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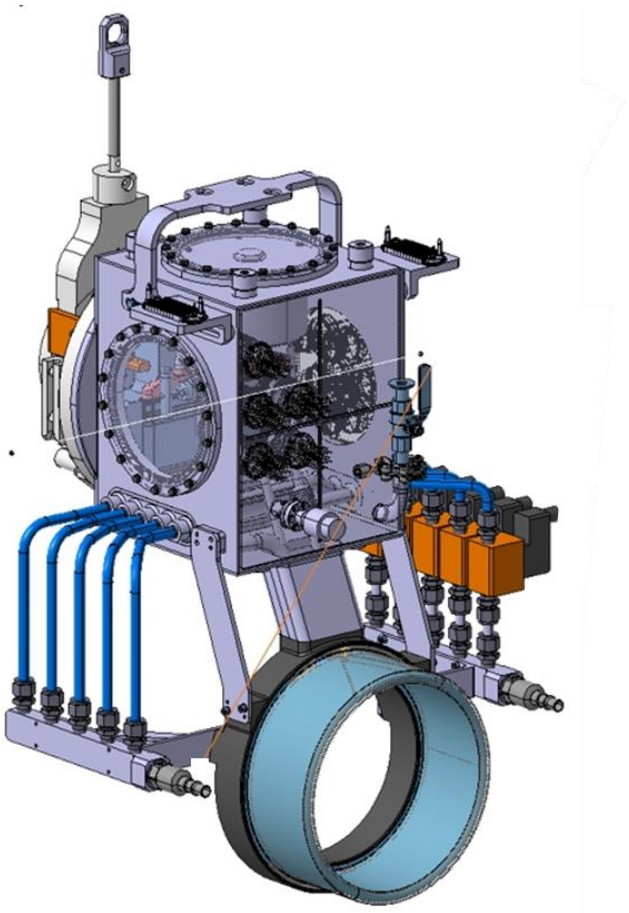
ISOLDE
LIEBE TARGET CYLINDER
Measurement of November 7th, 2017



The EDMS document: **1894729**, containing this report is available at the following address:
https://edms.cern.ch/document/**1894729**

1 General

On the demand of Ferran BOIX PAMIES the measurement of the LIEBE Target took place on 07th of November, 2017
The purpose of this measurement has been to check the good position of the LIEBE Target assembly with respect to the future final alignment with the Electromagnetic pump axis. For this the following measurements have been done:

1. Control of the Inner and Outer cylindricity of the target assembly.
2. Determinate the four fiducials points on the top of the element relative to the target axis.

2 Local Coordinate System

2.1 Local right-handed Cartesian coordinate system (see figure 1):

- **Origin**: Intersection of outer cylinder axis and front plane of the target cylinder.(see figure 8)
- **X-axis**: Outer cylinders axis, positive towards the pump. (see figures 3&4)
- **Y-axis**: Perpendicular to X and horizontal.
- **Z-axis**: Perpendicular to X and Y axis.

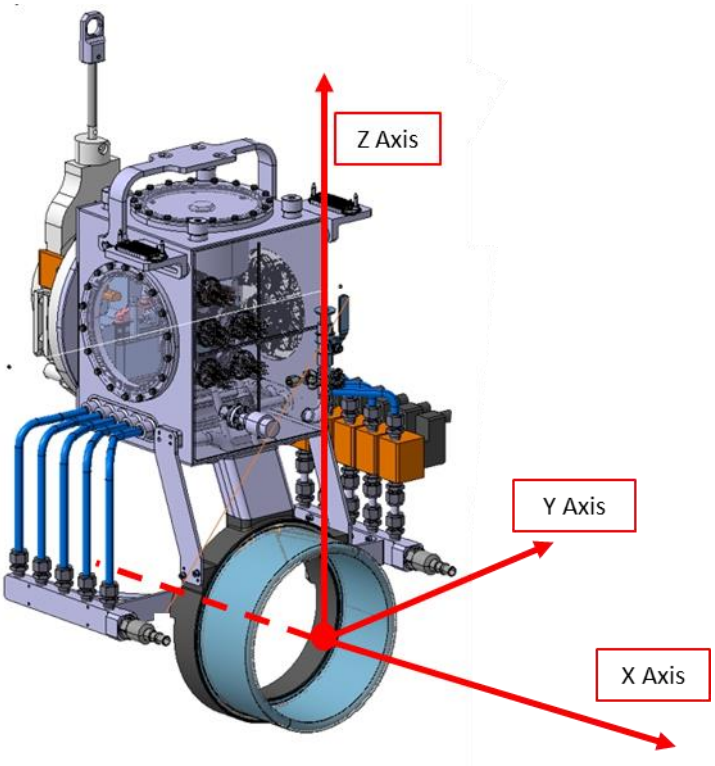


Figure1: Local Coordinate System for LIEBE Target.

