	<b>Technical Specification/Requirements</b>		
	<b>Penetrator DOM-BEOC Pressure Test Setup 1</b>		
Nikhef number:  <b>45361-MT-01269</b>	Item number:  <b>AA5769</b>	Date: <b>15 04 2013</b>	Page: <b>1 of 9</b>
		Status: Released	Revision: B
Project: <b>Astroparticle Physics KM3NeT</b>			
Department: <b>Mechanical Technology</b>		Top folder: <b>VEOC for LOM-test B</b>	

### Project goal/ Description

This document describes a method for high-pressure tests (up to 600 bar (=60MPa.) of penetrators used in 17 inch Nautilus Vitrovex specified for a depth of 6700m below sea-level.

Finally there will be several tests with different conditions.

For the pressure tests the existing HERA-vessel (max. 800 bar or 80 MPa.) working load allowed) located at Nikhef Electronics Department will be used.

**Goal of this pressure test is to test the leak-tightness of a penetrator used for VEOC/LOM-test B01-B at location DOM 17 and OFM and at the design pressure of 600 bar (60MPa.)**

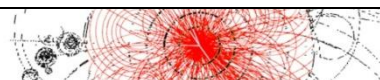
The deployment depth, planned begin of April 2013, is approx. 1000 m below sea level near Malaga-Spain.

**This test sample consists of a feed-through of 2 copper power cables only.**

Other types (i.e. other type of cable feed-through or stud) will follow.

During this pressure test we observe/measure the leak-tightness of the penetrator by increasing the pressure stepwise up to the design pressure of 600 bar. ( see test procedure below)

<i>Created by:</i> A. Korporaal	<i>Checked by:</i>	<i>Approved by:</i>
<i>Distribution list:</i>		



