PROCUREMENT SPECIFICATION

TITLE: LRR PROCUREMENT SPECIFICATION

DRL Item or D.R.D. No:

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DOCUMENT CHANGE RECORD

ISSUE	DATE	REASON FOR CHANGE	AFFECTED PARAGRAPHS
01	**30-04-2003**	**First Issue**	
02	**23-05-2003**	**Implementatio of comments received from ESA (ref. Fax EOP/PGM/RF/0515 16 May 2003)**	**2.1, 2.2 , 3.1, 3.2, 3.4, 3.5, 3.6, 4, 6**

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1. INTRODUCTION

1.1 LRR PROCUREMENT APPROACH

The Laser Retro Reflector (LRR) for GOCE is procured through the European Space Agency (ESA), with the same procedure adopted for the LRR of CryoSat. The LRR procurement specification written for CryoSat (ref. [AD 1]) applies also to the GOCE LRR, with the specific amendments indicated in the present document.

1.2 SCOPE

The purpose of this document is to define the technical specifications and the scope of the work for the design, manufacturing, testing and delivery of two flight models (FM) of the Laser Retro Reflector (LRR) for the GOCE mission. This is performed by recalling the sections of [AD 1] and indicating the amendments to these sections where applicable (i.e. in case of relevant differences between the CryoSat case and the GOCE case). In the framework of the present specification, the applicable document [AD 1] must be read by replacing the satellite name CryoSat with GOCE.

2. APPLICABLE AND REFERENCE DOCUMENTS

2.1 APPLICABLE DOCUMENTS

[AD 1] Laser Retroreflector (LRR) Procurement Specification, CS-RS-DOR-LR-0001 Issue 2, 11.02.03 (see Annex 1).

[AD 2] Minute of the LRR Array Procurement Meeting, CS-MN-DOR-LR-0240, 06.03.2003 (see Annex 2)

2.2 REFERENCE DOCUMENTS

The reference documents recalled in section 2.3 of [AD 1] apply, with the following clarification:

The issue of the RD /1/ CS-MN-DOR-LR-0001, LRR Array Clarification Meeting, is the Draft 2.

3. TECHNICAL BASELINE

3.1 BASIC TECHNICAL PARAMETERS

The contents of section 3.1 of [AD 1] apply, with the following amendments:

- Cross section of the retro-reflector system $\geq 0.7 \cdot 10^{-6}$ m^2
- RMS target error (intended as the knowledge accuracy of the reference reflection center w.r.t. the LRR mounting interface) ≤ 1 mm RMS
- Field of view ≥ 130 deg (full cone angle)
- Mass of the GOCE LRR unit < 0.5 kg

Reference numbers shall be engraved on both flight units, e.g. LRR-01 and LRR-02. Likewise, the flight direction shall be indicated on both units.

The reflectors shall be provided with baffles in order to ensure the proper operation of the LRR from the GOCE orbit at the mean altitude of 250 km.

3.2 TECHNICAL DESCRIPTION

The contents of section 3.2 of [AD 1] apply, with the following amendments:

2.2 Specifications

2.2.3 The range finding correction factor relative to the LRR reference point (the centre of the mounting surface) shall be defined for the GOCE LRR configuration and shall have an uncertainty ≤ 1 mm RMS.

2.2.9 Overall dimensions of the GOCE LRR (including baffles of the reflectors): ∅ 125 mm ×57 mm.

2.2.11 The materials and coatings of the LRR shall withstand the high ATOX fluence without degradation during the lifetime of the satellite.

2.2.12 The qualification temperature range of the LRR shall be between –125 °C to +125 °C.

2.3 Complete Delivery Set

The complete delivery set of the described equipment shall include:

- GOCE LRR - 2 completely assembled flight units;
- Technical Description and Operation Manual - 2 copies (of for each LRR);
- Passport-certificate (certificate of compliance) - 2 copies (of for each LRR);
- Dimensional Drawings - 2 copies (of for each LRR);
- Stowing Containers and reflector protection caps - 2 sets (one for each LRR).

The Technical Description and Operation Manual shall include test reports on all tests performed on each of the two flight models before delivery to the customer.

2.6 Marking, Container Sealing and Packing

2.6.1 GOCE-LRR-01 (LRR-02 for the second unit) Laser Retro Reflector designation and Serial No. is inscribed on equipment housing.

On completion of testing, the equipment placed inside a protective cover is stowed sealed in the container. The inscriptions “Glass” and “Not to be tipped” are made on the outside of the packing.

3.3 ICD

The contents of section 3.3 of [AD 1] shall be amended with the drawings relative to the LRR configuration for GOCE, recalled in Figure 3.3-1 (ref. [AD 2]).

In addition, an arrow indicating the flight direction and the reference hole shall be marked on the LRR.

3.4 MECHANICAL TEST REQUIREMENTS

Each LRR Flight Unit shall be submitted to random vibration and shock vibration according to Table 3.4-1. Test results shall be included in the Technical Description and Operation Manual.

Random vibration Single direction, t = 3 min	**Frequency range, Hz** **20 – 100** **100 – 200** **200 – 400** **400 – 500** **500 – 1000** **1000 – 2000**	**Spectral density of acceleration, g^2/Hz** **0.02** **0.02 – 0.07** **0.07** **0.07 – 0.05** **0.05 – 0.04** **0.04 – 0.02**
Shock	**Peak shock acceleration: ±40 g**	**Shock duration:** 4^{+2}_{-1} **ms** **Three shocks in each of the three orthogonal directions**

Table 3.4-1 Levels for the vibration and shock testing of the LRR FM

3.5 THERMAL TEST REQUIREMENTS

The contents of section 3.5 of [AD 1] apply.

3.6 OPTICAL TEST REQUIREMENTS

The reflection pattern prior and after the mechanical tests shall be measured. Test results shall be included in the Technical Description and Operation Manual.

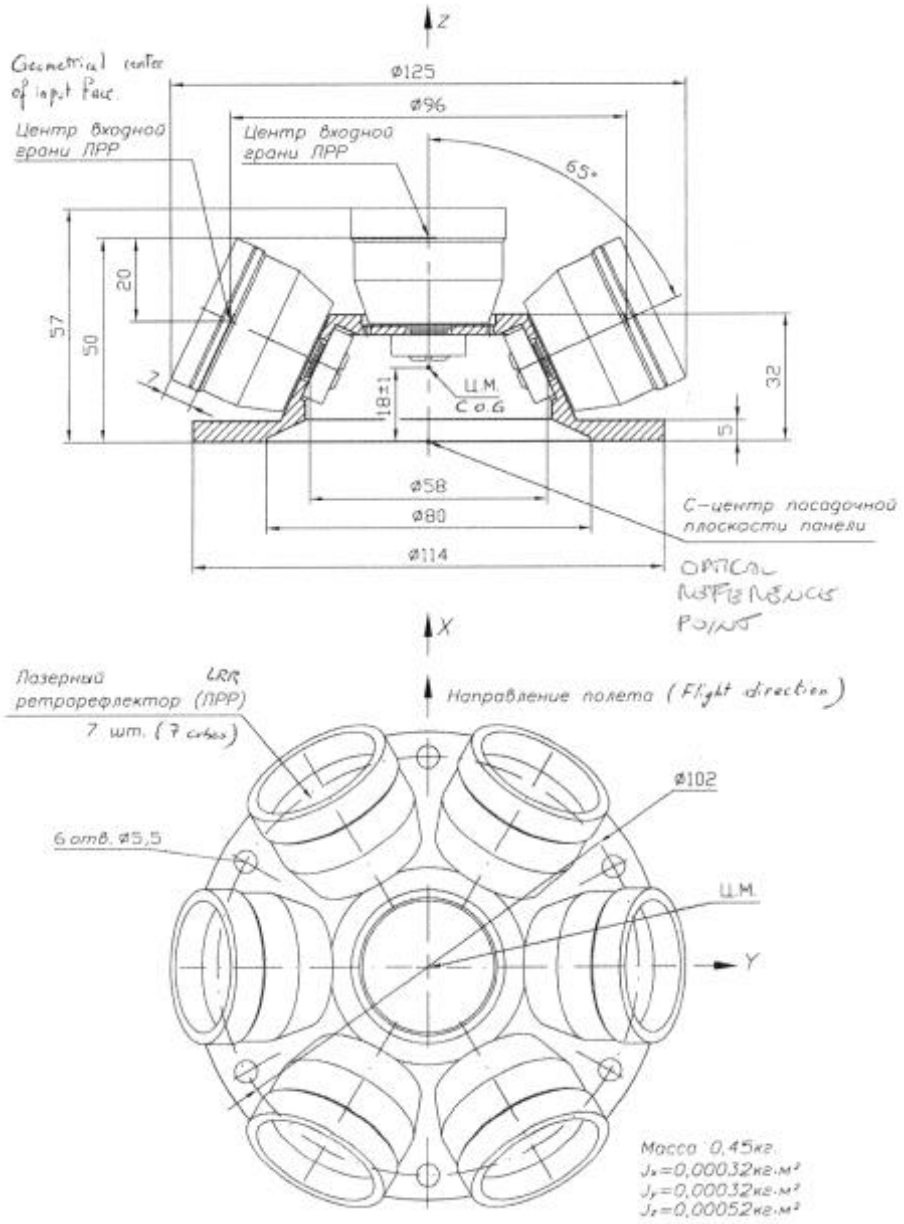

Figure 3.3-1: Configuration of the LRR for GOCE

4. OPERATIONAL MANUAL

The contents of Attachment 2 of [AD 1] apply with the following amendments:

- The paragraph 3.2.2 of Attachment 2 shall be read without the words “small-size satellite”.
- Any premises intended for visual inspection of the LRR flight models shall be a 100 000 class clean room, in addition to the features prescribed in paragraph 3.3.1 of Attachment 2.

