ACTIVITY OF RUSSIAN FEDERATION ON SPACE DEBRIS PROBLEM

51-th session
of the UN Committee on the Peaceful Uses of Outer Space (COPUOS)

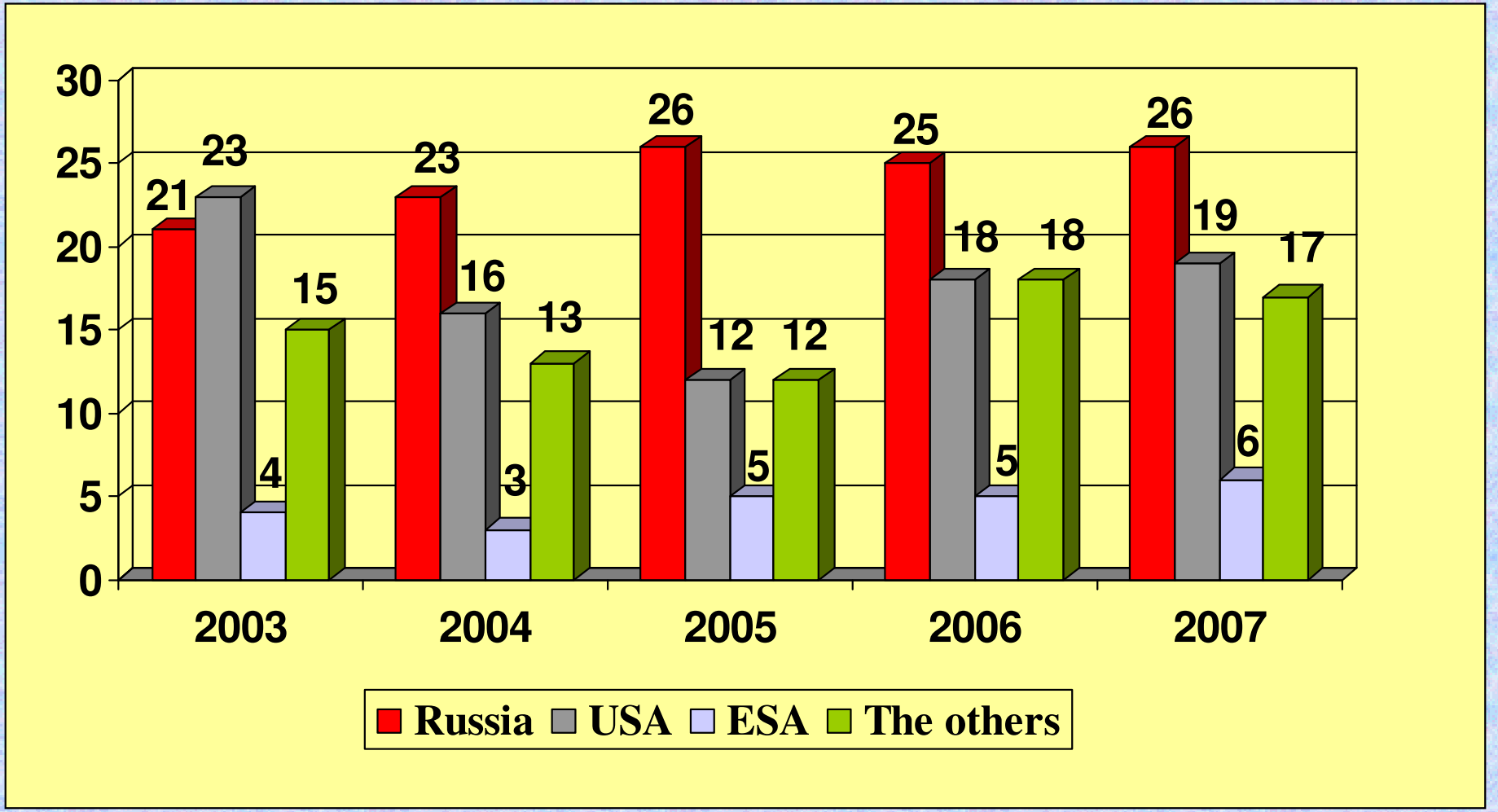
June 11-20, 2008

- **Federal Space Agency of Russia continues consecutive activity in the field of space debris problems. This work concerns the safety of spacecraft and the International Space Station, the latest one in a especial meaning.**

