

**Thermal-vacuum and vibration test campaigns that led to the OUFTI-1 nanosatellite being fully qualified by ESA for launch and operation in Earth orbit**

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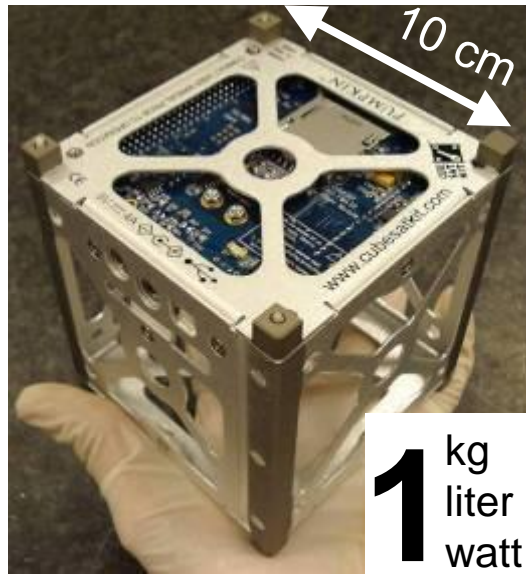
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**Liège, Belgium**

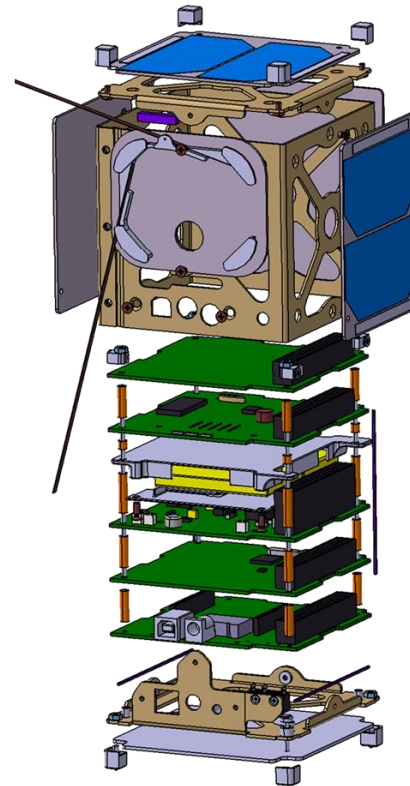
**7<sup>th</sup> European CubeSat Symposium, Liège, Belgium, 9-11 Sept. 2015**

- OUFTI-1 CubeSat
- Fly Your Satellite! program
- Phase 1: Build Your Satellite!
- Phase 2: Test Your Satellite!
- Conclusions

# OUFTI-1 CubeSat



1 Unit CubeSat



Subsystems developed by students



Main payload



- OUFTI-1 CubeSat
- **Fly Your Satellite! program**
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# Fly Your Satellite! program

- ESA educational program
- Structured in 4 phases
  - Build Your Satellite!
  - Test Your Satellite!
  - Ticket to Orbit!
  - CubeSats in Space!
- OUFTI-1 selected in June 2013
- Current state: end of Phase 2



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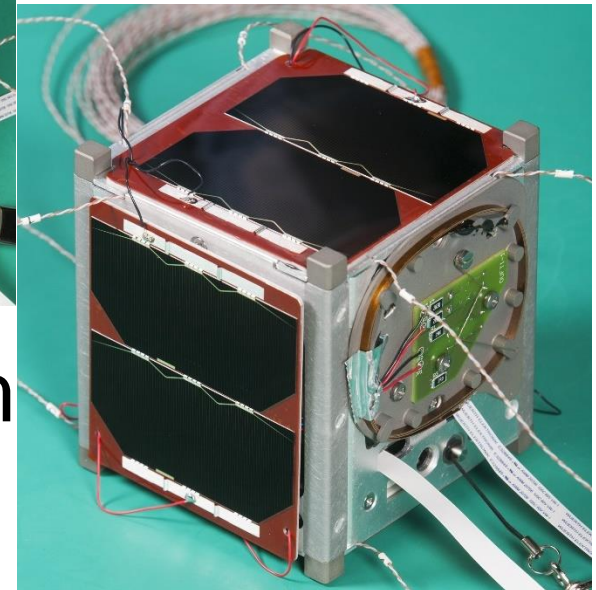
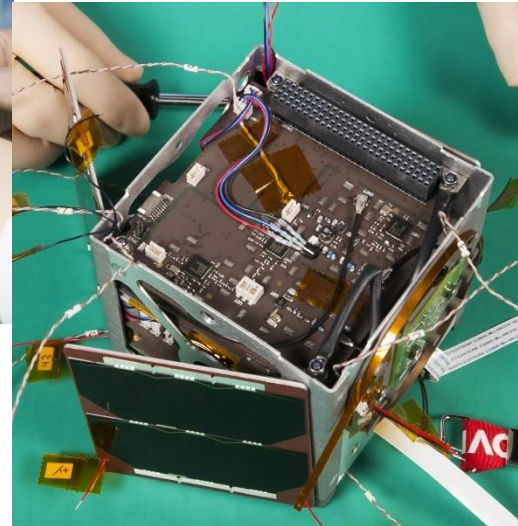
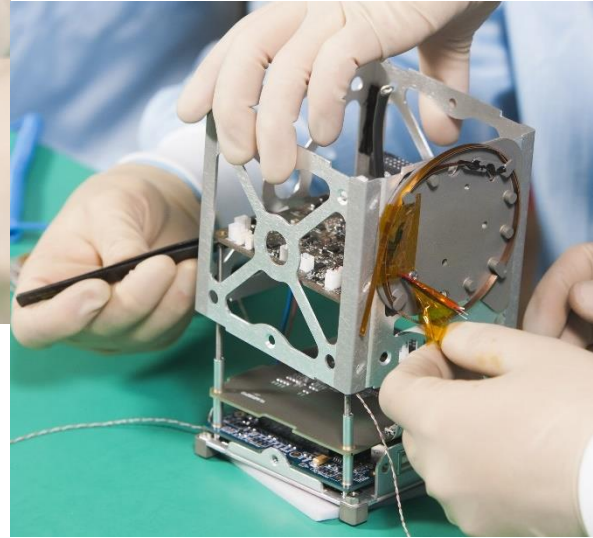
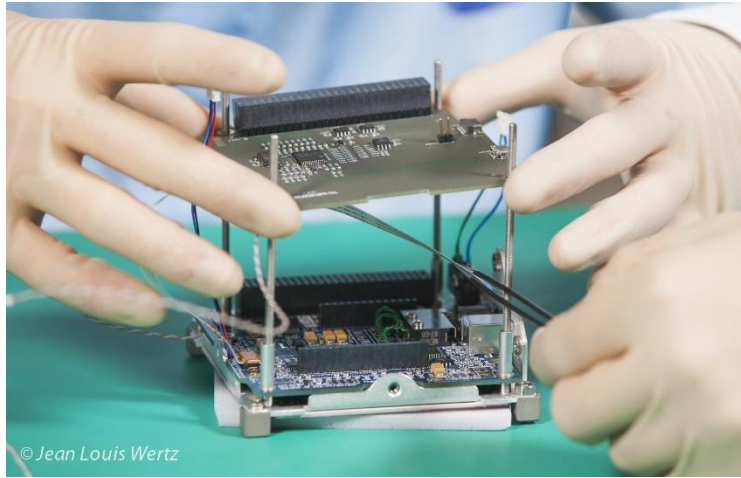


