Operations / Assembly Manual
Universal Dome Standoff Bonding Tool

Bill of Materials

Part Number	Part Name	Quantity	Description/Operation
1	Inner Clamp	1	Ring clamp that goes on the inside of the motor ring
2	Outer Clamp	1	Ring clamp that goes on the outside of the motor dome
3	Motor Clamp Screws	2	Connects the inner and outer clamps
4	Ring hole Screws	3	Threads through rocket ring holes and connects the inner and outer clamps
5	Ring hole screw nuts	3	Locks ring hole screws in place onto the outer clamp
6	P-Piece	2	P-shaped piece which allows the device to angle vertically
7	Rail Mount	1	Long rectangular piece which inserts into the rail and connects to p-pieces
8	¼" x4" quick release pin	1	Biggest pin inserted through the rail mount and the p-pieces
9	¼" x4" quick release pin	1	Longest small diameter pin which inserts through the rail mount and p-pieces
10	Aluminum Shoulder Screws	6	Connect the p-pieces to the inner clamp
11	3ft Aluminum Rail	1	Allows the rail cart to translate
12	¼" x1-⅛" quick release pin	2	Smallest pins which insert through the rail mount and the rail
13	Rail Cart Pins	2	Allows lead screw housing to rotate
14	Lead Screw Housing	1	Holds the lead screw in place
15	C-Channel	1	C-shaped channel piece which clamps around the rail
16	Curved Angling Mechanism	1	Channel piece with a curved hole; angles the lead screw housing
17	Bronze Nut	1	Rests inside the lead screw housing allowing the lead screw to apply an axial force
18	Lead Screw	1	Long screw which applies axial force
19	Top Plate	1	Holds the brass nut inside the lead screw housing
20	#8-32, ½" long Aluminum Socket Head Screws	25	Blue Anodized screws which connects much of the assembly
21	Threaded Knob for Angling Mechanism	1	Locks lead screw housing in place through the curved angling mechanism
22	Lead Screw Knob	1	Knob which rotates lead screw to apply axial force
23	Pressure Plate H	1	H shaped piece which presses onto the rail
24	Pressure Plate C	1	Presses H piece to rail
25	Pressure Plate Nut	1	Allows for the pressure plate to not rotate when rail cart locks into place
26	Front Plate	1	Connects to the c-channel piece to clamp all around the rail, and connects to the pressure plate assembly through its center hole
27	Pressure Plate Threaded Screw	1	Locks rail cart in place
28	Lead Screw Plate	1	Similar to the top plate, but connects to the lead screw rotator
29	Lead Screw Threaded Cap	1	Threads into the lead screw. Allows for bracket clamp to rotate freely
30	Lead Screw Rotator	1	Allows the bracket clamp to rotate 45 degrees normal to surface
31	Slot Angler	1	Slotted piece which holds the lead screw rotator
32	¼" x2-1/16" quick release pin	2	Pins through slot angler and lead screw rotator locking the angle
33	Bracket Holder	1	Long slotted piece which holds the bracket holders
34	Template Holder	2	Small staircase pieces which hold the bracket templates
35	Thumb Screws	4	Tighten and loosen the bracket holders in place
36	Pull Test Piece	1	Threaded into the mounted standoff to conduct pull test

	Angling/Clamp Mechanism
	Rail Cart Assembly
	Bracket Holder Clamp
	Part of Multiple Subassemblies

1 Assembly/Disassembly

1.1 Angling Mechanism and Motor Ring Clamp

1.1.1 Angling Mechanism and Motor Ring Clamp Bill of Materials

Part Number	Part Name	Quantity	Description
1	Inner Clamp	1	Ring clamp that goes on the inside of the motor ring
2	Outer Clamp	1	Ring clamp that goes on the outside of the motor dome
3	Motor Clamp Screws	2	Connects the inner and outer clamps
4	Ring hole Screws	3	Threads through rocket ring holes and connects the inner and outer clamps
5	Ring hole screw nuts	3	Locks ring hole screws in place onto the outer clamp
6	P-Piece	2	P-shaped piece which allows the device to angle vertically
7	Rail Mount	1	Long rectangular piece which inserts into the rail and connects to p-pieces
8	¾" x4" quick release pin	1	Biggest pin inserted through the rail mount and the p-pieces
9	¼"x4" quick release pin	1	Longest small diameter pin which inserts through the rail mount and p-pieces
10	Aluminum Shoulder Screws	6	Connect the p-pieces to the inner clamp
11	3ft Aluminum Rail	1	Allows the rail cart to translate
12	¼"x1-⅛" quick release pin	2	Smallest pins which insert through the rail mount and the rail