- **The activity on debris mitigation is being carried out within the framework of Russian National Legislation, taking into account the dynamics of similar measures and practices of other space-faring nations and also the international initiatives on space debris mitigation, especially the UN Space Debris Mitigation Guidelines (Ref. Doc. is A/RES/62/217 issued 10 January, 2008).**

- **Russian designers and operators of spacecraft and orbital stages are in charge to follow the requirements of Federal Space Agency Standard "Space Technology Items. General Requirements for Mitigation of Space Debris Population" in all projects of space vehicles being again developed.**

DYNAMICS OF LAUNCHES IN RUSSIA AND IN OTHER STATES AND ORGANIZATIONS



RUSSIAN LAUNCHES IN 2007

№/№	Type of Launcher	Accelerating Engine	Number of Launches	Type of Orbit
1	"Proton-K"	"DM"	1	Circular
2	"Proton-M"	"Briz-M	4 + 1*)	Geostationary
3	"Proton-M"	"DM"	1	Circular
4	"Soyuz-FG"	-	2	Circular
5	"Soyuz-U"	-	6	Circular
6	"Soyuz-FG"	"Fregat"	3	Circular
7	"Kosmos-3M"	-	3	Circular
8	"Dnepr"	-	3	Circular
9	"Zenit"	-	1	Circular
10	"Molniya"	-	1	Highly elliptical
Total:			**26**	

*) – failed launch with the Japan SC JC Sat 11

COMPLIANCE OF ROSCOSMOS ACTIVITY IN SPACE DEBRIS MITIGATION WITH THE UN SPACE DEBRIS MITIGATION GUIDELINES

№/№	The UN Principle of Space Debris Mitigation	The measures undertaken in the space vehicles design and operation
1	Limit debris released during normal operations	• "Briz-M", "DM" orbital stages , 3-rd stage (block "I") of "Soyuz-2" Launcher don't release space debris during normal operations. • Spacecraft "Kazsat", "Kazsat-2", "Monitor-E", "Express-MD1", "Resurs-DK1", "Resurs-P", "Spektr", "Electro-L", "Meteor-M", "Kanopus-B" don't release space debris during normal operations.
2	Minimize during operational phases	• Strengthening of constructive materials of space vehicles and using of shields around fuel tanks, high pressure vessels not to admit accidental break-ups and to protect against impact of meteors and space debris fragments ("Monitor-E", "Resurs-DK1", "Resurs-P", "Spektr", "Electro-L", "Bion-M", "Briz-M"). • At spacecraft of "Ekran" type to prevent explosions of the detonating gas that is being produced by the silver-cadmium batteries, the said batteries were changed to the nickel-hydrogen ones. • In case of orbital stages of "DM" type the minimizing of the potential for break-ups is provided due to presence of relief dampers on fuel tanks and gas cylinders.

