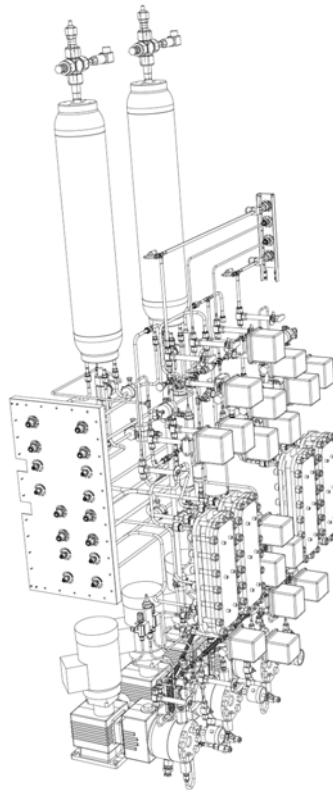




## Appendices CO2 cooling

Nikhef number: <b>39300-MT-00002</b>	Item number: <b>AA1762</b>	Date: <b>06/06/2012</b>	Page: <b>1 of 132</b>
		Status: Released	Revision: B
Project: <b>LHCb VELO</b>			
Department: <b>Mechanical Technology</b>		Top folder: <b>CO2 cooling</b>	

### SAFETY ANALYSIS OF THE ACCUMULATOR, HEAT EXCHANGER AND DAMPER FOR THE LHCb VELO

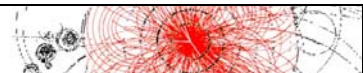


*Created by:*  
M.J. Kraan

*Checked by:*  
B. Verlaat

*Approved by:*

*Distribution list:*



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# APPENDIX A

Accumulator  
Welding radiographic examination report (*RTD*)

# Radiographic Examination report

RTD branch office Beverwijk 275-2006-34-077  
 Telephone number 0251-226163  
 Fax 0251-210405  
 Contact Dhr Veelbehr Examination date 25-08-2006

Client Verum B.V.  
 Address Postbus 42  
 Post code and city 1850 AA Heiloo  
 Country Nederland.  
 Contract Dhr. N. Wester  
 Order no 06-889  
 Request no ---  
 Report no client 02 083

RTD report no 275-2006-34-077  
 RTD order no 1995  
 F&A-number 5003-8490-120  
 Examination date 25-08-2006

Röntgen Technische Dienst bv



Exam. standard EN 1435 Class A  
 Exam. procedure RT21001 R 4  
 Accept. standard CODAP  
 Accept. procedure CODAP. R 5  
 Material R.V.S 316L  
 Weld metal niet opgegeven  
 Weld method GTAW  
 Heat treated  Yes  No

Film type D4  
 Screens (f/b) Pb 0.027 mm  
 IQI Afnor. Pct. exam. 10 %  
 Processing RTD Beverwijk  
 Set no 1841 Focal spot eff. 3 mm  
 Source type Röntgen 280 kV 4/6 mA  
 Ci GBq

## Remarks

Film no	Film Dim. [cmxcm]	Discontinuity type / location Na [cm]	Welder	Weld prep.	Weld [mm x mm]	[kV]	[mA. Pen. th. min]	[mm]	f [mm]	b [mm]	Setup
F252	1 6 x 16	A/Na Acc		V	Ø 168 x 7.1	248	12	15	792.9	7.1	DWSI
F252	2 6 x 16	Acc		V	Ø 168 x 7.1	248	12	15	792.9	7.1	DWSI
F252	3 6 x 16	Acc		V	Ø 168 x 7.1	248	12	15	792.9	7.1	DWSI
F252	4 6 x 16	Acc		V	Ø 168 x 7.1	248	12	15	792.9	7.1	DWSI
F252	5 6 x 16	Acc		V	Ø 168 x 7.1	248	12	15	792.9	7.1	DWSI
F253	1 6 x 16	Acc		V	Ø 168 x 7.1	248	12	15	792.9	7.1	DWSI
F253	2 6 x 16	Acc		V	Ø 168 x 7.1	248	12	15	792.9	7.1	DWSI
F253	3 6 x 16	Acc		V	Ø 168 x 7.1	248	12	15	792.9	7.1	DWSI
F253	4 6 x 16	Acc		V	Ø 168 x 7.1	248	12	15	792.9	7.1	DWSI
F253	5 6 x 16	Acc		V	Ø 168 x 7.1	248	12	15	792.9	7.1	DWSI

## Films and reporting

Film quantity 15  
 Name 0448 J Klijin  
 Level 2 Cert. no 473/347

Page 1  
 Total pages 2

## Operators

Name  
 Level

Cert. no

## Filminterpretation

Name  
 Level

Cert. no 573/039

## Report checked by

Name  
 Date



75 AUG 2006

# Radiographic Examination report

RTD branch office Beverwijk 275-2006-34-077  
 Telephone number 0251-226163  
 Fax 0251-210405  
 Contact Dhr Veelbehr  
 Order no 06-889

Röntgen Technische Dienst bv  
 Delftweg 144  
 Postbus 10065  
 3004 AB Rotterdam



Client Verum B.V. Report no client 02 083 Drawing no --

Film no	Film Dim. [cmxcm]	Discontinuity type / location Na [cm]	A/Na	Welder	Weld prep.	Weld [mm x mm]	[mA. min]	Pen. th. [mm]	f [mm]	b [mm]	Setup
F254	6 x 16		Acc		V	Ø 168 x 7.1	248	15	792.9	7.1	DWSI
F254	6 x 16		Acc		V	Ø 168 x 7.1	248	15	792.9	7.1	DWSI
F254	6 x 16		Acc		V	Ø 168 x 7.1	248	15	792.9	7.1	DWSI
F254	6 x 16		Acc		V	Ø 168 x 7.1	248	15	792.9	7.1	DWSI
F254	6 x 16		Acc		V	Ø 168 x 7.1	248	15	792.9	7.1	DWSI

Films and reporting		Operators			Filminterpretation			Report checked by		
Film quantity 15	Name 0448 J Klijn	Name	Level	Cert. no	Filminterpretation	Name	Level	Cert. no	Date	
Page 2	Level 2 Cert. no 473/347	Level	Level	Cert. no				2 5 AUG 2006	273/639	
Total pages 2										



# Radiographic Examination report

RTD branch office Beverwijk  
 Telephone number 0251-226163  
 Fax 0251-210405  
 Contact Dhr. Veelbehr

RTD report no 74-2006-35-004  
 RTD order no 3250  
 F&A-number 5003-8518-120  
 Examination date 29-08-2006

Client Verum B.V.  
 Address Postbus 42  
 Post code and city 1850 AA Heiloo  
 Country Nederland.  
 Contact Dhr. N. Wester  
 Order no 06-889  
 Request no ---  
 Report no client 00 007

Carried out at RTD Thuisinstallatie  
 Address Basisweg 50  
 Post code and city 1951 NE Velsen Noord.  
 Country Nederland.  
 Contractor Hoefnagel & Meijn  
 Project --  
 Drawing no --  
 Object Welds.

# Röntgen Technische Dienst bv

Delftweg 144  
 Postbus 10065  
 3004 AB Rotterdam  
 Tel. (010) 208 82 08  
 Fax (010) 415 80 22  
 E-mail rtd@rtd.nl



Exam. standard EN 1435 Class A  
 Exam. procedure RT21001 R 4  
 Accept. standard CODAP-90-1/22  
 Accept. procedure CODAP R 4  
 Material R.V.S 316L  
 Weld metal niet opgegeven  
 Weld method GTAW  
 Heat treated  Yes  No

Film type D4  
 Screens (f/b) Pb 0.027 mm Per cassette  
 IQI Afnor. Pct. exam. 10 %  
 Processing RTD Beverwijk  
 Set no 1841 Focal spot eff. 3 mm  
 Source type Röntgen 280 kV 4/6 mA  
 Ci GBq  
 edUserField1

### Remarks

Film no	Film Dim. [cmxcm]	Discontinuity type / location Na [cm]	Welder	Weld prep.	Weld [mm x mm]	[mA. Pen. th. min]	D [mm]	d [mm]	Setup
F255	6 x 16	A/Na A		V	Ø 168 x 7.1	3	392.9	7.1	DWSI
F255	6 x 16	A		V	Ø 168 x 7.1	3	392.9	7.1	DWSI
F255	6 x 16	A		V	Ø 168 x 7.1	3	392.9	7.1	DWSI
F255	6 x 16	A		V	Ø 168 x 7.1	3	392.9	7.1	DWSI
F255	6 x 16	A		V	Ø 168 x 7.1	3	392.9	7.1	DWSI
F255	6 x 16	A		V	Ø 168 x 7.1	3	392.9	7.1	DWSI

### Films and reporting

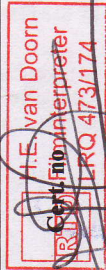
Film quantity 18  
 Name Level 0448 J Klijn  
 Cert. no 473/347  
 Page 1  
 Total pages 2

### Operators

Name Level  
 Cert. no

### Filminterpretation

Name Level  
 Cert. no  
 Report checked by Name Date



30 AUG 2006

# Radiographic Examination report

RTD branch office  
 Telephone number  
 Fax  
 Contact

RTD report no  
 RTD order no  
 F&A-number  
 Examination date

74-2006-35-004  
 3250  
 0-8518-120  
 29-08-2006

# Röntgen Technische Dienst bv

Delftweg 144  
 Postbus 10065  
 3004 AB Rotterdam  
 Tel. (010) 208 82 08  
 Fax (010) 415 80 22  
 E-mail rtd@rtd.nl



Client		Verum B.V.		Report no client		Drawing no						
Film no	Film Dim. [cmxcm]	Discontinuity type / location Na [cm]	A/Na	Welder	Weld prep.	Weld [mm x mm]	[kV]	[mA, min]	Pen. th. [mm]	D [mm]	d [mm]	Setup
F256	1	6 x 16	A		V	Ø 168 x 7.1	220	3	15	392.9	7.1	DWSI
F256	2	6 x 16	A		V	Ø 168 x 7.1	220	3	15	392.9	7.1	DWSI
F256	3	6 x 16	A		V	Ø 168 x 7.1	220	3	15	392.9	7.1	DWSI
F256	4	6 x 16	A		V	Ø 168 x 7.1	220	3	15	392.9	7.1	DWSI
F256	5	6 x 16	A		V	Ø 168 x 7.1	220	3	15	392.9	7.1	DWSI
F256	6	6 x 16	A		V	Ø 168 x 7.1	220	3	15	392.9	7.1	DWSI
F257	1	6 x 16	A		V	Ø 168 x 7.1	220	3	15	392.9	7.1	DWSI
F257	2	6 x 16	A		V	Ø 168 x 7.1	220	3	15	392.9	7.1	DWSI
F257	3	6 x 16	A		V	Ø 168 x 7.1	220	3	15	392.9	7.1	DWSI
F257	4	6 x 16	A		V	Ø 168 x 7.1	220	3	15	392.9	7.1	DWSI
F257	5	6 x 16	A		V	Ø 168 x 7.1	220	3	15	392.9	7.1	DWSI
F257	6	6 x 16	A		V	Ø 168 x 7.1	220	3	15	392.9	7.1	DWSI

Films and reporting		Operators		Filminterpretation		Report checked by	
Film quantity	18	Name	0448 J Klijn	Name		Name	
Page	2	Level	2	Level		Date	
Total pages	2	Cert. no	473/347	Cert. no			

H.E. van Doorn  
 Cert. no. 473/174  
 LRO 473/174  
 29 AUG 2006

# APPENDIX B

Accumulator  
EN 17020 DAP Certificates (*RTD*)



DAP Deutsches Akkreditierungssystem Prüfwesen GmbH

vertreten im

# Deutschen AkkreditierungsRat



## Akkreditierung

Die DAP Deutsches Akkreditierungssystem Prüfwesen GmbH bestätigt hiermit, dass die

**Röntgen Technische Dienst bv**

Delftweg 144  
3004 AB Rotterdam  
Niederlande

mit ihrer

**Inspektionsstelle Typ A**

die Kompetenz nach DIN EN ISO/IEC 17020 besitzt, Inspektionen in den Bereichen

**Untersuchungen von individuellen Erzeugnissen oder Anlagen mit Hilfe zerstörungsfreier Prüfverfahren (Dichtheitsprüfung, Durchstrahlungsprüfung, Eindringprüfung, Magnetpulverprüfung, Ultraschallprüfung, Sichtprüfung, Wirbelstromprüfung, Härteprüfung sowie Verwechslungsprüfung) und Feststellung ihrer Übereinstimmung mit bestimmten normativen Anforderungen**

gemäß den in der Anlage aufgeführten Inspektionsbereichen auszuführen.

Die Akkreditierung ist gültig vom 2005-02-22 bis 2010-02-21.

DAR-Registriernummer: **DAP-IS-3425.00**

Berlin, 2005-02-22

Univ.-Prof. Dr.-Ing. habil. K. Ziegler  
Geschäftsführer  
DAP Deutsches Akkreditierungssystem  
Prüfwesen GmbH

Dr. rer. nat. K. Kolb  
Verantwortlicher Begutachter der DAP GmbH  
ZPKo Dr. Kolb  
Zerstörungsfreie Prüfungen und  
Technische Inspektionen  
Stuttgart

Die Akkreditierung erfolgt aufgrund einer Begutachtung und des mit der DAP Deutsches Akkreditierungssystem Prüfwesen GmbH (im folgenden DAP genannt) abgeschlossenen Vertrages über die Akkreditierung einer Inspektionsstelle nach den Regeln und Verfahren des Deutschen Akkreditierungssystems, gemäß den Normen DIN EN ISO/IEC 17020 und DIN EN ISO/IEC 17011.

Die materiellen und personellen Voraussetzungen nach DIN EN ISO/IEC 17020 für die in der Akkreditierungsurkunde angegebenen Inspektionsbereiche sowie für die in der Anlage zur Akkreditierungsurkunde beschriebenen Inspektionsanweisungen und zugrundeliegenden Prüfverfahren sind erfüllt.

Angaben über den Umfang der Akkreditierung (Inspektionsbereiche, Verfahren und Spezifikationen) sind in der Anlage zu dieser Akkreditierungsurkunde aufgeführt.

Die Anlage sowie die eingereichten Unterlagen sind Bestandteil der Akkreditierung. Änderungen bedürfen der Schriftform.

Die Akkreditierung wird unter dem Vorbehalt des jederzeitigen Widerrufs bei Wegfall der im Vertrag sowie in der Anlage zu dieser Akkreditierungsurkunde festgelegten Voraussetzungen erteilt.

---

Akkreditierungsurkunden und Anlagen dürfen nur unverändert weiterverbreitet werden. Die auszugsweise Veröffentlichung bedarf der Genehmigung des DAP.



# APPENDIX C

Accumulator  
EN 473/347 Certificate (*RTD*)



Geaccrediteerd voor certificatie van persoonlijke vakbekwaamheid volgens EN 45013  
 Accredited certifying body pursuant to EN 45013  
 DAR Reg.-Nr.: ZLS-ZP-019/99

## Certificaat / Certificate

Nr. / No.  
 473/347

Hiermee certificeren wij, dat  
 We hereby certify that

**Jacob Klijn**

Voornaam, familienaam / first name, surname

**20.03.1965**

Geboortedatum / Date of birth

**Leiden**

Geboorteplaats / Place of birth

Volgens EN 473 deskundig is voor  
 is competent in according to EN 473 for

**Radiografie 2**

NDO-methode, niveau / NDT method, level

inclusief permanente verbindingen in drukkoudende apparatuur volgens Richtlijn  
 97/23/EG\*

including permanent joints of pressure equipment according to Directive 97/23/EC\*

**c, f, t, w, wp**

Productsector\* / Product sector\*

**06/2009**

Einde geldigheidsdatum / Expiry date

Handtekening certificaathouder  
 Signature of certified person

**08.07.2004**

Certificatiedatum  
 Date of certification



Hoofd certificatie-instelling  
 Head of certifying body

\*Verklaringen op achterzijde / \* Explanations overleaf  
 Het certificaat kan worden ingetrokken ingeval van onterecht gebruik of misbruik ervan.  
 The certificate can be revoked, if it is misleadingly quoted or misused.

# APPENDIX D

Accumulator  
ISO 9001:2000 Certificate (*Hoefnagel & Meijn B.V.*)



## CERTIFICAAT

*Hiermede wordt verklaard dat het Kwaliteitsmanagementsysteem van:*

***Hoefnagel & Meijn B.V.  
Zaandam, Nederland***

*door Lloyd's Register Quality Assurance is geëvalueerd en goedgekeurd  
volgens de volgende kwaliteitsmanagementsysteemnormen:*

**ISO 9001 : 2000**

*Het kwaliteitsmanagementsysteem is van toepassing op:*

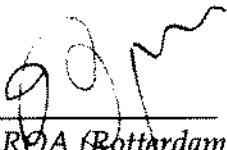
***Het ontwerpen en vervaardigen van procesapparatuur voor  
chemische-, petrochemische- en voedingsmiddelen industrie.***

Certificaat no: 654653

*Datum van uitgifte eerste certificaat: 30 januari 2001*

*Datum van uitgifte huidig certificaat: 3 december 2003*

*Certificaat Vervaldatum: 31 januari 2007*

  
Afgegeven door: LRQA (Rotterdam)



*Op dit document zijn de aan de ommezijde vermelde voorwaarden van toepassing  
Deze goedkeuring is uitgevoerd in overeenstemming met LRQA audit- en certificatie-procedures en zal periodiek door LRQA worden beoordeeld.*

Metris 10.1

# APPENDIX E

Accumulator  
Welding Procedure Approval Record (*Hoefnagel & Meijn B.V.*)

Client Order no. WPS no. Code	Hoefnagel & Meijn BV, [NLD] Zaandam 04060 Q4431h EN 288-3 and ASME section IX.	Certificate no. Stork FDO order no. Amsterdam	MKW 04-0067 OMKW 4038 2004-01-28
--	---	---	--

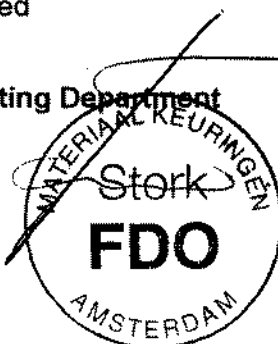
**TEST RESULTS PROCEDURE QUALIFICATION**

Test sample / material Test sample marked	Welded testpipe $\varnothing$ 114.3 x 8.56 wt mm 1.4404 LPN	Stainless steel ASTM 312 TP 316L
Welding process / -position	141 [GTAW] and 136 [FCAW]	PA [1G]
Filler metal / gas	141: Avesta 316L-Si / SKR-Si [ER316LSi] 136: Avesta FCW-316L-TO-4	141: Shieldinggas: Argon 99.995% 136: Shieldinggas: 80% Argon + 20% CO <sub>2</sub> 141: Backinggas : Argon 99.995%
Welding joint	V	
Heat treatment	n.a.	
NDT: VISUAL INSPECTION RADIOGRAPHIC EX. PENETRANT EXAM.	acceptable [Lloyd's Register Nederland BV] acceptable [RTD report no. 2003-5065-103 / film no. F0067] acceptable [RTD report no. 224-2004-04-006]	

TENSILE TEST	Dimensions testpiece	Area	Temp.	Yield str. ReH/Rp0,2	Tensile str. Rm	Elong. Lo	Red	Fracture Character of failure
Type	mm	mm <sup>2</sup>	°C	MPa [N/mm <sup>2</sup> ]	MPa [N/mm <sup>2</sup> ]	%	%	failure
Requirements					≥ 485	-	-	
Transverse - 1	12.03 x 8.3	99.9	RT	-	530	-	-	In pipe mat.
Transverse - 2	11.96 x 8.3	99.3	RT	-	549	-	-	In pipe mat.

BEND TEST	mandrel: $\varnothing$ = 4 x t / angle 180 °		IMPACT TEST		Charpy - V	temp. °C	- 60
type	results	type	results	Dimensions mm	10 x 7.5 x 55	Area mm <sup>2</sup>	60
face	good	root	good	Location of notch	Joules		Av.
face	good	root	good	Requirements	min. 21 / single 15		21
				Weld centre	121 - 104 - 104		110
				H.a.z.	184 - 189 - 184		186

MACRO SPECIMEN	acceptable
----------------	------------

**Conclusion/Remarks : Approved**
**Stork FDO B.V., Materials Testing Department**
**Verified: H.J.M. van Tol**
**Authorised: G.V. Tokarenko**

**Tests witnessed by:**  
 Lloyd's Register Nederland B.V.  
 Ing. N.J. Huppen  
 Witnessed / Reviewed / Examined  
 Stw. no. 164410




## REGISTRATIE DOCUMENT

### HOEFNAGEL & MEIJN B.V. ZAANDAM-HOLLAND

Van lasmethode aanvaarding volgens NEN-EN 288-3 & ASME sect. IX.

Naam van de lasser(s) : J.J. Tanger

Kenmerk(en): JT12

Nummer lasvaardigheidsbewijs: MKW 04-0067

WPS: Q4431h

#### Gegevens van de proeflas

Basismateriaal : ASTM 312 TP316L

Volgens norm : ASTM

Materiaalgroep : 8-9.2-9.3-10

Wanddikte [mm] : 8.56

Uitwendige diameter van de pijp [mm]: ø114.3

Elektrodemerk en -dikte [mm] : —

Draadtype en -dikte [mm] : Avesta 316L-Si/SKR-Si [ER316Lsi], Avesta FCW-316L-TO-4

Bescherm gas : Argon 99.995%, Argon 80% + CO2 20%

Lasproces : 141[GTAW] / 136[FCAW]

Stand van de proeflas : PA [1G]

Eenzijdig of tweezijdig? : eenzijdig

Lasvorm : zie WPS

Wel of geen onderlegstrip : geen

Stroomsoort : gelijkstroom

Boogspanning, stroomsterkte : 100-240 A

Lassnelheid [cm/min] : 15-20

Voorverwarmingstemperatuur : —

Afkoelprocedure : —

Overige warmtebehandeling : —

Proeflas vervaardigd in bijzijn van : Dhr. N.J. Huppen, Stoomwezen

#### Onderzoekresultaten van de proeflas:

Visueel onderzoek : goed

Niet-destructief onderzoek : goed

Filmnummer(s): F0067

Beoordeling: goed

Destructief onderzoek volgens aangehecht (e) rapport(en): goed

Resultaat: goed

Proeven zijn uitgevoerd in het bijzijn van: Dhr. N.J. Huppen, Stoomwezen

Eindresultaat: Aanvaardbaar

#### Geldigheidsgebied

Lasproces : 141 / 136

Lasstanden : PA PB

Materiaalgroep(en) : 8-9.2-9.3-10

Lastechniek : eenzijdig

Wanddikte [mm] : 3.0 – 17.1

Uitwendige diameter van de pijp [mm] : De >= 57.2

Voorverwarmingstemperatuur [°C] : —

Warmtebehandeling : —

Metaaltemperatuur [°C] : —

Ondergetekende verklaart dat de bovengenoemde gegevens naar waarheid zijn verstrekt en dat de eindresultaten voldoen aan de in de "NEN-EN 288-3" vermelde eisen.

Datum: 28-01-2004



HOEFNAGEL & MEIJN B.V. ZAANDAM - HOLLAND

# APPENDIX F

Accumulator  
Welder qualification (*Hoefnagel & Meijn B.V.*)

**STORK®****CERTIFICATE****Stork FDO B.V.**

Materials Technology

MKW 04-0067A, PAGE 1 OF 1

Client Order no. WPS no.	Hoefnagel & Meijn BV, [NLD] Zaandam 04060 Q4431h	Certificate no. Stork FDO order no. Amsterdam	MKW 04-0067A OMKW 4038 2004-01-28
Code	EN 287-1 [2003] and ASME section IX.		

**WELDER PERFORMANCE QUALIFICATION**

Test sample marked	1.4404 LPN
--------------------	------------

Welder name Identification Method of identification Place and date of birth Job knowledge	J.J. Tanger JT12 Passport no. H479971 [NLD] Westzaan // d.o.b. 20-12-1953 n.a.
---	--

	weld test details	range of approval	
		EN 287-1 [2003]	ASME sect. IX
Welding process	141 [GTAW] 136 [FCAW]	141 136	GTAW FCAW
Plate [P] or pipe [T] Joint type	T BW	P T BW FW	P T BW FW
Parent metal group[s] Filler metal type / designation	ASTM A312 TP 316L 141 Avesta 316L-Si / SKR-Si [ER316LSi] 136 Avesta FCW-316L-TO-4	8 - 9.2 - 9.3 - 10 S S M	P1 up to P11 F6 F6
Shielding gas	141 Argon 99.995% 136 80% Argon + 20% CO <sub>2</sub>	- -	- -
Backing gas	141 Argon 99.995%	-	-
Test sample thickness [mm] Pipe outside diameter [mm]	8.56 114.3	3 - 17.12 ≥ 57.15	Max. 17.12 ≥73
Welding position	PA [1G]	PA PB	F
Performance Gouging / backing	ss nb	ss mb nb bs	one- and two side

	Number	RESULTS
Visual ex.	1	accepted by Lloyd's Register [Ned. BV]
Radiographic ex.	7	acceptable [RTD report no. 2003-5065-103 / film no. F0067]
Bend test	1	acceptable
face	1	acceptable
root	1	acceptable
Mandrel Ø 4xt / angle 180 °		

**Conclusion/Remarks:** Approved**Stork FDO B.V., Materials Testing Department**

Verified: H.J.M. van Tol

Authorised: G.V. Tokarenko

Tests witnessed by:  
Lloyd's Register Nederland B.V.

*[Signature]*  
M. W. E. Z. E. N.  
Ing. H. J. Huppen  
Witnessed /  Reviewed /  Examined  
Stw. no. 164410



**BEWIJS VAN LASVAARDIGHEID****HOEFNAGEL & MEIJN B.V. ZAANDAM-HOLLAND**

Van lasmethode aanvaarding volgens NEN-EN 287-1 &amp; ASME sect. IX.

Naam van de lasser(s) : J.J. Tanger

Kenmerk(en): JT12

Nummèr lasvaardigheidsbewijs: MKW 04-0067

WPS: Q4431h

**Gegevens van de proeflas**

Basismateriaal : ASTM 312 TP 316L

Volgens norm: ASTM

Materiaalgroep : 8-9.2-9.3-10

Wanddikte [mm] : 8.56

Uitwendige diameter van de pijp [mm]: ø114.3

Elektrode merk en -dikte [mm] : —  
 Draadtype en -dikte [mm] : Avesta 316L-Si/SKR-Si [ER316Lsi], Avesta FCW-316I-TO-4  
 Bescherm gas : Argon 99.995%, Argon 80% + CO2 20%  
 Lasproces : 141[GTAW] / 136[FCAW]  
 Stand van de proeflas : PA [1G]  
 Eenzijdig of tweezijdig? : eenzijdig  
 Lasvorm : zie WPS  
 Wel of geen onderlegstrip : geen

Proeflas vervaardigd in bijzijn van : Dhr. N.J. Huppen, Stoomwezen

**Onderzoekresultaten van de proeflas:**

Visueel onderzoek : goed

Niet-destructief onderzoek : goed

Filmnummer(s): F0067

Beoordeling: goed

Macroscopisch onderzoek (aantal doorsneden): 1 ; resultaat: goed

Destructief onderzoek (aantal buigstaven): 2 ; resultaat: goed

(aantal tegenbuigstaven): 2 ; resultaat: goed

Proeven zijn uitgevoerd in het bijzijn van: Dhr. N.J. Huppen, Stoomwezen

Eindresultaat: Aanvaardbaar

**Geldigheidsgebied**

Lasproces : 141 / 136  
 Lasstanden : PA PB  
 Materiaalgroep(en) : 8-9.2-9.3-10  
 Lastechniek : ss mb nb  
 Wanddikte [mm] : 3.0 – 17.1  
 Uitwendige diameter van de pijp [mm] : De >= 57.2

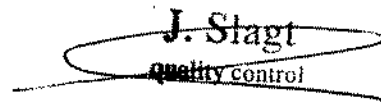


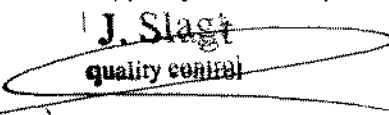


Ondergetekende verklaart dat de bovengenoemde gegevens naar waarheid zijn verstrekt en dat de eindresultaten voldoen aan de in de "NEN-EN 287-1" vermelde eisen.

Datum: 28-01-2004


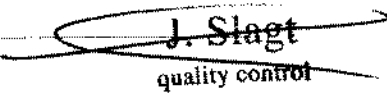
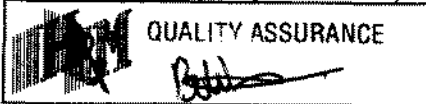
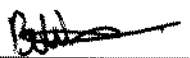

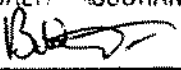
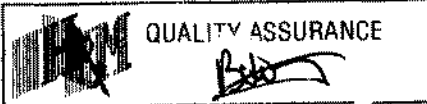
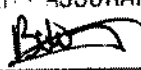


HOEFNAGEL &amp; MEIJN B.V. ZAANDAM - HOLLAND

## Blad 1

Naam lasser (welders name): J.Tanger		Lasserskenmerk (stamp): JT12	
Datum bewijs (date of qualification): 28-01-2004		Lasproces (weldingproc.): 141 / 136	
Nummer bewijs (no. of qualification): MKW 04-0067			
Datum van uitvoering (date of perform.): 05-09-'04	Ordernr. (ordemo.): 04206	Materiaal (material): RVS 316L	Diameter x dikte (mm): Ø219.1 x 3.76
Kwaliteitsbeheer (quality assurance):  quality control	Röntgenrapport (Xray): 1501	Inspectie door (inspection by): SHELL	
Datum van uitvoering (date of perform.): 07-07-04	Ordernr. (ordemo.): 04576	Materiaal (material): RVS 316L	Diameter x dikte (mm): Ø114.3 x 3.4
Kwaliteitsbeheer (quality assurance):  quality control	Röntgenrapport (Xray): 1501	Inspectie door (inspection by): SHELL	
Datum van uitvoering (date of perform.): 15-10-04	Ordernr. (ordemo.): 04841	Materiaal (material): RVS 316L	Diameter x dikte (mm): Ø114.3 x 6.02
Kwaliteitsbeheer (quality assurance):  quality control	Röntgenrapport (Xray): 1501	Inspectie door (inspection by): SHELL	
Datum van uitvoering (date of perform.): 04-02-05	Ordernr. (ordemo.): 05005 040205 1561	Materiaal (material): RVS 316L	Diameter x dikte (mm): 13 x 9.62
Kwaliteitsbeheer (quality assurance):  quality control	Röntgenrapport (Xray): 040205	Inspectie door (inspection by): HAN	
Datum van uitvoering (date of perform.): 05/09/05	Ordernr. (ordemo.): 05747	Materiaal (material): RVS 316	Diameter x dikte (mm): Ø69.3
Kwaliteitsbeheer (quality assurance):  quality control	Röntgenrapport (X-ray): 276-2005-36- 003	Inspectie door (inspection by):  07-09-2005	

## Blad 2

Naam lasser (welders name) : J.Tanger		Lasserskenmerk (stamp): JT12	
Datum bewijs (date of qualification) : 28-02-2004		Lasproces (weldingproc.): 141 / 136	
Nummer bewijs (no. of qualification): MKA 04-0067			
Datum van uitvoering (date of perform.) 01-11-05	Ordernr. (ordemo.) 05667	Materiaal (material) 316L	Diameter x dikte (mm) Ø 114.3 x 6
Kwaliteitsbeheer (quality assurance)  quality control	Röntgenrapport (Xray) 3007	Inspectie door (inspection by) ZETON	
Datum van uitvoering (date of perform.) 09-09-06	Ordernr. (ordemo.) 06118	Materiaal (material) AUS	Diameter x dikte (mm) Ø 114.3 x 8.6
Kwaliteitsbeheer (quality assurance)  quality control	Röntgenrapport (Xray) 1501	Inspectie door (inspection by) TUV NORD	
Datum van uitvoering (date of perform.) 14-09-06	Ordernr. (ordemo.) 06606	Materiaal (material) 316L	Diameter x dikte (mm) Ø 219.1 x 8.2
Kwaliteitsbeheer (quality assurance)  QUALITY ASSURANCE 	Röntgenrapport (Xray) 1501	Inspectie door (inspection by) LLOYD'S REGISTER	
Datum van uitvoering (date of perform.) 16-02-07	Ordernr. (ordemo.) 061264	Materiaal (material) 316L	Diameter x dikte (mm) Ø 114.3 x 6.2
Kwaliteitsbeheer (quality assurance)  QUALITY ASSURANCE 	Röntgenrapport (Xray) 9343/2	Inspectie door (inspection by) LLOYD'S REGISTER	
Datum van uitvoering (date of perform.) 14-06-07	Ordernr. (ordemo.) 07435	Materiaal (material) 316L	Diameter x dikte (mm) Ø 168.3 x 7.11
Kwaliteitsbeheer (quality assurance)  QUALITY ASSURANCE 	Röntgenrapport (X-ray) 9343/23	Inspectie door (inspection by) LLOYD'S REGISTER	

# APPENDIX G

Accumulator  
Material Certificates

2407153869  
-10

ABNAHMEPRUEFZEUGNIS 3.1 (EN 10204:2004)  
(A03) BESCHNEIDUNGS-NR 2005024542  
PAGE 1/2



COGNE ACCIAI SPECIALI S.p.A.  
11100 AOSTA - VIA PARAVERA, 16  
TEL +39.0165.3021 - FAX +39.0165.302296  
CAP. SOC. 80.000.000 EUR INT. VERS.  
P.I. 008571320076 F. 02187360967  
REG. IMP. A0003 - 7234 REA 50474



(A06) BESTELLER ..  
(A07) KUNDENBESTELLN:  
(A01) HERSTELLERWERK :  
(A01) HERSTELLERWERK :  
(A05) AUSSTELLER :  
(A08) WERKSAUFTRAGSNR ..  
COGNE EDELSTAHL GmbH  
Oda: DE01 4500105429  
COGNE ACCIAI SPECIALI - AOSTA, VIA PARAVERA 16  
QUALITATSTELLE (A04) ZEICHEN DES HERSTELLERWERKES.:  
C5400886 /10

NORMBEZEICHNUNG : ANFORDERUNGEN : AD 2000  
(B01) ERZEUGNIS : RUND HSTD  
(B04) LIEFERZUSTAND :  
(B11) MASSE (MM) : 04000 /06000  
(B02) STAHLSORTE : F316L 1.4404  
(B08) SCHMELZE-NR.: 286110  
(B06) KENNZEICHNUNG : KURZZEICH. F. SCHMELZE-NR 611

US-PRUEFUNG: BESTANDEN  
GEMAESS DIN 17440 (96) W2, W.1.4401, W.1.4404  
CHEMISCHE ZUSAMMENSETZUNG NACH ASTM A182/A182M-02, A479/A479M-03, ASME SA479/SA479M-01  
GEMAESS NACE MR 01.75 (01)  
GEMAESS SPECIFIKATION NF A35-574/90, NUANCE Z3 CND 17-11-02  
QUALITAETSSCHMELZE GEMAESS EN10088-3 (95)  
GEMAESS RICHTLINIEN PED 97/23/CE  
GEMAESS EN10272/00

(C71) CHEMISCHE ZUSAMMENSETZUNG - SCHMELZE ANALYSE NACH ASTM E1019-E1086-E415

Ref.	81.000,000								
ELEMENTE	C	Si	Mn	P	S	N	Cr	Mo	Ni
ERREICHT	0,018	0,470	1,830	0,028	0,015	0,076	16,770	2,000	10,100
ELEMENTE	Co								
ERREICHT	0,110								0,420

HARTEPRUEFUNG IM LIEFERZUSTAND  
Ref. 020000174674  
VORSCHRIFT EN 10003  
ERREICHT 169,0  
HARTEPRUEFUNG HB

KERBSCHAGZAEBIGKEIT IM LIEFERZUSTAND  
Ref. 020000174674  
VORSCHRIFT EN 10045  
(C40) PROBENFORM KV 20,0000  
(C03) PRUFTEMPERATUR °C J  
MASSEINHEIT 114,00 120,00 121,00 110,00 114,00 120,00 124,00 108,00 106,00 112,00  
ERREICHT 118,00 115,00

(C02) PROBENRICHTUNG: T





COGNE ACCIAI SPECIALI S.p.A.  
 17100 ASTI VIA PARVA 15  
 TEL. 011 65 3024 FAX. 0165 302296  
 CAP. SOC. 80.000.000 EUR INT. VERS.  
 VAT. IT00571320076 C.F. 02187360967  
 REG. IMP. A0003 - 7234 REA 50474



ABNAHMEPRUEFFZEUGNIS 3.1 (EN 10204:2004)  
 (A03) BESCHEINIGUNGS-NR 2005024542  
 PAGE 2/2

ZUGVERSUCH IM LIEFERZUSTAND  
 Ref. 020000174674  
 VORSCHRIFT EN 10002

(C02) PROBENRICHTUNG: T

MASSEINHEIT	RM NMM	RP02 NMM	A %	Z %	RP1 NMM
ERREICHT	569,00	311,00	5,0 D	59,00	361,00
	573,00	306,00	48,00	57,80	358,00
	579,00	312,00	47,40	57,80	360,00
	567,00	306,00	46,80	59,00	355,00
			47,00		

GEMAESS EN 10222/5 '00  
 LOESUNGSGLUEHEN 1050 °C/WASSER  
 ERSCHMELZUNG IM ELEKTROOFEN + AOD  
 KORROSIONSVERSUCK:  
 (SEC. ASTM A262/02a PRACT. E / EN ISO 3651-2 (00) ): GEMAESS  
 100% VERWECHSLUNGSPRUEFUNG DURCHGEFUHRT  
 OBERFLAECHE UND MASSKONTROLLE: OHNE BEANSTANDUNG.  
 DAS MATERIAL WURDE NICHT DURCH QUECKSILBER VERUNREINIGT  
 ES IST KEINE BESSERUNG DES MATERIALS DURCH DEN SCHWEISSFORANG ERFOLGT.  
 100%IGE US-PRUEFUNG: BESTANDEN  
 MATERIAL LOESUNGSGEGLUET 1050 °C/1MM/WASSER  
 DAS MATERIAL ENTSPRICHT DEN TECHNISCHEN ABNAHMEBEDINGUNGEN  
 KENNZEICHNUNG: HERSTELLERZEICHEN, WERKSTOFF-NR, SCHELZEN-NR, PROBE/LOS-NR, STEMPEL DES WERKSACHVERSTAENDIGEN.  
 (Z02) ZEICHEN DES SACHVERSTAENDIGEN LF  
 Ausgesstellt im einvernehmen mit dem TUV Bayern (11.1.1972)  
 Auf eine gegenzeichnung durch die uberwachungs-organisation ( schreiben  
 TUV-Bayern vom 17.01.80 ) kann verzichtet werden  
 RISSGEPRUFT BESTATIGT - + US-GEPRUFT AM STAB BESTELLT.  
 MATERIAL HERGESTELLT GEMAESS EINEM SYSTEM DAS DIE QUALITAET NACH UNI  
 EN ISO 9001:2000 - QS.9000 ED.3 MAR.98 GARANTIIERT. (DIE LETZTGENANNT  
 NORM GILT NUR FUER GEWALZT-GESCHAELT-GESCHLIFFEN STABSTAHL UND FÜR  
 TOMISIERTE METALLISCHE PULVER) MIT IGQ BESCHEINIGUNG.



*Giorgio Mero*

247-365

R-20



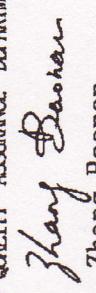
**SHANGHAI JINCHANG STAINLESS STEEL TUBE MANUFACTURING CO., LTD.**

158 Xinyang Road, Shaoshang Town, Fengxian District, Shanghai, China  
 AD WO/TRD100: 01 202 CHI/AD-04 0106 97/23/EC: 01 202 CHI/Q-04 0106



**MILL TEST CERTIFICATE**

DIN EN ISO9001:2000 No:01 100 038935 DATE OF ISSUE:2005.5.15

COMMODITY: STAINLESS STEEL SEAMLESS PIPES		CERTIFICATE NO: E2-05-05-12												
CONDITION: COLD FINISH / SOLUTION TREATED / PICKLED / PLAIN END.		ORDER NO: 12-25												
GRADE: ASTM A312 TP 316L		HEAT NO: J0405-140												
CHEMICAL CONTENTS (WT%)														
ELEMENTS	C	Mn	P	S	Si	Ni	Cr	Mo						
SPECIFICATION	≤0.030	≤2.00	≤0.045	≤0.030	≤1.00	10.00-14.00	16.00-18.00	2.00-3.00						
RESULTS (PRODUCT)	0.021	0.64	0.030	0.001	0.36	12.19	16.52	2.08						
PHYSICAL PROPERTIES														
Dimensions	O.D. (mm)	W.T. (mm)	Length (m)	TEST No.	Pieces	Quantity (m/kg)	0.2%YS (Mpa)	TS (Mpa)	EL (%)	EDDY CURRENT TEST (100%)	FLATTENING TEST	HARDNESS (HRB)	P.M.I. TEST	HYDRO-STATIC TEST (Mpa/time)
REMARKS:														
AS PER ASTM A312/ASTM A999 LATEST EDITION & ASME SA312/ASME SA999 LATEST EDITION														
WALL THICKNESS TOLERANCE AS PER ASTM A312 -04 MELTING PROCESS:EF														
POSITIVE MATERIAL IDENTIFICATION TEST:SATISFACTORY														
CORROSION TEST PER ASTM A-262 PRACTICE "E"														
HARDNESS TEST PER NACE MR-01-75														
SOLUTION HEAT TREATMENT:1920 F×1.15h/min														
WATER COOLED TO BELOW 800 F in 3min														
NO WELD REPAIR WAS PERFORMED														
FREE FROM MERCURY CONTAMINATION														
MARKING: JINCHANG / ASTM A312,ASTM A999 TP 316L / 168.28 mm × 7.11 mm H eat No: J0405-140 PROD.: C12-26														
THE MATERIALS HAVE BEEN MANUFACTURED, TESTED AND EXAMINATED IN ACC. WITH ALL THE REQUIREMENTS OF THE ORDERED STANDARDS AND WE CONFIRM THAT ALL TEST RESULTS ARE ACCEPTABLE														
SHANGHAI JINCHANG STAINLESS STEEL TUBE MANUFACTURING CO., LTD. MANAGER OF QUALITY ASSURANCE DEPARTMENT:														
 Zhang Baonan														

VERIFIED TRUE COPY OF ORIGINAL DOCUMENTS

## DMV STAINLESS Italia s.r.l

Via Piò, 30 24062 Costa Volpino (BG)  
Tel : 035.975.811 - Fax : 035.971624  
e-mail: dmvitally@dmv-stainless.com



No

01.03573

Page 1/2

## INSPECTION CERTIFICATE

3.1.B - EN 10204 :1991+A1:1995

Purchaser  
Address  
Customers Order 107230 date 23/07/2001 .  
DMV Ref. Order / Item 0000203736/000018 .  
Part number 088.17.125 .

247-365

E10

## Product

Seamless Stainless Steel Cold Finished Tubes Solution Annealed in Bright Condition Plain Ends Square Cut Deburred

## Specification

ASTM A 213-98A ASME SA-213 ED98 ASTM A 213-99A ASTM A 269-98 DIN  
17458 PK1 07.85 088.17E:2000. ASTM A 269-98

## Grade

1.4401 1.4404 TP316 TP316L

## Tolerances

DIN 2391 09.94

## Marking

{LOGO\_DMV} ASTM A 312 /A 213 A.W. /A269 -117- TP316/TP316L  
1.4404/1.4401 CD NDE SMLS MS1 {HEAT} 18 x 1,5 - DMV-IF (BUNDLE)

Heat	No	Weight	Total length	OD	W. Th.	Length
355570	335	1242,00 Kg	2041,88 m	18,00 mm	1,50 mm	6096 mm
Tot.	335	1242,00 Kg	2041,88 m			

Heat 355570 Melting Process

Electric + AOD/VOD

## Chemical analysis (%)

	C	Si	Mn	P	S	Cr	Mo	Ni	Co
Min						16.500	2.000	11.000	
Max	0.030	0.75	2.00	0.040	0.0300	18.000	2.500	13.500	0.200
Heat	0.015	0.46	1.60	0.028	0.0010	17.110	2.070	11.300	0.100
product	0.014	0.50	1.64	0.033	0.0010	16.940	2.010	11.150	0.100

## Mechanical and Metallurgical Properties

## Tensile test (at 20 °C)

	Direct.	Y.S. 0,2%	Y.S. 1,0%	U.T.S.	EI 5d	EI 50 mm
	Long/Trans	MPa	MPa	MPa	%	%
Min		205.00	240.00	515.00	40.00	35.00
Max				690.00		
No 72158	L	315.37	349.54	614.98	52.00	52.00
No 72159	L	312.75	346.91	617.61	51.80	51.80
No 72449	L	306.18	339.03	614.98	53.20	53.20
No 72450	L	317.46	351.85	615.74	51.60	51.60

## HARDNESS TEST

Sample 72158 Required HRB max 90,00 Result	79,00 / 80,00
Sample 72159 Required HRB max 90,00 Result	79,00 / 80,00
Sample 72449 Required HRB max 90,00 Result	78,50 / 79,50
Sample 72450 Required HRB max 90,00 Result	79,00 / 80,00

## FLARING TEST

Required ASTM A 450

Result OK

**VERIFIED TRUE COPY OF ORIGINAL DOCUMENTS**

**DMV STAINLESS Italia s.r.l**

Via P16, 30 24062 Costa Volpino (BG)  
Tel : 035.975.813 - Fax: 035.971624  
e-mail: dmvitaly@dmv-stainless.com

**DMV**

**INSPECTION CERTIFICATE**

**3.1.B - EN 10204 :1991+A1:1995**

No

**01.03573**

Page 2/2

**RING FLATTENING TEST**

Required **DIN 50 136** **Result OK**

**FLATTENING TEST**

Required **ASTM A 450** **Result OK**

**CORROSION TEST**

Required **ASTM A 262 PR E** **Result OK**

**Other tests and declarations**

Heat treatment	<b>1070°C</b>	
PMI examination		<b>OK</b>
Visual and dimensional examination		<b>OK</b>
Eddy current examination	<b>SEP 1925</b>	<b>OK</b>
Hydrostatic test	<b>6.9 MPa / 5 s</b>	<b>OK</b>
<b>HARDNESS TEST</b>	<b>HRB&lt;= 80</b>	<b>OK</b>

No weld repair

Tubes are free from mercury contamination

**We certify that the delivered products comply with the request of the order**

La Société DMV garantit que tous les produits objet du Certificat susdit, respectent en leur totalité les Specifications de l'Article 15 de l'Arrêté Ministeriel du 24 Mars 1978 modifié: C max 0,25% P max 0,05% Rm max 800 N/mm<sup>2</sup> A (Lo=5,65VS<sub>0</sub>) min 16% long.Rm (A-2) min 10500 N/mm<sup>2</sup>

Date 05-NOV-2001

Issue by: Mr F. ANNIBALI

This certificate is issued by a computerized system and is valid without signature. In case the owner of the original certificate would release a copy of it, he must attest its conformity to the original one taking upon himself the responsibility for any unlawful or not allowed use. Any alteration and/or falsification will be subject to the law

**DMV STAINLESS Italia s.r.l. ISO 9001 - IGQ N° .9408**



# APPENDIX H

Accumulator  
Pressure test report

**RUSCH ARMADAC® BV CALIBRATION LABORATORY (R.A.C.L.)**  
**Laboratory Mechanical Quantities**  
**C E R T I F I C A T E O F V A L I D A T I O N ©**

**CERTIFICATE** :2006-VAL-PRESSURE VESSEL / 01  
T.a.g. :F-257  
Date of valibration :05-October-2006

**ENVIRONMENTAL CONDITIONS** :R.A.C.L.  $\delta$   
Temperature :T = 16°C 1°C  
Relative Humidity :rh= 48% 3% rh  
Barometric pressure :P = 1011 HPa 10 HPa  
Gravity :g = 9.81298875 m/s<sup>2</sup> NKO Pr II

**PURCHASER** :Nikhef BV, Kruislaan 409, 1098 SJ, Amsterdam.  
:the Netherlands

**INSTRUMENT** :Pressure Vessel  
Manufacturer :Nikhef BV (see purchaser)  
Type :TVC-51  
Model :n/a  
Serial number :F257

**STANDARD (S)** :Input pressure : **Applicable instrument**  
Manufacturer :Barnett : Steward & Buchanan Ltd.  
Type :Dual 33T/45T/78T/78: 100 mm / 4"  
Serial number :8856/280D : n/a  
Measuring range :0.1 > 300 BarG : 0-250 BarG  
Uncertainty :0.020 %R : 1% FSO  
Traceability :E.A. / NKO : R.A.C.L.

**CALIBRATION METHODE** :According procedure :Pro258/P=g/s

**RESULTS** :Pe=170 BarG v/s Vt=300 s within requirements  
:Thith party Mr. Hans de Haan

**UNCERTAINTY** :The reported uncertainty is based  
On the standard uncertainty, multiplied by a coverage factor of K=2  
Which provides a confidance level of approximately 95%.  
The standard uncertainty is according E.A.

**TRACEABILITY** :The measurements have been executed using  
standards for which the traceability to (inter) national standards has  
been demonstrated towards the NKO / RvA ( E.A.)

**DATE** :05-October-2006

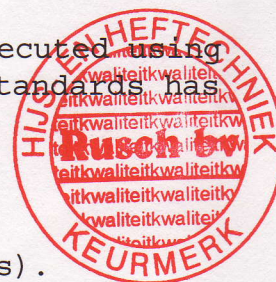
**NAME** :Ir. C.P.Veth Manager Metrology, Head R.A.C.L.

**NAME** :Hans de Haan Thirth party (Pe x Vt) = (170 BarG x 300 s).

Rusch Armadac® Postbus 4128 1620 HC HOORN. ☎ +031(0)229-212698. Fax +031(0)229-211439.

Reproductie van het volledige rapport en/of certificaat is toegestaan. Gedeelten van het

Rapport en/of certificaat mogen slechts worden gereproduceerd na schriftelijke toestemming van Rusch Armadac® Dit  
rapport en certificaat wordt v erstrekt onder voorbehoud dat Rusch Armadac® generlei aansprakelijkheid aanvaardt.



