

# Engineering Project: Building a Grapple Fixture

## Introduction

A grapple fixture is any of various grasping devices that close around an object. It can be used to lift/move objects, such as objects too heavy to move by hand or moving objects remotely in hazardous environments.

A grapple fixture can be as simple as a claw-like device where the claws close around an object to move the object or fairly complex like those used in space.



## Robots on Space Shuttle:

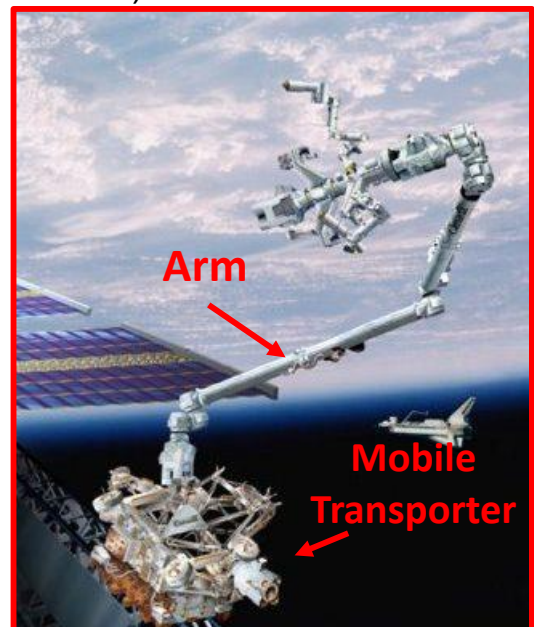
The Space Shuttle Remote Manipulator System (RMS) robot arm, also called the Canadian arm, because it was designed and constructed by Canada, has been instrumental to the success of numerous space missions. The 15-meter-long arm was mounted near the forward end of the port side of the orbiter's payload bay. The gripping device at the end of the arm is called a **grapple fixture**. The Shuttle's **grapple fixture** was a snare device that closed around special posts to attach to the objects the RMS was trying to grasp. On several occasions, the RMS was used to grasp the Hubble Space Telescope and bring the spacecraft into the orbiter's payload bay. After Hubble was locked into position, the RMS helped spacewalking astronauts repair the telescope and replace some of its instruments. During operations, the RMS was controlled by an astronaut inside the orbiter. The RMS actually became an extension of the operator's own arm. Television cameras spaced along the RMS permitted the operator to see what the arm was doing.



*The Space Shuttle Remote Manipulator robot arm and the Hubble Space Telescope.*

## Robots on International Space Station:

The International Space Station (ISS) has several robots to help astronauts complete their tasks in space. Five of the ISS international partner nations developed robotic systems for the station. Japan built the JEM Remote Manipulator System. The European Space Agency and the Russian Space Agency developed the European Robotic Arm. Canada and the United States developed the Mobile Servicing System (MSS), the most complex robotic system on the ISS. It's main components include the Space Station Remote Manipulator System (SSRMS) and the Mobile Transporter (MT). The SSRMS is similar to the Shuttle RMS and rides from one end of the station to the other on the MT, which glides along the giant truss beam. The MSS is controlled by an astronaut working at one of two Robotic Work Stations inside the ISS. The MSS robotic system assisted in the assembly of the main elements of the station. It now handles large payloads and equipment. It supports astronauts during extravehicular activities and station maintenance activities.



*The SSRMS on the left attaching to the Mobile Servicing Systems on the right.*



*The SSRMS grappling the SpaceX Dragon spacecraft to move the spacecraft to the ISS docking port.*

# Grapple Fixture Instructions



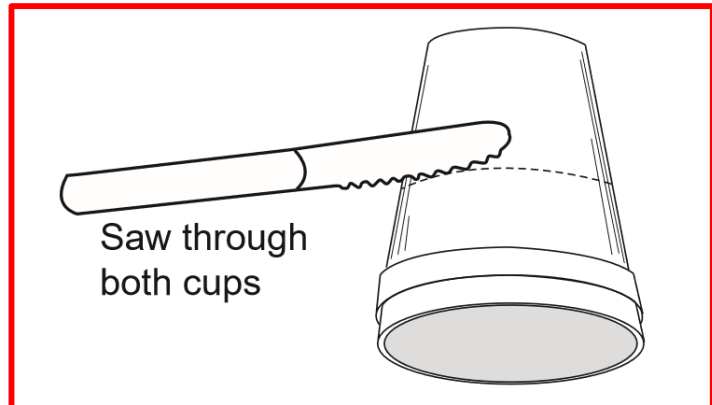
## Materials:

- (2) Styrofoam cups
- (3) strings, 5" long
- (6) pieces of tape, 1 ½" long
- (1) pencil or pen

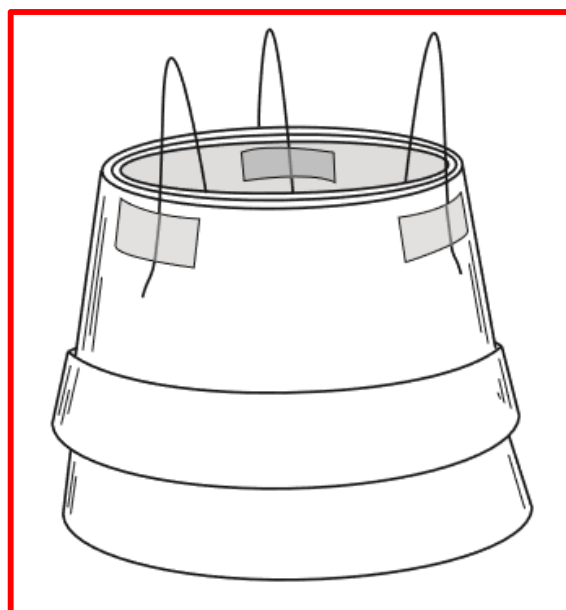


## Grapple Fixture Instructions:

1. Nest the two cups together and cut through both cups  $\frac{2}{3}$  from the rim as indicated in the diagram by the dashed line.



2. Tape the end of the first string to the inside of the inner coffee cup just below the cut edge. Tape the other end of the string to the outside of the cup. There should be a loop as shown in the picture. Repeat every 120 degrees for the other two strings



## Grapple Fixture Instructions (continued):

3. Take the small bottom of the cup and stick a pencil or pen in the middle of the bottom.



4. Use the grapple fixture to pick up the pencil/Styrofoam cup.
  - Open your grapple fixture so that the strings are not crossing each other.
  - Lower the fixture over the pencil so that the pencil extends through the center of the mechanism.
  - Rotate the outside cup until the strings wrap around and grasp the pencil or pen.