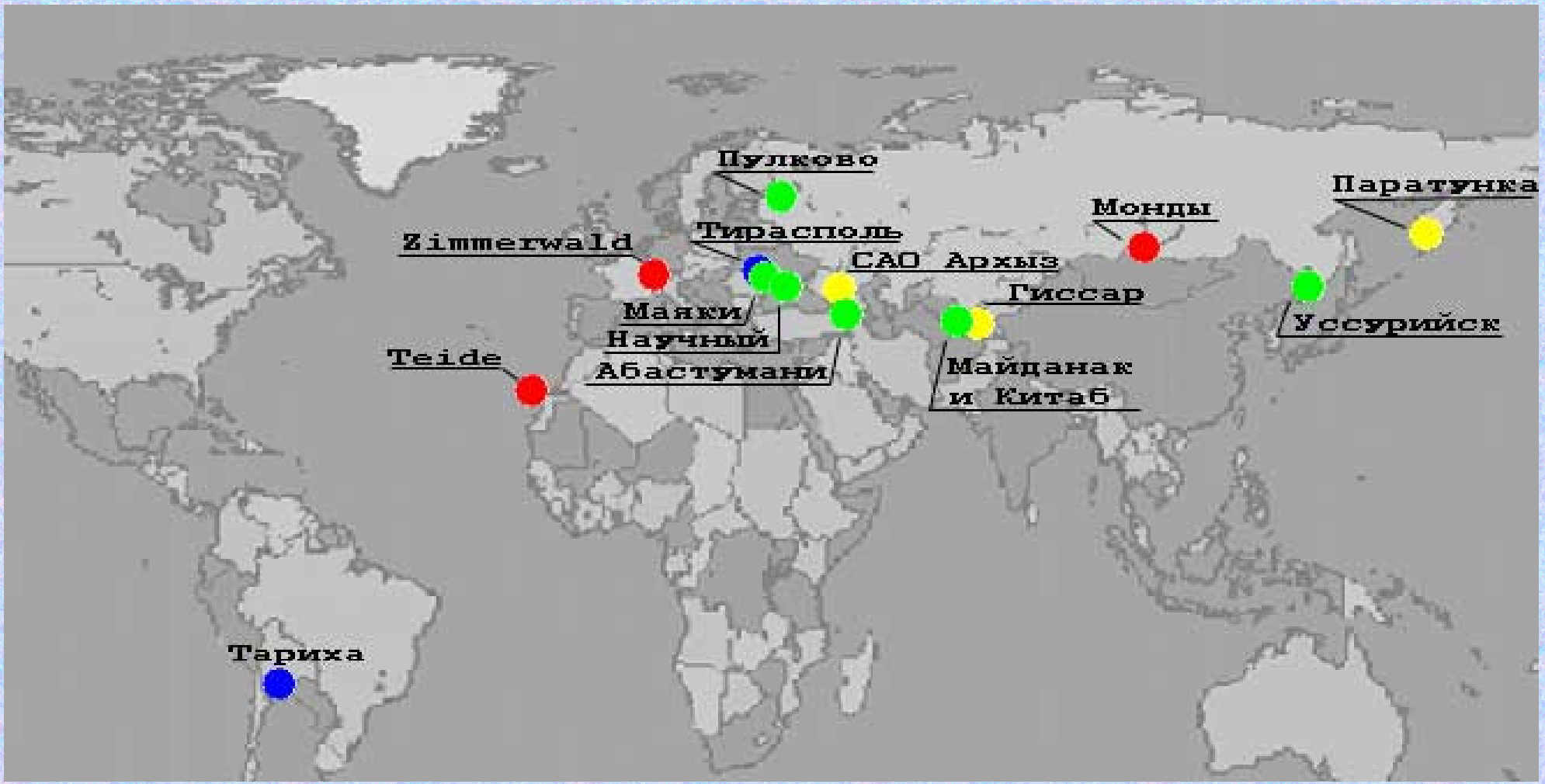
COMPLIANCE OF ROSCOSMOS ACTIVITY IN SPACE DEBRIS MITIGATION WITH THE UN SPACE DEBRIS MITIGATION GUIDELINES

№/№	The UN Principle of Space Debris Mitigation	The measures undertaken in the space vehicles design and operation
3	Limit the probability of accidental collision in orbit	• Guaranteed withdrawal of orbital stages from the launched spacecraft is being undertaken thus decreasing the probability of dangerous collisions. • In case of the International Space Station (ISS) the estimation of probability of collisions with large debris fragments is being carried out on a regular basis. Maneuvers of the ISS for leaving from dangerous fragments are envisioned thus decreasing the probability of collisions.
4	Avoid intentional destruction and other harmful activities	• Intentional destructions are not applied at all launchers, apogee motors and spacecraft developed by Roscosmos.
5	Minimize potential for post-mission break-ups resulting from stored energy	• The pressure release from fuel tanks is made in case of orbital stages after their withdrawal from the launched spacecraft • In case of orbital stages of “DM” type the following procedures are implemented: the removal of the remainders of fuel of the sustainer, a burning out of the remainders of fuel from SOZ engine after separation of spacecraft, a discharge of onboard storage batteries. • In case of spacecraft of “Express” and “Gonets” types the following procedures are implemented: termination of rotation of handwheels, gyros and other mechanical devices, removal of the remainders of fuel under large pressure, a discharge of chemical sources of a current.

