



Sliding Carpet Repair for Commercial Aviation Aircraft

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Introduction

Sliding Carpet Loading Systems assist airlines in expediting the loading and unloading of passenger baggage on and off the aircraft. Anyone familiar with the commercial aviation industry understands the airlines' desire to minimize the time that the aircraft is at the gate between flights. The Sliding Carpet System is integral to minimizing the time and labor to load and unload aircraft with baggage and freight. Along with the maintenance and repair of other areas within the cargo hold section of the aircraft, the Sliding Carpet Loading System is not immune to malfunctions. When these systems malfunction, some of the impacts are a) longer turn-times may occur as a result of the damaged system, b) additional labor required to load and unload baggage, and c) the high cost of replacing a damaged carpet.

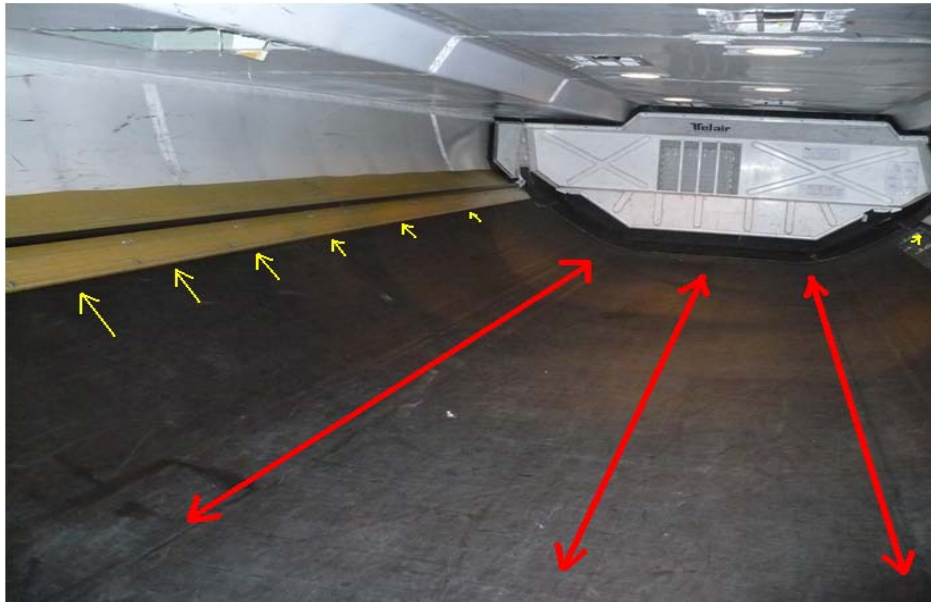
Working closely with customers, AmSafe® has developed a process to repair the carpet, thereby saving the airlines in overall maintenance costs and reducing the downtime of the system.

The following pages illustrate AmSafe's repair procedure, test results and industry approvals for the maintenance of the Telair Sliding Carpet® Loading System.

Situation Analysis

When loading the aircraft with passenger luggage (using the Telair Sliding Carpet® Loading System), the baggage handler must be cognizant that the weight of the bags is evenly distributed across the width of the carpet. In the event that heavier bags are not evenly dispersed across the width of the carpet, an unbalanced load occurs.

The carpet's core strength is situated along its length (referenced below by red arrows). In the event that baggage on the carpet is evenly disbursed, the effort required to operate the sliding carpet system is equivalent to the weight of the load plus the drag that the load places on the floorboards. This effort is illustrated in the picture below with the red arrows.



If the luggage is not loaded properly and the weight of the bags is not evenly distributed across the width of the carpet, a condition called a "point load" may occur. Using the illustration below, if a heavy load were placed on the carpet (identified by the anvil), the carpet would not pull evenly and it would tend to rotate (identified by the yellow arrow). This rotation creates high stress points (large red arrow) on the edge of the carpet. This stress may result in damage to the guide rails or the urethane profile being torn from edge of the carpet.



The guide rail is an aluminum extrusion with integral rollers (pictured at right).

The guide rail keeps the carpet in the normal operating position by limiting the carpets lateral movement (identified below, Fig. A).

