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RESEARCH & INDUSTRIAL OPTICS

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Tydex, J. S. Co.

Postal address: Domostroitel'naya str. 16, 194292 St. Petersburg, Russia

CERTIFICATE № 120521-1

Order № / date:	75ADV – S125757 dd. September 23, 2011	Material:	Astro Sitall (CO115M glass-ceramics)	
Design of part:	Off-axis parabolic mirror	Quantity:	1 pc	
Mirror number:	D1000075-V9 S/N004			
№	Parameter	Specification		Measured value
		nominal	tolerance	
1	Diameter, mm	230.0	-0.1	229.9
2	Edge thickness, mm	41.0	± 1.0	41.1
Surface 1 (parabolic)				
3	Clear aperture, mm	>190		≥ 190
4	Zonal radius, mm	562.2	± 1	562.7 ± 0.5
5	Parent focal length (true parabolic) (REF only), mm	2000	± 20	2001.8 ± 1.0
6	Slant focal length, mm	2039.5	-	2041.3
7	Surface quality, scr/dig	60/40		20/20
8	Surface microroughness (measured at witness), Rz, Å	< 100		< 50
9	Tilt of the back surface to the optical axis, deg.	90	± 30"	90° ± 10"
10	Surface accuracy for wave length, λ @ 0.63 μm, RMS	1/8		1/10 (annex 1 is attached)
11	Coating	None		-
Surface 2 (plane)				
12	Surface quality, scr/dig	Technologically polished		Technologically polished
13	Surface accuracy, λ @ 633 nm	-		-
14	Coating	-		-

Senior Sales
Engineer:

/Alexander Timofeevsky/

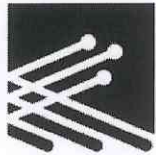
Packer:

/Margarita Laube/

Date:

13.05.12





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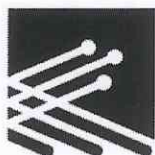
CERTIFICATE № 120521-2

Order № / date:	75ADV – S125757 dd. September 23, 2011	Material:	Astro Sital (CO115M glass-ceramics)	
Design of part:	Off-axis parabolic mirror	Quantity:	1 pc	
Mirror number:	D1000075-V9 S/N005			
№	Parameter	Specification		Measured value
		nominal	tolerance	
1	Diameter, mm	230.0	-0.1	230.0
2	Edge thickness, mm	41.0	± 1.0	41.4
Surface 1 (parabolic)				
3	Clear aperture, mm	>190		≥ 190
4	Zonal radius, mm	562.2	± 1	562.4 ± 0.5
5	Parent focal length (true parabolic) (REF only), mm	2000	± 20	2000.3 ± 0.5
6	Slant focal length, mm	2039.5	-	2039.8
7	Surface quality, scr/dig	60/40		20/20
8	Surface microroughness (measured at witness), Rz, Å	< 100		< 50
9	Tilt of the back surface to the optical axis, deg.	90	± 30"	90° ± 10"
10	Surface accuracy for wave length, λ @ 0.63 μm, RMS	1/8		1/13 (annex 1 is attached)
11	Coating	None		-
Surface 2 (plane)				
12	Surface quality, scr/dig	Technologically polished		Technologically polished
13	Surface accuracy, λ @ 633 nm	-		-
14	Coating	-		-

Senior Sales Engineer:  /Alexander Timofeevsky/

Packer:  /Margarita Laube/
Date: 21.05.12





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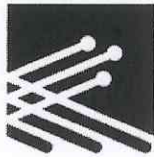
CERTIFICATE № 120521-3

Order № / date:	75ADV – S125757 dd. September 23, 2011	Material:	Astro Sitall (CO115M glass-ceramics)	
Design of part:	Off-axis parabolic mirror	Quantity:	1 pc	
Mirror number:	D1000075-V9 S/N006			
№	Parameter	Specification		Measured value
		nominal	tolerance	
1	Diameter, mm	230.0	-0.1	229.9
2	Edge thickness, mm	41.0	± 1.0	41.8
Surface 1 (parabolic)				
3	Clear aperture, mm	>190		≥ 190
4	Zonal radius, mm	562.2	± 1	562.4 ± 0.5
5	Parent focal length (true parabolic) (REF only), mm	2000	± 20	1996.5 ± 1.0
6	Slant focal length, mm	2039.5	-	2035.0
7	Surface quality, scr/dig	60/40		20/20
8	Surface microroughness (measured at witness), Rz, Å	< 100		< 50
9	Tilt of the back surface to the optical axis, deg.	90	± 30"	90°± 10"
10	Surface accuracy for wave length, λ @ 0.63 μm, RMS	1/8		1/11 (annex 1 is attached)
11	Coating	None		-
Surface 2 (plane)				
12	Surface quality, scr/dig	Technologically polished		Technologically polished
13	Surface accuracy, λ @ 633 nm	-		-
14	Coating	-		-

Senior Sales Engineer:  /Alexander Timofeevsky/

Packer:  /Margarita Laube/
Date: 21.05.12





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CERTIFICATE № 120521-4

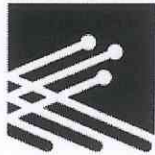
Order № / date:	75ADV – S125757 dd. September 23, 2011	Material:	Astro Sital (CO115M glass-ceramics)	
Design of part:	Secondary (convex) off-axis parabolic mirror		Quantity:	1 pc
Mirror number:	D0901565-v11-S/N004			
№	Parameter	Specification		Measured value
		nominal	tolerance	
1	Diameter, mm	38.1	-0.1	38.04
2	Edge thickness, mm	21.0	+1.0	21.9
Surface 1 (parabolic)				
3	Clear aperture, mm	>32		≥ 32
4	Zonal radius, mm	28.1	± 0.3	28.1
5	Parent focal length (true parabolic) (REF only), mm	100.0	± 1.0	100.0
6	Slant focal length, mm	102	-	102
7	Surface quality, scr/dig	60/40		20/20
8	Surface microroughness (measured at witness), Rz, Å	< 100		< 50
9	Back surface orthogonal to optical axis within, deg.	90	± 30"	90° ± 10"
10	Surface accuracy for wave length, λ @ 0.63 μm, RMS	1/8		1/8.5 (annex 1 is attached)
11	Coating	None		-
Surface 2 (plane)				
12	Surface quality, scr/dig	Technologically polished		Technologically polished
13	Surface accuracy, λ @ 633 nm	-		-
14	Coating	-		-

Senior Sales Engineer:  /Alexander Timofeevsky/

Packer:  /Margarita Laube/

Date: 21.05.12





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CERTIFICATE № 120521-5

Order № / date:	75ADV – S125757 dd. September 23, 2011	Material:	Astro Sitall (CO115M glass-ceramics)	
Design of part:	Secondary (convex) off-axis parabolic mirror		Quantity:	1 pc
Mirror number:	D0901565-v11-S/N005			
№	Parameter	Specification		Measured value
		nominal	tolerance	
1	Diameter, mm	38.1	-0.1	38.04
2	Edge thickness, mm	21.0	+1.0	21.9
Surface 1 (parabolic)				
3	Clear aperture, mm	>32		≥ 32
4	Zonal radius, mm	28.1	± 0.3	28.1
5	Parent focal length (true parabolic) (REF only), mm	100.0	± 1.0	100.0
6	Slant focal length, mm	102	-	102
7	Surface quality, scr/dig	60/40		20/20
8	Surface microroughness (measured at witness), Rz, Å	< 100		< 50
9	Back surface orthogonal to optical axis within, deg.	90	± 30"	90° ± 10"
10	Surface accuracy for wave length, λ @ 0.63 μm, RMS	1/8		1/8 (annex 1 is attached)
11	Coating	None		-
Surface 2 (plane)				
12	Surface quality, scr/dig	Technologically polished		Technologically polished
13	Surface accuracy, λ @ 633 nm	-		-
14	Coating	-		-

Senior Sales
Engineer:

/Alexander Timofeevsky/

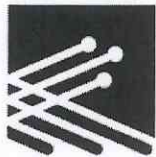
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CERTIFICATE № 120521-6

Order № / date:	75ADV – S125757 dd. September 23, 2011	Material:	Astro Sitall (CO115M glass-ceramics)	
Design of part:	Secondary (convex) off-axis parabolic mirror	Quantity:	1 pc	
Mirror number:	D0901565-v11-S/N006			
№	Parameter	Specification		Measured value
		nominal	tolerance	
1	Diameter, mm	38.1	-0.1	38.04
2	Edge thickness, mm	21.0	+1.0	21.9
Surface 1 (parabolic)				
3	Clear aperture, mm	>32		≥ 32
4	Zonal radius, mm	28.1	± 0.3	28.1
5	Parent focal length (true parabolic) (REF only), mm	100.0	± 1.0	100.00
6	Slant focal length, mm	102	-	102
7	Surface quality, scr/dig	60/40		20/20
8	Surface microroughness (measured at witness), Rz, Å	< 100		< 50
9	Back surface orthogonal to optical axis within, deg.	90	± 30"	90° ± 10"
10	Surface accuracy for wave length, λ @ 0.63 μm, RMS	1/8		1/10.5 (annex 1 is attached)
11	Coating	None		-
Surface 2 (plane)				
12	Surface quality, scr/dig	Technologically polished		Technologically polished
13	Surface accuracy, λ @ 633 nm	-		-
14	Coating	-		-