5. ACRONYMS AND ABBREVIATIONS

AD	Applicable Document
ESA	European Space Agency
FM	Flight Model
FOV	Field Of View
GOCE	Gravity Field and Steady-State Ocean Circulation Explorer
ICD	Interface Control Document
LRR	Laser Retro Reflector
RMS	Root Mean Square

ANNEX 1: LRR Procurement Specification, CS-RS-DOR-LR-0001

Title: **Laser Retroreflector, LRR, Procurement Specification**

DRD No.: LR-1

Prepared by:	K. Jäger	Date:	11.02.03
Checked by:			
Project Management:	U. Mallow		13.02.2003

Distribution: See Distribution List

Change Record

Issue	Date	Sheet	Description of Change	Release
Dr	14.06.00	All	Draft Issue	
1	04.12.00	All	First Issue	
2Dr	28.11.01	All	Draft Issue	
2	11.02.03	All	Implementation of agreed as built info 13.2.03	

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1 INTRODUCTION

The LRR is procured as rebuild of existing LRR´s from

"Institute of Precision Instrument Engineering, IPIE, in Moscow.

Several LRRs from IPIE are used on Russian missions. In addition the German Satellite GFZ-1 and the GPS-35/-36 from US use LRR´s from IPIE.

This document represents the technical baseline of the FM-LRR procurement, which bases on

- the agreement of the technical characteristics in the procurement meeting, 04.12.01, see RD/1/ (guideline for discussion: Draft-2 specification, which however has not been accepted fully as formal requirements source).
- information supplied together with the first LRR, LRR01

The first LRR (LRR01) has been delivered already to ESTEC and has been used for vibration and optical testing, results see RD/2/.

1.1 Structure and Content of Document

Chapter 2 contains the technical information available from the manufacturing of the first LRR (LRR01).

2 DOCUMENTS

2.1 Applicable Documents

NA

2.2 Standards

NA

2.3 Reference Documents

RD	Doc. No.	Title	Issue	Date
/1/	CS-MN-DOR-LR-0001	LRR Array Clarification Meeting	-	04.12.01
/2/	CS-DP-ESA-LR-0218	CryoSat LRR01 Datapackage	-	01.11.02
/3/	CS-TN-GMV-SY-0003	Radiation Environment Analysis		
/4/	CS-LI-DOR-SY-0015	CryoSat General Supporting Information	1	31.10.00
/5/	CS-RS-DOR-PM-0001	Management Requirements for Subcontractors	2	16.11.00
/6/	CS-SW-DOR-LR-0001	Statement of Work	1	29.11.00

3 Technical Baseline

The technical specification of LRR-01 covers the following points:

- Basic Technical Data and Parameters
- Description
- Test-Levels
- ICD
- Open Points

3.1 Basic Technical Parameters:

No	Parameter name	Value
1	Number of reflectors	7
2	Cross-section of the retroreflector system	$\geq 0.7 \cdot 10^6$ m^2
3	RMS target error	<6 mm
4	Elevation range	>20 deg
5	CRYOSAT-LRR-01 system field-of-view	>115 deg
6	Reflection center offset relative to the baseplate center	<2 mm
7	Overall dimensions of the CRYOSAT-LRR-01 unit	114 mm (diam)x51 mm
8	Mass of the CRYOSAT-LRR-01 unit	0.32 kg ±0.01

3.2 Technical Description

1. INTRODUCTION

1.1. This Technical Description and Operating Manual for CryoSat-LRR-01 Laser Retro Reflector contains information required for study and correct operation of the CryoSat-LRR-01 Laser Retro Reflector.

1.2. Chapter Two hereof presents description and operating principle of the reviewed equipment.

1.3. Chapter Three includes operating instructions.

2. TECHNICAL DESCRIPTION

2.1. PURPOSE

2.1.1. This CryoSat-LRR-01 Laser Retro Reflector is designed to find the range between ground laser stations and the CryoSat satellite as required to determine satellite orbit with high accuracy.

2.2. SPECIFICATIONS

2.2.1. The CryoSat-LRR-01 Laser Retro Reflector enables range finding at the wavelength of 532 nm.

2.2.2. The CryoSat-LRR-01 Laser Retro Reflector supports laser range finding at 20+ deg. angle of position above horizon for all possible bearings.

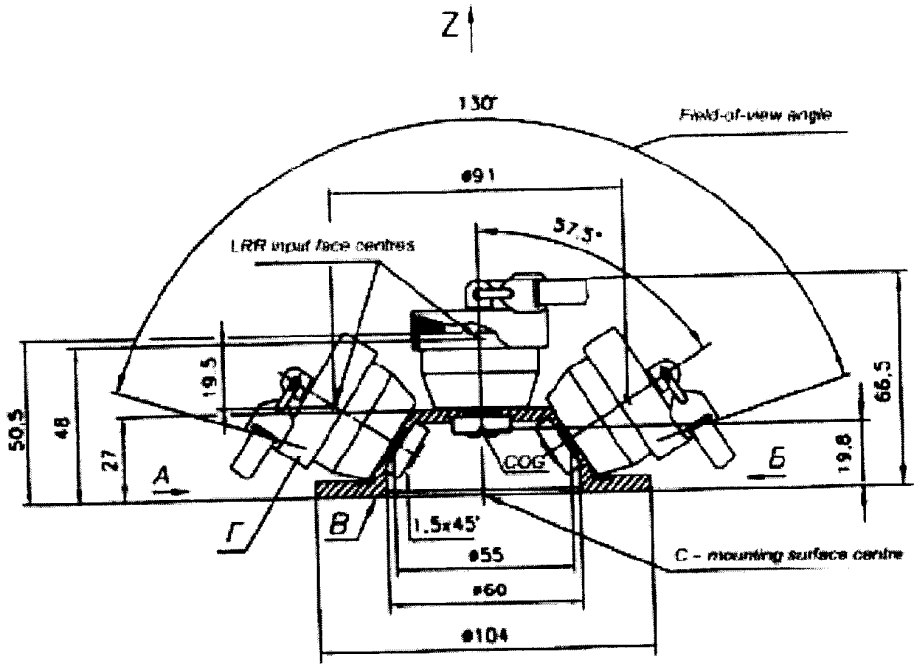
2.2.3. The range finding correction relative to CryoSat-LRR-01 mounting surface on the spacecraft amounts to +19±6 mm, and depends on the angle of position and the spacecraft bearing relative to station SLR, and shall be added to the measured range.

2.2.4. The location error of CryoSat-LRR-01 equivalent reflex plane relative to the reference point (the centre of the mounting surface) is less than 2 mm.

2.2.5. The CryoSat-LRR-01 Laser Retro Reflector maintains its designed parameters in open space environment.

2.2.6. The CryoSat-LRR-01 Laser Retro Reflector shall remain operational after exposure to mechanical impacts during spacecraft orbital insertion.

2.2.7. The CryoSat-LRR-01 Laser Retro Reflector shall maintain its designed parameters in compliance with the climatic and thermal requirements.



Protective caps Г are not shown for convenience.

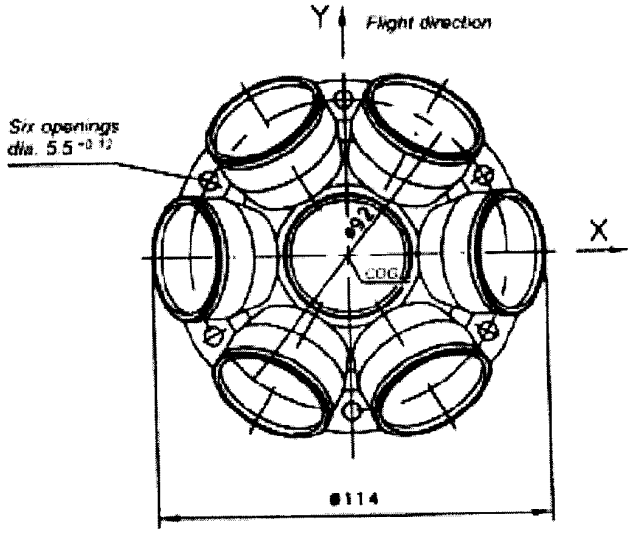


Fig. 1

The stability of temperature conditions for the CryoSat-LRR-01 Laser Retro Reflector during exposure to open space environment is achieved by applying special thermoregulating white paint AK-512 to all (non-optical) outside surfaces.

Red-colour protective caps with FS-01 flags cover all Laser Reflector assemblies.

