

What's the difference between ESA's zero debris approach and the Zero Debris Charter?

Zero debris approach is a term used by any space organisation – science or business, public or private – that seeks to reduce drastically its debris footprint.

The ESA zero debris approach kick starts a profound ESA-wide internal transformation to revise the agency's space debris mitigation requirements and policies for its missions and projects, and pursue technical developments to support its zero debris ambition. One question is at the centre:

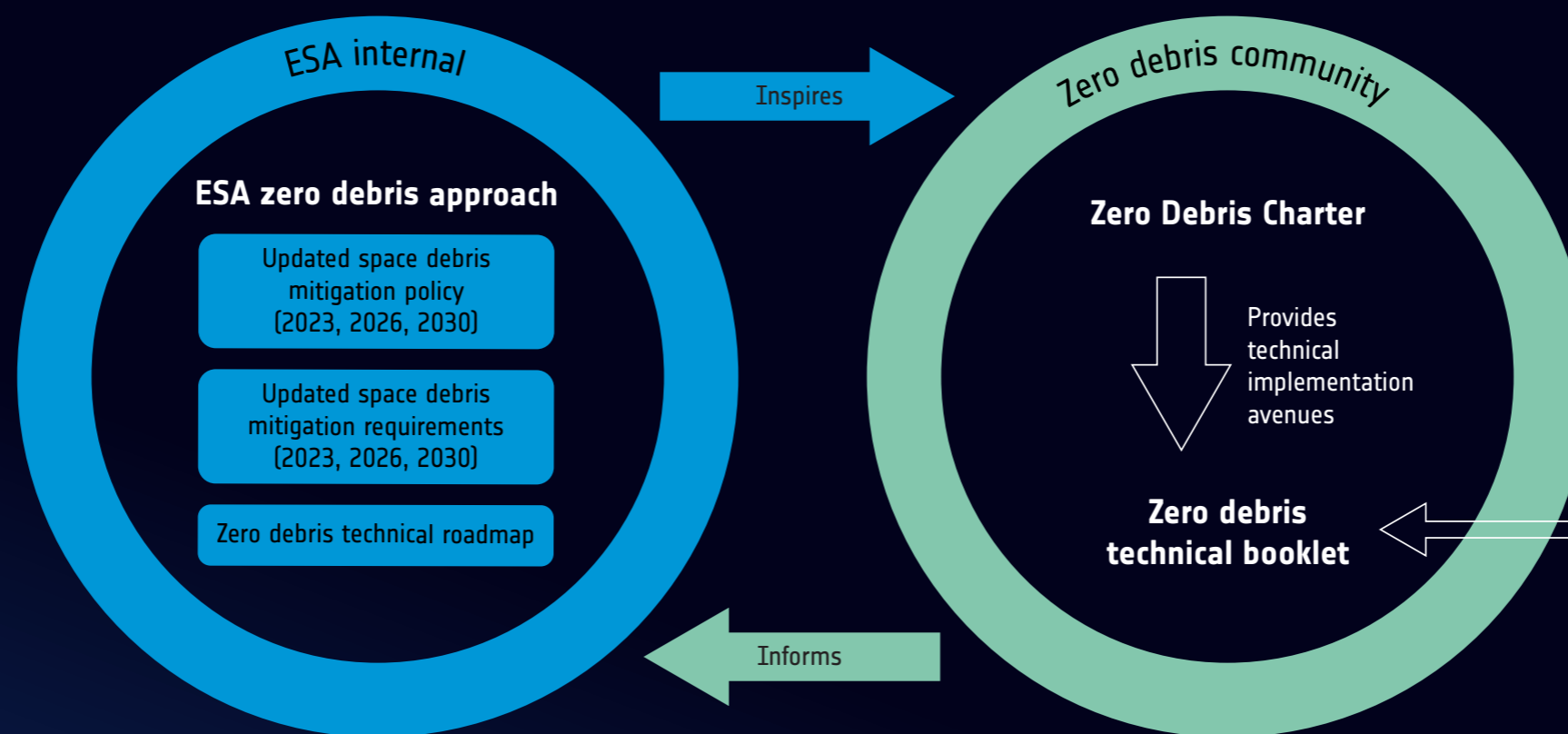
How much debris is it OK to create?
Ideally, zero debris.