**RUSCH HIJS- EN HEFTECHNIEK B.V.**  
Factorij 24 - 1689 AL Zwaag  
Postbus 4128 - 1620 HC Hoorn

**RUSCH ARMADAC® BV CALIBRATION LABORATORY (R.A.C.L.)**  
**Laboratory                      Mechanical                      Quantities**  
**C E R T I F I C A T E   O F   V A L I D A T I O N ©**

**CERTIFICATE** : 2006-VAL-PRESSURE VESSEL / 02  
T.a.g. : F-256  
Date of valibration : 05-October-2006

**ENVIRONMENTAL CONDITIONS** : R.A.C.L.                      δ  
Temperature : T = 16°C                      1°C  
Relative Humidity : rh= 48%                      3% rh  
Barometric pressure : P = 1011 HPa                      10 HPa  
Gravity : g = 9.81298875 m/s<sup>2</sup>                      NK0 Pr II

**PURCHASER** : Nikhef BV, Kruislaan 409, 1098 SJ, Amsterdam.  
: the Netherlands

**INSTRUMENT** : Pressure Vessel  
Manufacturer : Nikhef BV (see purchaser)  
Type : TVC-51  
Model : n/a  
Serial number : F256

**STANDARD (S)** : Input pressure : **Applicable instrument**  
Manufacturer : Barnett : Steward & Buchanan Ltd.  
Type : Dual 33T/45T/78T/78: 100 mm / 4"  
Serial number : 8856/280D : n/a  
Measuring range : 0.1 > 300 BarG : 0-250 BarG  
Uncertainty : 0.020 %R : 1% FSO  
Traceability : E.A. / NK0 : R.A.C.L.

**CALIBRATION METHODE** : According procedure : Pro258/P=g/s

**RESULTS** : Pe=170 BarG v/s Vt=300 s within requirements  
: Thith party Mr. Hans de Haan

**UNCERTAINTY** : The reported uncertainty is based  
On the standard uncertainty, multiplied by a coverage factor of K=2  
Which provides a confidance level of approximately 95%.  
The standard uncertainty is according E.A.

**TRACEABILITY** : The measurements have been executed using  
standards for which the traceability to (inter) national standards has  
been demonstrated towards the NK0 / RvA ( E.A.)

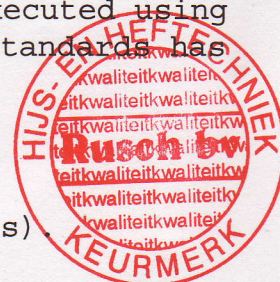
**DATE** : 05-October-2006

**NAME** : Ir. C.P.Veth Manager Metrology, Head R.A.C.L.

**NAME** : Hans de Haan Thirth party (Pe x Vt) = (170 BarG x 300 s)

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rapport en certificaat wordt v erstrekt onder voorbehoud dat Rusch Armadac® generlei aansprakelijkheid aanvaardt.



# APPENDIX I

Accumulator  
Declaration of Conformity F-256 / F-257





The National Institute for Nuclear Physics and  
High Energy Physics

Kruislaan 409  
1098 SJ Amsterdam  
The Netherlands

Declaration of conformity  
Issued in accordance with the  
PRESSURE EQUIPMENT DIRECTIVE (PED)  
97/23/CE

We hereby declare that in compliance with the above Directive, that the product below has been manufactured in accordance with the conformity assessment CAT III and Code De Construction des Appareils a Pression (CODAP). Pressure test has been done by RUSCH ARMACDAC BV CALIBRATION LABRORY with certificate no. 2006-VAL-PRESSURE VESSEL / 02. Two main welds are examined by Rontgen Technische Dienst (RTD) with the NDO-method level 2 according the EN 473/347 with report no. 74-2006-35-004 and no. 275-2006-34-077

Product description: **CO<sub>2</sub> Accumulator Pressure Vessel**  
(MAWP 130 Bar / Vol. 14.2 Liter)

Product Reference: **F-256**

Signed

Name: Frank Linde

Position: Director of Nikhef

Date: august 3, 2007



The National Institute for Nuclear Physics and  
High Energy Physics

Kruislaan 409  
1098 SJ Amsterdam  
The Netherlands

Declaration of conformity  
Issued in accordance with the  
**PRESSURE EQUIPMENT DIRECTIVE (PED)**  
97/23/CE

We hereby declare that in compliance with the above Directive, that the product below has been manufactured in accordance with the conformity assessment CAT III and Code De Construction des Appareils a Pression (CODAP). Pressure test has been done by RUSCH ARMACDAC BV CALIBRATION LABRORY with certificate no. 2006-VAL-PRESSURE VESSEL / 01. Two main welds are examined by Rontgen Technische Dienst (RTD) with the NDO-method level 2 according the EN 473/347 with report no. 74-2006-35-004 and no. 275-2006-34-077

Product description: **CO<sub>2</sub> Accumulator Pressure Vessel**  
(MAWP 130 Bar / Vol. 14.2 Liter)

Product Reference: **F-257**

Signed

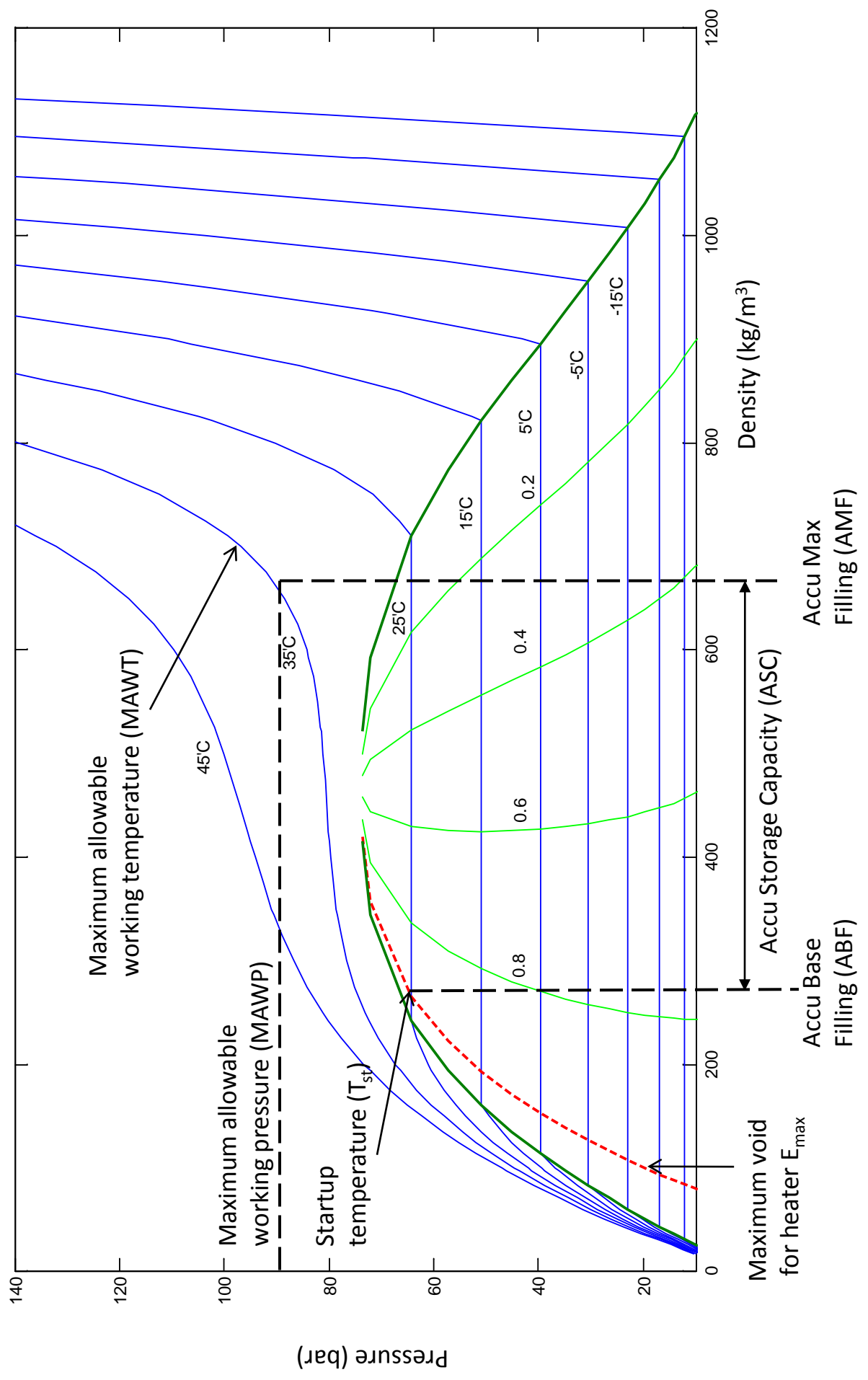
Name: Frank Linde

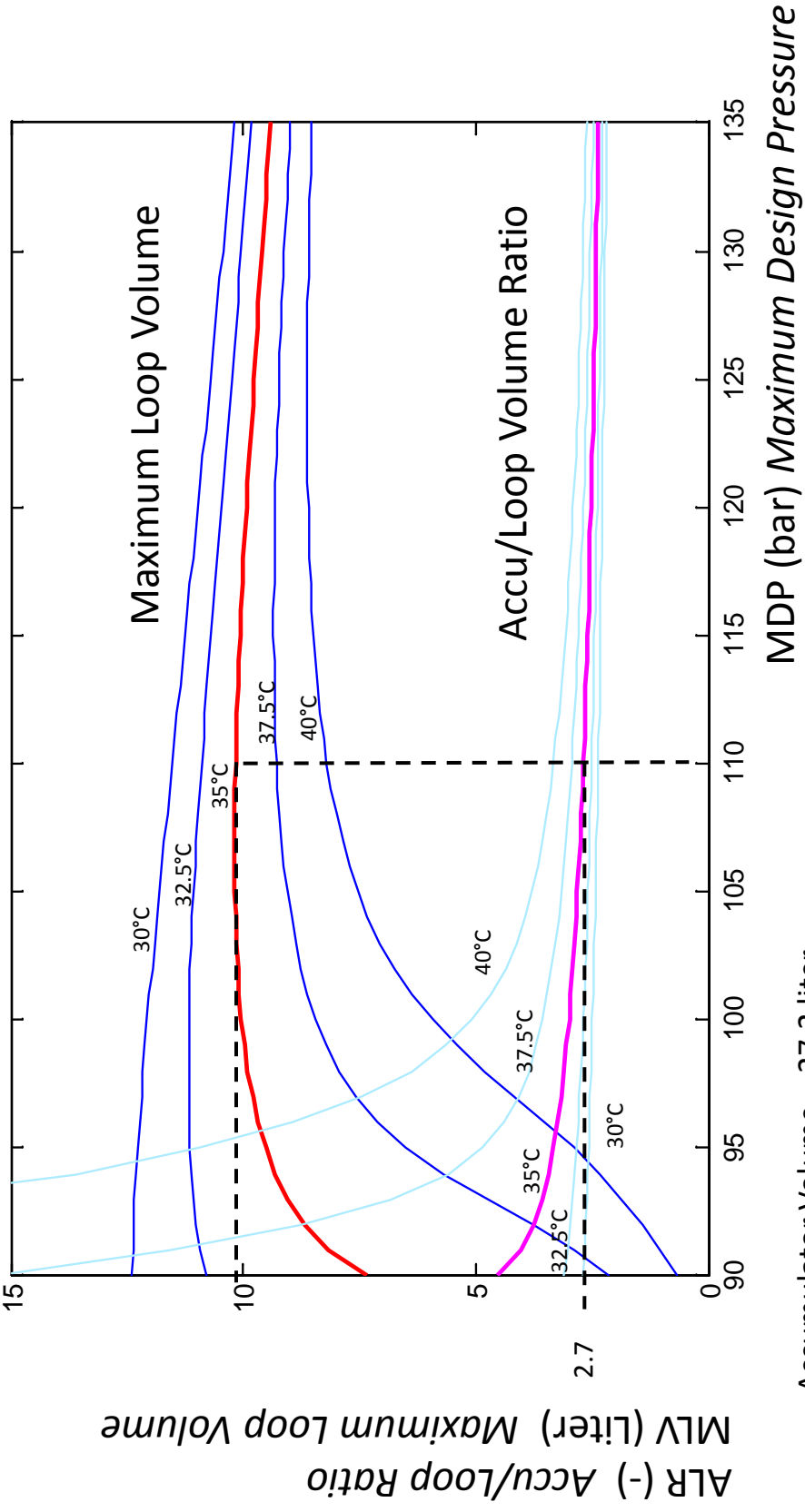
Position: Director of Nikhef

Date: august 3, 2007

# APPENDIX J

Accumulator  
Calculation Accumulator volume and pressure





Accumulator Volume = 27.2 liter

Maximum Loop Volume = 10 Liter (Full Functionality)

Fluid Mass = 19.4 kg

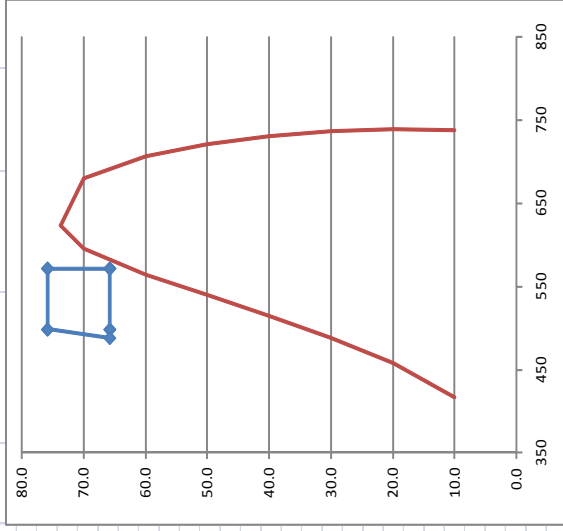
Accumulator volume is chosen as the optimum volume for a highest possible loop volume under the following conditions:

- Start-up at 26°C saturation
- Minimum accumulator liquid level= 5%
- Fully liquefied loop at -50°C and 26°C saturation
- All fluid stored in closed off accumulator.
- Maximum ambient temperature of 35°

## Start-up DT loop (step 1):

- Plant is liquefied and pumping at high pressure (65.8 bar) and medium cold liquid(-5°C).
- Evaporators and transfer lines are warm and filled with 20 bar gas

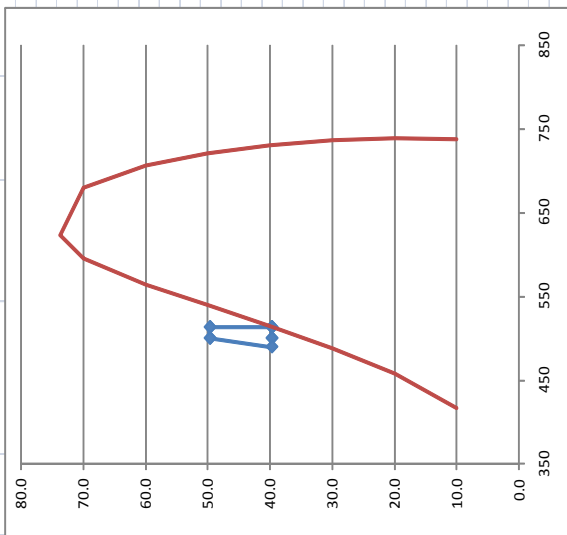
Settings:	Taccu_Setpoint 26 °C	Paccu 65.81817 bar	Tliquid -5 °C	Qevaporator 0 W	P@40C 118.5095 bar	MDP 110 bar	Accu Stored Energy 2986.719 bar*1			
Pump:	Stroke 8.5 mm	Massflow 11.44071 g/s	VF @ pump 0.700968 l/min	Pump Head 10.0 Bar						
Masses & Volumes:	Mloop 16.0 Liter	Mloop 2.1 kg	Straight Length 1400.0 mm	Cooling coil length 20.0 m	Vaccu 27.2 Liter	Vsystem 43.2 Liter	Filling ratio 449.2348 gram/liter			
	Messa CO2 19.4 kg	Accu mass 17.3 kg	Accu/loop 1.7 x							
Statepoints:										
Plant liquid tube	ID (mm)	Length (m)	Volume (liter)	Applied Power (W)	Enthalpy (kJ/kg)	Pressure (Bar)	Temperature (°C)	Subcooling (°C) / Vapor quality (-)	Density (kg/m <sup>3</sup> )	Mass (kg)
Damper	7.747	10	0.13	116.8279768	498.4829	75.8	-0.22021	0.779791777	121.2523263	0.0157628
HX liquid Side			0.5	0.09	571.2949	75.8	80		149.2032743	0.07460164
Transfer liquid tube	12	50	5.654866776	833.0215301	571.2949	75.8	26	27	750.704701	0.06756342
Restriction	1	1	0.000785398	0	571.2949	65.8	24.29896	-1.70103877	40.39240359	0.22841366
Evaporator			0.6		571.2949	65.8	24.29896	-1.70103877	40.39240359	0.02423544
Transfer vapor tube	14	50	7.696902001	-833.0215301	498.4829	65.8	-0.48702	-26.48702229	954.6514306	0.31089637
HX vapor side	10.2108	10	0.05		498.4829	65.8	-0.48702	-26.48702229	954.6514306	0.04773257
Condenser			1.23		488.2713	65.81817	-5	-31.00000034	979.2783759	1.2045124
			16.03255418		Liter					2.05012215 kg
plant liquid			0.72							
plant vapor			1.36							
plant total			2.08							
external liquid			5.655652175							
external vapor			8.296902001							
external total			13.95255418							



# Start-up DT loop (step 2):

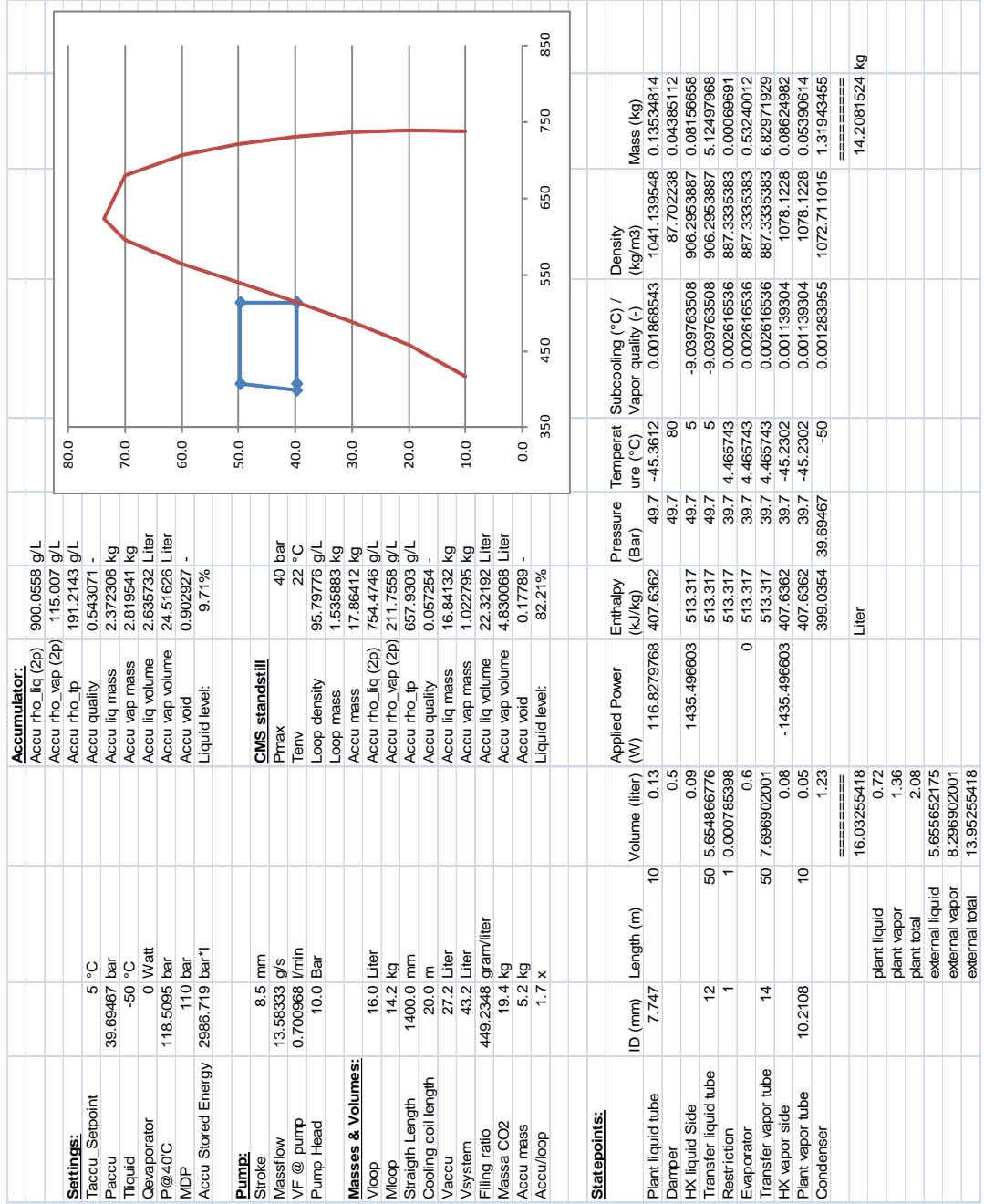
- Plant is liquefied and pumping at medium pressure (40 bar) and medium cold liquid (-5°C).
- Evaporators and transfer lines are warm and filled with 20 bar gas
- Transfer lines can now be opened and cooled

<b>Settings:</b>																										
Taccu_Setpoint	5 °C																									
Paccu	39.69467 bar																									
Tliquid	-5 °C																									
Qevaporator	0 Watt																									
P @40°C	118.5095 bar																									
MDP	110 bar																									
Accu Stored Energy	2986.719 bar*1																									
<b>Pump:</b>																										
Stroke	8.5 mm																									
Massflow	11.23994 g/s																									
Vf @ pump	0.700968 l/min																									
Pump Head	10.0 Bar																									
<b>Masses &amp; Volumes:</b>																										
Vloop	16.0 Liter																									
Mloop	2.1 kg																									
Straight Length	1400.0 mm																									
Cooling coil length	20.0 m																									
Vaccu	27.2 Liter																									
Vsystem	43.2 Liter																									
Filling ratio	449.2348 gram/liter																									
Massa CO2	19.4 kg																									
Accu mass	17.3 kg																									
Accu/loop	1.7 x																									
<b>Statepoints:</b>																										
Plant liquid tube	7.747	Length (m)	10	Volume (liter)	0.13	Applied Power (W)	116.8279768	Enthalpy (kJ/kg)	500.112	Pressure (Bar)	49.7	Temperature (°C)	-0.30219	Subcooling (°C) / Vapor quality (-)	-14.3419567	Density (kg/m3)	941.3700415	Mass (kg)	0.12237811							
Damper					0.5						49.7	80					87.702238		0.04385112							
HX liquid Side	12		50	5.654866776	0.09	148.4226323		513.317	49.7	49.7	5	5	-9.039763508	-9.039763508		906.2953887	0.08156658	0.22841366								
Transfer liquid tube	1		1	0.000785398	0.6	0		513.317	39.7	4.465743			0.002616536	0.002616536		40.39240359	0.02423544	3.1724E-05								
Restriction								513.317	39.7	4.465743			0.002616536	0.002616536		40.39240359	0.02423544									
Evaporator	14		50	7.696902001	0.08	-148.4226323		513.317	39.7	4.465743			0.00013598	0.00013598		934.4703323	0.07475763									
Transfer vapor tube								500.112	500.112	39.7	-0.67248	-0.67248	0.00013598	0.00013598		934.4703323	0.04672352									
HX vapor side	10.2108		10	0.05				500.112	489.718	39.69467	-5		0.00013598	0.00013598		962.0927655	1.1833741									
Plant vapor tube					1.23			489.718	489.718	39.69467	-5		0.00013598	0.00013598		962.0927655	1.1833741									
Condenser								489.718	489.718	39.69467	-5		0.00013598	0.00013598		962.0927655	1.1833741									
									Liter																	
					16.03255418																					
					0.72																					
		plant liquid																								
		plant vapor																								
		plant total																								
		external liquid			5.655652175																					
		external vapor			8.296902001																					
		external total			13.95255418																					



### Start-up DT loop (step 3):

- Plant is connected to transfer lines and evaporator, transfer lines are cooled to 5°C and 40 bar
- Loop is now operational and unpowered at 5°C set point

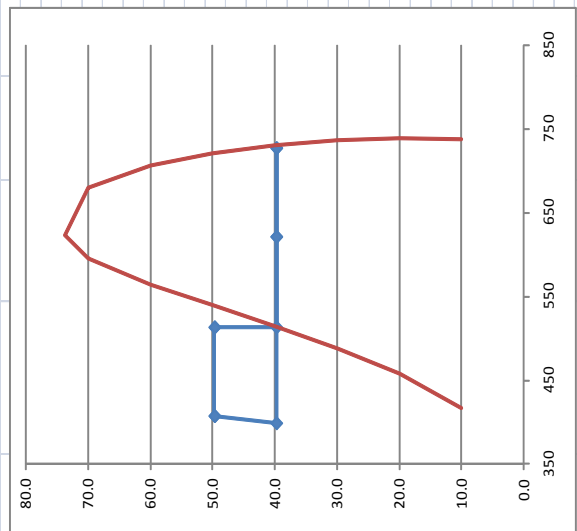




# Operational DT loop:

Loop is fully powered at 5°C set point

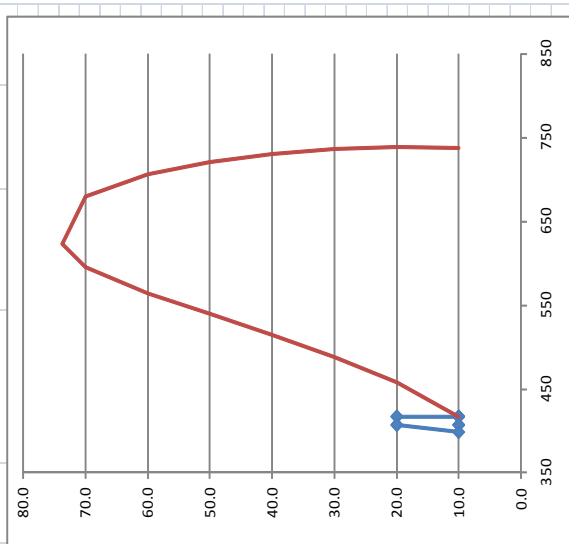
<b>Settings:</b>																							
Taccu Setpoint	5 °C																						
Paccu	39.69467 bar																						
Tliquid	-50 °C																						
Qevaporator	2900 Watt																						
P@40°C	118.5095 bar																						
MDP	110 bar																						
Accu Stored Energy	2986.719 bar·l																						
<b>Pump:</b>																							
Stroke	8.5 mm																						
Massflow	13.58333 g/s																						
VF @ pump	0.700968 l/min																						
Pump Head	10.0 Bar																						
<b>Masses &amp; Volumes:</b>																							
Vloop	16.0 Liter																						
Mloop	7.7 kg																						
Straight Length	1400.0 mm																						
Cooling coil length	20.0 m																						
Vaccu	27.2 Liter																						
Vsystem	43.2 Liter																						
Filling ratio	449.2348 gram/liter																						
Massa CO2	19.4 kg																						
Accu mass	11.7 kg																						
Accu/loop	1.7 x																						
<b>Statepoints:</b>																							
Plant liquid tube	ID (mm)	Length (m)	Volume (liter)	Applied Power (W)	Enthalpy (kJ/kg)	Pressure (Bar)	Temperature (°C)	Subcooling (°C) / Vapor quality (-)	Density (kg/m³)	Mass (kg)													
Damper	7.747	10	0.13	116.8279768	407.6362	49.7	-45.3612	0.001868543	1041.139548	0.13534814													
HX liquid Side			0.5	1435.496603	513.317	49.7	80		87.702238	0.04385112													
Transfer liquid tube	12	50	5.654866776		513.317	49.7	5	-9.039763508	906.2953887	0.08156658													
Restriction	1		0.000785398		513.317	39.7	4.465743	0.002616536	887.3335383	0.00069691													
Evaporator			0.6	2900	726.8139	39.7	4.999997	0.983759079	116.6595655	0.06999574													
Transfer vapor tube	14	50	7.696902001		726.8139	39.7	4.999997	0.983759079	116.6595655	0.06999574													
HX vapor side			0.08	-1435.496603	621.1332	39.7	5.000003	0.494997906	205.5437016	0.0164435													
Plant vapor tube	10.2108	10	0.05		621.1332	39.7	5.000003	0.494997906	205.5437016	0.01027719													
Condenser			1.23		399.0354	39.69467	-50	0.001283955	1072.711015	0.131943455													
			===== 16.03255418		Liter					===== 7.70051065													
		plant liquid	0.72																				
		plant vapor	1.36																				
		plant total	2.08																				
		external liquid	5.65652175																				
		external vapor	8.296902001																				
		external total	13.95255418																				



# Operational DT loop:

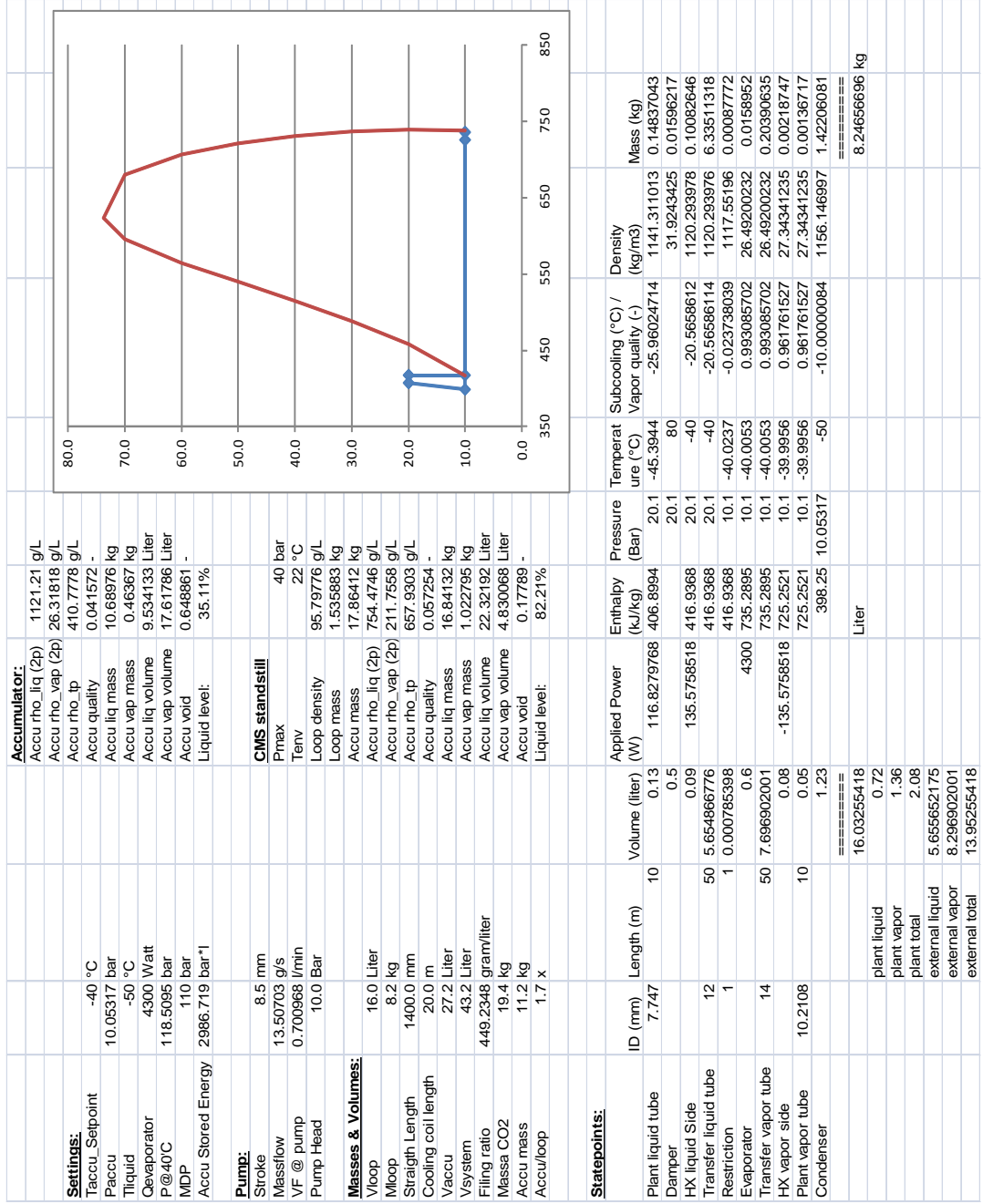
Loop is unpowered at -40°C set point

<b>Settings:</b>				<b>Accumulator:</b>			
Taccu_Setpoint	-40 °C			Accu rho_liq (2p)	1121.21 g/L		
Paccu	10.05317 bar			Accu rho_vap (2p)	26.31818 g/L		
TLiquid	-50 °C			Accu rho_ip	72.0603 g/L		
Evaporator	0 Watt			Accu quality	0.349966		
P@40°C	118.5095 bar			Accu liq mass	1.271844 kg		
MDP	110 bar			Accu vap mass	0.684737 kg		
Accu Stored Energy	2986.719 bar*1			Accu liq volume	1.13435 Liter		
				Accu vap volume	26.01764 Liter		
				Accu void	0.958222		
				Liquid level:	4.18%		
<b>Pump:</b>				<b>CMS standstill</b>			
Stroke	8.5 mm			Pmax	40 bar		
Massflow	13.50703 g/s			Tenv	22 °C		
VF @ pump	0.700968 l/min			Loop density	95.79776 g/L		
Pump Head	10.0 Bar			Loop mass	1.535883 kg		
<b>Masses &amp; Volumes:</b>							
Vloop	16.0 Liter			Accu mass	17.86412 kg		
Mloop	17.4 kg			Accu rho_liq (2p)	754.4746 g/L		
Straighn Length	1400.0 mm			Accu rho_vap (2p)	211.7558 g/L		
Cooling coil length	20.0 m			Accu rho_ip	657.9303 g/L		
Vaccu	27.2 Liter			Accu quality	0.057254		
Vsystem	43.2 Liter			Accu liq mass	16.84132 kg		
Filling ratio	449.2348 gram/liter			Accu vap mass	1.022795 kg		
Massa CO2	19.4 kg			Accu liq volume	22.32192 Liter		
Accu mass	2.0 kg			Accu vap volume	4.830068 Liter		
Accu/loop	1.7 x			Accu void	0.17789		
				Liquid level:	82.21%		
<b>Statepoints:</b>							
Plant liquid tube	ID (mm)	Length (m)	Volume (liter)	Applied Power (W)	Enthalpy (kJ/kg)	Pressure (Bar)	
Damper	7.747	10	0.13	116.8279768	406.8994	20.1	
HX liquid Side			0.5			80	
Transfer liquid tube	12	50	5.654866776	135.5758518	416.9368	20.1	
Restriction	1	1	0.000785398	0	416.9368	10.1	
Evaporator			0.6			20.1	
Transfer vapor tube	14	50	7.696902001	-135.5758518	416.9368	10.1	
HX vapor side			0.08			10.1	
Plant vapor tube	10.2108	10	0.05		406.8994	10.1	
Condenser			1.23			10.05317	
			16.03255418		398.25	10.05317	
	plant liquid		0.72	Liter			
	plant vapor		1.36				
	plant total		2.08				
	external liquid		5.655652175				
	external vapor		8.296902001				
	external total		13.95255418				
				Temperat ure (°C)	Subcooling (°C) / Vapor quality (-)	Density (kg/m3)	Mass (kg)
				-45.3944	-25.96024714	1141.311013	0.14837043
				80		31.9243425	0.01586217
				-40	-20.5658612	1120.293978	0.10082646
				-40	-20.56586114	1120.293976	6.33511318
				-40.0237	-0.023738039	1117.55196	0.00087772
				-40.0237	-0.023738039	1117.55196	0.67053118
				-40.0237	-0.023738039	1117.55196	8.60168792
				-45.2823	-5.282293218	1136.381053	0.09107048
				-45.2823	-5.282293218	1136.381053	0.05691905
				-50	-10.00000084	1156.146997	1.42206081
							17.4434194 kg



# Operational DT loop:

Loop is fully powered at -40°C set point



**Accumulator:**

Accu rho_liq (2p)	1121.21 g/L
Accu rho_vap (2p)	26.31818 g/L
Accu rho_ip	410.7778 g/L
Accu quality	0.041572 -
Accu liq mass	10.68976 kg
Accu vap mass	0.46367 kg
Accu liq volume	9.534133 Liter
Accu vap volume	17.61786 Liter
Accu void	0.648861 -
Liquid level:	35.11%

**CMS standstill**

Pmax	40 bar
Tenv	22 °C
Loop density	95.79776 g/L
Loop mass	1.535883 kg
Accu mass	17.86412 kg
Accu rho_liq (2p)	754.4746 g/L
Accu rho_vap (2p)	211.7558 g/L
Accu rho_ip	657.9303 g/L
Accu quality	0.057254 -
Accu liq mass	16.84132 kg
Accu vap mass	1.022795 kg
Accu liq volume	22.32192 Liter
Accu vap volume	4.830068 Liter
Accu void	0.17789 -
Liquid level:	82.21%

**Statepoints:**

Component	ID (mm)	Length (m)	Volume (liter)	Applied Power (W)	Enthalpy (kJ/kg)	Pressure (Bar)	Temperature (°C)	Subcooling (°C) / Vapor quality (-)	Density (kg/m <sup>3</sup> )	Mass (kg)
Plant liquid tube	7.747	10	10	116.8279768	406.8994	20.1	80	-25.96024714	1141.311013	0.14837043
Damper			0.5			20.1	80		31.9243425	0.01596217
HX liquid Side			0.09	135.5758518	416.9368	20.1	-40	-20.5658612	1120.293978	0.10082646
Transfer liquid tube	12	50	5.654866776		416.9368	20.1	-40	-20.56586114	1120.293976	6.33511318
Restriction	1	1	0.000785398		416.9368	10.1	-40.0237	-0.023738039	1117.55196	0.00087772
Evaporator			0.6	4300	735.2895	10.1	-40.0053	0.993085702	26.49200232	0.0158952
Transfer vapor tube	14	50	7.696902001		735.2895	10.1	-40.0053	0.993085702	26.49200232	0.20390635
HX vapor side			0.08	-135.5758518	725.2521	10.1	-39.9956	0.961761527	27.34341235	0.00218747
Plant vapor tube	10,2108	10	10		725.2521	10.1	-39.9956	0.961761527	27.34341235	0.00136717
Condenser			1.23		398.25	10.05317	-50	-10.00000084	1156.146997	1.42206081
			16.03255418		Liter					
			0.72							8.24656696
		plant liquid	1.36							
		plant vapor	2.08							
		plant total								
		external liquid	5.65652175							
		external vapor	8.296902001							
		external total	13.95255418							

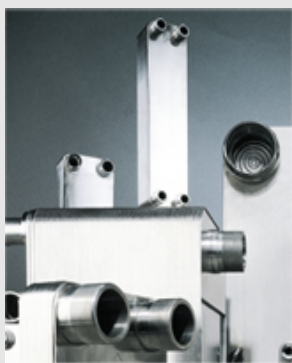
# APPENDIX K

Data sheet  
SWEP high pressure heat exchanger (DBDW16DW)

# BDW16DW

Ultra high-pressure

## COMPACT BRAZED HEAT EXCHANGER



### Thermal efficiency and Double Wall safety: the BDW-type

This double-wall product is designed for applications where a leak can be crucial and must therefore be detectable. The design offers the same compactness and thermal performance as other SWEP CBEs.

Ultra-high pressure units are an excellent choice when the design pressure of the system is very high. This includes applications such as carbon dioxide heat pumps and supermarket refrigeration. The units are standard-pressure units reinforced with a steel frame held together by bolts.

### Easy to choose the right product solution

With SWEP's unique SSP CBE, the SWEP Software Package, you can do advanced heat transfer calculations yourself, and choose the product solution that suits your application best. It's also easy to choose connections and generate drawings of the complete product. If you would like advice, or you would like to discuss different product solutions, SWEP offers all the service and support your need.

### THIRD-PARTY APPROVALS (selection)

SWEP BPHEs are generally approved by below certification organizations.

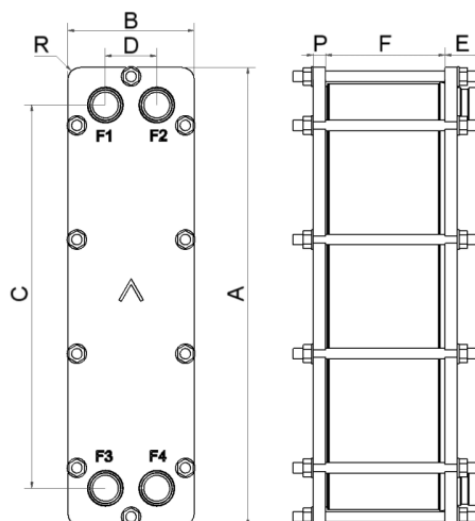
Europe, Pressure Equipment Directive (PED)  
America, Underwriters Laboratories Inc (UL)  
Japan, Kouatsu-Gas Hoan Kyoukai (KHK)

Additionally SWEP holds approvals from a vast variety of other certification organizations. For approval information regarding a specific product please contact your local SWEP representative. SWEP reserves the right to make changes without prior notice.

A DOVER COMPANY

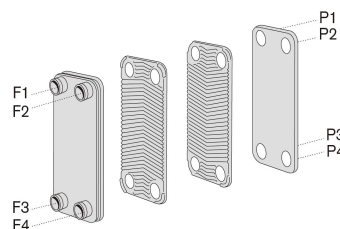
SWEP INTERNATIONAL AB

Box 105, SE-261 22 Landskrona, Sweden  
Phone +46 418 40 04 00  
Fax +46 418 292 95  
Internet: www.swep.net  
E-mail: info@swep.net



Measurements(mm)	Tolerance
A	+2 /-2
B	+1 /-1
C	+1 /-1
D	+1 /-1
E	+0 /-0
F	+0.5% /-1.5%
G	+1 /-1

Port size F/P: 27mm



CBE port denomination

### STANDARD CONNECTIONS

For specific dimensions, or information about other types of connections, please contact your SWEP sales representative.



Externally Threaded Connections (Male)



Soldering Connections (Sweat Connections)

### TECHNICAL DATA

Max working pressure at 150°C

Test pressure:  
Min temperature:  
Max temperature:  
Max number of plates (NoP)  
CBE weight

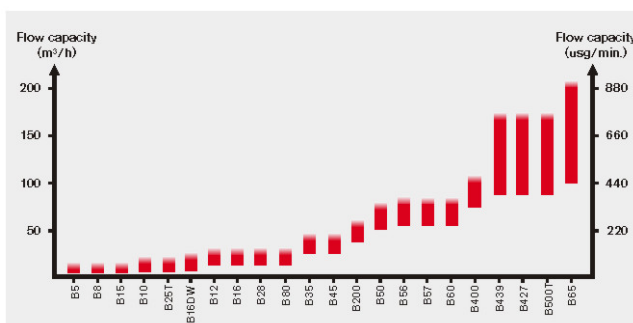
Hold-up volume: inner circuit

Plate material:

Brazing material:  
Standard connection material

Inner circuit: 140 bar (2031psi)  
Outer circuit: 140 bar (2031psi)  
210 bar (3046psi)  
-10°C (14F)  
150°C (302F)  
100  
48.47+NoPx0.22kg  
(106.9+NoPx0.5lbs)  
(NoP/2-1)x0.061 litres  
(NoP/2-1)x0.002 ft3.)  
Parts in contact with fluid:  
AISI 316  
Parts not in contact with fluid:  
AISI 304  
Pure Copper  
AISI 316

### CAPACITY GRAPH




### MATERIAL DISCLAIMER

The information and recommendations in regards to the products are presented in good faith, however, SWEP makes no representations or warranties as to the completeness or accuracy of the information. Information is supplied upon the condition that the purchasers will make their own determination as to the products' suitability for their purposes prior to use. Purchasers should note that the properties of the products are both application and material selection dependent and that products containing stainless steel, both 316 and 304 families, are still subject to corrosion if used in unsuitable environments. Purchasers should also be advised that stainless steel from the 304 family can be more sensitive in regards to corrosion than stainless steel from the 316 family. By purchasing products displayed here upon SWEP disclaims all responsibility due to corrosion of the products and/or other materials attached to the products and also for any damages resulting from the use of the products.

# APPENDIX L

Evaporator Capillary  
Material Certificates (Merinox)



Abnahmeprüfzeugnis Inspection Certificate		DIN EN 10204 / 3.1		Zeugnis - Nr. Wz003095-1								
UTI-SFM Feinmechanik GmbH, Staatsstrasse 5, D-97773 Aura  Merinox B.V. Postfach 23  NL-2950 Aiblasserdam				Kundenauftrag: Your order:		20050195 dd. 14-04-05						
				Unser Auftrag Our order:		CF003095						
				Lieferbedingung: Terms of Delivery:		Lt. Auftragsbestätigung						
				Lieferzustand: Delivery state:		geglüht						
				Besondere Vereinbarungen: Special terms:								
Prüfgegenstand: Nichtrostende Rohre / Rohrformteile Object Stainless steel tubes / fittings Werkstoff: Material: 1.4404 nahtlos				Position Item		Menge: Quantity		Abmessung (mm) size (mm)		Toleranzen Tolerances		
1		4,46 kg = 593 m		1,50 mm Ad. x 0,25 mm Wdd.		D4 T3						
Mechanische Werte / Mechanical Properties												
Position Item	Zugfestigkeit Tensile strength Rm N/mm <sup>2</sup>		Streckgrenze Yield strength Rp 0,2 N/mm <sup>2</sup>		Dehnung Elongation %	Härteprüfung Hardness Vickers 0,5		Dichtheitsprüf. Leak proof test bar		Rauigkeit Roughness my		
1 2	617 615		267 269		80,42 79,06							
Chemische Zusammensetzung des Einsatzmaterials Chemical composition (according to works certificate of steel mill)								Schmelz - Nr.: Cast No.: 501989				
C %	Si %	Mn %	P %	S %	Cr %	Mo %	Ni %	Ti %	Fe %	Al %	N %	Cu %
0,014	0,390	1,650	0,026	0,009	16,93	2,100	11,22					0,250
Ringaufdornversuch: Ring expansion test:												
Kennzeichnung: Marking:												
Sicht- und Maßkontrolle: Visual inspection and control of dimension: o.B.												
Andere Prüfungen: Other tests:						UTI-SFM Feinmechanik GmbH Zertifiziert nach QS-9000 und DIN EN ISO 9001: 2000 Qualitätsstelle  97773 Aura, 28.06.05  Abnahme:  Werksachverständige						
Wir bestätigen, daß die oben aufgeführten Rohre den Lieferbedingungen entsprechend geprüft u. in Ordnung befunden wurden. It is certified that the tubing listed as above has been tested in accordance with the terms of delivery and found satisfactory.												

# APPENDIX M

CO<sub>2</sub> rack  
Pressure test report





**RUSCH ARMADAC® BV CALIBRATION LABORATORY (R.A.C.L.)**  
 Laboratory Mechanical Quantities  
**C E R T I F I C A T E O F V A L I D A T I O N ©**

**CERTIFICATE** : 2007-C=561  
 T.a.g. : NIKHEF TERTIARY VTCS CO2 circulation unit.  
 Date of calibration : 29-January-2007

**ENVIRONMENTAL CONDITIONS** : R.A.C.L. δ  
 Temperature : T = N/A  
 Relative Humidity : rh= N/A  
 Barometric pressure : P = N/A  
 Gravity : g = N/A

**PURCHASER** : NIKHEF BV Amsterdam the Netherlands

**INSTRUMENT** : TERTIARY VTCS 170 barg x 300 sec  
 Manufacturer : NIKHEF  
 Type : N/A  
 Model : N/A  
 Serial number : N/A

**STANDARD (S)** : Input pressure :  
 Manufacturer : ERIKS :  
 Type : 100 MM / 4" :  
 Serial number : N/A :  
 Measuring range : 0 - 250 Barg :  
 Accuracy : 1.0 % FSO :  
 Traceability : NKO/E.A.L. :

**VALIDATION METHODE** : N/A

**RESULTS** : Accepted

**UNCERTAINTY** : The reported uncertainty is based  
 On the standard uncertainty, multiplied by a coverage factor of K=2  
 Which provides a confidence level of approximately 95%.  
 The standard uncertainty is according EA.

**TRACEABILITY** : The measurements have been executed using  
 standards for which the traceability to (inter) national standards has  
 been demonstrated towards the NKO / RvA ( E.A.)

**DATE** : 29-January-2007

**NAME** : C.P.Veth Manager Metrology, Head R.A.C.L.

Rusch Armadac® Postbus 4128 1620 HC HOORN. ☎ +031(0)229-212698. Fax +031(0)229-211439  
 Reproductie van het volledige rapport en/of certificaat is toegestaan. Gedeelten van het  
 Rapport en/of certificaat mogen slechts worden gereproduceerd na schriftelijke toestemming van Rusch Armadac® Dit  
 rapport en certificaat wordt verstrekt onder voorbehoud dat Rusch Armadac® generlei aansprakelijkheid aanvaardt.





**RUSCH ARMADAC® BV CALIBRATION LABORATORY (R.A.C.L.)**  
 Laboratory Mechanical Quantities  
**C E R T I F I C A T E O F C A L I B R A T I O N ©**

**CERTIFICATE** :2007-C=559  
 T.a.g. :NIKHEF / P-001  
 Date of calibration :30-January-2007

**ENVIRONMENTAL CONDITIONS** :R.A.C.L.  $\delta$   
 Temperature :T = 20°C 1°C  
 Relative Humidity :rh= 49% 3% rh  
 Barometric pressure :P = 1013 hPa 10 hPa  
 Gravity :g = 9.81298875 m/s<sup>2</sup> NKO Pr II

**PURCHASER** :NIKHEF BV Amsterdam the Netherlands

**INSTRUMENT** :Pressure gauge 0-250 barg  
 Manufacturer :ERIKS  
 Type :4" (100MM)  
 Model :1/2" BSP EN 837-1  
 Serial number :N/A WSN 1.4571 Klasse 1.0

**STANDARD (S)** :Input pressure :  
 Manufacturer :BARNETT LTD :  
 Type :943061 :  
 Serial number :3781/74 :  
 Measuring range :5 - 300 Barg :  
 Uncertainty :0.025% R :  
 Traceability :NKO/E.A.L. :

**CALIBRATION METHODE** :According procedure:Pro258/Pg/S.

**RESULTS** :See achieved calibration values  
 :at report # 3233/ 1 page.

**UNCERTAINTY** :The reported uncertainty is based  
 On the standard uncertainty, multiplied by a coverage factor of K=2  
 Which provides a confidence level of approximately 95%.  
 The standard uncertainty is according EA.