2.5. CryoSat-LRR-01 LASER RETRO REFLECTOR INTEGRATION

2.5.1. Make sure the requirements of Item 3.3 of the CryoSat-LRR-01 Laser Retro Reflector Operating Manual are strictly followed during equipment integration into the means of delivery.

2.6. MARKING, CONTAINER SEALING AND PACKING

2.6.1. CryoSat-LRR-01 Laser Retro Reflector designation and Serial No. is inscribed on equipment housing.

On completion of testing, the equipment placed inside a protective cover is stowed in the Container. The inscriptions "*Glass*" and "*Not to be tipped*" are made on the outside of the packing.

2.2.8. The mass of the CryoSat-LRR-01 Laser Retro Reflector equals 0.32 kg.

2.2.9. Overall dimensions of the CryoSat-LRR-01 Laser Retro Reflector: ∅ 114 x 51 mm.

2.2.10. Total guaranteed lifetime of the CryoSat-LRR-01 Laser Retro Reflector is 5.5 years.

2.3. COMPLETE DELIVERY SET

2.3.1. The complete delivery set of the described equipment includes:

- CryoSat-LRR-01 Laser Retro Reflector - 1 set;
- Technical Description and Operating Manual - 1 copy;
- Passport-certificate - 1 copy;
- Dimensional Drawing - 1 copy;
- Stowing Container - 1 set.

2.4. CryoSat-LRR-01 LASER RETRO REFLECTOR DESIGN AND OPERATION

2.4.1. This CryoSat-LRR-01 Laser Retro Reflector includes seven panel-mounted Laser Reflectors. See Fig. 1 below for the general view and dimensions of the CryoSat-LRR-01 Laser Retro Reflector.

The panel is made as a flattened cone with a flange provided in the cone base. The material of the panel and the optical assemblies of the Laser Reflectors is non-magnetic aluminium alloy. Cone flange includes six openings of diameter 5.5 mm designed for attaching the CryoSat-LRR-01 Laser Retro Reflector to the carrying equipment.

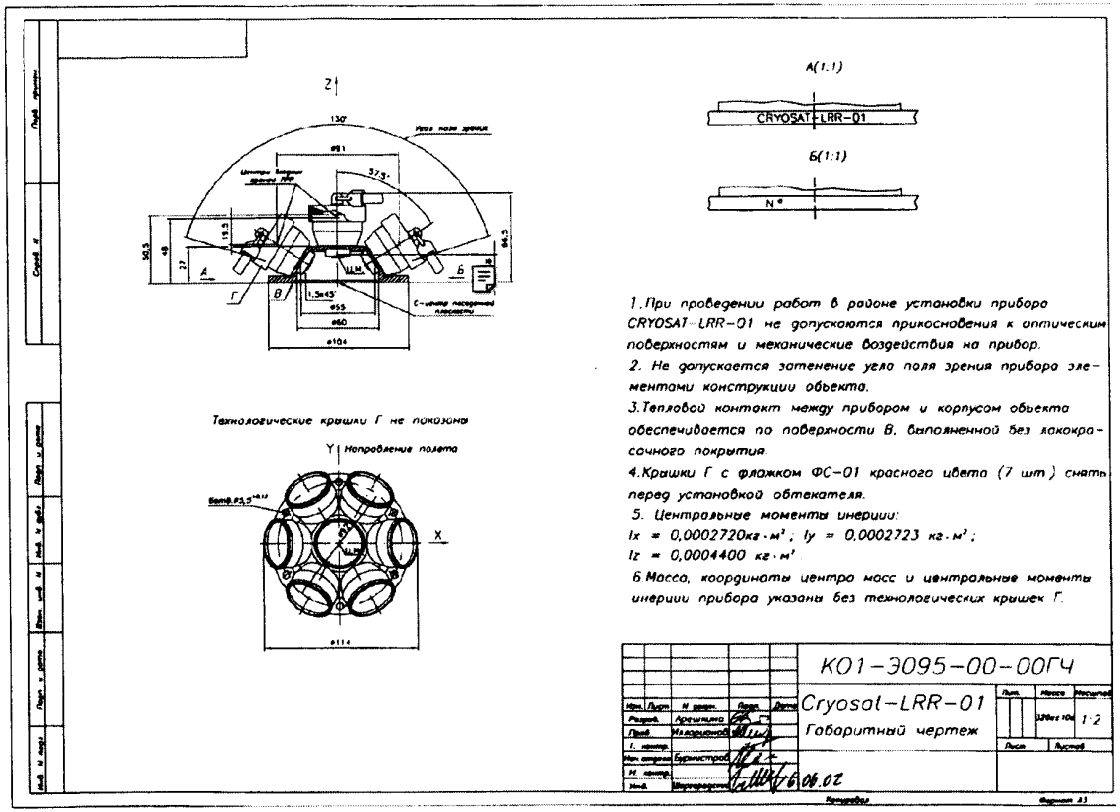
One Laser Reflector assembly is mounted on the top of the flattened cone; the lateral surface of the cone accommodates six Laser Reflector assemblies fixed by special nuts.

To avoid unwanted unscrewing, the fixing nuts are mastic-locked.

To minimize thermal distortion of Laser Reflector directivity pattern caused by differing temperature expansion coefficients specific to the Laser Reflector material and the rim material, each of the seven Laser Reflector assemblies incorporates a mechanism designed to normalise the mechanical impacts applied to the Laser Reflector.

Laser Reflectors are made of fused quartz with aluminium-coated reflecting prism faces. Where light incidence is normal, the equivalent optical aperture of the Laser Reflector equals ∅ 28.2 mm; the distance between the input face plane and the prism vertex equals 19.1 mm.

3.3 ICD



The foot thickness (5mm, tbc by IPIE) shall be indicated for FM02

3.4 Mechanical Test Requirements

No	Types of tests	Requirements	Result	Note
1	Sine vibration with the following levels applied to all axes: 5 Hz – 20 Hz 1 – 1.7 g 20 Hz – 50 Hz 1.7 – 3 g 50 Hz – 600 Hz 3 – 10 g 600 Hz – 2000 Hz 10 – 12 g Sweep Duration: 4 minutes Before and after the sine vibration test, a low-level sine sweep shall be performed from 5 to 2000 Hz with 2 g with 2 octaves/min	L1-4719	In accordance with the Specification	Test Protocol No. 1403-116
2	Random vibration tests are conducted with the following levels: 20 Hz – 100 Hz 6 dB/octave 6 dB/octave 100 Hz – 400 Hz 0.17 g^2/Hz 0.17 g^2/Hz 400 Hz – 2000 Hz 6 dB/octave 6 dB/octave	L1-5841	In accordance with the Specification	Test Protocol No. 1403-116
3	Shock loads: ±200 g for 0.5 ms each axis	L1-4718	In accordance with the Specification	Test Protocol No. 1403-116

Testresults: see attachment 1

Note:

Following info concerning mechanical aspects shall be supplied:

- Eigenfrequency of the LRR.
- Flatness (mm over x mm)
- Surface Roughness, Ra (µm)

3.5 Thermal Test Requirements

Thermal Testing has been performed in the frame of the generic qualification of the IPIE LRR´s. The tests are not repeated for CryoSat.

However the following info shall be supplied for the FM LRR, LRR02:

- shape of cycle (temperature limits, duration ,etc.), see AI-5, RD/2/.

Attachment **Testresults for Info**

AGREED with
(signed)
O.Golubovsky

Deputy General Designer.
QA Dept Head
May 24, 2002

APPROVED by:
(signed)
V.Shargorodsky.

General Designer

May 26, 2002

TEST REPORT

April 04, 2002

N 1403-116

1. **TEST ARTICLE:** CryoSat Laser Retro Reflector LRR-01 К01-Э095-00-00.
2. **TEST OBJECTIVE:** Check of compliance with technical specifications L1-4719, L1-5841, L1-4718 Annex2 of CS-RS-DOR-LR-0001.
3. **TEST PROGRAM:** according to section 5.2.2.3, 5.2.2.4, 5.2.2.5 Annex 2 of CS-RS-DOR-LR-0001.

   3.1. Sine vibration levels

5 – 20 Hz	20 – 50 Hz	50 – 600 Hz	600 – 2000 Hz
1 –1.7 g	1.7 –3 g	3 –10 g	10 –12 g

   3 axes, duration 4 min along each axis.

   3.2. Random vibration levels

	20 – 100 Hz	100 – 400 Hz	400 – 2000 Hz
Perpendicular	6 dB/octave	0.17 g^2/Hz	-6 dB/octave
Lateral	6 dB/octave	0.17 g^2/Hz	-6 dB/octave

   3 axes, duration 2 min along each axis with spectrogram registration for resonance search.

   3.3. Shocks

   3 shocks +/- 200 g with pulse duration 0.5 ms along each axis.

   3.4. Sine resonance search

5 – 2000 Hz
2 g

   To be performed during 2 min prior and after tests 3.1, 3.2 and 3.3.

4. **TEST EQUIPMENT AND INSTRUMENTATION**

   4.1. Vibroshaker УВЭ-100/5-3000.

   4.2. Shock bench СТТ-400/500.

   4.3. Supporting frame N 485619.

5. TEST RESULTS

Allocation of accelerometers and sine resonance curves are shown in Annex 1and 2 correspondingly.