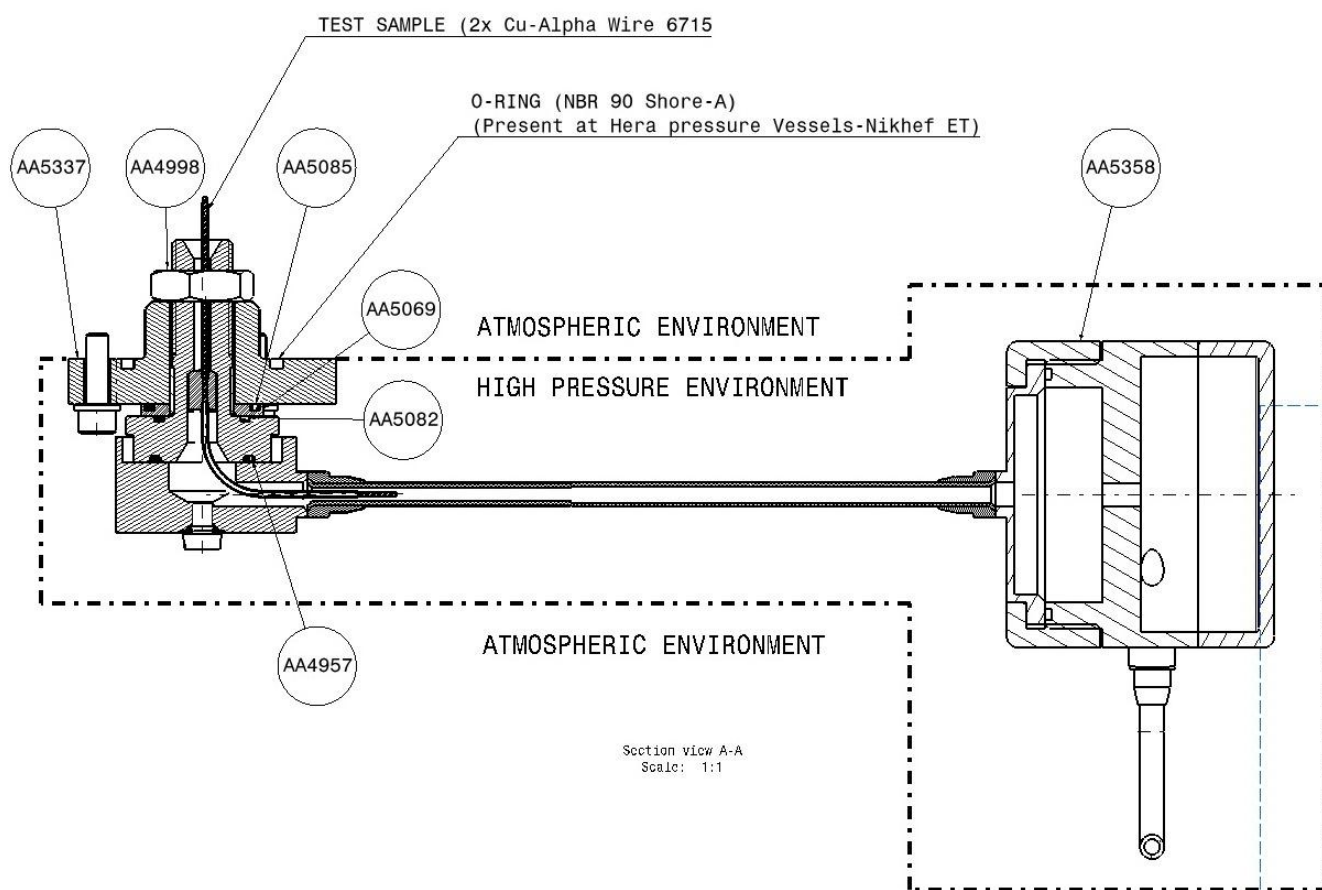
