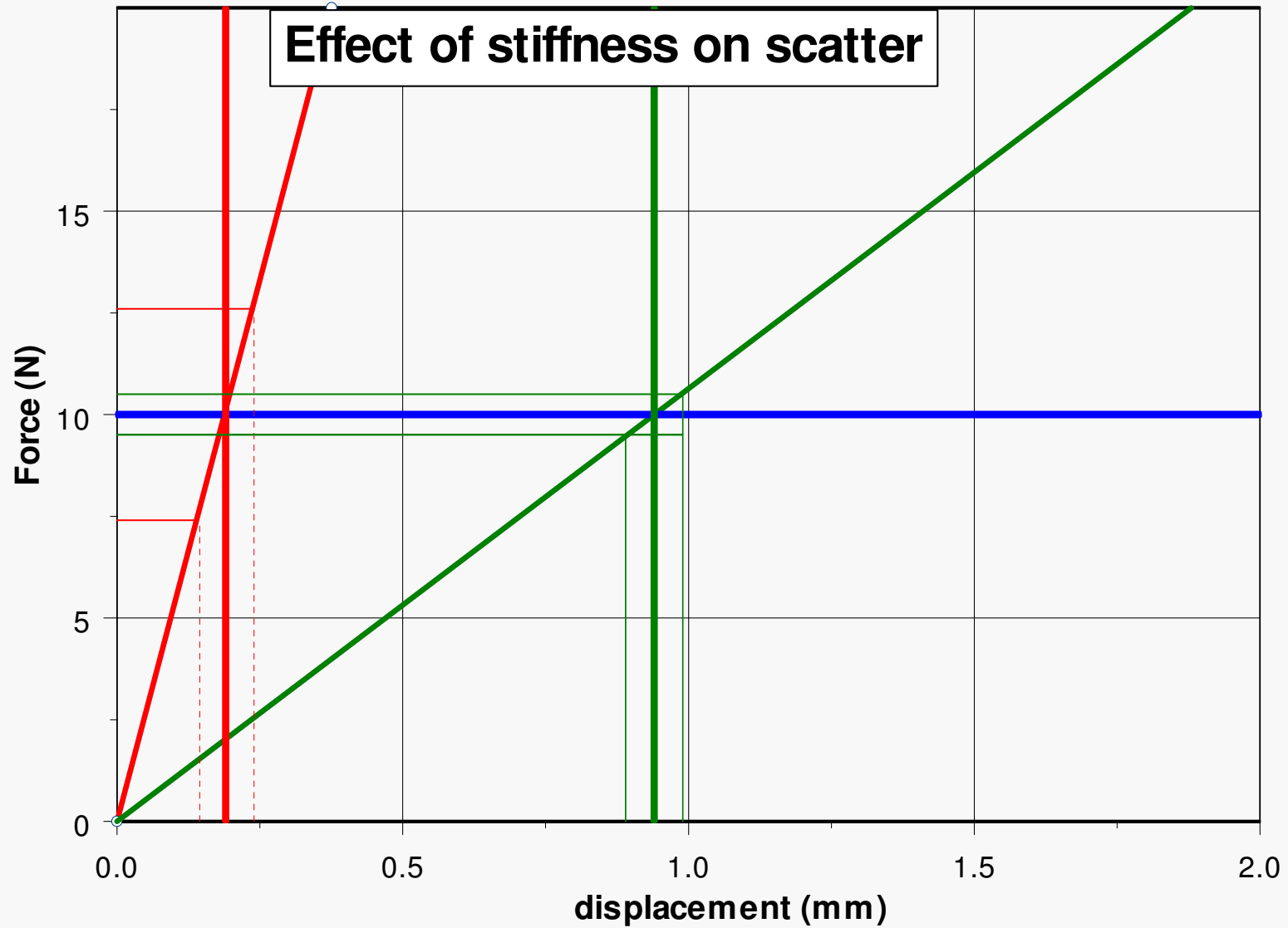
Deformation of ABS test bar after 1 hour in water of 100 C



FEM calculation to reduce stiffness



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Conclusions

- The design of the Keysaver was very much in error due to insufficient **dimensional stability**.
- **Trial and error methods** some times work, but not all the time.
- It is very **dangerous to let a mold maker design plastic products** by directly making a mold.
- **Lawyers should not irritate expert witnesses** by telling that laws of nature do not apply for the sake of their client.
- The bitterness of poor quality remains long after the sweetness of a low cost (trial and error) design has been forgotten.