3 Distribution of the measured points – Survey Target and applied Adapter.

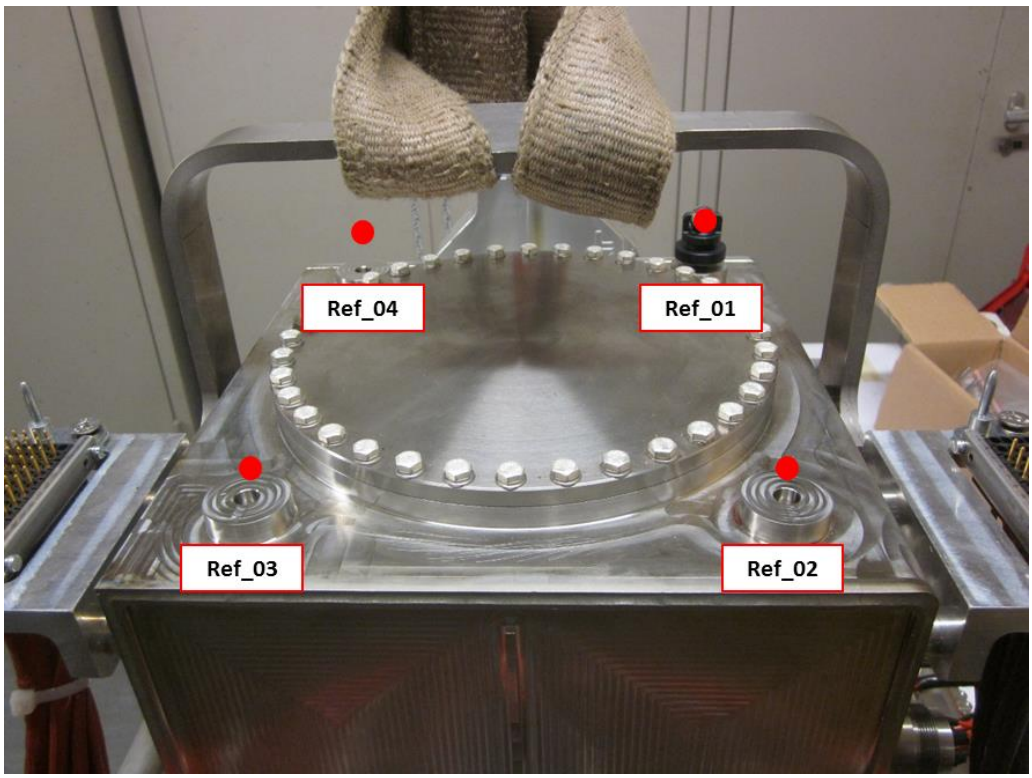


Figure2: Four References points on the top of target assembly.

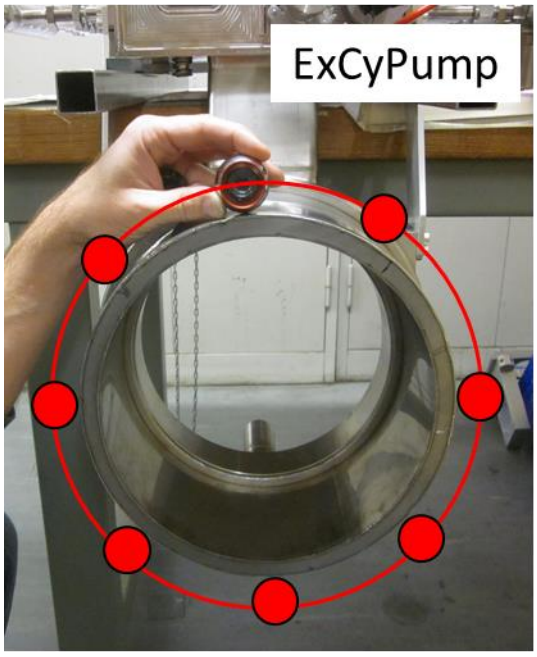


Figure3: Outer Cylinder points measured Number 1 to 8.