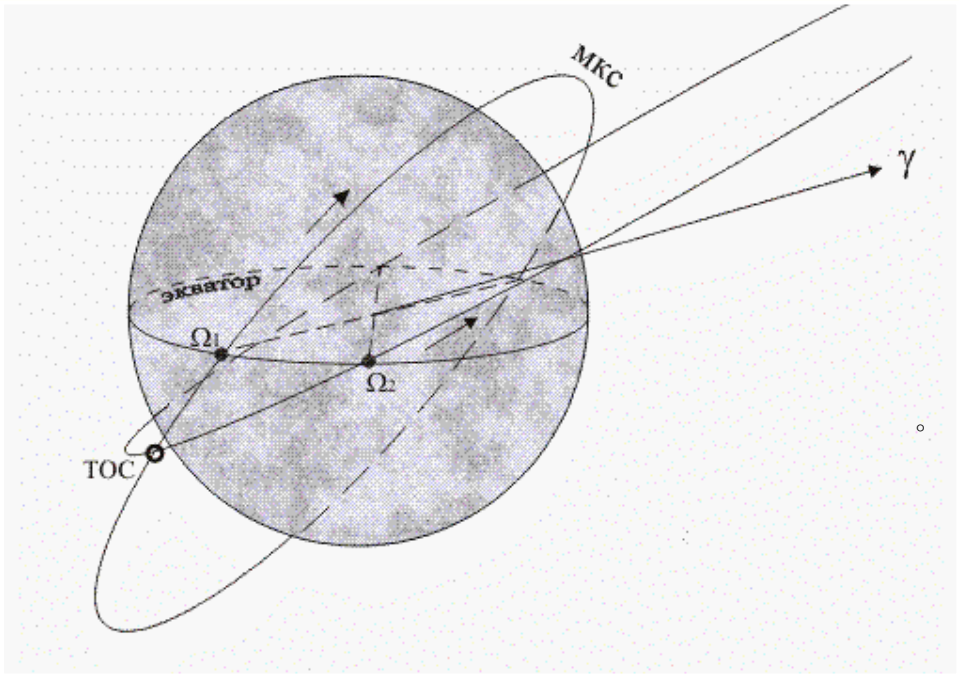
COMPLIANCE OF ROSCOSMOS ACTIVITY IN SPACE DEBRIS MITIGATION WITH THE UN SPACE DEBRIS MITIGATION GUIDELINES

№/№	The UN Principle of Space Debris Mitigation	The measures undertaken in the space vehicles design and operation
6	Limit the long-term presence of spacecraft and launch vehicle orbital stages in the low Earth orbit (LEO) region after the end of their mission	• At the end of mission at presence of a fuel reserve the orbital stage "Frigat" is disposed with the subsequent splashing down. • In case of orbital stages of “DM” type after separation of spacecraft it is flooded by the last momentum pulse of the sustainer. • In case of spacecraft "Monitor" type its disposal is envisioned from to lower orbit, providing braking of space vehicle and combustion in an atmosphere. • In a design of spacecraft “Sterkh” «Стерх» the capability of reduction in time of its presence in an orbit by change of a configuration of solar arrays is incorporated.
7	Limit the long-term interference of spacecraft and launch vehicle orbital stages with the	• The newly designed geostationary spacecraft disposal to a burial zone (the IADC formula and eccentricity less than 0.003) is envisioned after the end of their mission

INTERNATIONAL SCIENTIFIC OPTICAL NETWORK



DANGEROUS APPROACHES OF SPACE DEBRIS OBJECTS TO INTERNATIONAL SPACE STATION



The orbital parameters of space debris object (1992-058E)
(the fragment of carrier rocket «Delta- 7925»):

- $H_p \approx 245{,}5$ km,
- $H_a \approx 11900{,}2$ km,
- $I \approx 34{,}88^{\circ}$