1.1.2 Angling Mechanism and Motor Ring Clamp Assembly Directions

1. Lining up the inner (1) and outer clamp (2) together, screw the motor clamp screws (3) through the inner clamp into the outer clamp combining the two parts.
2. Lining up where the motor arm should be located on the motor ring, screw the ring hole screws (4) through the inner/outer clamp and three of the holes of the motor ring. Then tighten the ring hole screw nuts (5) onto the ring hole screws on the side of the outer clamp. This will make sure the ring hole screws do not loosen during operation.
3. Line up the two p-pieces (6) and the rail mount (7), with the rail mount in between the two p-pieces. The ¾" holes should all line up.
4. Insert the ¾"x4" quick release pin (8) through the ¾" holes of the rail mount and the p-pieces.
5. Insert the ¼"x4" quick release pin (9) through a ¼" hole of the rail mount and p-pieces. This will allow operators to angle the device vertically.
6. Lining up the inner clamp with the holes on the P-pieces, connect the two assemblies with the aluminum shoulder screws (10).
7. Insert the rail mount into the aluminum rail (11). Connect these parts by inserting the ¼"x1-⅛" quick release pins (12) through the holes in the rail and the rail mount.

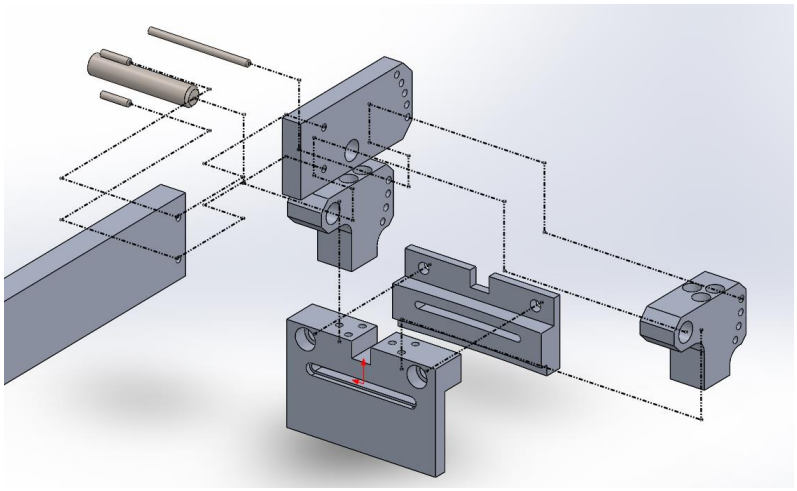

Figure 1: Exploded View of Ring Clamp Assembly

Figure (1) provides an exploded view of the ring clamp subassembly, with lines that represent the location of each part. The machine screws involved in this subassembly are not shown to simplify the image for viewing purposes.

1.2 Rail Cart

1.2.1 Rail Cart Bill of Materials

Part Number	Part Name	Quantity	Description
11	3ft Aluminum Rail	1	Allows the rail cart to translate
13	Rail Cart Pins	2	Allows lead screw housing to rotate
14	Lead Screw Housing	1	Holds the lead screw in place
15	C-Channel	1	C-shaped channel piece which clamps around the rail
16	Curved Angling Mechanism	1	Channel piece with a curved hole; angles the lead screw housing
17	Bronze Nut	1	Rests inside the lead screw housing allowing the lead screw to apply an axial force
18	Lead Screw	1	Long screw which applies axial force
19	Top Plate	1	Holds the brass nut inside the lead screw housing
20	#8-32, ½" long Aluminum Socket Head Screws	17	Blue Anodized screws which connects much of the assembly
21	Threaded Knob for Angling Mechanism	1	Locks lead screw housing in place through the curved angling mechanism
22	Lead Screw Knob	1	Knob which rotates lead screw to apply axial force
23	Pressure Plate H	1	H shaped piece which presses onto the rail
24	Pressure Plate C	1	Presses H piece to rail
25	Pressure Plate Nut	1	Allows for the pressure plate to not rotate when rail cart locks into place
26	Front Plate	1	Connects to the c-channel piece to clamp all around the rail, and connects to the pressure plate assembly through its center hole

