

Canadarm *Shuttle Remote Manipulator System*



Since its maiden voyage aboard U.S. Space Shuttle Columbia in 1981, the Shuttle Remote Manipulator System (SRMS), known as Canadarm, has demonstrated its reliability, usefulness, and versatility and has provided strong, yet precise and delicate handling of its payloads.

Canadarm was designed, developed and built by Spar Space Systems Robotics operation, now MD Robotics under contract to the National Research Council of Canada. The first arm was Canada's contribution to NASA's Space Shuttle Program. Subsequently, NASA ordered four additional units which have resulted in over \$700 million in export sales for Canada.

Canadarm has performed flawlessly for 20 years; placing satellites into their proper orbit and retrieving malfunctioning ones for repair. Perhaps its most notable mission was the repair of the Hubble Space Telescope. Canadarm was used as a mobile work platform for astronauts during numerous space walks required to repair the faulty telescope. Canadarm played a critical role retrieving the satellite, placing it in the cargo bay for repairs, and then re-deploying it.

Unplanned exercises for Canadarm have included knocking a block of ice from a clogged waste-water vent that might have endangered the shuttle upon re-entry, pushing a faulty antenna into place, and successfully activating a satellite that failed to go into proper orbit.

In December, 1998 Canadarm played a critical role in the first assembly mission of the International Space Station, mating the U. S. Unity node to the Russian-built Zarya. Canadarm will continue to play a vital role in the assembly of the space station.

The Shuttle Remote Manipulator System consists of a shoulder, elbow and wrist joint separated by an upper and lower arm boom. The shoulder joint has two degrees of freedom, the elbow joint has one degree of freedom, and the wrist joint has up to three degrees of freedom.

At a total weight of approximately 905 lbs., the Canadarm has recently been upgraded to manoeuvre payloads of up to 266,000 kgs. (in the weightlessness of space). Canadarm uses an end effector with a specially designed grapple fixture to place payloads in orbit.

Notable Missions



STS-2
First Canadarm flies on
board U.S. Space
Shuttle Columbia



STS-31 - Canadarm
deploys Hubble
Space Telescope



STS-100 - Canadarm
assists with the installation
of Canadarm2 on the
International Space Station

STS-49 - Canadarm retrieves Intelsat and served as work platform for astronauts



STS-51A - Canadarm used to rescue Westar Palapa Satellite



STS-82 - Canadarm assists during second Hubble servicing mission



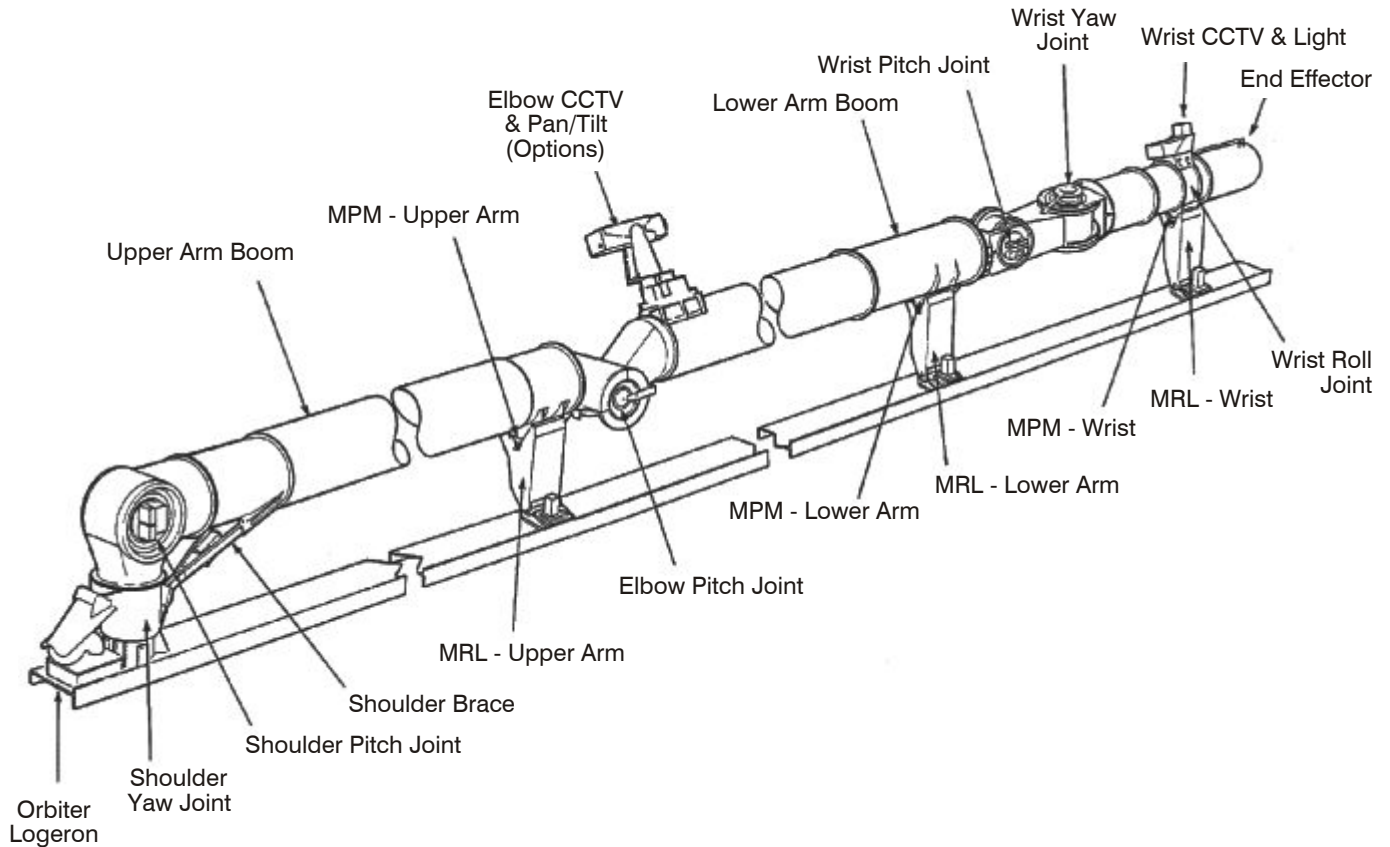
STS-88 - First Space Station assembly mission. Canadarm mates U.S. built Unity to Russian FGB Zarya



STS-74 - View of Canadarm after successful docking with the MIR Space Station



Canadarm Overview



Technical Details

The Canadarm comprises an upper and lower arm boom, an end effector, and a control centre where the translational and rotational hand controllers direct the movement of the arm.

Length	15.2m (50 ft.)
Diameter	38 cm (15 in.)
Weight on Earth	410 kg (905 lbs.)
Speed of Movement	- unloaded 60 cm/sec.(2 ft./sec.) - loaded 6 cm/sec. (2.4 in./sec.)
Upper & Lower Arm Boom	Carbon Composite Material
Wrist Joint	Three degrees of movement (pitch/yaw/roll)
Elbow Joint	One degree of movement (pitch)
Shoulder Joint	Two degrees of movement (pitch/yaw)
Translational Hand Controller	Right, up, down, forward, and backward movements of the arm
Rotational Hand Controller	Controls the pitch, roll, and yaw of the arm