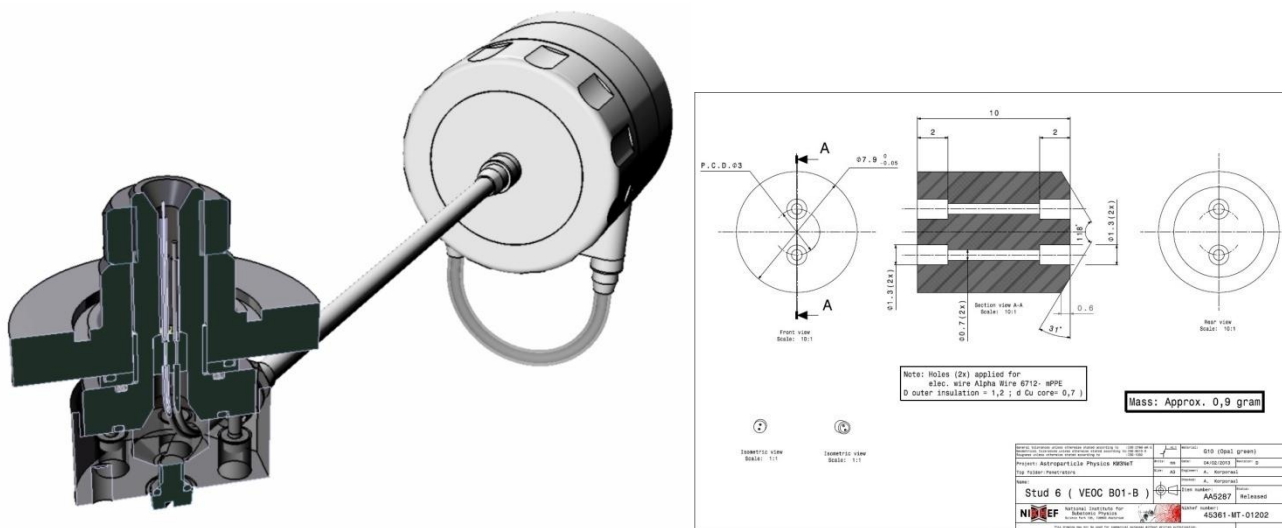
***HISTORY OF CHANGES***