**TRACEABILITY** :The measurements have been executed using  
 standards for which the traceability to (inter) national standards has  
 been demonstrated towards the NKO / RvA ( E.A.)

**DATE** :30-January-2007  
**NAME** :C.P.Veth Manager Metrology, Head R.A.C.L.

Rusch Armadac® Postbus 4128 1620 HC HOORN. ☎ +031(0)229-212698. Fax +031(0)229-211439.  
 Reproductie van het volledige rapport en/of certificaat is toegestaan. Gedeelten van het  
 Rapport en/of certificaat mogen slechts worden gereproduceerd na schriftelijke toestemming van Rusch Armadac® Dit  
 rapport en certificaat wordt verstrekt onder voorbehoud dat Rusch Armadac® generlei aansprakelijkheid aanvaardt.



## KALIBRATIE RAPPORT

## Ingangs Standaard

## Instrument

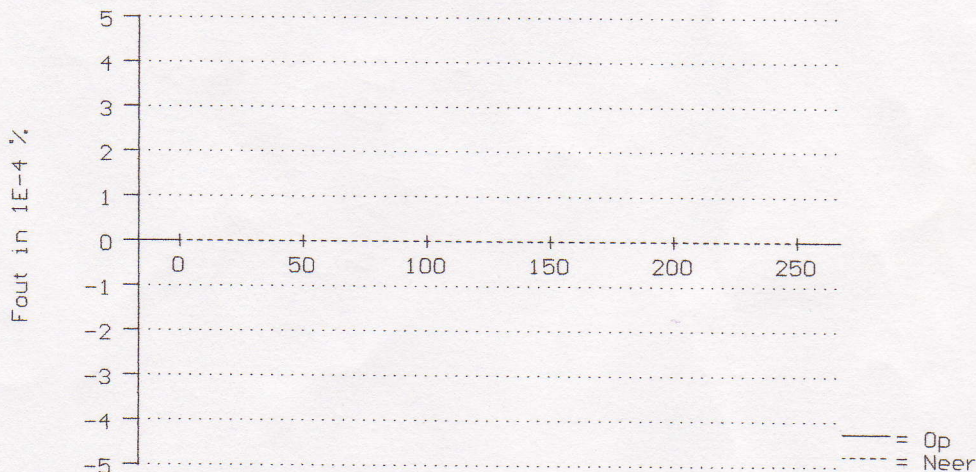
Tagnummer ... : RACL/M-PE/02  
 Fabrikant ... : BARNET LTD  
 Type ..... : 943061  
 Beschrijving : GAS DRUKBALANS  
 Serienummer . : 3781/74  
 Bereik ingang : 5 - 300 bar  
 Bereik uitgang: -----  
 Nauwkeurigheid: 0.025 %R  
 Test medium . : N2 [6.0]  
 Temperatuur . : 20.00 °C  
 Gravity ..... : 9.81298875 m/s<sup>2</sup>

NIKHEF / P-001  
 ERIKS  
 100MM / EN 837-1  
 PRESSURE INDICATOR  
 N/A WSN=1.4571  
 0 - 250 bar  
 0 - 250 bar  
 1 %FS  
 N2  
 20.00 °C  
 9.81298875 m/s<sup>2</sup>

## STANDAARD

## INSTRUMENT

INGANG OP bar	INGANG NEER bar	AFLEZING OP bar	AFLEZING NEER bar	FOUT OP % of Full Scale	FOUT NEER % of Full Scale
0.00000	0.00000	0.0	0.0	0.0	0.0
49.99875	49.99875	50.0	50.0	0.0	0.0
99.99875	99.99875	100.0	100.0	0.0	0.0
149.99875	149.99875	150.0	150.0	0.0	0.0
199.99875	199.99875	200.0	200.0	0.0	0.0
249.99875		250.0		0.0	0.0



PRESSURE INDICATOR IS CALIBRATED WITH N2-6.0  
 THE GAUGE TAG = # NIKHEF / P-001.

Gekalibreerd door

Klant ref. ... : P/O:39559/25-01-2007

C.P. VETH

Onze ref. .... : 2007.P20.00040/C=559

Kal. datum : 30/ 1/2007

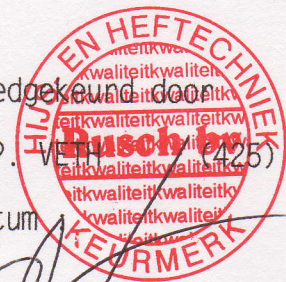
Klantnaam : NIKHEF BV AMSTERDAM HOLLAND

Rapportnummer. : 3233

Goedgekeurd door

C.P. VETH

Datum



Pag 1 van 1



**RUSCH ARMADAC® BV CALIBRATION LABORATORY (R.A.C.L.)**  
 Laboratory Mechanical Quantities  
**C E R T I F I C A T E O F C A L I B R A T I O N ©**

**CERTIFICATE** :2007-C=560  
 T.a.g. :NIKHEF / P-002  
 Date of calibration :29-January-2007

**ENVIRONMENTAL CONDITIONS** :R.A.C.L.  $\delta$   
 Temperature :T = 20°C 1°C  
 Relative Humidity :rh= 48% 3% rh  
 Barometric pressure :P = 1013 hPa 10 hPa  
 Gravity :g = 9.81298875 m/s<sup>2</sup> NKO Pr II

**PURCHASER** :NIKHEF BV Amsterdam the Netherlands

**INSTRUMENT** :Pressure gauge 0-250 barg  
 Manufacturer :ERIKS  
 Type :4" (100MM)  
 Model :1/2" BSP EN 837-1  
 Serial number :N/A WSN 1.4571 Klasse 1.0

**STANDARD (S)** :Input pressure :  
 Manufacturer :BARNETT LTD :  
 Type :943061 :  
 Serial number :3781/74 :  
 Measuring range :5 - 300 Barg :  
 Uncertainty :0.025% R :  
 Traceability :NKO/E.A.L. :

**CALIBRATION METHODE** :According procedure:Pro258/Pg/S.

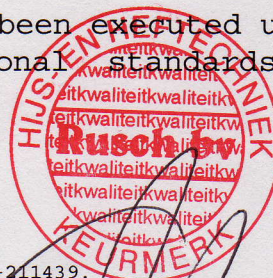
**RESULTS** :See achieved calibration values  
 :at report # 3234/ 1 page.

**UNCERTAINTY** :The reported uncertainty is based  
 On the standard uncertainty, multiplied by a coverage factor of K=2  
 Which provides a confidence level of approximately 95%.  
 The standard uncertainty is according EA.

**TRACEABILITY** :The measurements have been executed using  
 standards for which the traceability to (inter) national standards has  
 been demonstrated towards the NKO / RvA ( E.A.)

**DATE** :30-January-2007  
**NAME** :C.P.Veth Manager Metrology, Head R.A.C.L.

Rusch Armadac® Postbus 4128 1620 HC HOORN. ☎ +031(0)229-212698. Fax +031(0)229-211439.  
 Reproductie van het volledige rapport en/of certificaat is toegestaan. Gedeelten van het  
 Rapport en/of certificaat mogen slechts worden gereproduceerd na schriftelijke toestemming van Rusch Armadac® Dit  
 rapport en certificaat wordt verstrekt onder voorbehoud dat Rusch Armadac® generlei aansprakelijkheid aanvaardt.



# KALIBRATIE RAPPORT

## Ingangs Standaard

## Instrument

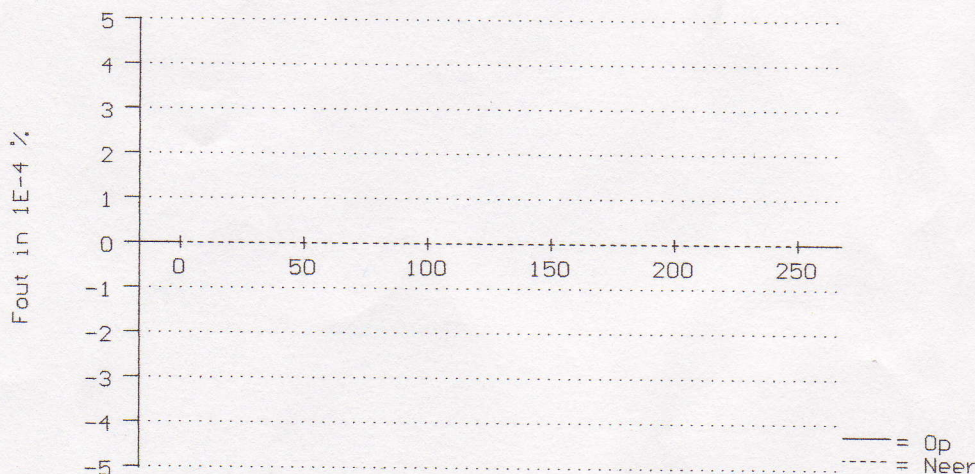
Tagnummer ... : RACL/M-PE/02  
 Fabrikant ... : BARNET LTD  
 Type ..... : 943061  
 Beschrijving : GAS DRUKBALANS  
 Serienummer . : 3781/74  
 Bereik ingang : 5 - 300 bar  
 Bereik uitgang: -----  
 Nauwkeurigheid: 0.025 %R  
 Test medium . : N2 [6.0]  
 Temperatuur . : 20.00 °C  
 Gravity ..... : 9.81298875 m/s<sup>2</sup>

NIKHEF / P-002  
 ERIKS  
 100 MM EN 837-1  
 PRESSURE INDICATOR  
 N/A WSN = 1.4571  
 0 - 250 bar  
 0 - 250 bar  
 1 %S  
 N2  
 20.00 °C  
 9.81298875 m/s<sup>2</sup>

## STANDAARD

## INSTRUMENT

INGANG OP bar	INGANG NEER bar	AFLEZING OP bar	AFLEZING NEER bar	FOUT OP % of Span	FOUT NEER % of Span
0.00000	0.00000	0.0	0.0	0.0	0.0
49.99875	49.99875	50.0	50.0	0.0	0.0
99.99875	99.99875	100.0	100.0	0.0	0.0
149.99875	149.99875	150.0	150.0	0.0	0.0
199.99875	199.99875	200.0	200.0	0.0	0.0
249.99875		250.0		0.0	0.0



PRESSURE INDICATOR IS CALIBRATED WITH N2-6.0  
 GAUGE TAG = # NIKHEF / P-002

Gekalibreerd door

Goedgekeurd door

Klant ref. ... : P/O:39559 25-01-2007 C.P. VETH  
 Onze ref. .... : 2007.P20.00040/C=560 Kal. datum : 29/ 1/2007  
 Klantnaam : NIKHEF BV AMSTERDAM HOLLAND  
 Rapportnummer. : 3234



# APPENDIX N

Freon rack  
Pressure test report

## 1. Vaste gegevens over en van de koelinstallatie

---

### GEGEVENS EIGENAAR/GEBRUIKER

Naam : Nikhef  
 Bezoekadres : Kruislaan 409  
 Postcode + plaats : 1009 DB  
 Postbus : BOX 41882  
 Postcode postbus :  
 Telefoonnummer : 020-5922000  
 Faxnummer : 020-5925156  
 Naam contactpersoon : Bart Verlaat

---

### GEGEVENS LEVERANCIER/INSTALLATEUR

(inbedrijfstelling installatie)

STEK-registratienummer : W1375  
 Naam : Wagenaar koeltechniek  
 Adres : Zaadmarkt 17  
 Postcode + plaats : 1681 PD ZWAAGDIJK  
 Telefoonnummer : 0228-567 567  
 Faxnummer : 0228-564942  
 Naam contactpersoon : C. Wagenaar  
 Ordernummer : 10608

---

### GEGEVENS INSTALLATEUR

(periodieke controle/reparatie van de installatie)

STEK-registratienummer : W1375  
 Naam : Wagenaar koeltechniek  
 Adres : Zaadmarkt 17  
 Postcode + plaats : 1681 PD ZWAAGDIJK  
 Telefoonnummer : 0228-567 567  
 Faxnummer : 0228-564942  
 Naam contactpersoon : C. Wagenaar  
 Onderhoudscontractnummer : 1 x per jaar

## 4. Drukbeproevings-/Vacumeer- en vulbewijs/document

### Algemeen

Installatie/identificatienr. Koelinstallatie : 10608-2

### Drukbeproeving

De complete installatie<sup>1</sup> is drukbeproefd bij een afpersdruk

: 23 bar

Beproevingdruk LD-gedeelte : 23 ba bar/kPa<sup>2</sup>

Beproevingdruk HD-gedeelte : 23 ba bar/kPa<sup>2</sup>

Druktijd (tijd dat de proefdruk wordt gehandhaafd) : 24 uren 20 min.

Gedurende de beproeving is de installatie op lekdichtheid en vervorming gecontroleerd. De lekdichtheidscontrole is uitgevoerd d.m.v. een visuele controle van de drukken en m.b.v. lekopsporingsmiddelen. De installatie is lekdicht bevonden en er zijn geen vervormingen

### Vacumeren en vullen

De complete installatie is gevacumeerd conform de RLK '97

Installaties met koudemiddelvulling < 10 kg

- bereikte vacuümdruk : 198pa Pa/Torr/Micron

- standtijd<sup>3</sup> : 2,5 uren min. (minimaal 30)

Installaties met koudemiddelvulling ≥ 10 en < 200 kg

- bereikte vacuümdruk : Pa/Torr/Micron<sup>2</sup>

- aantal maal gebroken met N<sup>2</sup> : (minimaal 1x)

- standtijd<sup>3</sup> : uren min. (minimaal 60)

Installaties met koudemiddelvulling ≥ 200 kg

- bereikte vacuümdruk : Pa/Torr/Micron<sup>2</sup>

- aantal maal gebroken met N<sup>2</sup> : (minimaal 2x)

- standtijd : uren min. (minimaal 90)

Tijdens het vacumeren is een druk in de/het installatie/installatiedeel van minder dan 270 Pa bereikt en deze druk kon gedurende de vereiste standtijd gehandhaafd worden

Tijdens het vullen is de volgende Type koudemiddel : R 507a  
hoeveelheid koudemiddel toegevoegd: Hoeveelheid : 5,4kg kg

Totale hoeveelheid koudemiddelvulling van de installatie : 5,4kg kg

Naam leverancier/installateur : Wagenaar koeltechniek

Naam CFK- monteur : C. Wagenaar

Diploma nummer : EO 2846

Datum : 25-5-2007

Handtekening : 

<sup>1</sup> Indien installatiedelen, dan de delen noemen. De tekst moet dan vervangen worden door:

De volgende installatiedelen zijn drukbeproefd bij een afpersdruk:  
onderdelen afpersdruk

.....  
.....

<sup>2</sup> doorhalen wat niet van toepassing is

1 bar = 100 kPa

<sup>3</sup> tijd dat vacuüm wordt gehandhaafd

270 Pa = 2 Torr = 2000 Micron



## 5. Lekdichtheids-/Installatiecontrole bewijs/document

Algemeen

Installatie/identificatienr. koelinstallatie : 10608-2

Lekdichtheidscontrole

De installatie is gecontroleerd op correct functioneren en lekdichtheid na het in werking stellen van de installatie. De lekdetectie is uitgevoerd met een lekdetector waarvan de detectiegrens ten minste 5 p.p.m. bedraagt.

De lekdichtheidscontrole is conform RLK'97 uitgevoerd.

De installatie bleek geheel lekdicht te zijn tijdens deze controle.

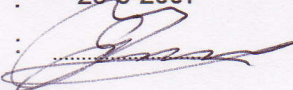
Installatiecontrole

Naam leverancier/installateur	:	Wagenaar koeltechniek	
Type koelinstallatie	:	Dx koelinstallatie	
Typekoudemiddel	:	R 507a	
Totale hoeveelheid koudemiddelvulling	:	5,4 kg	kg
Hoogste temperatuur*	:	52	°C
Hoogste druk*	:	25BAR	bar/kPa <sup>1</sup>
Laagste temperatuur*	:	-40	°C
Laagste druk*	:	0,4B	bar/kPa <sup>1</sup>
Afblaasdruk ontlastorgaan(alg.) <sup>2</sup>	:	27	bar/kPa <sup>1</sup>
Afblaasdruk veiligheidsklep <sup>2</sup>	:	25	bar/kPa <sup>1</sup>
Afblaasdruk ontlastklep <sup>2</sup>	:		bar/kPa <sup>1</sup>
Nominale breek(barst)druk breekplaat <sup>2</sup>	:	COMPRESSOR	bar/kPa <sup>1</sup>
Aanwezig bedieningsvoorschrift	:	ja (als inhoud ≥300 kg)/ nee <sup>1</sup>	

Bij dit certificaat horen:

- druk/keuringsbewijzen/documenten installatiedelen<sup>3</sup>
- drukkbeproevingsbewijs/document<sup>3</sup>
- lekdichtheidscontrole-bewijs/document<sup>3</sup>
- vacumeer- en vulprocedurebewijs/document<sup>3</sup>

De gehele installatie is in orde bevonden conform de Regeling Lekdichtheidsvoorschriften Koelinstallaties 1997.

Naam leverancier /installateur	:	Wagenaar koeltechniek
Naam CFK-monteur	:	C. Wagenaar
Diplomanummer	:	EO 2846
Controle datum	:	25-3-2007
Handtekening	:	

1 doorhalen wat niet van toepassing is 1 bar= 100 kPa

2 voorzover aanwezig (een ontlastorgaan kan ook een pressostaat zijn)

3 niet van toepassing bij beperkte installatiecontrole

\* Dit zijn de gemeten/gecontroleerde waarden tijdens inbedrijfstelling van de koelinstallatie, b.v.:

a) De werkelijke zuig- en persdruk en overeenkomstige temperatuur

b) De maximale waarde aan de hogedrukkzijde en de minimale waarden aan de lagedrukkzijde die tijdens normaal bedrijf kunnen voorkomen

c) De ingestelde waarden van de hoge- en lagedruk pressostataten.

## 1. Vaste gegevens over en van de koelinstallatie

---

### GEGEVENS EIGENAAR/GEBRUIKER

Naam : Nikhef  
 Bezoekadres : Kruislaan 409  
 Postcode + plaats : 1009 DB  
 Postbus : BOX 41882  
 Postcode postbus :  
 Telefoonnummer : 020-5922000  
 Faxnummer : 020-5925156  
 Naam contactpersoon : Bart Verlaat

---

### GEGEVENS LEVERANCIER/INSTALLATEUR

(inbedrijfstelling installatie)

STEK-registratienummer : W1375  
 Naam : Wagenaar koeltechniek  
 Adres : Zaadmarkt 17  
 Postcode + plaats : 1681 PD ZWAAGDIJK  
 Telefoonnummer : 0228-567 567  
 Faxnummer : 0228-564942  
 Naam contactpersoon : C. Wagenaar  
 Ordernummer : 10608

---

### GEGEVENS INSTALLATEUR

(periodieke controle/reparatie van de installatie)

STEK-registratienummer : W1375  
 Naam : Wagenaar koeltechniek  
 Adres : Zaadmarkt 17  
 Postcode + plaats : 1681 PD ZWAAGDIJK  
 Telefoonnummer : 0228-567 567  
 Faxnummer : 0228-564942  
 Naam contactpersoon : C. Wagenaar  
 Onderhoudscontractnummer : 1 x per jaar

## 4. Drukbeproevings-/Vacumeer- en vulbewijs/document

### Algemeen

Installatie/identificatienr. Koelinstallatie : 10608-1

### Drukbeproeving

De complete installatie<sup>1</sup> is drukbeproefd bij een afpersdruk

: 23 bar

Beproevingdruk LD-gedeelte : 23 ba bar/kPa<sup>2</sup>

Beproevingdruk HD-gedeelte : 23 ba bar/kPa<sup>2</sup>

Druktijd (tijd dat de proefdruk wordt gehandhaafd) : 24 uren 10 min.

Gedurende de beproeving is de installatie op lekdichtheid en vervorming gecontroleerd. De lekdichtheidscontrole is uitgevoerd d.m.v. een visuele controle van de drukken en m.b.v. lekopsporingsmiddelen. De installatie is lekdicht bevonden en er zijn geen vervormingen

### Vacumeren en vullen

De complete installatie is gevacumeerd conform de RLK '97

Installaties met koudemiddelvulling < 10 kg

- bereikte vacuümdruk : 196pa Pa/Torr/Micron

- standtijd<sup>3</sup> : 2,5 uren min. (minimaal 30)

Installaties met koudemiddelvulling ≥ 10 en < 200 kg

- bereikte vacuümdruk : Pa/Torr/Micron<sup>2</sup>

- aantal maal gebroken met N<sup>2</sup> : (minimaal 1x)

- standtijd<sup>3</sup> : uren min. (minimaal 60)

Installaties met koudemiddelvulling ≥ 200 kg

- bereikte vacuümdruk : Pa/Torr/Micron<sup>2</sup>

- aantal maal gebroken met N<sup>2</sup> : (minimaal 2x)

- standtijd : uren min. (minimaal 90)

Tijdens het vacumeren is een druk in de/het installatie/installatiedeel van minder dan 270 Pa bereikt en deze druk kon gedurende de vereiste standtijd gehandhaafd worden

Tijdens het vullen is de volgende Type koudemiddel : R 507a  
hoeveelheid koudemiddel toegevoegd: Hoeveelheid : 2,9kg kg

Totale hoeveelheid koudemiddelvulling van de installatie : 2,9kg kg

Naam leverancier/installateur : Wagenaar koeltechniek

Naam CFK- monteur : C. Wagenaar

Diploma nummer : EO 2846

Datum : 25-5-2007

Handtekening : 

<sup>1</sup> Indien installatiedelen, dan de delen noemen. De tekst moet dan vervangen worden door:

De volgende installatiedelen zijn drukbeproefd bij een afpersdruk:  
onderdelen afpersdruk

<sup>2</sup> doorhalen wat niet van toepassing is

1 bar = 100 kPa

<sup>3</sup> tijd dat vacuüm wordt gehandhaafd

270 Pa = 2 Torr = 2000 Micron

## 5. Lekdichtheids-/Installatiecontrole bewijs/document

Algemeen

Installatie/identificatienr. koelinstallatie : 10608-1

Lekdichtheidscontrole

De installatie is gecontroleerd op correct functioneren en lekdichtheid na het in werking stellen van de installatie. De lekdetectie is uitgevoerd met een lekdetector waarvan de detectiegrens ten minste 5 p.p.m. bedraagt.

De lekdichtheidscontrole is conform RLK'97 uitgevoerd.

De installatie bleek geheel lekdicht te zijn tijdens deze controle.

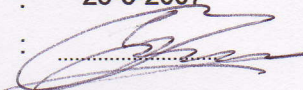
Installatiecontrole

Naam leverancier/installateur	:	Wagenaar koeltechniek	
Type koelinstallatie	:	Dx koelinstallatie	
Typekoudemiddel	:	R 507a	
Totale hoeveelheid koudemiddevulling	:	2,9 kg	kg
Hoogste temperatuur*	:	52	°C
Hoogste druk*	:	25BAR	bar/kPa <sup>1</sup>
Laagste temperatuur*	:	-40	°C
Laagste druk*	:	0,4BA	bar/kPa <sup>1</sup>
Afblaasdruk ontlastorgaan(alg.) <sup>2</sup>	:	27	bar/kPa <sup>1</sup>
Afblaasdruk veiligheidsklep <sup>2</sup>	:	25	bar/kPa <sup>1</sup>
Afblaasdruk ontlastklep <sup>2</sup>	:		bar/kPa <sup>1</sup>
Nominale breek(barst)druk breekplaat <sup>2</sup>	:	COMPRESSOR	bar/kPa <sup>1</sup>
Aanwezig bedieningsvoorschrift	:	ja (als inhoud ≥300 kg)/ nee <sup>1</sup>	

Bij dit certificaat horen:

- druk/keuringsbewijzen/documenten installatiedelen<sup>3</sup>
- drukkbeproevingsbewijs/document<sup>3</sup>
- lekdichtheidscontrole-bewijs/document<sup>3</sup>
- vacumeer- en vulprocedurebewijs/document<sup>3</sup>

De gehele installatie is in orde bevonden conform de Regeling Lekdichtheidsvoorschriften Koelinstallaties 1997.

Naam leverancier /installateur	:	Wagenaar koeltechniek
Naam CFK-monteur	:	C. Wagenaar
Diplomanummer	:	EO 2846
Controle datum	:	25-3-2007
Handtekening	:	

1 doorhalen wat niet van toepassing is 1 bar= 100 kPa

2 voorzover aanwezig (een ontlastorgaan kan ook een pressostaat zijn)

3 niet van toepassing bij beperkte installatiecontrole

\* Dit zijn de gemeten/gecontroleerde waarden tijdens inbedrijfstelling van de koelinstallatie, b.v.:

- a) De werkelijke zuig- en persdruk en overeenkomstige temperatuur
- b) De maximale waarde aan de hogedrukkzijde en de minimale waarden aan de lagedrukkzijde die tijdens normaal bedrijf kunnen voorkomen
- c) De ingestelde waarden van de hoge- en lagedruk pressostataten.

# APPENDIX O

Transfer tube (SIMIN)  
EDMS 699623 test report

ISTRUZIONE	IST10.03	Page 1 of 1
<b>PNEUMATIC TEST</b>	Emiss. 22/04/04	Rev. 22/04/04
	Emesso S.R.	Appr. B.M.

## PURPOSE

To describe the standard procedure for execution of the pneumatic test to pressure performed on systems of pipelines, plates of reinforcement or sets of single valves and to the necessity complete skid to kept.

How maximum pressures are considered and you apply those indicated by the values of test brought in the chart data of the drawing of reference or specific attached, in lack of such indications for plates of reinforcement (ex. legs support reservoirs - reinforcements nozzle) he will apply a variable pressure from 0,5 to 1 bar according to the thickness to try.

## USED SYSTEM

The system used for pressurizing the plant / vessel is constituted by a rubber pipe to high pressure laced air instruments to the plant present in shop and the check when possible is administered by a gauge calibrated regularly and certified.

## OPERATIVE METHODOLOGY

The operator before the beginning of the test must perform the under you bring phases of control and check of the plant that he must test and of the own apparatus.

Check that all the attacks or connections to the instruments or valves are perfectly closed.

In the case that were used valves NA or with pressure of equal closing, that of test to make sure that is replaced with plugs or other systems to isolate possible leaks.

To introduce a fit valve of interception for employment and section on the feeding of the water of net.

To make sure some correct connection of the same one to the pipeline of net.

To introduce a gauge in accessible and well visible position with fit reading scale.

To check that is reported on the special certificate the inherent data to the gauge indicating class of precision and number of register and builder initials.

To use air of net or in case it was not possible to use dry air from packages cylinders.

To make sure that alone the pressure of net is fit to reach the value of pressure of test established.

To make sure to have executed a correct filling of the line, vessel, or system.

To check visually with gas proof that is not introduced losses and to check the indicator of pressure, to bring the gotten data and to communicate them to the A.Q. for the layout of the final certificate that will be transmitted to the customer then with the remainder final documentation to Decompress the system in pressure always maintaining the due distances and following prescribes safety procedures to them.

N.B. The operator must also hold like reference the Customer specific : \*\*\*\*\*

<b>SIMIND S.r.l.</b> Via del Tiglio, 3 20090 SEGRATE (MI) Tel. 02/2137592	Cliente/Customer :	<b>CERN</b>	Std. N°:	<b>PP-05160-01</b>
	Località/Location :	<b>CERN - GINEVRA</b>	Commessa/Job :	<b>05/160</b>
	Impianto/Plant :	<b>LINEE DI</b>	Data/date:	<b>22/5/2006</b>
		<b>TRASFERIMENTO CO2</b>	Fg./Sh. :	<b>1 / 2</b>

**RAPPORTO DI PROVA PNEUMATICA**  
Pneumatic Test Report

<b>CANTIERE :</b> Field	<b>CERN</b> <b>GINEVRA</b>	<b>APPALTATORE :</b> Contractor	<b>SIMIND s.r.l.</b>
----------------------------	-------------------------------	------------------------------------	----------------------

**A. DOCUMENTI DI RIFERIMENTO - REFERENCE DOCUMENTS :**

A.1	ELENCO LINEE MECCANICO <i>MECHANICAL LINE LIST</i>	:	Doc. n° _____	Rev. _____
A.2	P&ID	:	Doc. n° _____	Rev. _____
			Doc. n° _____	Rev. _____
			Doc. n° _____	Rev. _____
A.3	SPECIFICA DI PROVA <i>TEST SPECIFICATION</i>	:	Doc. n° _____	Rev. _____
A.4	<b>DISEGNO</b>	:	Doc. n° _____ \	Rev. _____
A.5	_____	:	Doc. n° _____	Rev. _____

**B. OGGETTO DELLA PROVA - TO BE TESTED**

B.1 SISTEMA/CIRCUITO - *SYSTEM/CIRCUIT*

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

B.2 LINEE (indicare items) - *LINES (show items)*  
**N°2 CO2 TRANSFERT LINES - LINEE INCAMICIATE**  
**LATO INTERNO**

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

B.3 MACCHINE/APPARECCHI (indicare items) - *MACHINERY/VESSELS/DRUMS (show items)*

\_\_\_\_\_  
\_\_\_\_\_

B.4 ACCESSORI (indicare items) - *ACCESSORIES (show items)*

\_\_\_\_\_  
\_\_\_\_\_

B.5 DOCUMENTI ALLEGATI - *ATTACHED DOCUMENTS*  
**CERTIFICATO MANOMETRO 102-SP-05 del 30/09/2005**

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

<b>SIMIND S.r.l.</b> Via del Tiglio, 3 20090 SEGRATE (MI) Tel. 02/2137592	Cliente/Customer :	<b>CERN</b>	Std. N°:	<b>PP-05160-01</b>
	Località/Location :	<b>CERN - GINEVRA</b>	Commessa/Job :	<b>05/160</b>
	Impianto/Plant :	<b>LINNE DI TRASFERIMENTO CO2</b>	Data/date:	<b>22/5/2006</b>
			Fg./Sh. :	<b>2 / 2</b>

**RAPPORTO DI PROVA PNEUMATICA**

Peumatic Test Report

**C. DATI DI PROVA - TEST DATA**

C.1	FLUIDO DI PROVA - TEST FLUID	:	<u>ARIA</u>
C.2	PRESSIONE DI PROVA - TEST PRESSURE	:	<u>125 bar</u>
C.3	DURATA MINIMA DI PROVA - TEST MINIMUM TIME	:	<u>15 min</u>
C.4	STRUMENTI IMPIEGATI - INSTRUMENTS USED	:	<u>MN018</u>

TIPO TYPE	COSTRUTTORE MANUFACTURER	N° MATRICOLA SERIAL N°	SCALA RANGE
<u>MN018</u>	<u>FANTINELLI</u>	<u>2105066</u>	<u>0 ÷ 400</u>
<u> </u>	<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>	<u> </u>

C.5	ORA INIZIO - START TIME	<u>10.00</u>	ORA FINE - END TIME	<u>10.15</u>
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**D. RISULTATI - RESULTS**

D. 1 ACCETTABILE - ACCEPTABLE  NON ACCETTABILE - NOT ACCEPTABLE 

D. 2 DIAGRAMMI &amp; DOCUMENTI ALLEGATI - ATTACHED DIAGRAMS &amp; DOCUMENTS:

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D. 3 NOTE - NOTES:

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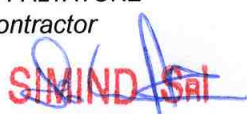
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APPALTATORE Contractor  <b>SIMIND S.r.l.</b>			ENTE INCARICATO Third Party Inspector
DATA/Date	DATA/Date	DATA/Date	DATA/Date



**SIMIND** srl

Società Italiana Montaggi Industriali

**DICHIARAZIONE di PULIZIA**

Cleaning check declaration

Certificato n°

Certificate No

**CD05160-01**

NUMERO DI FABBRICA :

Serial Number :

//

COMMESSA SIMIND :

Simind Job :

05/160

CLIENTE :

Customer :

CERN / NIKHEF

ORDINE CLIENTE :

Customer's order :

00037774 del 13.10.05

IMPIANTO :

Plant :

CERN - GINEVRA

OGGETTO :

Object :

LINEE DI TRASFERIMENTO CONCENTRICHE CO2

DISEGNO DI RIFERIMENTO :

Reference Dwg. :

AS BUIL

**CON LA PRESENTE SI DICHIARA CHE LE TUBAZIONI IN OGGETTO,  
SONO STATE PULITE**

*We declare that the piping in object has been Cleaned*

NOTE :

Remarks :

RISULTATO DEL CONTROLLO :

Check result :



POSITIVO

Positive



NEGATIVO

Negative

DATE / Date

FIRMA / Signature

SIMIND Srl :

CUSTOMER :

INSPECTOR :

**SIT**

**SERVIZIO DI TARATURA IN ITALIA**  
Calibration Service in Italy



Il SIT è uno dei firmatari dell'Accordo Multilaterale della European co-operation for Accreditation (EA) per il mutuo riconoscimento dei certificati di taratura.  
SIT is one of the signatories to the Multilateral Agreement of EA for the mutual recognition of calibration certificates.

**CENTRO DI TARATURA N° 11**  
Calibration Centre

istituito da  
established by

**GEFRAN**

GEFRAN S.p.A.  
Sede Legale: Via Statute Sabina, 74 - 25050 PROVAGLIO D'ISEO (BS) ITALIA  
TEL. 03068881 - Fax 0306839083 - Internet: http://www.gefran.it  
Sede operativa: Via Cave, 11 - 25050 PROVAGLIO D'ISEO (BS) ITALIA  
TEL. 030 9291411 r.a. - Fax 0309523292  
COD. FISC. E.P. IVA 00292180179

PRODUZIONE DI ELEMENTI SENSIBILI PER  
APPLICAZIONI INDUSTRIALI:  
-Trasduttori di posizione lineari e relativi  
-Trasduttori di pressione "thin film" e per le alte temperature  
-Celle di carico e trasduttori di forza  
-Encoder  
-Termocoppie e termometri a resistenza

MANUFACTURING OF SENSOR FOR  
INDUSTRIAL:  
-Linear and angular displacement transducer  
-Pressure transducers "thin film" and for high temperature application  
-Load cells  
-Encoders  
-Thermocouples and resistance thermometers

**CERTIFICATO DI TARATURA N. 102-SP-05**  
Certificate of Calibration No.

Pagina 1 di 3  
Page 1 of 3

- Data di emissione  
date of issue  
- destinatario  
addressee  
- richiesta  
application  
- in data  
date

2005/09/30

Si riferisce a  
referring to

- oggetto  
item  
- costruttore  
manufacturer  
- modello  
model  
- matricola  
serial number  
- data delle misure  
date of measurements  
- registro di laboratorio  
laboratory reference

**BOCCHI s.r.l.**  
Via Palazzolo, 41 - 25037 Pontoglio ( BS )  
n. ordine 1196715

2005/09/21

Manometro a quadrante

FANTINELLI

0÷400 bar , div. 2,5 bar

2105066 ( MN018 )

settembre-05

102-SP-05

Il presente certificato di taratura è rilasciato in base all'accreditamento SIT N. 11 concesso dall'Istituto Metrologico Primario competente in attuazione della legge n. 273/1991 che ha istituito il Sistema Nazionale di Taratura (SNT). Tale Istituto, nei campi di misura ed entro le incertezze precisate nell'accreditamento stesso, garantisce:

- il mantenimento della riferibilità degli apparecchi usati dal Centro a campioni nazionali delle unità del Sistema Internazionale delle Unità (SI);
- la correttezza metrologica delle procedure di misura adottate dal Centro.

This certificate of calibration is issued in accordance with the accreditation SIT No. 11 guaranteed by the relevant Primary Metrological Institute in enforcement of the law No. 273/1991 which has established the National Calibration System. The Institute, for the measurement ranges and within the uncertainties stated in the approval, guarantees:

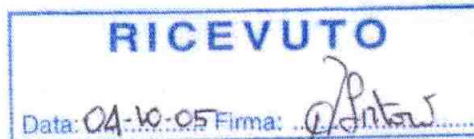
- the maintenance of the traceability of the apparatus used by the Centre to national standards of the International System of Units (SI);
- the metrological correctness of the measurement procedures adopted by the Centre.

I risultati di misura riportati nel presente Certificato sono stati ottenuti applicando le procedure riportate alla pagina seguente insieme ai campioni di prima linea che iniziano la catena di riferibilità e ai rispettivi certificati validi di taratura.  
The measurement results reported in this Certificate were obtained following the procedures reported in the following page together with the first line standards which begin the traceability chain and their valid certificates of calibration.

Le incertezze di misura dichiarate in questo documento sono espresse come due volte lo scarto tipo (corrispondente, nel caso di distribuzione normale, a un livello di confidenza di circa 95%).

The measurement uncertainties stated in this document are estimated at the level of twice the standard deviation (corresponding, in the case of normal distribution, to a confidence level of about 95%).

MN018



Il Responsabile del Centro  
Head of the Centre  
Alfredo Gargaglione

[Signature]

La riproduzione del presente documento è ammessa in copia conforme integrale. La riproduzione conforme parziale è ammessa soltanto a seguito di autorizzazioni scritte dell'Istituto Metrologico Primario competente e del Centro di Taratura, da riportare con i relativi numeri di protocollo in testa alla riproduzione medesima.

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SIT

SERVIZIO DI TARATURA IN ITALIA  
Calibration Service in Italy

GEFRAN

GEFRAN S.p.A.  
Sede Legale: Via Statale Sebina, 74 - 25085 PROVAGLIO D'ISEO (BS) ITALIA  
TEL. 030988611 - Fax 0309830063 - Internet: <http://www.gefran.it>  
Sede operativa: Via Cave, 11 - 25050 PROVAGLIO D'ISEO (BS) ITALIA  
TEL. 030 9291411 r.s. - Fax 0309823292  
COD. FISC. E P. IVA 00292100170

Laboratorio Misure di Pressione

CENTRO DI TARATURA 11

Certificato di taratura n. 102-SP-05

Data di emissione 2005/09/30

Pagina 2 di 3

Page 2 of 3

Certificate of calibration no.

I risultati di misura riportati nel presente Certificato sono stati ottenuti applicando le procedure N. POP-006  
The measurement results reported in this Certificate were obtained following procedures No.

La catena di riferibilità ha inizio dai campioni di prima linea N. N. 2975 ( accoppiamento 7294 )  
Traceability is through first line standards No.

muniti di certificati validi di taratura rispettivamente N. 515/2004-816/2005-515/2005-516/2005  
validated by certificates of calibration No.

## CONDIZIONI AMBIENTALI DI TARATURA

Temperatura:  $20 \pm 1^\circ\text{C}$   
Umidità relativa:  $50 \pm 10\% \text{ U.R.}$   
Pressione atmosferica:  $100.3 \pm 0.1 \text{ kPa}$

## CONDIZIONI DI TARATURA DELLO STRUMENTO

Campo di misura:  $0 \div 400 \text{ bar}$   
Minima divisione: 5 bar  
Risoluzione: 2,5 bar  
Modalità di taratura: Pressione relativa alla pressione atmosferica  
Posizione di montaggio: Verticale  
Fluido di taratura: Dietilsebacato  
Campione di riferimento: N. 2975 ( accoppiamento 7294 )  
Incertezza del campione:  $\pm 0,04 \text{ bar}$   
Livello di riferimento: Piano del raccordo di connessione idraulico  
Nota: Il manometro è stato picchettato ad ogni punto di misura.

## INCERTEZZA DI MISURA DEL PROCEDIMENTO DI TARATURA

L'incertezza di misura del procedimento di taratura ( $I_t$ ), espressa come due volte lo scarto tipo ( $2\sigma$ ), è data da:

$$I_t = \pm(I_p + I_s)$$

$I_p$ : Incertezza di misura della pressione di riferimento del campione  
 $I_s$ : Incertezza di indicazione (risoluzione) dello strumento in taratura o incertezza di misura dell'apparecchiatura ausiliaria utilizzata per la misura del segnale d'uscita

e risulta essere:

$$I_t = \pm 0,64\% = \pm 2,5 \text{ bar}$$

## INCERTEZZA DI MISURA DELLO STRUMENTO IN TARATURA

L'incertezza di misura dello strumento in taratura ( $I_m$ ), espressa come due volte lo scarto tipo ( $2\sigma$ ) è pari all'incertezza di misura del procedimento di taratura ( $I_t$ ), se, tramite opportune correzioni, sono considerati gli errori di indicazione rilevati.  
Nel caso in cui non si effettuino alcuna correzione, l'incertezza ( $I_m$ ) è data da:

$$I_m = \pm \sqrt{(I_t^2 + E_{\text{max}}^2)}$$

$E_{\text{max}}$ : Errore di indicazione, massimo positivo o negativo dello strumento in taratura (si veda l'errore di indicazione rilevato nella pagina seguente).

e risulta essere:

$$I_m = \pm 1,40\% = \pm 5,6 \text{ bar}$$

Copy conform  
to the original!  
SIMIND s.r.l.

SIT

SERVIZIO DI TARATURA IN ITALIA



Calibration Service in Italy

GEFRAN

GEFRAN S.p.A.  
Sede Legale: Via Statte Sabina, 74 - 25050 PROVAGLIO D'ISEO (BS) ITALIA  
TEL. 0300898.1 - Fax 0300830063 - Internet: http://www.gefran.it  
Sede operativa: Via Cave, 11 - 25050 PROVAGLIO D'ISEO (BS) ITALIA  
TEL. 030. 9291411 f.a. - Fax 0300823292  
COD.FISC. E.P. IVA 00292100179

Laboratorio Misure di Pressione

CENTRO DI TARATURA 11

Certificato di Taratura n.

102-SP-05

Data di emissione 2005/09/30

Pagina 3 di 3

Certificate of calibration no.

Page 3 of 3

## RISULTATI DELLA TARATURA

1 bar = 1,0000E+5 Pa

Pressione di riferimento (bar)	Valore indicato (bar)		Errore di indicazione (%)	
	Pressione		Pressione	
	crescente	decrescente	crescente	decrescente
0,0	-	0,0	-	0,0
80,0	82,5	85,0	0,6	1,3
160,0	162,5	165,0	0,6	1,3
240,0	242,5	245,0	0,6	1,3
320,0	322,5	322,5	0,6	0,6
400,0	400,0	-	0,0	-

## ERRORE DI INDICAZIONE RILEVATO

ERRORE MASSIMO RILEVATO		(%)
Errore di indicazione Emax	positivo	1,25
	negativo	0,00

Per errore di indicazione  $E_i$ , si intende la differenza tra l'indicazione dello strumento in taratura e la pressione di riferimento, espressa in percentuale dell'ampiezza del campo di misura:

$$E_i = \frac{V_i - P_r}{C_m} \cdot 100$$

$V_i$ : Valore indicato  
 $P_r$ : Pressione di riferimento  
 $C_m$ : Campo di misura

Copy conform  
to the original  
SIMIND S.r.l.

L'errore di indicazione è affetto dall'incertezza di misura del procedimento di taratura riportata nella pagina precedente.

