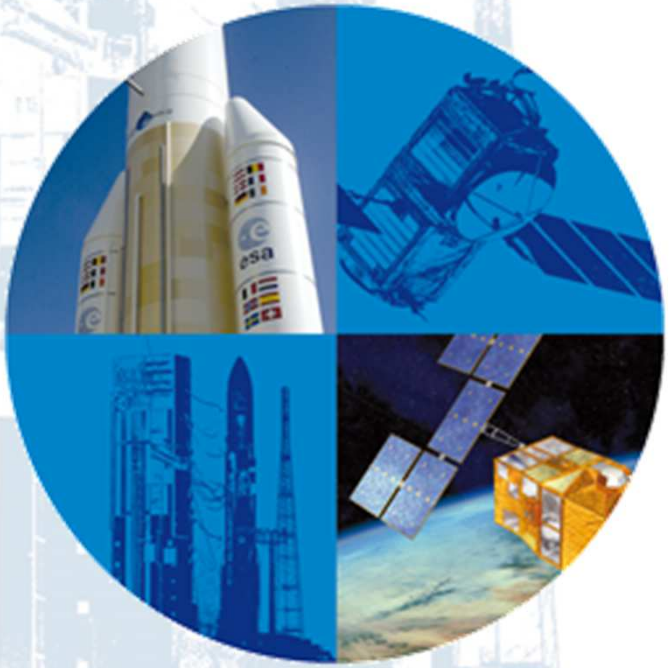
Technical Regulation Modification Proposal (Orbital Systems part)



2017

Art 29 - Description of the space operation and associated systems and procedures

The description of the space operation and the implemented systems and procedures as mentioned in II.1° of article 1 of the above-mentioned decree of 9th June 2009 presents the space system used for the planned operation, consisting of the ground segment and the space object, as well as the duration of the space operation. This description also presents the various subsystems of said object.

When dealing with space object performing re-entry at end of life, the description presents the platform and payload components, as well as their equipment, able to reach the ground, stating the dimensions, masses and materials used.

This description comprises a mission analysis presenting the reference orbit, the means of attaining it (injection, station acquisition) and maintaining it (station-keeping) with the associated space and time coordinates, the measures for reconstructing the orbit with the intended degree of precision, the ability to control the object (existence and visibility of ground stations or relay satellites, of the control centre or on-board autonomous capability), as well as the disposal strategy. It states the space system models used to perform this mission analysis.

This description comprises the control capability covered by article 39 of this order.

Art. 40. 1 – Space debris limitation

1. The systems must be designed, produced and implemented so as to avoid generating debris during nominal operations of the space object.

The above requirement does not apply:

- to pyrotechnic systems. The largest dimension of any products they generate must however be less than 1 mm;
- to solid propellant boosters. The size of any combustion debris they generate in protected region B must however be less than 1 mm. With regard to the design and operation of solid propellant boosters, the operator implements measures allowing to avoid placing durably in orbit solid combustion products which could contaminate protected region A.

However the on orbit release of a single additional propulsion module is allowed. This module, as a space object, must comply with all the provisions of the third part of this Order.

Art. 40. 3 – Space debris limitation

3. The systems must be designed, produced and implemented so that, following the disposal phase:

- all the on-board energy reserves are permanently depleted or placed in such a condition that they entail no risk of generating debris,
- all the means for producing energy on-board are permanently deactivated.
- all the radio-frequency emission capabilities of the platform and the payload are permanently switched off.

The above requirements are not applicable for controlled re-entries.

Art. 40. 4 – Space debris limitation

4. The systems equipped with propulsive elements allowing to modify the orbit must be designed, produced and implemented so that, ~~once~~ the space object is no longer present in the protected region A twenty five years after having ~~has~~ completed its operational phase in an orbit passing through protected region A~~,~~ ~~the space object is deorbited with controlled atmospheric re-entry.~~

~~If the impossibility of meeting this requirement can be duly proven, it must be designed, produced and implemented so that it is no longer present in protected region A twenty-five years after the end of the operational phase.~~

This result is preferably achieved by ~~uncontrolled~~ atmospheric re-entry or, failing that, by placing in a stable orbit for which the perigee remains above protected region A for one hundred years following the end of the operation.