Resonance spikes in a frequency range from 1 650 to 1 850 Hz were revealed along all 3 axes during sine vibration tests (3.1), however amplitudes did not exceed doubled amplitude of the control accelerometer.

No changes discovered in spectrograms recorded prior and after each mechanical test according 3.4. Visual inspection also revealed no changes after each mechanical test.

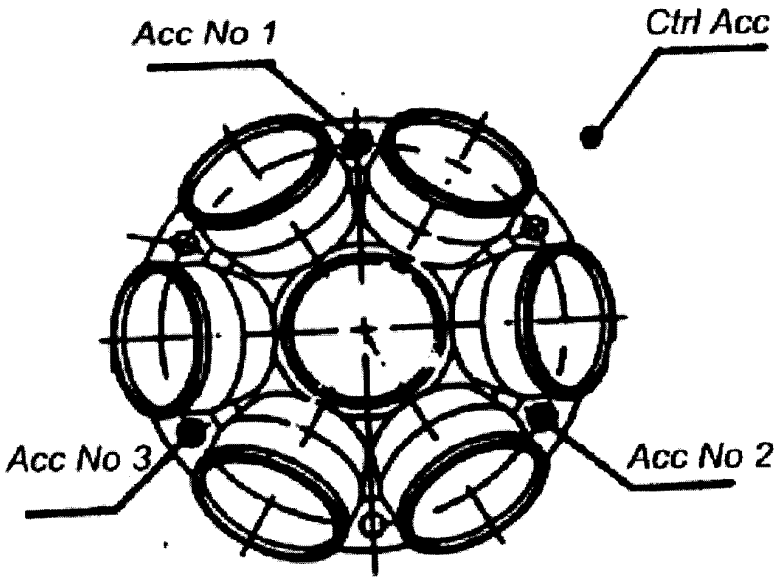
Hold-down pressure in all retro reflector's supports remained unchanged and complaint with design specification.

6. CONCLUSION

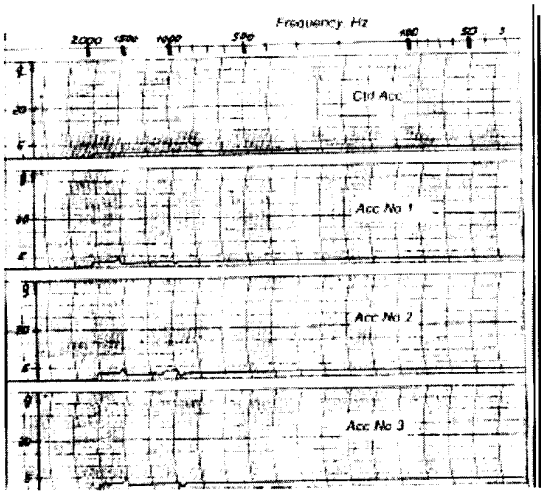
Laser Retro Reflector LRR-01 К01-Э095-00-00 had passed the tests specified in section 3 without anomalies.

Head of Test Division	*signed*	I.V.VASSILETZ
Test operators	*signed*	L.E.BIRYUKOVA
		A.S.ILLARIONOV
		Ye.A.NIKOLAYEV
		T.I.KHOROSHEVA

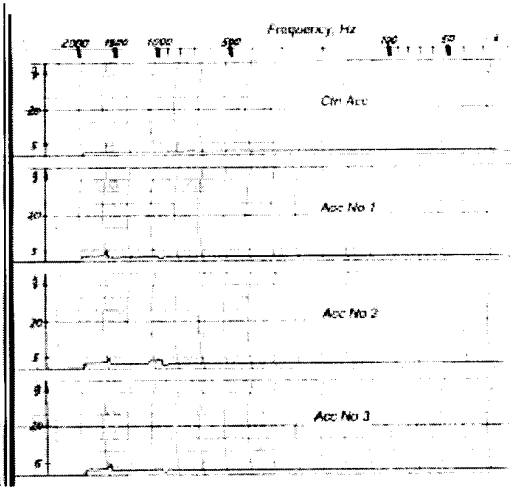
Annex 1



Sine resonance curves before and after sine vibration

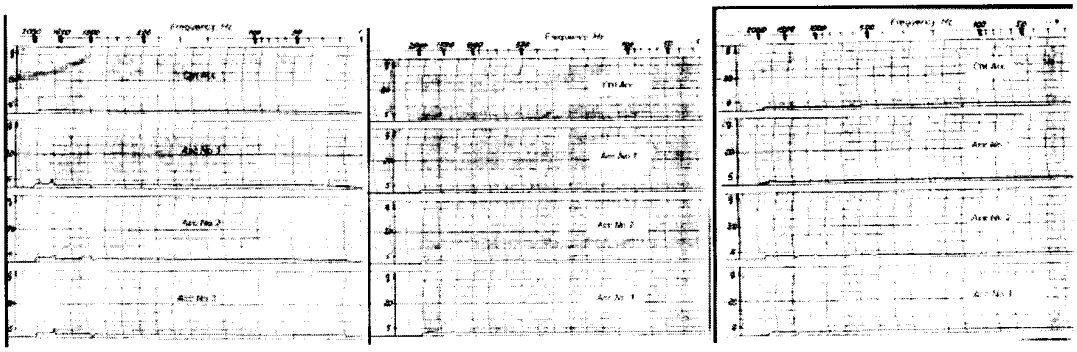


Sine resonance prior testing



Sine resonance after testing

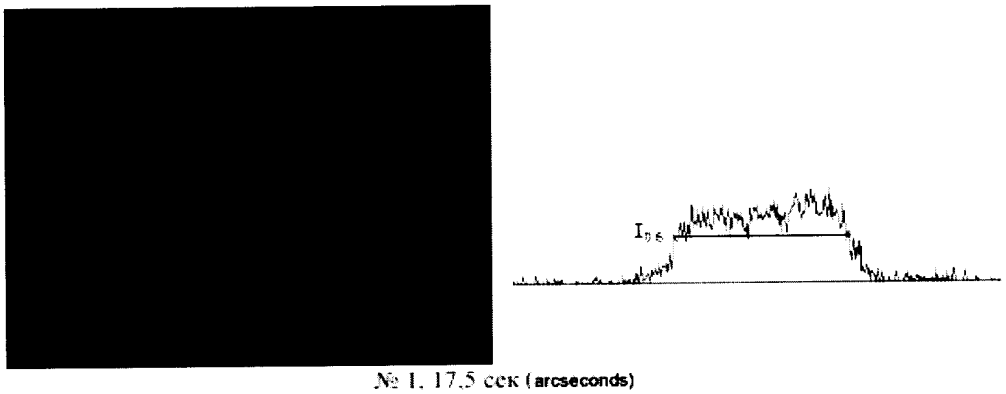
Resonance curves before and after random vibration