The profile (identified below, Fig. B) slides back and forth in a guiderail. Unbalanced loading occurs when heavier objects are not evenly distributed across the width of the carpet which may result in the carpet pulling out of the guide rail and causing damage to either the guiderail, carpet or both (identified below, Fig. C)

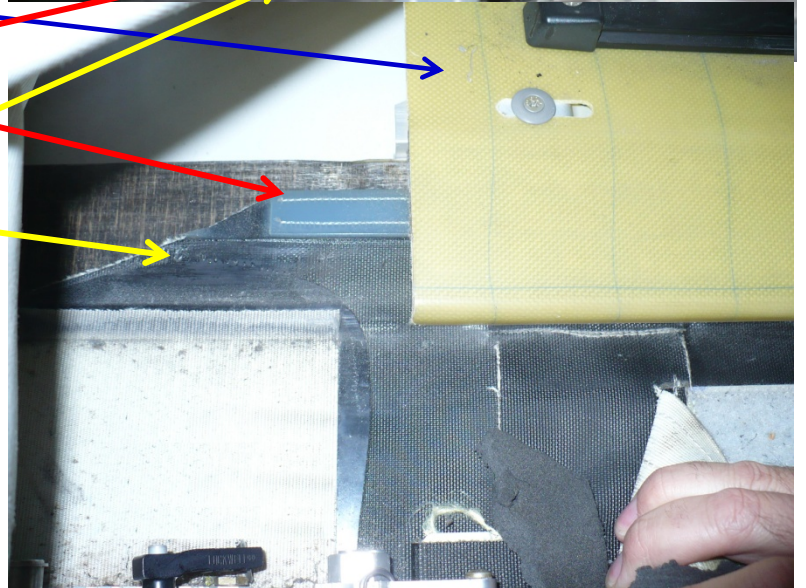
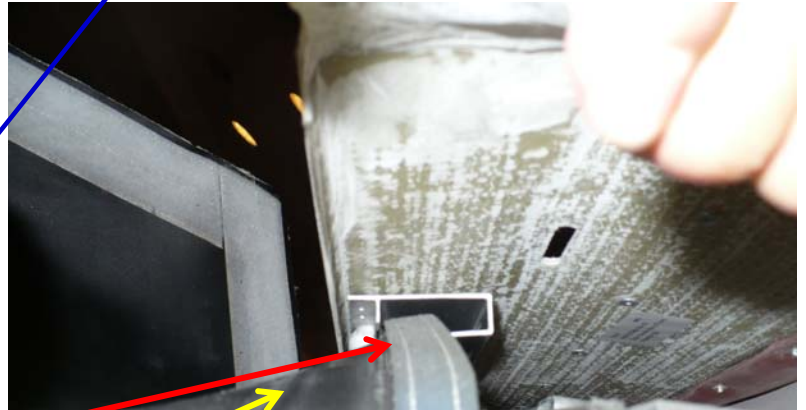
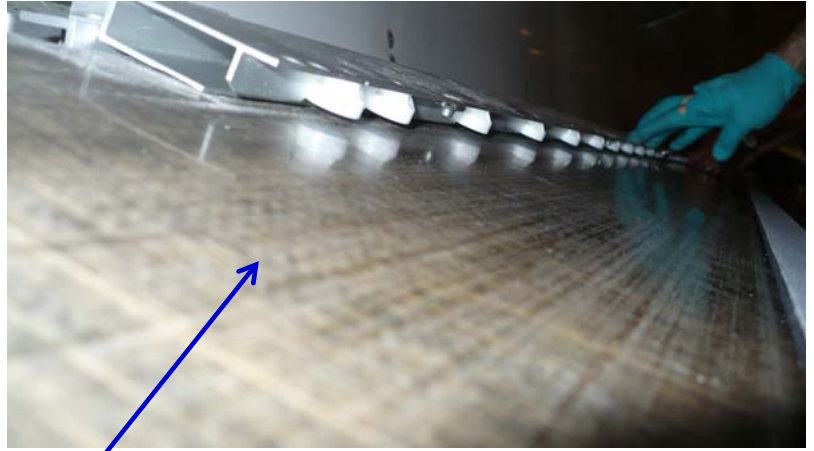