Lo Sperimentatore  
Tiziano Soardi

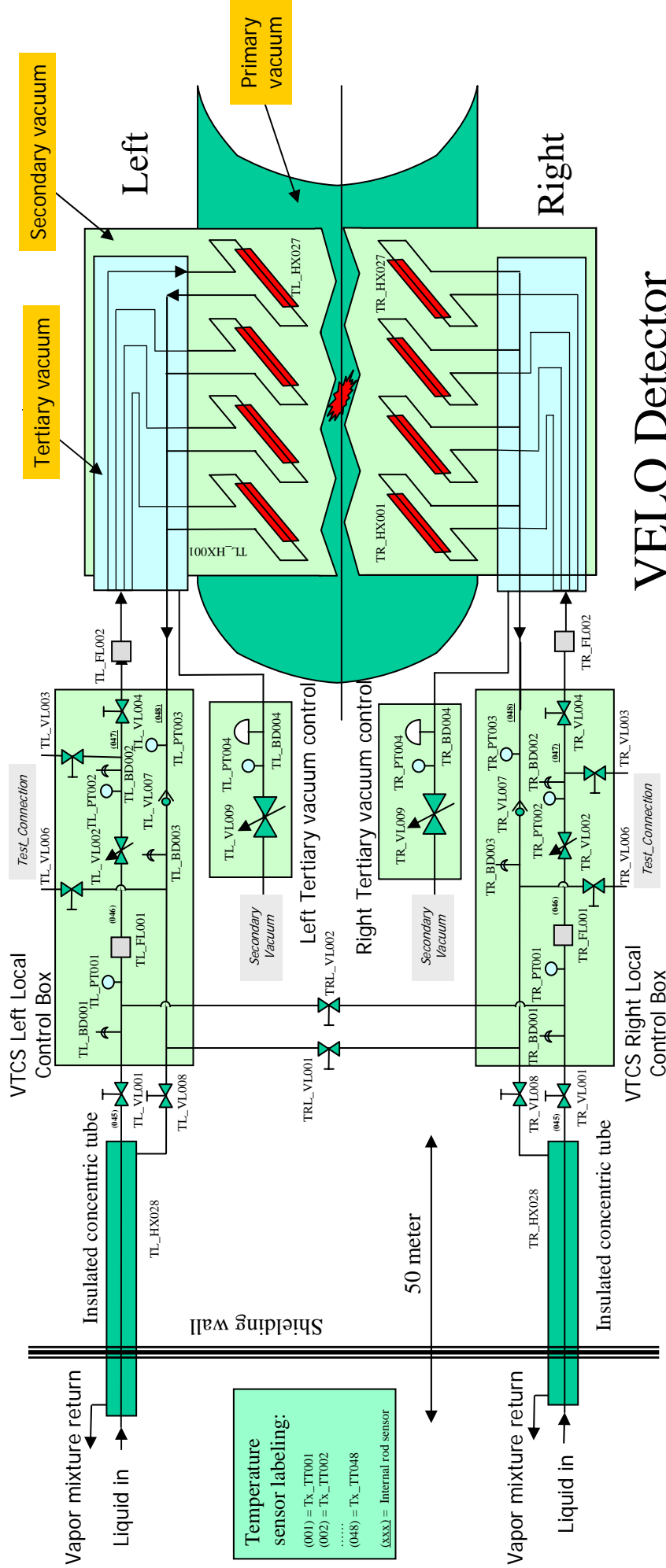
Il Responsabile del Centro  
Head of the Centre  
Alfredo Gargaglione

# APPENDIX P

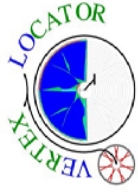
System schema

# VELO Thermal Control System (VTCS)

## Tertiary System Layout at VELO



Tx = TL for left detector half, TR for right detector half, TRL for combined hardware

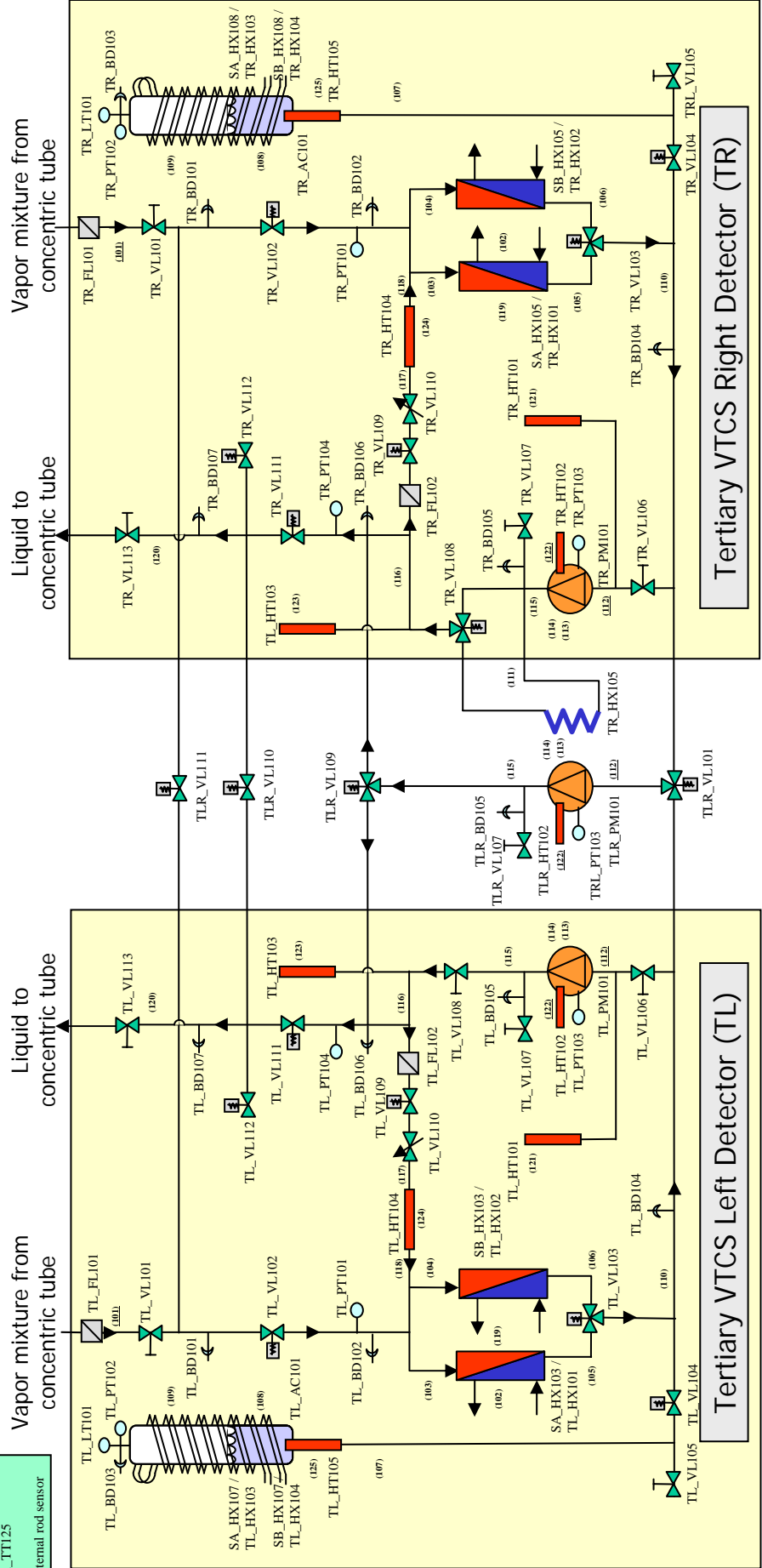


Schematics 2 March 07

Velo Thermal Control System

Temperature sensor labeling:  
 (001) = Tx\_TTI01  
 (002) = Tx\_TTI02  
 .....  
 (125) = Tx\_TTI25  
 (xxxx) = Internal rod sensor

## Tertiary VTCS schematics at RB84 plant



bverlaat@nikhef.nl

Tx = TL for left detector half, TR for right detector half, TRL for combined hardware

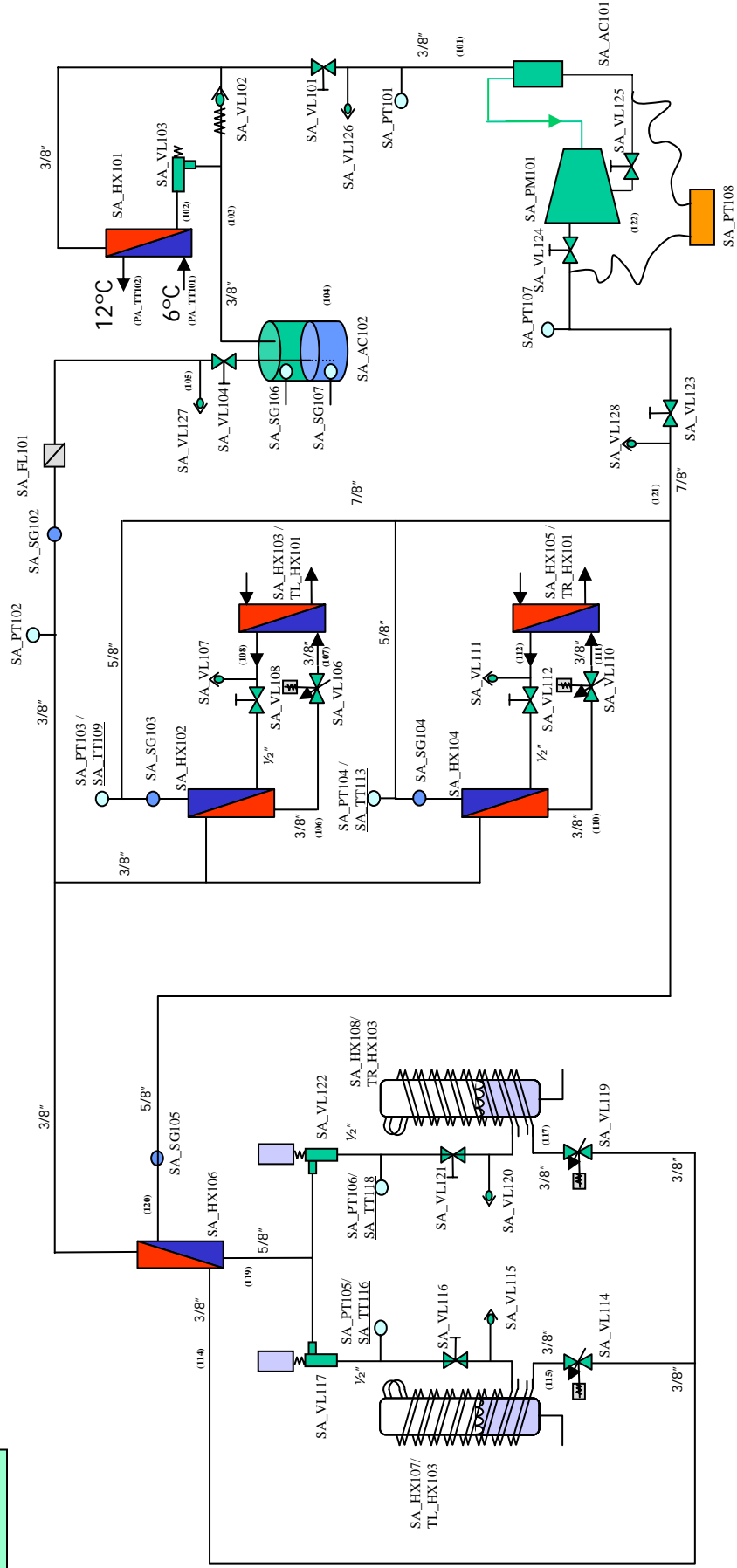


Schematics 2 March 07

Velo Thermal Control System

Temperature sensor labeling:  
 (01) = Sx\_TTI01  
 (02) = Sx\_TTI02  
 .....  
 (122) = Sx\_TTI22  
 (xxx) = Internal rod sensor

## Secondary VTCS main chiller (A)



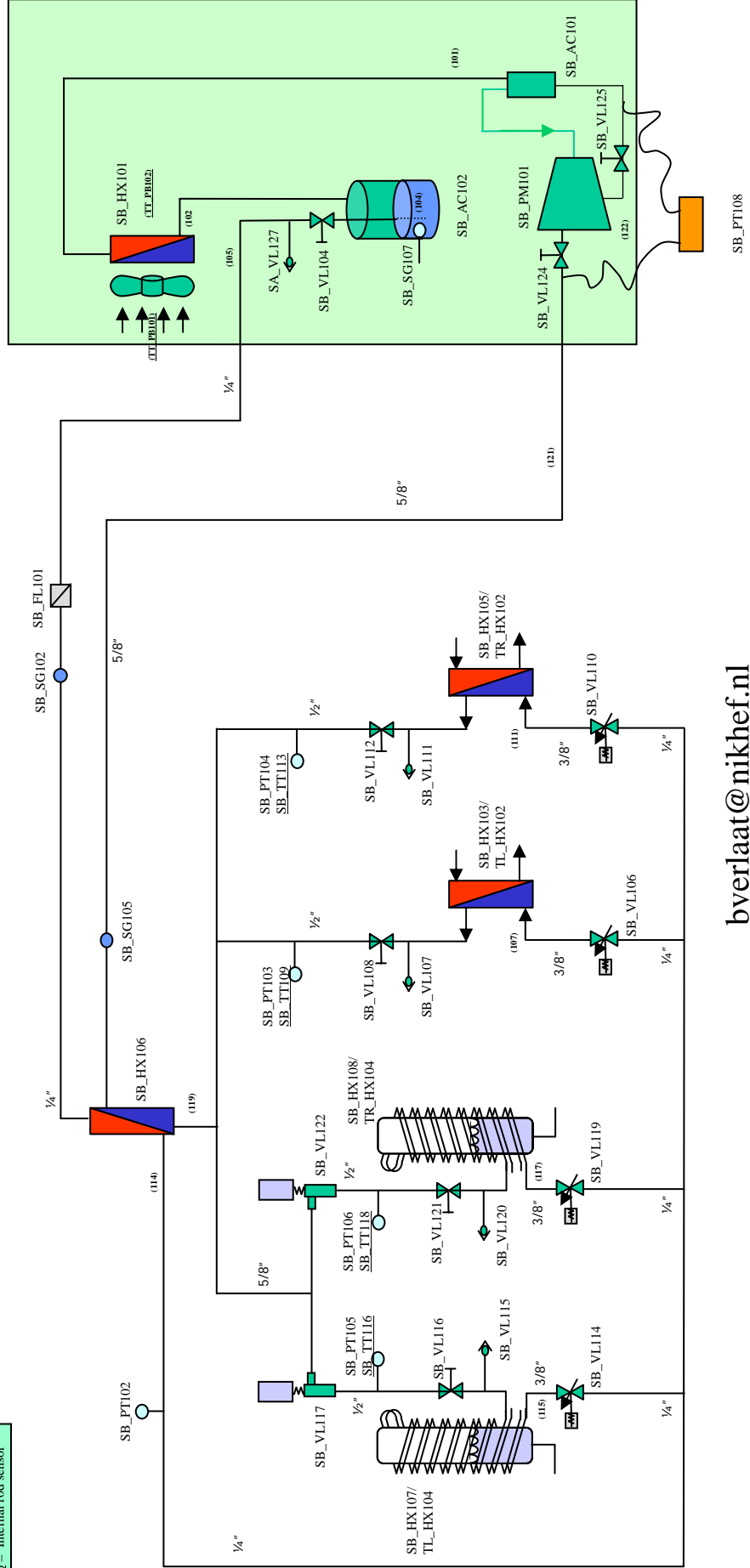
bverlaat@nikhef.nl

Sx = SA for Water cooled chiller, SB for back\_up air\_cooled chiller



Temperature sensor labeling:  
 (101) = Sx\_TTI01  
 (102) = Sx\_TTI02  
 .....  
 (122) = Sx\_TTI22  
 (xxx) = Internal rod sensor

## Secondary VTCS back-up chiller (B)



Sx = SA for Water cooled chiller, SB for back-up air-cooled chiller

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Schematics 2 March 07



# VTCs

## Velo Thermal Control System

### Acronyms

- Px = Primary Cooling System (6\_12°C Water)
  - PA= Primary A (6\_12°C Water)
  - PB= Primary B (Ambient air)
- Sx = Secondary Cooling system (R404a chiller)
  - SA = Secondary A
  - SB = Secondary B
- Tx = Tertiary Cooling System (CO2 system)
  - TL = Tertiary Left
  - TR = Tertiary Right
- AC = Accumulator
- PT = Pressure Transmitter
- BD = Burst Disc
- HX = Heat Exchanger
- HT = Heater
- FT = Flow Transmitter
- LT = Liquid Level Transmitter
- TT = Temperature Transmitter
- FL = Filter
- PM = Pump/Compressor
- VL = Valve
- SG = Sight glass

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# APPENDIX Q

Components list and data sheets

Valves  
C02 Cooling System

Code	PVSS Identifier	Part number	Function	Operating Pressure (Bar)	Maximum Design Pressure (Bar)	Minimum design temp. (°C)	Maximum design temp. (°C)	Pressure setting range (Bar)	Orifice (mm)	Manual Control	Output signal
TL_VL001	Manual2WayValve	Swagelok SS-4UW-TW	Transfer tube shut-off	100	172	-29	343	NA	4.4	Proportional	NA
TL_VL002	ManualRegulatingValve	Swagelok SS31RS4 (Modified)	Liquid expansion	100	212	-65	343	NA	1.6	Proportional	NA
TL_VL003	Manual2WayValve	Swagelok SS-4UW-TW	Test evaporator inlet	100	172	-29	343	NA	4.4	Proportional	NA
TL_VL004	Manual2WayValve	Swagelok SS-4UW-TW	Evaporator inlet	100	172	-29	343	NA	4.4	Proportional	NA
TL_VL006	Manual2WayValve	Swagelok SS-6UW-TW	Test evaporator outlet	100	172	-29	343	NA	7.1	Proportional	NA
TL_VL007	Manual2WayValve	Swagelok SS-58SW8T	Check valve	100	307	-53	176	NA	11.1	NA	NA
TL_VL008	Manual2WayValve	Swagelok SS-6UW-TW	Transfer tube shut-off	100	172	-29	343	NA	4.4	Proportional	NA
TL_VL009	Manual2WayValve	TBVT	Tert. vacuum evacuation	2	NA	NA	NA	NA	NA	Proportional	NA
TL_VL101	Manual2WayValve	Swagelok SS-43GHLVCR4	Transfer tube shut-off	100	172	-53	37	NA	4.8	Open/Close	NA
TL_VL102	Automatic2WayValve	Swagelok SS-43GHLVCR4-42dc	Left VTCS shut-off	100	172	-53	37	NA	4.8		Position switch
TL_VL103	Automatic3WayValve	Swagelok SS-43GXVCR4-42dcx	3-way Condenser selection	100	172	-53	37	NA	4.8		Position switch
TL_VL104	Automatic2WayValve	Swagelok SS-43GHLVCR4-42dc	Accumulator shut-off	100	172	-53	37	NA	4.8		Position switch
TL_VL105	Manual2WayValve	Swagelok SS-43GHLVCR4	Filling port	100	172	-53	37	NA	4.8	Open/Close	NA
TL_VL106	Manual2WayValve	Swagelok SS-43GHLVCR4	Pump shut-off	100	172	-53	37	NA	4.8	Open/Close	NA
TL_VL107	Manual2WayValve	Swagelok SS-43GHLVCR4	Filling port	100	172	-53	37	NA	4.8	Open/Close	NA
TL_VL108	Manual2WayValve	Swagelok SS-43GHLVCR4	Pump shut-off	100	172	-53	37	NA	4.8	Open/Close	NA
TL_VL109	Automatic2WayValve	Swagelok SS-43GHLVCR4-42dc	By-pass	100	172	-53	37	NA	4.8		Position switch
TL_VL110	ManualRegulatingValve	Swagelok SS31RS4	Liquid expansion	100	212	-65	343	NA	1.6	Proportional	NA
TL_VL111	Automatic2WayValve	Swagelok SS-43GHLVCR4-42dc	Left VTCS shut-off	100	172	-53	37	NA	4.8		Position switch
TL_VL112	Automatic2WayValve	Swagelok SS-43GHLVCR4-42dc	Liquid vent	100	172	-53	37	NA	4.8		Position switch
TL_VL113	Manual2WayValve	Swagelok SS-43GHLVCR4	Transfer tube shut-off	100	172	-53	37	NA	4.8	Open/Close	NA
TR_VL001	Manual2WayValve	Swagelok SS-4UW-TW	Transfer tube shut-off	100	172	-29	343	NA	4.4	Proportional	NA
TR_VL002	ManualRegulatingValve	Swagelok SS31RS4 (Modified)	Liquid expansion	100	212	-65	343	NA	1.6	Proportional	NA
TR_VL003	Manual2WayValve	Swagelok SS-4UW-TW	Test evaporator inlet	100	172	-29	343	NA	4.4	Proportional	NA
TR_VL004	Manual2WayValve	Swagelok SS-4UW-TW	Evaporator inlet	100	172	-29	343	NA	4.4	Proportional	NA
TR_VL006	Manual2WayValve	Swagelok SS-6UW-TW	Test evaporator outlet	100	172	-29	343	NA	7.1	Proportional	NA
TR_VL007	Manual2WayValve	Swagelok SS-58SW8T	Check valve	100	307	-53	176	NA	11.1	NA	NA
TR_VL008	Manual2WayValve	Swagelok SS-6UW-TW	Transfer tube shut-off	100	172	-29	343	NA	4.4	Proportional	NA
TR_VL009	Manual2WayValve	TBVT	Tert. vacuum evacuation	2	NA	NA	NA	NA	NA	Proportional	NA
TR_VL101	Manual2WayValve	Swagelok SS-43GHLVCR4	Transfer tube shut-off	100	172	-53	37	NA	4.8	Open/Close	NA
TR_VL102	Automatic2WayValve	Swagelok SS-43GHLVCR4-42dc	Left VTCS shut-off	100	172	-53	37	NA	4.8		Position switch
TR_VL103	Automatic3WayValve	Swagelok SS-43GXVCR4-42dcx	3-way Condenser selection	100	172	-53	37	NA	4.8		Position switch
TR_VL104	Automatic2WayValve	Swagelok SS-43GHLVCR4-42dc	Accumulator shut-off	100	172	-53	37	NA	4.8		Position switch
TR_VL105	Manual2WayValve	Swagelok SS-43GHLVCR4	Filling port	100	172	-53	37	NA	4.8	Open/Close	NA
TR_VL106	Manual2WayValve	Swagelok SS-43GHLVCR4	Pump shut-off	100	172	-53	37	NA	4.8	Open/Close	NA
TR_VL107	Manual2WayValve	Swagelok SS-43GHLVCR4	Filling port	100	172	-53	37	NA	4.8	Open/Close	NA
TR_VL108	Automatic3WayValve	Swagelok SS-43GXVCR4-42dcx	Pump shut-off/TLR pump cooling	100	172	-53	37	NA	4.8		Position switch
TR_VL109	Automatic2WayValve	Swagelok SS-43GHLVCR4-42dc	By-pass	100	172	-53	37	NA	4.8		Position switch
TR_VL110	ManualRegulatingValve	Swagelok SS31RS4	Liquid expansion	100	212	-65	343	NA	1.6	Proportional	NA
TR_VL111	Automatic2WayValve	Swagelok SS-43GHLVCR4-42dc	Left VTCS shut-off	100	172	-53	37	NA	4.8		Position switch
TR_VL112	Automatic2WayValve	Swagelok SS-43GHLVCR4-42dc	Liquid vent	100	172	-53	37	NA	4.8		Position switch
TR_VL113	Manual2WayValve	Swagelok SS-43GHLVCR4	Transfer tube shut-off	100	172	-53	37	NA	4.8	Open/Close	NA
TLR_VL001	Manual2WayValve	Swagelok SS-4UW-TW	Left right inter connect	100	172	-29	343	NA	4.4	Proportional	NA
TLR_VL002	Manual2WayValve	Swagelok SS-6UW-TW	Left right inter connect	100	172	-29	343	NA	7.1	Proportional	NA
TLR_VL101	Automatic3WayValve	Swagelok SS-43GXVCR4-42dcx	Spare pump	100	172	-53	37	NA	4.8		Position switch
TLR_VL107	Manual2WayValve	Swagelok SS-43GHLVCR4	Filling port	100	172	-53	37	NA	4.8		
TLR_VL109	Automatic3WayValve	Swagelok SS-43GXVCR4-42dcx	3-way Condenser selection	100	172	-53	37	NA	4.8		Position switch
TLR_VL110	Automatic2WayValve	Swagelok SS-43GHLVCR4-42dc	Left-right liquid inter connect	100	172	-53	37	NA	4.8		Position switch
TLR_VL111	Automatic2WayValve	Swagelok SS-43GHLVCR4-42dc	Left-right vapor inter connect	100	172	-53	37	NA	4.8		Position switch
SA_VL101	Manual2WayValve	Danfoss GB10S/009G7051	Compressor section shut-off	20	48	-40	150	NA	TBD		
SA_VL102	SelfRegulatingValve	Danfoss NR020-1132	Condenser control	20	28	-45	130	1.4 - 3	TBD		
SA_VL103	ManualRegulatingValve	Danfoss/KVR-12/034L0093	Condenser pressure control	20	28	-45	130	5 - 17.5	TBD		
SA_VL104	Manual2WayValve	Integral in SA-AC102	Liquid line shut-off								
SA_VL106	AutomaticRegulatingValve	Danfoss AKV 10-2/068F1164+018F6701	Evaporator expansion valve and shut-off valve	20	42	-60	60	NA	0.65		
SA_VL107	Manual2WayValve	Integral in SA-VL108	Schrader valve	20	TBV	TBV	TBV	NA	TBD		
SA_VL108	Manual2WayValve	Danfoss GBC12S/009G7052	Evaporator shut-off	20	48	-40	150	NA	TBD		
SA_VL110	AutomaticRegulatingValve	Danfoss AKV 10-2/068F1164+018F6701	Expansion valve	20	42	-60	60	NA	0.65		
SA_VL111	Manual2WayValve	Integral in SA-VL112	Schrader valve	20	TBV	TBV	TBV	NA	TBD		
SA_VL112	Manual2WayValve	Danfoss GBC12S/009G7052	Evaporator shut-off	20	48	-40	150	NA	TBD		
SA_VL114	AutomaticRegulatingValve	Danfoss AKV 10-1/068F1161+018F6701	Evaporator expansion valve and shut-off valve	20	42	-60	60	NA	0.5		
SA_VL115	Manual2WayValve	Integral in SA-VL116	Schrader valve	20				NA			
SA_VL116	Manual2WayValve	Danfoss GBC12S/009G7052	Accu evaporator shut-off	20	48	-40	150	NA	TBD		
SA_VL117	ManualRegulatingValve	Danfoss KVP-12	Accu evaporator pressure	18	28	-45	130	0 - 7	NA		
SA_VL119	AutomaticRegulatingValve	Danfoss AKV 10-1/068F1161+018F6701	Expansion valve	20	42	-60	60	NA	0.5		
SA_VL120	Manual2WayValve	Integral in SA-VL121	Schrader valve	20				NA			
SA_VL121	Manual2WayValve	Danfoss GBC12S/009G7052	Accu evaporator shut-off	20	48	-40	150	NA	TBD		
SA_VL122	ManualRegulatingValve	Danfoss KVP-12	Accu evaporator pressure	18	28	-45	130	0 - 7	NA		
SA_VL123	Manual2WayValve	Danfoss GBC22S/009G7055	Gas line shut-off	20	48	-40	150	NA	TBD		
SA_VL124	Manual2WayValve	Integral in SA-PM101	Compressor Suction shut-off	20				NA			
SA_VL125	Manual2WayValve	Integral in SA-PM101	Compressor discharge shut-off	20				NA			
SA_VL126	Manual2WayValve	Integral in SA-VL101	Schrader valve	20				NA			
SA_VL127	Manual2WayValve	Integral in SA-VL104	Schrader valve	20				NA			
SA_VL128	Manual2WayValve	Integral in SA-VL123	Schrader valve	20				NA			
SB_VL104	Manual2WayValve	Integral in SB-AC102	Liquid line shut-off								
SB_VL106	AutomaticRegulatingValve	Danfoss AKV 10-2/068F1164+018F6701	Evaporator expansion valve and shut-off valve	20	42	-60	60	NA	0.65		
SB_VL107	Manual2WayValve	Integral in SB-VL108	Schrader valve	20	TBV	TBV	TBV	NA	TBD		
SB_VL108	Manual2WayValve	Danfoss GBC12S/009G7052	Evaporator shut-off	20	48	-40	150	NA	TBD		
SB_VL110	AutomaticRegulatingValve	Danfoss AKV 10-2/068F1164+018F6701	Expansion valve	20	42	-60	60	NA	0.65		
SB_VL111	Manual2WayValve	Integral in SB-VL112	Schrader valve	20	TBV	TBV	TBV	NA	TBD		
SB_VL112	Manual2WayValve	Danfoss GBC12S/009G7052	Evaporator shut-off	20	48	-40	150	NA	TBD		
SB_VL114	AutomaticRegulatingValve	Danfoss AKV 10-1/068F1161+018F6701	Evaporator expansion valve and shut-off valve	20	42	-60	60	NA	0.5		
SB_VL115	Manual2WayValve	Integral in SB-VL116	Schrader valve	20				NA			
SB_VL116	Manual2WayValve	Danfoss GBC12S/009G7052	Accu evaporator shut-off	20	48	-40	150	NA	TBD		
SB_VL117	ManualRegulatingValve	Danfoss KVP-12	Accu evaporator pressure	18	28	-45	130	0 - 7	NA		
SB_VL119	AutomaticRegulatingValve	Danfoss AKV 10-1/068F1161+018F6701	Expansion valve	20	42	-60	60	NA	0.5		
SB_VL120	Manual2WayValve	Integral in SB-VL121	Schrader valve	20				NA			
SB_VL121	Manual2WayValve	Danfoss GBC12S/009G7052	Accu evaporator shut-off	20	48	-40	150	NA	TBD		
SB_VL122	ManualRegulatingValve	Danfoss KVP-12	Accu evaporator pressure	18	28	-45	130	0 - 7	NA		
SB_VL124	Manual2WayValve	Integral in SB-PM101	Compressor Suction shut-off	20				NA			
SB_VL125	Manual2WayValve	Integral in SB-PM101	Compressor discharge shut-off	20				NA			
SB_VL126	Deleted										
SB_VL127	Manual2WayValve	Integral in SB-VL104	Schrader valve	20				NA			
SB_VL128	Manual2WayValve	Integral in SB-VL123	Schrader valve	20				NA			

MEET THE CHALLENGE<sup>SM</sup>

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 The Netherlands  
 31-(0)182-624060

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## Lift Check Valves



Ordering #: SS-58SW8T  
 Description: SS Lift Check Valve, 2.20 Cv, 1/2 in. TSW  
 Availability: Call for Availability

## Specification Summary

General	
Body Material	Stainless Steel
Connection 1 Size	1/2 in.
Connection 1 Type	Tube Socket Weld
Connection 2 Size	1/2 in.
Connection 2 Type	Tube Socket Weld
eClass	37010801
UNSPSC Code	40141601

REVIEW PRODUCT CATALOG FOR COMPLETE SPECIFICATIONS INCLUDING WARNINGS AND CAUTIONS.

Safe Product Selection: When selecting a product, the total system design must be considered to ensure safe, trouble-free performance. Function, material compatibility, adequate ratings, proper installation, operation, and maintenance are the responsibilities of the system designer and user.

Caution: Do not mix or interchange valve components with those of other manufacturers.

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## Secondary Packed Bellows Valves, Manual and Actuated, up to 1200°F [648°C]



**Ordering #:** SS-4UW-TW  
**Description:** SS Secondary Packed Bellows-Sealed Valve, Welded, Spherical Stem Tip, 1/4 in. TSW and 3/8 in. TBW  
**Availability:** Call for Availability

### Specification Summary

General	
Actuator Type	Manual
Body Material	Stainless Steel
Body Type	Straight
Flow Pattern	Straight (2-way)
Service Class	General
End Connections	
End Connection 1 Size	1/4 in
End Connection 1 Type	Tube socket weld
End Connection 2 Size	1/4 in
End Connection 2 Type	Tube socket weld
Handle	
Handle Color	Green
Handle Style	Aluminum bar
Options	
Bellows Material	347 Stainless Steel
Body Seal	Welded
Cleaning	Swagelok SC-10
Gasket	None
Packing	Grafoil®
Stem Type	Spherical
Surface Finish	Standard
Testing	Helium leak testing according to SCS-00020
Stem Tip Material	Cobalt based alloy
Ratings	
Max Temperature with Pressure Rating	900°F @ 600 PSIG /482°C @ 41.3 BAR
Room Temperature Pressure Rating	100°F @ 2500 PSIG /172 @ BAR 37°C

REVIEW PRODUCT CATALOG FOR COMPLETE SPECIFICATIONS INCLUDING WARNINGS AND CAUTIONS.

Safe Product Selection: When selecting a product, the total system design must be considered to ensure safe, trouble-free performance. Function, material compatibility, adequate ratings, proper installation, operation, and maintenance are the responsibilities of the system designer and user.

Caution: Do not mix or interchange valve components with those of other manufacturers.

Temperature Transmitters  
CO2 Cooling System

Code	PVSS Identifier	Part number	Function	Classification
TL_TT001	Temperature Transmitter	PT100	TL_HX001 Liquid inlet	
TL_TT002	Temperature Transmitter	PT100	TL_HX001 block 1	
TL_TT003	Temperature Transmitter	PT100	TL_HX001 Dry-out monitoring	Monitoring
TL_TT004	Temperature Transmitter	PT100	TL_HX001 Vapor outlet	
TL_TT005	Temperature Transmitter	PT100	TL_HX002 Dry-out monitoring	Monitoring
TL_TT006	Temperature Transmitter	PT100	TL_HX003 Dry-out monitoring	Monitoring
TL_TT007	Temperature Transmitter	PT100	TL_HX004 Dry-out monitoring	Monitoring
TL_TT008	Temperature Transmitter	PT100	TL_HX005 Dry-out monitoring	Monitoring
TL_TT009	Temperature Transmitter	PT100	TL_HX006 Dry-out monitoring	Monitoring
TL_TT010	Temperature Transmitter	PT100	TL_HX007 Dry-out monitoring	Monitoring
TL_TT011	Temperature Transmitter	PT100	TL_HX008 Dry-out monitoring	Monitoring
TL_TT012	Temperature Transmitter	PT100	TL_HX009 Dry-out monitoring	Monitoring
TL_TT013	Temperature Transmitter	PT100	TL_HX010 Dry-out monitoring	Monitoring
TL_TT014	Temperature Transmitter	PT100	TL_HX011 Dry-out monitoring	Monitoring
TL_TT015	Temperature Transmitter	PT100	TL_HX012 Liquid inlet	
TL_TT016	Temperature Transmitter	PT100	TL_HX012 block 1	
TL_TT017	Temperature Transmitter	PT100	TL_HX012 Dry-out monitoring	Monitoring
TL_TT018	Temperature Transmitter	PT100	TL_HX012 Vapor outlet	
TL_TT019	Temperature Transmitter	PT100	TL_HX013 Dry-out monitoring	Monitoring
TL_TT020	Temperature Transmitter	PT100	TL_HX014 Dry-out monitoring	Monitoring
TL_TT021	Temperature Transmitter	PT100	TL_HX015 Dry-out monitoring	Monitoring
TL_TT022	Temperature Transmitter	PT100	TL_HX016 Dry-out monitoring	Monitoring
TL_TT023	Temperature Transmitter	PT100	TL_HX017 Dry-out monitoring	Monitoring
TL_TT024	Temperature Transmitter	PT100	TL_HX018 Dry-out monitoring	Monitoring
TL_TT025	Temperature Transmitter	PT100	TL_HX021 Dry-out monitoring	Monitoring
TL_TT026	Temperature Transmitter	PT100	TL_HX024 Dry-out monitoring	Monitoring
TL_TT027	Temperature Transmitter	PT100	TL_HX025 Dry-out monitoring	Monitoring
TL_TT028	Temperature Transmitter	PT100	TL_HX026 Dry-out monitoring	Monitoring
TL_TT029	Temperature Transmitter	PT100	TL_HX027 Liquid inlet	
TL_TT030	Temperature Transmitter	PT100	TL_HX027 block 1	
TL_TT031	Temperature Transmitter	PT100	TL_HX027 Dry-out monitoring	Monitoring
TL_TT032	Temperature Transmitter	PT100	TL_HX027 Vapor outlet	
TL_TT033	Temperature Transmitter	PT100	Vapor return	
TL_TT034	Temperature Transmitter	PT100	Vapor return	
TL_TT035	Temperature Transmitter	PT100	Manifold	
TL_TT036	Temperature Transmitter	PT100	Bellow flange	
TL_TT037	Temperature Transmitter	PT100	TL_HT001 Heater Control	Monitoring
TL_TT038	Temperature Transmitter	PT100	TL_HT002 Heater Control	Monitoring
TL_TT039	Temperature Transmitter	PT100	TL_HT003 Heater Control	Monitoring
TL_TT040	Temperature Transmitter	PT100	TL_HT004 Heater Control	Monitoring
TL_TT041	Temperature Transmitter	PT100	Module base	
TL_TT042	Temperature Transmitter	PT100	Module base	
TL_TT043	Temperature Transmitter	PT100	RF-Foil	Monitoring
TL_TT044	Temperature Transmitter	PT100	RF-Foil	Monitoring
TL_TT045	Temperature Transmitter	PT100	Transfer tube liquid outlet	
TL_TT046	Temperature Transmitter	PT100	Local control box liquid inlet	Monitoring
TL_TT047	Temperature Transmitter	PT100	Capillaries inlet	Monitoring
TL_TT048	Temperature Transmitter	PT100	Local control box vapor outlet	Monitoring
TL_TT101	Temperature Transmitter	Internal PT100 Rodax: PPA_PT100_SO_S_A1_D3_W4_130_6D	Transfer tube vapor outlet	Monitoring
TL_TT102	Temperature Transmitter	PT100	Main condenser Front plate	
TL_TT103	Temperature Transmitter	PT100	Main condenser inlet	
TL_TT104	Temperature Transmitter	PT100	Back-up condenser inlet	
TL_TT105	Temperature Transmitter	PT100	Main condenser outlet	
TL_TT106	Temperature Transmitter	PT100	Back-up condenser outlet	
TL_TT107	Temperature Transmitter	PT100	Accumulator line	Monitoring*
TL_TT108	Temperature Transmitter	PT100	Accumulator Liquid	
TL_TT109	Temperature Transmitter	PT100	Accumulator Vapor	
TL_TT110	Temperature Transmitter	PT100	Condenser outlet	Monitoring*
TL_TT112	Temperature Transmitter	Internal PT100 Rodax: PPA_PT100_SO_S_A1_D3_W4_130_6D	TL-PM101 pump inlet	Monitoring
TL_TT113	Temperature Transmitter	PT100	TL-PM101 pump head oil side	
TL_TT114	Temperature Transmitter	PT100	TL-PM101 pump head CO2 side	
TL_TT115	Temperature Transmitter	PT100	TL-PM101 pump outlet	Monitoring
TL_TT116	Temperature Transmitter	PT100	liquid line	
TL_TT117	Temperature Transmitter	PT100	By-pass liquid	
TL_TT118	Temperature Transmitter	PT100	By-pass vapor	Monitoring
TL_TT119	Temperature Transmitter	PT100	Condenser Back plate	
TL_TT120	Temperature Transmitter	PT100	Transfer tube liquid inlet	Monitoring
TL_TT121	Temperature Transmitter	Thermocouple K	TL-HT101 Control	Monitoring
TL_TT122	Temperature Transmitter	Thermocouple K	TL-HT102 Control (pump oil heater)	Monitoring
TL_TT123	Temperature Transmitter	Thermocouple K	TL-HT103 Control	Monitoring
TL_TT124	Temperature Transmitter	Thermocouple K	TL-HT104 Control	Monitoring
TL_TT125	Temperature Transmitter	Thermocouple K	TL-HT105 Control (Accu heater)	Monitoring
TR_TT001	Temperature Transmitter	PT100	TR_HX001 Liquid inlet	
TR_TT002	Temperature Transmitter	PT100	TR_HX001 block 1	

Temperature Transmitters  
CO2 Cooling System

TR_TT003	Temperature Transmitter	PT100	TR_HX001 Dry-out monitoring	Monitoring
TR_TT004	Temperature Transmitter	PT100	TR_HX001 Vapor outlet	
TR_TT005	Temperature Transmitter	PT100	TR_HX002 Dry-out monitoring	Monitoring
TR_TT006	Temperature Transmitter	PT100	TR_HX003 Dry-out monitoring	Monitoring
TR_TT007	Temperature Transmitter	PT100	TR_HX004 Dry-out monitoring	Monitoring
TR_TT008	Temperature Transmitter	PT100	TR_HX005 Dry-out monitoring	Monitoring
TR_TT009	Temperature Transmitter	PT100	TR_HX006 Dry-out monitoring	Monitoring
TR_TT010	Temperature Transmitter	PT100	TR_HX007 Dry-out monitoring	Monitoring
TR_TT011	Temperature Transmitter	PT100	TR_HX008 Dry-out monitoring	Monitoring
TR_TT012	Temperature Transmitter	PT100	TR_HX009 Dry-out monitoring	Monitoring
TR_TT013	Temperature Transmitter	PT100	TR_HX010 Dry-out monitoring	Monitoring
TR_TT014	Temperature Transmitter	PT100	TR_HX011 Dry-out monitoring	Monitoring
TR_TT015	Temperature Transmitter	PT100	TR_HX012 Liquid inlet	
TR_TT016	Temperature Transmitter	PT100	TR_HX012 block 1	
TR_TT017	Temperature Transmitter	PT100	TR_HX012 Dry-out monitoring	Monitoring
TR_TT018	Temperature Transmitter	PT100	TR_HX012 Vapor ouTRet	
TR_TT019	Temperature Transmitter	PT100	TR_HX013 Dry-out monitoring	Monitoring
TR_TT020	Temperature Transmitter	PT100	TR_HX014 Dry-out monitoring	Monitoring
TR_TT021	Temperature Transmitter	PT100	TR_HX015 Dry-out monitoring	Monitoring
TR_TT022	Temperature Transmitter	PT100	TR_HX016 Dry-out monitoring	Monitoring
TR_TT023	Temperature Transmitter	PT100	TR_HX017 Dry-out monitoring	Monitoring
TR_TT024	Temperature Transmitter	PT100	TR_HX018 Dry-out monitoring	Monitoring
TR_TT025	Temperature Transmitter	PT100	TR_HX021 Dry-out monitoring	Monitoring
TR_TT026	Temperature Transmitter	PT100	TR_HX024 Dry-out monitoring	Monitoring
TR_TT027	Temperature Transmitter	PT100	TR_HX025 Dry-out monitoring	Monitoring
TR_TT028	Temperature Transmitter	PT100	TR_HX026 Dry-out monitoring	Monitoring
TR_TT029	Temperature Transmitter	PT100	TR_HX027 Liquid inlet	
TR_TT030	Temperature Transmitter	PT100	TR_HX027 block 1	
TR_TT031	Temperature Transmitter	PT100	TR_HX027 Dry-out monitoring	Monitoring
TR_TT032	Temperature Transmitter	PT100	TR_HX027 Vapor ouTRet	
TR_TT033	Temperature Transmitter	PT100	Vapor return	
TR_TT034	Temperature Transmitter	PT100	Vapor return	
TR_TT035	Temperature Transmitter	PT100	Manifold	
TR_TT036	Temperature Transmitter	PT100	Bellow flange	
TR_TT037	Temperature Transmitter	PT100	TR_HT001 Heater Control	Monitoring
TR_TT038	Temperature Transmitter	PT100	TR_HT002 Heater Control	Monitoring
TR_TT039	Temperature Transmitter	PT100	TR_HT003 Heater Control	Monitoring
TR_TT040	Temperature Transmitter	PT100	TR_HT004 Heater Control	Monitoring
TR_TT041	Temperature Transmitter	PT100	Module base	
TR_TT042	Temperature Transmitter	PT100	Module base	
TR_TT043	Temperature Transmitter	PT100	RF-Foil	Monitoring
TR_TT044	Temperature Transmitter	PT100	RF-Foil	Monitoring
TR_TT045	Temperature Transmitter	PT100	Transfer tube liquid outlet	
TR_TT046	Temperature Transmitter	PT100	Local control box liquid inlet	Monitoring
TR_TT047	Temperature Transmitter	PT100	Capillaries inlet	Monitoring
TR_TT048	Temperature Transmitter	PT100	Local control box vapor outlet	Monitoring
TR_TT101	Temperature Transmitter	Internal PT100 Rodax: PPA_PT100_SO_S_A1_D3_W4_130_6D	Transfer tube vapor outlet	Monitoring
TR_TT102	Temperature Transmitter	PT100	Main condenser Front plate	
TR_TT103	Temperature Transmitter	PT100	Main condenser inlet	
TR_TT104	Temperature Transmitter	PT100	Back-up condenser inlet	
TR_TT105	Temperature Transmitter	PT100	Main condenser outlet	
TR_TT106	Temperature Transmitter	PT100	Back-up condenser outlet	
TR_TT107	Temperature Transmitter	PT100	Accumulator line	Monitoring
TR_TT108	Temperature Transmitter	PT100	Accumulator Liquid	
TR_TT109	Temperature Transmitter	PT100	Accumulator Vapor	
TR_TT110	Temperature Transmitter	PT100	Condenser outlet	Monitoring
TR_TT111	Temperature Transmitter	PT100	TLR-PM101 pump head cooling	
TR_TT112	Temperature Transmitter	Internal PT100 Rodax: PPA_PT100_SO_S_A1_D3_W4_130_6D	TR-PM101 pump inlet	Monitoring
TR_TT113	Temperature Transmitter	PT100	TR-PM101 pump head oil side	
TR_TT114	Temperature Transmitter	PT100	TR-PM101 pump head CO2 side	
TR_TT115	Temperature Transmitter	PT100	TR-PM101 pump outlet	Monitoring
TR_TT116	Temperature Transmitter	PT100	liquid line	
TR_TT117	Temperature Transmitter	PT100	By-pass liquid	
TR_TT118	Temperature Transmitter	PT100	By-pass vapor	Monitoring
TR_TT119	Temperature Transmitter	PT100	Condenser Back plate	
TR_TT120	Temperature Transmitter	PT100	Transfer tube liquid inlet	Monitoring
TR_TT121	Temperature Transmitter	Thermocouple K	TR-HT101 Control	Monitoring
TR_TT122	Temperature Transmitter	Thermocouple K	TR-HT102 Control (pump oil heater)	Monitoring
TR_TT123	Temperature Transmitter	Thermocouple K	TR-HT103 Control	Monitoring
TR_TT124	Temperature Transmitter	Thermocouple K	TR-HT104 Control	Monitoring
TR_TT125	Temperature Transmitter	Thermocouple K	TR-HT105 Control (Accu heater)	Monitoring
TLR_TT112	Temperature Transmitter	Internal PT100 Rodax: PPA_PT100_SO_S_A1_D3_W4_130_6D	TLR-PM101 pump inlet	Monitoring
TLR_TT113	Temperature Transmitter	PT100	TLR-PM101 pump head oil side	
TLR_TT114	Temperature Transmitter	PT100	TLR-PM101 pump head CO2 side	
TLR_TT115	Temperature Transmitter	PT100	TLR-PM101 pump outlet	Monitoring
TLR_TT122	Temperature Transmitter	Thermocouple K	TLR-HT102 Control (pump oil heater)	Monitoring
SA_TT101	Temperature Transmitter	PT100	Discharge	Monitoring



Temperature Transmitters  
C02 Cooling System

SA_TT102	Temperature Transmitter	PT100	Condensor outlet	Monitoring
SA_TT103	Temperature Transmitter	PT100	Liquid vessel inlet	
SA_TT104	Temperature Transmitter	PT100	Liquid vessel	
SA_TT105	Temperature Transmitter	PT100	Liquid	
SA_TT106	Temperature Transmitter	PT100	SA-HX103 subcooled liquid	
SA_TT107	Temperature Transmitter	PT100	SA-HX103 evaporator inlet	
SA_TT108	Temperature Transmitter	PT100	SA-HX103 evaporator outlet	Monitoring
SA_TT109	Temperature Transmitter	Internal PT100 Rodax: PPA_PT100_SO_S_A1_D3_W4_130_6D	SA-HX103 superheat	Monitoring
SA_TT110	Temperature Transmitter	PT100	SA-HX105 subcooled liquid	
SA_TT111	Temperature Transmitter	PT100	SA-HX105 evaporator inlet	
SA_TT112	Temperature Transmitter	PT100	SA-HX105 evaporator outlet	Monitoring
SA_TT113	Temperature Transmitter	Internal PT100 Rodax: PPA_PT100_SO_S_A1_D3_W4_130_6D	SA-HX105 superheat	Monitoring
SA_TT114	Temperature Transmitter	PT100	SA-HX107/108 subcooled liquid	
SA_TT115	Temperature Transmitter	PT100	SA-HX107 evaporator inlet	
SA_TT116	Temperature Transmitter	Internal PT100 Rodax: PPA_PT100_SO_S_A1_D3_W4_130_6D	SA-HX107 superheat	Monitoring
SA_TT117	Temperature Transmitter	PT100	SA-HX108 evaporator inlet	
SA_TT118	Temperature Transmitter	Internal PT100 Rodax: PPA_PT100_SO_S_A1_D3_W4_130_6D	SA-HX108 superheat	Monitoring
SA_TT119	Temperature Transmitter	PT100	SA-HX107/108 cold gas	
SA_TT120	Temperature Transmitter	PT100	SA-HX107/108 Suction	
SA_TT121	Temperature Transmitter	PT100	Suction	Monitoring
SA_TT122	Temperature Transmitter	PT100	Compressor	Monitoring
SB_TT101	Temperature Transmitter	PT100	Discharge	Monitoring
SB_TT102	Temperature Transmitter	PT100	Condensor outlet	Monitoring
SB_TT104	Temperature Transmitter	PT100	Liquid vessel	
SB_TT105	Temperature Transmitter	PT100	Liquid	
SB_TT107	Temperature Transmitter	PT100	SB-HX103 evaporator inlet	
SB_TT109	Temperature Transmitter	Internal PT100 Rodax: PPA_PT100_SO_S_A1_D3_W4_130_6D	SB-HX103 superheat	Monitoring
SB_TT111	Temperature Transmitter	PT100	SB-HX105 evaporator inlet	
SB_TT113	Temperature Transmitter	Internal PT100 Rodax: PPA_PT100_SO_S_A1_D3_W4_130_6D	SB-HX105 superheat	Monitoring
SB_TT114	Temperature Transmitter	PT100	subcooled liquid	
SB_TT115	Temperature Transmitter	PT100	SB-HX107 evaporator inlet	
SB_TT116	Temperature Transmitter	Internal PT100 Rodax: PPA_PT100_SO_S_A1_D3_W4_130_6D	SB-HX107 superheat	Monitoring
SB_TT117	Temperature Transmitter	PT100	SB-HX108 evaporator inlet	
SB_TT118	Temperature Transmitter	Internal PT100 Rodax: PPA_PT100_SO_S_A1_D3_W4_130_6D	SB-HX108 superheat	Monitoring
SB_TT119	Temperature Transmitter	PT100	Cold gas	
SB_TT121	Temperature Transmitter	PT100	Suction	Monitoring
SB_TT122	Temperature Transmitter	PT100	Compressor	Monitoring
PA_TT101	Temperature Transmitter	PT100	Cooling water inlet	Monitoring
PA_TT102	Temperature Transmitter	PT100	Cooling water outlet	Monitoring
PB_TT101	Temperature Transmitter	PT100	Air inlet	Monitoring
PB_TT102	Temperature Transmitter	PT100	Air outlet	Monitoring

Burst Discs / Relief Valve  
C02 Cooling System

Code	PVSS Identifier	Part number	Functionality	Burst Pressure (Bar)
TL_BD001	BurstDisc	Swagelok SS-RDK-16-1900	Local control box liquid line safety	130+/- 7 bar
TL_BD002	BurstDisc	Swagelok SS-RDK-16-1900	Local control box vapor line safety	130+/- 7 bar
TL_BD003	BurstDisc	Swagelok SS-RDK-16-1900	Local control box vapor line safety	130+/- 7 bar
TL_BD004	BurstDisc	TBD	Tertiary vacuum safety	1.5
TL_BD101	BurstDisc	Swagelok SS-RDK-16-1900	Vapor line safety	130+/- 7 bar
TL_BD102	BurstDisc	Swagelok SS-RDK-16-1900	Condenser safety	130+/- 7 bar
TL_BD103	BurstDisc	Swagelok SS-RDK-16-1900	Accumulator safety	130+/- 7 bar
TL_BD104	BurstDisc	Swagelok SS-RDK-16-1900	Suction line safety	130+/- 7 bar
TL_BD105	BurstDisc	Swagelok SS-RDK-16-1900	TL-PM101 safety	130+/- 7 bar
TL_BD106	ReliefValve	Swagelok SS-4R3A	Pump outlet safety	130 bar
TL_BD107	BurstDisc	Swagelok SS-RDK-16-1900	Liquid line safety	130+/- 7 bar
TR_BD001	BurstDisc	Swagelok SS-RDK-16-1900	Local control box liquid line safety	130+/- 7 bar
TR_BD002	BurstDisc	Swagelok SS-RDK-16-1900	Local control box vapor line safety	130+/- 7 bar
TR_BD003	BurstDisc	Swagelok SS-RDK-16-1900	Local control box vapor line safety	130+/- 7 bar
TR_BD004	BurstDisc	Swagelok SS-RDK-16-1900	Local control box vapor line safety	130+/- 7 bar
TR_BD101	BurstDisc	TBD	Tertiary vacuum safety	1.5
TR_BD102	BurstDisc	Swagelok SS-RDK-16-1900	Vapor line safety	130+/- 7 bar
TR_BD103	BurstDisc	Swagelok SS-RDK-16-1900	Condenser safety	130+/- 7 bar
TR_BD104	BurstDisc	Swagelok SS-RDK-16-1900	Accumulator safety	130+/- 7 bar
TR_BD105	BurstDisc	Swagelok SS-RDK-16-1900	Suction line safety	130+/- 7 bar
TR_BD106	BurstDisc	Swagelok SS-RDK-16-1900	TR-PM101 safety	130+/- 7 bar
TR_BD107	BurstDisc	Swagelok SS-RDK-16-1900	Pump outlet safety	130+/- 7 bar
TLR_BD105	BurstDisc	Swagelok SS-RDK-16-1900	Liquid line safety	130+/- 7 bar
TLR_BD105	BurstDisc	Swagelok SS-RDK-16-1900	TRL-PM101 safety	130+/- 7 bar

MEET THE CHALLENGE<sup>SM</sup>

Nederland Sales & Service B.V.  
 Coenecoop 770  
 2741 PW Waddinxveen  
 The Netherlands  
 31-(0)182-624060

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## Proportional Relief Valves, High Pressure



Ordering #: SS-4R3A  
 Description: SS High-Pressure Proportional Relief Valve, 1/4 in. Swagelok Tube Fitting  
 Availability: Call for Availability

## Specification Summary

General	
Valve Material	316 Stainless Steel
End Connections	
End Connection 1 Size	1/4 in
End Connection 1 Type	Swagelok® tube fitting
End Connection 2 Size	1/4 in
End Connection 2 Type	Swagelok® tube fitting
Options	
Cleaning	Swagelok SC-10
Seal Material	Fluorocarbon FKM
Ratings	
Max Temperature with Pressure Rating	250°F @ 4910 PSIG /121°C @ 338 BAR
Room Temperature Pressure Rating	6000 PSIG @ 100°F /413 BAR @ 37°C

REVIEW PRODUCT CATALOG FOR COMPLETE SPECIFICATIONS INCLUDING WARNINGS AND CAUTIONS.

Safe Product Selection: When selecting a product, the total system design must be considered to ensure safe, trouble-free performance. Function, material compatibility, adequate ratings, proper installation, operation, and maintenance are the responsibilities of the system designer and user.

Caution: Do not mix or interchange valve components with those of other manufacturers.

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 The Netherlands  
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3/12/2007 12:09:15 PM

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## Needle Valves - Spare Parts and Accessories



**Ordering #:** SS-RDK-16-1900  
**Description:** Stainless Steel Rupture Disc Kit for 16D Series Integral Bonnet Non-Rotating Stem Valves, 1900 ± 100 psig (130 ± 6.8 bar)  
**Availability:** Call for Availability

## Specification Summary

General	
Body Material	316L Stainless Steel
eClass	37010904
Feature	1900 PSI
UNSPSC Code	40141616

REVIEW PRODUCT CATALOG FOR COMPLETE SPECIFICATIONS INCLUDING WARNINGS AND CAUTIONS.

Safe Product Selection: When selecting a product, the total system design must be considered to ensure safe, trouble-free performance. Function, material compatibility, adequate ratings, proper installation, operation, and maintenance are the responsibilities of the system designer and user.