<i>Rev. No.</i>	<i>Date</i>	<i>Pages</i>	<i>Description of changes</i>

Technical Specifications	
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## Geometrical:

- a. Test sample acc. Nikhef dwg.: **AA5341\_C** Penetrator DOM-BEOC Pressure test setup (**Fig. 1+2**)

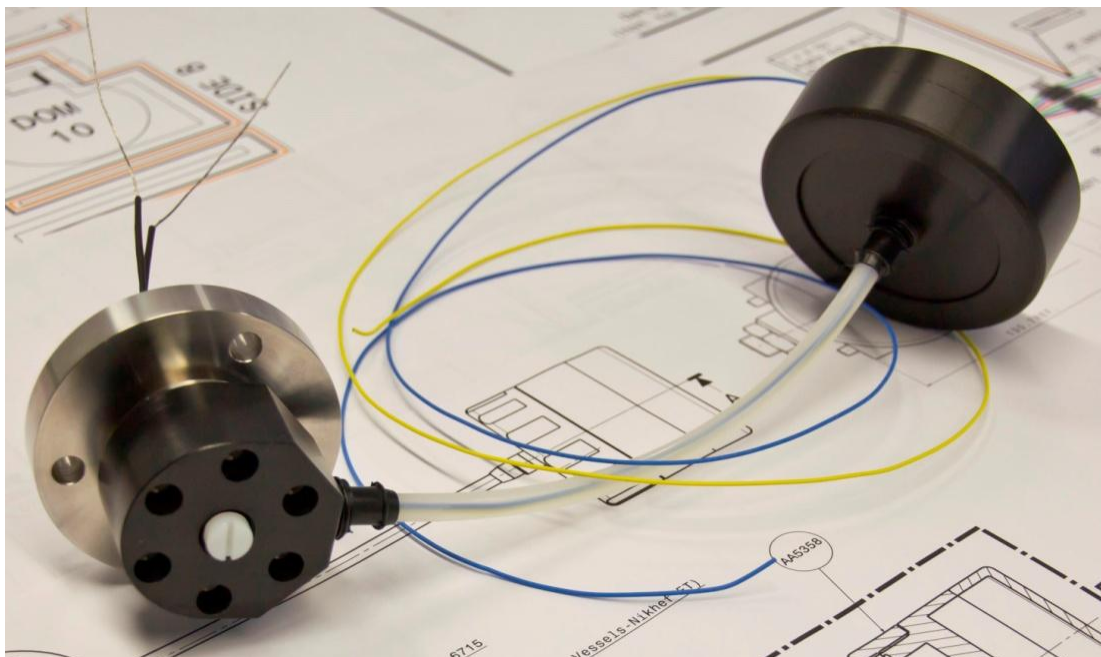
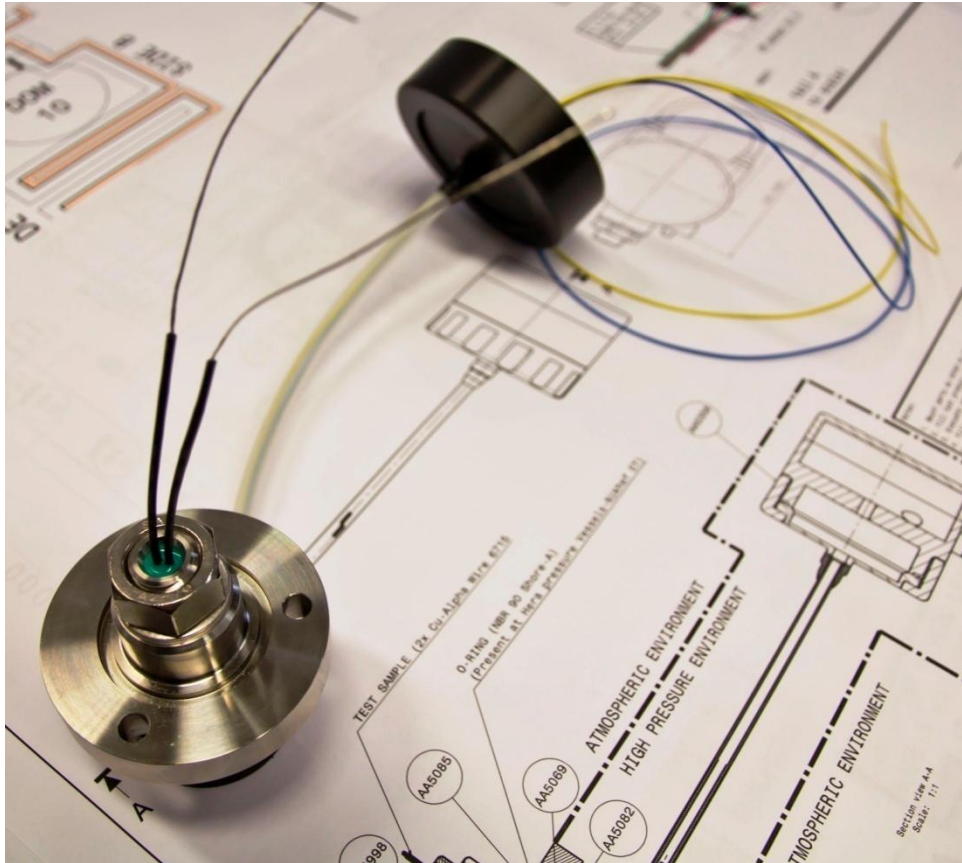


