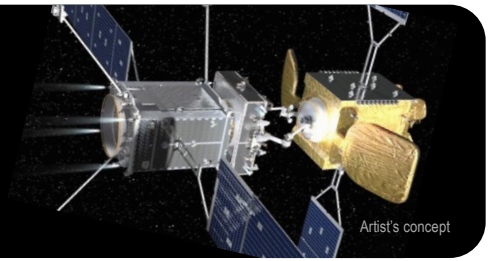


Robotic Servicing of Geosynchronous Satellites

INTERFACE FACT SHEET



Marman Ring Tool (MRT)

Overview

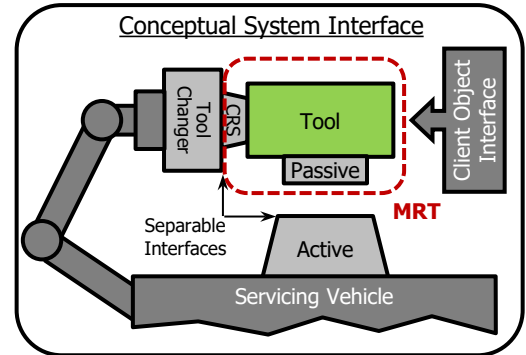
- Enables robotic grapple of client vehicle / resident space object (RSO) using existing Marman ring launch vehicle interface.
- Gripper establishes a rigid mechanical connection between the two vehicles
 - Supports ultra-close inspection, client relocation, other servicing activities
- Use of two MRTs provides increased load capacity for orbit modification maneuvers for larger satellites

Tool Details

- Internal cam design allows capture to complete in less than 2 seconds
- Able to grapple and maintain preload without back-driving
- Integrated geared brake ensures grip is maintained in power-off condition
- Integrated charge bleed system provides a safe discharge path during first contact between space vehicles
- Designed to minimize risk of debris generation and damage to Marman ring
- Three primary interfaces:
 - Common Receptacle Subassembly (CRS) – to attach to robotic arm tool changer
 - Structural Power & Data Port (SPDP) – for storage when not in use
 - Capture Mechanism - structural interface with the RSO Marman ring

Marman Ring Properties

- Designed to accommodate the most common Marman rings used on GEO spacecraft
- Rings are assumed to be made from aluminum alloy, coated with Alodine 1200
 - Functional surfaces have a finish roughness (Ra) of $\leq 1.6 \mu\text{m}$
 - Non-functional surfaces have a finish roughness (Ra) of $\leq 3.2 \mu\text{m}$
- Alternate geometries and material properties can be assessed for compatibility



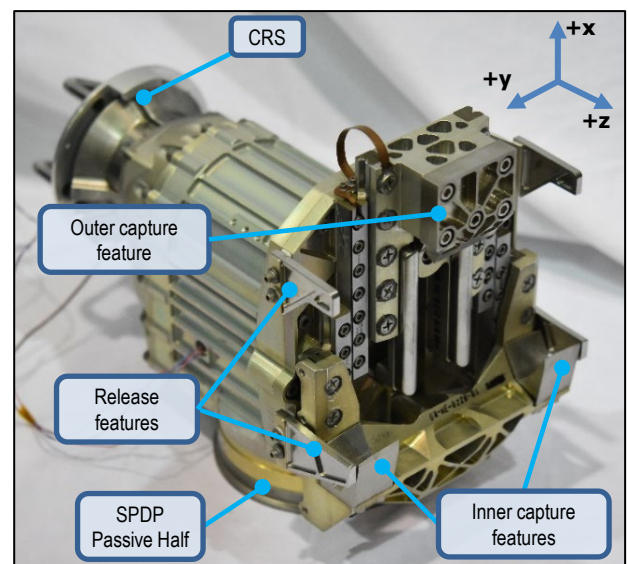
SYSTEM FEATURES:

- Works with existing interface rings, no specialized hardware required
- Jaws lock in place for rigid structural connection
- Once captured, power not required to maintain lock
- Interfaces to robotic arm through Tool Changer interface
- Stores on SPDP when not in use

Product Specifications

	U.S.	SI
Maximum MRT Dimensions (Including CRS and Port Passive Unit)		
Total Length (Z-axis)	10.79 in	274.0 mm
Total Width (Y-axis)	6.95 in	176.5 mm
Total Height (X-axis)	9.00 in	228.6 mm
Capture Feature Dimensions		
Width (at Full Open)	3.12 in	79.4 mm
Physical Properties		
Thermal Constraints	-85°F to +185°F	-65°C to +85°C
Total Mass (with CRS and SPDP passive half)	17.09 lbm	7.75 kg