Caution: Do not mix or interchange valve components with those of other manufacturers.

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Level Transmitters  
C02 Cooling System

<b>Code</b>	<b>PVSS Identifier</b>	<b>Part number</b>	<b>Function</b>	<b>Operating Pressure (Bar)</b>
TL_LT101	Level Transmitter	American Magnetics Model 175 RF	TL Accumulator liquid level	100
TR_LT101	Level Transmitter	American Magnetics Model 175 RF	TR Accumulator liquid level	100

Pumps, Compressors  
C02 Cooling System

Code	PVSS Identifier	Part number	Function	Connection	Pressure Head (Bar)	Flow range (ml/s)	Supply (V)	Power (W)	Electrical Control	Manual Control	Output signal
TL_PM101	Pump	LEWA 475967-010.001	Liquid pump	G 3/8 Fem	99 max	1 - 18 (4-65 l/h)	380 VAC 3p 50HZ	1500 max	on/off	Manual flow control	Membrane leak detection switch
TR_PM101	Pump	LEWA 475967-010.001	Liquid pump	G 3/8 Fem	99 max	1 - 18 (4-65 l/h)	380 VAC 3p 50HZ	1500 max	on/off	Manual flow control	Membrane leak detection switch
TRL_PM101	Pump	LEWA 475967-010.001	Liquid pump	G 3/8 Fem	99 max	1 - 18 (4-65 l/h)	380 VAC 3p 50HZ	1500 max	on/off	Manual flow control	Membrane leak detection switch
SA_PM101	Pump	Bitzer 2CC-3.2Y	Gas Compressor	7/8" in / 5/8" out	28 max	4511 (16.2 m <sup>3</sup> /h) @ 50Hz	380 VAC 3p 25-50Hz		Frequency regulation		
SB_PM101	Pump	Bitzer 2KC-05.2y	Gas Compressor								

# Technical Data Sheet

Customer NIKHEF Kruislaan 409 MBO 1098 SJ Amsterdam Netherlands	Customer-Reference No. P.O. No.: 38852; Issued: 220606 GEVEKE 12000608
	LEWA-Quotation-No. LEWA-Commission-No. LEWA-Position --000 E12-485983 010

1	Element	a	Page	1	of	1
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### Enquiry Data (If operating data are incomplete LEWA takes no responsibility for the pump selection!)

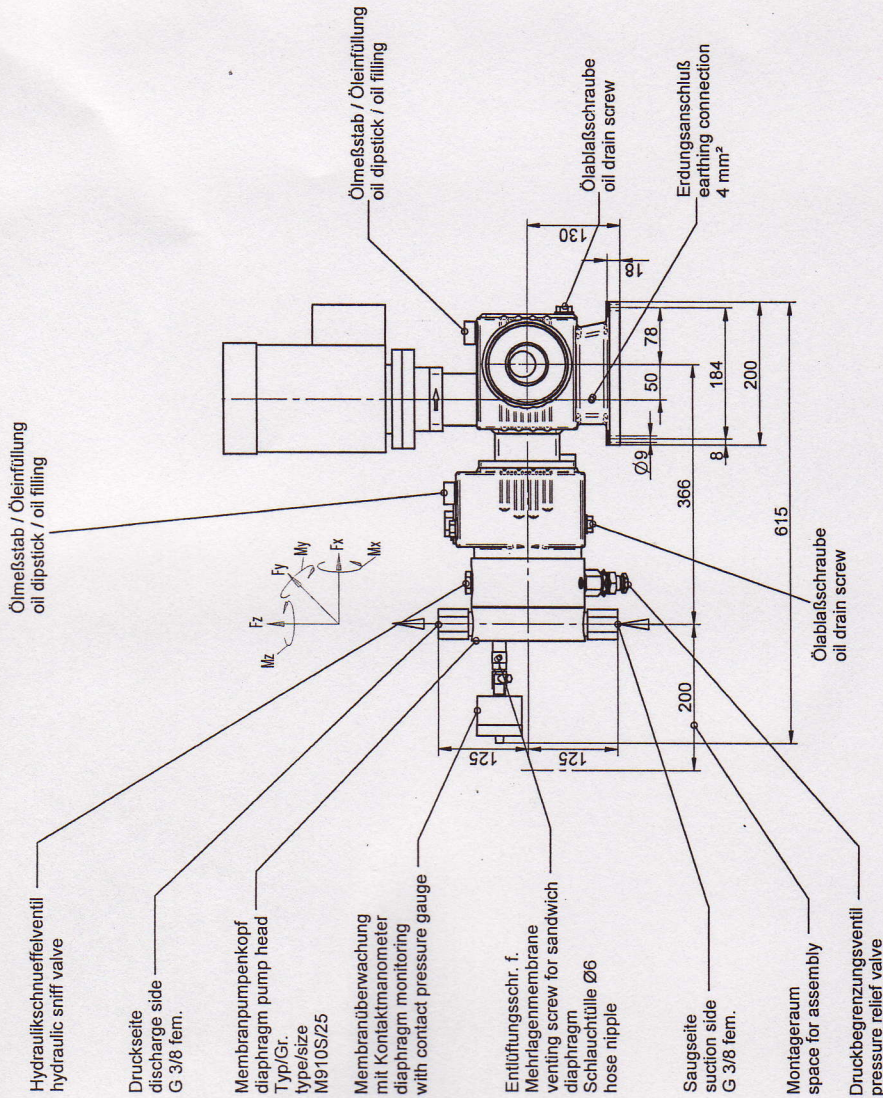
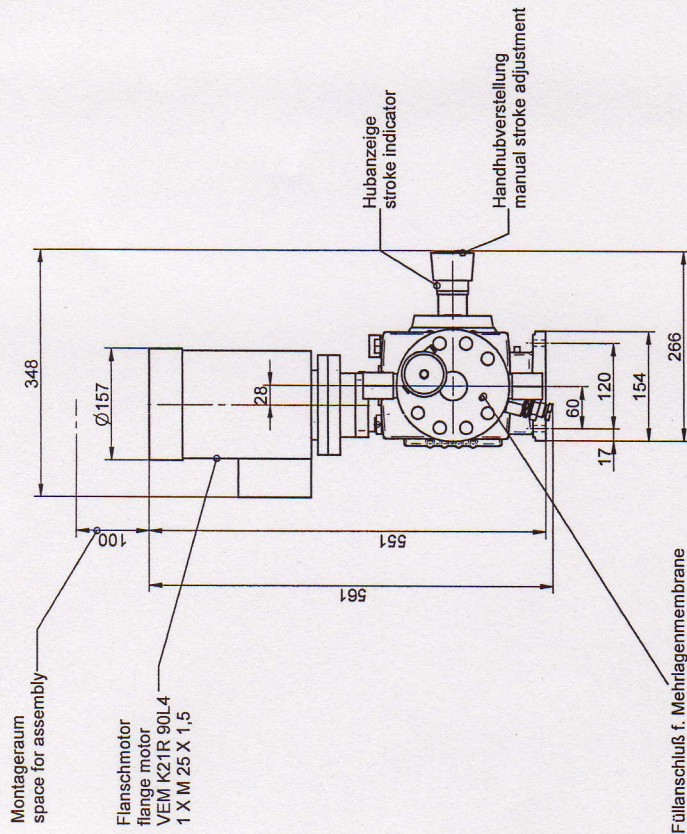
2	Fluid	CO2		dangerous acc. 67/548/EEC		<input type="checkbox"/>
3		min	max		min	max
4	Concentration [%]	100.00	100.00	Vapour pressure [bar abs]	16.87	16.87
5	Fluid temperature [°C]	-25	-25	Solidifying point [°C]	--	--
6	Density [g/cm3]	1.05	1.05	Solids Concentration [%]	--	--
7	Viscosity [mPa s]	0.16	0.16	Density [g/cm3]	--	--
8	Required flow [l/h]	4.00	65.00	Solids sizes [mm]	--	--
9	Operating press. discharge [bar]	99.00	99.00	Hardness [Mohs]	--	--
10	Operating press. suction [bar]	50.0	50.0	Settling rate [m/s]	--	--
11	Area classification			Compressibility [%]	0.51	
12	Ambient conditions (temperature, climate,...)					

### Design data

13	No.	3	LEWA-Serial-No.	485983-010. 001.002.003
14	Type	LDC1	horiz. (h) / vertical (v) v	Custom.-Item-No.

15	Crankcase	Type	LDC	Driver	Make	VEM
17	Rod thrust	[N]	5000	Type	K21R 90L4	
18	Stroke adjustment	manual (HHV)		Power	[kW]	1.50
19	Eccentricity	[°]	0	Rpm	[min-1]	1400
20	Gear reduction	8.33		Ex-protection	-	
21	Strokes per minute	[min-1]	168	Protection / Insulation	IP55 / F	
22	Intermed. elem.-Type/Width	[mm]	- / -	Voltage	[V]	400
23	Pumphead	Type	M910S	Phases / Frequency	[Hz]	3 / 50
24	Plunger-Ø	[mm]	25	Size / Mounting	090 / V18	
25	Flow @ max. operating press.	[l/h]	62.69	Flange-Ø	[mm]	C140
26	Max. perm. operating press.	[bar]	100.0	Shaft-Ø	[mm] x [mm]	24Dx50
27	Diaphragm condition monitor	pressure contactor		Thermistors	3	
28	Vent screw	No		design (VIK,CSA,-)	-	
29	Type of plunger sealing	ground bush		Additional remarks :		
30	Plunger linkage	-		-		
31	Valve Suction / DN	K1	/ 10	Variable frequency drive	-	
32	Spring load	[bar]	-	Range	[Hz]	-
33	Valve Discharge / DN	K1	/ 10	Start-up against load	yes	
34	Spring load	[bar]	-	Rated torque at max. press.	[Nm]	3.25
35	Setting PRV pumphead int.	[bar]	109	Start-up torque at max. press.	[Nm]	12.05
36	Setting PRV external	[bar]	100	Additional remarks :		
37	Inlet pressure loss	[bar]	0.06			
38	Min. required suction press.[bar abs]	16.93		General		
39	Connection Suction	ISO G 3/8 fem.		Paint	RAL 5015	
40	Discharge	ISO G 3/8 fem.		Name plate	nl	
41	Connection Flushing	-		Weight	[kg]	73
42	Heating / Cooling	-		Sound pressure	[dB[A]]	
43	Materials LEWA material-Code	3		Ex-protection (pump)	-	
44	Pumphead / Valve body	1.4571	/ 1.4571	Accessories / Documentation / Remarks :		
45	diaphragm	PTFE				
46	Valve Seat / Insert ring	1.4122	/ -			
47	Guide / ball	1.4581BZ	/ 1.3541			
48	Spring / Sealing ring	-				
49	Type of plunger sealing	-				
50	Hydraulic fluid (diaphragm head)	M-5				
51	Intermed. fluid (sandwich diaphr.)	Alkohol				

issued	24.06.06	Name	PC-To	Rev.(1)	Name	Rev.(4)	Name
checked		Name		Rev.(2)	Name	Rev.(5)	Name
checked		Name		Rev.(3)	Name	Rev.(6)	Name

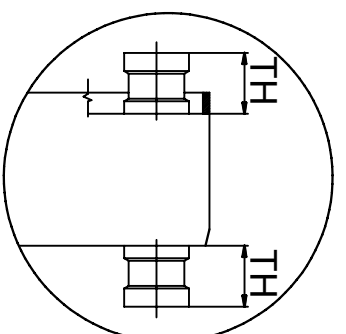
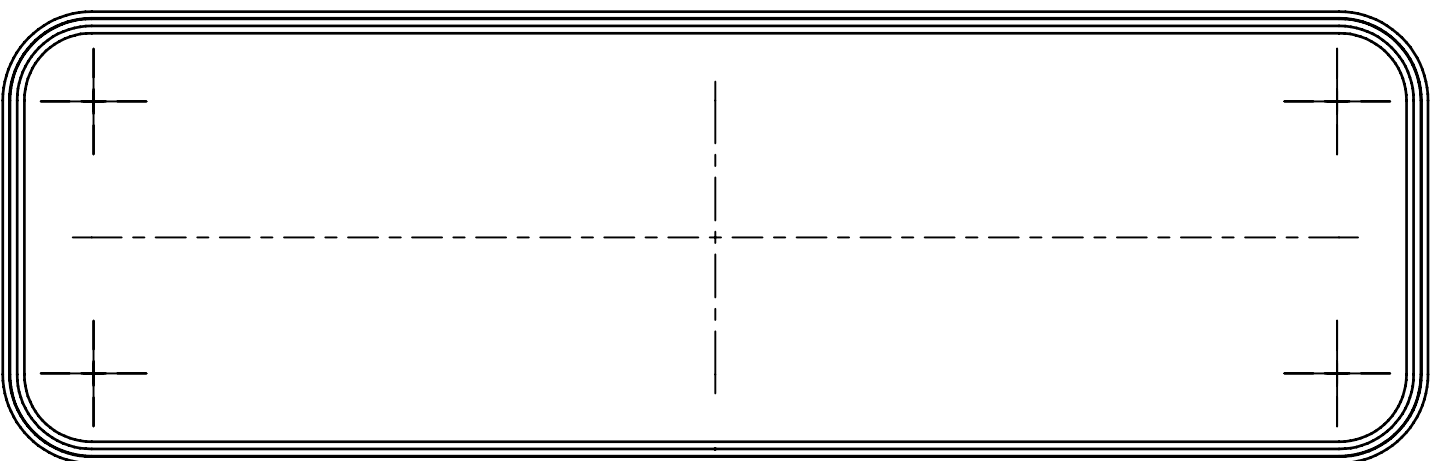
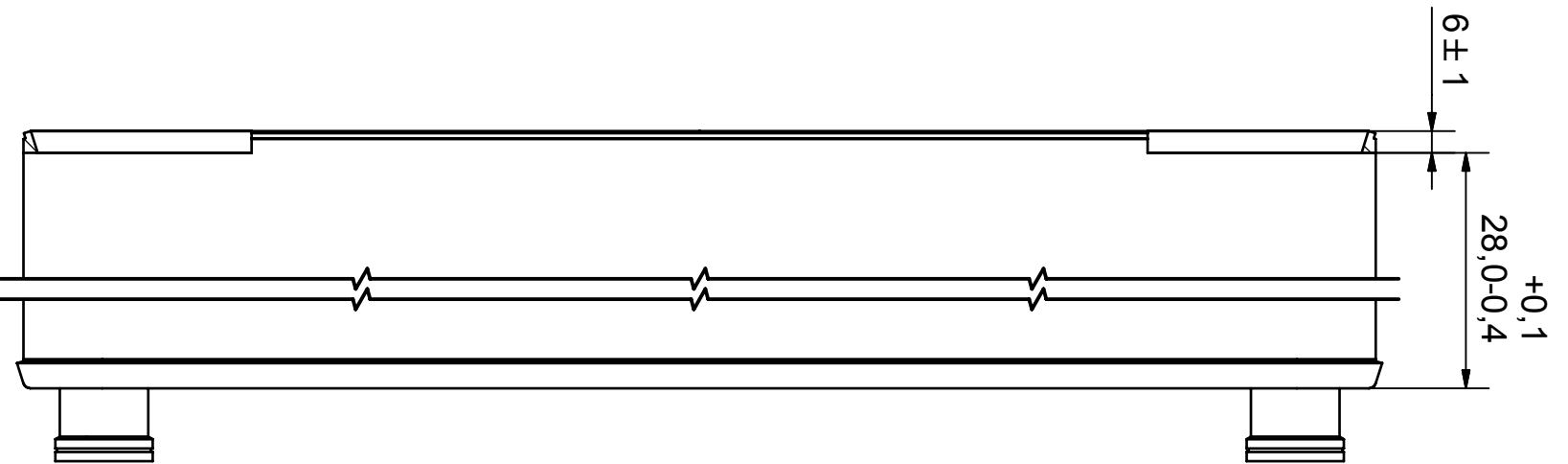
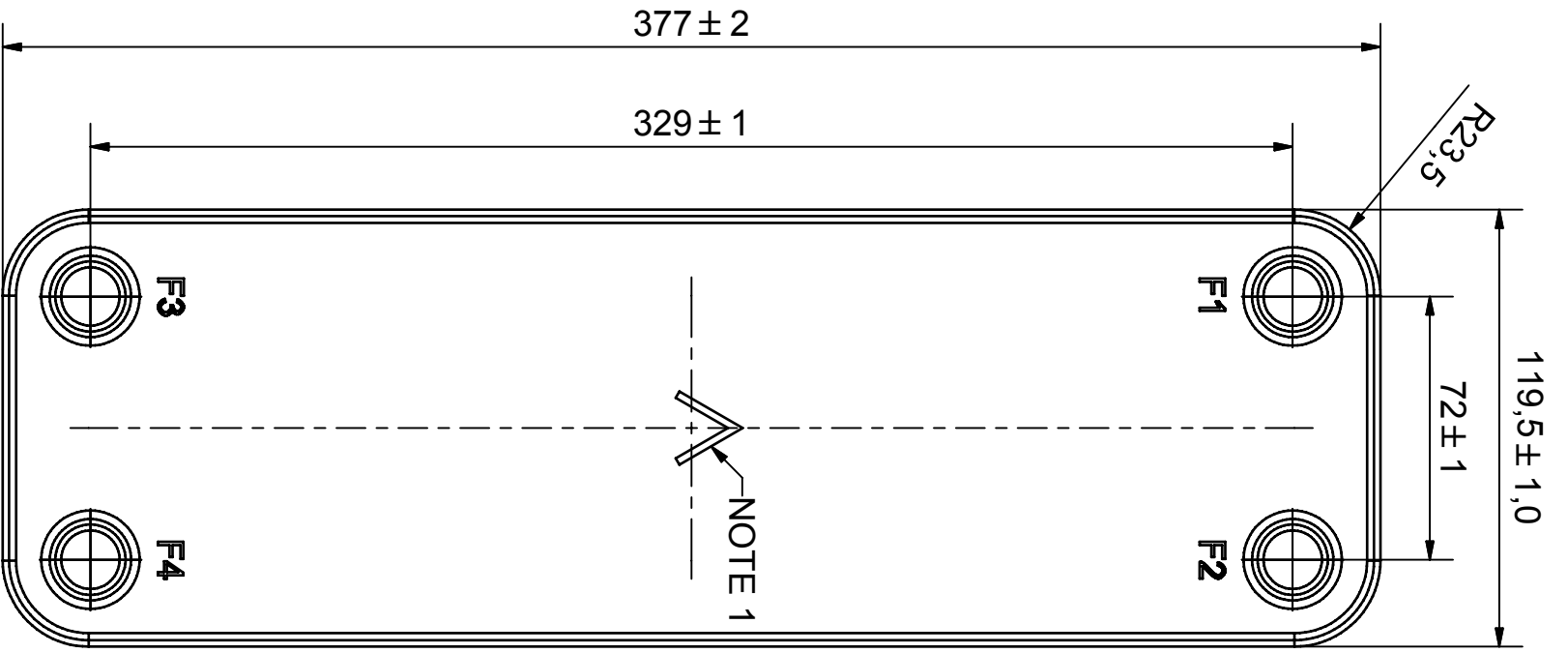


<b>LEWA</b>		Fa. / Company / Sté	NILHEF
Angebots/Auftrags-Nr. Quotation/Commission no. No. d'offre / commande	E12-485983-010	Anfrage/Bestell-Nr. Enquiry/Order no. No. Demande/Commande	38852 12000608
Fabrik-Nr. Serial-no. No. de fabrication	485983-010.001002.003	Positions-Nr. / Item-no. / Repère No.	
Gewicht der kompletten Dosierpumpe Weight of the complete metering pump ca. Poids de la pompe doseuse complète		73 kg	
Darstellung nicht streng verbindlich ! Drawing not strictly binding ! Représentation donnée sans engagement !		Technische Daten siehe Spezifikationsblatt Technical details see specification sheets Caractéristiques techniques voir spécifications	
Installation siehe Betriebsanleitung Installation see operating instructions Installation voir notice de service		Meistab/Scale	
CAD		S. E.	
Name/Name		DOSIERPUMPE METERING PUMP LDC M910S GR. 25	
Zeichnungs-Nr./Drawing No.		1800014948/2D/00	
Blatt/Page		1800014948/2D/00	
Blatt/Sheet		1800014948/2D/00	
Name		LEWA	
Adressen/Addresses		LEWA Heber, Ott GmbH & Co KG D - 71229 Leimbach	
Datum			
Name			
Blatt/Sheet			
Blatt/Page			

Triebwerkselement drive element	LDC	
Rohrleitungskräfte (saugs./drucks) suction/discharge	Fx (N)	300
	Fy (N)	300
	Fz (N)	300
Rohrleitungs Momente (saugs./drucks) suction/discharge	Mx (Nm)	10
	My (Nm)	10
	Mz (Nm)	0



Code	PVSS Identifier	Location	Part number	Function	Supply (V)	Power (W)	Resistance (Ohm)	Electrical Control	Output signal	Diameter (mm)	Length (mm)	No-heat length (mm)	Heated area (cm <sup>2</sup> )	Thermocouple location	Heatflux (W/cm <sup>2</sup> )
TL_HTT001	Heater	Module base left	2 parallel / 3 serial Waitlow K010030c500000	Module base temperature control	30	34.8	52.30/32 = 8.7Ω	DC Voltage regulation					19.4		1.8
TL_HTT002	Heater	"	2 parallel / 3 serial Waitlow K010030c500000	Module base temperature control	30	34.8	52.30/32 = 8.7Ω	DC Voltage regulation					19.4		1.8
TL_HTT003	Heater	"	2 parallel / 3 serial Waitlow K010030c500000	Module base temperature control	30	34.8	52.30/32 = 8.7Ω	DC Voltage regulation					19.4		1.8
TL_HTT004	Heater	"	2 parallel / 3 serial Waitlow K010030c500000	Module base temperature control	30	34.8	52.30/32 = 8.7Ω	DC Voltage regulation				60	19.4	center	4.4
TL_HTT001	Heater	Tertiary Left	Waitlow: KFRJ016DM001A	Suction line damper	240	130	443.1	PWM	Internal Thermocouple K	12.7	410	60	139.6	center	4.4
TL_HTT002	Heater	"	Waitlow: KFRJ016DM001A	Pump oil heater	220	620	78.1	PWM	Internal Thermocouple K	12.7	410	100	282.7	center	7.1
TL_HTT003	Heater	"	Waitlow: KFRG100DM001A	Liquid line damper	220	2000	24.2	PWM	Internal Thermocouple K	10	1000	85	117.7	center	8.5
TL_HTT004	Heater	"	Waitlow: KFRG100DM001A	By pass heater	220	1000	48.4	PWM	Internal Thermocouple K	12.7	380				
TL_HTT005	Heater	"	Waitlow: KFRJ015AM001A	Accumulator heater	220	1000		DC Voltage regulation							
TL_HTT001	Heater	Module base right	2 parallel / 3 serial Waitlow K010030c500000	Module base temperature control	30	34.8	52.30/32 = 8.7Ω	DC Voltage regulation					19.4		1.8
TL_HTT002	Heater	"	2 parallel / 3 serial Waitlow K010030c500000	Module base temperature control	30	34.8	52.30/32 = 8.7Ω	DC Voltage regulation					19.4		1.8
TL_HTT003	Heater	"	2 parallel / 3 serial Waitlow K010030c500000	Module base temperature control	30	34.8	52.30/32 = 8.7Ω	DC Voltage regulation					19.4		1.8
TL_HTT004	Heater	"	2 parallel / 3 serial Waitlow K010030c500000	Module base temperature control	30	34.8	52.30/32 = 8.7Ω	DC Voltage regulation				60	19.4	center	4.4
TR_HT101	Heater	Tertiary Right	Waitlow: TBD	Suction line damper	220	130	443.1	PWM	Internal Thermocouple K	12.7	410	60	139.6	center	4.4
TR_HT102	Heater	"	Waitlow: TBD	Pump Oil heater	220	620	78.1	PWM	Internal Thermocouple K	12.7	410	100	282.7	center	7.1
TR_HT103	Heater	"	Waitlow: KFRJ016DM001A	Liquid line damper	220	2000	24.2	PWM	Internal Thermocouple K	10	1000	85	117.7	center	8.5
TR_HT104	Heater	"	Waitlow: KFRJ015AM001A	Accumulator heater	220	1000		PWM	Internal Thermocouple K	12.7	380				
TR_HT105	Heater	"	Waitlow: TBD	Pump Oil heater	240	130	443.1	PWM					130.0	center	1.0

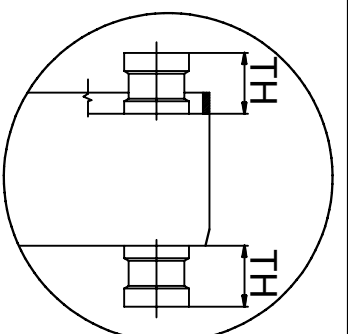
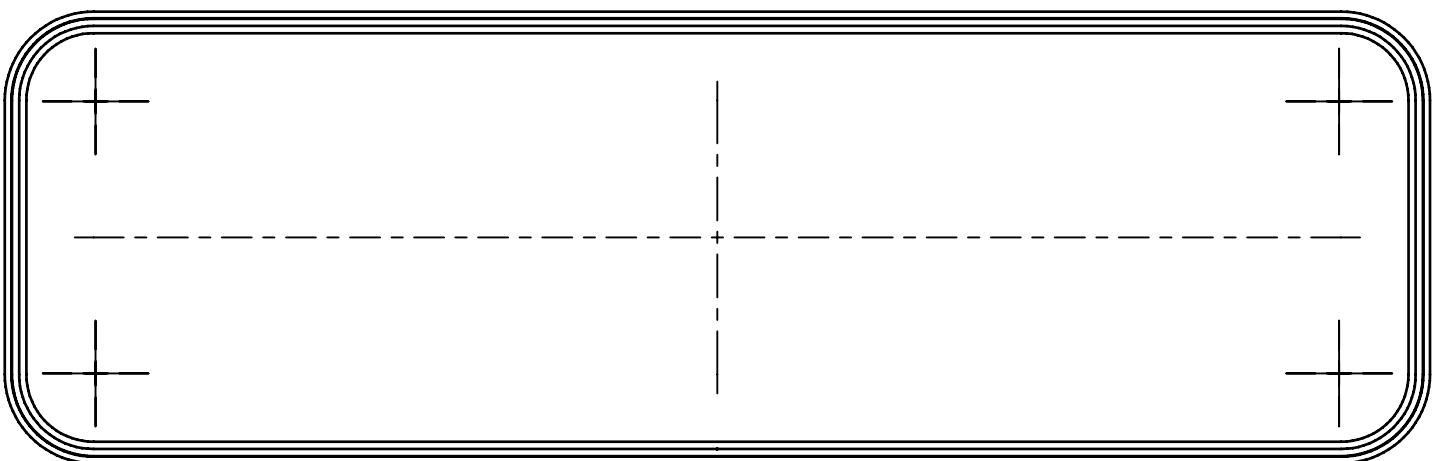
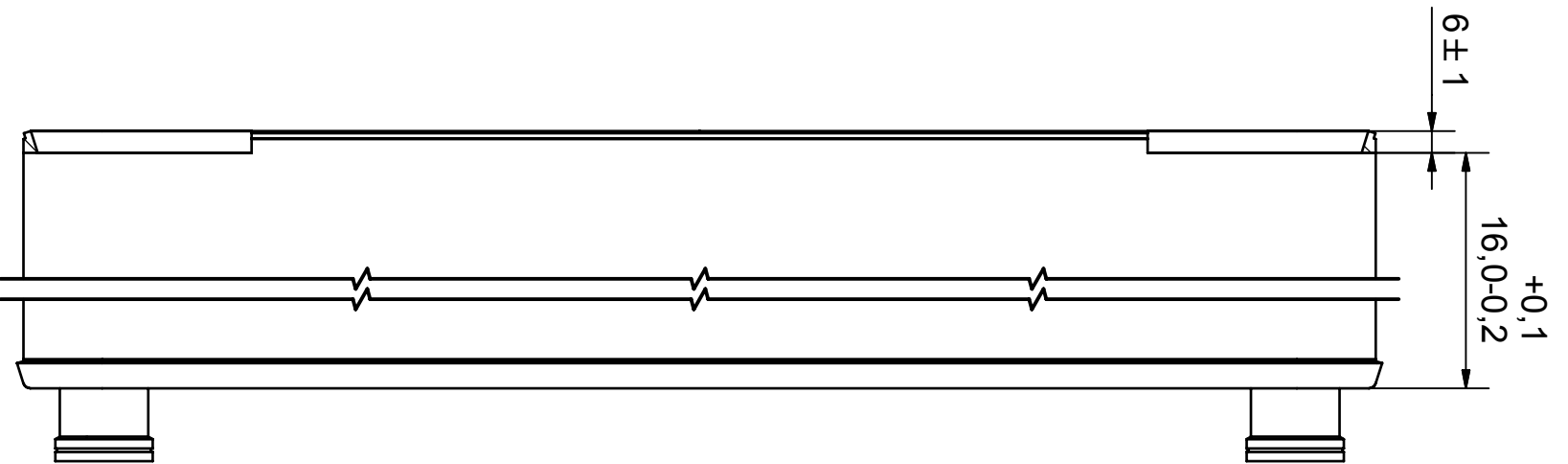
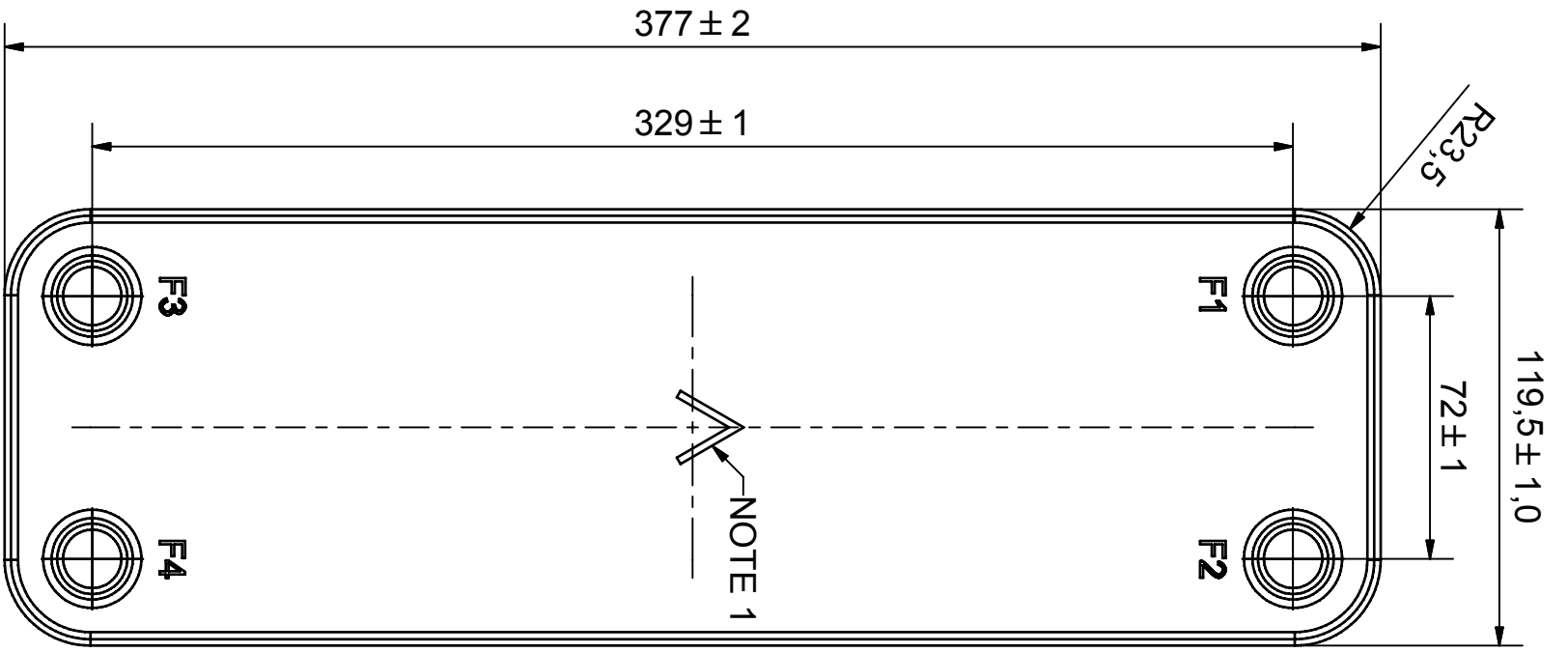


NOTE 1 ALTERNATE MARKING: STICKER OR STAMP

Pos	Article No	Title / Denomination, code, material, dimension etc	Drawing No./ref
F1	45434	NPT 1/2-14 INT, TH = 20,1	CD000080
F2	45434	NPT 1/2-14 INT, TH = 20,1	CD000080
F3	45434	NPT 1/2-14 INT, TH = 20,1	CD000080
F4	45434	NPT 1/2-14 INT, TH = 20,1	CD000080

Pos	Article No	Title / Denomination, code, material, dimension etc	Drawing No./ref

Title		Created Date		Created By	
B16DWHX12/P-SC-H 4X1/2"INT.NPT		2006-07-06		AU	
A DOVER COMPANY		Article/Configuration number		Drawing number	
		090803.0		AU00008597	



NOTE 1 ALTERNATE MARKING: STICKER OR STAMP

Pos	Article No	Title / Denomination, code, material, dimension etc	Drawing No./ref
F1	45434	NPT 1/2-14 INT, TH = 20,1	CD000080
F2	45434	NPT 1/2-14 INT, TH = 20,1	CD000080
F3	45434	NPT 1/2-14 INT, TH = 20,1	CD000080
F4	45434	NPT 1/2-14 INT, TH = 20,1	CD000080

Pos	Article No	Title / Denomination, code, material, dimension etc	Drawing No./ref

Title		B16DWHX6/1P-SC-H 4X1/2"INT.NPT	
Created Date		2006-07-05	
Article/Configuration number		090800.0	
Created By		AU	
Drawing number		AU00008568	

**SWEP** COMPANY

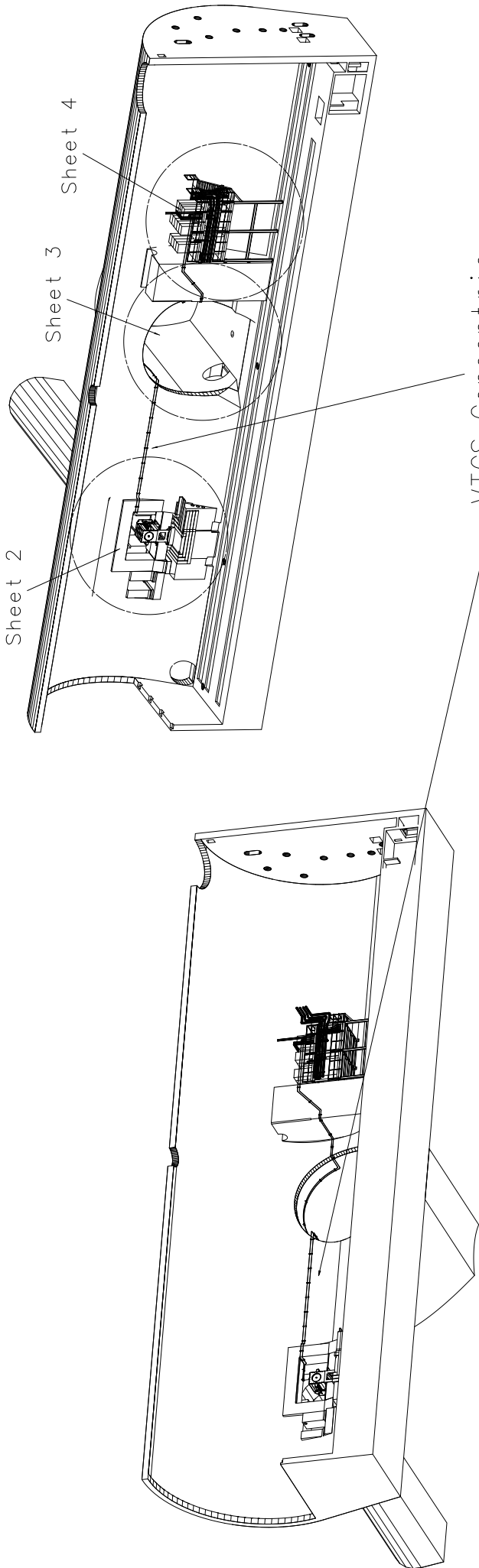
Filters  
C02 Cooling System

Code	PVSS Identifier	Part number	Function	Connection	Operating Pressure (Bar)	Maximum Design Pressure (Bar)	Minimum design temperature (°C)	Maximum design temperature (°C)	Poros (micron)
TL_FL001	Filter	Swagelok ss-4TF-TW-15	TL-VL002 protection	1/4" Weld	100	413	-28	37	15
TL_FL002	Filter	Swagelok element ss-4f-k4-15	protection	1/4" Weld	100	413	-28	37	15
TR_FL001	Filter	Swagelok ss-4TF-TW-15	TL-VR002 protection	1/4" Weld	100	413	-28	37	15
TR_FL002	Filter	Swagelok element ss-4f-k4-15	protection	1/4" Weld	100	413	-28	37	15
TL_FL101	Filter	Swagelok ss-4TF-TW-15	Transfer tube filter	3/8" Weld	100	413	-28	37	15
TL_FL102	Filter	Swagelok ss-4TF-TW-15	TL-VL109 protection	1/4" Weld	100	413	-28	37	15
TR_FL101	Filter	Swagelok ss-4TF-TW-15	Transfer tube filter	3/8" Weld	100	413	-28	37	15
TR_FL102	Filter	Swagelok ss-4TF-TW-15	TL-VR109 protection	1/4" Weld	100	413	-28	37	15
SA_FL101	Filter	Danfoss DML 033s/023Z5050	Liquid line filtering	3/8 solder					
SB_FL101	Filter	Danfoss DML032s/023Z5048	Liquid line filtering	1/4 solder					

Code	PVSS Identifier	Part number	Serial Number	Function	Connection	Operating Pressure (Bar)	Maximum Design Pressure (Bar)	Minimum design temperature (°C)	Maximum design temperature (°C)	Minimum measuring range (Bar)	Maximum measuring range(Bar)	Supply (V)	Output signal
TL_PT001	Pressure Transmitter	25		Transfer tube outlet pressure	1/4x1/8NPT	100	150	-73	162	0	100	10Vdc	10Vdc
TL_PT002	Pressure Transmitter	25		Evaporator inlet pressure	1/4x1/8NPT	100	150	-73	162	0	100	10Vdc	10Vdc
TL_PT003	Pressure Transmitter	FJ BG-G15011		Evaporator (Outlet) pressure	1/4x1/8NPT	100	150	-73	162	0	100	10Vdc	10Vdc
TL_PT004	Pressure Transmitter	FJ BG-G15011		Tertiary vacuum monitoring	CF-16	2				1,00E-06	1		
TL_PT101	Pressure Transmitter	Druck PTX7511-100bar	2437061	Accumulator pressure	G1/4"Female	100	200	-40	80	0	100	9-30Vdc	4-20mA
TL_PT102	Pressure Transmitter	Druck PTX7511-100bar	2437064	Condensor pressure	G1/4"Female	100	200	-40	80	0	100	9-30Vdc	4-20mA
TL_PT103	Pressure Switch	Lewa pump integral		Accumulator pressure	TL-FM101 Membrane Pressure	100	200	-40	80	0	100	9-30Vdc	Open/close
TL_PT104	Pressure Transmitter	Druck PTX7511-100bar	2437062	Pump outlet	G1/4"Female	100	200	-40	80	0	100	9-30Vdc	4-20mA
FR_PT001	Pressure Transmitter	25		Transfer tube outlet pressure	1/4x1/8NPT	100	150	-73	162	0	100	10Vdc	10Vdc
FR_PT002	Pressure Transmitter	25		Evaporator inlet pressure	1/4x1/8NPT	100	150	-73	162	0	100	10Vdc	10Vdc
FR_PT003	Pressure Transmitter	25		Evaporator (Outlet) pressure	1/4x1/8NPT	100	150	-73	162	0	100	10Vdc	10Vdc
FR_PT004	Pressure Transmitter	FJ BG-G15011		Tertiary vacuum monitoring	CF-16	2				1,00E-06	1		
FR_PT101	Pressure Transmitter	Druck PTX7511-100bar	2437058	Accumulator pressure	G1/4"Female	100	200	-40	80	0	100	9-30Vdc	4-20mA
FR_PT102	Pressure Transmitter	Druck PTX7511-100bar	2437065	Accumulator pressure	G1/4"Female	100	200	-40	80	0	100	9-30Vdc	Open/close
FR_PT103	Pressure Switch	Lewa pump integral		TR-FM101 Membrane Pressure	G1/4"Female	100	200	-40	80	0	100	9-30Vdc	Open/close
TLR_PT103	Pressure Transmitter	Druck PTX7511-100bar	2437063	Pump outlet	G1/4"Female	100	200	-40	80	0	100	9-30Vdc	Open/close
SA_PT101	Pressure Transmitter	Danfoss AKS33/060G2120		TLR-PM101 Membrane Pressure	G3/8" Male	20	40	-40	85	0	7	10-30Vdc	4-20mA
SA_PT102	Pressure Transmitter	Danfoss AKS33/060G2120		Discharge pressure	G3/8" Male	20	40	-40	85	0	7	10-30Vdc	4-20mA
SA_PT103	Pressure Transmitter	Danfoss AKS33/060G2120		Liquid pressure	G3/8" Male	20	40	-40	85	0	7	10-30Vdc	4-20mA
SA_PT104	Pressure Transmitter	Danfoss AKS33/060G2127		Left evaporator pressure	G3/8" Male	6	33	-40	85	0	7	10-30Vdc	4-20mA
SA_PT105	Pressure Transmitter	Danfoss AKS33/060G2127		Right evaporator pressure	G3/8" Male	6	33	-40	85	0	7	10-30Vdc	4-20mA
SA_PT106	Pressure Transmitter	Danfoss AKS33/060G2127		Left accumulator pressure	G3/8" Male	6	33	-40	85	0	7	10-30Vdc	4-20mA
SA_PT107	Pressure Transmitter	Danfoss AKS33/060G2127		Right accumulator pressure	G3/8" Male	6	33	-40	85	0	7	10-30Vdc	4-20mA
SA_PT108	Pressure Switch	Danfoss KP15066-126166		Suction gas pressure protection	G3/8" Male	6	33	-40	85	0	7	10-30Vdc	4-20mA
SB_PT102	Pressure Transmitter	Danfoss AKS33/060G2120		Liquid pressure	G3/8" Male	20	40	-40	85	0	7	10-30Vdc	4-20mA
SB_PT103	Pressure Transmitter	Danfoss AKS33/060G2127		Left evaporator pressure	G3/8" Male	6	33	-40	85	0	7	10-30Vdc	4-20mA
SB_PT104	Pressure Transmitter	Danfoss AKS33/060G2127		Right evaporator pressure	G3/8" Male	6	33	-40	85	0	7	10-30Vdc	4-20mA
SB_PT105	Pressure Transmitter	Danfoss AKS33/060G2127		Left accumulator pressure	G3/8" Male	6	33	-40	85	0	7	10-30Vdc	4-20mA
SB_PT106	Pressure Transmitter	Danfoss AKS33/060G2127		Right accumulator pressure protection	G3/8" Male	6	33	-40	85	0	7	10-30Vdc	4-20mA

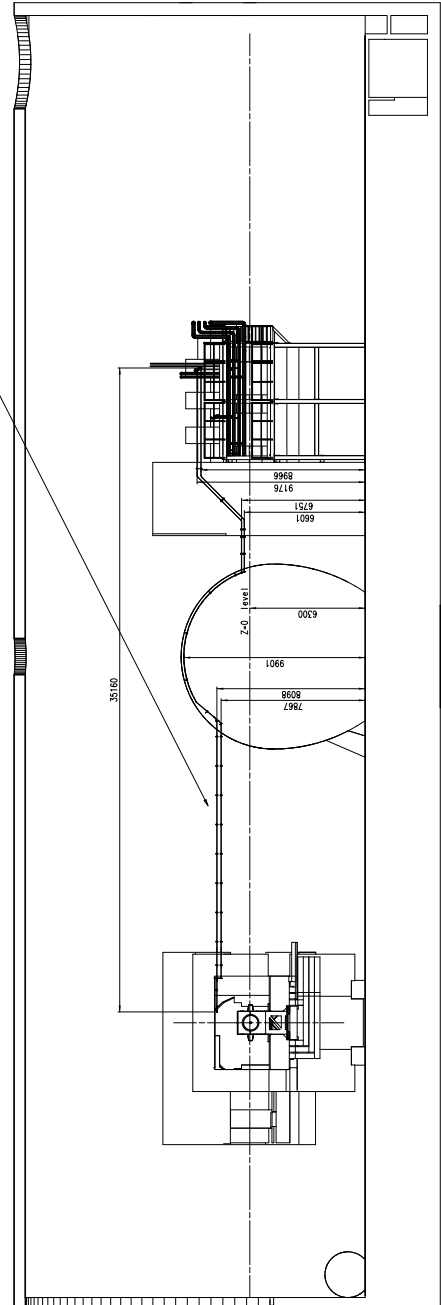
# APPENDIX R

Technical Drawings (summary)



VTCS Concentric Transfer Tubes

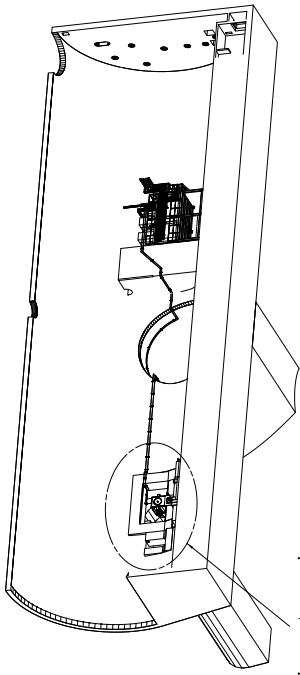
- For construction details and partlist of the concentric tube and connections see sheet 5.
- Partlist is at sheet 5.
- Dimensions of general tube routing are for reference, CERN drawing LHC28280013 must be followed for construction.
- For information on neighbouring tubes see CERN drawings:  
 lhc28280005  
 lhc28280008  
 lhc28280010



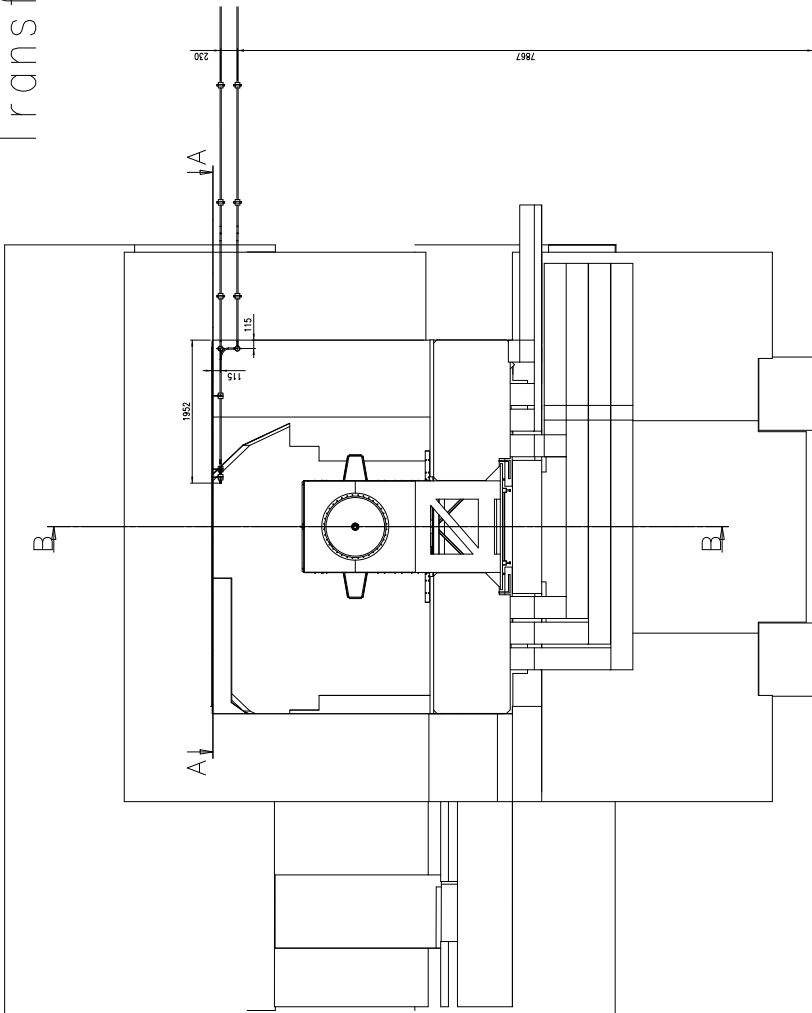
NO.	REV.	TITLE	MATERIAL	DATE	BY	CHKD.	APP.	DATE	BY	CHKD.	APP.
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2	B	VTCS Concentric		21-10-05	M/103						
3	C	VTCS Concentric		21-10-05	M/103						
4	D	VTCS Concentric		21-10-05	M/103						
5	E	VTCS Concentric		21-10-05	M/103						
6	F	VTCS Concentric		21-10-05	M/103						
7	G	VTCS Concentric		21-10-05	M/103						
8	H	VTCS Concentric		21-10-05	M/103						
9	I	VTCS Concentric		21-10-05	M/103						
10	J	VTCS Concentric		21-10-05	M/103						

Project: LHCb Vertex Locator  
 Title: VTCS Concentric  
 Scale: 1:100  
 Date: 9-10-05  
 Checked: M/103  
 Drawn: M/103  
 Size: Identification No.: AG [V]C12 Sheet J  
 Revision: 10  
 Date: 21-10-05  
 Drawn: M/103  
 Checked: M/103  
 Scale: 1:100  
 Project: LHCb Vertex Locator