ESA's eight recommendations for zero debris by 2030

- 1. Ensure the safe disposal of space objects*
- 2. Reduce the time a redundant object is in orbit from less than 25 years to less than five years*
- 3. Avoid in-orbit collisions*
- 4. Prevent satellites breaking up*
- 5. Halt the intentional release of space debris (covers, caps, rocket fairings)*
- 6. Improve on-ground casualty risk assessment: design for demise*
- 7. Guarantee dark and quiet skies to minimise the impact on optical and infrared astronomy*
- 8. Extend mitigation measures beyond the protected regions, for example, Global Navigation Satellite System constellations and lunar orbits*

The **Zero Debris Charter** refers to the open and collaborative development of a common vision of space debris mitigation and remediation. It has more than 100 partners globally who are engaged in collaborative capacity-building activities to achieve a zero debris future by 2030. ESA's initiative to protect space assets – the so-called **"Protect accelerator"** – helps to facilitate and contribute to the zero debris community.

The **zero debris technical booklet** aims to compile the technical needs and solutions required to reach a zero debris future by 2030. Its contents are provided by the zero debris community and are for information only.



ESA is already acting now with its zero debris approach

ESA has already updated its policy and technical requirements related to space debris mitigation. From November 2023, all ESA missions must ensure:

- The probability of collision for missions in low Earth orbit remains below 1 in 1000 after the end of life,
- De-orbit takes place within five years after the end of mission, or even sooner, depending on the risk profile of the mission (disposal orbit below 375 km required for large constellations),
- Probability of successful disposal must be higher than 90%, including the contribution from impacts with debris and micrometeoroids, with more stringent requirements for large constellations,
- Preparation for removal, to foster the development of robust active debris removal solutions,
- Actionable space traffic management solutions with improved collision-avoidance services and access to robust data in maintained catalogues.

A zero debris approach for Europe and the world

In addition, ESA is also addressing two emerging issues: avoiding the proliferation of space debris in lunar orbits; and minimising interference with radio and optical astronomy. It has developed a preliminary set of requirements that will be furthered matured in the coming years.

The agency will revise its zero debris policy and requirements again in 2026 and 2030 to achieve zero debris for all ESA missions developed after 2030 (i.e., break-up risk below 1 in 1000 for whole orbital lifetime with guaranteed disposal or removal). This will be laid down in openly accessible documents.

What's new? – some examples

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| <p>Clearance criteria</p> | <p>Probability of successful disposal</p> | <p>COLA & STM</p> | <p>Design for removal</p> | <p>Lunar orbits</p> |
| <p>+ 5 years in LEO + Collision probability threshold</p> | <p>+ ≥ 90% considering both internal and external factors</p> | <p>+ Encoding of current best practices + Collision probability threshold ≤ 1:10 000</p> | <p>+ Preparation for removal, except low-risk objects</p> | <p>+ Break-up prob. < 1:1000 + Analysis of disposal options</p> |



In parallel to the change in policy and requirements, ESA is implementing its roadmap to guarantee the swift implementation of the zero debris approach to its own missions and to support the European space industry towards a zero debris future. For the benefit of Europe, ESA is working with relevant institutions at national and European levels to ensure a convergence of approaches.

As orbital capacity is limited, zero debris guarantees more space activities while reducing environmental constraints. Its early implementation will provide a competitive edge to the European space industry in satellite design and operations. Several technical activities will be kicked off by ESA:

- Evolution of spacecraft platforms to implement systematically zero debris
- Enhanced tracking and disposal strategies for all Earth orbits and lunar orbits for long-term sustainability
- Development of reliable designs and harmonised risk assessment tools, to promote fair competition
- Preparation of in-orbit demonstration of removal interfaces such as grappling points on satellites
- Safe re-entry and enhanced demise, particularly for large constellations

ESA is also preparing building blocks to enable a circular economy in space – the next challenge following the achievement of zero debris.