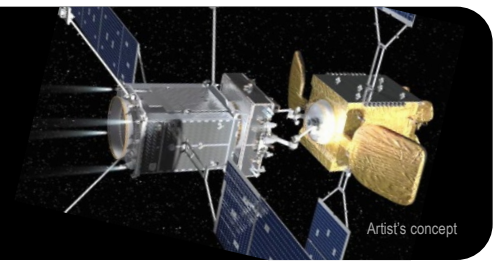
Information provided is current as of April 2021. Interested parties should contact the manufacturer for up-to-date information



Marman Ring Tool
(Engineering Model)

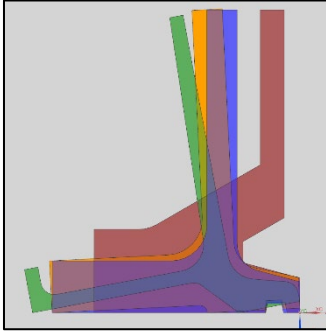
Robotic Servicing of Geosynchronous Satellites

INTERFACE FACT SHEET



Marman Ring Tool (MRT)

Candidate Ring Profiles

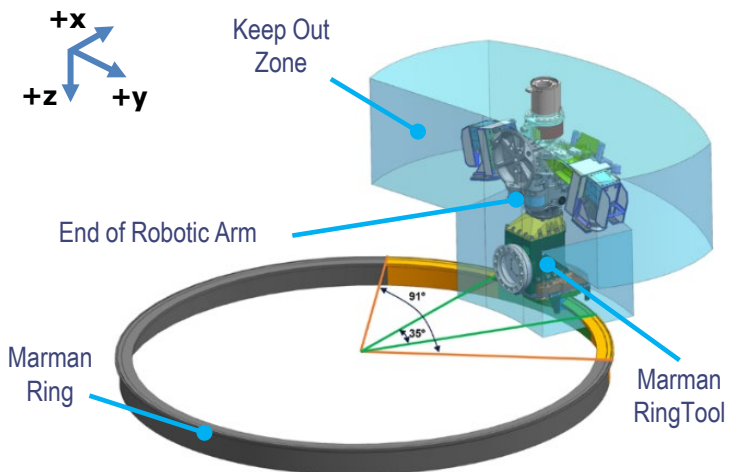
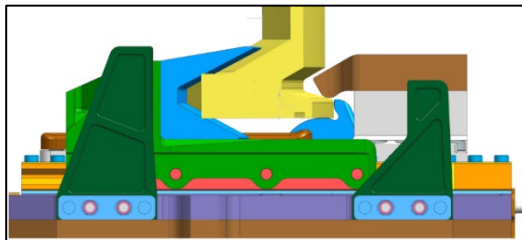
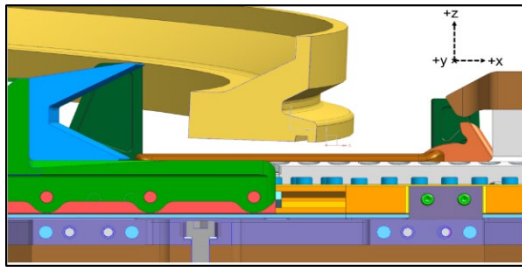


MANUFACTURER:

Naval Research Lab

4555 Overlook Ave. SW
Washington, DC 20375

Jim Barnds
Program Manager
(202) 767-4001
w.j.barnds.civ@us.navy.mil



Marman Ring Capture

Performance Characteristics		
	U.S.	SI
Grapple Capabilities		
Compatible Marman Rings (*Case by case assessment may be needed)	937S, 937C, A937 1194VS, 1194C, B1194, 1194-4, 1194-5 1666S*, D1666*, 1666-4*, 1666-5*	
Client Satellite Mass	2,200 - 6,600 lbm	1,000 - 3,000 kg
Misalignment Tolerances (Min. Concurrent Envelope)		
Angular (About each MRT axis)	$\pm 2.0^\circ$	
X Radial (Linear offset along MRT X-axis)	± 0.39 in	± 10.0 mm
Y Radial (Linear offset along MRT Y-axis)	± 1.57 in	± 40.0 mm
Axial (Linear offset along MRT Z-axis)	0 - 0.19 in	0 - 5.0 mm

Information provided is current as of April 2021. Interested parties should contact the manufacturer for up-to-date information