**Fig. 3**

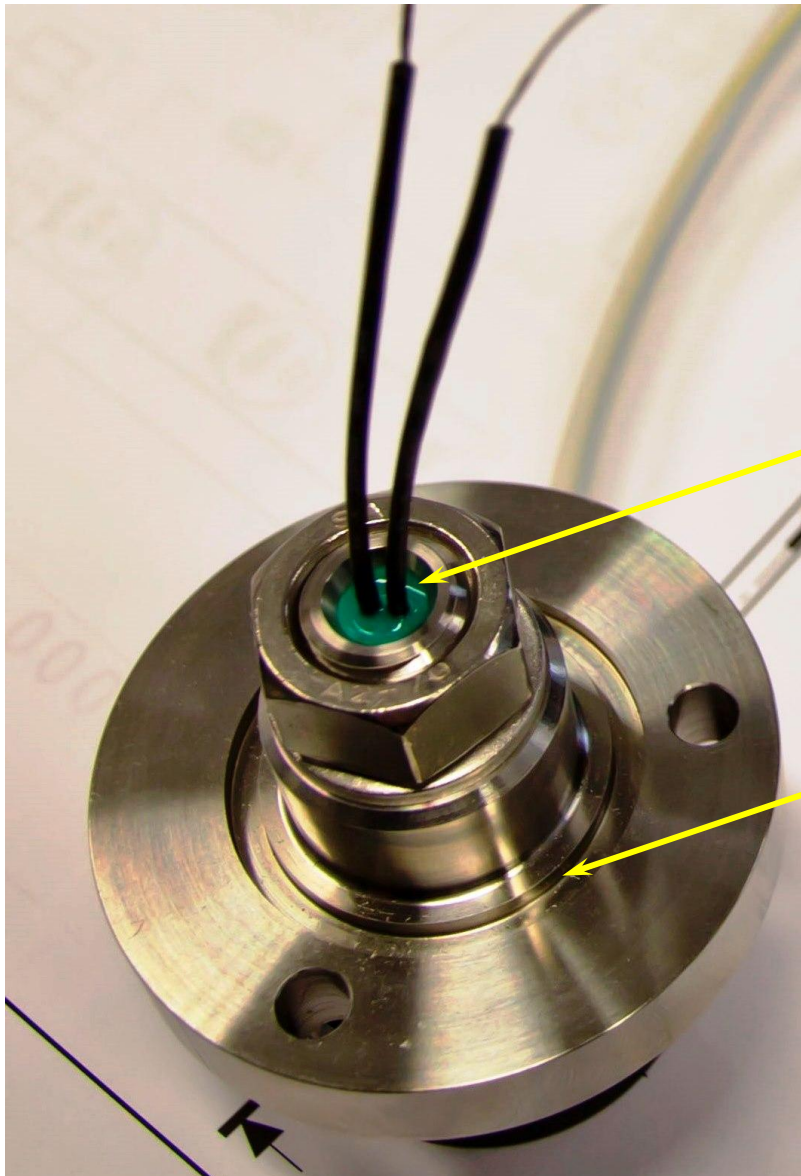
**Material test sample:**

- a. Penetrator (AA5071): Ti. Grade 5 (3.7165) ; Adapter ring 2 (AA5069): Ti. Grade 2 (3.7035) ; Stud 6 (AA5287): G10
- b. Break out Electrical Optical Cable (BEOC): HDPE - black /transparent.
- c. IMPORTANT ! Make sure NO air stays inside the BEOC/VEOC before testing.

**Fig. 4+5**



**Fig. 6 BEOC mounted to pressure vessel adaptor piece.**



Observe possible  
leakage during test with  
“paper tissue tool”

Clean groove  
carefully !  
Place O-ring !

**Temperature during tests:**

- a. Room temperature: Approx. 20°C

**Vacuum or pressure:**

- a. Pressure vessels HERA validated till 800 bar (see Smarteam Itemnumber: **AA1338** )

**Fluids and/or gasses:**

- a. Hera pressure vessel: **MIDEL® 7131** (approx. .... liter.)
  - b. Ass’y BEOC+BOB Acc. Nikhef.dwg.: AA5358 : **Siemens MIDEL® 7131** (approx. 50 cc)
- Note: This system must be vented carefully be supplied !

**Electronics:**

- a. Not relevant

**Radiation:**

- a. Not relevant.

**Other technical requirements:**

- a. 3 HERA-vessel(s) located at Nikhef Electronics Department room **H147b**.

**Test sample(s):**

- a. 1x Penetrator with 2-Copper wires (diam. 0,6mm) ; see dwg.: **AA5071/AA5287**
- b. ~~1x Penetrator with 6 Copper wires (diam. 0,6mm) ; see dwg.: **AA5071/AA5291**~~
- c. ~~1x Penetrator with 8 Copper wires (diam. 0,6mm) ; see dwg.: **AA5080/AA5278**~~
- d. ~~1x Penetrator with 2 Copper wires (diam. 1,3mm) + 2xFibre(diam.0,254/0,129) ; see dwg.: **AA5080**~~