27	Pressure Plate Threaded Screw	1	Locks rail cart in place

1.2.2 Rail Cart Assembly Directions

1. Insert the rail cart pins (13) into the side of the lead screw housing (14). Half of the pins should be exposed.
2. Attach the c-channel (15) and the curved angling mechanism (16) together with the lead screw housing/pins between them. The pins should insert into the holes in the middle of the c-channel and curved angling mechanisms.
3. Screw the brass nut (17) onto the lead screw (18).
4. Insert the lead screw/brass nut into the lead screw housing where the brass nut will rest inside. The bottom of the lead screw which has a threaded hole should exit through the smaller of the two holes in the lead screw housing.
5. Slide the top plate (19) through the lead screw housing where it will rest on top of the lead screw housing. The four holes on top of the lead screw housing should align with the four holes on the top plate. Insert four of the #8-32 screws (20) into these four holes to connect these two parts.
6. Screw the threaded knob for angling mechanism (21) through the angling mechanism into the lead screw housing until hand tight. This will allow operators to angle the lead screw to set locations.
7. Screw the lead screw knob (22) onto the top of the lead screw where there is no hole.
8. Screw the pressure plate H (23) and pressure plate C (24) together with 4 #8-32 screws with the pressure plate nut (25) going through the center hole of the pressure plate C.
9. Push the pressure plate nut through the front plate(26) to full depth and screw the pressure plate threaded screw(27) onto the pressure plate nut. Secure in place with 1 #8 set screw.
10. Connect the front plate/ pressure plate assembly with the c-channel piece using 4 #8-32 screws (13).
11. Slide rail cart assembly onto the rail and lock in place by rotating the pressure plate threaded screw.

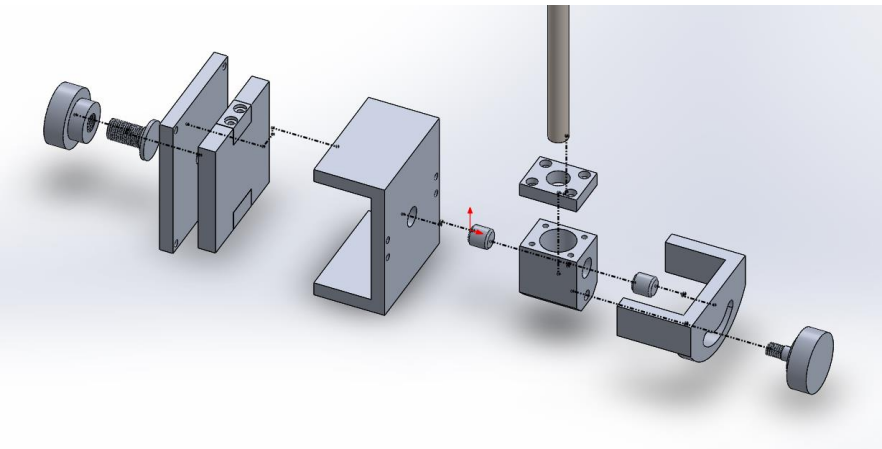

Figure 2: Exploded view of Rail Cart

Shown in figure (2) is an exploded view of the rail cart subassembly, which includes the mechanism that secures the cart in position along the rail.