Senior Sales
Engineer:

/Alexander Timofeevsky/

Packer:

/Margarita Laube/

Date:

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CERTIFICATE № 120403-1

Order № / date:	75ADV – S125757 dd. September 23, 2011	Material:	Astro Sital (CO115M glass-ceramics)	
Design of part:	Off-axis parabolic mirror	Quantity:	1 pc	
Mirror number:	D1000075-V9 S/N002			
№	Parameter	Specification		Measured value
		nominal	tolerance	
1	Diameter, mm	230.0	-0.1	230.0
2	Edge thickness, mm	41.0	± 1.0	41.77
Surface 1 (parabolic)				
3	Clear aperture, mm	>190		≥ 190
4	Zonal radius, mm	562.2	± 1	562.8 ± 0.3
5	Parent focal length (true parabolic) (REF only), mm	2000	± 20	1999.9 ± 0.3
6	Slant focal length, mm	2039.5	-	2039.5
7	Surface quality, scr/dig	60/40		20/20
8	Surface microroughness (measured at witness), Rz, Å	< 100		≅ 50
9	Tilt of the back surface to the optical axis, deg.	90	± 10"	90°10" ± 10"
10	Surface accuracy for wave length, λ @ 0.63 μm, RMS	1/8		1/11 (annex 1 is attached)
11	Coating	None		-
Surface 2 (plane)				
12	Surface quality, scr/dig	Technologically polished		Technologically polished
13	Surface accuracy, λ @ 633 nm	-		-
14	Coating	-		-

Senior Sales Engineer:  /Alexander Timofeevsky/

Packer:  /Margarita Laube/

Date: 03.04.12





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CERTIFICATE № 120403-2

Order № / date:	75ADV – S125757 dd. September 23, 2011	Material:	Astro Sitall (CO115M glass-ceramics)	
Design of part:	Off-axis parabolic mirror	Quantity:	1 pc	
Mirror number:	D1000075-V9 S/N003			
№	Parameter	Specification		Measured value
		nominal	tolerance	
1	Diameter, mm	230.0	-0.1	230.0
2	Edge thickness, mm	41.0	± 1.0	41.36
Surface 1 (parabolic)				
3	Clear aperture, mm	>190		≥ 190
4	Zonal radius, mm	562.2	± 1	562.3 ± 0.4
5	Parent focal length (true parabolic) (REF only), mm	2000	± 20	1999.5 ± 0.5
6	Slant focal length, mm	2039.5	-	2039.0
7	Surface quality, scr/dig	60/40		20/20
8	Surface microroughness (measured at witness), Rz, Å	< 100		≅ 50
9	Tilt of the back surface to the optical axis, deg.	90	± 10"	90° ± 10"
10	Surface accuracy for wave length, λ @ 0.63 μm, RMS	1/8		1/13 (annex 1 is attached)
11	Coating	None		-
Surface 2 (plane)				
12	Surface quality, scr/dig	Technologically polished		Technologically polished
13	Surface accuracy, λ @ 633 nm	-		-
14	Coating	-		-

Senior Sales
Engineer:

/Alexander Timofeevsky/



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CERTIFICATE № 120403-3

Order № / date:	75ADV – S125757 dd. September 23, 2011	Material:	Astro Sitall (CO115M glass-ceramics)	
Design of part:	Secondary (convex) off-axis parabolic mirror	Quantity:	1 pc	
Mirror number:	D0901565-v11-S/N001			
№	Parameter	Specification		Measured value
		nominal	tolerance	
1	Diameter, mm	38.1	-0.1	38.05
2	Edge thickness, mm	21.0	+1.0	21.9
Surface 1 (parabolic)				
3	Clear aperture, mm	>32		≥ 32
4	Zonal radius, mm	28.1	± 0.3	28.1
5	Parent focal length (true parabolic) (REF only), mm	100.0	± 1.0	100.0
6	Slant focal length, mm	102	-	102
7	Surface quality, scr/dig	60/40		20/20
8	Surface microroughness (measured at witness), Rz, Å	< 100		≅ 50
9	Back surface orthogonal to optical axis within, deg.	90	± 30°	90° ± 10°
10	Surface accuracy for wave length, λ @ 0.63 μm, RMS	1/8		1/11 (annex 1 is attached)
11	Coating	None		-
Surface 2 (plane)				
12	Surface quality, scr/dig	Technologically polished		Technologically polished
13	Surface accuracy, λ @ 633 nm	-		-
14	Coating	-		-

Senior Sales Engineer:  /Alexander Timofeevsky/

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Date: 03.04.12





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CERTIFICATE № 120403-4

Order № / date:	75ADV – S125757 dd. September 23, 2011		Material:	Astro Sital (CO115M glass-ceramics)
Design of part:	Secondary (convex) off-axis parabolic mirror			Quantity:
Mirror number:	D0901565-v11-S/N002			
№	Parameter	Specification		Measured value
		nominal	tolerance	
1	Diameter, mm	38.1	-0.1	38.05
2	Edge thickness, mm	21.0	+1.0	21.9
Surface 1 (parabolic)				
3	Clear aperture, mm	>32		≥ 32
4	Zonal radius, mm	28.1	± 0.3	28.1
5	Parent focal length (true parabolic) (REF only), mm	100.0	± 1.0	100.0
6	Slant focal length, mm	102	-	102
7	Surface quality, scr/dig	60/40		20/20
8	Surface microroughness (measured at witness), Rz, Å	< 100		≅ 50
9	Back surface orthogonal to optical axis within, deg.	90	± 30"	90° ± 10"
10	Surface accuracy for wave length, λ @ 0.63 μm, RMS	1/8		1/10 (annex 1 is attached)
11	Coating	None		-
Surface 2 (plane)				
12	Surface quality, scr/dig	Technologically polished		Technologically polished
13	Surface accuracy, λ @ 633 nm	-		-
14	Coating	-		-

Senior Sales Engineer:  /Alexander Timofeevsky/

Packer:  /Margarita Laube/

Date: 03.04.12





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CERTIFICATE № 120403-5

Order № / date:	75ADV – S125757 dd. September 23, 2011	Material:	Astro Sitall (CO115M glass-ceramics)	
Design of part:	Secondary (convex) off-axis parabolic mirror	Quantity:	1 pc	
Mirror number:	D0901565-v11-S/N003			
№	Parameter	Specification		Measured value
		nominal	tolerance	
1	Diameter, mm	38.1	-0.1	38.05
2	Edge thickness, mm	21.0	+1.0	21.9
Surface 1 (parabolic)				
3	Clear aperture, mm	>32		≥ 32
4	Zonal radius, mm	28.1	± 0.3	28.1
5	Parent focal length (true parabolic) (REF only), mm	100.0	± 1.0	100.0
6	Slant focal length, mm	102	-	102
7	Surface quality, scr/dig	60/40		20/20
8	Surface microroughness (measured at witness), Rz, Å	< 100		≅ 50
9	Back surface orthogonal to optical axis within, deg.	90	± 30"	90° ± 10"
10	Surface accuracy for wave length, λ @ 0.63 μm, RMS	1/8		1/9 (annex 1 is attached)
11	Coating	None		-
Surface 2 (plane)				
12	Surface quality, scr/dig	Technologically polished		Technologically polished
13	Surface accuracy, λ @ 633 nm	-		-
14	Coating	-		-

Senior Sales Engineer:  /Alexander Timofeevsky/

Packer:  Margarita Laube/

Date: 03.04.12





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CERTIFICATE № 120216-1

Order № / date:	75ADV – S125757 dd. September 23, 2011	Material:	Astro Sitall (CO115M glass-ceramics)	
Design of part:	Off-axis parabolic mirror	Quantity:	1 pc	
Mirror number:	D1000075-V9 S/N001			
№	Parameter	Specification		Measured value
		nominal	tolerance	
1	Diameter, mm	230.0	-0.1	230.0
2	Edge thickness, mm	41.0	± 1.0	40.8
Surface 1 (parabolic)				
3	Clear aperture, mm	>190		≥ 190
4	Zonal radius, mm	562.2	± 15.0	562.2 ± 0.5
5	Parent focal length (true parabolic) (REF only), mm	2000	± 20	1999.6 ± 1.0
6	Slant focal length, mm	2039.5	-	2039.1
7	Surface quality, scr/dig	60/40		40/20
8	Surface microroughness (measured at witness), Rz, Å	< 100		< 30
9	Tilt of the back surface to the optical axis, deg.	90	± 0.5	90 ± 0.25
10	Surface accuracy for wave length, λ @ 0.63 μm, RMS	1/8		1/12 (annex 1 is attached)
11	Coating	None		-
Surface 2 (plane)				
12	Surface quality, scr/dig	Ground		Ground
13	Surface accuracy, λ @ 633 nm	-		-
14	Coating	-		-