**Test procedure 1:**

**A sinking speed of 6000 m/hr is chosen for Km3Net.**

**For validating a safety factor of 1,5 is used during this test. (see reference: C)**

**This means 60 [min] x 6/9 = 40 minutes. (=> 15 bar/min.)**

- a. Read user manual ( Nikhef- SmarTeam Item: AA1338) of the HERA-vessels carefully.
- b. Clean contact surfaces carefully.
- c. Mount bulkhead /test sample together with 0-ring inside vessel end cap.
- d. Apply pressure on system in 7 –steps.
  - 1. **1 up to 100 bar** in 5 minutes.
  - 2. Keep pressure constant during 10 min. => Visual inspection (leakage control, photo, data)
  - 3. **100 up to 200 bar** in 5 minutes.
  - 4. Keep pressure constant during 10 min. => Visual inspection (leakage control, photo, data)
  - 5. **200 up to 300 bar** in 6 minutes.
  - 6. Keep pressure constant during 10 min. => Visual inspection (leakage control, photo, data)
  - 7. **300 up to 400 bar** in 7 minutes.
  - 8. Keep pressure constant during 10 min. => Visual inspection (leakage control, photo, data)
  - 9. **400 up to 500 bar** in 7 minutes.
  - 10. Keep pressure constant during 10 min. => Visual inspection (leakage control, photo, data)
  - 11. **500 up to 550 bar** in 5 minutes.
  - 12. Keep pressure constant during 10 min. => Visual inspection (leakage control, photo, data)
  - 13. **550 up to 600 bar** in 5 minutes.
  - 14. Keep pressure constant during 10 min. => Visual inspection (leakage control, photo, data)
  - 15. Keep pressure constant during 48 hours => Visual inspection (leakage control, photo, data)

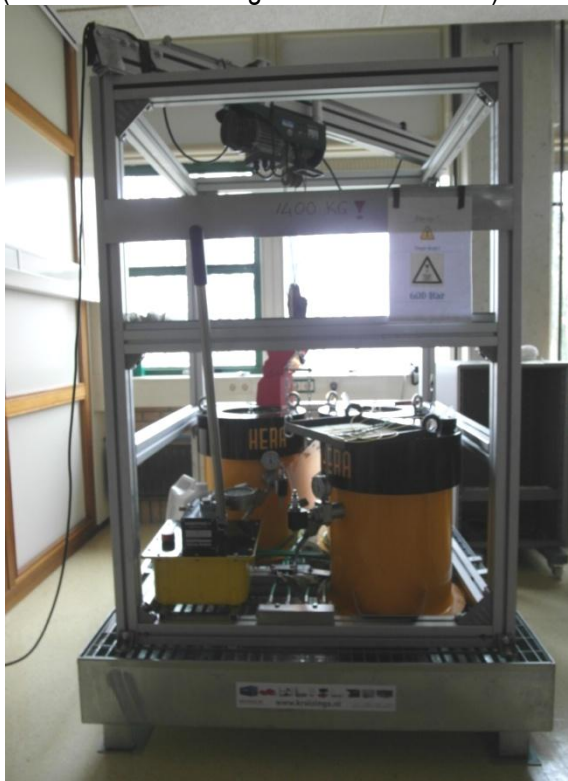
**Other technical requirements:**

- e. .... NONE



## Preparations:

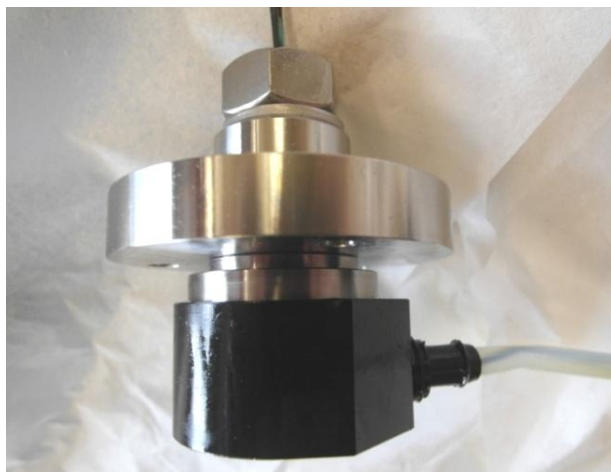
Pressure vessel equipment at Nikhef  
(Each vessel: Working Load max. 800 Bar)