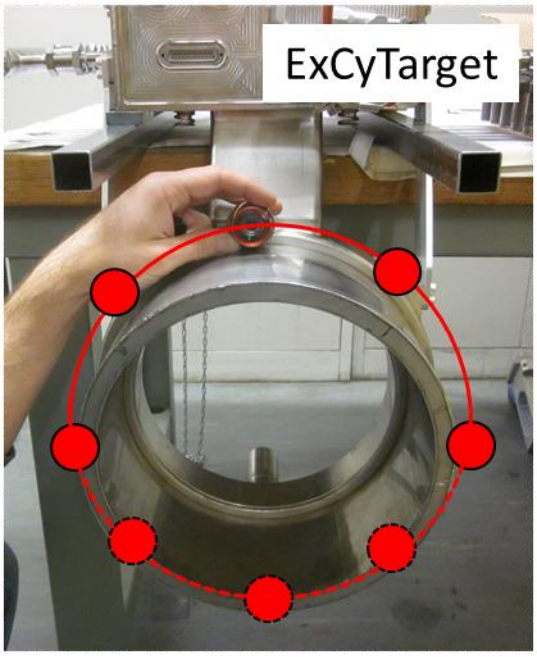


Figure4: Outer Cylinder points measured Number 9 to 16.

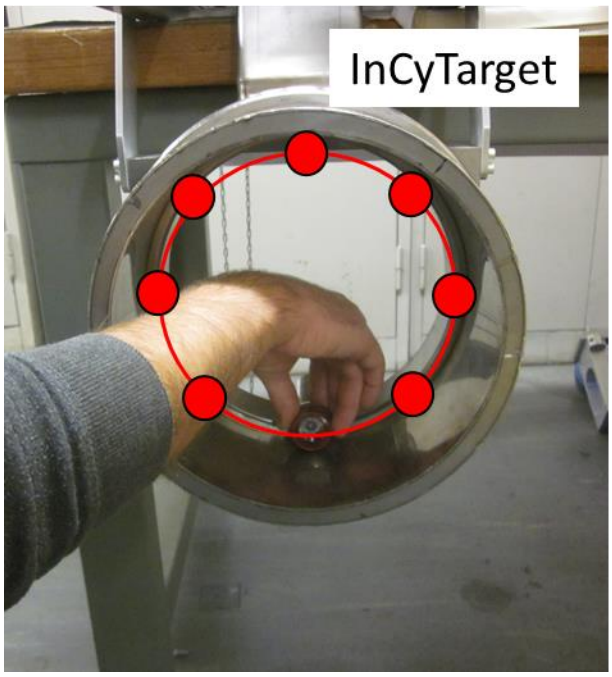


Figure5: Inner Cylinder points measured Number 1 to 8.

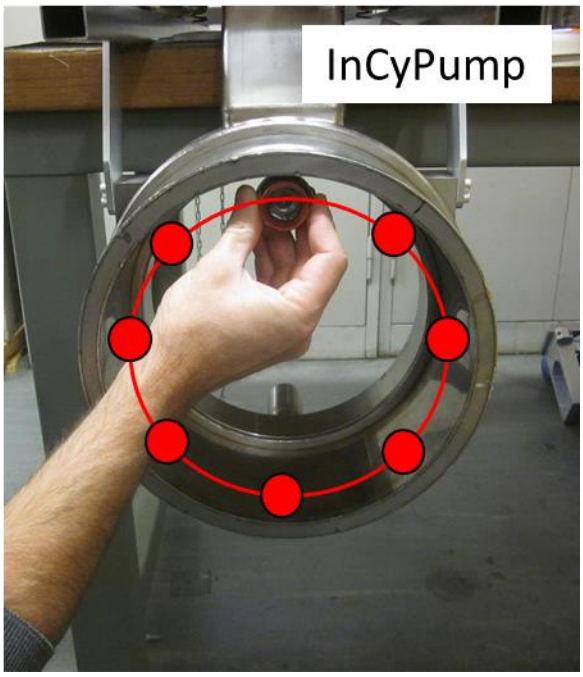


Figure6: Inner Cylinder points measured Number 9 to 16.