Senior Sales Engineer:  /Alexander Timofeevsky/

Packer:  /Margarita Laube/

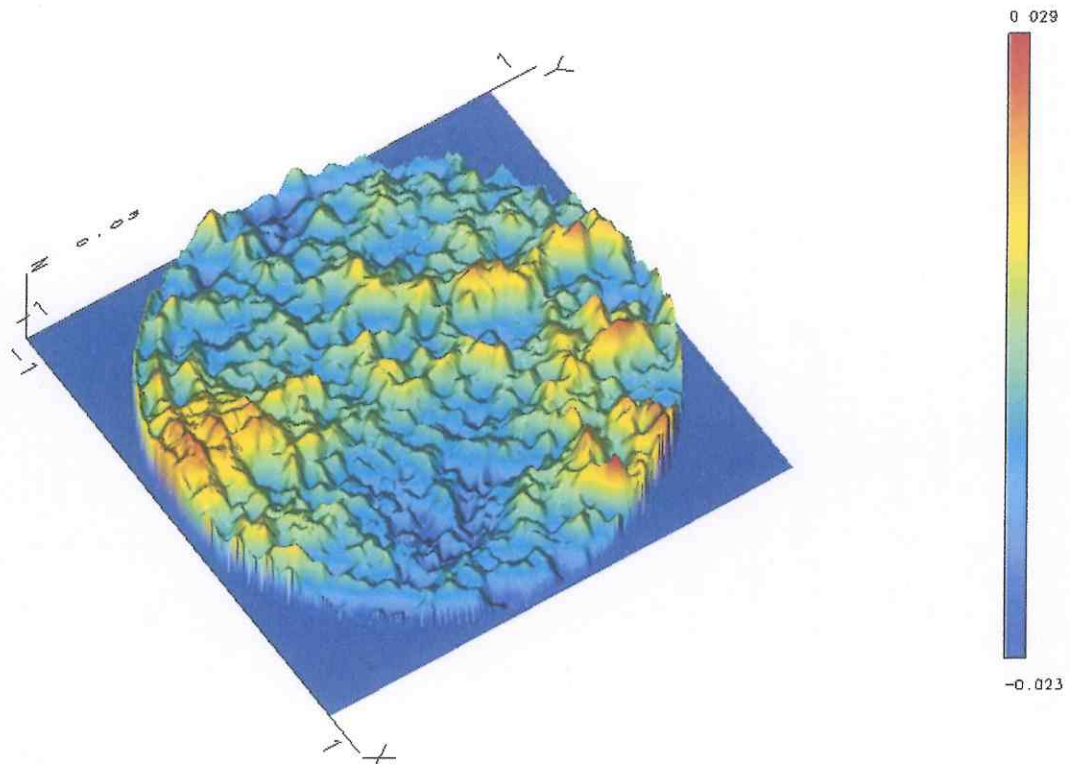
Date: 21.02.12



#2



E0900347-V9 S/N 001



Wave front analysis

Date: Tue Feb 14 2012 Time: 15:52:06
 File: I230-001_C13.asr.mtr
 Name: E0900347-V9 S/N 001, cycle N13
 Units of deformations measuring: microns
 Wave length: 0.633
 Reference surface: sphere
 Subtracted aberrations:
 Form of zonal error - Zernike polynomial

-----Parameters of regular errors-----

D= 0.000 Lx= 0.000 LY= 0.000 C= -0.000 RMS(W)= 0.008
 A= 0.010 FIA= -16.255 PV= 0.020 RMS(W-A)= 0.006 FA=0.283
 B0= -0.001 PV= 0.001 RMS(W-Z)= 0.008 FZ=0.003
 B2= 0.005
 B4= -0.005
 C= 0.012 FIC=-127.926 PV= 0.008 RMS(W-C)= 0.007 FC=0.034

 Local errors: PV= 0.052 RMS(M)= 0.006

Characteristics of wavefront

RMS	MIN	MAX	PV
0.008	-0.023	0.029	0.052

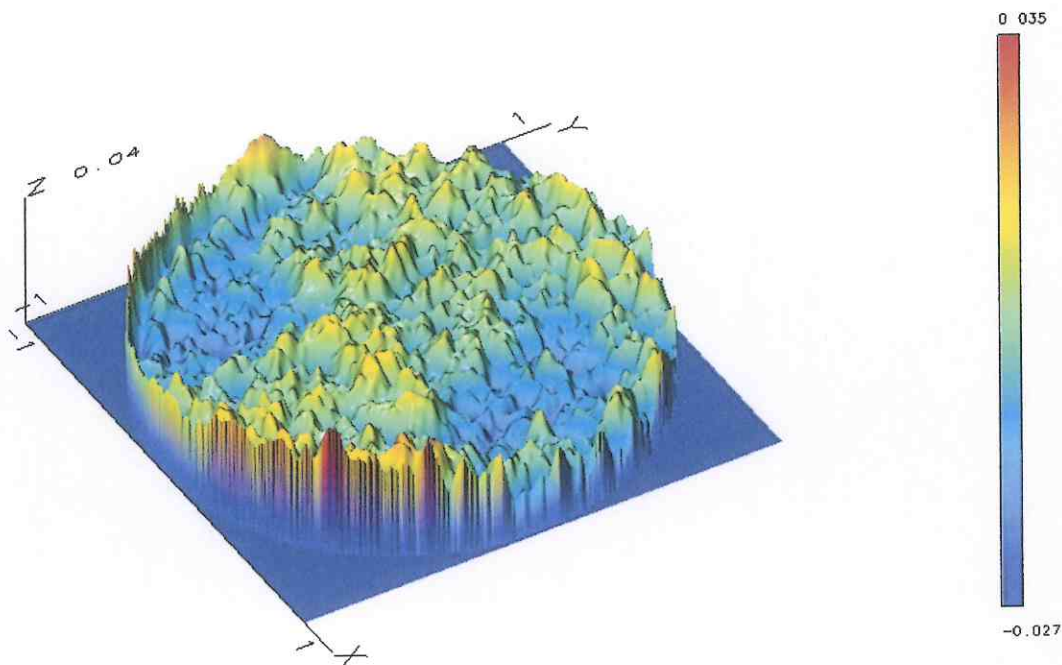
Notes:

- The results given comply with measurements in auto-collimator scheme with sample flat mirror and tested paraboloid mirror.
- Twyman interferometer with unequal arms was used to conduct measurements.
- Single fringe corresponds to $\lambda/4$ surface deflection.
- Statistics were estimated within clear aperture (circle of 190-mm diameter).
- Numbers supplied refer to surface deflections, not wavefront aberrations.
- OX axis denotes direction from parabola apex to mirror center.



D1000075-v9 S/N 004 (CA 190 mm)

Annex 1 to Certificate for Off-Axis Parabolic Mirror E0900347-V9 S/N 004



Wave front analysis

Date: Wed Apr 18 2012 Time: 09:58:34
 File: 004-att-ave.mtr
 Name: D1000075-v8 S/N 004, cycle N20
 Units of deformations measuring: microns
 Wave length: 0.633
 Reference surface: sphere
 Subtracted aberrations:
 Form of zonal error - Zernike polynomial

-----Parameters of regular errors-----

D= -0.000 Lx= -0.000 LY= 0.000 C= 0.000 RMS(W)= 0.008
 A= 0.010 FIA= 40.496 PV= 0.020 RMS(W-A)= 0.007 FA=0.283
 B0= 0.005 PV= 0.007 RMS(W-Z)= 0.008 FZ=0.072
 B2= -0.028
 B4= 0.028
 C= 0.011 FIC= -97.600 PV= 0.007 RMS(W-C)= 0.008 FC=0.026