Art. 40. 4 – Space debris limitation

Systems not equipped with propulsive elements allowing to modify the orbit must be designed, produced and implemented so that the space object is no longer present in the protected area twenty-five years after its in-orbit injection.

- If the orbit targeted by the space object after the disposal maneuvers is inside, or passes through, protected region A, and has an eccentricity lower than 0.25, the compliance with the above requirements shall be ensured with a probability of at least 0.5 considering the effect of natural orbital disturbances.

- If the orbit targeted by the space object after the disposal maneuvers has an eccentricity higher than 0.25, the compliance with the above requirements shall be ensured with a probability of at least 0.9 considering the effect of natural orbital disturbances and their associated uncertainties.

Art. 40. 5 – Space debris limitation

5. The space object must be designed, produced and implemented so that, once it has completed its operational phase in an orbit in or passing through protected region B, it is placed in an orbit which does not interfere with this region and located above it. This orbit must be such that, under the effect of natural disturbances, the object does not return to protected region B within one hundred years following the end of the operation.

If the orbit targeted by the space object after the disposal maneuvers has an eccentricity higher than 0.25, the compliance with the above requirements shall be ensured with a probability of at least 0.9 considering the effect of natural orbital disturbances and their associated uncertainties

Art. 40. 6 – Space debris limitation

~~7~~.6. The probability to successfully perform the disposal maneuvers referred to in paragraphs 3, 4 and 5 above must be at least 0.85. ~~The operator must evaluate the probability of being able to successfully carry out the disposal manoeuvres mentioned in paragraphs 3, 4 and 5 above~~. This ~~evaluation,~~ probability which does not include the availability of energy resources, must be calculated before launch ~~made~~ by the operator for the total duration of the ~~operation~~ phase of control for which the system has been qualified and take account of all systems, subsystems and equipments usable for these manoeuvres, their level of redundancy, if any, and their reliability~~, taking account of the effects of the ageing reached at the time they are scheduled to be carried out~~.

Art. 40. 7 – Space debris limitation

~~6~~. 7. The probability of having sufficient consumable energy resources, to successfully carry out the disposal manoeuvres mentioned in paragraphs 3, 4 and 5 above must be at least 0.99 when starting them.

Art. 44-1– Quantitative human safety objectives for return of a space object to Earth

1. With regard to the return of a space object, the quantitative safety objectives, expressed as the maximum probability of causing at least one casualty (collective risk) ~~are defined as follows:~~ is 10^{-4}

~~· 2*10-5 for return of an integral object;~~

~~· 2*10-5 for controlled atmospheric re-entry with destruction of the space object;~~

~~· If it can be duly proven that controlled atmospheric re-entry with destruction of the space object as mentioned above is impossible, the operator must do its best efforts to meet a quantitative objective of 10-4 for uncontrolled re-entry with destruction of the space object.~~

Art. 44-2– Quantitative human safety objectives for return of a space object to Earth

2. The provisions mentioned in the first paragraph above must be evaluated ~~using a calculation method based on~~ considering :

- the re-entry strategy (controlled or uncontrolled)

- earth population at planned re-entry date

- ~~consideration of~~ all phenomena leading to a risk of catastrophic damage;

- ~~consideration of~~ the trajectories before fragmentation;

- modelling of the fragmentation and debris generation scenarios corresponding to re-entry;

- dispersion of the debris on the ground and evaluation of their effects;

- ~~consideration of~~ the reliability of the space object.

Art 55.2 – Interim provisions

b) For space objects launched between 10th December 2010 and 31st December 2020:

· the provisions of paragraphs 1 to 2 of article 40 and those of article 45 do not apply;

· with regard to the provisions of paragraph 3 to 7 ~~6~~ of article 40 and those of article 41, the operator must implement the best possible strategy considering the space object definition;

· with regard to the provisions of article 44, the operator must implement the best possible strategy considering the space object definition and must perform a risk estimate.