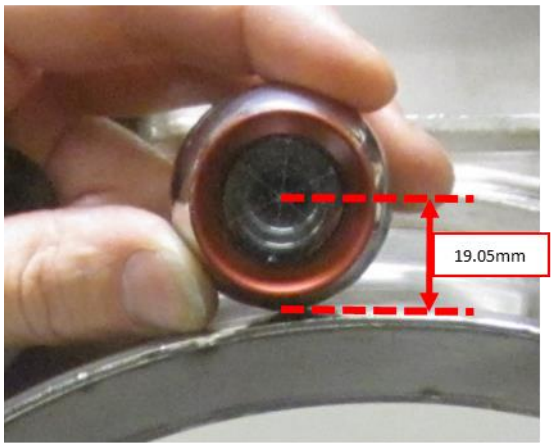


Figure 7: Survey target used to measure cylinder points.

Figure 8: Survey target and adapter used to measure front plane cylinder.

4 Results of the measurements

In the tables below, results are given at the centre of survey target, except the results of the two radius. Measured coordinates are given with precision: 0.2 mm

ISOLDE MEASURMENT OF LIEBE TARGET November 7th 2017				
Point description	**Name**	**X [m]**	**Y [m]**	**Z [m]**
Survey reference point on top of target	REF1	-0.33085	0.08100	0.59781
Survey reference point on top of target	REF2	-0.14011	0.08156	0.59511
Survey reference point on top of target	REF3	-0.13973	-0.08775	0.59433
Survey reference point on top of target	REF4	-0.33016	-0.08854	0.59691
Outer Cylinder Axis Pump side	ExCyPump	0.00000	0.00000	0.00000
Inner Cylinder Axis Pump side	InCyPump	0.00000	0.00014	0.00007
Outer Cylinder Axis target side	ExCyTarget	-0.09356	0.00000	0.00000
Inner Cylinder Axis target side	InCyTarget	-0.09356	-0.00006	0.00005

Outer Cylinder Radius with support adapter correction[m]	**0.14044**
Inner Cylinder Radius with support adapter correction [m]	**0.12526**

See § 5 for details on the different geometrical calculations. Several of the key values have been highlighted in red.

5 ATTACHMENT

5.1 OUTER CYLINDER FITTING OF THE TARGET

Results of Cylinder Fitting							***Date of Calculation:***		07/11/2017	
Co-ordinates of Point on Cylinder Axis							Time of Calculation:		18:08:42	
	X	-0.1045		Sig X	0.0000					
	Y	0.0000		Sig Y	0.0001					
	Z	0.0000		Sig Z	0.0001					
Direction Cosines of Cylinder Axis										
	l	-1.0000		Sig l	0.0000					
	m	0.0000		Sig m	0.0008					
	n	0.0000		Sig n	0.0008					
Radius of Cylinder										
	R	0.1595		Sig R	0.0000					
ATTENTION ! ALL THE VALUES ARE IN THE SAME UNIT WITH THE GIVEN DATA !										
Points used in calculations:				13 of 16						
Coords					**Residuals**				Dist to	Diff to
Name	X	Y	Z		vX	vY	vZ		Axis	Rad
					X,Y,Z + vX,vY,vZ = Pt. on Cyl.				+ve outside cylinder	
									-ve inside cylinder	
CYLIEX_01	-0.0045	-0.0024	0.1596		0.0000	0.0000	-0.0001		0.1596	0.0001
CYLIEX_02	-0.0062	0.1171	0.1081		0.0000	0.0001	0.0001		0.1594	-0.0001
CYLIEX_03	-0.0089	0.1581	-0.0223		0.0000	-0.0001	0.0000		0.1596	0.0001
CYLIEX_05	-0.0212	-0.0605	-0.1478		0.0000	0.0001	0.0002		0.1597	0.0002
CYLIEX_07	-0.0104	-0.1399	0.0762		0.0000	-0.0001	0.0001		0.1593	-0.0002
CYLIEX_08	-0.0062	-0.0818	0.1372		0.0000	0.0001	-0.0002		0.1597	0.0002
CYLIEX_09	-0.0850	0.0080	0.1592		0.0000	0.0000	0.0001		0.1594	-0.0001
CYLIEX_10	-0.0881	0.1200	0.1050		0.0000	0.0000	0.0000		0.1595	0.0000
CYLIEX_11	-0.0955	0.1573	-0.0257		0.0000	0.0001	0.0000		0.1593	-0.0001
CYLIEX_12	-0.1010	0.0920	-0.1303		0.0000	0.0000	0.0000		0.1595	0.0000
CYLIEX_13	-0.1013	-0.0618	-0.1469		0.0000	-0.0001	-0.0001		0.1594	-0.0001
CYLIEX_15	-0.0906	-0.1514	0.0496		0.0000	-0.0001	0.0000		0.1594	-0.0001
CYLIEX_16	-0.0864	-0.0941	0.1289		0.0000	0.0000	-0.0001		0.1596	0.0001
Summary of the data										
Equation of the cylinder										
0.15949^2 = (x- -0.10454)^2 + (y- 0.00000)^2+(z- 0.00000)^2										
	+ [-1.0000000(x- -0.10454)+0.0000036(y- 0.00000)+0.0000012(z- 0.00000)]^2									
Maximum Difference to Cylinder Radius				0.0002	At Point CYLIEX_08		+ve outside cylinder			
Minimum Difference to Cylinder Radius				-0.0002	At Point CYLIEX_07		-ve inside cylinder			
Information regarding Cylinder Axis										
The parametric equations of the cylinder axis are:										
y = Ax + P		A:	0.0000		z = Bx + Q		B:	0.0000		
		P:	0.0000				Q:	0.0000		
The intersection point of the cylinder axis and the YZ plane is :										
		x	0.0000							
		y	0.0000							
		z	0.0000							
Direction Cosines of Cylinder Axis				**Point on Cylinder Axis**						
	l	-1.0000			X	-0.1045				
	m	0.0000			Y	0.0000				
	n	0.0000			Z	0.0000				
Bearing of the Cylinder Axis (CYLIEX_01 to CYLIEX_16)						300.0002	grades			
Vertical Angle of the Cylinder Axis (CYLIEX_01 to CYLIEX_16)						99.9999	grades			
Perpendicular distance from origin to axis						0.0000				
Bearing of the Vector from origin to axis						N/A				
Vertical Angle of the Vector from origin to axis						200.0000	grades			

