WILLIAM E. BOEING DEPARTMENT OF
AERONAUTICS & ASTRONAUTICS
College of Engineering

AA421
Flexure Buckling Test Procedure

SPACE Lab

Part Name: Pendulum flexures

Part Number: _____

Date: _____ / _____ / _____
yyyy mm dd

Results: 0.01” _____(Pass/Fail)

0.015” _____(Pass/Fail)

0.02” _____(Pass/Fail)

0.025” _____(Pass/Fail)

Test Team:

Name	**Initials**

Test Objective

Verify through testing that requirement Sys.5 and structures requirement Pm.1 are met by the test stand supporting thrusters up to 17.6 lbf (8kg) without the flexures buckling. Each flexure thickness is used for a small range of impulse values, which correspond to typical thruster mass ranges. The test stand must show no buckling in the flexures for the upper end of the mass range for each flexure thickness. Buckling is defined as vertical displacement due to loading diverges relative to applied load.

Equipment Required

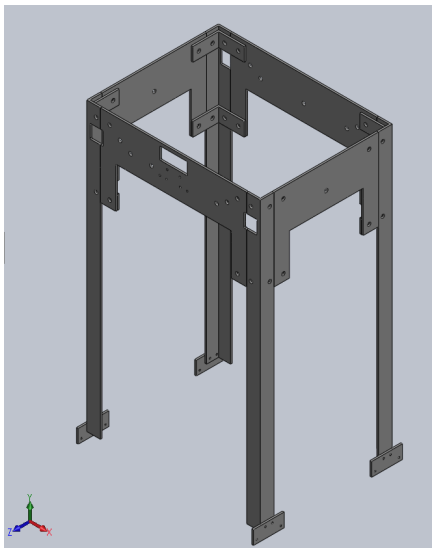
Qty	Description	Specs/Calibration	Check
10	1 gram masses		
10	10 gram masses		
10	100 gram masses		
8	1 kilogram masses		
1	0-25mm Dial indicator		
8	0.01” thick flexures p/n- FX1		
8	0.015” thick flexures p/n- FX2		
8	0.02” thick flexures p/n- FX3		
8	0.025” thick flexures p/n- FX4		
2	Pendulum Support Pins p/n- PSP1		
1	Crystal Chamber Test Stand Pendulum p/n- PA2		
1	Test Stand Frame p/n- FA1		
1	Support table for pendulum		

Test Procedure

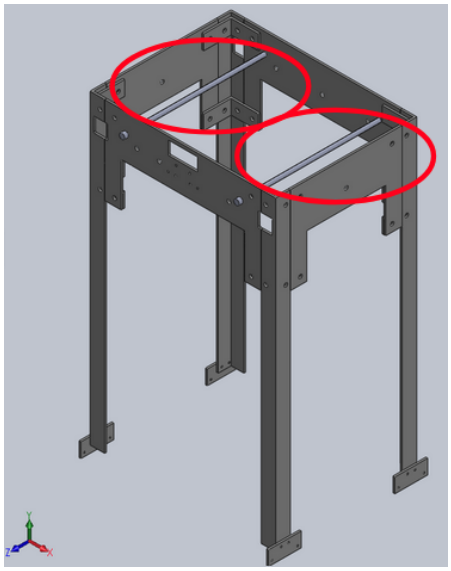
1 Setup

Assemble test stand frame (p/n-FA1) per assembly procedure, leaving three top panels off