# Phase 1: Build Your Satellite!

- Subsystems Functional Tests (SFT)
- Integration at Centre Spatial de Liège (CSL), Liège, Belgium
- Full Functional Test (FFT)
- Communication Test
- Mission Test (MT)



# Phase 1: Integration



- Write, test, and correct integration procedures
- Integration performed at CSL, Liège, Belgium

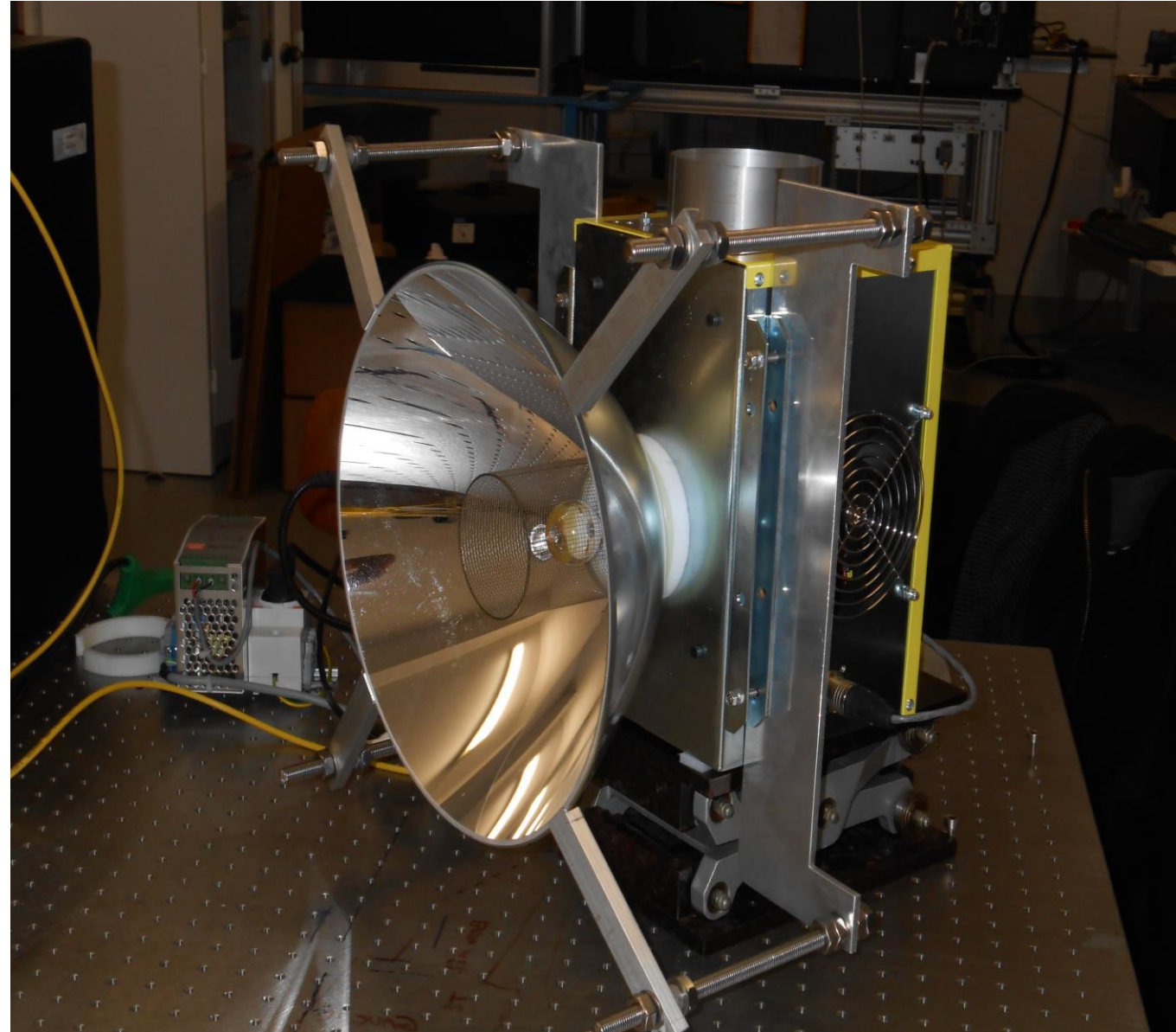
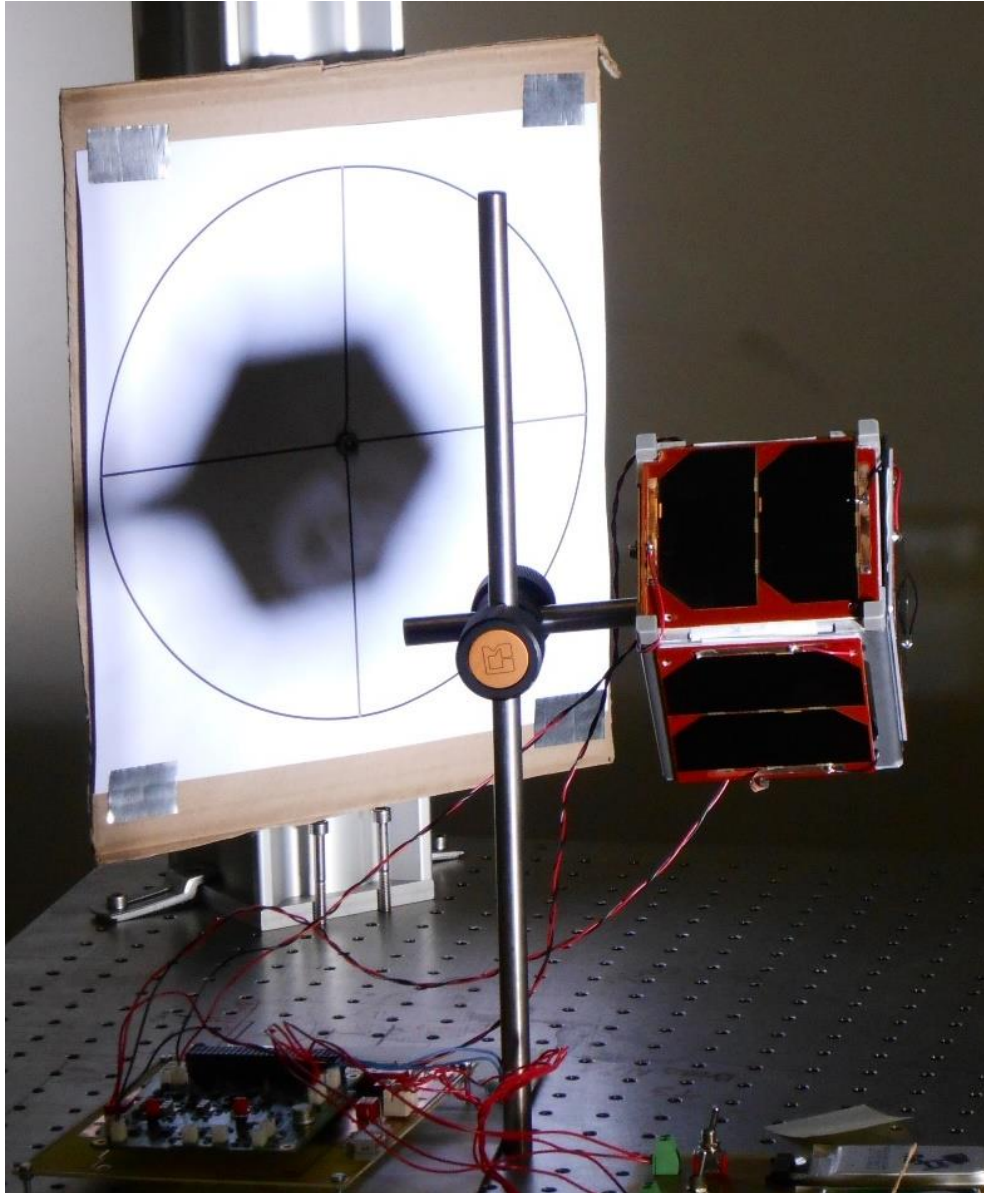