 Local errors: PV= 0.053 RMS(M)= 0.006

Characteristics of wavefront

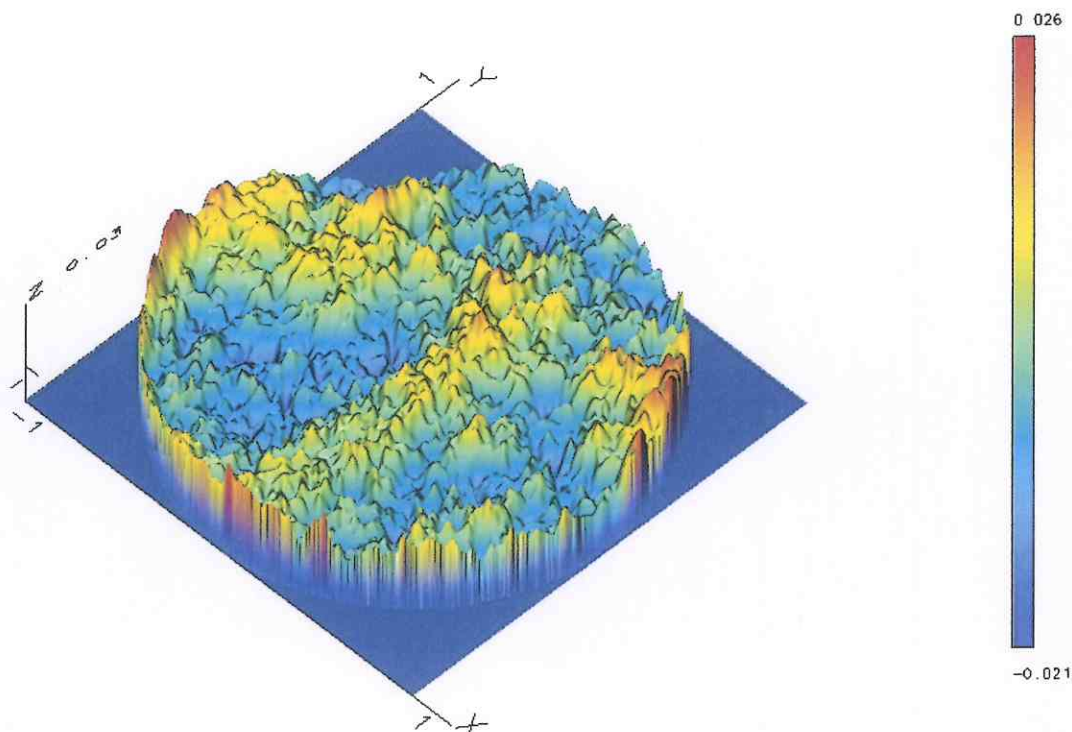
RMS	MIN	MAX	PV
0.008	-0.027	0.035	0.062

Notes:

- The results given comply with measurements in auto-collimator scheme with sample flat mirror and tested paraboloid mirror.
- Twyman interferometer with unequal arms was used to conduct measurements.
- Single fringe corresponds to $\lambda/4$ surface deflection.
- Statistics were estimated within clear aperture (circle of 190-mm diameter).
- Numbers supplied refer to surface deflections, not wavefront aberrations.
- PV is measured in direction from paraboloid apex to mirror center.



D1000075-v9 S/N 005 (CA 190 mm)



Wave front analysis

Date: Thu Apr 26 2012 Time: 15:37:44
 File: lp005-att-ave.mtr
 Name: D1000075-v8 S/N 005, cycle N17
 Units of deformations measuring: microns
 Wave length: 0.633
 Reference surface : sphere
 Subtracted aberrations:
 Form of zonal error - Zernike polynomial

-----Parameters of regular errors-----

D= -0.000 Lx= -0.000 LY= 0.000 C= 0.000 RMS(W)= 0.007
 A= 0.004 FIA= -73.557 PV= 0.008 RMS(W-A)= 0.007 FA=0.052
 B0= 0.002 PV= 0.004 RMS(W-Z)= 0.007 FZ=0.024
 B2= -0.014
 B4= 0.014
 C= 0.018 FIC=-175.921 PV= 0.012 RMS(W-C)= 0.006 FC=0.100

 Local errors: PV= 0.040 RMS(M)= 0.006

Characteristics of wavefront

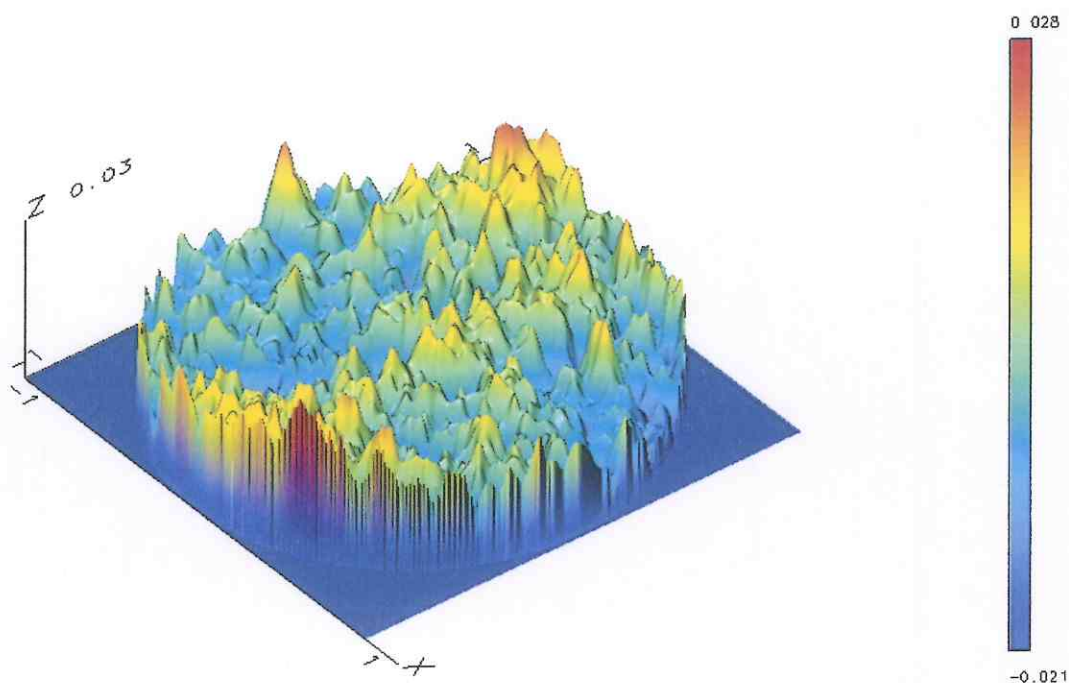
RMS	MIN	MAX	PV
0.007	-0.021	0.026	0.047

Notes:

- The results given comply with measurements in auto-collimator scheme with sample flat mirror and tested paraboloid mirror.
- Twyman interferometer with unequal arms was used to conduct measurements.
- Single fringe corresponds to $\lambda/4$ surface deflection.
- Statistics were estimated within clear aperture (circle of 190-mm diameter).
- Numbers supplied refer to surface deflections, not wavefront aberrations.
- OX axis denotes direction from parabola apex to mirror center.



D1000075-v9 S/N 006 (CA 190 mm)



Wave front analysis

Date: Thu Apr 26 2012 Time: 17:02:27
 File: lp006-att-ave.mtr
 Name: D1000075-v8 S/N 006, cycle N16
 Units of deformations measuring: microns
 Wave length: 0.633
 Reference surface: sphere
 Subtracted aberrations:
 Form of zonal error - Zernike polynomial

-----Parameters of regular errors-----

D= -0.000 Lx= -0.001 LY= 0.001 C= 0.000 RMS(W)= 0.006
 A= 0.008 FIA= 25.390 PV= 0.016 RMS(W-A)= 0.006 FA=0.266
 B0= -0.000 PV= 0.001 RMS(W-Z)= 0.006 FZ=0.001
 B2= 0.002
 B4= -0.002
 C= 0.011 FIC= 158.826 PV= 0.007 RMS(W-C)= 0.006 FC=0.041

 Local errors: PV= 0.045 RMS(M)= 0.005

Characteristics of wavefront

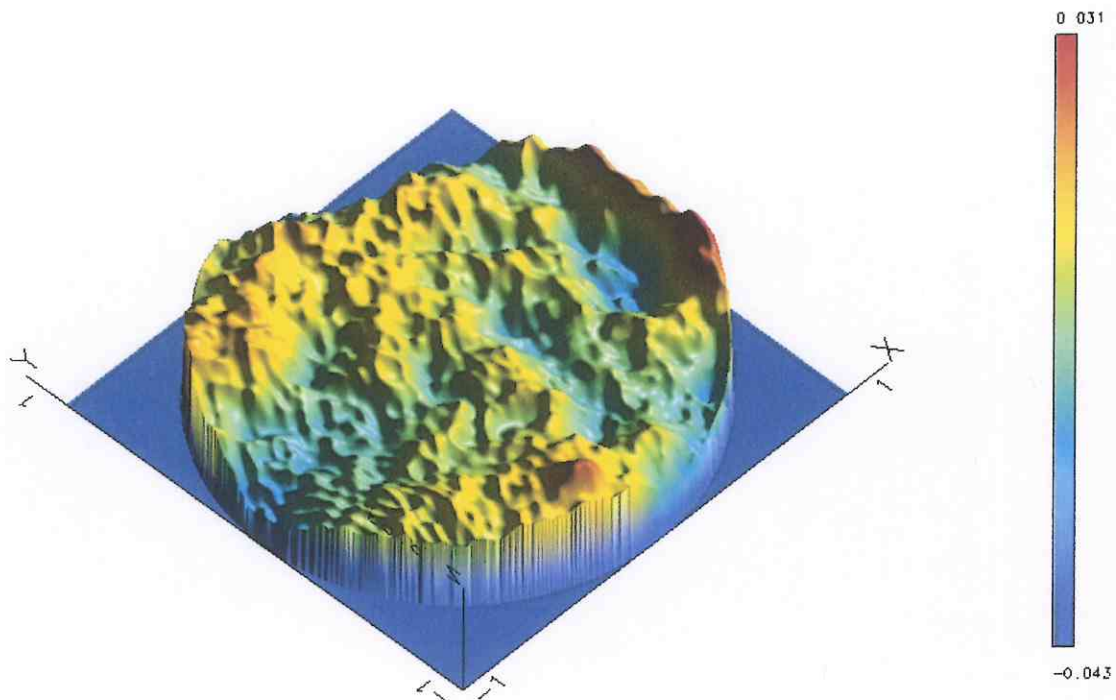
RMS	MIN	MAX	PV
0.006	-0.021	0.028	0.049

Notes:

