Boeing Commercial Crew Program and Crew Space Transportation (CST)-100 Spacecraft

Pictured: Boeing’s CST-100 spacecraft docks with the International Space Station (Boeing illustration)

NASA’s Commercial Crew Program is an innovative partnership to help the aerospace industry in the United States develop space transportation systems that can safely launch humans to low-Earth orbit destinations such as the International Space Station (ISS) and the Bigelow planned station.

The Boeing Commercial Crew Program (CCP) is responsible for the development of the company’s fully integrated Commercial Crew Transportation System, comprised of the Crew Space Transportation (CST)-100 spacecraft, launch system, mission operations and ground systems.

On September 16, 2014, Boeing was awarded $4.2 billion by NASA to build the CST-100, American’s next spacecraft. The award includes at least two and up to six post-certification service missions.

NASA issued a task order as part of Boeing’s Commercial Crew Transportation Capability (CCtCap) contract on May 27, 2015, to include the company’s first flight to the ISS. The award marks the first time in human spaceflight history NASA has contracted with a commercial company for a human spaceflight mission.
The CST-100 is a reusable spacecraft, featuring a weldless structure as well as wireless and tablet technology. The capsule was developed with proven materials and subsystem technologies and will transport up to seven people, or a combination of crew and cargo. The CST-100 was designed at the Houston Product Support Center and is being assembled at the Commercial Crew and Cargo Processing Facility (C3PF), formerly the OPF3, at Kennedy Space Center in Florida.

**CST-100 Features:**

- Weldless structure
- Tablet technology
- Wireless Internet
- Boeing LED “Sky Lighting” interior
- Land landing system
- Pusher abort system
- Resuseable up to 10 times with a six month turn around time
- Will accommodate five NASA Astronauts for NASA service missions, but can accommodate up to seven, or a mix of crew and cargo
- Autonomous

**Program Timeline:**

**Commercial Crew Development Phase 1 (CCDev-1): February 2010 – October 2010**

Under a Commercial Crew Development (CCDev) Space Act Agreement in 2010, Boeing successfully completed several risk reduction demonstrations that culminated in a System Definition Review (SDR) in October 2010, with $18 million in government funding. The SDR defined Boeing’s CST-100 spacecraft’s system characteristics and configuration, and established a baseline design.

**Commercial Crew Development Phase 2 (CCDev-2): April 2011 – July 2012**

NASA’s 14-month CCDev-2 Space Act Agreement, a $92.3 million award in April 2011, enabled Boeing to bring its system to a Preliminary Design Review (PDR), completed in March 2012, a critical step toward ensuring the system design meets all requirements. In the first two phases of this program, the company successfully completed more than 45 milestone tests on engines, abort systems, propulsion, heat shield jettison, attitude control systems and landing systems to provide full data on functional elements of the spacecraft’s integrated design.

**Commercial Crew Integrated Capability Phase (CCiCap): August 2012 – May 2014**

In August 2012, NASA selected Boeing for a $460-million investment in the Commercial Crew Integrated Capability (CCiCap) phase of this program, to further mature the
company’s fully integrated CCTS. During this 21-month phase of the program, Boeing intends to prepare for certification and operations, leading to an initial test flight in 2017.

**Certification Products Contract (CPC): January 2013 – May 2014**

NASA awarded Boeing $9.9 million under the Certification Products Contract (CPC) in December 2012. Under CPC, Boeing will begin the process of formally engaging with NASA to ensure its integrated crew transportation system will meet NASA safety requirements and standards to launch American astronauts to the ISS. Boeing and the other selected companies will work closely with NASA’s CCP to develop products to implement NASA’s flight safety and performance requirements across all aspects of the space system, including the spacecraft, launch vehicle, and ground and mission operations. The next phase of certification will begin in mid-2014 and will result in a separately competed contract.

**Commercial Crew Transportation Capability (CCtCap) Phase: September 2014**

In September 2014, NASA selected Boeing for a $4.2 billion investment in the Commercial Crew Transportation Capability (CCtCap) phase of this program. During this phase Boeing will complete the NASA certification for human space transportation. This phase includes one crewed flight test with one NASA astronaut on board to verify the fully integrated rocket and spacecraft system can launch, maneuver in orbit and dock to the International Space Station, as well as validate that all systems perform as expected. After NASA certification, Boeing will conduct at least two, as many as six, crewed missions to the ISS.

**Upcoming Milestones**

- Pad Abort Test 2017
- First uncrewed flight 2017
- First crewed flight 2017

**Boeing Commercial Crew Program Sites:**

- *Houston, Texas*, serves as headquarters for the Space Exploration division and is home to Boeing’s International Space Station program as well as Commercial Programs. Boeing’s Commercial Space Transportation System is currently in development at this site, with operational design tests conducted at various facilities in the U.S. In addition, Boeing supports NASA’s Johnson Space Center with exploration strategy development, engineering, software development, advanced research and light manufacturing support.

- *Kennedy Space Center (KSC), Fla.*, supports CAPPS payload processing activities at NASA’s KSC. Boeing also provides site engineering support for the ISS and houses offices for the Commercial Crew Program and the Space Launch System. Boeing is currently reconstructing one of NASA’s Orbital Processing Facilities – formerly used for space shuttle refurbishment – for the manufacturing, testing and operations of its Commercial Crew Transportation System.
Huntsville, Ala., is home to Exploration Launch Systems, and supports development of the Space Launch System (SLS), in collaboration with NASA’s Marshall Space Flight Center. In addition, Huntsville performs sustaining engineering/advanced studies and provides technology growth for NASA and the U.S. Army and provides engineering and manufacturing support for the International Space Station.

Huntington Beach, Calif., provides design support for the ISS, having been responsible for the initial manufacture of many ISS components. Huntington Beach also supports Boeing’s Commercial Crew Program, with emphasis on simulations, such as abort systems and rendezvous and docking.

New Orleans, La., provides manufacturing capability for the Boeing SLS heavy-lift rocket at the NASA Michoud Assembly Facility.

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Contact:
Kelly Kaplan
Boeing Commercial Crew & Cargo Communications
Office: 281-226-4367
Mobile: 479-422-6740
Kelly.g.kaplan@boeing.com

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