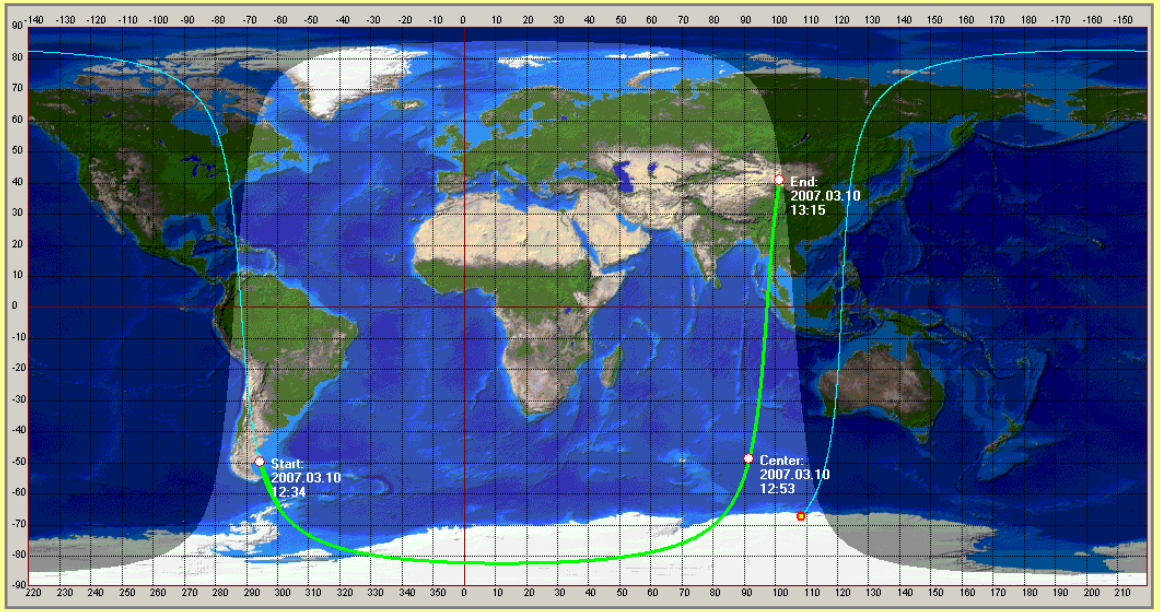
The point of dangerous closing (PDC) – 20.10.07 10:56:36 DMT

The deviation in altitude R≈0,66 km (VR≈0,95 km/*s*)

The deviation along the orbit N≈-3,0 km (VN≈-2,82 km)

The lateral deviation B≈1,15 km (VB≈-7,86 *km/s*)

The IADC Re-entry Campaign 2007-1



The Russian Part was one of the most active participants in the 8-th test campaign. During this exercise 20 TLE, generated by RSSS, and 7 re-entry predictions produced in Mission Control Centre have been inserted into *REDB* on behave of Roscosmos.

1. The final estimate of COIW, obtained with using 8 RSSS orbits, 5 TLE data, produced USA SSN and 2 ESA TLE was:

   Epoch: 2007/03/10, 12:53:50 UTC;

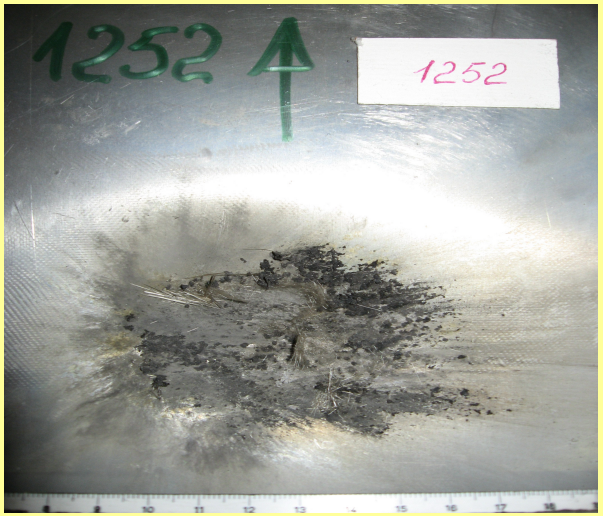
   Impact coordinates: 48.7° S, 91.8° E.

