

NAME P/N QTY	CRIT	FAILURE MODE & CAUSES	FAILURE EFFECT	RATIONALE FOR ACCEPTANCE
-----				
		106FM17		
4000 TMG, ITEM 106 (1) LEFT (1) RIGHT ----- 0106-88975-03/04 (2)	2/2	Separation of seam or hole in TMG including fingercaps, exposing restraint.	END ITEM: Degraded abrasion and thermal protection.	A. Design - 4000/4750/Modified Enhanced/Phase VI: The finger and hand back and the gauntlet of the glove TMG consist of from 5 to 7 layers of material. The outer material is 10.5 oz teflon fabric which exhibits minimum tear strength of 8 lbs (warp)/6 lbs (fill) in addition to high abrasion resistance and long cycle life.
OR 4750 TMG, ITEM 106 (1) LEFT (1) RIGHT ----- 0106-811211-01/02 (2)		Defective Material: thread/fabric abrasion. UV degradation, tear.	GFE INTERFACE: Local heating/cooling /UV on restraint materials.	The TMG palm surface (4000/4750) is made up of 4.3 oz Nomex fabric coated with abrasion resistant RTV to protect seams and other areas vulnerable to high wear and abrasion. The Nomex fabric, conforming to MIL-C-83429, Type II, Class I, exhibits minimum tensile strength of 180 lb (warp) and 100 lbs. (fill); tear strength of 12 lb (warp) and 8 lbs (fill): The Phase VI TMG palm surface is made of 4.3 oz Vectran Tricot knit fabric coated with abrasion resistant RTV. The fabric exhibits a minimum ball burst strength of 300 lbs.
OR MODIFIED ENHANCED TMG, ITEM 106 (1) LEFT, (1) RIGHT ----- 0106-810609- 01/02, 03/-04 (2)			MISSION: Terminate EVA.	The 4000 TMG's have molded RTV fingercaps that are reinforced with Kevlar tricot material which provides high tear strength. The Modified Enhanced TMG has dipped RTV fingercaps which are reinforced with Kevlar tricot material. The 4750 TMG has dipped RTV fingercaps which are reinforced with 4.3 OZ Nomex fabric. The Phase VI TMG has dipped RTV fingercaps that are reinforced with Vectran Tricot material. All fabric is edge-locked with polyurethane adhesive to prevent seam fraying/pullout. Seams are formed with a join stitch and one row of top stitching. Stitching is terminated on the interior with a surgeon's knot coated with urethane adhesive. Stitching is a Type 301 lock stitch per FED-STD-751A. Nomex thread size "E" per MIL-T-43636 is used for glove TMG stitching.
OR PHASE VI TMG, ITEM 106 (1) LEFT (1) RIGHT ----- 0106-812144- 01/02, -03/04 (2)			CREW/VEHICLE: None.  TIME TO EFFECT /ACTIONS: Minutes.	
OR REMOTE POWERED HEATED GLOVE TMG, ITEM 106 (1) LEFT (1) RIGHT ----- 0106-812754-01/02 (2)			TIME AVAILABLE: N/A  TIME REQUIRED: N/A  REDUNDANCY SCREENS: A-N/A B-N/A C-N/A	Analysis has shown that exposure to ultra violet does not significantly degrade the glove TMG thread.  Teflon fabric and silicone coating create abrasion resistance surfaces. Seams in finger flex areas are concealed as a further protection against abrasion.  Tearing of the TMG palm (4000/4750) and hand grip area is precluded by the tear strength of Nomex fabric and the RTV coating. Tearing of the Phase VI TMG palm and hand grip area is precluded by the tear strength of the Vectran fabric and the RTV coating. Tearing of the teflon fabric is minimized by the smooth slippery surface of the fabric. It is unlikely that 5 to 7 plies of material would tear simultaneously and expose the glove restraint.
4000: With periodic repairs to the areas of high wear, this TMG has a six year operational life. Wear on the RTV coating is detectable before the Nomex base cloth is exposed to wear to preclude exposing the restraint.				
Modified Enhanced/4750: With periodic repairs to the areas of high wear, this TMG has an eight year operational life. Wear on the RTV coating is detectable before the Nomex base cloth is exposed to wear to preclude exposing the restraint.				
B. Test - 4000/4750/Modified Enhanced/Phase VI: Acceptance:				

NAME P/N QTY	CRIT	FAILURE MODE & CAUSES	FAILURE EFFECT	RATIONALE FOR ACCEPTANCE
--------------------	------	-----------------------------	----------------	--------------------------

106FM17

Component - See Inspection.

PDA:  
 Component - See Inspection.

Certification:

4000:  
 The following usage, reflecting requirements of significance for the glove was documented during certification (Ref. ILC Documents 0111-77511 and 0111-79241).

Requirements	S/AD	Actual
Glove Joint Cycles		
Flex/Ext (Fingers)	42412	56726
Wrist Joint Cycles		
Add/Abd	21206	29484
Flex/Ext	21206	29484
Rotations	21206	29484
Pressurized Hours	461	615
Pressurized Cycles	432	576
Don/Doff Cycles	144	192

4750:  
 The 4750 TMG is used with the 4000 series glove. The following usage, reflecting requirements for the TMG was documented during certification: (Ref. ILC Document 0111-711593).