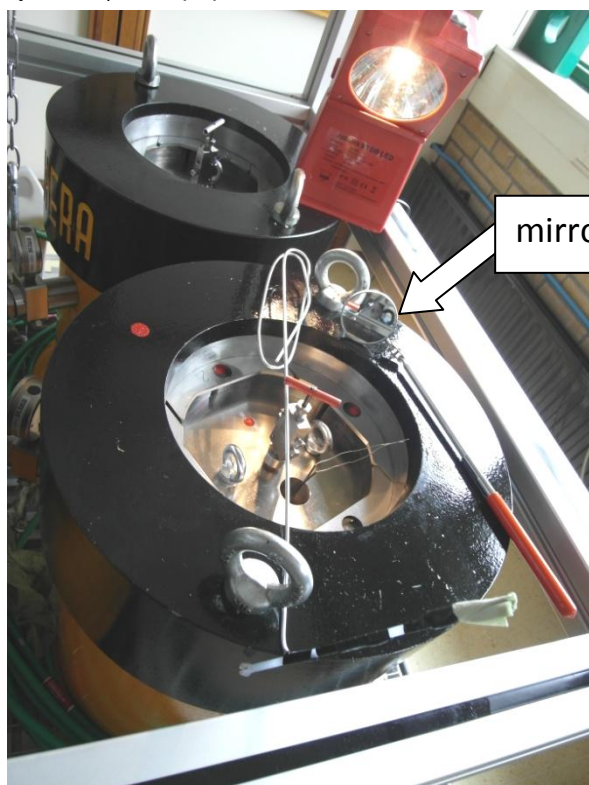
Pressure vessel ( Load max. 800 Bar)



Penetrator mounted on vessel adaptor piece.



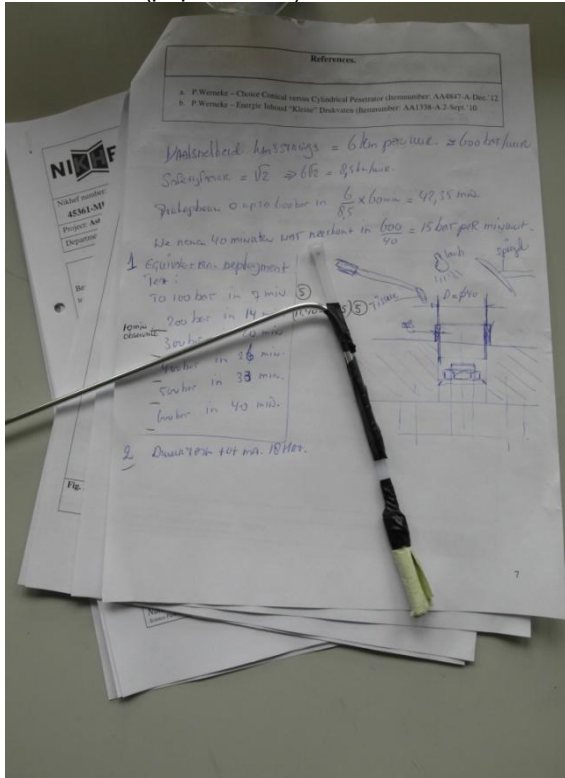
Save observing "at distance". Tools (Penetrator O-rings by mirror) and "paper tissue tool"



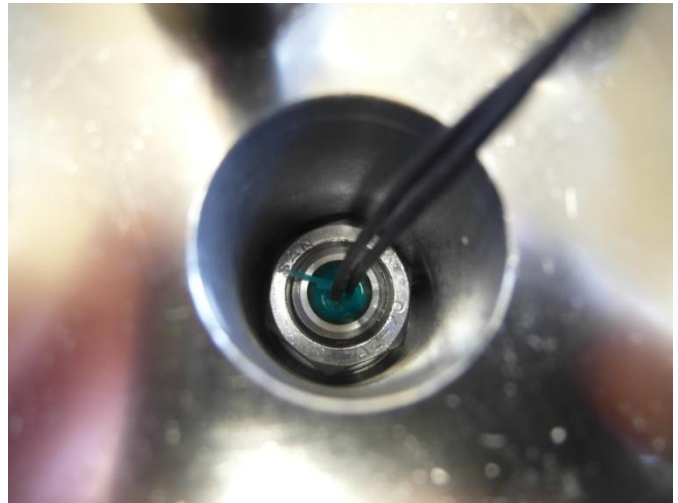
(Oil-filled) BEOC mounted on vessel end cap.