# Phase 1: Communication Test

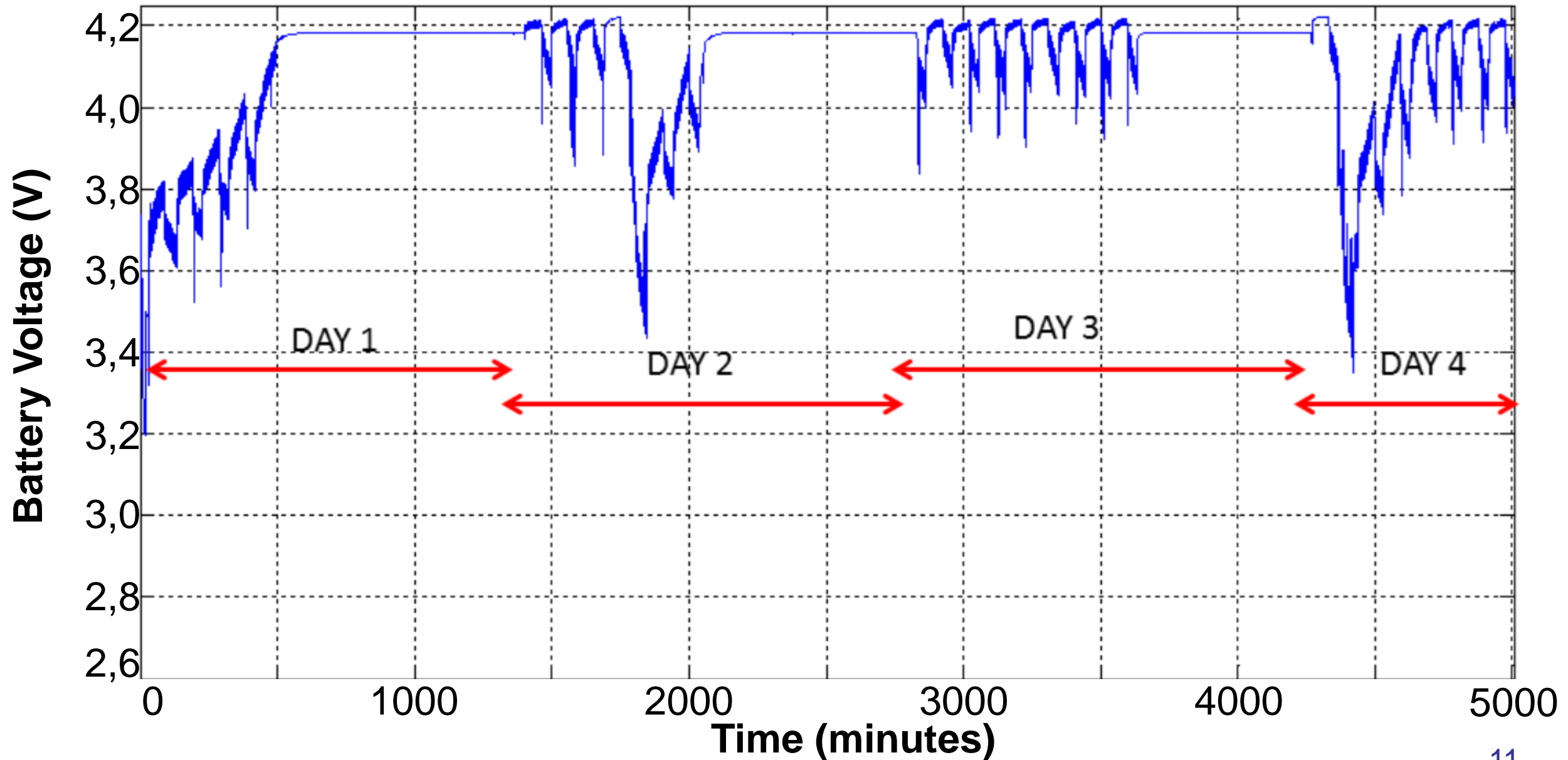
- Engineering Model on a zeppelin at 100m (~328ft) high
- Test performed at Euro Space Center, Transinnes, Belgium
- TC/TM, beacon, and D-STAR test in a wide open area



