

Node 2 Development History

The following information provides an overview of different steps in the development of Node 2 and related issues.

1995

Two Nodes are planned for the ISS at that time, both to be built by Boeing. The structure of one is finished, to be used for testing, the other (now Node 1) is under construction. The test article would have been refurbished, following testing, and flown as Node 2, though following ESA/NASA agreements in 1997 ESA and European industry took over responsibility for development of a revised Node 2.



Members of the STS-88 crew examine Node 1 in the Space Station Processing Facility in June 1997. Node 2 originally had the same design though this was revised following ESA taking responsibility for its development in 1997. (Image: NASA)

At the ESA Ministerial Council meeting in Toulouse in October the programme for European participation in the International Space Station is approved. This includes the Columbus laboratory

1997

On 5 March 1997, ESA and NASA sign an agreement in principle under which ESA is to provide additional hardware and services to NASA for the International Space Station in exchange for the launch of the European Columbus laboratory



The European Columbus laboratory being lowered onto a workstand at the Space Station Processing Facility at the Kennedy Space Center in June 2006. (Image: NASA)

on the Space Shuttle. This additional hardware includes Node 2 and Node 3, the Minus 80°C Laboratory Freezer for the ISS or MELFI (the first of which is currently on the ISS), a crew refrigerator/freezer and additional hardware. This agreement in principle develops into the Columbus Launch barter agreement, which is ratified by the ESA Council in June and signed by ESA and NASA in Turin on 8 October 1997.



Antonio Rodotà, ESA's former Director General (left) and Sergio de Julio, former President of the Italian Space Agency during the signing of the ESA/ASI arrangement concerning Nodes 2 and 3 on 12 December 1997. (Image: ASI)

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Under a parallel agreement signed between ESA and the Italian Space Agency (ASI) on 12 December 1997 in Rome, ESA entrusts the development of the nodes to ASI. This allows Europe to take advantage of the experience gained by Italian industry through the ASI development of the Multipurpose Logistics Modules (MPLMs), for NASA. As such Italian company Alenia Aerospazio (now part of Thales Alenia Space) is chosen as the prime contractor to develop the nodes.



First European-built Multi-Purpose Logistics Module on orbit in Discovery's cargo bay during STS-102 mission on 10 March 2001. Node 2 follows the same structural concept as the MPLMs. (Image: NASA)

1998

Initial system configuration and primary structure design activities for the Nodes have been completed and an initial selection of subcontractors has been made, with the exception for the Environmental Control and Life Support System components.

A second design review is completed. A number of proposed interface changes have arisen, some

of which affect the Columbus Laboratory. Design changes to Node 2, to accommodate crew quarters and revised internal configuration layouts, have been performed.



Structural Test Article Forward Cone in June 1998. (Image: Thales Alenia Space)

Manufacturing and welding of the Structural Test Article primary structure has started. The Structural Test Article is a structural copy of Node 2, which is used for testing purposes. The first radial bulkheads finish final machining. End cone welding is complete and Node 2 system analysis is nearing completion.



Node 2 Structural Test Article radial bulkhead during final machining in Turin in October 1998. (Image: Thales Alenia Space)

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Node 2 design has progressed well and flight-unit assembly is planned for the first half of 2000.



Two radial bulkheads following welding in June 1999.
(Image: Thales Alenia Space)

2000

Negotiations with NASA have been completed to incorporate the effects of design changes into a revision of the Columbus Launch Barter Agreement.



Node 2 Structural Test Article during testing.
(Image: Thales Alenia Space)

Manufacturing of the Node 2 Structural Test Article is completed. This is mounted in the test facility for a pressure/inertia loads test campaign. The pressure testing (covering pressure and leak

tests) is successfully completed, and the Modal Survey Test campaign is initiated. The modal survey tests check whether the module can withstand the dynamic conditions during launch (and in orbit). This is carried out by placing elements over the module, which are made to vibrate to a certain frequency. Data gathered is compared to computer models for verification.

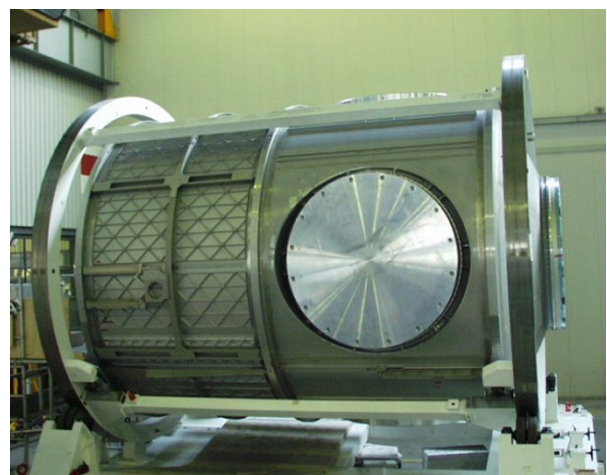
The Node 2 flight unit structure is also completed and integrated for the modal-survey test.