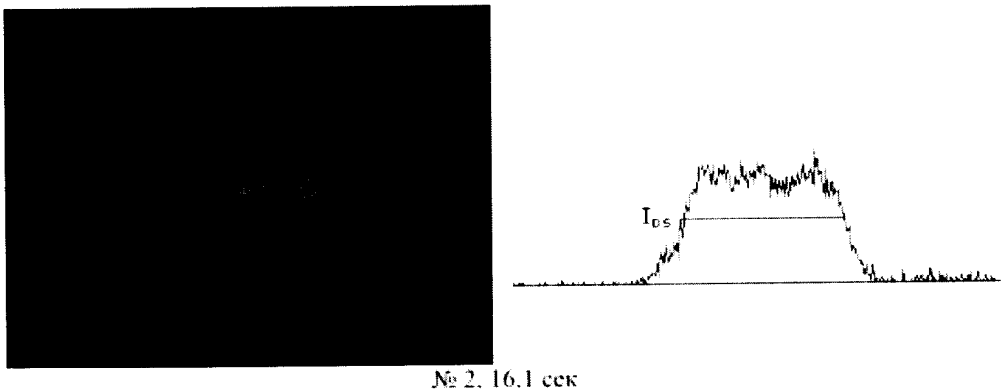
Along XX axis

Along YY axis

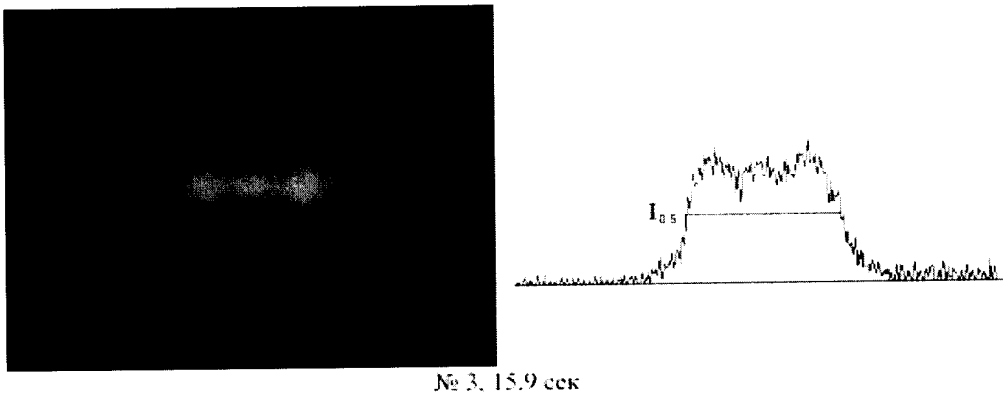
Along ZZ axis



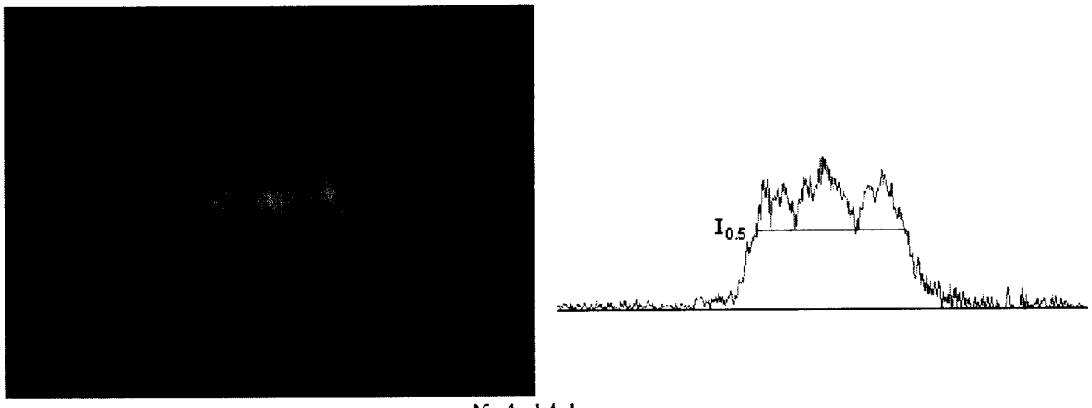
№ 1. 17.5 сек (arcseconds)



№ 2. 16.1 сек



№ 3. 15.9 сек



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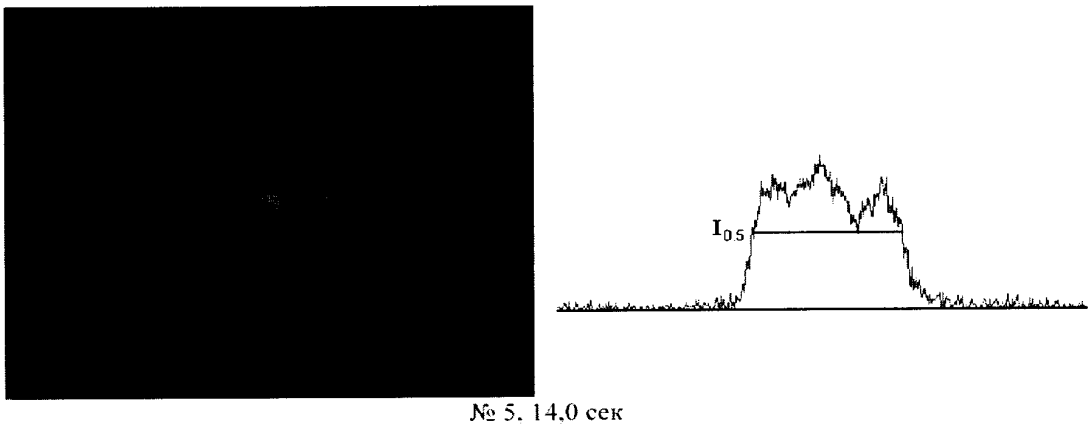

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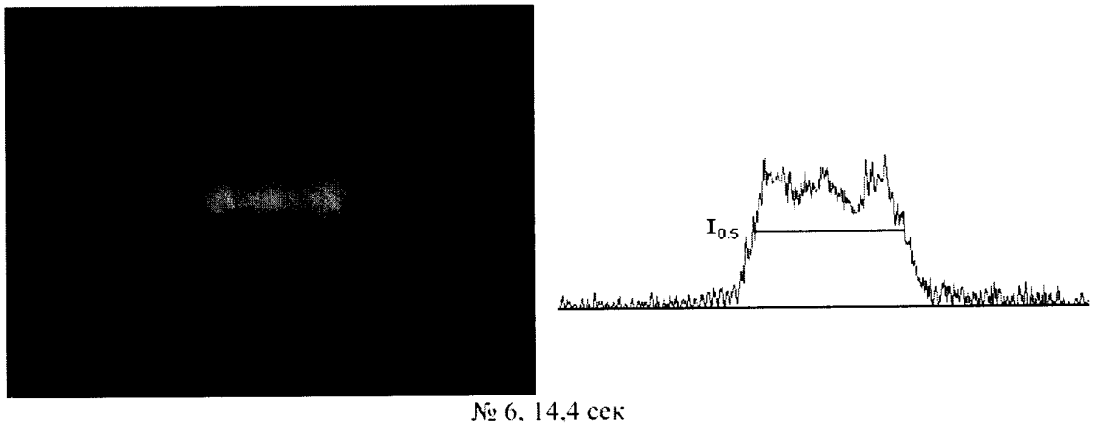

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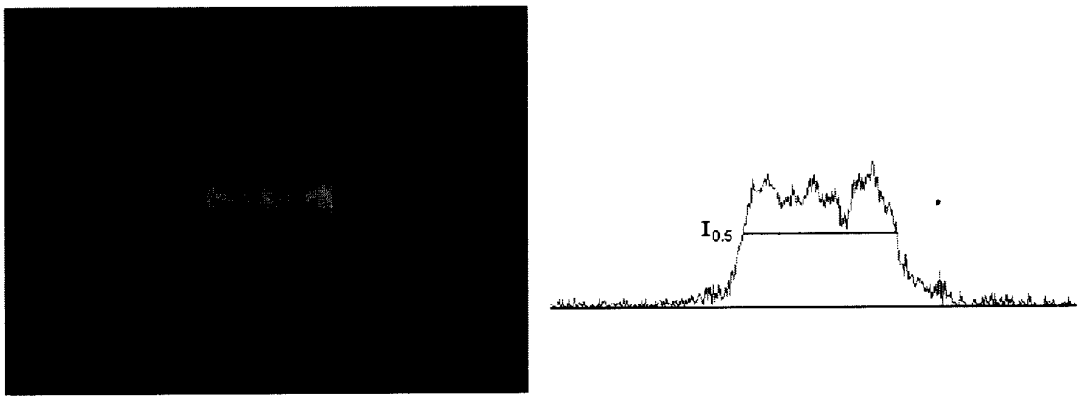

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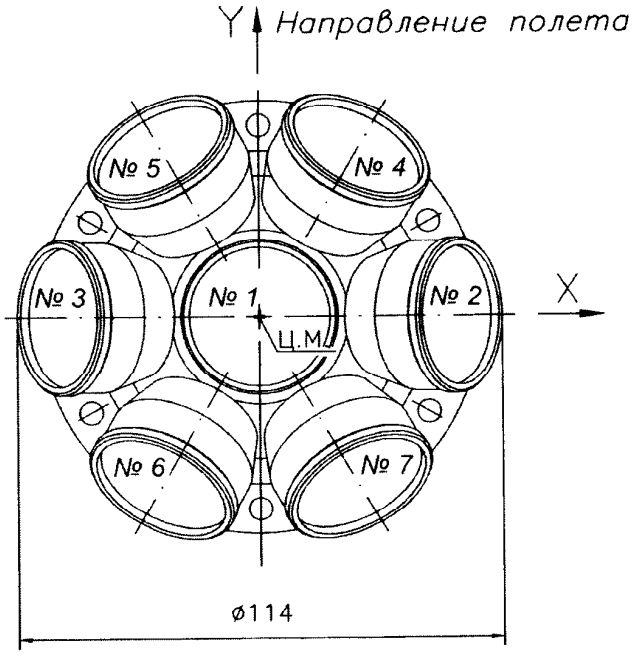

Note: further testresults see RD/2/

Attachment 2 Operational Manual

3. OPERATION MANUAL

3.1. INTRODUCTORY

3.1.1. This Operating Manual is designed to ensure correct operation of the CryoSat-LRR-01 Laser Retro Reflector. The Manual includes information related to CryoSat-LRR-01 Laser Retro Reflector transportation, storage, maintenance and operational readiness.

Use additional guidance of the CryoSat-LRR-01 Laser Retro Reflector Technical Description during equipment operation.

3.2. GENERAL INSTRUCTIONS

3.2.1. The Manufacturer supplies this CryoSat-LRR-01 Laser Retro Reflector in the Container designed for equipment transportation and storing.

3.2.2. Personnel shall not be authorized to perform integration and/or operate the Reflector small-size satellite unless properly briefed on this Technical Description and Operating Manual.

3.3. INTEGRATION PROCEDURE

3.3.1. User shall inspect the equipment before commencing any operations on the CryoSat-LRR-01 Laser Retro Reflector.

Any premises intended for visual inspection of the CryoSat-LRR-01 Laser Retro Reflector shall protect the equipment against atmospheric effects and shall provide for max. 80 percent relative humidity at +15°C through +35°C.