# Phase 1: Mission Test (MT)



# Phase 1: Mission Test (MT)

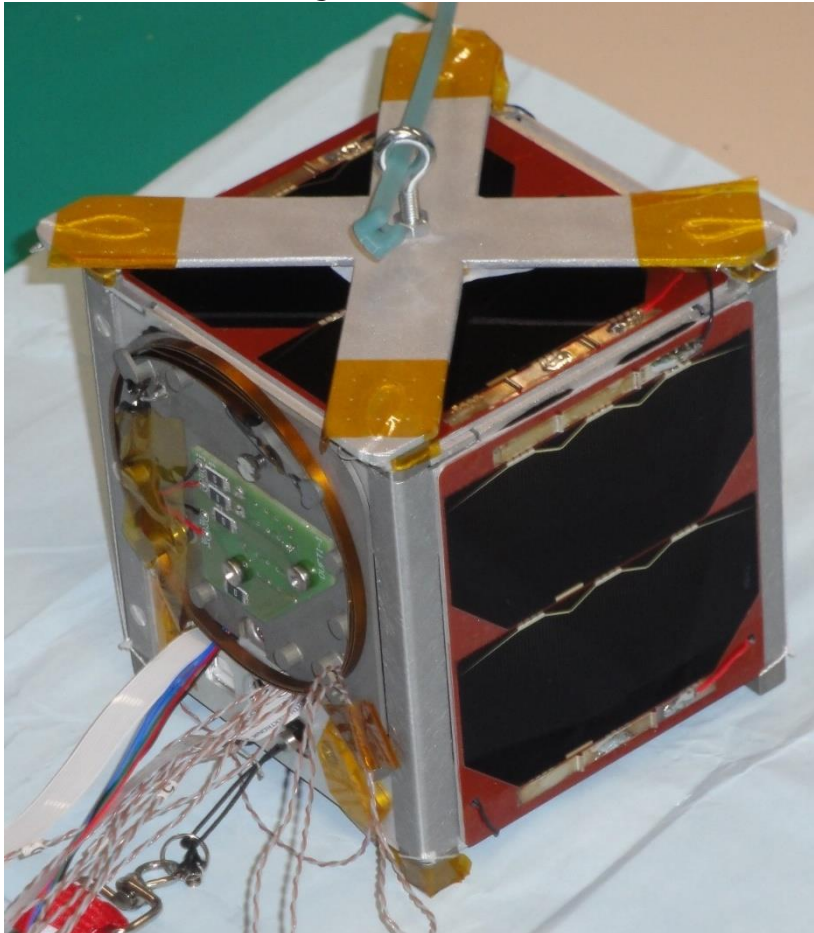


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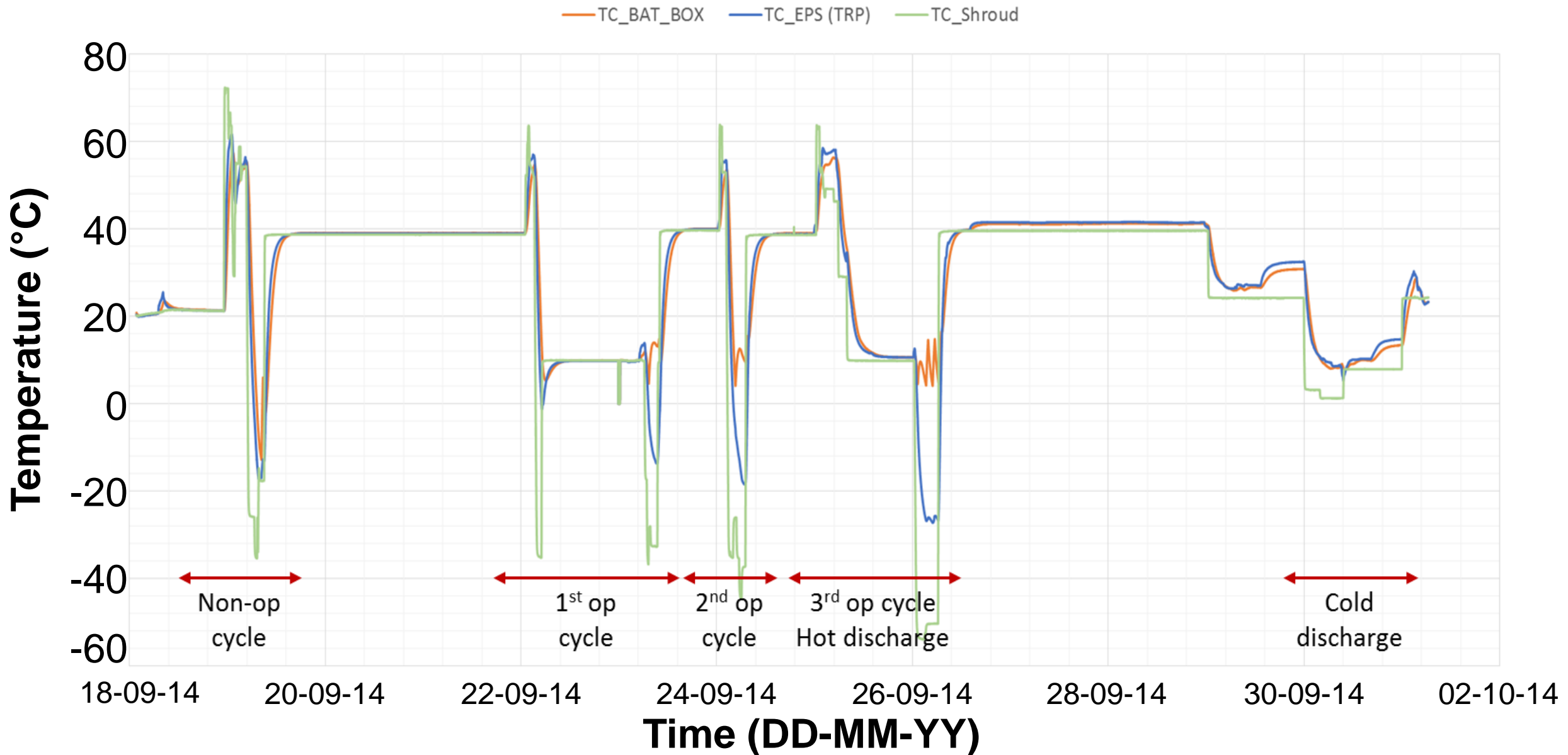