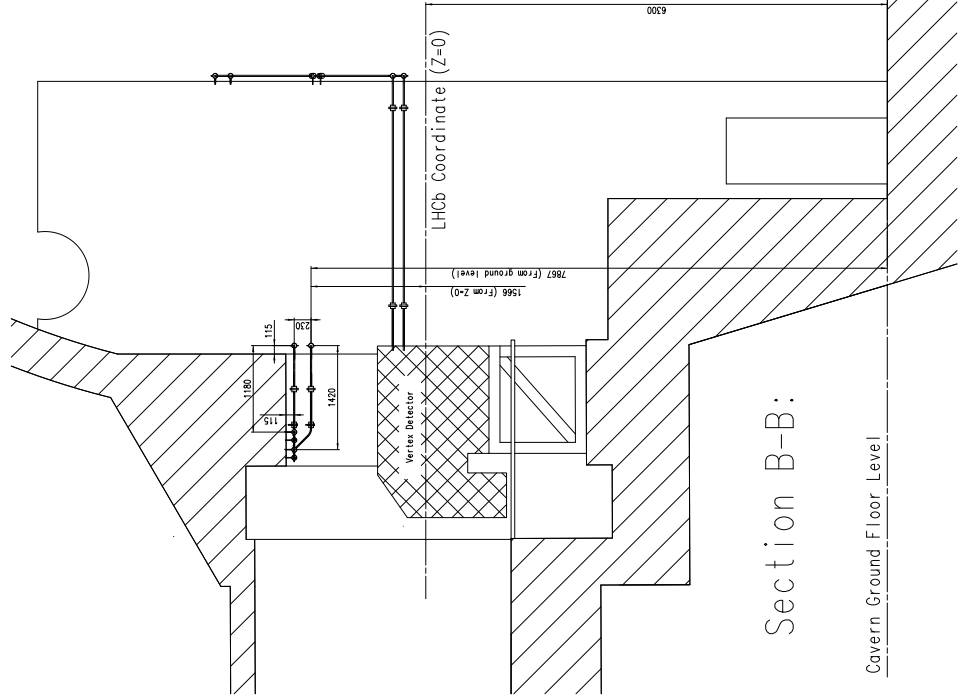
Transfer tube details at detector cave



Dimensioned region



Section A-A:



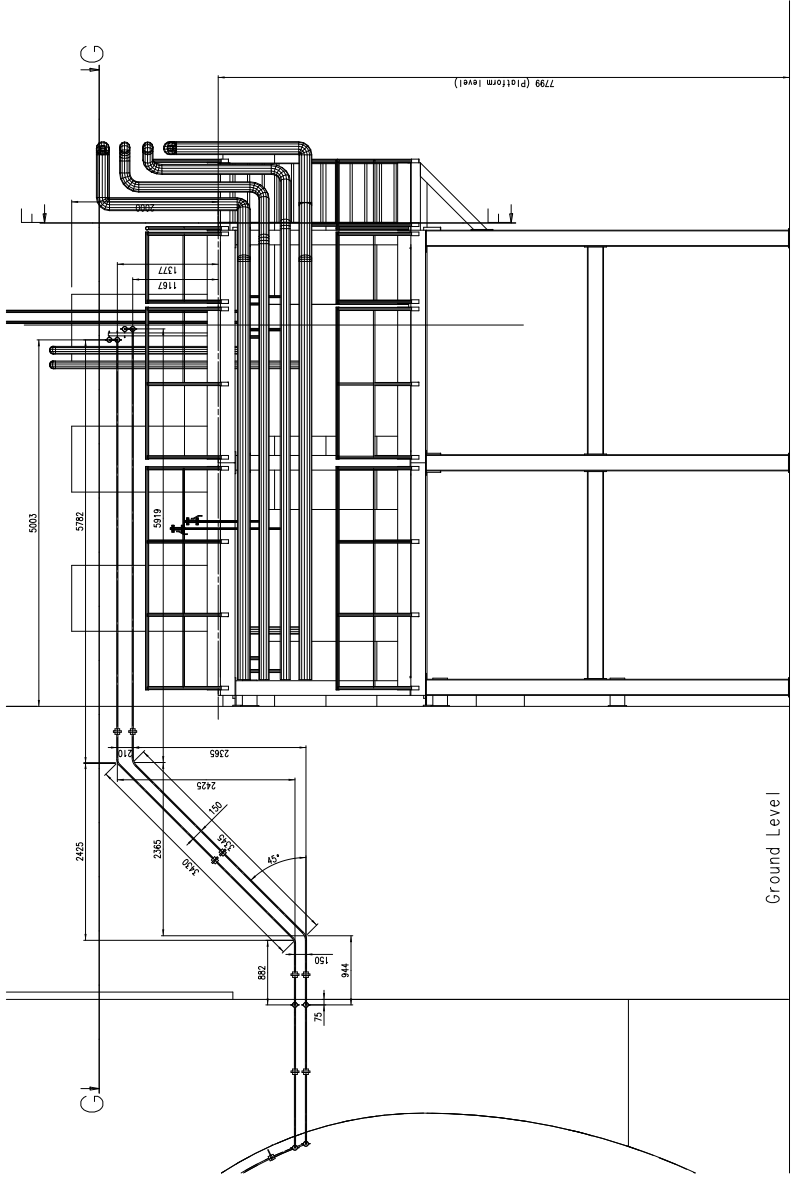
Section B-B:

Cavern Ground Floor Level

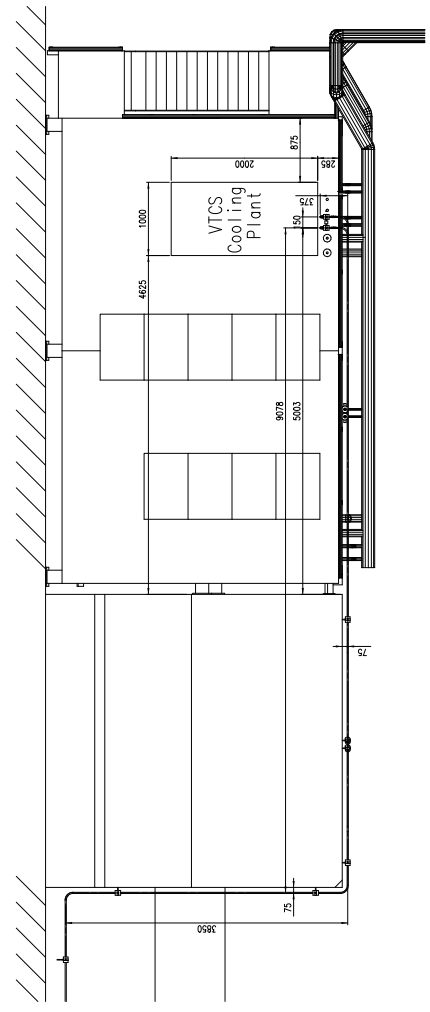
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7	20-10-05	M/1031		Scale: 1:25	
8	20-10-05	M/1031		Scale: 1:25	
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10	20-10-05	M/1031		Scale: 1:25	
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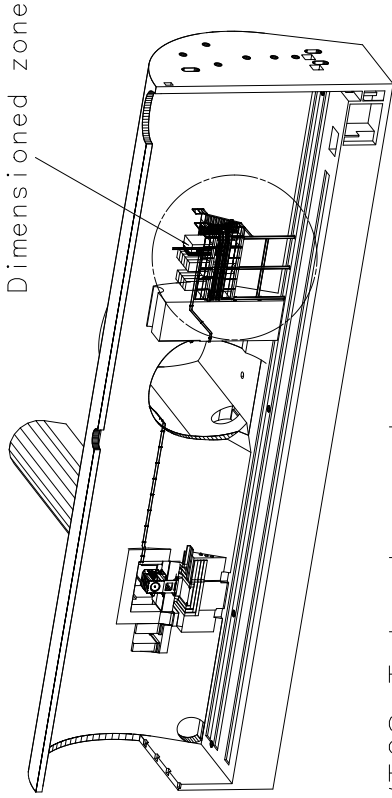




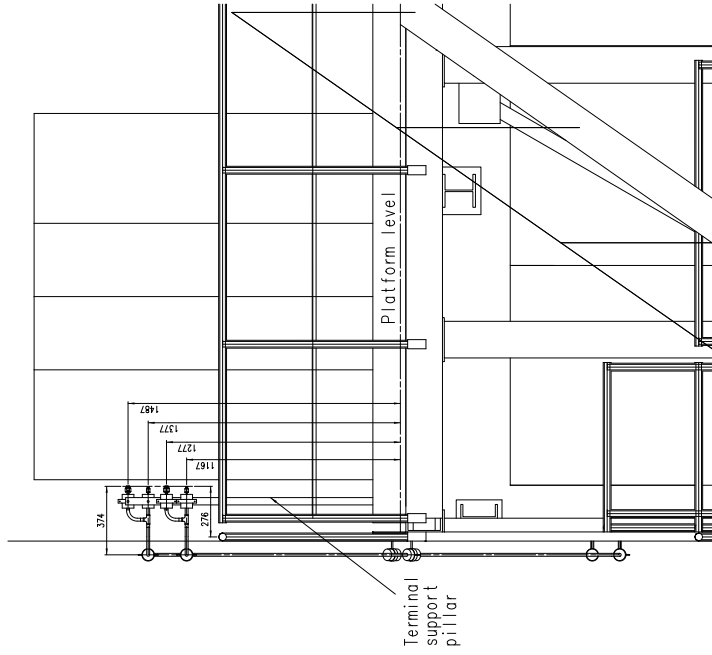
Section G-G:



Section F-F:  
(Scale 1:10)



VTCS Tube Layout near  
Cooling Tower RB84



Terminal  
support  
pillar

NO.	DATE	TITLE	MATERIAL	BY	CHKD.	DATE	REVISION
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2	20-10-05	Title: VTCS Concentric					
3	20-10-05	Scale: 1:25					
4	20-10-05	Drawn: B. M. J. J.					
5	20-10-05	Checked: B. M. J. J.					
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12	20-10-05	Scale: 1:25					
13	20-10-05	Scale: 1:25					
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15	20-10-05	Scale: 1:25					
16	20-10-05	Scale: 1:25					
17	20-10-05	Scale: 1:25					
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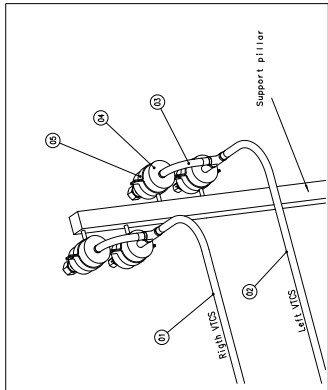
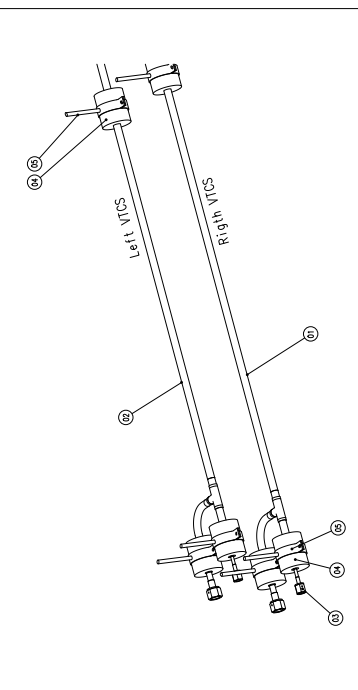


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1. THIS DRAWING IS THE PROPERTY OF NICEF. IT IS TO BE USED ONLY FOR THE PROJECT AND SITE SPECIFICALLY MENTIONED THEREIN.  
2. ANY REVISIONS TO THIS DRAWING MUST BE APPROVED BY THE PROJECT MANAGER AND NICEF.  
3. ANY REVISIONS TO THIS DRAWING MUST BE APPROVED BY THE PROJECT MANAGER AND NICEF.  
4. ANY REVISIONS TO THIS DRAWING MUST BE APPROVED BY THE PROJECT MANAGER AND NICEF.  
5. ANY REVISIONS TO THIS DRAWING MUST BE APPROVED BY THE PROJECT MANAGER AND NICEF.

Cooling Tower side

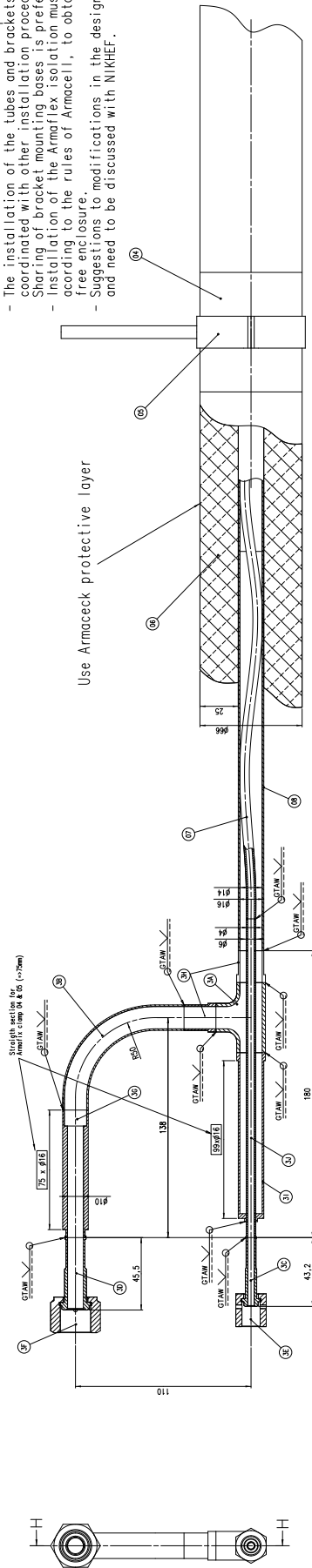
Detector side

Left VTCS Transfer tube concentric length: 47.8 meter  
 Right VTCS Transfer tube concentric length: 46.7 meter



- The transfer tube assembly is a PN100 pressure system.
- The transfer tube is part of the cold section of a cooling system. Operational temperature range: (-45 to 30°C) inner tube and outer tube are always in the same temperature range.
- Proof pressure test inner and outer tube with 150bar inert gas.
- A helium leak test has to be performed to ensure a leak tightness of 10e-7 mbar·l/s.
- Ports have to be cleaned using acetone, and dried with Nitrogen flushing.
- Welds made in the experimental hall are preferably made by orbital welding because of the limited space.
- Welds shall be submitted to a CERN inspection (X-ray control).
- The installation of the tubes and brackets need to be coordinated with other installation procedures.
- Sharing of bracket mounting bases is preferred.
- Installation of the Armaflex isolation must be performed according to the rules of Armacell, to obtain a moisture free enclosure.
- Suggestions to modifications in the design are negotiable and need to be discussed with NIKHEF.

Section H-H:

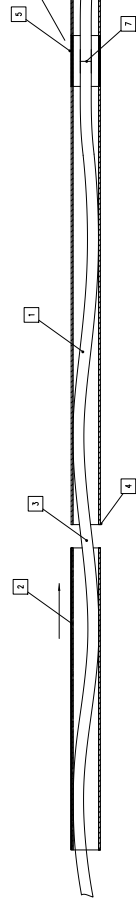


Concentric tube assembly sequence and rules.

1. Make the inner tube coming from roll not to straight so it will be jammed inside the outer tube.
2. Slide section of outer tube over the longer inner tube.
3. Make sure that the inner tube is centered and not touching the outer tube wall near the weld.
4. Weld the outer tubes together preferably by orbital welding (limited space).
5. In case sliding over the outer tube is not possible (at the end or with prefabricated sections) an intermediate section with longitudinal cut can be used.
6. The inner and outer tube can be bend safely together to a radius of 80mm with a normal 16mm tube bender. However all the radii in the design are 100mm
7. Maintain inner tube as long as possible to minimize unreachable welds. If needed an orbital weld is preferred.
8. Do not use flow blocking spacers to center the tube!

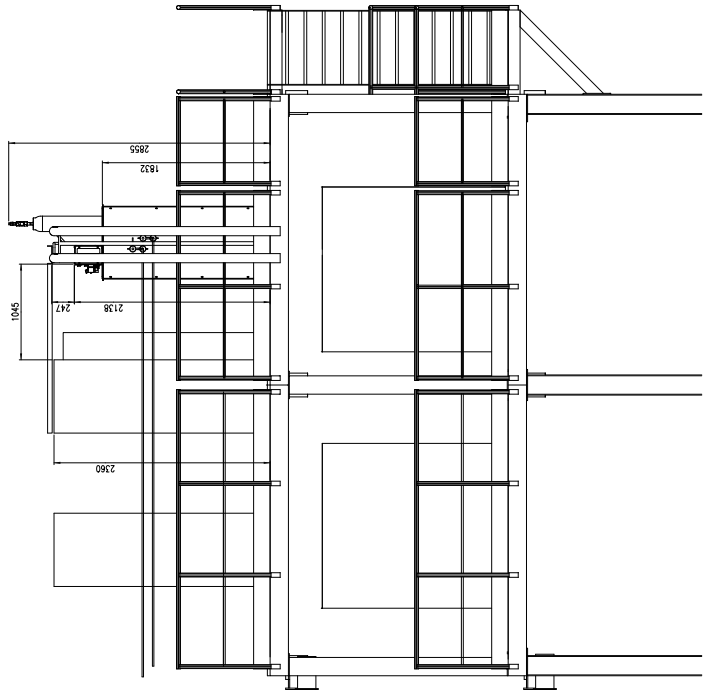
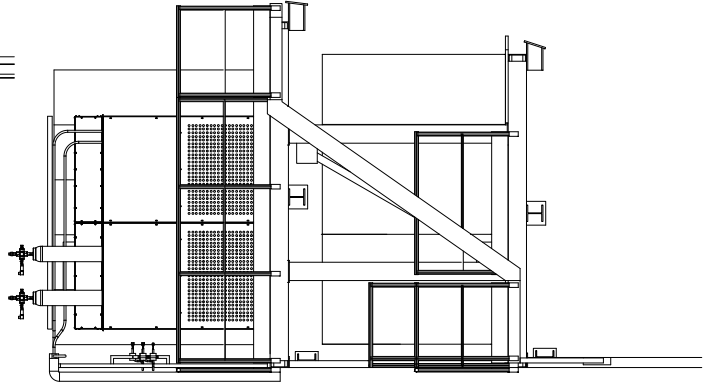
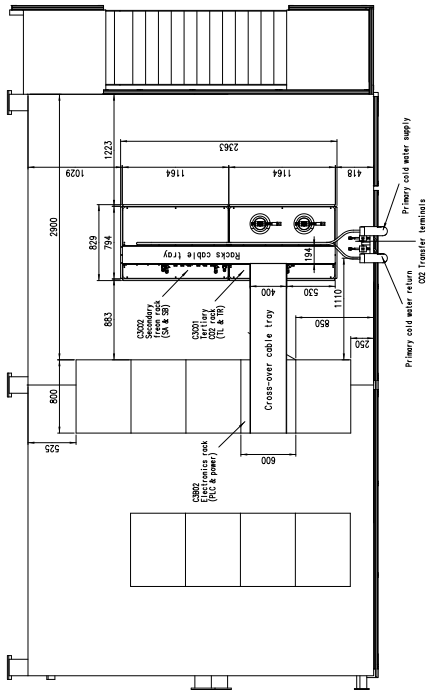
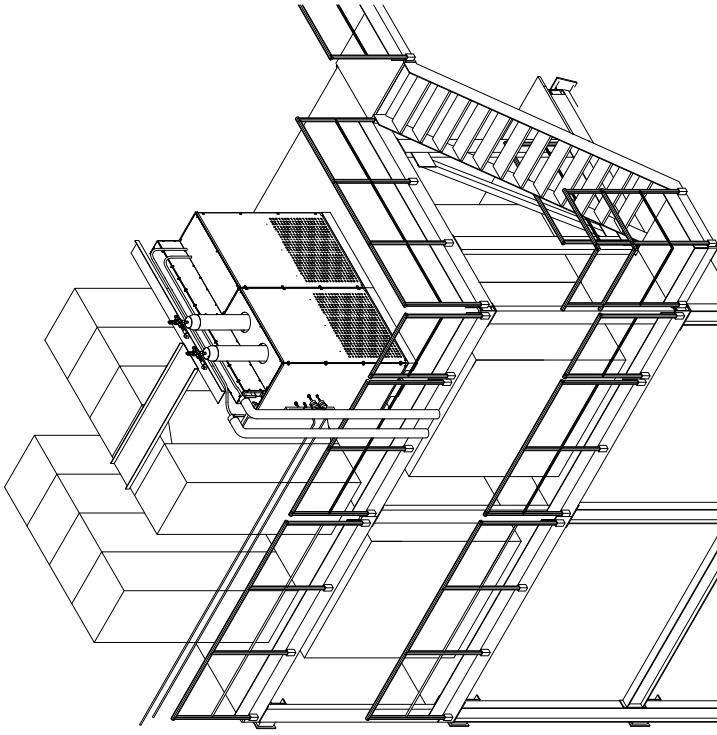
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32	1	Roll (length: 1.5m) (720mm)	316L/304	www.arni.com.nl		
33	2	Roll (length: 1.5m) (720mm)	316L/304	www.arni.com.nl		
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79	1	Roll (length: 1.5m) (720mm)	316L/304	www.arni.com.nl		
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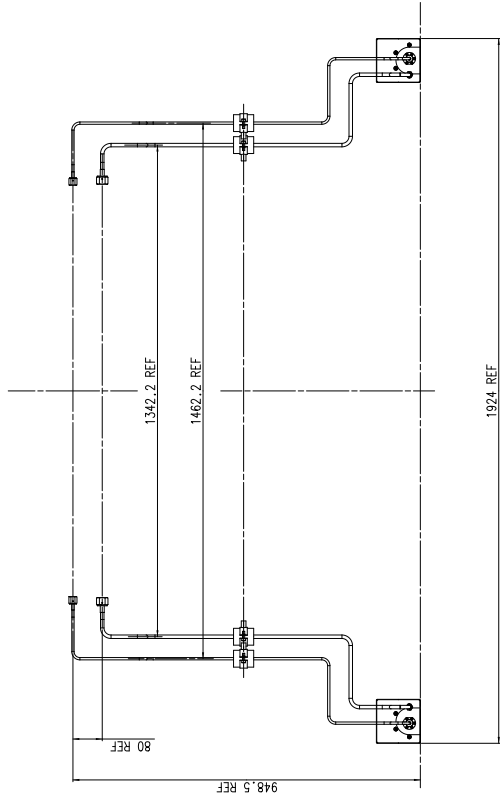
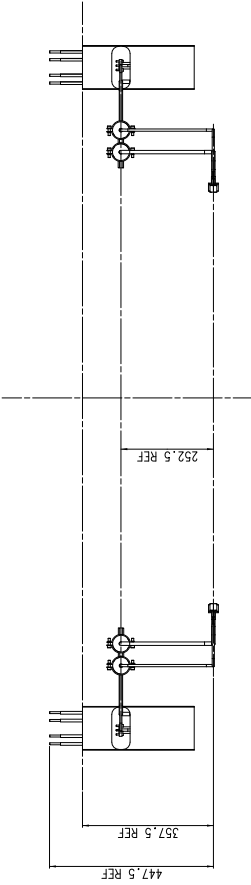
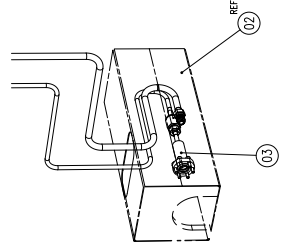
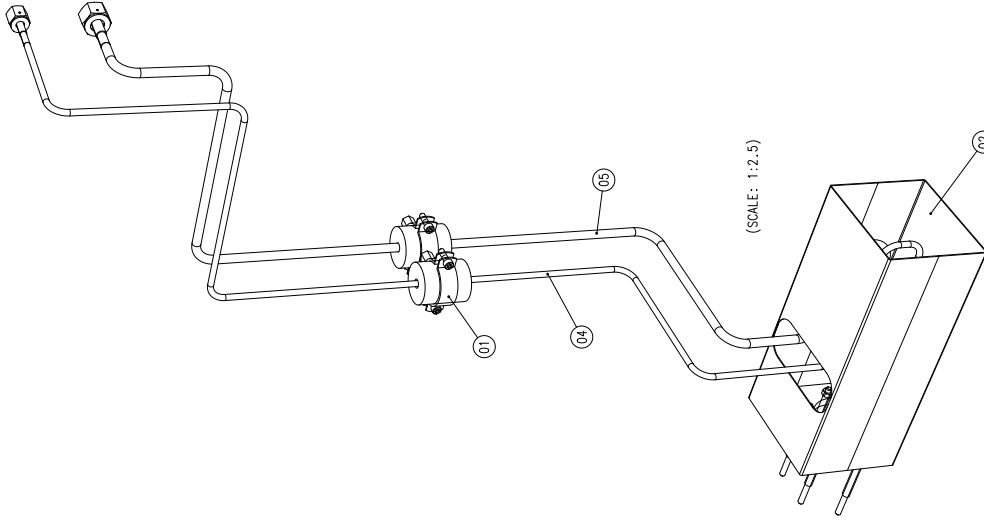
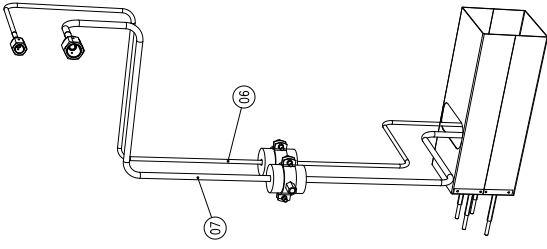
VTCS Situation at UXAC03 Platform



PARTIAL NO.	TITLE	MATERIAL	DATE	BY	NO. OF SHEETS
1	Project: LHCb Vertex Locator		29-11-06	M/1031	
2	Title: VTCS-overall in LHCb				
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SCALE: 1:20  
 DRAWN: B. M. M. M.  
 CHECKED: S. E. E. E.  
 DATE: 15-11-06  
 PROJECT: LHCb Vertex Locator  
 TITLE: VTCS-overall in LHCb  
 SHEET: 101 OF 132  
 DRAWING NO.: AG IVC/0-Sheet 2



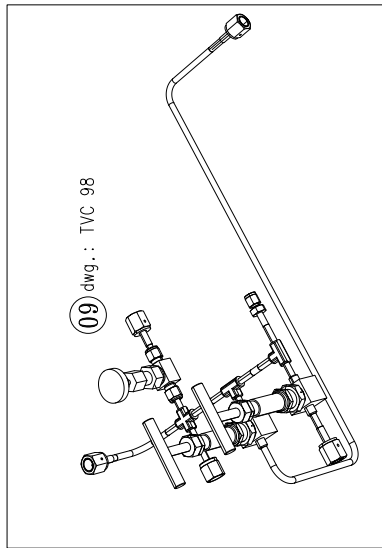
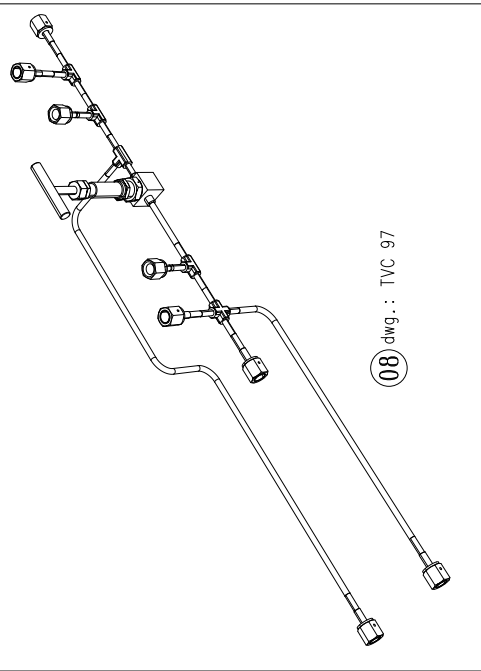
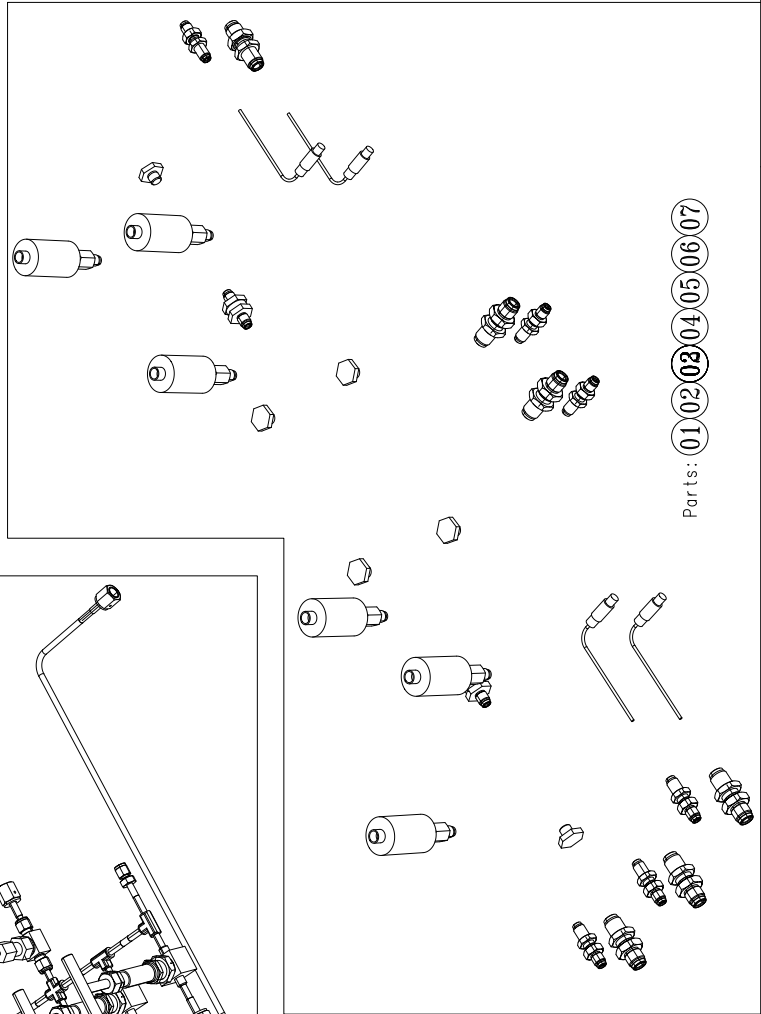
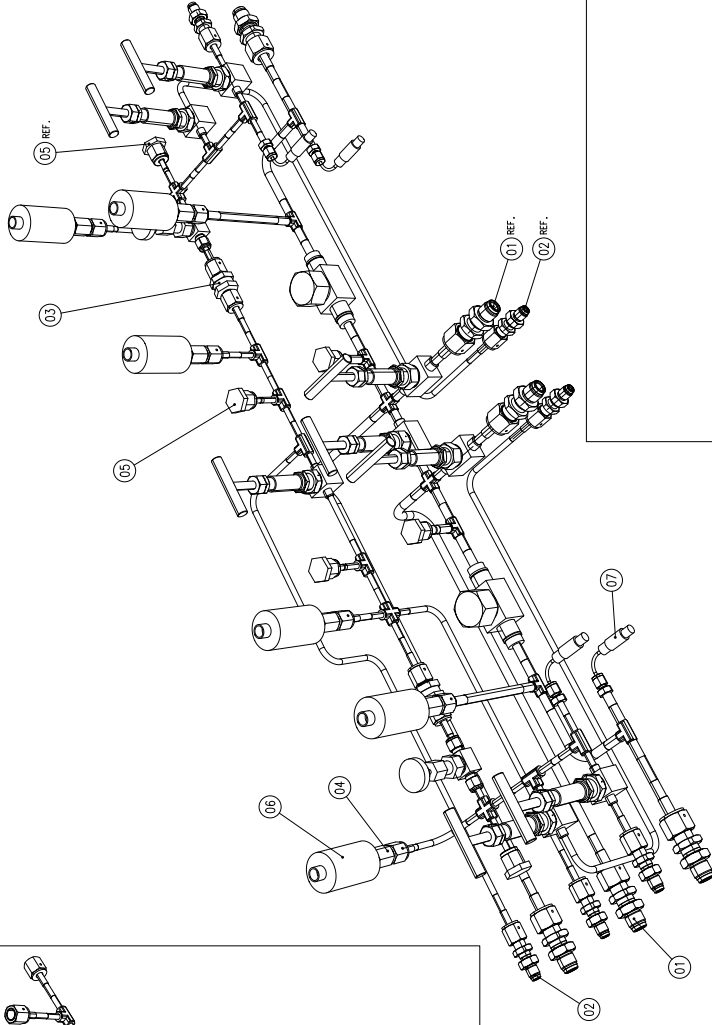
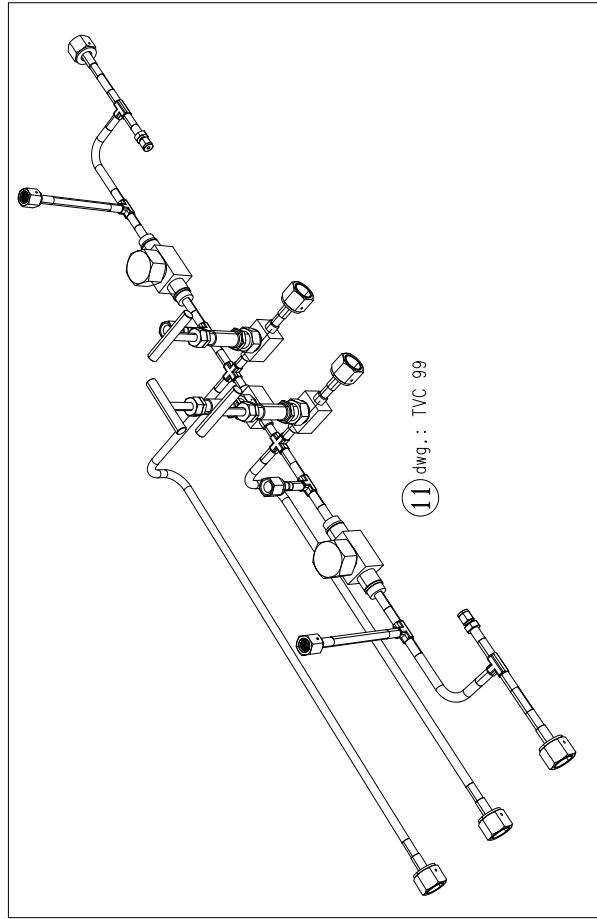
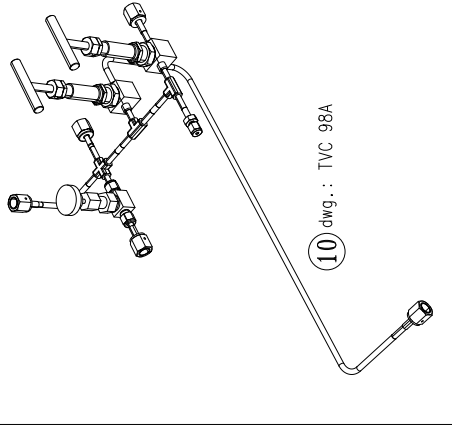


Part No.	Part Name	Material	Quantity	Rev.	By / Date
1	Right Detector Head Mounting Tube	NO100	1		
2	Right Detector Head Mounting Tube	NO100	1		
3	Left Detector Head Mounting Tube	NO100	1		
4	Left Detector Head Inlet Tube	NO100	1		
5	Right Detector Head Inlet Tube	NO100	1		
6	Support Arm	NO107	1		
7	Support Arm Connector	NO107	1		
8	Support Arm Connector Protection Cap	NO107	1		
9	Support Arm Support Assy	NO107	1		

Material	Quantity	By / Date
NO100	5	
NO107	4	

Project: Hub Vertex Detector / VIS Bridge  
 Title: Evaporator Tubing  
 Scale: 1:2.5  
 Date: 20-02-07  
 Drawn: A.K.  
 Checked: S.Y.  
 E.E.R. LABEL  
 Size: 20-270x44-20-402.4-101-105  
 Identification No.: AG IVC 111  
 WARNING: This drawing is for informational purposes only. It is not to be used for construction or manufacturing without the approval of the design engineer.

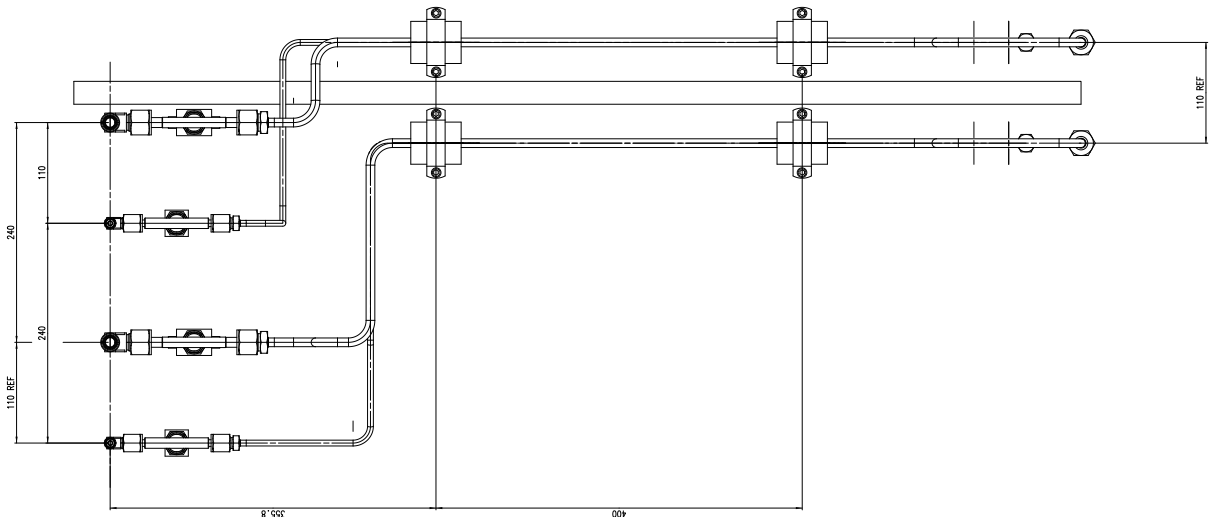
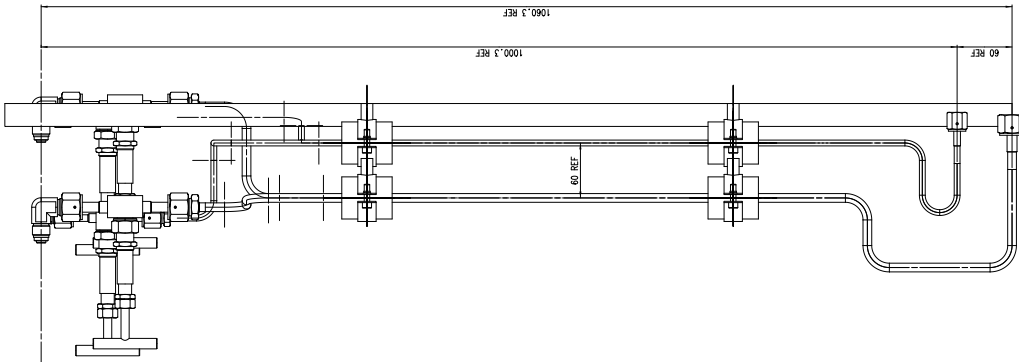
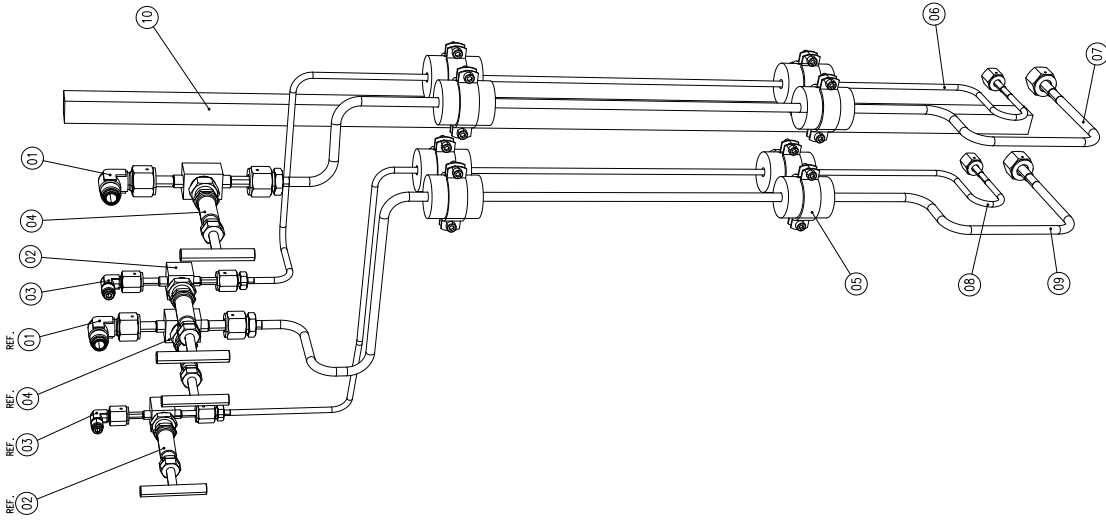


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1000	2	VIS 50 Edge Lower Water Pump	10000
1000	3	VIS 50 Edge Upper Water Pump	10000
1000	4	VIS 50 Edge Lower Water Pump	10000
1000	7	P100 1/2" Ball Valve 1/2" NPT	10000
1000	8	P100 1/2" Ball Valve 1/2" NPT	10000
1000	9	VIS 50 Edge Upper Water Pump	10000
1000	10	VIS 50 Edge Lower Water Pump	10000
1000	11	VIS 50 Edge Upper Water Pump	10000
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1000	17	VIS 50 Edge Upper Water Pump	10000
1000	18	VIS 50 Edge Lower Water Pump	10000

Parts: 01 02 03 04 05 06 07

Project: E10b Veritas Ulector / VIS Bridges  
 Title: VIS Local Control Box  
 Size: Identification No.  
 Date: 2023/06/01  
 Scale: 1:1  
 Author: A.G. TVC 113





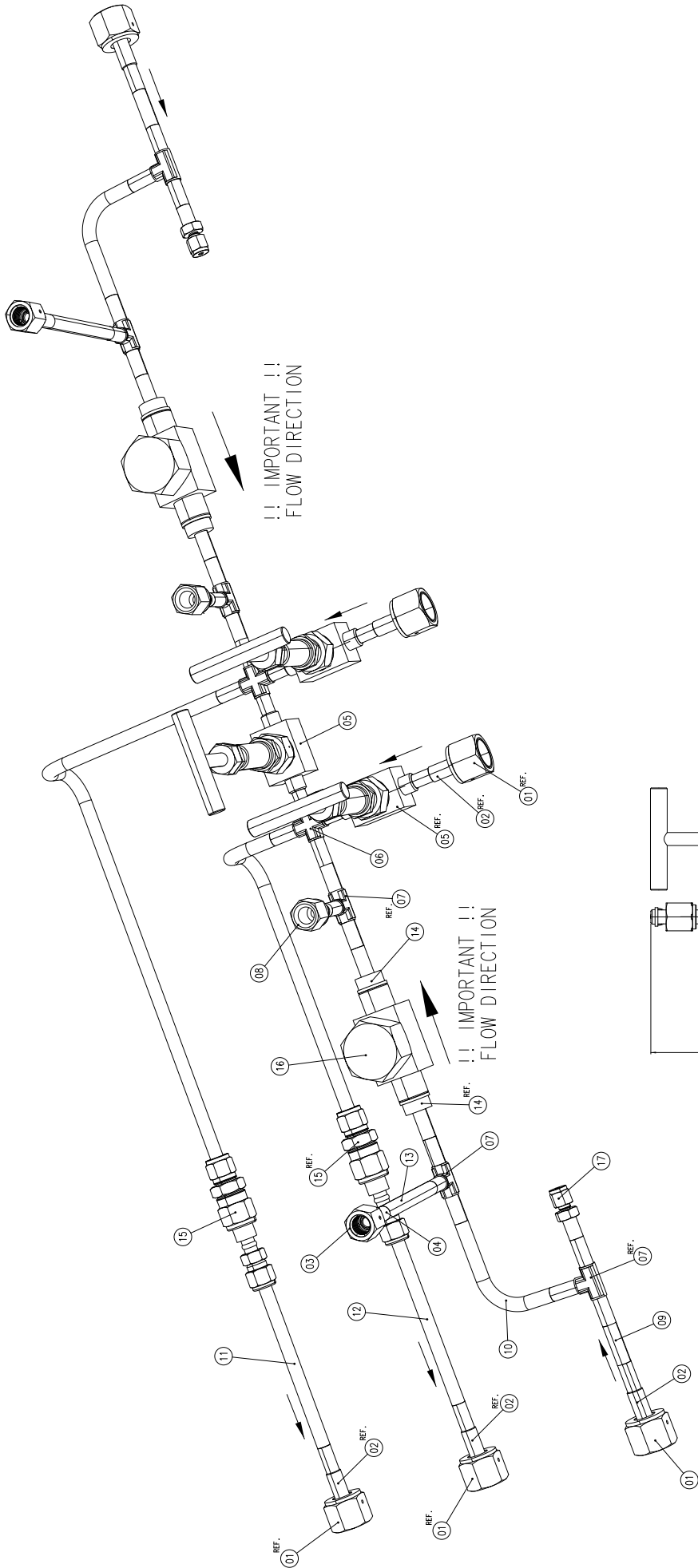
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9	1	High Visc Vapor Connection Tube	2	EA					
8	1	High Visc Liquid Connection Tube	2	EA					
7	1	1/4\"/>							

Part No.	Part Name	Material	Quantity	UoM	Drawn	Checked	By	Date	Rev
6	2	1/4\"/>							

Project: EUB Vertes Ubeator / VISC Bridge  
 Title: Bridge to Transfer Tube  
 Drawing No.: 105-001-01  
 Scale: 1:2  
 Date: 19-02-07  
 Checked: A.K.  
 Drawn: A.K.  
 E.E.R. C.A.B.E.L.

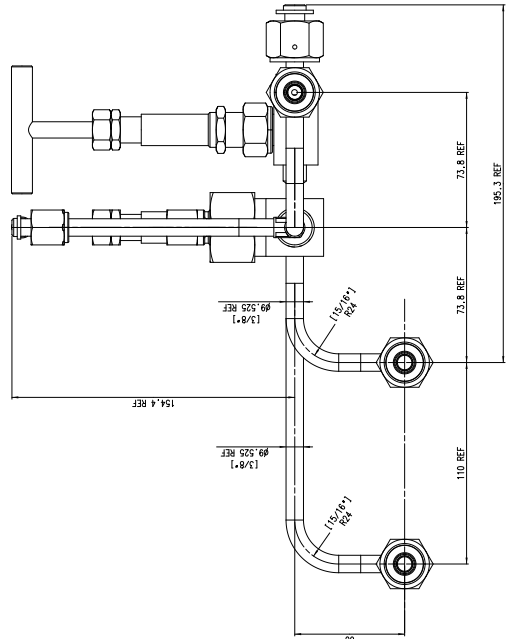
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 Project: EUB Vertes Ubeator / VISC Bridge  
 Title: Bridge to Transfer Tube  
 Drawing No.: 105-001-01  
 Scale: 1:2  
 Date: 19-02-07  
 Checked: A.K.  
 Drawn: A.K.  
 E.E.R. C.A.B.E.L.

**NIREF**  
 NATIONAL INSTRUMENTS REFERENCE EQUIPMENT  
 10000 10th Street, Suite 100, Dallas, Texas 75243  
 Phone: (972) 242-1000 Fax: (972) 242-1001  
 Email: sales@ni-ref.com Website: www.ni-ref.com



NOTE:

1. MATERIAL TUBES; STAINLESS STEEL AISI 316L
2. ALL CONNECTIONS ORBITAL WELDED.



VIEW P

17	2	SPT 3/8" Through 1.500" ID Tube Ball Valve	Modified Suporak SS-50T-14
16	2	LIFT check valve	Suporak SS-50BT1
15	2	Directing Fitting 3/8" Inch	SS-50-B-4
14	2	3/8" Tube x 1.500" ID Tube Adapter	Y02004
13	3	3/8" Tube 4	Y02004
12	1	3/8" Tube 5	Y02004
11	1	3/8" Tube 4	Y02004
10	2	3/8" Tube 2	Y02002
9	2	3/8" Tube 1	Y02002
8	2	3/8" Tube Reducer Disc Holder	Y02002
7	4	3/8" x 1/2" x 1/8" 316 SS Ball Valve	Suporak SS-50B-3
6	4	3/8" x 1/2" x 1/8" 316 SS Ball Valve	Suporak SS-50B-3
5	3	3/8" x 1/2" x 1/8" 316 SS Ball Valve	Suporak SS-50B-3
4	2	1/4" x 1/2" x 1/8" 316 SS Tube Ball Valve Gland	Suporak SS-4-40023-1-100
3	2	1/4" x 1/2" 316 SS Tube Ball Valve Gland	Suporak SS-4-40023-100
2	4	1/2" x 1/2" x 3/16" Long Tube Ball Valve Gland	Suporak SS-4-40023-4100
1	6	1/2" x 1/2" VOR Events Nut	Suporak SS-4-40023-1
REF. 02		Part of the name	Ref. Drawing no. / Size / Note

Project: VICS Verdes Uvector / VICS Bridge  
 Title: VICS Bridge Vpper (Sheet 1)  
 Author: A. J. M.  
 Date: 15-02-07  
 Scale: 1:1  
 Drawn: A. J. M.  
 Checked: A. J. M.