1.3 Bracket Clamp

1.3.1 Bracket Clamp Bill of Materials

Part Number	Part Name	Quantity	Description
18	Lead Screw	1	Long screw which applies axial force
20	#8-32, ½" long Aluminum Socket Head Screws	8	Blue Anodized screws which connect much of the assembly
28	Lead Screw Plate	1	Similar to the top plate, but connects to the lead screw rotator
29	Lead Screw Threaded Cap	1	Threads into the lead screw. Allows for bracket clamp to rotate freely
30	Lead Screw Rotator	1	Allows the bracket clamp to rotate 45 degrees normal to surface
31	Slot Angler	1	Slotted piece which holds the lead screw rotator
32	¼"X2-1/16" quick release pin	2	Pins through slot angler and lead screw rotator locking the angle
33	Bracket Holder	1	Long slotted piece which holds the bracket holders
34	Template Holder	2	Small staircase pieces which hold the bracket templates
35	Thumb Screws	4	Tighten and loosen the bracket holders in place

1.3.2 Bracket Clamp Assembly Directions

1. Take the lead screw plate (28) and insert the lead screw threaded cap (29) through the center hole. Then in this orientation, screw the threaded cap into the bottom of the lead screw (18).
2. Screw the lead screw plate onto the lead screw rotator (30) with #8-32 aluminum screws (20), where the four corner holes on the two parts are aligned. The cap on the lead screw threaded cap should fit into the circular hole in the lead screw rotator.
3. Place the lead screw rotator inside the slot angler (31), where the sides of the slot angler are lined up with the holes on the lead screw rotator. Then insert the ¼"x2-1/16" quick release pin (32) through the holes connecting the two parts.

4. Screw the bracket holder (33) into the slot angler from the bottom with four #8-32 aluminum screws. The screws should be inserted through the bracket holder into the bottom of the slot angler.
5. Then screw the template holder (34) onto the bracket holders with the four thumb screws (35). The thumb screws will screw through the four slots in the template holder into the bracket holder pieces. This will allow for custom clamping positions.

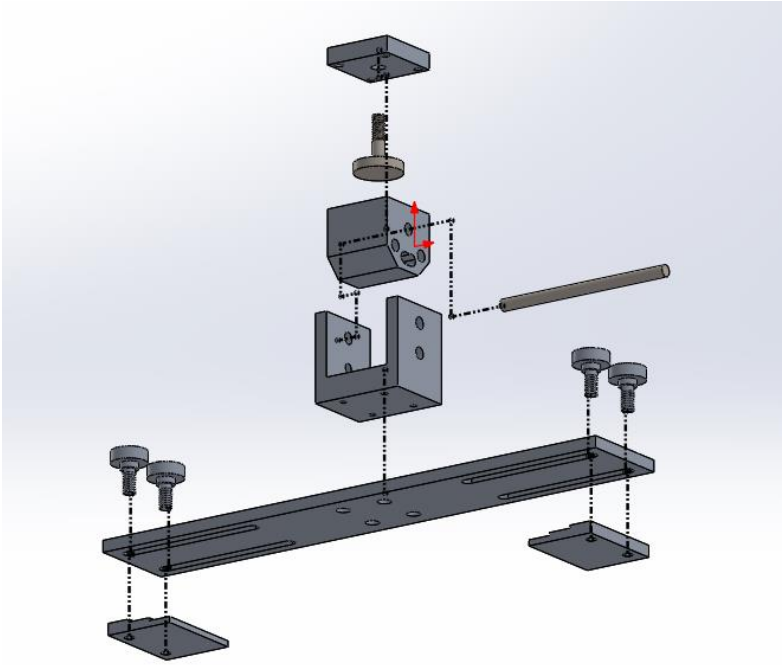

Figure 3: Exploded View of the Bracket Clamp

Figure (3) gives an exploded view of the bracket clamp system at the end of the lead screw. The lead screw itself has been left out of this assembly as it is included with the rail cart subassembly.