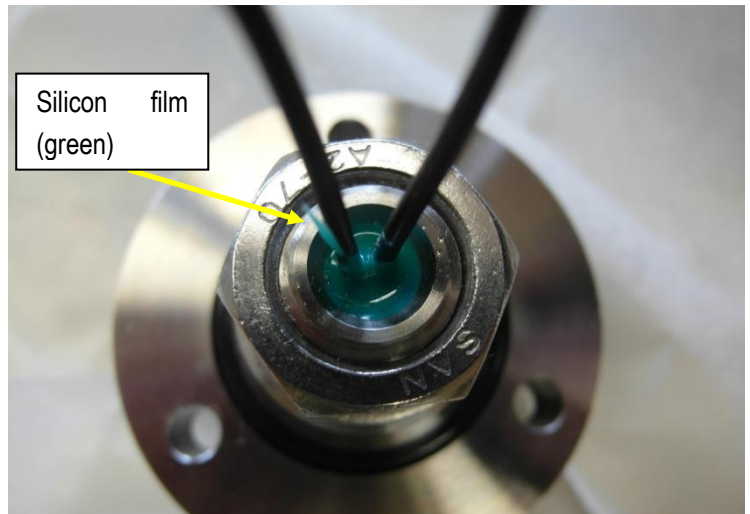
Tool used for oil leakage control of "wire region" on distance (paper tissue)



Looking on penetrator mounted in vessel end cap.



Silicon film loose (green) from wire observed during test. **NO VISIBLE leakage** measured. Probably caused by scraping with tissue tool.



Yes, the penetrator withstands the design pressure for at least 48 hours !



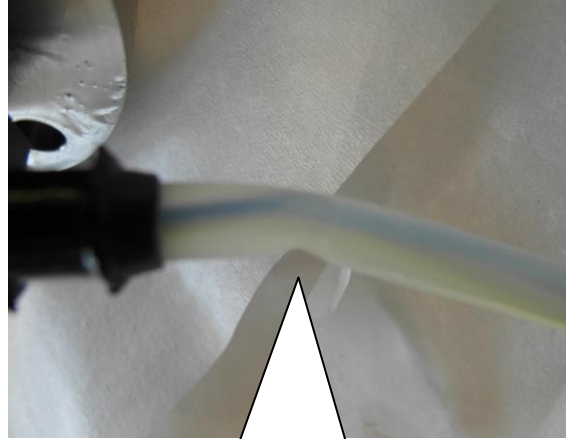


Observing the BEOC Assembly after the pressure test.

Closed packing of the BEOC Assembly.  
The diameter of the pressure vessel end cap = 220mm. The BEOC survived a pressure of 600 bar ! Note: The media outside the BEOC was oil too instead of seawater.  
We can not concluding a leak-tight BEOC assembly !  
This need further attention !



We observed a nod in the BEOC Cable located at penetrator end.



Nod caused by closed packing in pressure vessel.  
Need attention for following tests !!

#### Conclusion(s):

- f. Penetrator and O-rings withstand 600 bar (60 MPa.) for at least 48 hrs.
- g. No visual leakage observed.
- h. The BEOC can withstand a pressure of 600 bar (60 MPa.) for at least 48 hrs.
- i. ....

#### References.

- a. Werneke P. 2012 – Choice Conical versus Cylindrical Penetrator (Itemnumber: AA4847-A)
- b. Werneke P. 2010 – Energie Inhoud “Kleine” Drukvaten (Itemnumber: AA1338-A.2)
- c. Raymond S.O. 1975, Benthos, Inc. – Hollow Glass Spheres Under Pressure in the Ocean – experiments Show Interesting Properties (IEEE OCEAN '75)