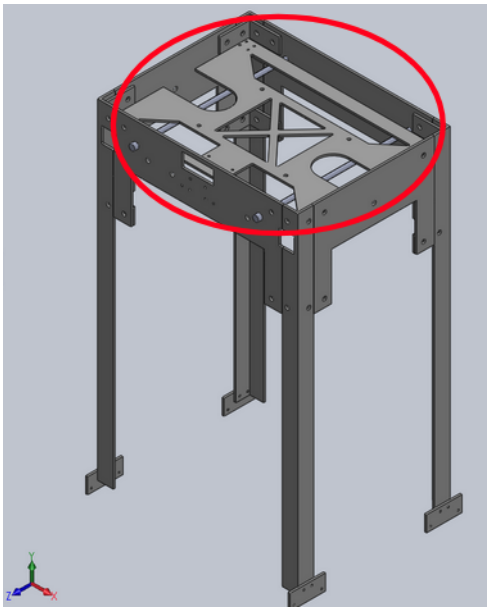
OK?_____



Install Pendulum Support Pins x2 (p/n-PSP1) OK?_____

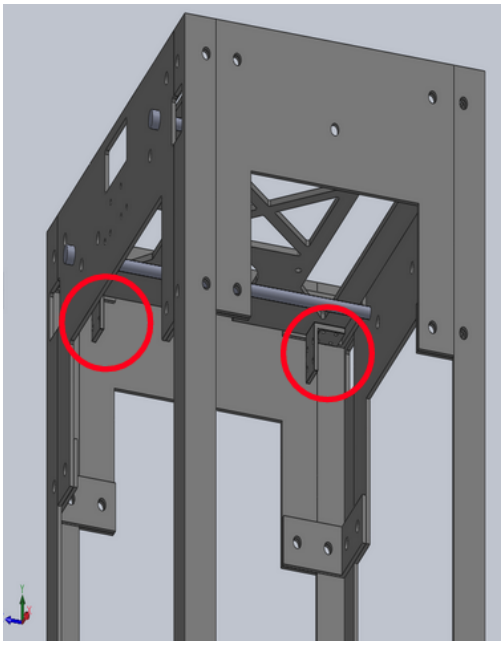


Install test stand Pendulum Top(p/n-PT1) onto Pendulum Support Pins OK?_____



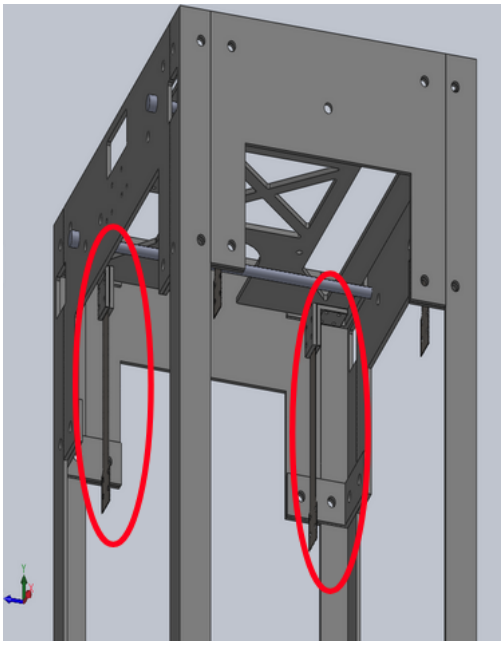
Install Pendulum 4 Corner Brackets(p/n-CB4) onto pendulum top

OK?_____

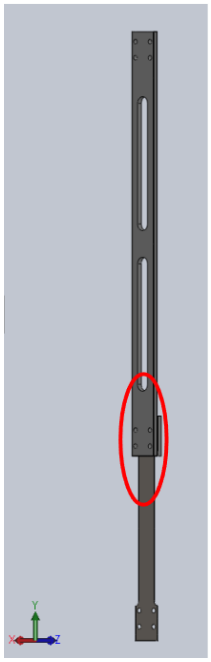


Install flexures to be tested using bracket connector(p/n-BC1) to clamp to corner bracket (p/n-CB4)

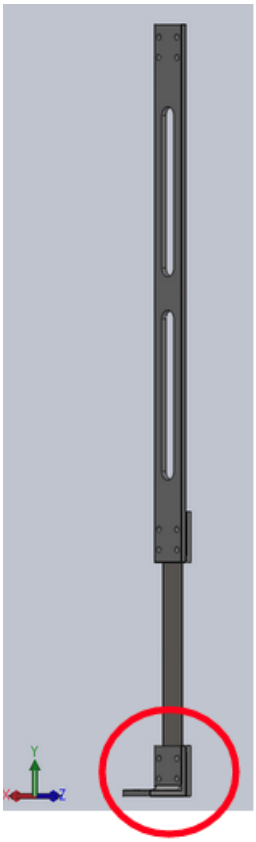
OK?_____



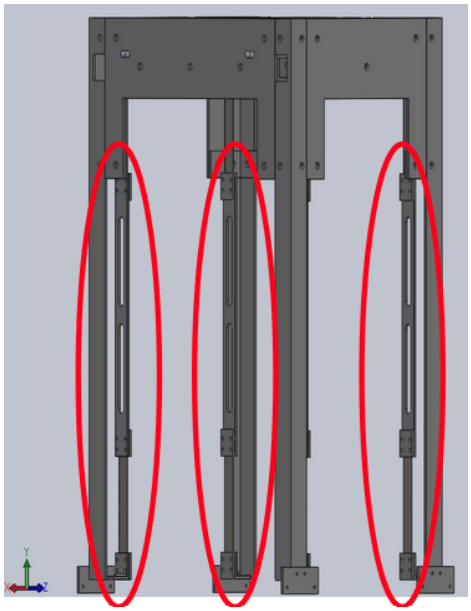
Install flexure to be tested onto vertical flexure support(p/n-VS1) using bracket connector (p/n-CB4) to clamp flexure in place OK?_____



Install pendulum corner bracket (p/n-CB4) onto flexure attached to vertical flexure support using bracket connector (p/n-BC1) to clamp corner bracket into place OK?_____