Node 2 primary structure. (Image: Thales Alenia Space)

2001

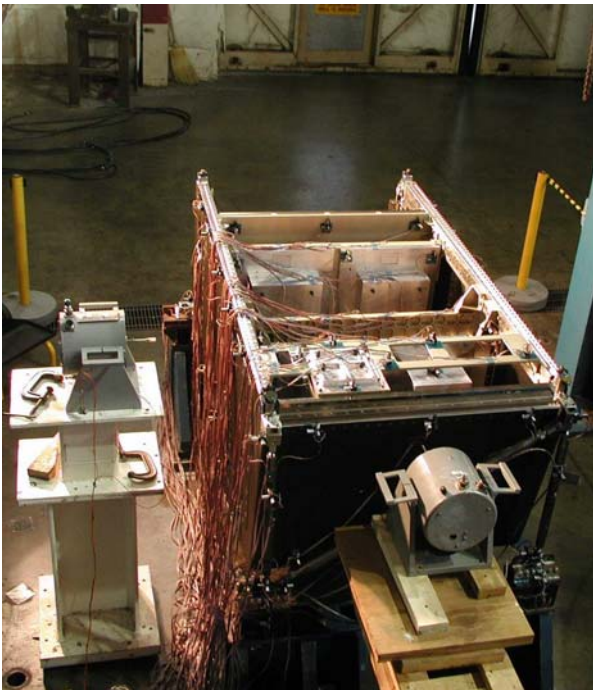
Another Node 2 System Design Review, equivalent to a Critical Design Review, has been completed successfully, pending closure of the assigned actions.



Node 2 in proof pressure test configuration.
(Image: Thales Alenia Space)

Structural qualification testing has been successfully completed (pressure, leakage and inertia loads). The Node 2 flight-unit proof pressure and leakage test campaign is started

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Node 2 avionics rack during modal survey test.
(Image: Thales Alenia Space)

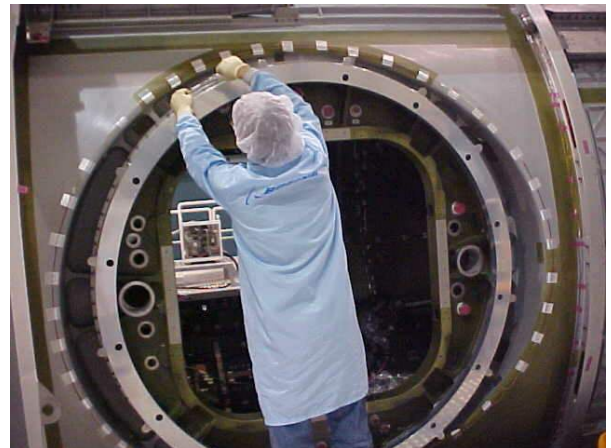
and successfully completed as is the system-level modal survey test. Flight unit integration of Node 2 is underway. The harnesses have all been delivered, as has much of the secondary structure.



Node 2 during Modal Survey Test on 13 July 2001.
(Image: Thales Alenia Space)

2002

Integration of the active and passive docking mechanisms has been initiated. A further safety review has been successfully completed. All four avionics racks have been integrated and the electrical tests completed. Integration of the cables and actuators of the common berthing mechanisms has also been finalised.



Node 2 at Alenia Spazio (now part of Thales Alenia Space) on 20 June 2002 during docking mechanism installation.
(Image: Thales Alenia Space)

2003

Grounding of the Shuttle fleet following the STS-107 Columbia accident on 1 February causes a long-term delay in the ISS assembly launch sequence.