# Phase 2: Thermal Vacuum Test Campaign (TVC)

- Thermal Vacuum test Campaign (TVC) at ESA/ESTEC, Noordwijk, The Netherlands



# Phase 2: Thermal Vacuum Test Campaign (TVC)



# Phase 2: Vibration Test Campaign (VIB)

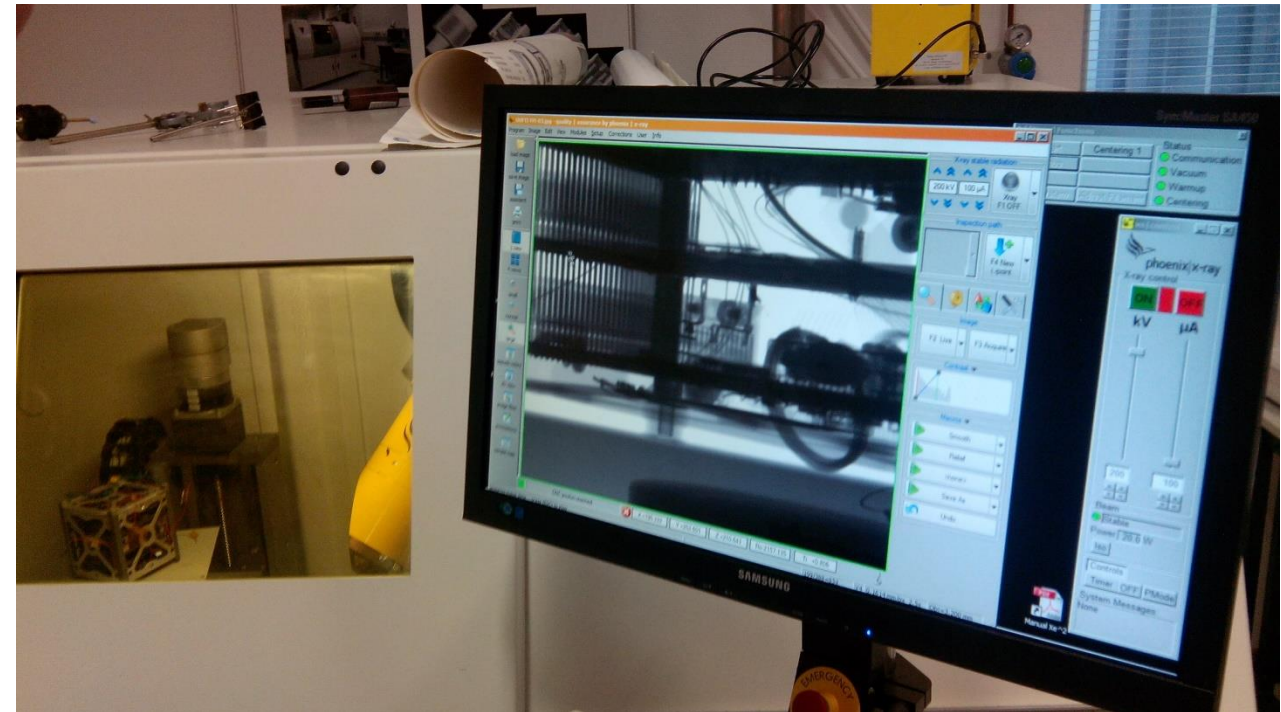
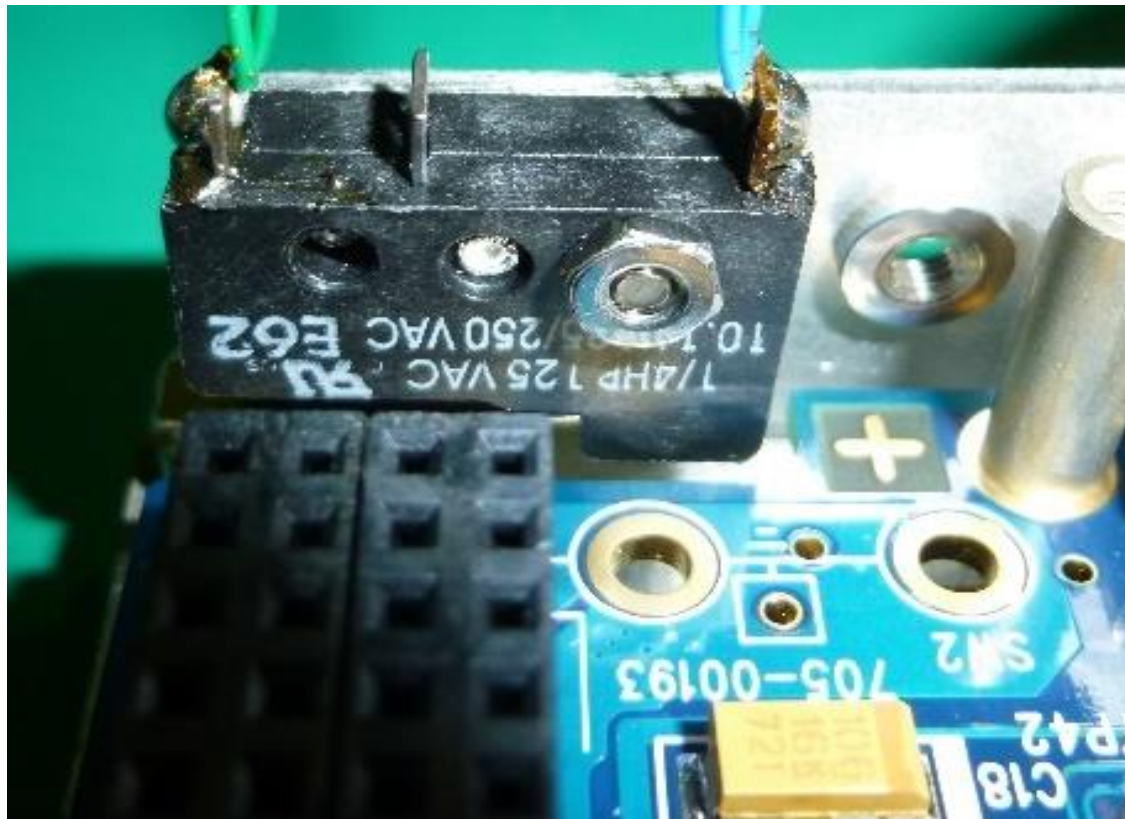


- Random and sine at ESA/ESTEC, Noordwijk, The Netherlands → aborted
- Random at ESA/ESTEC, Noordwijk, The Netherlands
- Sine and quasi-static at V<sup>2</sup>I, Liège, Belgium