3.3.2. To inspect this CryoSat-LRR-01 Laser Retro Reflector visually, remove the equipment from the Container, and remove the red-colour process caps from the Laser Reflectors. Make sure to wear cotton gloves at all times while handling this CryoSat-LRR-01 Laser Retro Reflector.

Wear cotton gloves to remove tightly mounted process caps carrying FS-01 flags with care; hold the CryoSat-LRR-01 Laser Retro Reflector with hands at the base of the housing to which the Laser Reflector assemblies are attached.

3.3.4. Inspect the CryoSat-LRR-01 Laser Retro Reflector visually; make sure to check the equipment for:

1) optical component chipping;
2) mechanical damage;
3) metal surface corrosion indications;
4) mudding.

3.3.5. Where dust, mud or fatty spots are identified on the input faces of the optical components, make sure to clean the optics by using guidance of the Appendix hereto.

3.3.6. Re-install red-colour process caps with FS-01 flags on Laser Reflector assemblies on completion of the CryoSat-LRR-01 Laser Retro Reflector handling operations.

Attention!

Make sure all red-colour process caps with FS-01 flags are removed before nose cone is rolled on after this CryoSat-LRR-01 Laser Retro Reflector has been integrated into the spacecraft. Wear cotton gloves to remove tightly mounted caps with care; hold the CryoSat-LRR-01 Laser Retro Reflector with hands at the base of the panel housing to which the Laser Reflector assemblies are attached.

3.4. STORING REQUIREMENTS

3.4.1. Store this CryoSat-LRR-01 Laser Retro Reflector at storage facilities in Manufacturer-supplied Stowing Container at +5°C through +35°C, 80 percent relative humidity. No vapour of acids, alkali or any different aggressive agent shall be tolerated in the storing environment.

3.5. RULES OF TRANSPORTATION

3.5.1. Make sure this CryoSat-LRR-01 Laser Retro Reflector is transported inside Manufacturer-supplied Stowing Container specially designed to properly protect the equipment against outside mechanical impacts, penetration of moist and/or dust.

This equipment can be hauled by any means of transport, at any distance or speed specified for the carrying means, at ambient temperature between minus 50°C through +50°C. Do not keep this equipment in the means of transportation for more than one month within the mentioned temperature range.

Attention!

It is prohibited to drop, tilt and/or shock this CryoSat-LRR-01 Laser Retro Reflector packed in the Container during loading, haulage or unloading operations.

APPENDIX

OPTICS CLEANING INSTRUCTIONS

Clean outer surfaces of the optical components as required to remove fatty spots, traces of moist, dust or any different mudding of the optical surfaces.

Make sure to wash hands with soap and wipe hands dry before doing the cleaning.

Wear cotton gloves to perform the following sequence:

1) use squirrel fur brush or dry air to remove dust or any different easily removable mudding;
2) use cambric napkin or purified cotton tampon wrapped around the opposite tip of the squirrel fur brush to clean fatty contamination. Wrap cotton as follows: dip the opposite tip of the brush in alcohol, insert tip in cotton and rotate brush. To avoid scratching the optical surfaces, make sure the tip is properly wrapped in cotton. Finally, soak cotton in alcohol before cleaning;
3) clean optical surfaces in circular motion, from centre to edge, by pressing slightly to exclude damage. Change tampons from time to time, making sure not to use mudded tampons;
4) use rectified ethyl alcohol of premium quality to clean the optics. Never apply hydrolytic alcohol for danger of oily stains on optical surfaces.

ANNEX 2: Minute of the LRR Array Procurement Meeting, CS-MN-DOR-LR-0240

Minutes Of Meeting

Doc.:No.: CS-MN-DOR-LR-0240

Date :06.03.2003

Page : 1

astrium

Subject : LRR Array Procurement Meeting

Project : **CryoSat** together with GOCE

Writer | **Company** | **Signature**

Participants			Agenda
Name	**Company**	**Signature**	
U. Mallow	Astrium	[signature]	
M. Notarnicola	Alenia		
H. HUET	ESO/EMO	[signature]	
I. Krotov	ESA/EMO	[signature]	
S. GALITSKY	ESA/EMO	[signature]	
G. GOURMELON	ESA/ESTEC		
V. Shargorodsky	[signature]	IPIE	
V. Vasiliev	[signature]	IPIE	
N. Parkhomenko	[signature]	IPIE	
V. Burmistrov	IPIE	[signature]	
A. ILLARIONOV	IPIE	[signature]	
N. Souzova	IPIE	[signature]	
T. KHOROSHEVA	IPIE	[signature]	

Distribution

CryoSat		
Mallow	[initials]	
Bruzek		
Bogler		
Dietsar		
Tejen	X	
Frank	X	
Rostan		
Rogers		
Usbeck		
Duske		
Alcatel		
ESA	X	
Alenia	X	
IPIE	X	

Document1

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	Action
joint Session	

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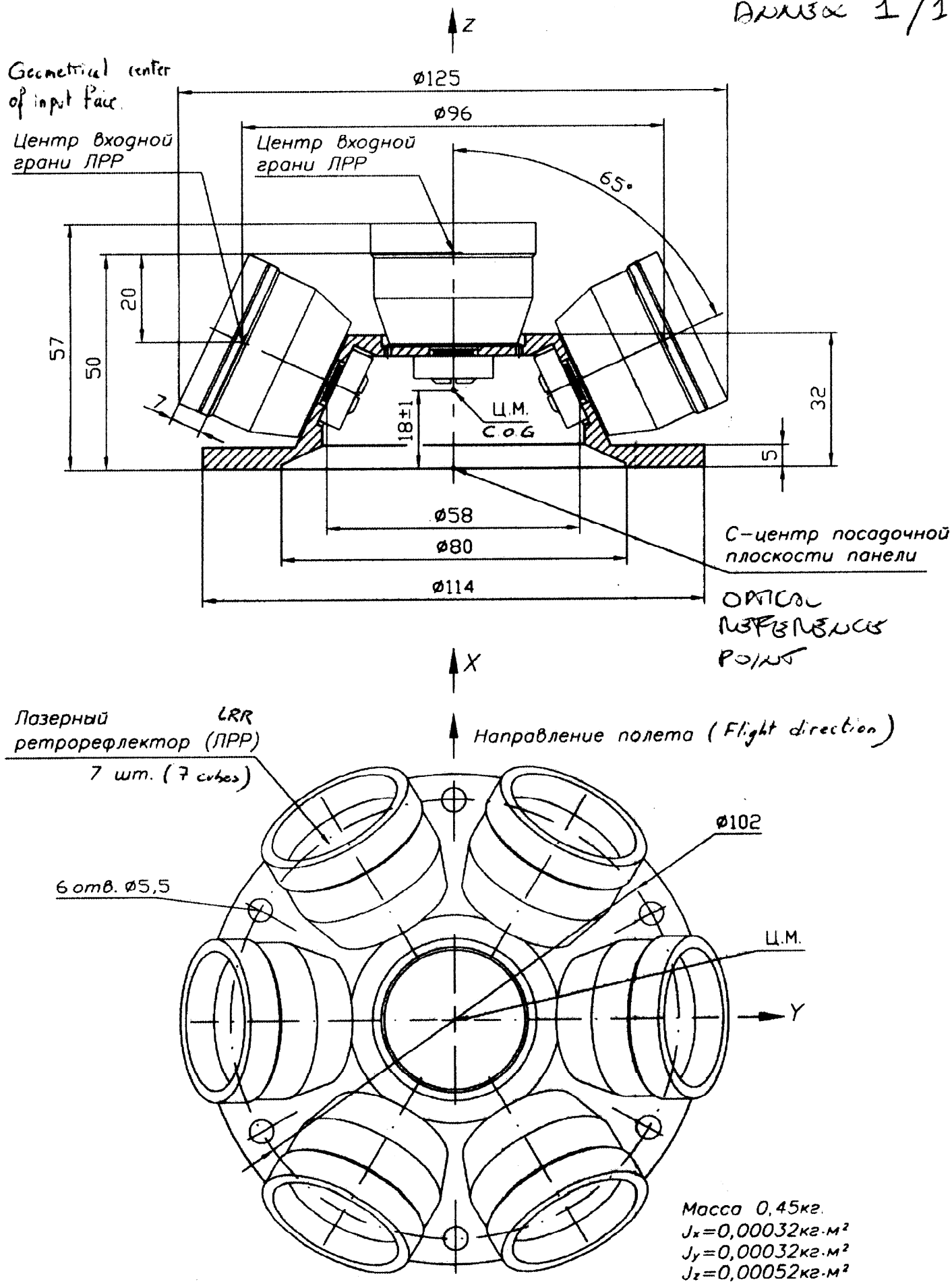
	Action
1) Introduction of participants and IPIE activities. 2) Introduction of CryoSat and GOCE mission by Astrium 3) Questions about Technical aspects - The CRR instrument has survived to a shock test of 500 g (shot test) - MSS, CSR, Inasse preliminary predictions as per annex 1 - If needed a mass dummy can be studied and manufactured by IPIE. IPIE recommends to use a flight unit for system tests. Real flight unit to be mounted on SC only before launch. - On arrow marker on CRR will identify the "flight direction" and consequently the reference hole, as for CRYOSAT. - Venting is realized through dedicated hole (2)	