- The results given comply with measurements in auto-collimator scheme with sample flat mirror and tested paraboloid mirror.
- Twyman interferometer with unequal arms was used to conduct measurements.
- Single fringe corresponds to $\lambda/4$ surface deflection.
- Statistics were estimated within clear aperture (circle of 190-mm diameter).
- Numbers supplied refer to surface deflections, not wavefront aberrations.
- OX axis denotes direction from parabola apex to mirror center.



D0901565-v11 SN 004 (CA 32 mm)



Wave front analysis

Date: Thu Apr 26 2012 Time: 11:17:40
 File: ls005-att-ave.mtr
 Name: D0901565-v11 SN 004, cycle N7
 Units of deformations measuring: microns
 Wave length: 0.6328
 Reference surface: sphere
 Subtracted aberrations:
 Form of zonal error - Zernike polynomial

-----Parameters of regular errors-----

D= 0.015 Lx= 0.000 LY= 0.000 C= -0.007 RMS(W)= 0.009
 A= 0.003 FIA= 23.864 PV= 0.006 RMS(W-A)= 0.009 FA=0.015
 B0= -0.001 PV= 0.002 RMS(W-Z)= 0.009 FZ=0.003
 B2= 0.007
 B4= -0.008
 C= 0.025 FIC=-172.188 PV= 0.016 RMS(W-C)= 0.009 FC=0.094

 Local errors: PV= 0.065 RMS(M)= 0.009

Characteristics of wavefront

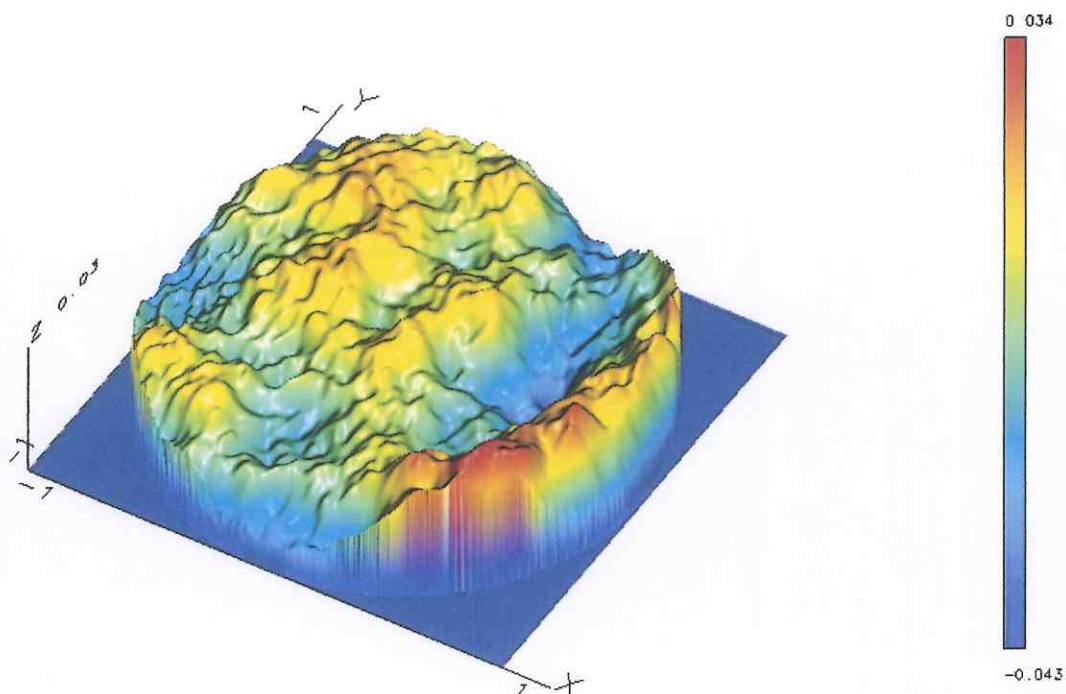
RMS	MIN	MAX	PV
0.009	-0.043	0.031	0.074

Notes:

- The results given comply with test using laser Fizeau interferometer IT-01, collimator, tested parabolic mirror and a sample spherical mirror.
- The polished rare surface were used as a reference to define a system's optical axis.
- Single fringe corresponds to $\lambda/4$ surface deflection.
- Statistics were estimated within clear aperture (circle of 32-mm diameter).
- Numbers supplied refer to surface deflections, not wavefront aberrations.
- OX axis denotes direction from parabola apex to mirror center.



D0901565-v11 SN 005 (CA 32 mm)



Wave front analysis

Date: Thu Apr 26 2012 Time: 11:39:26
 File: ls005-att-ave.mtr
 Name: D0901565-v11 SN 005, cycle N6
 Units of deformations measuring: microns
 Wave length: 0.6328
 Reference surface: sphere
 Subtracted aberrations:
 Form of zonal error - Zernike polynomial

-----Parameters of regular errors-----

D= 0.001 Lx= -0.000 LY= -0.000 C= -0.001 RMS(W)= 0.011
 A= 0.012 FIA= 52.735 PV= 0.023 RMS(W-A)= 0.010 FA=0.172
 B0= 0.001 PV= 0.001 RMS(W-Z)= 0.011 FZ=0.001
 B2= -0.004
 B4= 0.004
 C= 0.036 FIC=-103.694 PV= 0.024 RMS(W-C)= 0.011 FC=0.133

 Local errors : PV= 0.085 RMS(M)= 0.010

Characteristics of wavefront

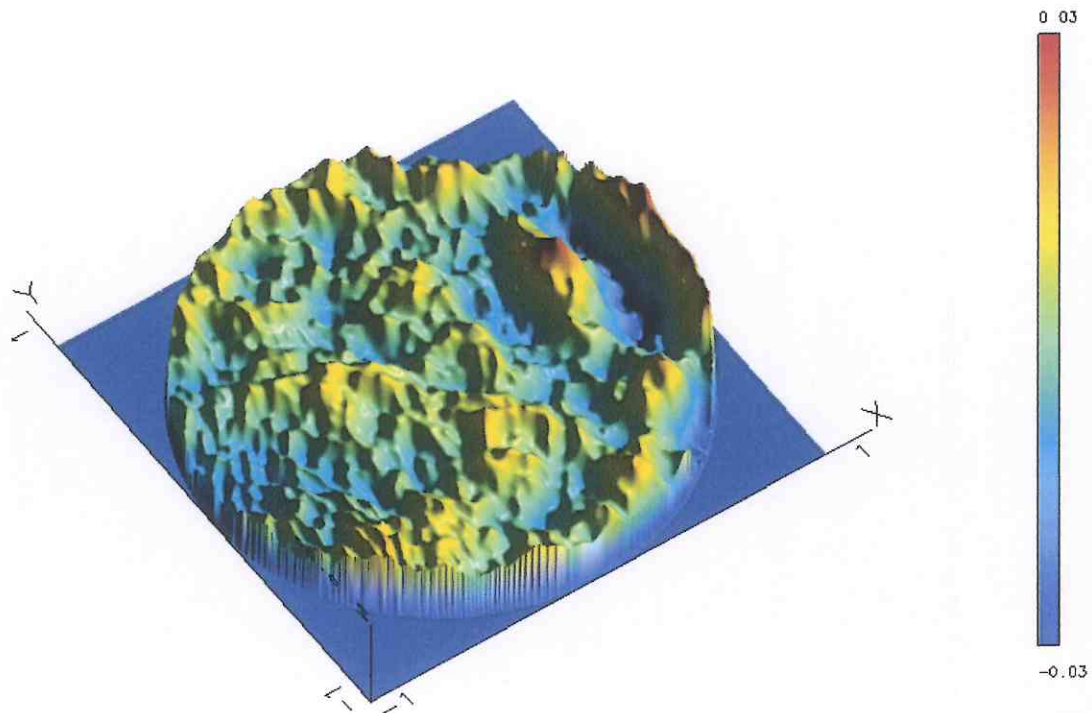
RMS	MIN	MAX	PV
0.011	-0.043	0.034	0.076

Notes:

- The results given comply with test using laser Fizeau interferometer IT-01, collimator, tested parabolic mirror and a sample spherical mirror.
- The polished rare surface were used as a reference to define a system's optical axis.
- Single fringe corresponds to $\lambda/4$ surface deflection.
- Statistics were estimated within clear aperture (circle of 32-mm diameter).
- Numbers supplied refer to surface deflections, not wavefront aberrations.
- OX axis denotes direction from parabola apex to mirror center.