SEER LABEL

AG IVC 99

Identification No. 101132

Rev. 01

Rev. 02

Rev. 03

Rev. 04

Rev. 05

Rev. 06

Rev. 07

Rev. 08

Rev. 09

Rev. 10

Rev. 11

Rev. 12

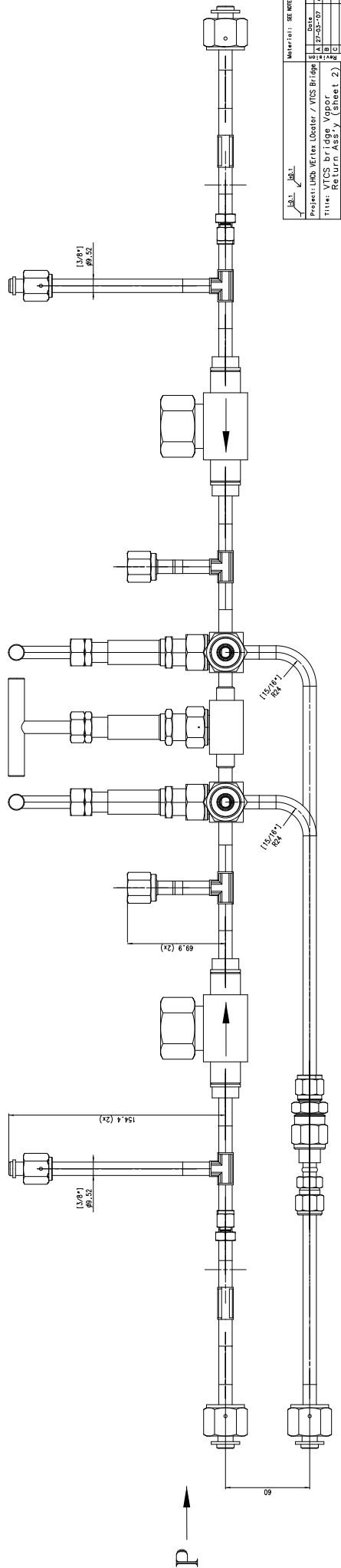
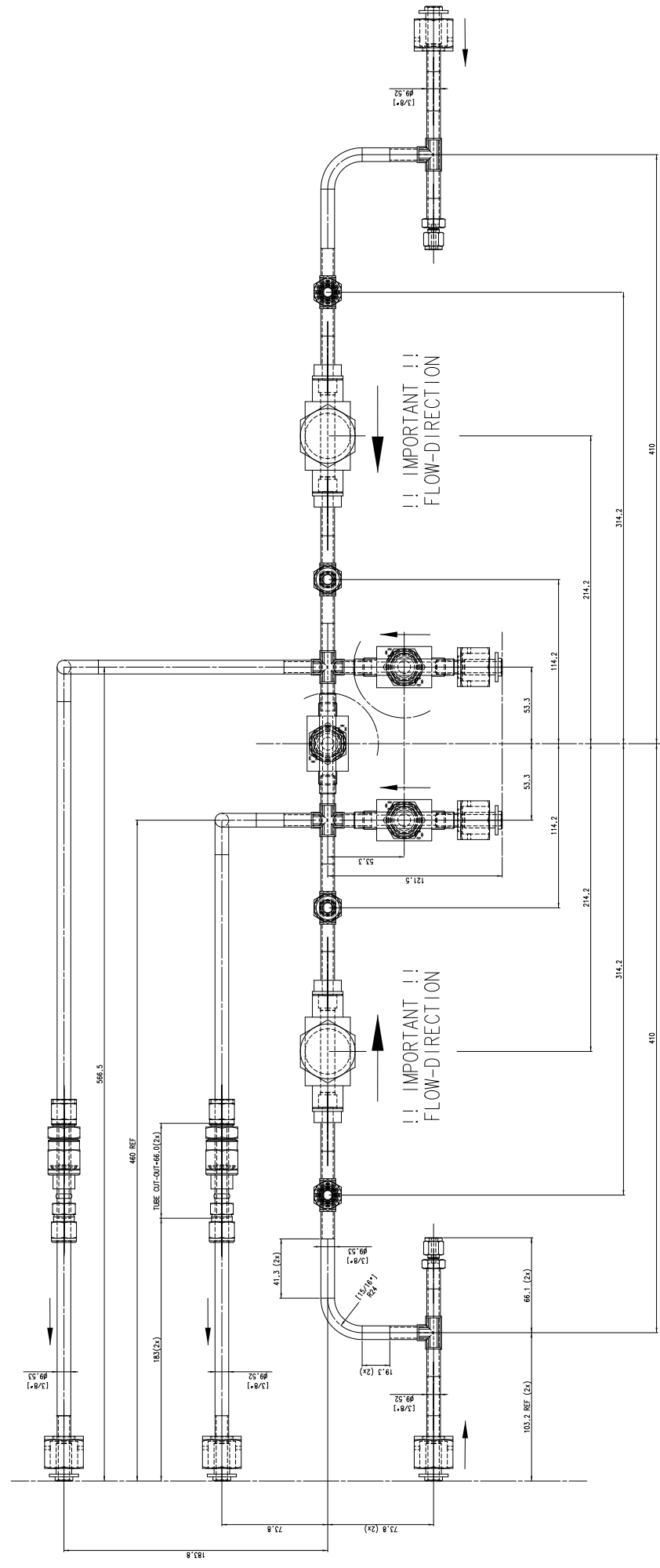
Rev. 13

Rev. 14

Rev. 15

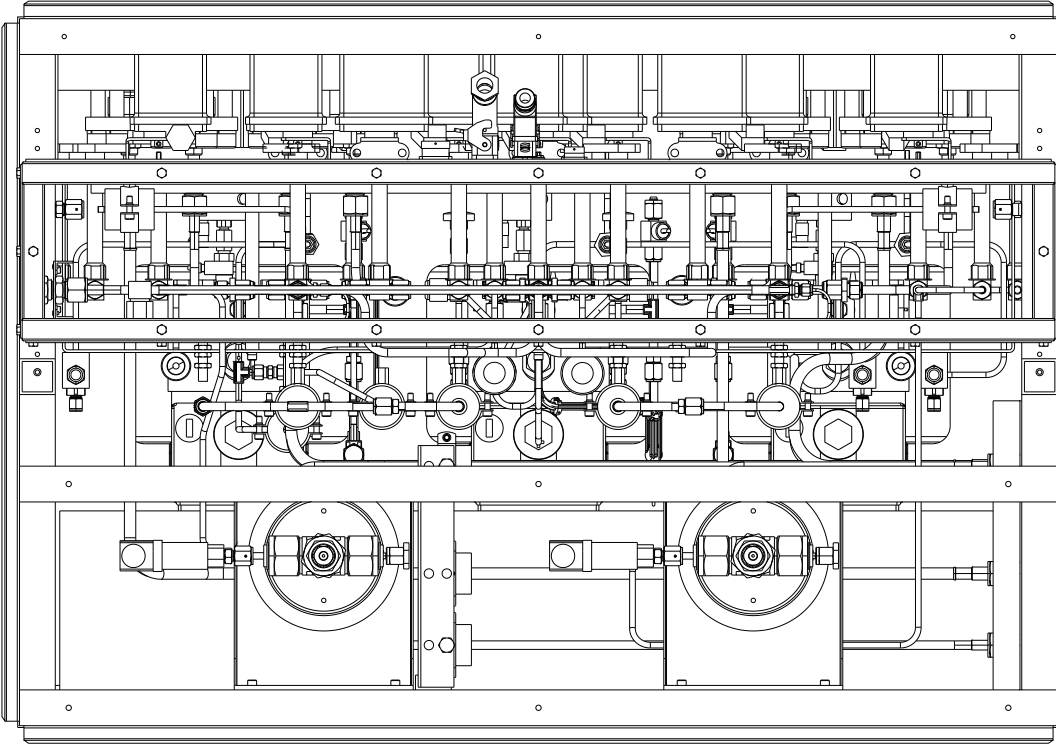
Rev. 16

Rev. 17

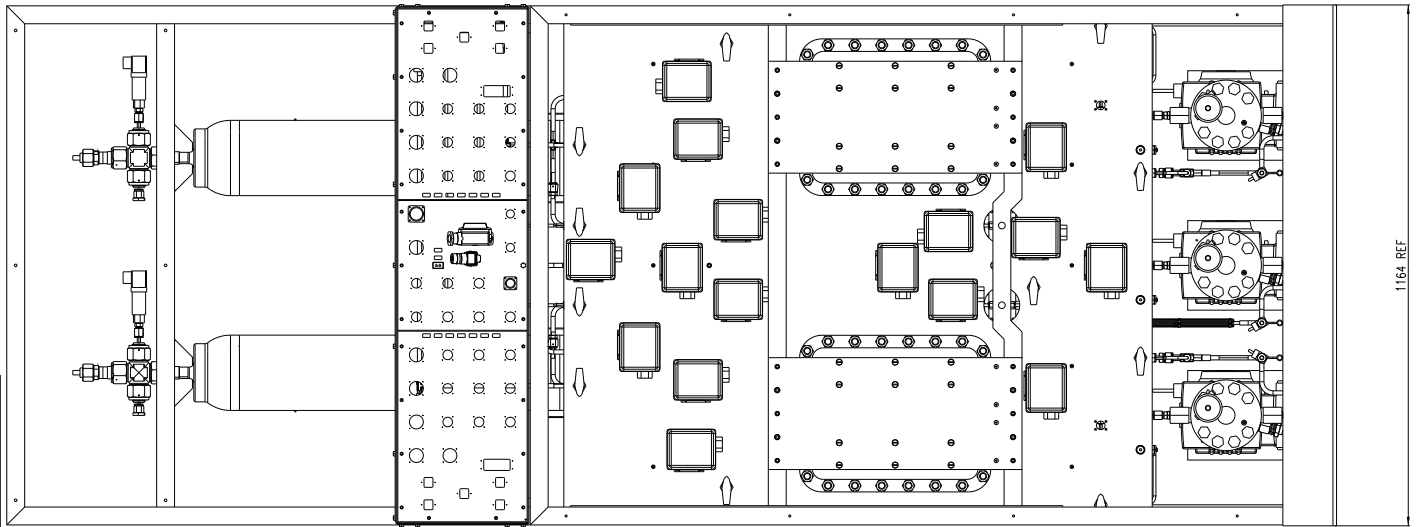


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82	17-03-07
83	17-03-07
84	17-03-07
85	17-03-07
86	17-03-07
87	17-03-07
88	17-03-07
89	17-03-07
90	17-03-07
91	17-03-07
92	17-03-07
93	17-03-07
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97	17-03-07
98	17-03-07
99	17-03-07
100	17-03-07



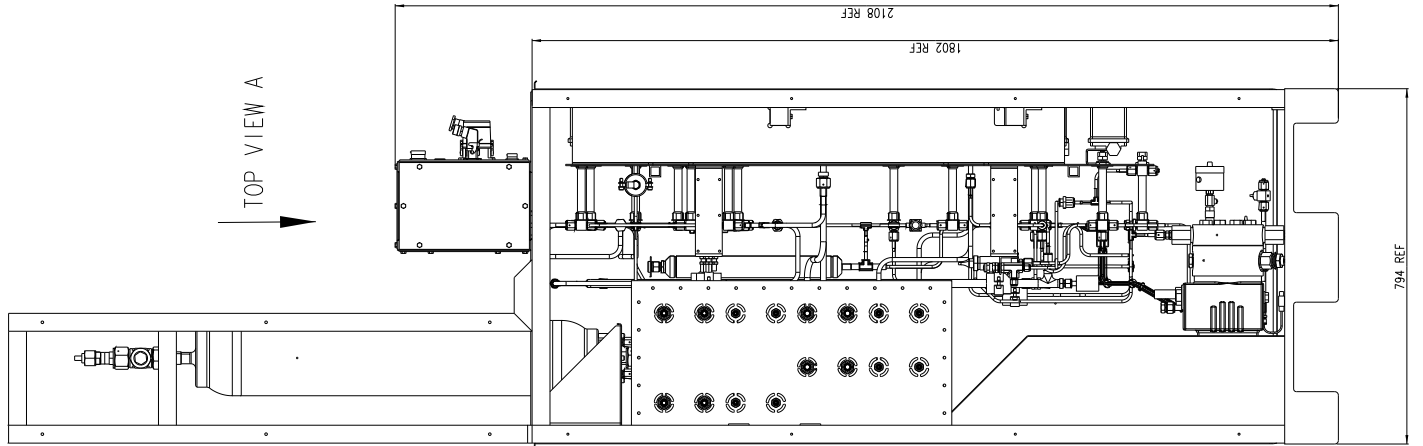


TOP VIEW A  
(SCALE: 1:2)



42986 REF

1164 REF



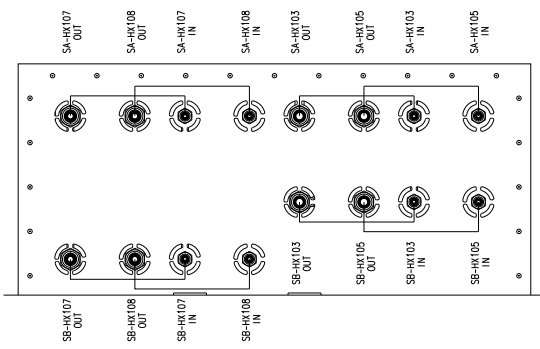
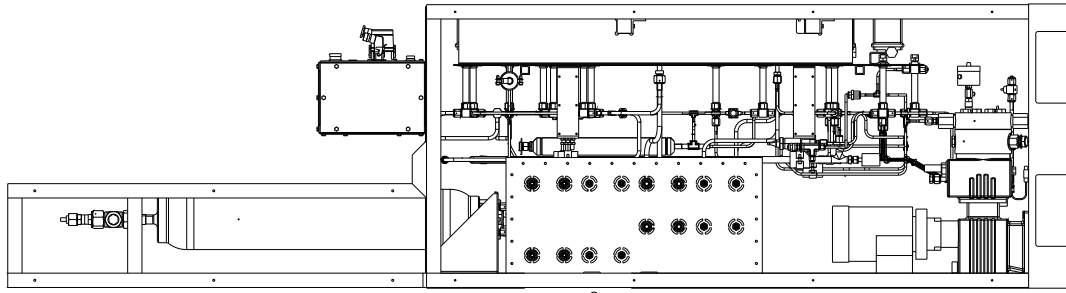
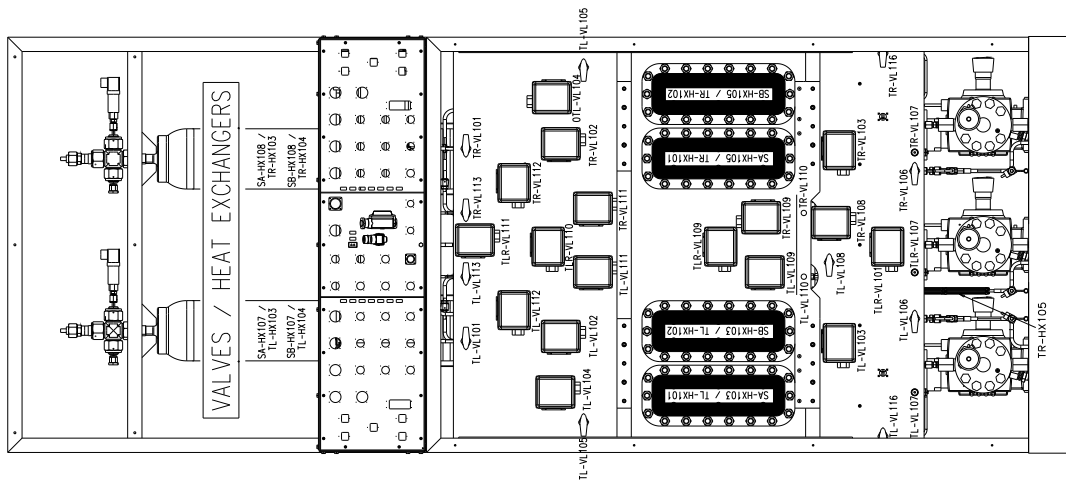
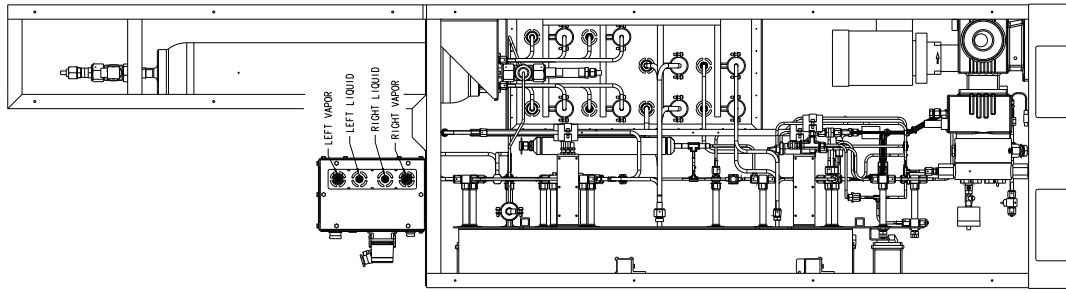
TOP VIEW A  
→

2108 REF

1802 REF

794 REF

QTY	SIZE/MATERIAL	TITLE	DATE	I.D. NO.
1	AS 1000	VERTICAL VALVE LOCATOR	12/15/06	
1	AS 1000	PROJECT: LCHD - VERTICAL VALVE LOCATOR	12/15/06	
1	AS 1000	TITLE: CO-2 VALVE AND PUMP RACK	12/06/07	
1	AS 1000	SCALE: 1:2	12/15/06	
1	AS 1000	DATE: 12/15/06	12/15/06	
1	AS 1000	CONTRACT: 1000000000	12/15/06	
1	AS 1000	CHECKED: J. J. J.	12/15/06	
1	AS 1000	DESIGNED: J. J. J.	12/15/06	
1	AS 1000	DATE: 12/15/06	12/15/06	
1	AS 1000	SCALE: 1:2	12/15/06	
1	AS 1000	PROJECT: LCHD - VERTICAL VALVE LOCATOR	12/15/06	
1	AS 1000	TITLE: CO-2 VALVE AND PUMP RACK	12/06/07	
1	AS 1000	SCALE: 1:2	12/15/06	
1	AS 1000	DATE: 12/15/06	12/15/06	
1	AS 1000	CONTRACT: 1000000000	12/15/06	
1	AS 1000	CHECKED: J. J. J.	12/15/06	
1	AS 1000	DESIGNED: J. J. J.	12/15/06	
1	AS 1000	DATE: 12/15/06	12/15/06	
1	AS 1000	SCALE: 1:2	12/15/06	
1	AS 1000	PROJECT: LCHD - VERTICAL VALVE LOCATOR	12/15/06	
1	AS 1000	TITLE: CO-2 VALVE AND PUMP RACK	12/06/07	
1	AS 1000	SCALE: 1:2	12/15/06	
1	AS 1000	DATE: 12/15/06	12/15/06	
1	AS 1000	CONTRACT: 1000000000	12/15/06	
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1	AS 1000	DESIGNED: J. J. J.	12/15/06	
1	AS 1000	DATE: 12/15/06	12/15/06	
1	AS 1000	SCALE: 1:2	12/15/06	



DETAILED VIEW PATCH PANEL

SEE DETAILED VIEW

PORT	SIZE	MATERIAL	TITLE	I.D.	NO.	NAME
4	1/2"	316	Project: LHCB Vertical Locator	4	4	None
5	1/2"	316	Title: 03 Valve and Pump Rack (Sheet 4)	5	5	None
6	1/2"	316	Project: LHCB Vertical Locator	6	6	None
7	1/2"	316	Project: LHCB Vertical Locator	7	7	None
8	1/2"	316	Project: LHCB Vertical Locator	8	8	None
9	1/2"	316	Project: LHCB Vertical Locator	9	9	None
10	1/2"	316	Project: LHCB Vertical Locator	10	10	None
11	1/2"	316	Project: LHCB Vertical Locator	11	11	None
12	1/2"	316	Project: LHCB Vertical Locator	12	12	None
13	1/2"	316	Project: LHCB Vertical Locator	13	13	None
14	1/2"	316	Project: LHCB Vertical Locator	14	14	None
15	1/2"	316	Project: LHCB Vertical Locator	15	15	None
16	1/2"	316	Project: LHCB Vertical Locator	16	16	None
17	1/2"	316	Project: LHCB Vertical Locator	17	17	None
18	1/2"	316	Project: LHCB Vertical Locator	18	18	None
19	1/2"	316	Project: LHCB Vertical Locator	19	19	None
20	1/2"	316	Project: LHCB Vertical Locator	20	20	None
21	1/2"	316	Project: LHCB Vertical Locator	21	21	None
22	1/2"	316	Project: LHCB Vertical Locator	22	22	None
23	1/2"	316	Project: LHCB Vertical Locator	23	23	None
24	1/2"	316	Project: LHCB Vertical Locator	24	24	None
25	1/2"	316	Project: LHCB Vertical Locator	25	25	None
26	1/2"	316	Project: LHCB Vertical Locator	26	26	None
27	1/2"	316	Project: LHCB Vertical Locator	27	27	None
28	1/2"	316	Project: LHCB Vertical Locator	28	28	None
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31	1/2"	316	Project: LHCB Vertical Locator	31	31	None
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33	1/2"	316	Project: LHCB Vertical Locator	33	33	None
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37	1/2"	316	Project: LHCB Vertical Locator	37	37	None
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41	1/2"	316	Project: LHCB Vertical Locator	41	41	None
42	1/2"	316	Project: LHCB Vertical Locator	42	42	None
43	1/2"	316	Project: LHCB Vertical Locator	43	43	None
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46	1/2"	316	Project: LHCB Vertical Locator	46	46	None
47	1/2"	316	Project: LHCB Vertical Locator	47	47	None
48	1/2"	316	Project: LHCB Vertical Locator	48	48	None
49	1/2"	316	Project: LHCB Vertical Locator	49	49	None
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60	1/2"	316	Project: LHCB Vertical Locator	60	60	None

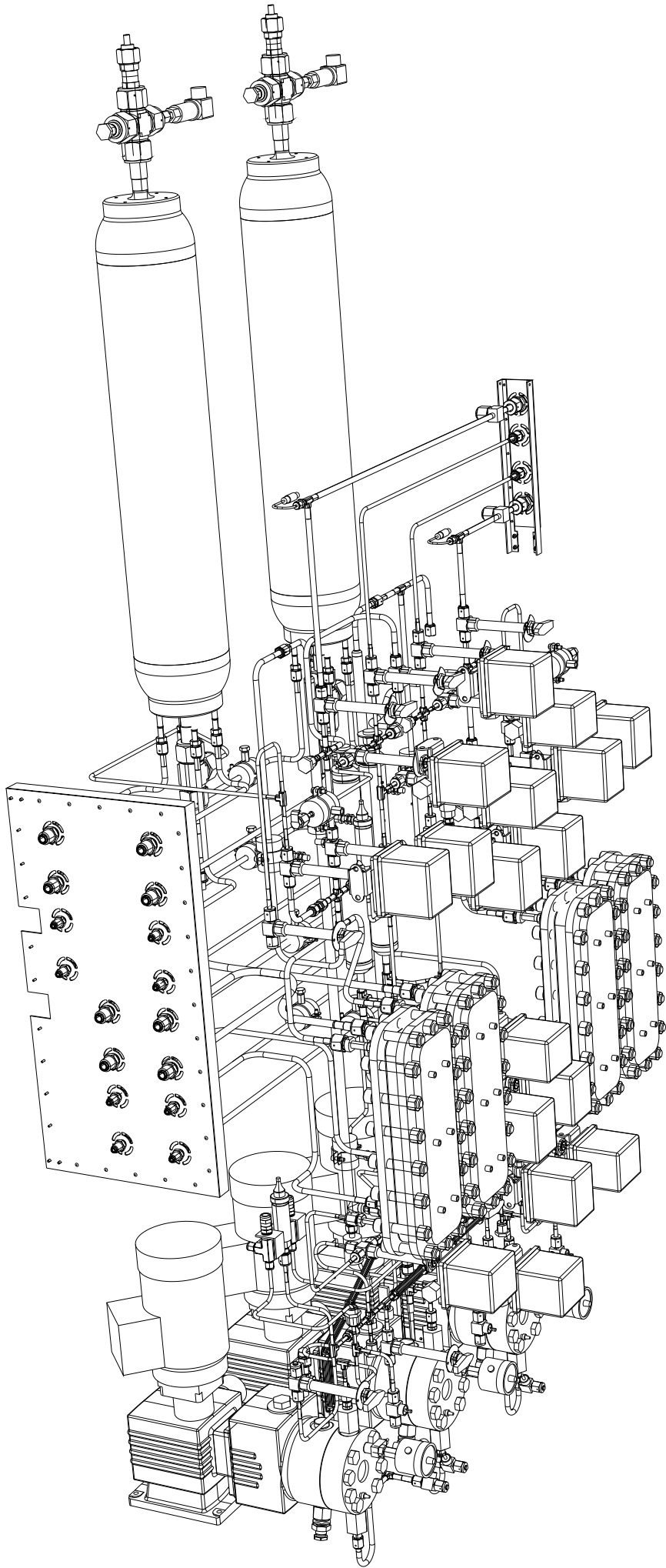










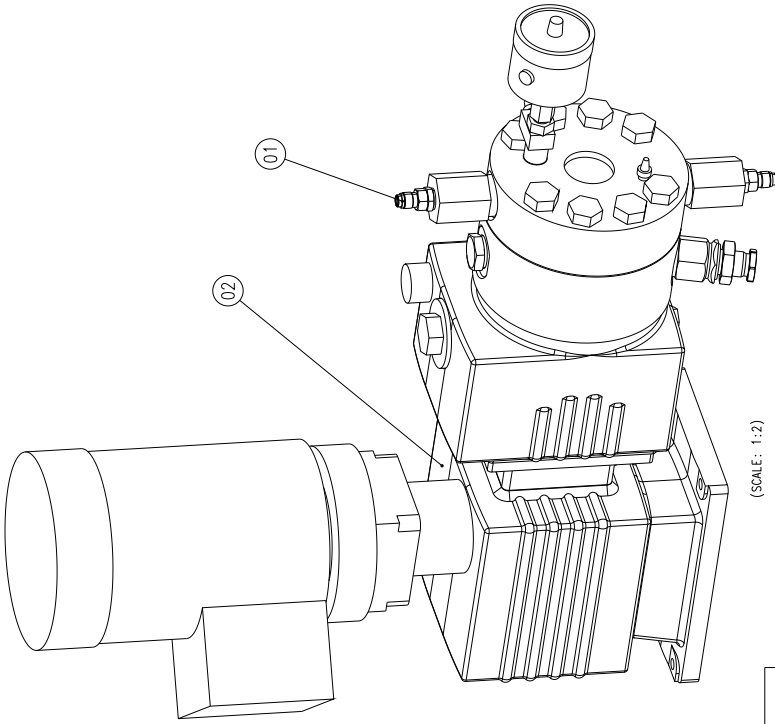


Project: LHCb Vertex Locator		Date:	Name:
4	0012142		
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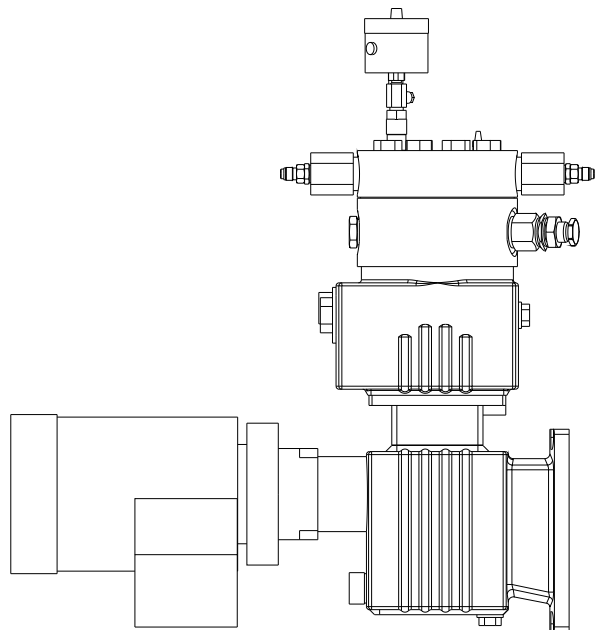
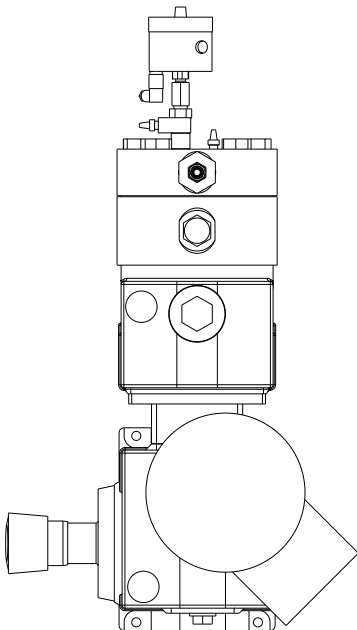
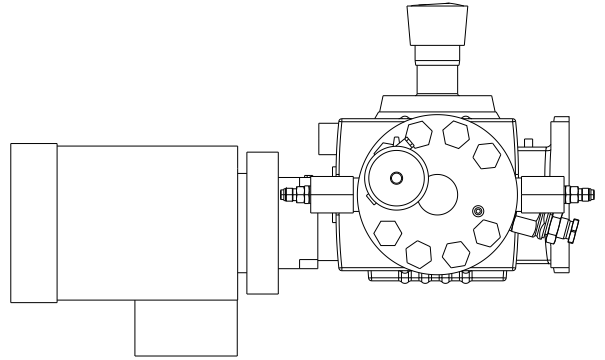
Title: O2 RACK ASSY (SHEET 6)  
Scale: 1:1  
Date: 08-05-12  
Checked: [Signature]  
Drawn: [Signature]  
Project: LHCb Vertex Locator  
Size: A0  
TVC: 60  
NIMTEF  
NIMTEF Engineering Services, Ltd.  
125, WILSON ROAD, SINGAPORE 120008  
Tel: 65 6349 3333  
Fax: 65 6349 3334  
Email: info@nimtef.com.sg  
Web: www.nimtef.com.sg







(SCALE: 1:2)

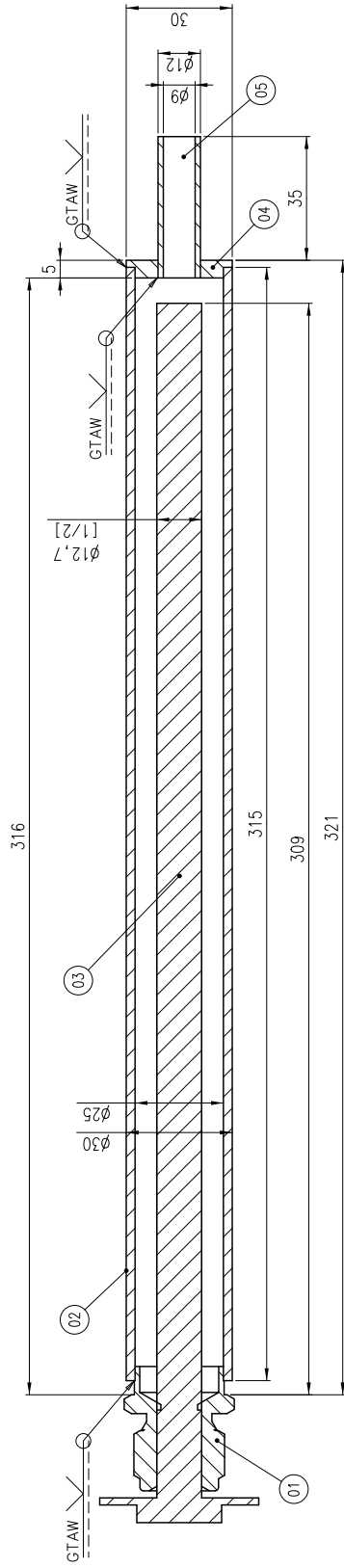
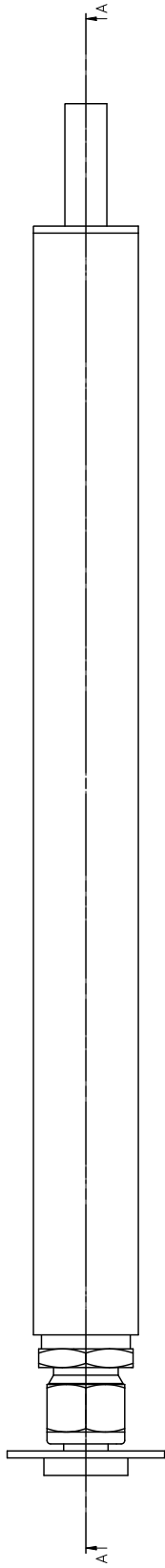


2	1	LEN 002 pump	LOC-900V1
1	2	Pump Connection weldassy	TV005
Part. Qty.		Part./Item Name	Material
Project: LHCB VERTEX LOCATOR		Drawing nr. / Size / ID / Norm	
Title: Pump Assembly 1		Date	Name
Scale: 1:2.5		19-09-06	A.K.
Date: 08-09-06		02-03-12	MJ Krcon
Drawn: A.K.		Checked:	
Date: 08-09-06		Checked:	
DIN 15270		ISO 9001	ISO 14001
C.E.R.N. L.A.B.E.L.		Identification No.:	
A1		TVC 55	
Sheet No: X		Number of sheets: X	

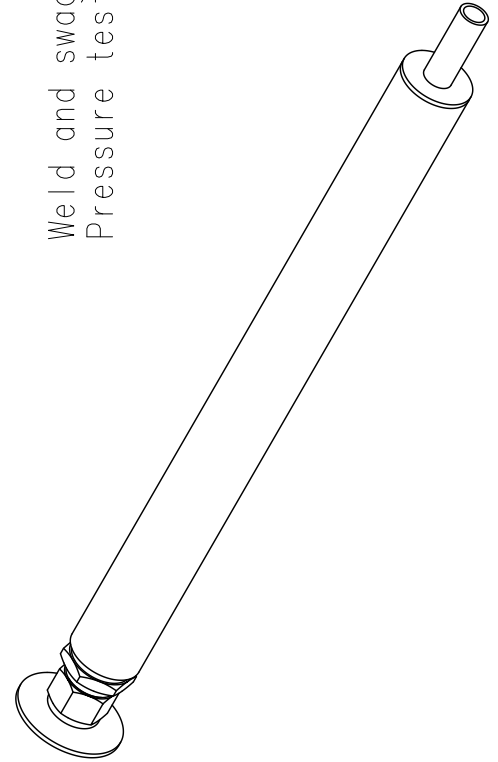


NIKHEF INSTITUUT VOOR NUCLEAIRE FYSICA'S  
P.O. BOX 10508 DE BOERHOF 1200 SB THE HAGUE THE NETHERLANDS

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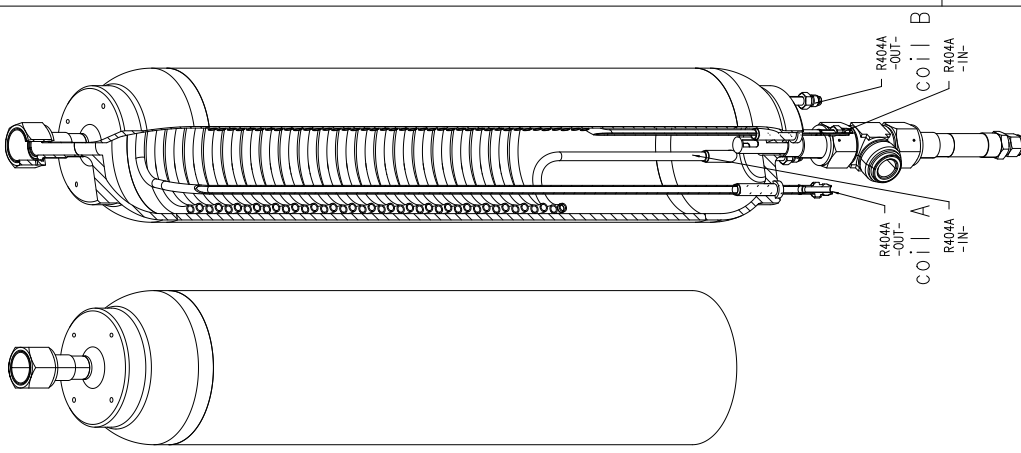
Weld and swage leaktight to  $1e-8$  mbar\*L/sec  
 Pressure test to 170 bar



05	1	Connection Tube	Stainless	$\phi 12 \times 1.5 \times 40$
04	1	End flange	Stainless	
03	1	Heater element	Stainless	$\phi 12.7 \times 340$ Matlow WFR013J1001
02	1	Damper vessel tube	Stainless	$\phi 30 \times 2.5 \times 315$ XX
01	1	Modified Swagelok	Stainless	316
PART NUMBER		TITLE	MATERIAL	SIZE/NOTE I. D. NO. /NORM
		Project: LHCb Vertex Locator		
		Title: Vibration Damper Assy		
Scale: 1:1	Drawn: B.Verlaat	Dim. in mm		
Date: 9-9-05	Checked:			
		C. E. R. N. L. A. B. E. L.		
		Size	Identification No.:	
		A2	TVC17	
		Sheet No: 1	Number of sheets: 1	



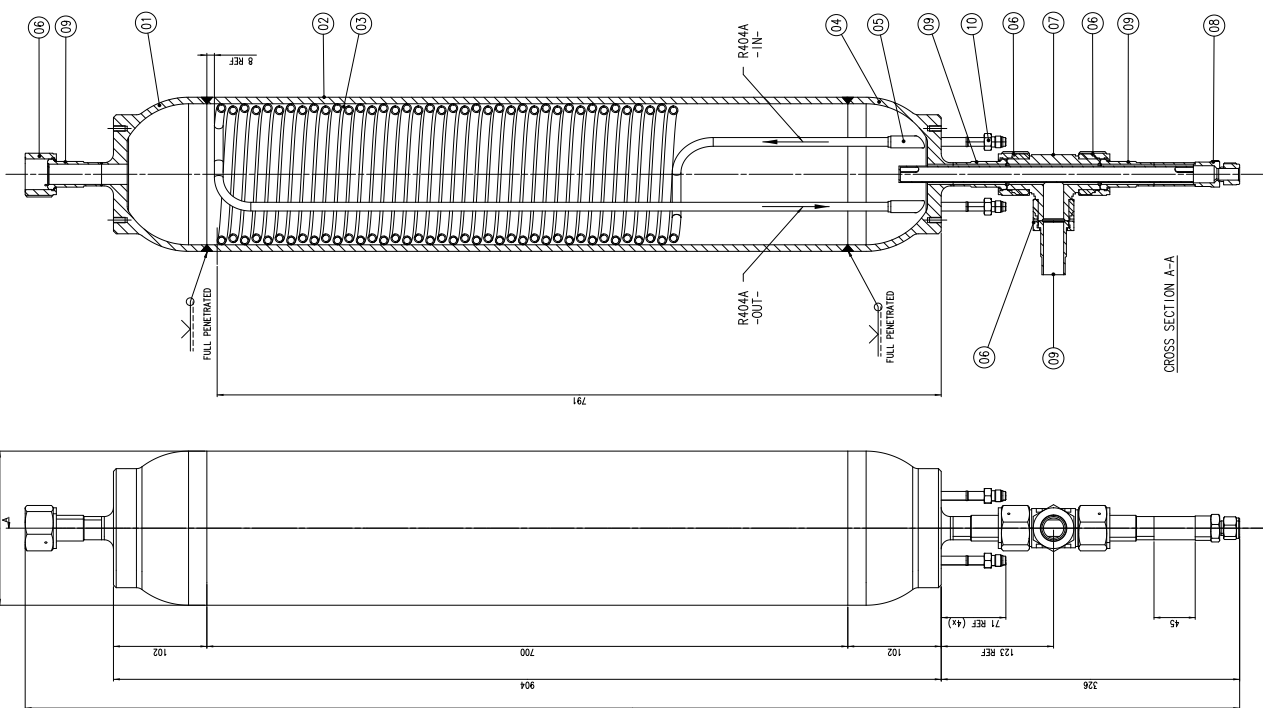
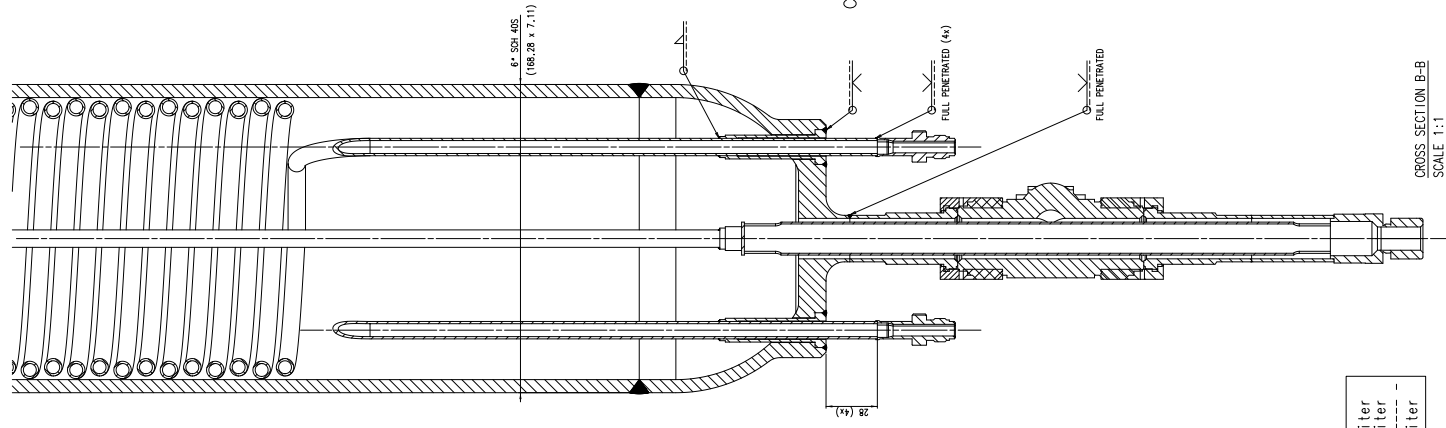
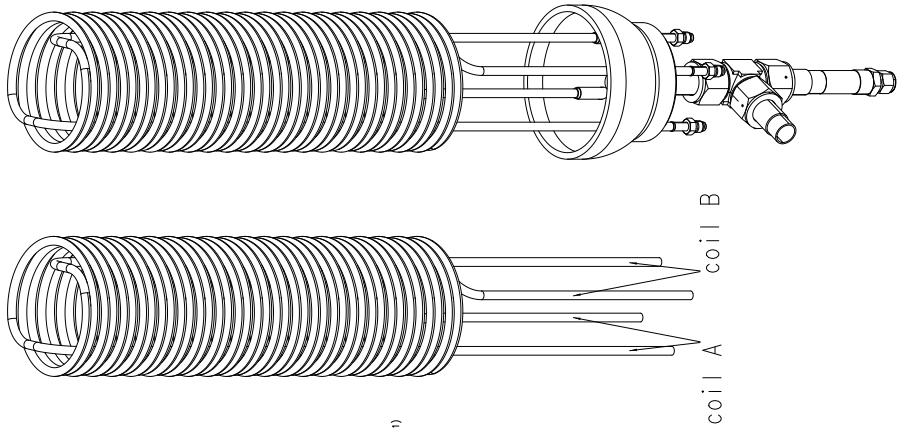
NATIONAL INSTITUTE FOR NUCLEAR PHYSICS,  
 P.O. 41882, 1009 JB Amsterdam, The Netherlands.  
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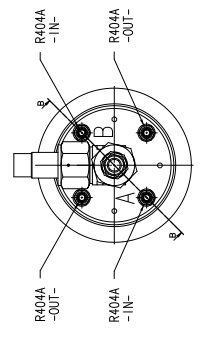
- NOTES:
- DESIGN/PRODUCTION PARAMETERS ACCORDING: COOMP
  - PRESSURE TEST AT 170 BAR (DESIGN PRESSURE = 130 BAR)
  - ALL MATERIAL (AISI 316L) WITH CERTIFICATE EN 10204/3.1.B

00	4	FACE SEAL FITTING	AISI 316L-4-VOR-1/4"	SWAGELOK
08	4	HEATER CONNECTION	AISI 6V-14-VOR-3/16B7	SWAGELOK
09	1	FACE SEAL FITTING	AISI 316	TYVISO1
07	1	FACE SEAL FITTING	SS-14-VOR-1	SWAGELOK
06	4	FACE SEAL FITTING	SS-14-VOR-1	SWAGELOK
05	4	WELDING CONNECTION	AISI 316L	TYVISO6
04	1	BOTTOM SPHERE	AISI 316L	TYVISO4
03	2	COIL	AISI 316L	TYVISO2
02	1	MAIN PIPE	AISI 316L	4" 50# 65 (18x8 x 7.11) / L=90
01	1	TOP SPHERE	AISI 316L	TYVISO5
TITLE		ELEVANTE 11.07.00.0000		
PROJECT		LHCb Vertex Locator		
PART NAME		ACCUMULATOR		
SCALE		1:1		
DATE		09.11.2008		
DRAWN		Dimitri M. Kozlov		
CHECKED		Dimitri M. Kozlov		
APPROVED		Dimitri M. Kozlov		
MATERIAL		AISI 316L		
FINISH		B		
TOLERANCE		D		
STANDARD		ISO 2768-M		
EQUIVALENT		A		
NICKEL LABEL		AG [TVC 51]		

ASSEMBLY SEQUENCE

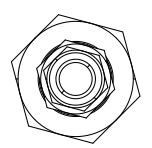
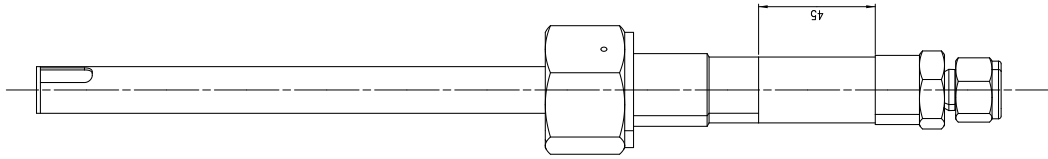
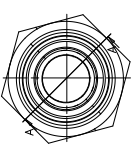
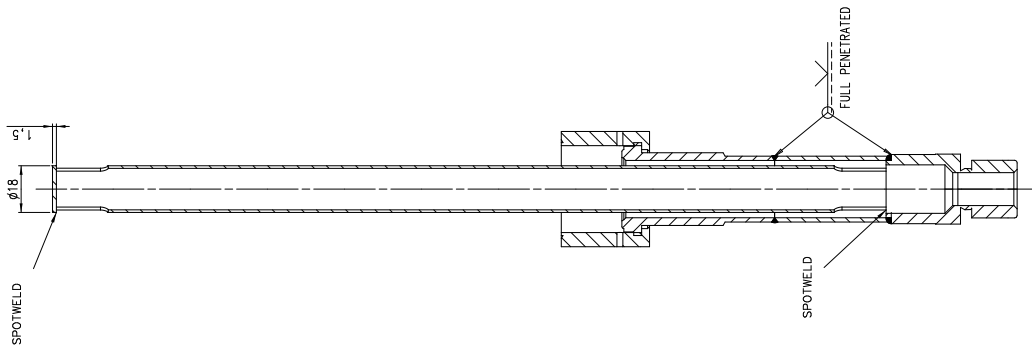
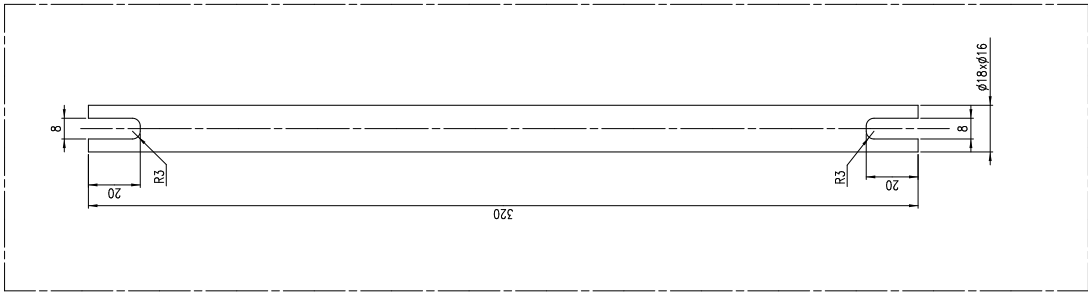
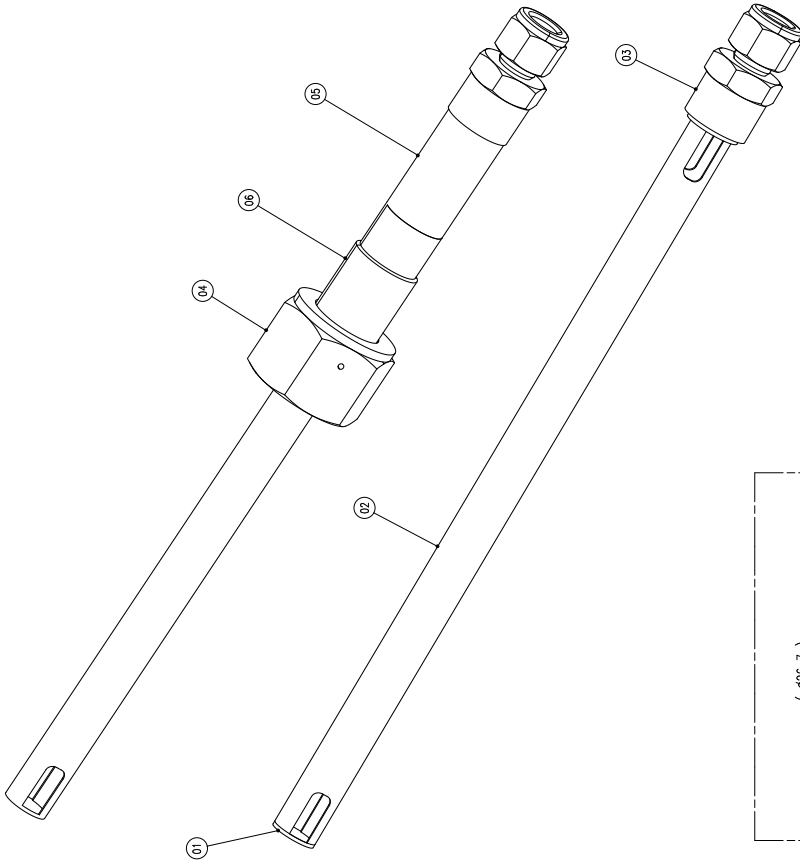


Volume COIL = 1.6 Liter  
 Volume VESSEL = 15.5 Liter  
 Volume INSIDE = 13.9 Liter