# Phase 2: Vibration Test Campaign (VIB)

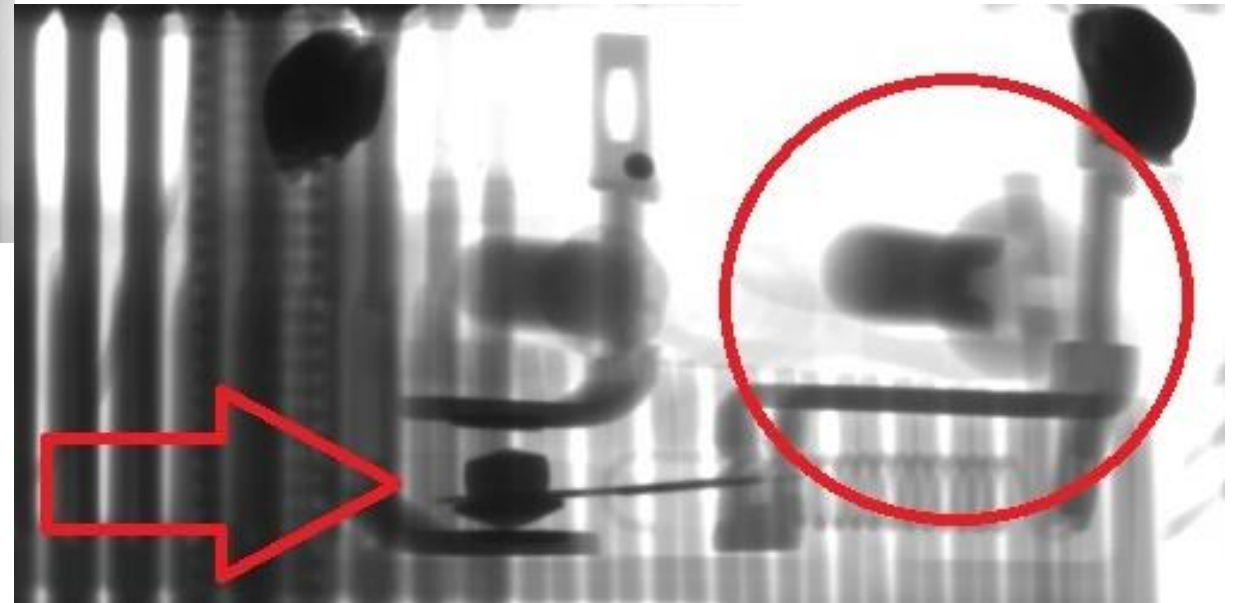
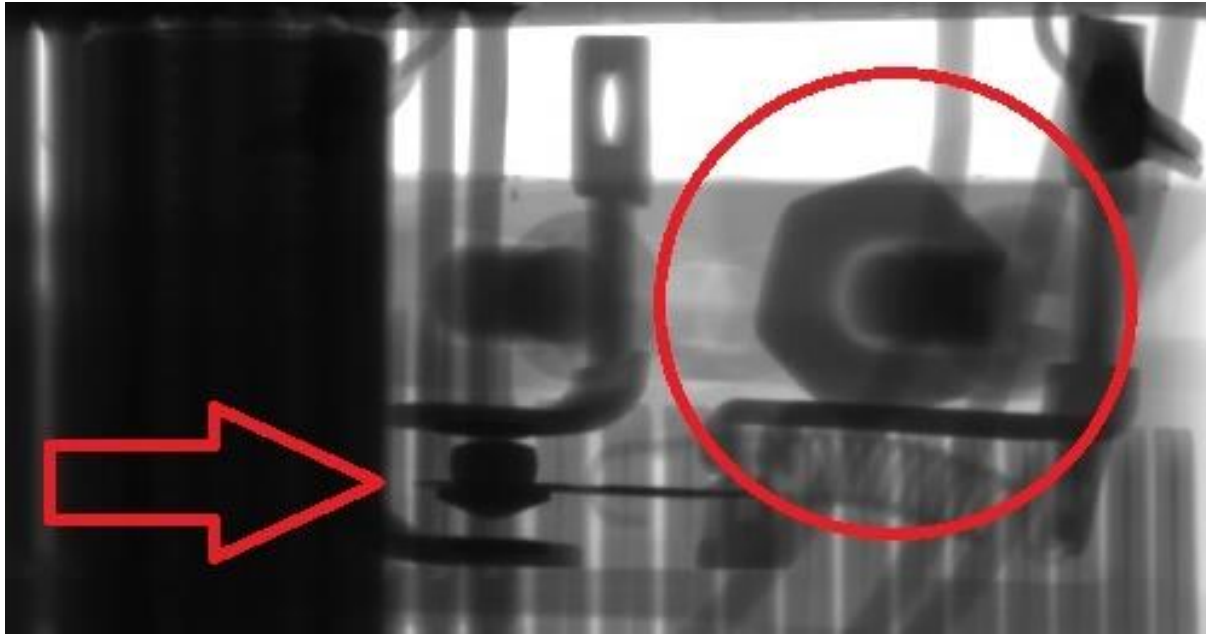
- OUFTI-1 turned ON during 1<sup>st</sup> VIB campaign
  - X-ray scan performed at ESA/ESTEC, Noordwijk, The Netherlands