D0901565-v11 SN 006 (CA 32 mm)



Wave front analysis

Date: Thu Apr 26 2012 Time: 14:27:17

File: Is006-att-ave.mtr

Name: D0901565-v11 SN 006, cycle N8

Units of deformations measuring: microns

Wave length: 0.6328

Reference surface: sphere

Subtracted aberrations:

Form of zonal error - Zernike polynomial

-----Parameters of regular errors-----

D= 0.001	Lx= -0.000	LY= -0.000	C= -0.001	RMS(W)= 0.007
A= 0.005	FIA= -10.421	PV= 0.009	RMS(W-A)= 0.007	FA=0.062
B0= 0.003		PV= 0.004	RMS(W-Z)= 0.007	FZ=0.025
B2= -0.016				
B4= 0.016				
C= 0.007	FIC= -52.875	PV= 0.004	RMS(W-C)= 0.007	FC=0.010

Local errors: PV= 0.061 RMS(M)= 0.007

Characteristics of wavefront

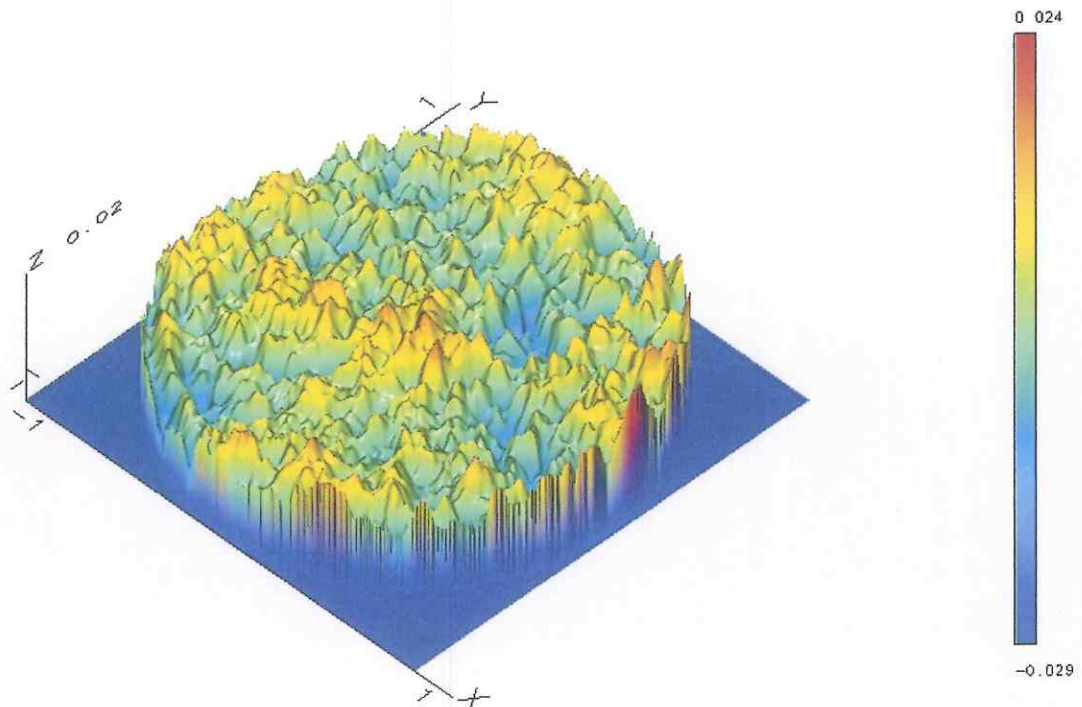
RMS	MIN	MAX	PV
0.007	-0.030	0.030	0.059

Notes:

- The results given comply with test using laser Fizeau interferometer IT-01, collimator, tested parabolic mirror and a sample spherical mirror.
- The polished rare surface were used as a reference to define a system's optical axis.
- Single fringe corresponds to $\lambda/4$ surface deflection.
- Statistics were estimated within clear aperture (circle of 32-mm diameter).
- Numbers supplied refer to surface deflections, not wavefront aberrations.
- OX axis denotes direction from parabola apex to mirror center.



D1000075-v9 S/N 002 (CA 190 mm)



Wave front analysis

Date: Thu Mar 22 2012 Time: 14:34:17
 File: lp002-att.mtr
 Name: D1000075-v9 S/N 002, cycle N14
 Units of deformations measuring: microns Wave length: 0.633
 Reference surface : sphere
 Subtracted aberrations:

Form of zonal error - Zernike polynomial

-----Parameters of regular errors-----

D= -0.000	Lx= -0.000	LY= -0.000	C= 0.000	RMS(W)= 0.005
A= 0.000	FIA= 0.000	PV= 0.000	RMS(W-A)= 0.005	FA=0.000
B0= 0.002		PV= 0.003	RMS(W-Z)= 0.005	FZ=0.024
B2= -0.011				
B4= 0.012				
C= 0.012	FIC= -41.722	PV= 0.008	RMS(W-C)= 0.005	FC=0.071

Local errors: PV= 0.045 RMS(M)= 0.005

Characteristics of wavefront

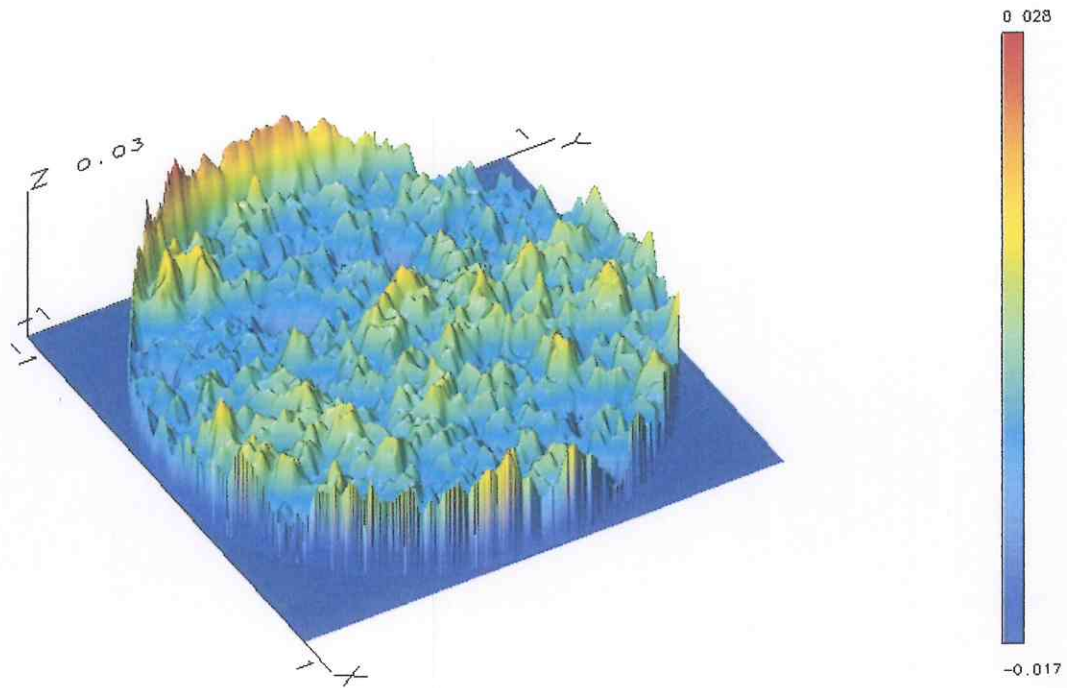
RMS	MIN	MAX	PV
0.005	-0.029	0.024	0.053

Notes:

- The results given comply with measurements in auto-collimator scheme with sample flat mirror and tested paraboloid mirror.
- Twyman interferometer with unequal arms was used to conduct measurements.
- Single fringe corresponds to $\lambda/4$ surface deflection.
- Statistics were estimated within clear aperture (circle of 190-mm diameter).
- Numbers supplied refer to surface deflections, not wavefront aberrations.
- OX axis denotes direction from parabola apex to mirror center.