Node 2 in the Alenia integration hall in Turin, Italy for final test, integration and verification: (Top) during Micrometeoroid and Debris Protection panels installation; (Bottom) during close-out procedures prior to shipment. (Image: Thales Alenia Space)

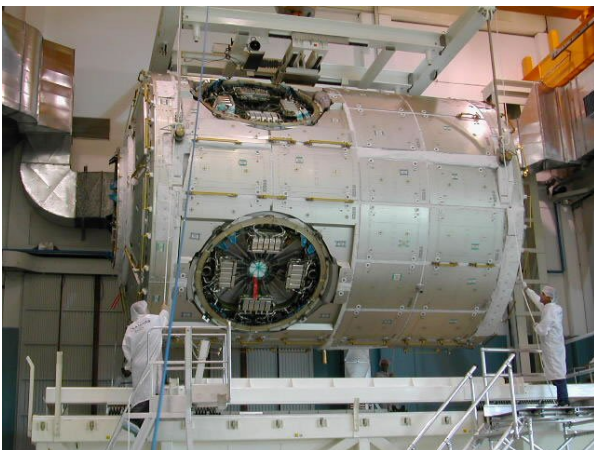
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The Node-2 Flight Acceptance Review has been concluded at Alenia Spazio (now part of Thales Alenia Space) in Turin with the participation of ESA, ASI and NASA.



Internal view of Node 2 in the Alenia integration hall in Turin during close-out procedures prior to shipment.
(Image: Thales Alenia Space)

Following the Acceptance Review, a Transportation Readiness Review is held. As a result of the successful completion of that review, Node 2 is flown from Turin to the Kennedy Space Centre in Florida, USA, in an Airbus Beluga heavy lift vehicle, landing on 1 June 2003. Following post-flight inspection, the Italian Space Agency formally hand over Node 2 to ESA



Node 2 being loaded into a transport container at Alenia Spazio (now part of Thales Alenia Space) in Turin prior to shipment to the Kennedy Space Center in the USA.
(Image: Thales Alenia Space)



(Top) Node 2 being loaded into an Airbus Beluga heavy lift vehicle at the Torino Caselle Airport in Italy prior to flight to the USA on 31 May 2003. (Centre) Node 2 arriving at the Kennedy space Center in Florida, USA. (Bottom) Node 2 in the Space Station Processing Facility at the Kennedy Space Center after removal from its transport carrier at the beginning of June 2003.
(Images: NASA)

The transfer of ownership to NASA takes place on 18 June in the Space Station Processing Facility of the Kennedy Space Center.

Multiple element integrated testing of Node 2 and the Japanese Kibo laboratory are completed in

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ESA ISS Programme Manager Alan Thirkettle (centre) shakes hands with NASA's Deputy Associate Administrator for the ISS and Shuttle Programmes Michael Kostelnik. Also part of the signing was Node 2 Programme Manager for the Italian Space Agency, Andrea Lorenzoni (left). (Image: NASA)

September at the Space Station Processing facility of the Kennedy Space Center involving an international team from among ISS partners.



Internal view of Japanese Kibo laboratory during multiple element integrated testing of Node 2 and Kibo in September 2003. Facing the camera is STS-114 mission specialist and JAXA astronaut Soichi Noguchi. (Image: NASA)

The test involved connecting cables between the modules to provide electrical power in order to validate the compatibility of the systems. Node 2 testing included emulating the ISS on-orbit configuration, and testing the command and track systems that support the audio and video systems on-orbit and the caution and warning systems that monitor life support systems in the module.

2004

Management of the Nodes programme, which had previously been delegated to Italian Space Agency (ASI) is transferred to ESA by mutual agreement.



Node 2 being moved by crane in preparation for its element leak test in February 2005. (Image: NASA)

The overall integrated leak test on Node 2 is successfully performed in the vacuum chamber at the Kennedy Space Center.



Node 2 in preparation for its element leak test in February 2005. (Image: NASA)

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2005

The Element Leak Test on Node 2 is successfully performed in February in a large vacuum chamber of the Operations and Checkout Building of the Kennedy Space Center. After testing it is returned to the Space Station Processing Facility to continue being readied for launch.

2006

Node 2 closeout activities are ongoing at the Kennedy Space Center. The work is part of the final preparations to ensure that all hardware and systems are in order for its launch to the Station.

On 19 June 2006, ESA astronaut Paolo Nespoli is assigned to the crew of the Space Shuttle flight STS-120 which will launch Node 2, and in August the STS-120 crew starts mission specific training.

2007

Workers in the Space Station Processing Facility are continuing closeout activities on Node 2.

On 15 March 2007 the new name of Node 2 is announced as 'Harmony' following a NASA-organised competition amongst schoolchildren.



Ceremony to announce renaming of Node 2 to 'Harmony' at the Space Station Processing Facility of the Kennedy Space Center in Florida, USA. (Image: NASA)

The STS-120 crew undergo crew familiarisation with Node 2 at the Kennedy Space Center.



ESA astronaut Paolo Nespoli and NASA astronaut Douglas Wheelock, both crew members on the STS-120/10A ISS assembly mission during a Node 2 familiarisation session at the Space Station Processing Facility of the Kennedy Space Center in Florida, USA on 25 April 2007. (Image: NASA)