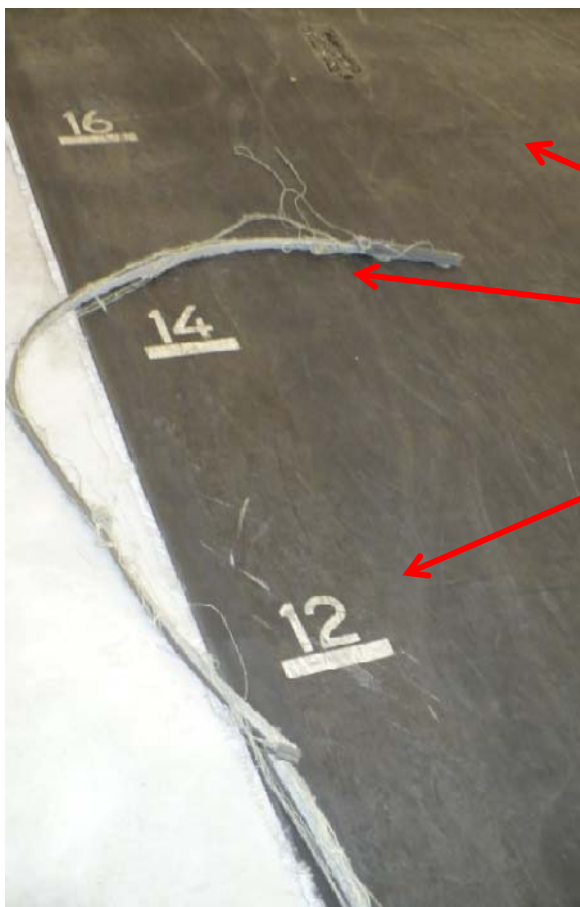
Fig. A: Guiderail under protective cover

Fig. B: Urethane profile

Fig. C: Carpet

Types of Common Carpet Damage

- **Urethane coating removal.** This is considered cosmetic damage and does not hinder the operation of the system. This damage is caused by articles (items that have fallen off of damaged luggage or other foreign matter) being wedged between the carpet and the sliding carpet structure scraping off the top urethane layer. (Pictured on the right.)
- **Carpet position markings.** Markings that have been worn away from use do not affect the operation of the unit. Since the loader stays close to the cargo door, once the first few rows of bags are used the loader is not able to easily determine how much available space remains in the cargo hold. Refreshing the markings on the repaired carpets is critical efficient loading and operation of the systems.
- **Urethane profile tears off.** The damage to the carpet occurs when the profile is ripped from the edge of the carpet. (Pictured below.)



Carpet
Torn urethane profile
Markings

AmSafe has developed a repair procedure that will return a carpet to a serviceable condition as long as the carpet is used within the OEM's operating parameters. The AmSafe repair and overhaul service will significantly reducing the cost of ownership as the carpet can now be repaired versus replaced.

AmSafe research focused on the following:

- identifying what structural, regulatory and operational requirements were required of the system; and
- a close working relationship with the customer to understand their problems and develop a customized solution.

Operational Aspects

A failure of Sliding Carpet System (either repaired or new) is not necessarily cause for grounding an aircraft. Should a situation happen where the bags are not evenly distributed and the carpet does rip out of the guide rail, the luggage should be unloaded, the carpet moved to its fully loaded state (ie., pulling the carpet down the track) and the system deactivated. This action maximizes cargo volume in the aircraft. Once deactivated, the operators need to load/unload bags by hand and the carpet should be replaced when the aircraft can be routed to a station capable of performing the work.

During the repair research, AmSafe learned that as long as the system was used as designed, (baggage load distributed over the width of the carpet and floating floor load limits not exceeded), the "interaction" between the repair splice will be minimal because it just slides "up and down" the guiderails with minimal loads being applied.

Although the performance characteristics of the OEM carpet were not available for direct comparison, AmSafe identified a carpet (through an extensive search) that was marketed in a similar application. The specification sheet for this carpet identified the tear strength at 700N (157 lbf) and the profile bonding strength at 20 N/mm (114 lbf). AmSafe was able to obtain an actual carpet that was installed in the Sliding Carpet System and through internal testing, was able to produce similar results.