D1000075-v9 S/N 003 (CA 190 mm)



Wave front analysis

Date: Fri Mar 23 2012 Time: 15:55:25
 File: lp003-att.mtr
 Name: D1000075-v9 S/N 003, cycle N13
 Units of deformations measuring: microns
 Wave length: 0.633
 Reference surface: plane
 Subtracted aberrations:
 Form of zonal error - Zernike polynomial

-----Parameters of regular errors-----

D= 0.000	Lx= 0.000	LY= 0.000	C= -0.000	RMS(W)= 0.005
A= 0.000	FIA= 10.626	PV= 0.000	RMS(W-A)= 0.005	FA=0.000
B0= 0.002		PV= 0.004	RMS(W-Z)= 0.005	FZ=0.045
B2= -0.014				
B4= 0.014				
C= 0.011	FIC= 106.128	PV= 0.007	RMS(W-C)= 0.005	FC=0.064

Local errors: PV= 0.043 RMS(M)= 0.005

Characteristics of wavefront

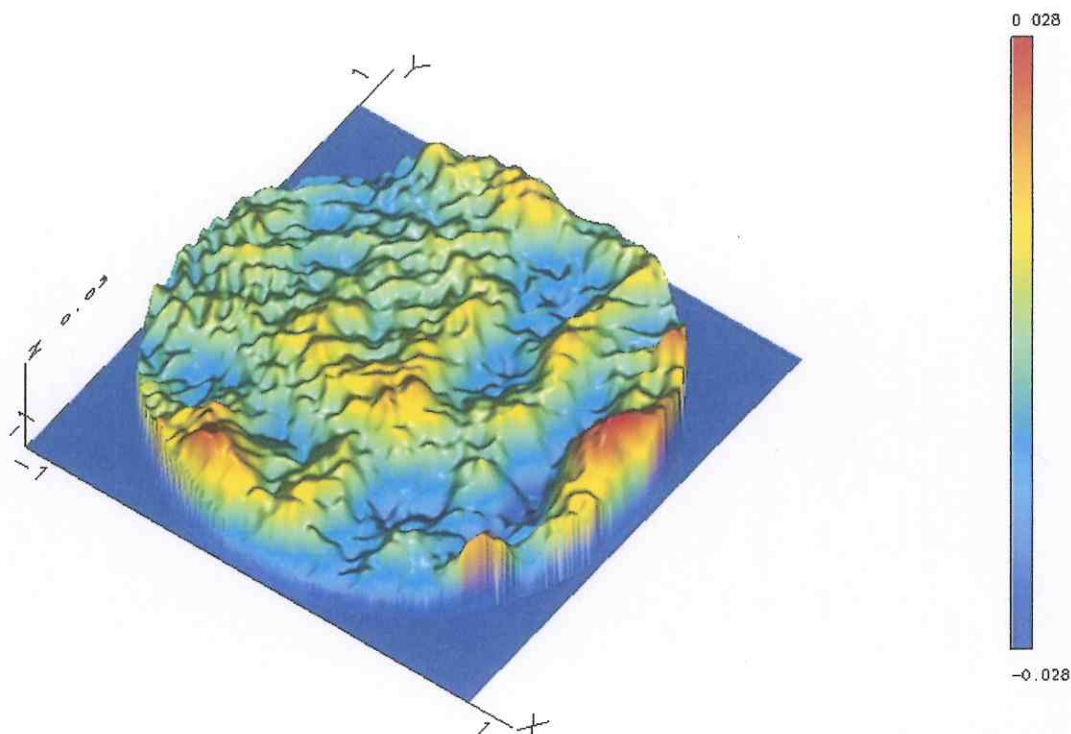
RMS	MIN	MAX	PV
0.005	-0.017	0.028	0.046

Notes:

- The results given comply with measurements in auto-collimator scheme with sample flat mirror and tested paraboloid mirror.
- Twyman interferometer with unequal arms was used to conduct measurements.
- Single fringe corresponds to $\lambda/4$ surface deflection.
- Statistics were estimated within clear aperture (circle of 190-mm diameter).
- Numbers supplied refer to surface deflections, not wavefront aberrations.
- OX axis denotes direction from parabola apex to mirror center.



D0901565-v11 SN 001 (CA 32 mm)



Wave front analysis

Date: Thu Mar 29 2012 Time: 16:44:55
 File: D0901565-v11_SN001-att.mtr
 Name: D0901565-v11 SN 001, cycle N8
 Units of deformations measuring: microns
 Wave length: 0.6328
 Reference surface: sphere
 Subtracted aberrations:
 Form of zonal error - Zernike polynomial

-----Parameters of regular errors-----

D= 0.000 Lx= -0.000 LY= -0.000 C= -0.000 RMS(W)= 0.008
 A= 0.005 FIA= -48.106 PV= 0.011 RMS(W-A)= 0.007 FA=0.077
 B0= 0.004 PV= 0.007 RMS(W-Z)= 0.008 FZ=0.062
 B2= -0.026
 B4= 0.027
 C= 0.016 FIC= -77.796 PV= 0.010 RMS(W-C)= 0.008 FC=0.055

 Local errors: PV= 0.049 RMS(M)= 0.007

Characteristics of wavefront

RMS	MIN	MAX	PV
0.008	-0.028	0.028	0.056

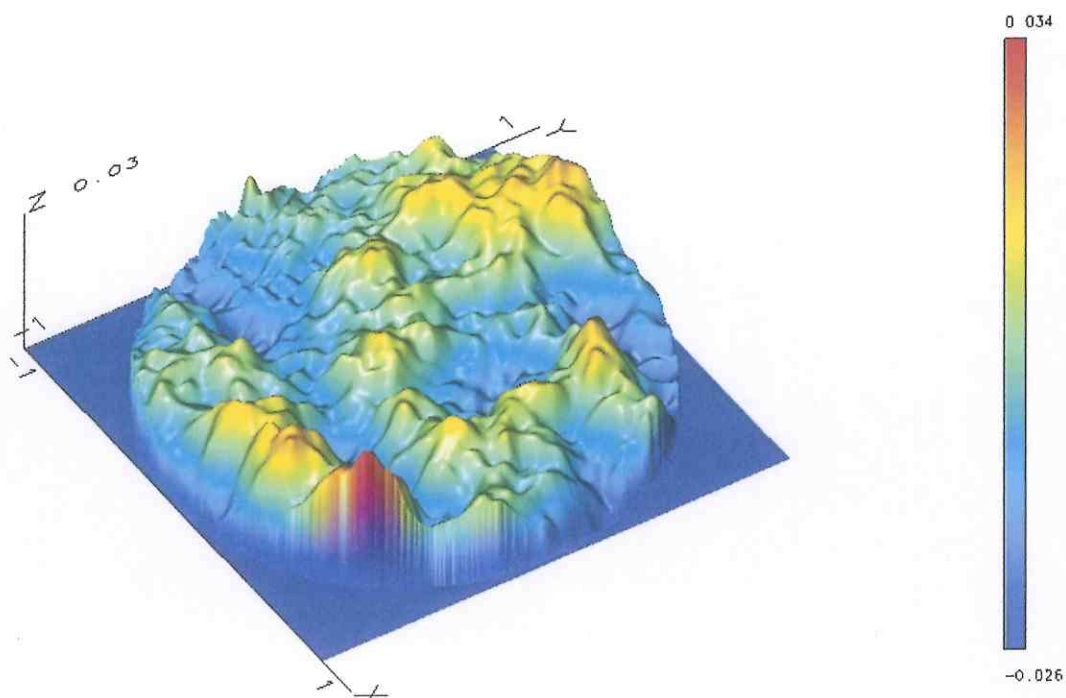
Notes:

- The results given comply with test using laser unequal paths interferometer IT-172, collimator, tested parabolic mirror and a sample spherical mirror.
- The polished rare surface were used as a reference to define a system's optical axis.
- Single fringe corresponds to $\lambda/4$ surface deflection.
- Statistics were estimated within clear aperture (circle of 32-mm diameter).
- Numbers supplied refer to surface deflections, not wavefront aberrations.
- OX axis denotes direction from parabola apex to mirror center.