5.2 INNER CYLINDER FITTING OF THE TARGET

Results of Cylinder Fitting							***Date of Calculation:***		07/11/2017	
Co-ordinates of Point on Cylinder Axis							Time of Calculation:		18:09:05	
	X	-0.1094		Sig X	0.0000					
	Y	-0.0001		Sig Y	0.0001					
	Z	0.0001		Sig Z	0.0001					
Direction Cosines of Cylinder Axis										
	l	1.0000		Sig l	0.0000					
	m	0.0021		Sig m	0.0010					
	n	0.0001		Sig n	0.0011					
Radius of Cylinder										
	R	0.1062		Sig R	0.0000					
ATTENTION ! ALL THE VALUES ARE IN THE SAME UNIT WITH THE GIVEN DATA !										
Points used in calculations:				15 of 16						
Coords					**Residuals**				Dist to	Diff to
Name	X	Y	Z		vX	vY	vZ		Axis	Rad
					X,Y,Z + vX,vY,vZ = Pt. on Cyl.				+ve outside cylinder	
									-ve inside cylinder	
CYLIIN_02	-0.0905	0.0858	0.0625		0.0000	0.0001	0.0001		0.1061	-0.0001
CYLIIN_03	-0.0941	0.1057	-0.0059		0.0000	0.0002	0.0000		0.1060	-0.0002
CYLIIN_04	-0.0984	0.0637	-0.0850		0.0000	-0.0001	0.0001		0.1063	0.0001
CYLIIN_05	-0.0992	-0.0001	-0.1063		0.0000	0.0000	0.0001		0.1063	0.0001
CYLIIN_06	-0.0971	-0.0807	-0.0687		0.0000	-0.0002	-0.0001		0.1060	-0.0002
CYLIIN_07	-0.0936	-0.1059	-0.0054		0.0000	-0.0002	0.0000		0.1060	-0.0002
CYLIIN_08	-0.0893	-0.0758	0.0747		0.0000	0.0001	-0.0001		0.1064	0.0002
CYLIIN_09	-0.0118	-0.0054	0.1063		0.0000	0.0000	-0.0002		0.1064	0.0002
CYLIIN_10	-0.0113	0.0752	0.0750		0.0000	0.0001	0.0001		0.1060	-0.0002
CYLIIN_11	-0.0183	0.1047	-0.0178		0.0000	0.0001	0.0000		0.1062	-0.0001
CYLIIN_12	-0.0179	0.0757	-0.0747		0.0000	-0.0001	0.0001		0.1064	0.0001
CYLIIN_13	-0.0200	0.0130	-0.1056		0.0000	0.0000	0.0002		0.1065	0.0002
CYLIIN_14	-0.0201	-0.0625	-0.0856		0.0000	0.0000	-0.0001		0.1061	-0.0001
CYLIIN_15	-0.0134	-0.1057	-0.0063		0.0000	-0.0002	0.0000		0.1060	-0.0002
CYLIIN_16	-0.0128	-0.0723	0.0781		0.0000	0.0001	-0.0001		0.1064	0.0002
Summary of the data										
Equation of the cylinder										
0.10621^2 = (x- -0.10942)^2 + (y- -0.00009)^2+(z- 0.00005)^2										
	+ [0.9999977(x- -0.10942)+0.0021317(y- -0.00009)+0.0001240(z- 0.00005)]^2									
Maximum Difference to Cylinder Radius				0.0002	At Point CYLIIN_13		+ve outside cylinder			
Minimum Difference to Cylinder Radius				-0.0002	At Point CYLIIN_03		-ve inside cylinder			
Information regarding Cylinder Axis										
The parametric equations of the cylinder axis are:										
y = Ax + P		A:	0.0021		z = Bx + Q		B:	0.0001		
		P:	0.0001				Q:	0.0001		
The intersection point of the cylinder axis and the YZ plane is :										
		x	0.0000							
		y	0.0001							
		z	0.0001							
Direction Cosines of Cylinder Axis				**Point on Cylinder Axis**						
	l	1.0000			X	-0.1094				
	m	0.0021			Y	-0.0001				
	n	0.0001			Z	0.0001				
Bearing of the Cylinder Axis (CYLIIN_02 to CYLIIN_16)						99.8643	grades			
Vertical Angle of the Cylinder Axis (CYLIIN_02 to CYLIIN_16)						99.9921	grades			
Perpendicular distance from origin to axis						0.0002				
Bearing of the Vector from origin to axis						399.8607	grades			
Vertical Angle of the Vector from origin to axis						72.6240	grades			