Requirements	S/AD	Actual
Flex/Ext. (Fingers)	42412	43500
Flex/Ext. (Wrist)	21206	22620
Add/Abd. (Wrist)	21206	22620
Rotation (Wrist)	21206	22620

Modified Enhanced:

The following usage, reflecting requirements of significance for the 5000 Series Glove was documented during Certification (Ref. ILC Document 0111-710532):

Requirements	S/AD	Single Mission	Actual
Glove Cycles	106076	19320	88200
Pressurized Hours	461	84	860
Pressurized Cycles	432	50	500
Don/Doff Cycles	144	25	316

The Modified Enhanced TMG is identical to the 5000 series TMG but is used with the 4000 series glove instead of the 5000 series glove. Certification testing consisted of thermal testing; the remaining S/AD requirements are certified by similarity to the 5000 series glove. (Ref. ILC EM 0111-710723.)

Phase VI:

NAME P/N QTY	CRIT	FAILURE MODE & CAUSES	FAILURE EFFECT	RATIONALE FOR ACCEPTANCE
--------------------	------	-----------------------------	----------------	--------------------------

106FM17

The TMG was successfully tested (manned) during certification testing to duplicate operational usage (Ref. Certification Test Report for the Phase VI Glove, ILC Doc. 0111-712701). The following usage, reflecting requirements of significance to the TMG, was documented during certification testing. The S/AD applies 229 hours in certification while the actual indicates 157 hours toward the Phase VI, 12-volt TMG in the Hamilton Sundstrand Limited Life Items list (EMU1-19-001).

Requirements	S/AD	Actual
-----	----	-----
Glove Joint Cycles		
Flex/Ext (fingers)	45142	31096
Wrist Joint Cycles		
Add/Abd	17104	11960
Flex/Ext	12646	9568
Rotations	20112	14144
Pressurized Hours	229	157
Pressurized Cycle @ 4.3 psig	97	99
5.3 psig	37	63
6.6 psig	16	18
Installation/Removal	49	38

C. Inspection -

Components and material manufactured to ILC requirements at an approved supplier are documented from procurement through shipping by the supplier. ILC incoming receiving inspection verifies that the materials received are as identified in the procurement documents, that no damage has occurred during shipment and that supplier certifications have been received which provide traceability information.

The following MIP's are performed during the glove assembly manufacturing process to assure that the failure causes are precluded from the fabricated item:

1. Visual inspection of the TMG to insure that there is no open seam or hole.
2. Visual inspection of the completed glove assembly to insure it is free from damage.

During PDA, the following inspection points are performed at the glove assembly level in accordance with ILC Documents 0111-70028 for the 4000 Series gloves and 0111-710112 for the Phase VI gloves:

1. Visual inspection for fabric or material degradation.
2. Visual inspection for damage following proof pressure test.

D. Failure History -

B-EMU-106-A017 (06/02/88). Tracked by I-106--005.  
 B-EMU-106-A019 (08/09/88). Tracked by I-106--005.  
 I-EMU-106--005 (10/11/88). Light areas visible through the glove TMG mylar, during inspection with light source, due to cracking of the aluminum layer which occurs with use as the TMG's are flexed and handled. Heat leakage through light areas has been determined to be insignificant when compared to overall acceptable SSA heat leak of 290 Btu/hr. Therefore, CCBD G6142 removes the high intensity light inspection of the glove gauntlet from the FEMU-R-001.

None.

NAME P/N QTY	CRIT	FAILURE MODE & CAUSES	FAILURE EFFECT	RATIONALE FOR ACCEPTANCE
--------------------	------	-----------------------------	----------------	--------------------------

106FM17

E. Ground Turnaround -  
During ground turnaround, in accordance with FEMU-R-001, the TMG (As part of the glove assembly) is visually inspected (interior and exterior) for material damage/degradation.

F. Operational Use -  
Crew Response -  
Pre/post-EVA : Troubleshoot problem.  
Consider use of spare gloves if available. Continue EVA operations.  
EVA : Troubleshoot problem, if no success, use thermal mitten for thermal and puncture protection. Continue EVA.  
Special Training -  
No training specifically covers this failure mode.  
Operational Considerations -  
Not applicable.

EXTRAVEHICULAR MOBILITY UNIT  
SYSTEMS SAFETY REVIEW PANEL REVIEW  
FOR THE  
I-106 GLOVE ASSEMBLY  
CRITICAL ITEM LIST (CIL)

EMU CONTRACT NO. NAS 9-97150

Prepared by: *J. Amman*  
HS - Project Engineering

Approved by: *[Signature]* 22mar/02  
NASA - SSA/SSM

*M. Snyder*  
HS - Reliability

*N. Blom* 5/23/02  
NASA - EME/SSM

*R. Mumford* 4/24/02  
HS - Engineering Manager

*Cherlyn* 6/3/02  
NASA - IS/MA

*Mike* 6/3/02  
NASA - MOD

*[Signature]* 6/5/02  
NASA - Crew

*[Signature]* 6/3/02  
NASA - Program Manager