1.4 Pull Test

1.4.1 Pull Test Bill of Materials

Part Number	Part Name	Quantity	Description
18	Lead Screw	1	Long screw which applies axial force
20	#8-32, ½" long Aluminum Socket Head Screws	8	Blue Anodized screws which connect much of the assembly
28	Lead Screw Plate	1	Similar to the top plate, but connects to the lead screw rotator
29	Lead Screw Threaded Cap	1	Threads into the lead screw. Allows for bracket clamp to rotate freely
30	Lead Screw Rotator	1	Allows the bracket clamp to rotate 45 degrees normal to surface
32	¼" x2-1/16" quick release pin	2	Pins through slot angler and lead screw rotator locking the angle
36	Pull Test Piece	1	Threaded into the mounted standoff to conduct pull test

1.4.2 Pull Test Assembly Directions

1. With the lead screw plate (28), lead screw threaded cap (29) and lead screw rotator (30) already assembled from section 1.3, interchanging the pull test component is quite simple.
2. Remove the two ¼"x2-1/16" quick release pins that go through the lead screw rotator.
3. Replace the removed slot angler (31) with the pull test piece (36).

4. Align the pin holes and secure the pieces together with the two ¼”x2-1/16” quick release pins removed prior.

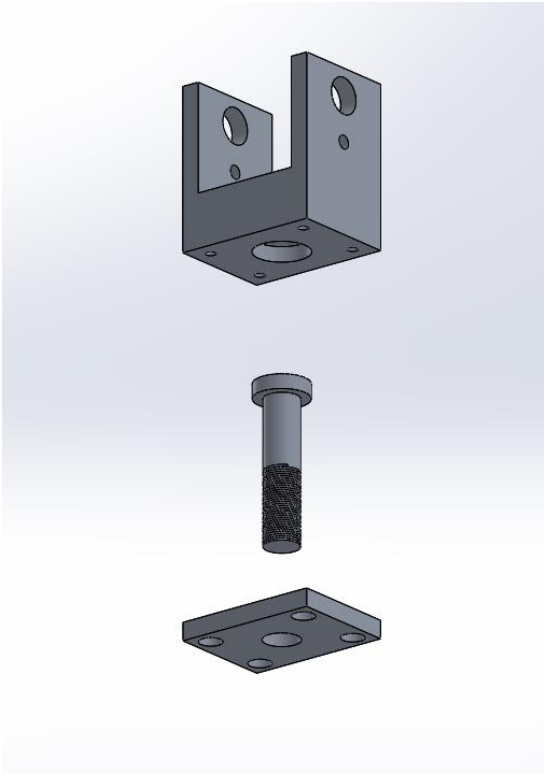

Figure 4: Exploded View of the Pull Test Subassembly

Figure (4) shows an exploded view of the pull test subassembly. Some parts are not shown as they coincide with parts in the bracket clamp subassembly.

2 Operations Manual

2.1 ESD Compliance

While using this device, operators will follow Northrop Grumman ESD compliance guidelines due to the electrical devices aboard Northrop Grumman Flight System devices. If this is not followed, operators may be subjected to disciplinary actions and avionic components would have to be replaced.

2.2 Vertical Angle

To angle the standoff mounting arm vertically, operators will hold the rail system in place by hand to ensure hole alignment, remove the ¼" pin from the two p-pieces and rail mount, move the mounting arm to the desired angle, and reinsert the ¼" pin back into the new hole alignment.

2.3 Moving the Mounting Arm Around the Motor Ring

To move the device around the motor ring, operators can first remove the bracket clamp from the lead screw by removing the screws attaching the lead screw plate and lead screw rotator. This step is optional as the bracket clamp can remain attached to the rail system and removed as a whole. The rail can then be removed by pulling the two ¼"x1-⅛" quick release pins from the rail and rail mount. By removing the ring hole screws from the device, the mounting arm can then be moved around the motor ring safely without risk of damaging the motor dome. Be sure when reinstalling the mounting arm onto the motor ring, that all three holes can be screwed through using the ring hole screws. Once the ring hole screws are reattached, the rail and ¼"x1-⅛" quick release pins can be reinstalled through the rail mount, the rail cart can be slid back onto the rail and tightened, and the bracket clamp can be screwed back onto the lead screw rotator through the lead screw plate.

2.4 Angling the Lead Screw

To rotate the angle of the lead screw, the threaded knob for the angling mechanism must be loosened. Be careful to hold the device in place when loosening this screw as the lead screw may fall from position due to gravity when loosened. The operator then positions the lead screw as needed and tightens the threaded knob once the device is in position.