5.3 DETERMINATION OF FRONT END OUTER CIRCLE CENTRE OF THE PUMP

Results of the Cylinder and the Plane Intersection								***Date of Calculation***	07/11/2017	
								Time of Calculation	18:09:53	
Equation of the plane is Ax + By + Cz + D = 0										
	Plane definition by the user:			Worksheet - Cylinder_fitting_ext						
	A:	0.99844		Dir Cos a:	0.99844	Attn! Dir Cos =				
	B:	0.00126		Dir Cos b:	0.00126	Unit Vector perpendicular to the Plane				
	C:	-0.05576		Dir Cos c:	-0.05576					
	D:	0.00000		d:	0.00000					
Cylinder defined by the vector of the axis, point on this axis and radius										
	Cylinder definition by the user:									
	Vector l:	-1.00000		Dir Cos l:	-1.00000					
	Vector m:	0.00000		Dir Cos m:	0.00000					
	Vector n:	0.00000		Dir Cos n:	0.00000					
	Point x:	-0.10454								
	Point y:	0.00000		**ATTENTION! ALL THE VALUES ARE**						
	Point z:	0.00000		**IN THE SAME UNIT WITH THE GIVEN DATA !**						
	Radius:	0.15949								
Coordinates of the intersection between the cylinder axis and the plane										
	X:	0.0000								
	Y:	0.0000								
	Z:	0.0000								
THE INTERSECTION IS AN ELLIPSE !										
The Coordinates of point A, A', B and B'										
	A (X)	0.00000		A'(X)	0.00000					
	A (Y)	0.15945		A'(Y)	-0.15945					
	A (Z)	0.00363		A'(Z)	-0.00363					
	B (X)	-0.15950		B'(X)	0.15950					
	B (Y)	0.06492		B'(Y)	-0.06492					
	B (Z)	-2.85444		B'(Z)	2.85444					
The length of the axis AA' and BB'										
	AA'	0.31899								
	BB'	5.71926								
The Bearing of the AA' (small axis)				0.0002	grades					
The Vertical of the AA' (small axis)				101.4477	grades					
The Bearing of the BB' (big axis)				124.6102	grades					
The Vertical of the BB' (big axis)				3.8360	grades					
Angle between the cylinder axis and the normal on the plane						103.5526	grades			