CROSS SECTION B-B  
 SCALE 1:1





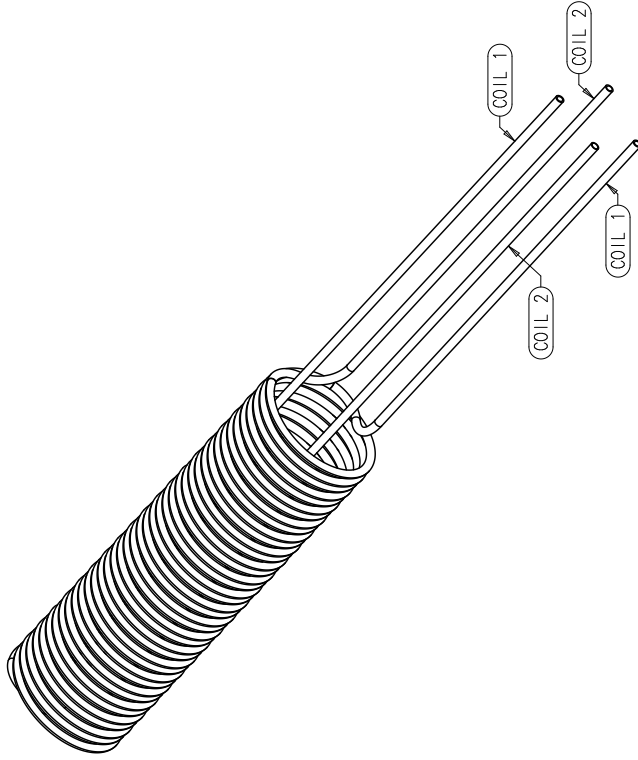
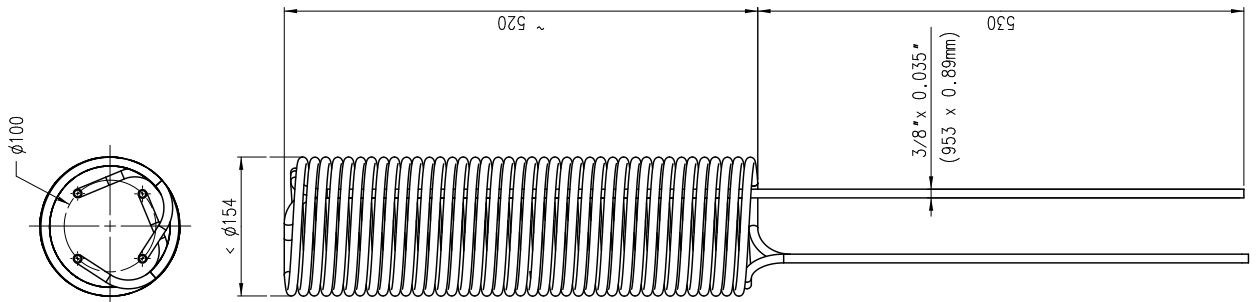
06	1	FACE SEAL TUBE	AISI	6V-16-VOR-3-18197	SWAGelok
05	1	PIPE	AISI	1"ø,065" (25.4x1.65) / L-45	SWAGelok
04	1	FACE SEAL FITTING	AISI	SS-16-VOR-1	SWAGelok
03	1	CONNECTION	AISI	SS-810-1-1-12W	SWAGelok
02	1	PIPE	AISI	ø18xø16x320	
01	1	PLATE	AISI	ø18x1.5	

PART NO.	REV.	TITLE	MATERIAL	SIZE/NOTE	I.D.	NO./NORM
		Project: LHCb Vertex Locator				
Title: HEATER CONNECTION ACCUMULATOR						
Scale: 1:1						
Date: may 2008						
Drawn: Mj Kraan						
Checked:						
CERN L.A.B.E.L.						
Revision No.:						
A1						
TVC 5101						



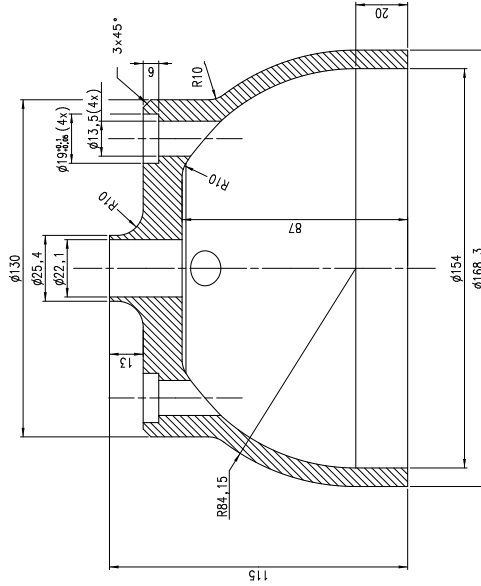
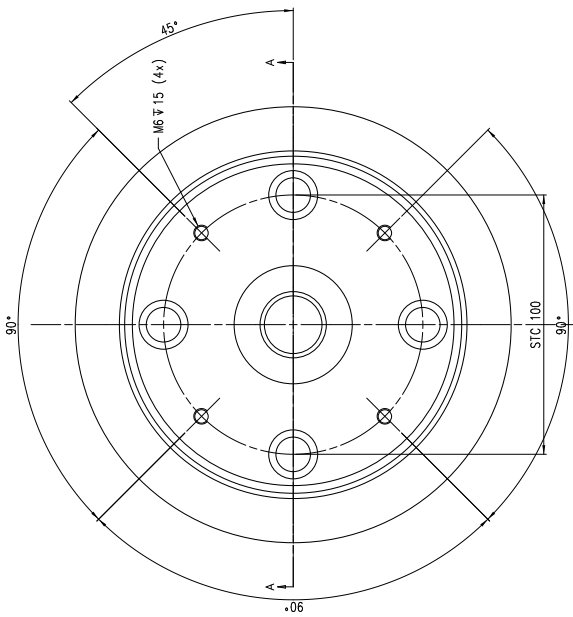
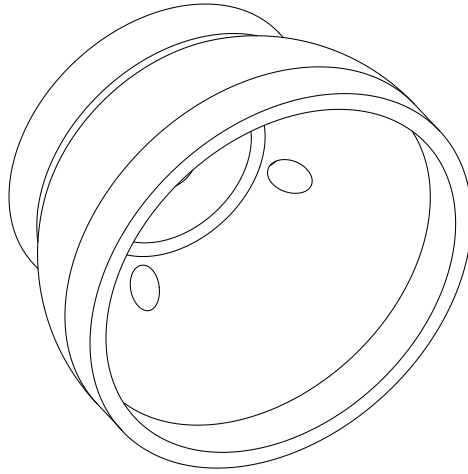
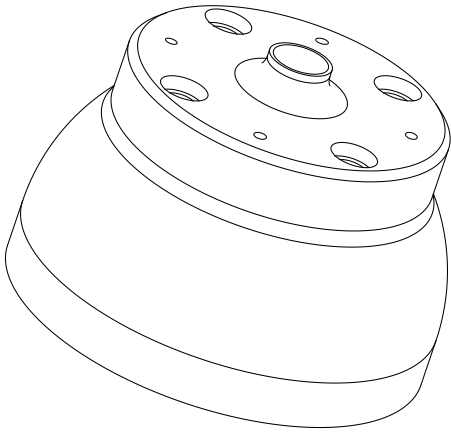
NATIONAL INSTITUTE FOR NUCLEAR PHYSICS  
 P.O. BOX 1050800, 1009 GB AMSTERDAM, THE NETHERLANDS  
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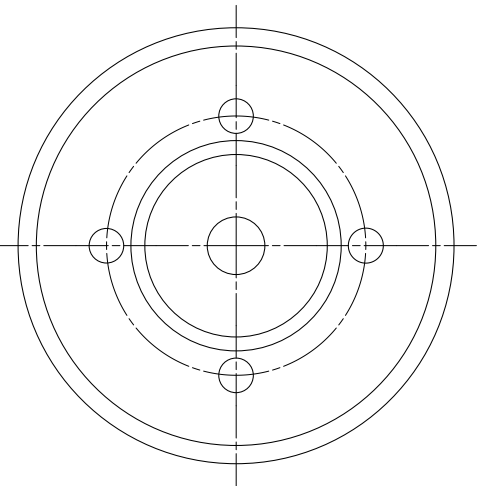
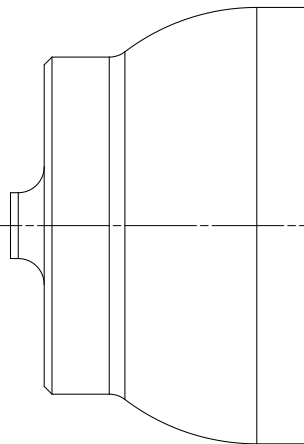
LENGTH ONE COIL ~ 11 METER

NOTE  
SEE FOR MANUFACTURING JIG DRAWING No. TVK 36

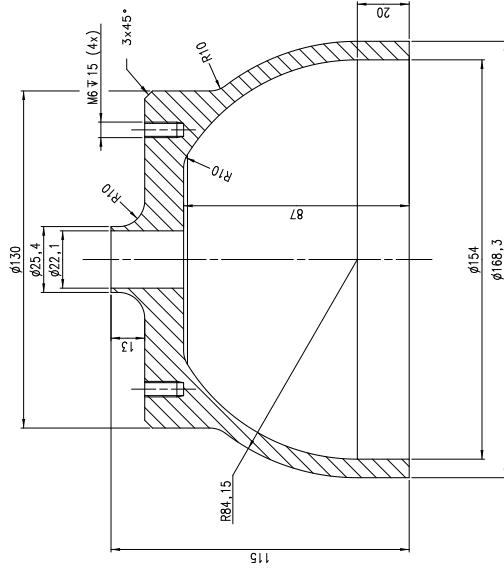
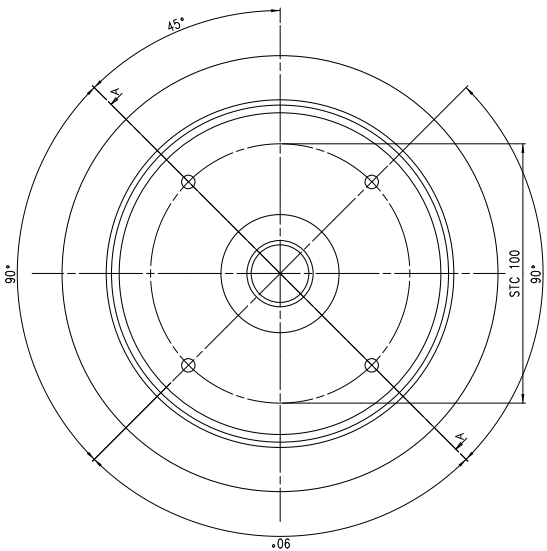
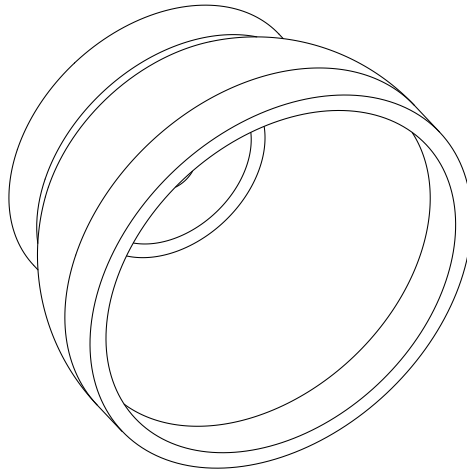
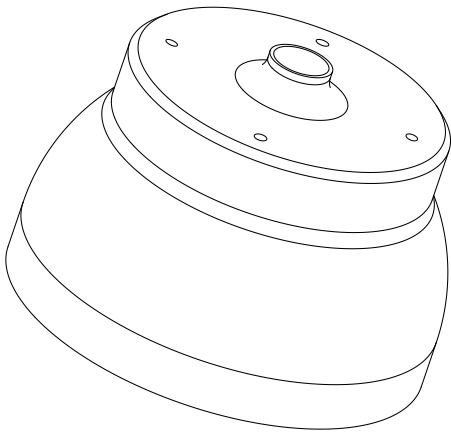
01	PIPE	AISI 316 L	3/8" x 0.035" (9.53 x 0.89) / L=11000
PART NUMBER	TITLE	MATERIAL	SIZE/NOTE I.D. NO./NORM
Project: LHCb Vertex Locator	Date		
Title: COIL ACCUMULATOR	Name		
Scale: 1:4	Drawn: MJ Kraan	Revision	
Date: may 2006	Checked:	Date	
C.E.R.N. L.A.B.E.L.		ISO-9001-2008	
NIIHEF		ISO-9001-2008	
NATIONAL INSTITUTE FOR NUCLEAR PHYSICS, Radboud University Nijmegen, Toernooiveld 1, P.O. 41882, 6500 HB Nijmegen, The Netherlands		ISO-9001-2008	
This drawing may not be used for commercial purposes without written authorisation.		ISO-9001-2008	
Size Identification No.:		Sheet No. X Number of sheets: X	
A2 TVC 5102		A2 TVC 5102	



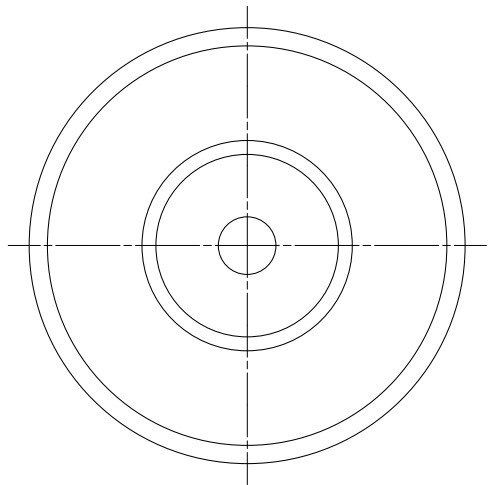
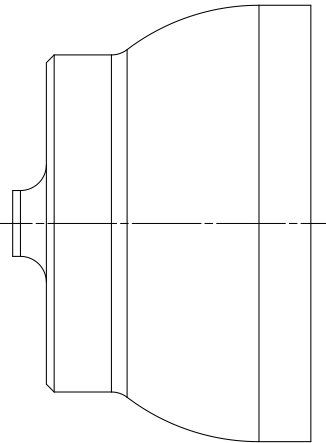
CROSS SECTION A-A



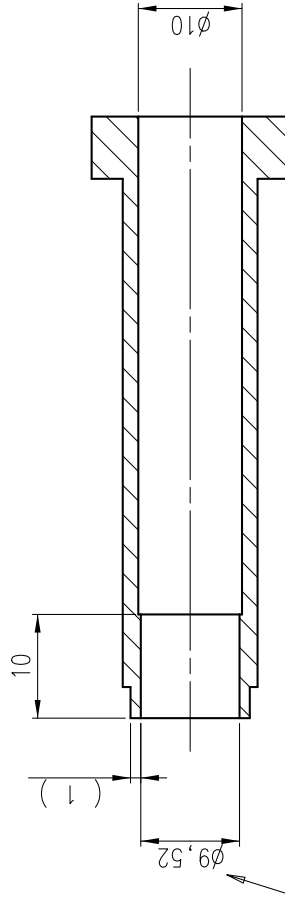
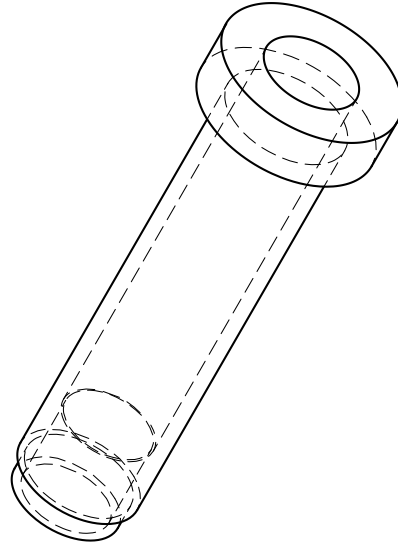
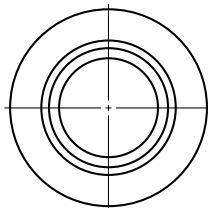
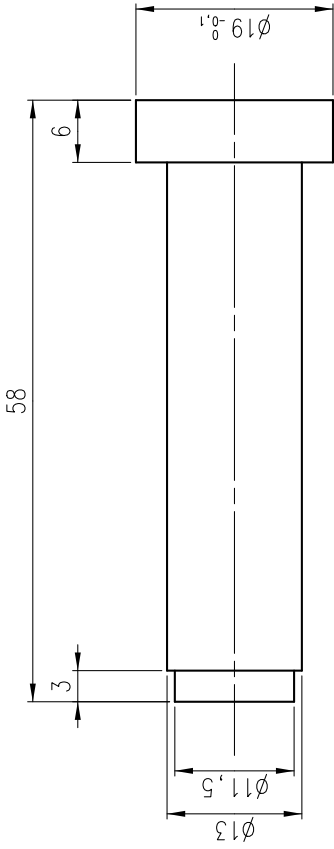
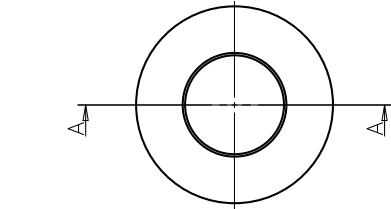
01		AISI 316 L								
PART NO.	NO. / REV.	TITLE	MATERIAL	SIZE/NOTE	I.D. NO./NORM	Date				
Project: LHCB Vertex Locator						A	B	C	D	
Title: ACCUMULATOR BOTTOM						Name				
Scale: 1:1	Drawn: Mj Kraon	Checked:				Date				
Date: may 06	Description: Accumulator Bottom		Drawing Standard: ISO 15024-1		Drawing Standard: ISO 15024-2		Drawing Standard: ISO 15024-3		Drawing Standard: ISO 15024-4	
C.E.R.N. L.A.B.E.L.						Identification No.:				
NIKHEF						A1 TVC 5104				
NATIONAL INSTITUTE FOR NUCLEAR PHYSICS, P.O. BOX 10508, 2500 GB JEU, THE NETHERLANDS						Sheet No. X Number of sheets: X				
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CROSS SECTION A-A





01		AISI 316 L		SIZE/NOTE	I.D. NO./NORM
PART NO.	TITLE	MATERIAL		6	
NO.				A	Name
REF				B	Date
				C	
				D	
Project: LHCB Vertex Locator					
Title: SPHERE TOP ACCUMULATOR					
Scale: 1:1	Drawn: Mj Kraan	Checked:			
Date: may 2006					
This drawing is the property of NIKHEF and shall remain confidential. It is to be used for the purpose of the project only. It is not to be used for commercial purposes without written authorization.					
NATIONAL INSTITUTE FOR NUCLEAR PHYSICS P.O. BOX 1050, 37200B BILTHOVEN, THE NETHERLANDS TEL: +31 (0) 484 650000 FAX: +31 (0) 484 650001 WWW.NIKHEF.NL					
C.E.R.N. L.A.B.E.L. Drawing No.: A1 Identification No.: TVC 5105 Sheet No.: X Number of sheets: X					



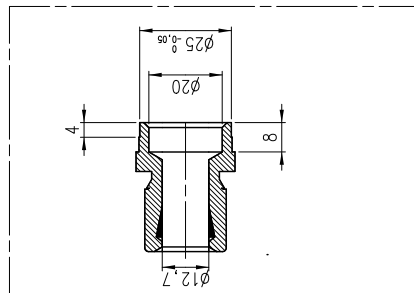
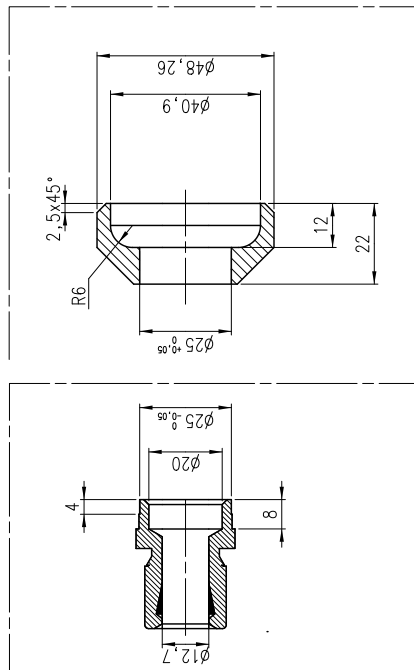
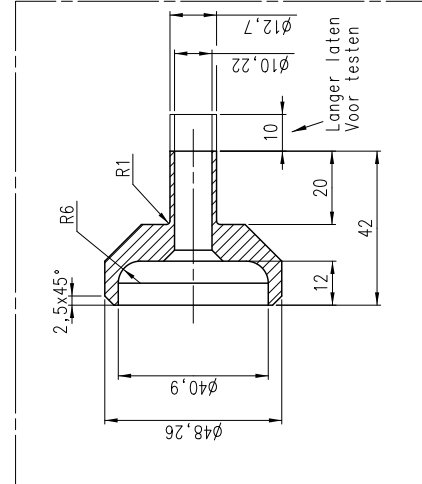
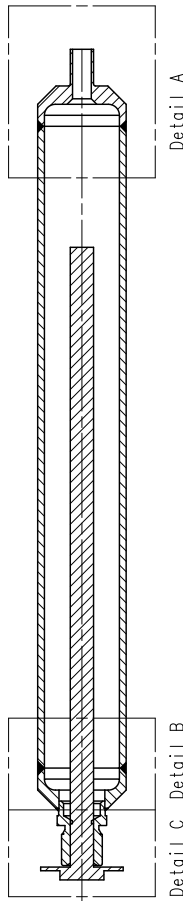
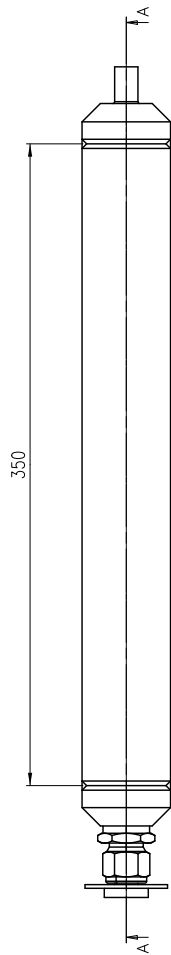
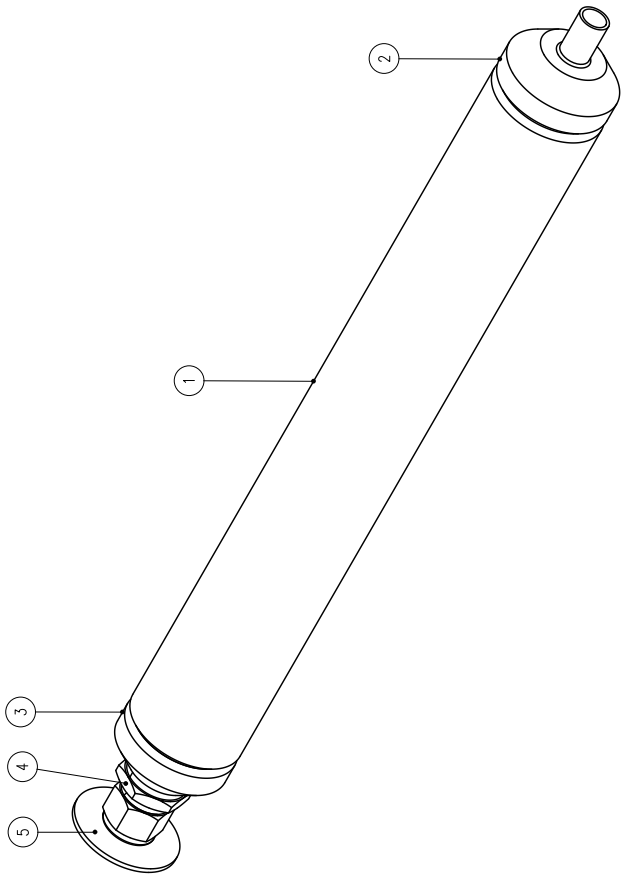
↳ FIT TO COIL POSNo. 03

CROSS SECTION A-A

01	XX	XX	AISI 316 L						
PART NO.	NUM-BER	TITLE	MATERIAL	SIZE/NOTE	I. D. NO. / NORM	Date			
Project: LHCb Vertex Locator				A		Name			
Title: WELD CONNECTION ACCUMULATOR				B					
Scale: 2:1				C					
Date: may 2006				D					
Drawn: 1:1			 Dim. in mm CERN LABEL	General tolerances		Geometrical tolerances		Roughness	
Checked:				unless stated otherwise according to ISO-2768-mk-E		unless stated otherwise according to ISO-8015-E		unless stated otherwise stated according to DIN 1302	
 NATIONAL INSTITUTE FOR NUCLEAR PHYSICS, AND HIGH ENERGY PHYSICS P.O. 41882, 1009 DB Amsterdam, The Netherlands			Identification No.:		Size		Sheet No: X Number of sheets: X		
			A3		TVC 5106				

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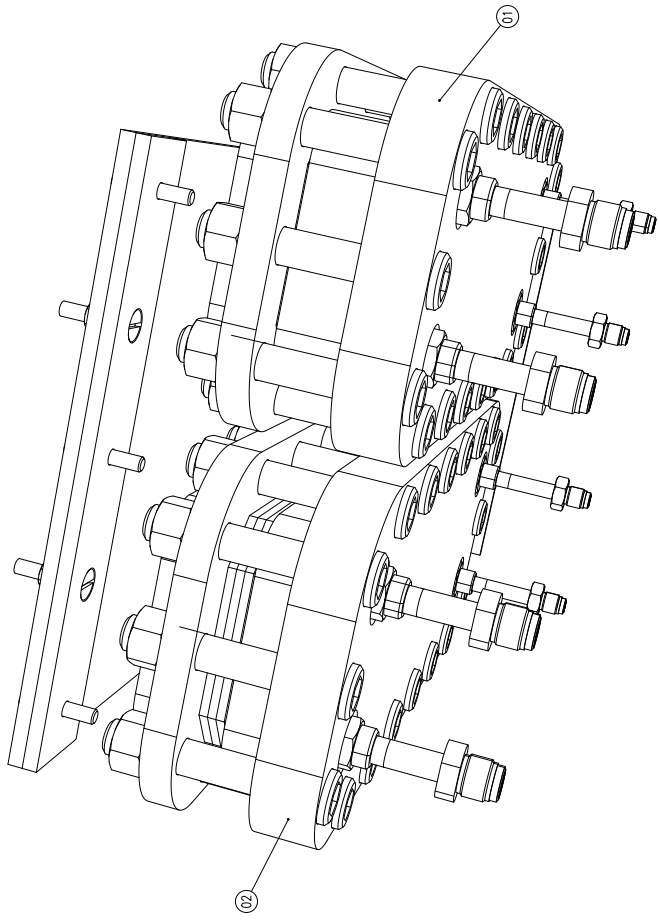


ALL WELDS FULL PENNATRATED  
 PRESSURE TEST 170 BAR

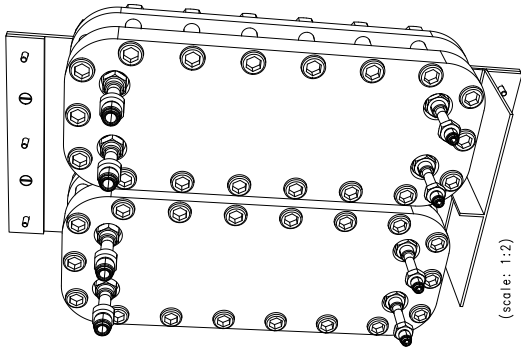
05	01	Heater			
04	01	Swagelok	SS-810-1-12W		
03	01	Flens	AISI 316L	$\phi 48,26 \times 22$	
02	01	Flens	AISI 316L	$\phi 48,26 \times 42$	
01	01	Pijp	AISI 316L	$\phi 48,26 \times 40,9$	
PART NO.		TITLE	MATERIAL	SIZE/NOTE	I.D. NO./NORM
Project: LHCb Vertex Locator					
Title: DEMPER					
Scale: 1:2	Drawn: M Doets	Checked:	Dwg. in mm		
Date: 07-04-2006			CERN LABEL		
			ISO-2768-mk-E   ISO-8015-E   DIN 1302		
			Size Identification No.:		
			A2 TVC54		
			Sheet No: X Number of sheets: X		
			This drawing may not be used for commercial purposes without written authorisation.		



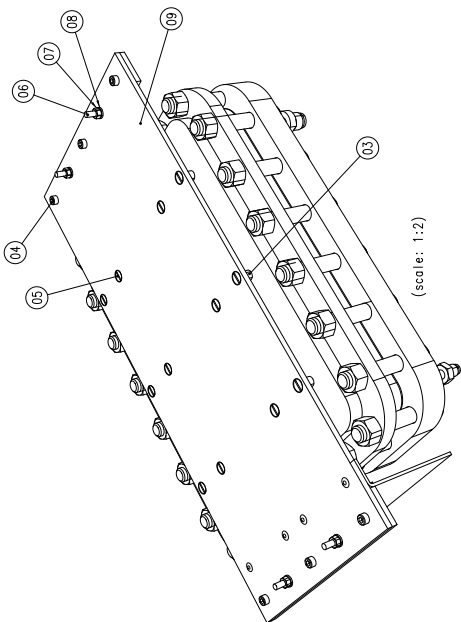
NATIONAL INSTITUTE FOR NUCLEAR PHYSICS  
 P.O. 41882, 1009 JB Amsterdam, The Netherlands



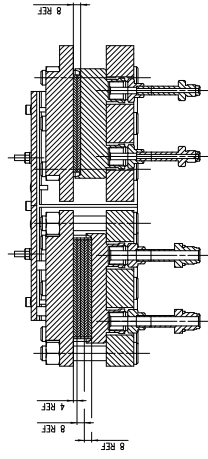
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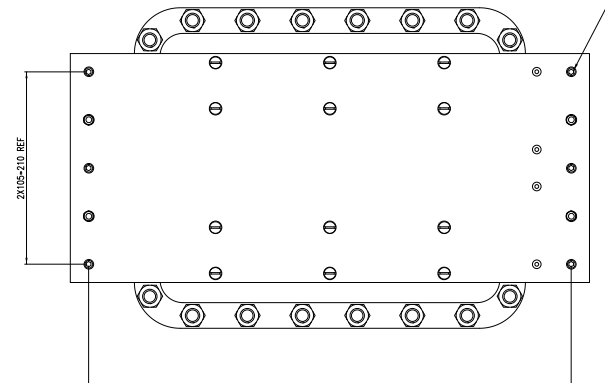
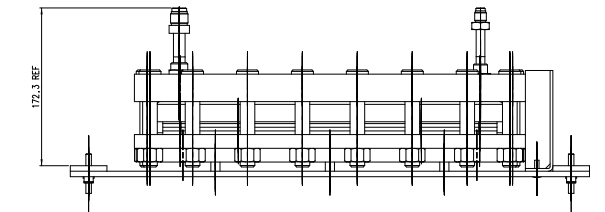
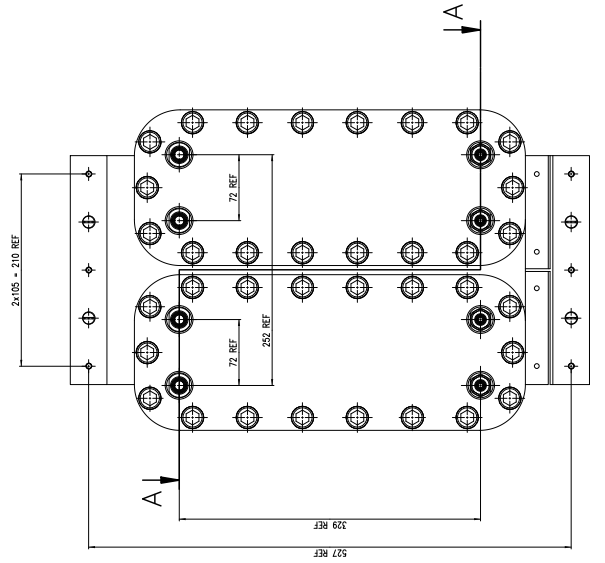
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(scale: 1:2)



SECTION A-A



527 REF

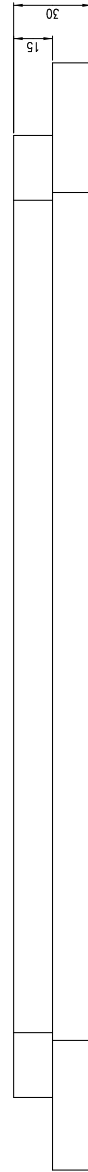
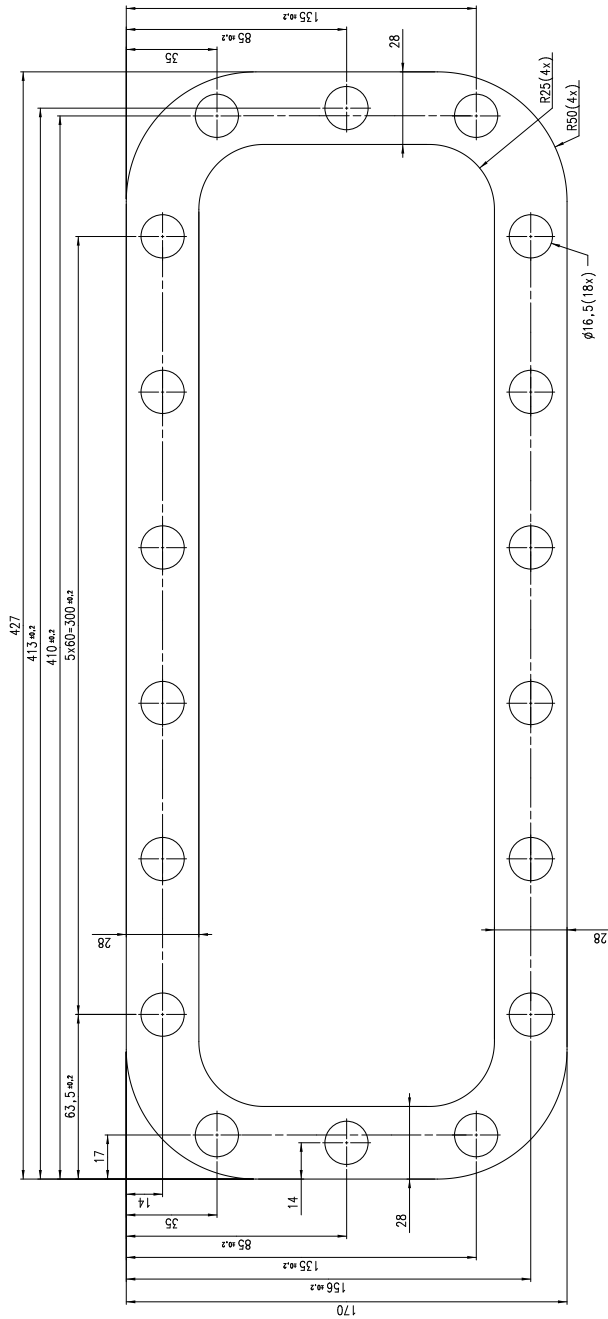
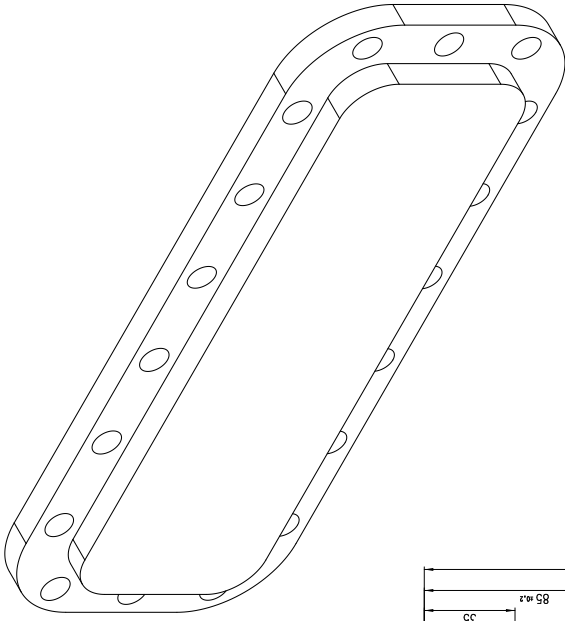
TYPER	CONDENSER SET SUPPORT BRACKET ASSY
1	CONDENSER SET SUPPORT BRACKET ASSY
2	BRACKET W/
3	1/2" DIA. CONDENSER TUBES
4	1/2" DIA. CONDENSER TUBES
5	1/2" DIA. CONDENSER TUBES
6	1/2" DIA. CONDENSER TUBES
7	1/2" DIA. CONDENSER TUBES
8	1/2" DIA. CONDENSER TUBES
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89	1/2" DIA. CONDENSER TUBES
90	1/2" DIA. CONDENSER TUBES
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92	1/2" DIA. CONDENSER TUBES
93	1/2" DIA. CONDENSER TUBES
94	1/2" DIA. CONDENSER TUBES
95	1/2" DIA. CONDENSER TUBES
96	1/2" DIA. CONDENSER TUBES
97	1/2" DIA. CONDENSER TUBES
98	1/2" DIA. CONDENSER TUBES
99	1/2" DIA. CONDENSER TUBES
100	1/2" DIA. CONDENSER TUBES



MS SCREW (6x)





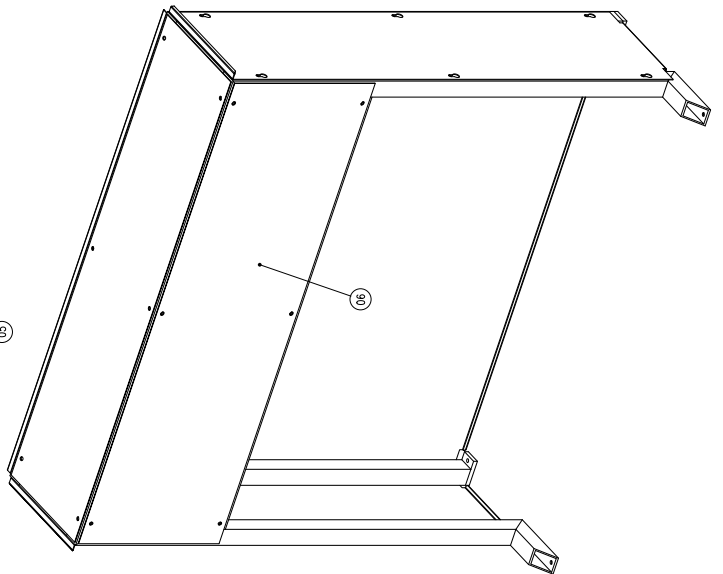
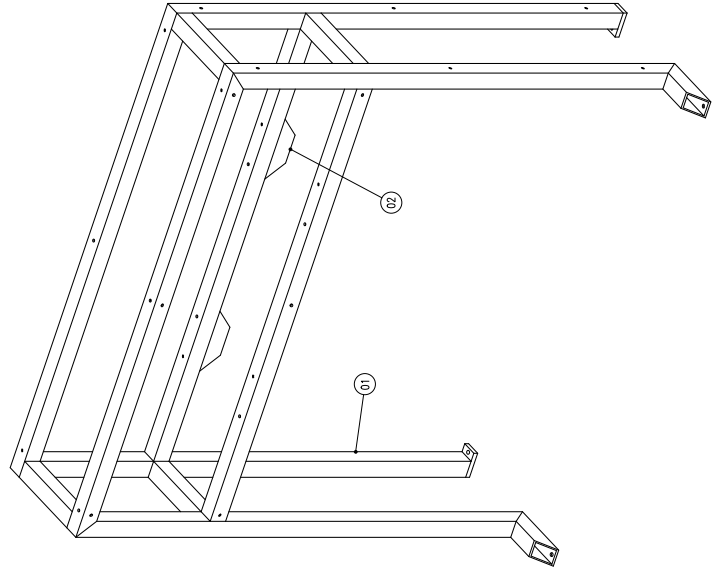
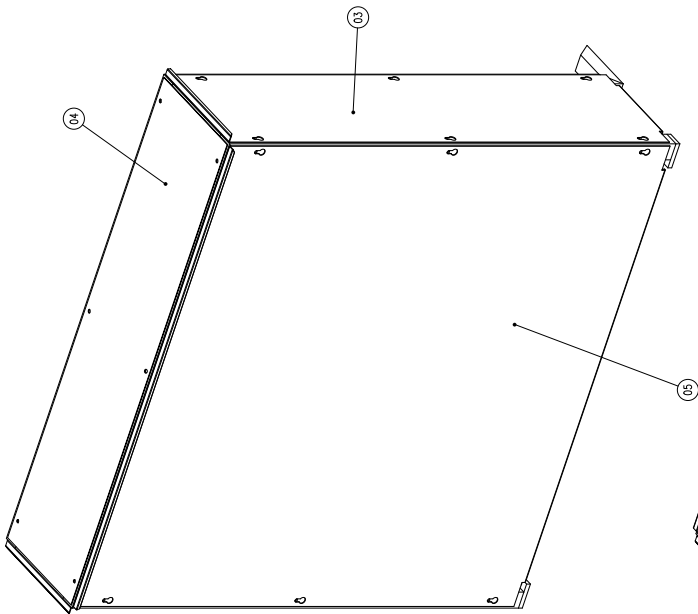
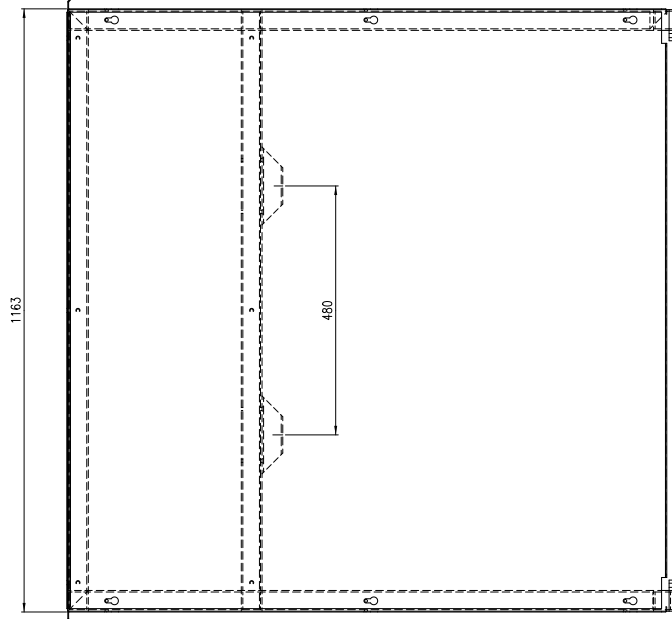
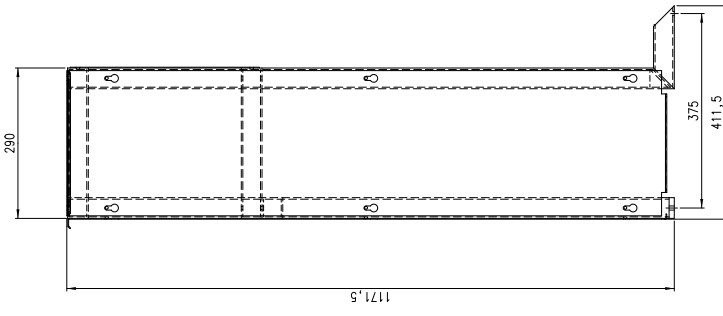


01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20
Part No.	Rev.	Material	Title	AI SI	SIZE/NOTE	I.D. NO./NORM	Date	Name											
			Project: LHCB Vertex Locator																
			Title: REINFORCED PLATE 1																
			Scale: 1:1																
			Date: July 2006																
			Drawn: M. Kraan																
			Checked: B. Verlaet																
			Approved: [Signature]																
			C.E.R.N. L.A.B.E.L.																
			Specification No.:																
			A1																
			TVC/201																
			Sheet No. X																
			Number of sheets: X																



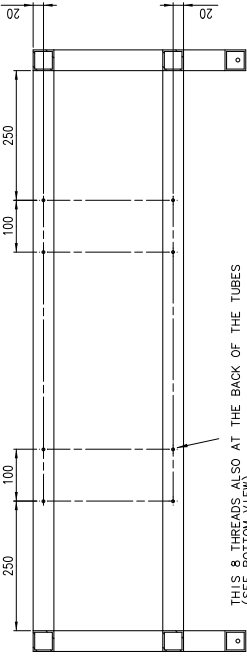
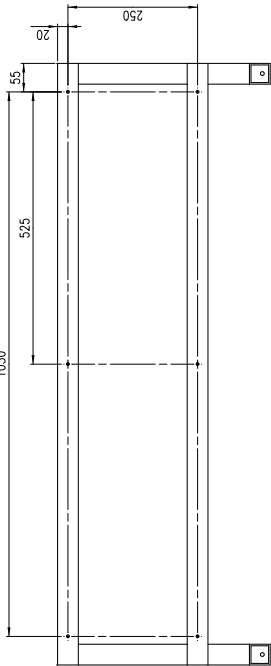
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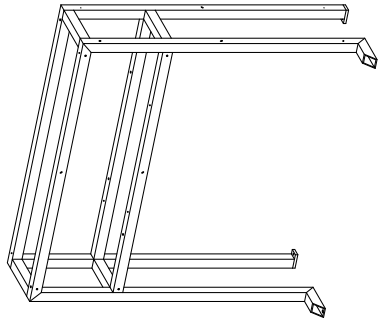
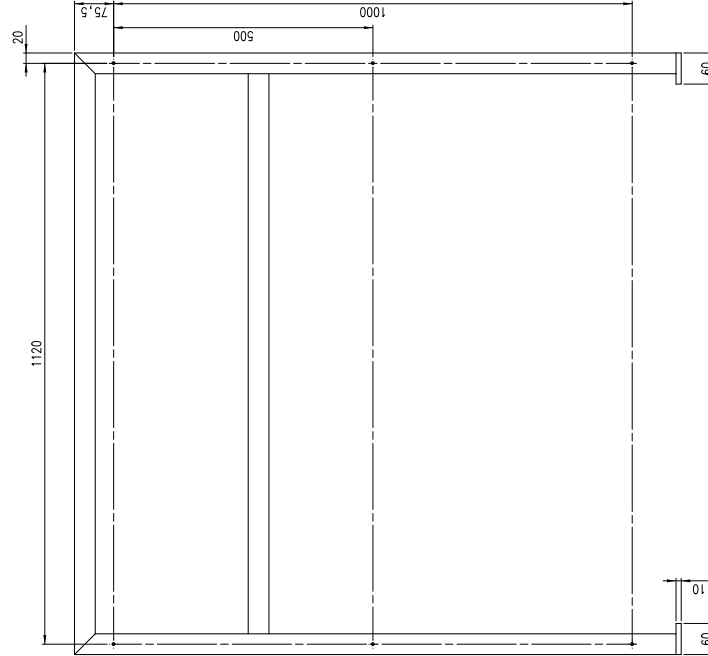
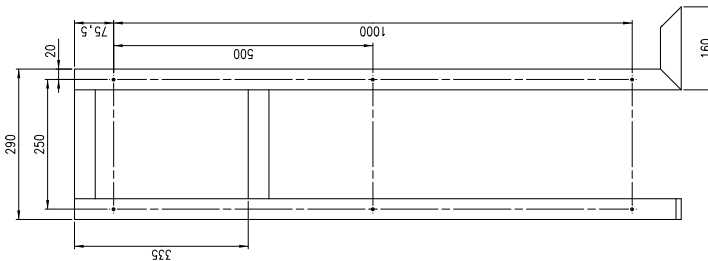
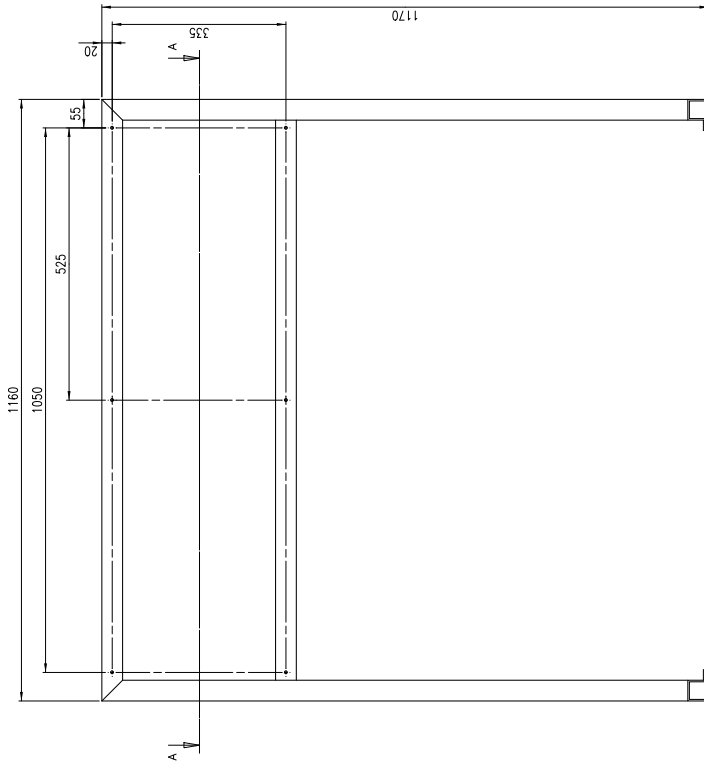


NO.	DESCRIPTION	MATERIAL	SIZE/NOTE	I.D.	NO./ANRM
06	1	Back cover plate			TVC 13004
05	1	Front cover plate			TVC 13002
04	1	Top cover plate			TVC 13001
03	2	Side cover plate			TVC 13003
02	2	intermediar			TVC 13005
01	1	Frame			TVC 130_1
PART NUMBER					
NO.	DESCRIPTION	MATERIAL	SIZE/NOTE	I.D.	NO./ANRM
Project: LHCb Vertex Locator					
Title: ACCUMULATOR PROTECTING FRAME					
Scale: 1:5 Drawn: M.J. Kraan					
Date: Oct. 2007 Checked:					
CERN LABEL					
Revision Table					
NO.	DESCRIPTION	DATE	BY		
A	Issue				
B					
C					
D					
This drawing is a technical drawing of a mechanical part. It is intended for manufacturing purposes and should be used in accordance with the CERN standards. The drawing is subject to change without notice.					
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CROSS SECTION A-A



THIS 8 THREADS ALSO AT THE BACK OF THE TUBES  
(SEE BOTTOM VIEW)



NOTES:

ALL HOLES M6 (40x) UNLESS OTHERWISE STATED  
FRAME MADE FROM 40x40x3mm STAINLESS STEEL TUBE  
WELD EVERYTHING TOGETHER

01	FRAME	STST	TUBE 40x40x3
PART NO.	TITLE	MATERIAL	SIZE/NOTE
NO.	Project: LHCb Vertex Locator		5
NO.	Title: Frame accumulator protecting frame		6
NO.	Scale: 1:5		7
NO.	Date: sept. 2007	Drawn: M Kraan	8
NO.	Checked:		9
NO.			10
NO.			11
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NO.			131
NO.			132



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Sheet No: X Number of sheets: X  
Revision No: A1 TVC130\_1

POSITIONS SEE: CROSS SECTION A-A