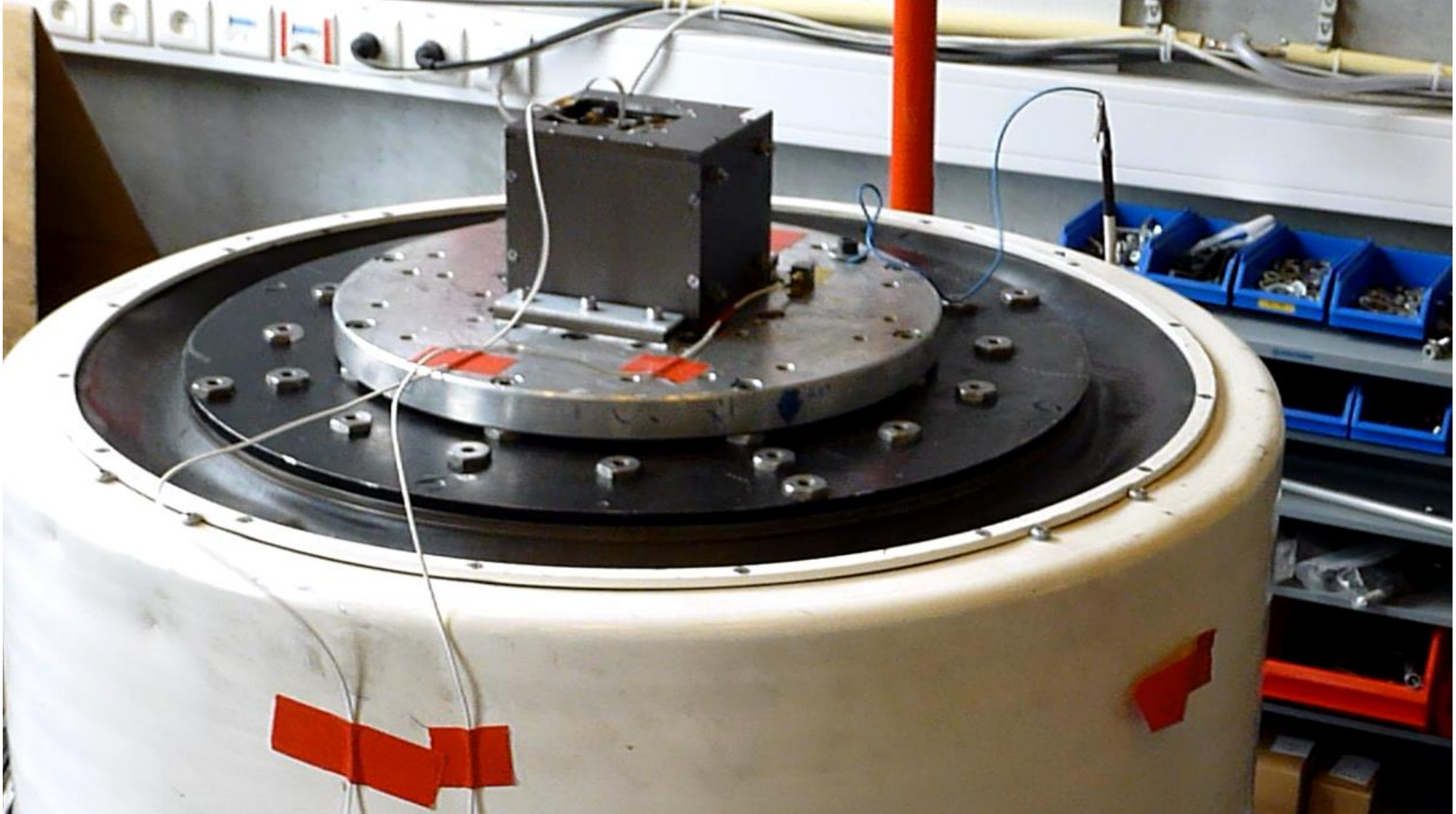


# Phase 2: Vibration Test Campaign (VIB)

- X-ray images: Engineering Model vs. Flight Model

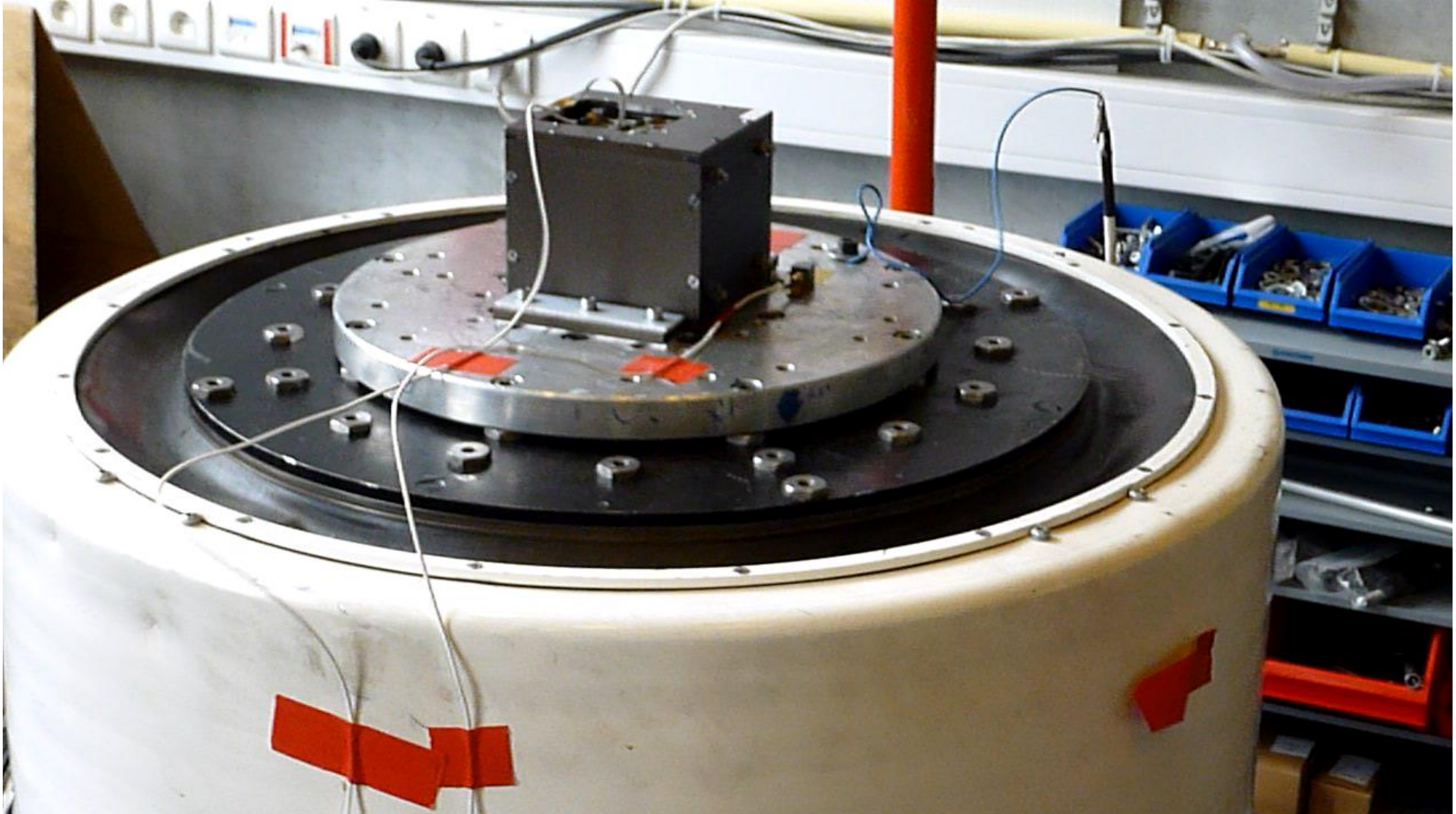


# Phase 2: Quasi-static vibrations





# Phase 2: Quasi-static vibrations



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- Tests must be considered since the very beginning of the design of the satellite.
- Tests are very important and useful.
- Step-by-step procedures must be carefully written.
- Take a lot of pictures and notes during tests.
- Design your spacecraft so that you can easily disassemble it.
- Glue all your bolts and nuts!



# Thank you for your attention !



*The view expressed herein by the authors can in no way be taken to reflect the official opinion of the European Space Agency*