

SIT Door Margin Test Plan and Record

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1 Introduction

1.1 Scope

This document describes the force margin tests that will be done on FM-1 and FM-2 SIT instruments before and after environmental testing. For each door, two functions will be tested: door opening (hinge) and pin puller actuation (latch).

1.2 Reference Documents

1. *General Environmental Verification Spec for STS & ELV Payloads, Subsystems, and Components*, GEVS-SE Rev. B (DRAFT)
2. *SIT Interface Control Drawing*, 2053410-A
3. *STEREO IMPACT Verification Matrix*, 2004

2 Force and Torque Ratio Requirements

The STEREO Project has been working to the mechanism requirements laid out in the draft of the next GEVS revision. This draft of GEVS has been the Code 540 de facto mechanism requirements document for several years, in anticipation of its inclusion into the next revision.

The resistive forces/torques for both door functions are predominately friction. GEVS-SE (Ref 1), Section 2.4.5 states that such mechanism functions must meet the following salient requirements:

1. Demonstrate a force/torque ratio of two or greater ($TR \geq 2$) before and after environmental testing.
2. After exposure to environmental testing, the reduction (if any) in test-verified force/torque ratio shall be no greater than 10%, after appropriate consideration has been given to the error inherent in the test methods used to measure the torque ratio.

3 Door Opening

When released, the SIT door is opened by a pair of torsion springs at the hinge. To demonstrate margin on this function, the door will be opened with just one spring installed, which will provide half the available torque. This half-torque, combined with the eccentric spring loading and work against gravity, demonstrates a torque ratio of at least 2:1 ($TR \geq 2$).

For environmental testing, the doors will have both springs installed; we do not want to break this configuration after testing. For post-environmental door openings, the doors will be opened with SIT facing horizontally (parallel to the floor). Attaching a second door will double the door weight and approximately double the torque gravitational and inertial loads as well as increase hinge friction.

Record the door openings before and after environmental testing in the table below.

Door Opening	Date	Configuration	Results and comments
Pre-Environmental FM-1	9 May 05	One torsion spring, otherwise flight config - no blankets.	Pass. Opens easily, quickly.
Post-Environmental FM-1		Flight config - no blankets; horizontal	Pass. See Note ③.
Pre-Environmental FM-2	9 May 05	Same as FM-1.	Pass. Opens easily; snaps open.

Note ③: It was decided that these post-environmental ambient tests were not very meaningful in terms of margin verification. Tests on EM SIT door will be useful. *ESW*

Door Opening	Date	Configuration	Results and comments
Post-Environmental FM-2		Same as FM-1	Pass. See Note ③

4 Pin Puller Actuation

The TiNi pin puller (P5-403-10S) holds the door closed until it is actuated. The TiNi pin retracts in a direction parallel to the hinge line, and when the door is closed, the kick-off springs and torsion springs exert a side load on the pin. See *SIT Interface Control Drawing* (Ref 2). The friction (drag) from this side load is the primary, external resistive force in the pin puller function.

To demonstrate margin we will measure this standard side load (F_s) and then actuate the pin puller while the side load is at least doubled ($\geq 2 \cdot F_s$). The following steps describe how these measurements are made.

Steps 1-3 are performed before environmental testing.

FM-1 *SW*
 FM-1 *SW*
 FM-1 *SW*

1. Rotate the SIT instrument so that the aperture faces straight up within 5° or so.
2. Put the door in the closed position without locking it shut with the TiNi pin puller.
3. Add weights to the top of the door until the TiNi pin fits into the lid tab slot. Verify the weight and record it below.

FM-2 *SW*
 FM-2 *SW*
 FM-2 *SW*

Actuation	Date	Weight
FM-1	6 May 05	3.295 kg [7.010] 3.295 kg ②
FM-2	6 May 05	3.395 kg ②

NOTE ①
 NOTE ②

~~3.190 kg?~~
~~3.295 kg~~

NOTE ②
 See back of this sheet.
SW

Steps 4-6 are performed before and after environmental testing.

4. Close the door with the TiNi pin puller set. Orient the SIT instrument so that the aperture faces straight down within 5° or so.
5. Hang the same amount of weight recorded above from the lid tab. Prepare to "catch" the door as it opens and actuate the pin puller. Record results below.

Unit	Date	Result [pass/fail]
Pre-Environmental FM-1	9 May 05	pass
Post-Environmental FM-1	27 JUL 05	pass
Pre-Environmental FM-2	9 May 05	pass
Post-Environmental FM-2	27 JUL 05	pass

NOTE ① Did not verify weight before recording. Correct weight (mass) recorded @ right, 3.295 kg

NOTE (2) :

- Realized that P5 pin puller max rated side load is 10 lbs. This margin test would put ~ 14 lbs ($7 \text{ lb} \times 2$) of side load on the P5.
- Called Michael Bokai of TiNi Aerospace to inquire about the 14 lbs. He recommended not actuating a flight unit with that high a side load; pin could get stuck in the extended position, ~~and~~ or the TiNi wire could overheat. Loads @ slightly higher than 10 lbs is OK.
- ^{new} • Decided to adjust the ~~side load~~ kick-off springs to reduce the side load to ~ 5 lbs on each FM.
 - Adjusted kick-off springs on FM-1. Also requires hinge position adjustment to even the Viton compression under the door.

Actuation	Date	Weight
FM-1	9 May 05	2.295 kg
FM-2	9 May 05	2.295 kg