	Action
and technological gap between glasses and housings - Unscrewing provisions are included in the CRR (Epoxy glue for trimming screws, small screws for mounting) - No coating is on lower face of CRR, for grounding reasons. Material is aluminium alloy 7075. Outer surfaces are painted with white paint SK-512. - Thermo-optical properties of SK-512: beginning of life: As (absorbivity) = 0,2; Es (emissivity) = 0,85 end of life (15000 equivalent solar hours): As = 0,55; Es = 0,85 - Based on IPIB experience no protection is to be foreseen for glass. - Contact between glass and metal are on corners (point contacts). The glass does not the thermal behavior of the	

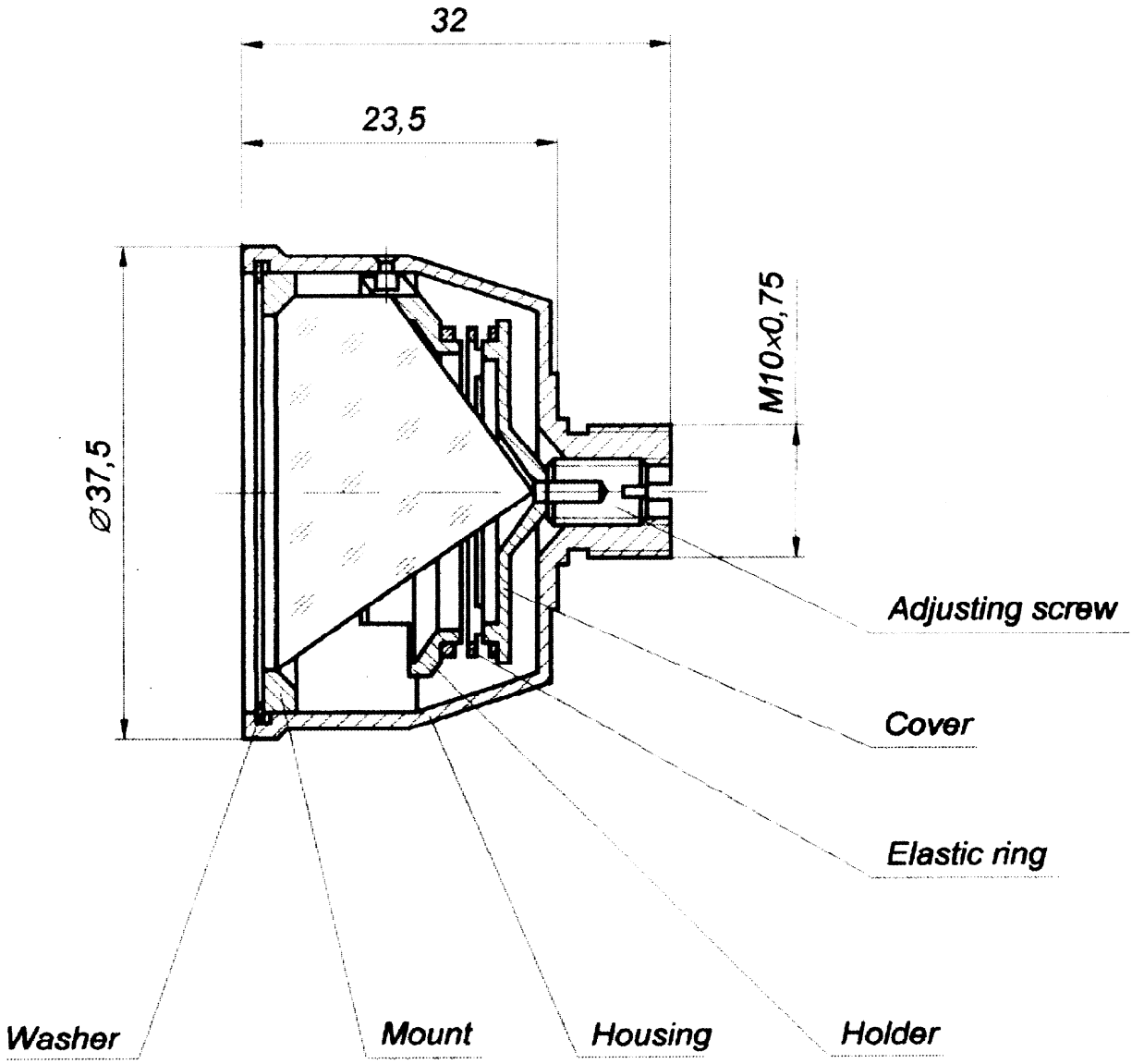
	Action
instrument, due to the large difference w.r.t. metal in terms of thermal capacity - Nylon emissivity about 0,93. absorbivity about 0,20. -- No thermal model is available. The thermal performances and parameters are confirmed by test. of single cube. - Reflectivity for function of angle is given in annex 2. Based on experience, IPS confirms that no degradation of return signal has been observed on Spacenets in orbit, even after more than 10 years. - Only one cube is seen by the station, so the global only performances are theoretically limited to the behaviour of the single cube. - Percentage of return signal, taking in account is reported in Table and figure reported in annex 3 - IPS will form the characteristics of the cubes to be compatible with ILS Tracking network.	

	Action
- The performance of the LRR are verified before and after unit test. At system level a visual inspection is considered sufficient by ESA (dust cracks and corrosion). Guidelines for inspection will be included in the user manual. - Optical reference point, see annex 1/1 - For each LRR unit the correction factor will be included in the acceptance certificate. A preliminary graph is provided in annex 4 - Accuracy for reference point position knowledge is due to mechanical manufacturing and is 0,3 mm. (includes metal cutting plus setting of planes and their supporting structures). The 0,3 mm is to be considered worst case (manual practice suggests 0,1 mm).	

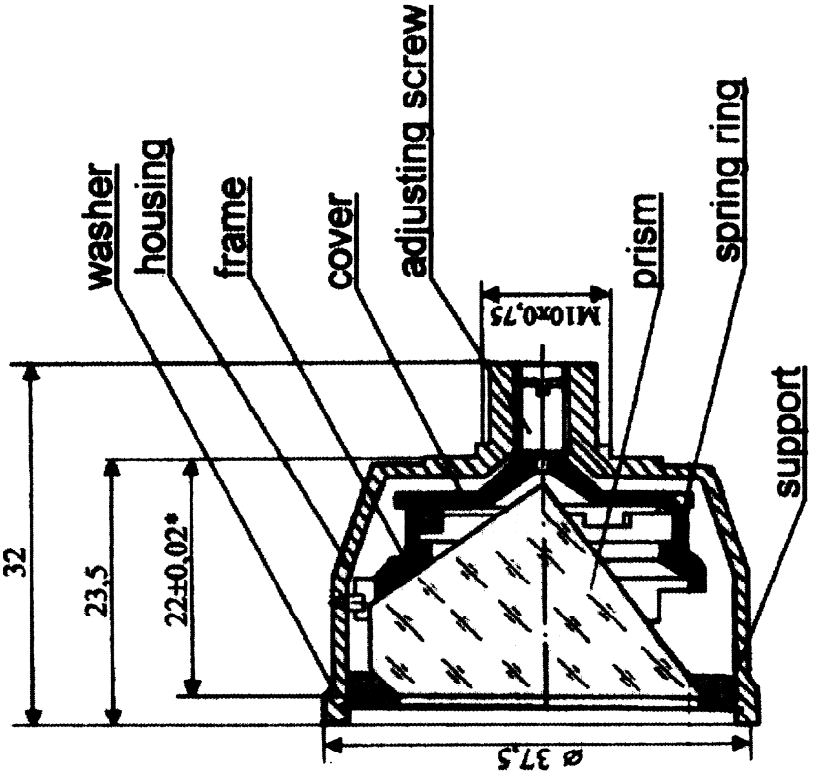
Лист 1/1



Масса 0,45кг.
$J_x = 0{,}00032$ кг·м²
$J_y = 0{,}00032$ кг·м²
$J_z = 0{,}00052$ кг·м²