D0901565-v11 SN 002 (CA 32 mm)

Annex 1 to Certificate for Off-Axis Parabolic Mirror D0901565-v11 s/n 002



Wave front analysis

Date: Thu Mar 29 2012 Time: 12:30:04

File: D091565-v11_sn002.mtr

Name: D0901565-v11 SN 002

Units of deformations measuring: microns

Wave length: 0.6328

Reference surface: sphere

Subtracted aberrations:

Form of zonal error - Zernike polynomial

-----Parameters of regular errors-----

D=	0.000	Lx=	0.000	LY=	-0.000	C=	-0.000	RMS(W)=	0.008		
A=	0.011	FIA=	37.938	PV=	0.021			RMS(W-A)=	0.007	FA=	0.254
B0=	-0.002			PV=	0.002			RMS(W-Z)=	0.008	FZ=	0.007
B2=	0.010										
B4=	-0.010										
C=	0.007	FIC=	169.219	PV=	0.004			RMS(W-C)=	0.008	FC=	0.009

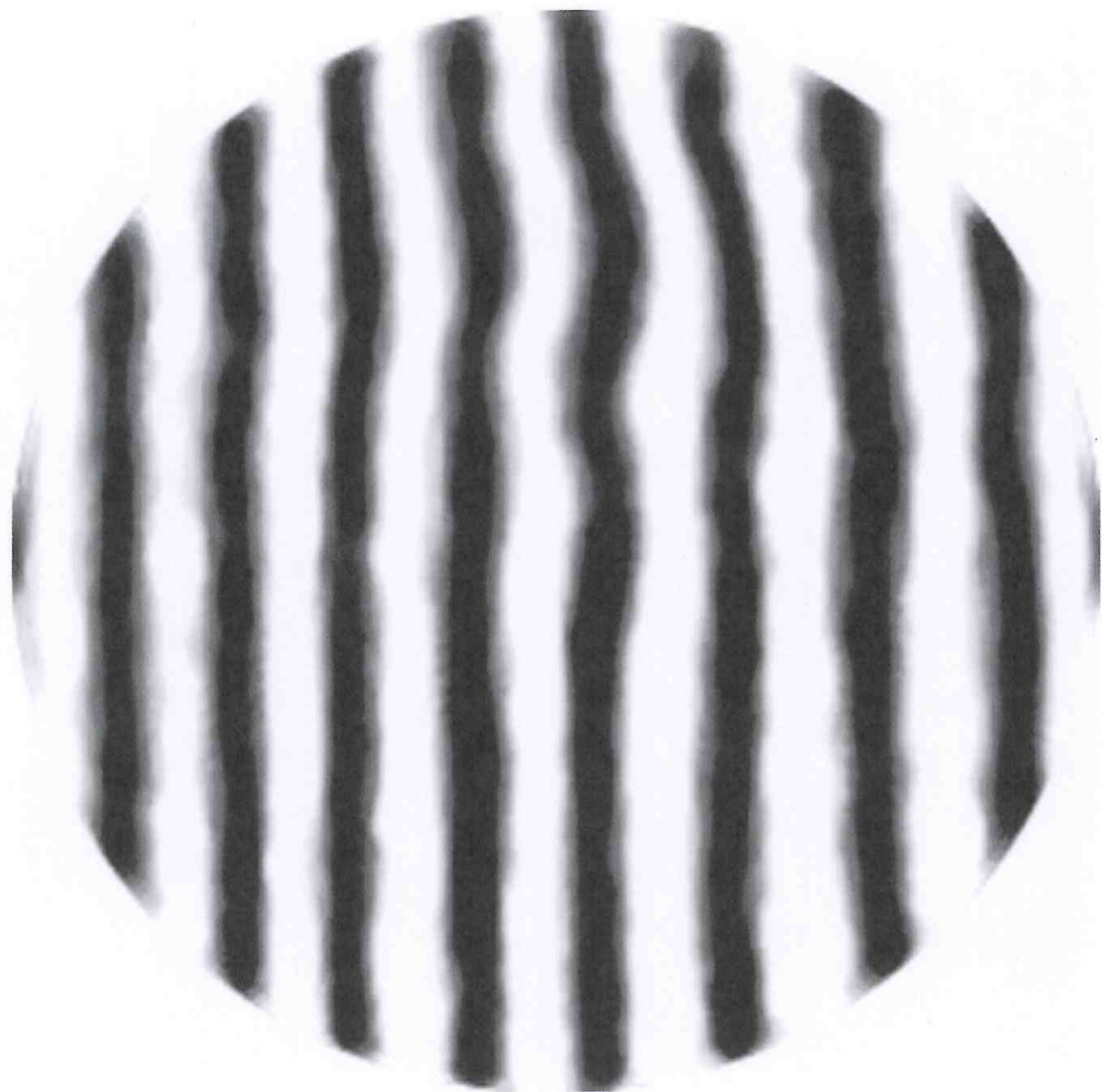
Local errors: PV= 0.052 RMS(M)= 0.007

Characteristics of wavefront

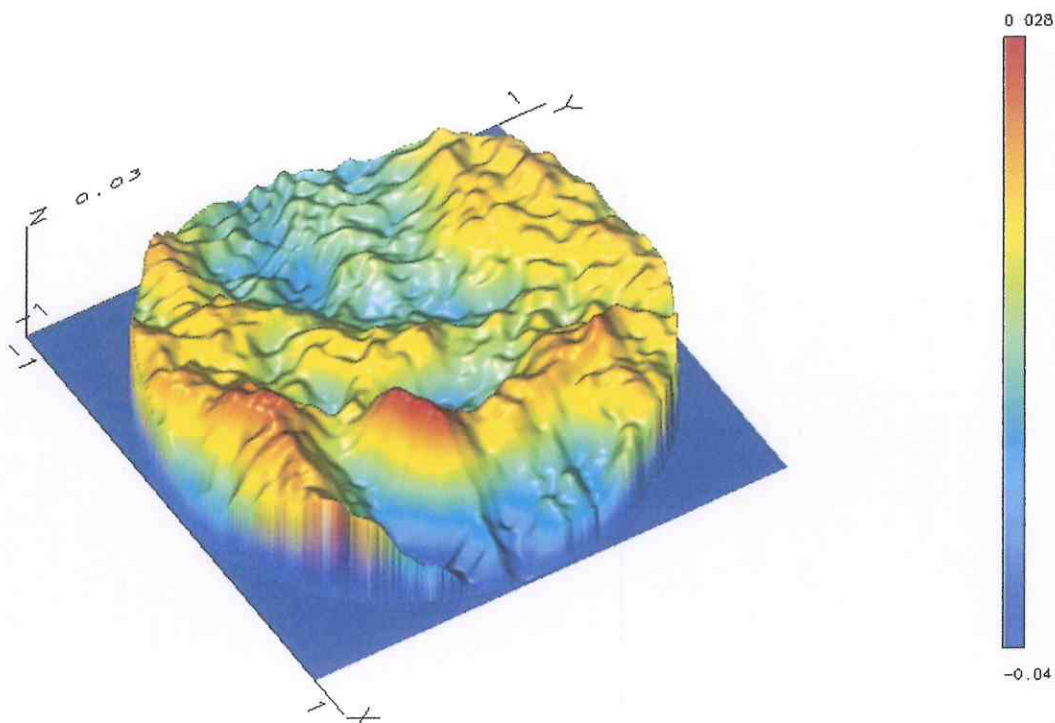
RMS	MIN	MAX	PV
0.008	-0.026	0.034	0.060

Notes:

- The results given comply with test using laser unequal paths interferometer IT-172, collimator, tested parabolic mirror and a sample spherical mirror.
- The polished rare surface were used as a reference to define a system's optical axis.
- Single fringe corresponds to $\lambda/4$ surface deflection.
- Statistics were estimated within clear aperture (circle of 32-mm diameter).
- Numbers supplied refer to surface deflections, not wavefront aberrations.
- OX axis denotes direction from parabola apex to mirror center.



D0901565-v11 SN 003 (CA 32 mm)



Wave front analysis

Date: Thu Mar 29 2012 Time: 15:37:08

File: D0901565-v11_sn003.mtr

Name: D0901565-v11 SN 003, cycle N5

Units of deformations measuring: microns

Wave length: 0.6328

Reference surface: sphere

Subtracted aberrations:

Form of zonal error - Zernike polynomial

-----Parameters of regular errors-----

D= 0.000	Lx= 0.000	LY= -0.000	C= -0.000	RMS(W)= 0.011
A= 0.016	FIA= -5.221	PV= 0.031		RMS(W-A)= 0.009 FA=0.346
B0= -0.004		PV= 0.006		RMS(W-Z)= 0.011 FZ=0.027
B2= 0.024				
B4= -0.024				
C= 0.030	FIC= 75.837	PV= 0.019		RMS(W-C)= 0.010 FC=0.109

Local errors: PV= 0.067 RMS(M)= 0.008

Characteristics of wavefront

RMS	MIN	MAX	PV
0.011	-0.040	0.028	0.068

Notes:

- The results given comply with test using laser unequal paths interferometer IT-172, collimator, tested parabolic mirror and a sample spherical mirror.
- The polished rare surface were used as a reference to define a system's optical axis.
- Single fringe corresponds to $\lambda/4$ surface deflection.
- Statistics were estimated within clear aperture (circle of 32-mm diameter).
- Numbers supplied refer to surface deflections, not wavefront aberrations.
- OX axis denotes direction from parabola apex to mirror center.