2. The Russian estimation of re-entry prediction shows the fine correlation with the official data.

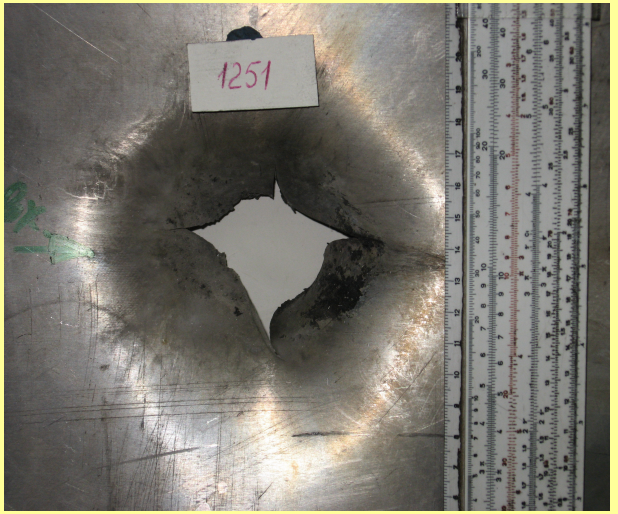
ISS PROTECTION AGAINST SPACE DEBRIS FRAGMENTS

HIGH VELOCITY IMPACT EXPERIMENTS WERE CARRIED OUT

- **Projectile – Al pellet of 10,72 mm in diameter, velocity ~ 6 km/s. Impact angle ~ 45°.**
- **The investigated structures of equivalent weight:**
  - **A - combination of mesh shield with continuous shield (*Russian proposal*).**
  - **B - combination of two continuous shields (*as it used at the ISS*).**



A. The protected wall – without through breakdown
(The first shield was made from the steel mesh of special weaving)



B. The protected wall– through breakdown
(The first continuous aluminum shield)

DEVELOPMENT OF RUSSIAN STANDARDS ON SPACE DEBRIS MITIGATION

NATIONAL STANDARD OF THE RUSSIAN FEDERATION

(Final Edition)

"General Requirements to Spacecraft and Orbital Stages on Space Debris Mitigation"

General requirements to design and operation of spacecraft and orbital stages to assure space debris mitigation.

- **The common requirements to space vehicles are established to limit the space debris population in Near Earth Space**
- **The requirements should be applied to new designed and updated space vehicles of different type: civil, science (including deep space investigations), commercial, military and manned missions.**
- **Application of the requirements of the standard must be putted into practice during the all stages of the life of space means: designing, manufacturing, launch, operation and utilization.**
- **The requirements of the NATIONAL STANDARD OF THE RUSSIAN FEDERATION were harmonized with the UN Space Debris Mitigation Guidelines**

Cooperation with ISO on Space Debris Mitigation

STANDARD ISO/WD 23339 (project)
Space systems – Unmanned spacecraft, estimating mass of remaining usable propellant

STANDARD ISO/WD 24113 (project)

Space Systems - Orbital Debris - Management for Debris Mitigation

STANDARD ISO/WD 26872 (project)

Disposal of Spacecraft from Geostationary Orbit

STANDARD ISO/WD 26885 (project)
Space systems – Orbital Data Transfer

STANDARD ISO/WD 27852 (project)
Space systems – Orbit Lifetime Estimation

STANDARD ISO/WD 27875 (project)

Space systems – Reentry Safety

SUMMARY

- The Russian Federation is devoted to the international efforts on space debris problem resolution and is already implementing practical steps on space debris mitigation on a voluntary basis within its own national mechanisms taking into account the UN Space Debris Mitigation Guidelines.

- The final version of the Russian NATIONAL STANDARD «General Requirements to Spacecraft and Orbital Stages on Space Debris Mitigation» have been prepared.

- The Russian Federation believes that approval of the UN Space Debris Mitigation Guidelines would increase mutual understanding on acceptable activities in space and thus enhance stability in space-related matters and decrease the likelihood of friction and conflict.