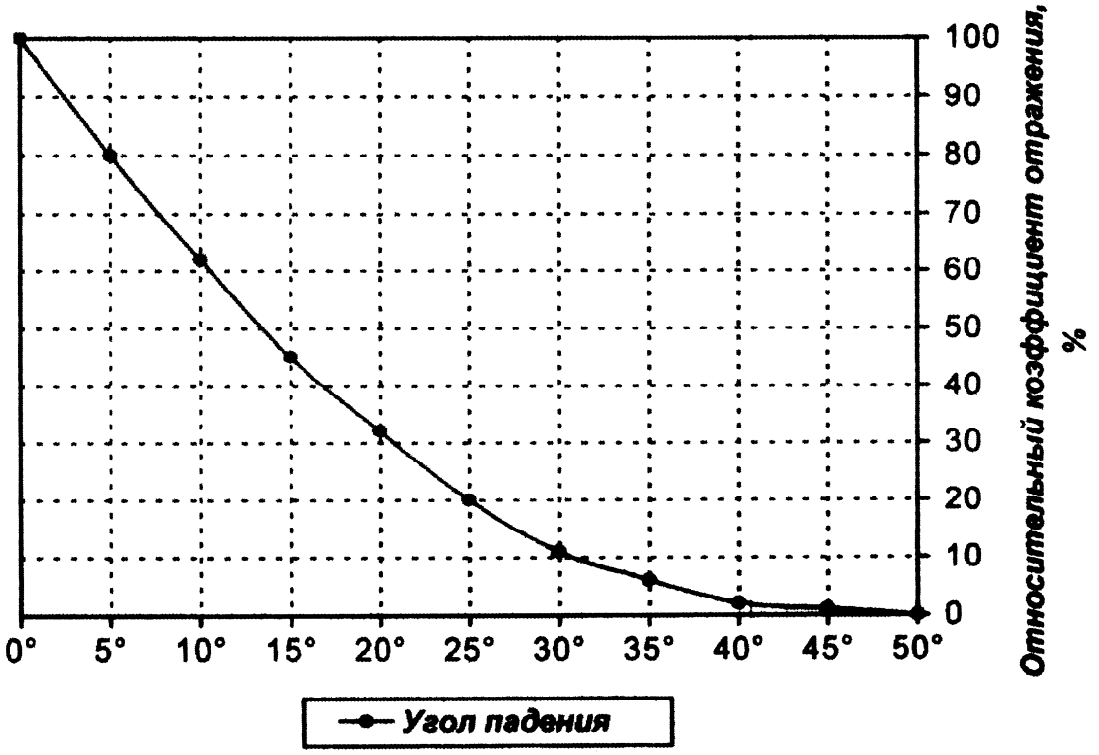
Cube corner prism in housing


washer
housing
frame
cover
adjusting screw
prism
spring ring
support
M10x0,75
32
23,5
22±0,02*
ø 37,5

Результаты предварительного анализа

Отражательная способность СВ при разных углах падения света.

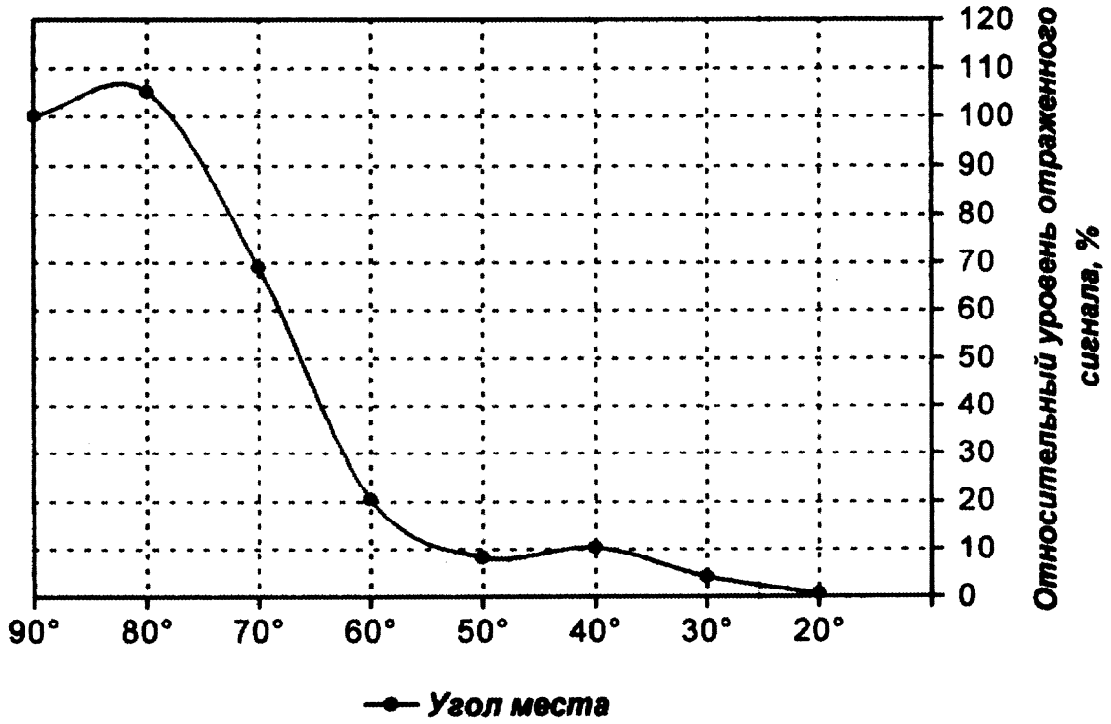
Угол падения	Коэффициент отражения	
	λ=0,532 мкм	λ=0,694 мкм
0°	0,57	0,64
5	0,46	0,51
10°	0,35	0,40
15	0,26	0,29
20°	0,18	0,21
25°	0,11	0,13
30°	0,06	0,07
35°	0,03	0,04
40°	0,01	0,01
45°	0,006	0,006



Отражательная способность блока СВ при разных углах места

Угол места	Эффективная поверхность рассеивания, $м^2 \times 10^3$
90°	136
80°	154
70°	125
60°	54
50°	38
40°	111
30°	152
20°	148

Высота орбиты 250 км, пропускание атмосферы в зените 0,7

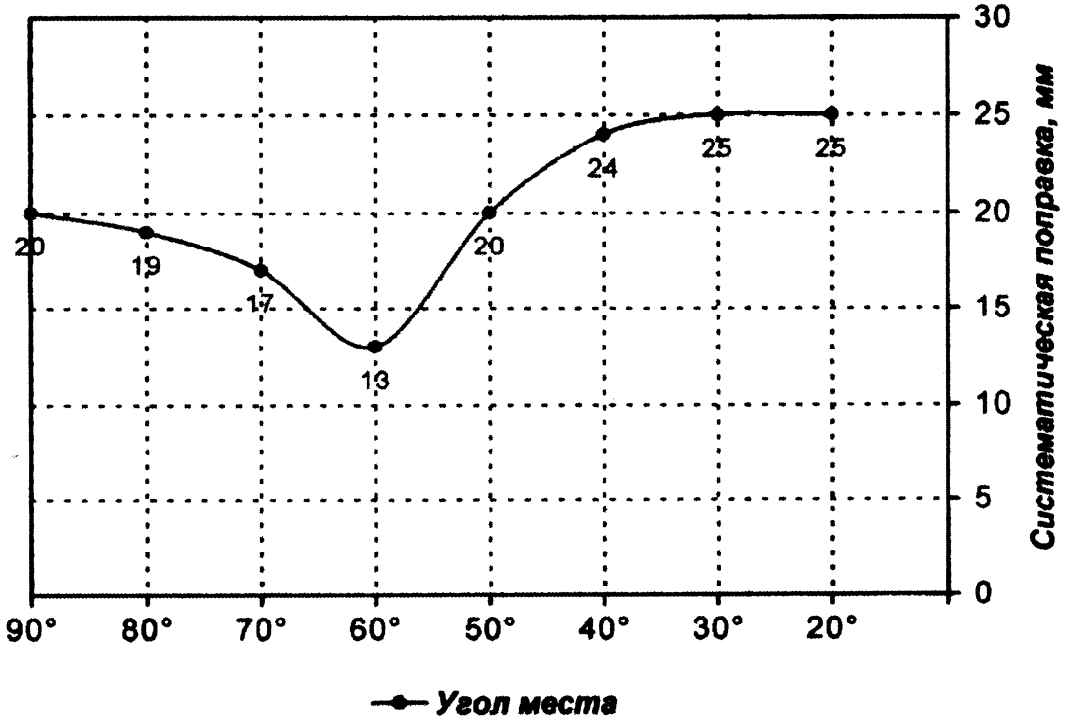


Для LRS станции в Щёлково минимальный уровень сигнала на угле места 20° составляет величину порядка 10 фотоэлектронов.

Результаты предварительного анализа

Систематическая поправка для измерения дальности относительно базовой точки блока СВ дляразличных углов места (см. рисунок в «Предложениях к тендеру»)

Угол места	Систематическая поправка, мм
90°	20
80°	19
70°	17
60°	13
50°	20
40°	24
30°	25
20°	25



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Date :06.03.2003

astrium

	Action
CryoSat Session	

	Action
Contract Splinter The LRR-2 for CryoSat is considered as complementary work to the first study. This complementary work contains - update of documentation - delivery of a second LRR The price is agreed to be 18,000 US$ without VAT An agreement on ~~the~~ order terms is found, which will govern the complementary work. Because of technical / administrative reasons the order terms will be signed next week. After signature of the order terms the first payment will be released. (50% of contract value) The final payment is due after delivery to ESA permanent mission in Moscow. During packaging at IPIE ESA / Astrium may be present for final acceptance of LRR-2	

	Action
IPIE states that an a priori orbit prediction of 1 km is not sufficient for laser tracking. The laser beam has a foot print of about 13m. The orbit prediction ~~shall~~ should be in the same order of magnitude. IPIE offers its support to establish the initial laser tracking network. The Laser Retroreflector, LRR, Procurement Specification, CS-RS-DOR-LR-0001, issue 2, dated 11.02.2003 was discussed and agreed without any modifications.	