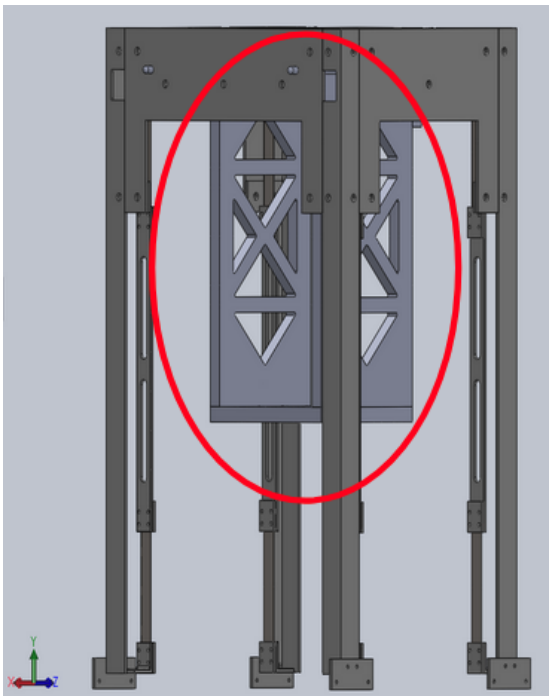
Install assembled flexure/vertical flexure support/corner bracket/bracket connector assembly to to flexure already installed onto pendulum top OK?_____



Fasten lower Corner Bracket (p/n-CB4) to support table(?)
OK?_____

Repeat steps 4-9 for each of the 4 pendulum legs
OK?_____

Assemble thruster support shelf per assembly (p/n-SH2) instructions and install onto Pendulum Top(p/n-PT1)
OK?_____



2 Test

Install dial indicator so that pin of indicator rests on pendulum top (p/nPT1). Zero dial indicator.

OK?_____

Flexure mass limit can be found using reference REF-IFS1 and REF-SSFS1

_____g

Install masses onto thruster support shelf, start with ¼ of the mass limit, measure and record deflection

_____mm

_____g

Install masses onto thruster support shelf, add enough to total ½ of the mass limit, measure and record deflection

_____mm

_____g

Install masses onto thruster support shelf, add enough to total 9/16 of the mass limit, measure and record deflection

_____mm

_____g

Install masses onto thruster support shelf, add enough to total 5/8 of the mass limit, measure and record deflection

_____mm

_____g

Install masses onto thruster support shelf, add enough to total 11/16 of the mass limit, measure and record deflection

_____mm

_____g

Install masses onto thruster support shelf, add enough to total 3/4 of the mass limit, measure and record deflection

_____mm

_____g

Install masses onto thruster support shelf, add enough to total 13/16 of the mass limit, measure and record deflection

_____mm

_____g

Install masses onto thruster support shelf, add enough to total 7/8 of the mass limit, measure and record deflection
_____mm

_____g

Install masses onto thruster support shelf, add enough to total 15/16 of the mass limit, measure and record deflection
_____mm

_____g

Install masses onto thruster support shelf, add enough to total the mass limit, measure and record deflection
_____mm

_____g

Plot results as a load(g) versus displacement (mm). Buckling is indicated as a divergence in displacement relative to loading. Was buckling indicated? _____Yes
_____No

3 Shut down

Reinstall Pendulum Support Pins
OK?_____

Remove fasteners for lower Corner Bracket (p/n-CB4) OK?_____

Remove Corner Bracket (p/n-CB4) and Bracket Connector (p/n-BC1) from lower flexure

OK?_____

Remove lower flexure from Vertical Flexure Support (p/n-VS1)
OK?_____

Remove Vertical Flexure Support (p/n-VS1) from upper flexure
OK?_____

Test procedure must be completed from step 1 of section 2 - Test for all 4 flexure sizes
0.010 inch flexure (p/n-FX1)
OK?_____
0.015 inch flexure (p/n-FX2)
OK?_____
0.020 inch flexure (p/n-FX3)
OK?_____
0.025 inch flexure (p/n-FX4)
OK?_____

If tests complete, proceed to step 8:

Stow dial indicator in box to return to AA machine shop
OK?_____

Remove flexure from Corner Bracket (p/n-CB4) and Bracket Connector (p/n-BC1) that are still attached to Pendulum Top (p/n-PT1) OK?_____

Remove Pendulum Top (p/n-PT1) from Pendulum Support Pins (p/n-PSP1)
OK?_____

Remove Pendulum Support Pins (p/n-PSP1) from test stand Frame (p/n-FA1)
OK?_____

Store pendulum parts and frame in box and return to AERB 139
OK?_____

Change Log

Ver	Date	By	E-mail	Change
1.0	4/22/2024	Adam Delbow	adelbow@uw.edu	Initial release