2.5 Translating the Rail Cart

To translate the rail cart across the rail, loosen the pressure plate threaded screw. This will loosen the friction lock the rail cart applies onto the rail. When this is done, operators can translate the rail cart across the length of the rail. Once a desired location is chosen tighten the pressure plate threaded screw hand tight.

2.6 Interchanging the Push and Pull Devices

Both the push and pull test attach onto the lead screw rotator. To remove either the pull or push test device, remove the ¼"x2-1/16" quick release pin from the lead screw rotator. This will remove the push/pull test. Then to attach the other device, place the device in position and reattach the ¼"x2-1/16" quick release pin.

2.7 Applying Axial Force

To apply axial force, the operator needs to position the device above the location avionics need to be mounted. Refer to sections 2.2, 2.3, and 2.4 for instructions on how to do this. The operator then uses a torque wrench on top of the lead screw knob and applies a torque of .313 ft-lbs to raise or .176 ft-lbs to lower the device to the necessary 50lb pull and 20lb push tests.

3 Maintenance

3.1 Operating Precautions

Precautions during operations of the device will ultimately reduce the maintenance required on the whole system. As operators will be using glues and adhesives on the standoffs, ensuring that no residue from these adhesives come into contact with the moving parts of the device will greatly reduce the wear of the device and increase longevity. Similarly, the tolerances and fittings within the design are very specific for the performance of the device thus careful operation and movement of the pieces to ensure no marring or deformation within the moving pieces of the device will lead to optimal performance. Aluminum 6061 is not the strongest material and will easily dent if dropped or hit with stronger material.

3.2 Moving Components

Due to the area the device is being implemented, moving components of the device weren't allowed to house grease or lubricant of any kind. As a precaution to the expensive avionics and motor equipement, the device was coated with a friction reducing lining to increase the longevity of the parts without a lubricant. Over time this coating will eventually begin to wear and potentially flake off. Proper inspection and replacement of the lining or the parts themselves will maintain optimal performance of the device.

4 Troubleshooting

4.1 Bolts Will Not Thread

This device has a wide assortment of threaded connections varying from small #8 screws to ½" bolts. When assembling or disassembling the device if a bolt/screw will not thread in or out, be sure not to over torque it and strip the threads. Doing so will result in broken hardware or parts that need to be replaced. Ensure that you are using the proper tool and size for the specific hardware. Check that the hardware is properly aligned with the hole and that cross threading is not occuring. If need be, small amounts of lubricating oil can be used to remove stubborn hardware.

4.2 Pins Will Not Go In / Come Out

Much like the hardware in section 2.1, the device uses a wide variety of different sized quick release pins. The holes that the pins seat in are specially manufactured to be tight fitting to reduce wobble in the various connection points. With these tight tolerances inserting or removing pins can be more difficult than expected. In situations where the pin won't go in, ensure that the two holes are properly aligned before applying any force to the pins. In events where the holes are properly aligned but the pin still won't go in, small taps with a rubber mallet to the end of the pin should suffice. Likewise, for pins that won't come out, make sure that the holes are aligned and there is no load applying shear to the pins. Once aligned if the pin still won't come out, small taps with the rubber mallet should work.

4.3 Rail Cart Will Not Slide / Lead Screw Will Not Angle

The rail cart and lead screw housing both utilize the same mechanics to lock in place. A threaded knob located on the sides of the rail cart uses friction locks to keep the cart from translating and the lead screw from angling. For both cases mentioned above, loosening the specific knob that locks that component should reduce the friction enough to slide/angle the piece. If the knobs still won't turn, look to section 4.1 above.

4.4 Lead Screw Will Not Move Axially

If the lead screw won't move axially through the brass nut of the lead screw housing first check that the movement isn't maxed out one way or the other. If the lead screw is fully moved to one extreme or the other, the angling mechanism or the lead screw knob will be flush up against the lead screw housing and prevent further movement in that direction. If more axial movement is needed, change the angle of the rail system itself and try again. If the lead screw isn't at one extreme or the other, there could potentially be dirt or debris stuck between the lead screw and the brass nut. A small amount of lubricating oil inserted between the components should loosen it up enough to move the lead screw.