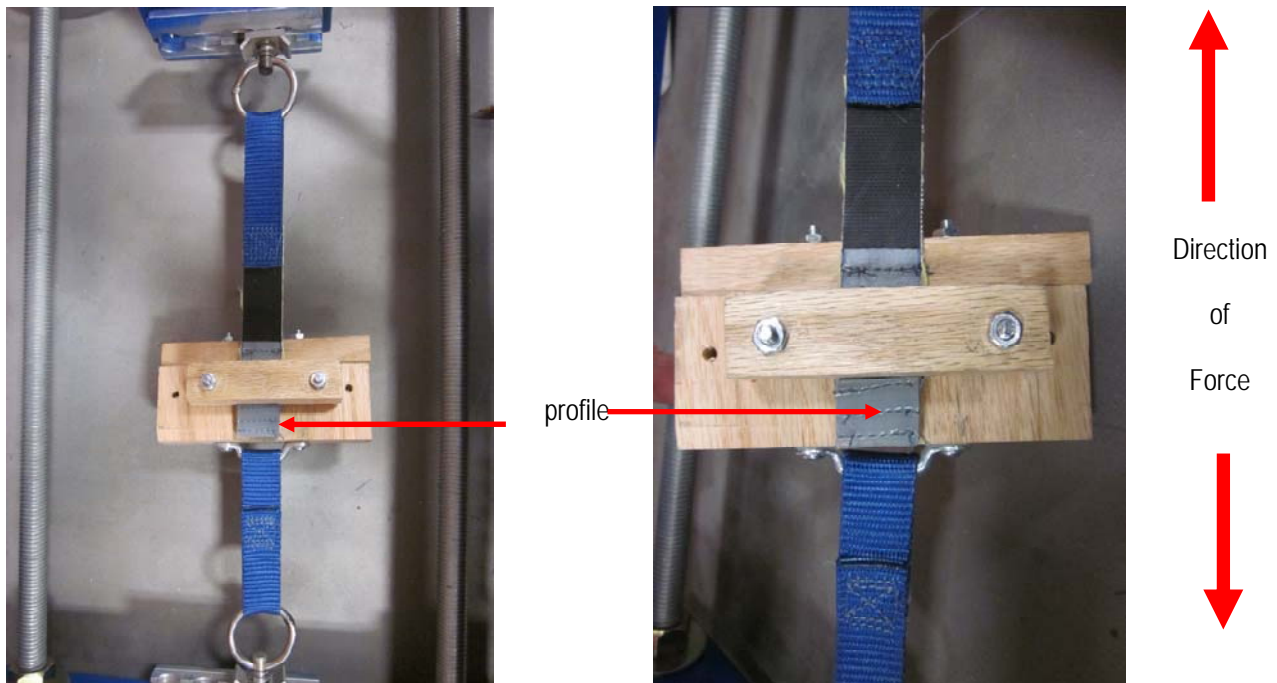
Informal Testing Program & Results

AmSafe developed an informal test program to quantify joint strength. Ten (one-inch wide) samples were created (as described below). The purpose of testing was to identify the shear strength of the repair in comparison to sections of the carpet.

- **New samples** – Three new samples were removed from a section of the carpet behind the movable bulkhead. This area of the carpet is not subject to any use or loading, therefore the joint between the PU Profile and carpet would not have been subject to any major stress.
- **Used samples** – Three used samples were removed from a middle section of the carpet. This area is used regularly for loading.
- **Repaired samples** – Four samples were constructed from a section of the carpet and repaired using the AmSafe repair procedure. This process used four rows of stitching.
- **Repairs of previously mended area (repair on repair)** – The AmSafe repair procedure was completed on a previously mended sample. The purpose of this second repair was to discover if there was any impact to having multiple repairs completed on the carpet. Repairs of the affected area were sewn with three rows of stitching.

Test Fixture

The test fixture was designed so the carpet would not bind in the test fixture and allowed for free movement of the sample.



Test Samples



Test samples before pull testing. (Top to bottom – New, Used, and Repaired)



New samples after testing.



Used samples after testing.



Testing samples of carpet subject to one repair.



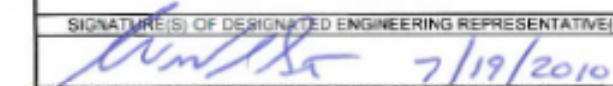
Test samples of carpet subject to two repairs.

Conclusion

AmSafe received approval from the Federal Aviation Administration to offer slide carpet repair to operators who use the Telair Sliding Carpet® Loading System. This test process has provided AmSafe with the below conclusions.

- A. Demonstrated a desire to work with customers to
 - understand the problem,
 - its root cause and
 - impact to their operation.
- B. Developed a non-standard solution that
 - extends the life of the carpet by rebuilding the edge;
 - retain high functionality for the user by remarking the position identifiers; and
 - repair cosmetic issues of urethane tear-off and possibly minimize future downtime.
- C. Demonstrated that this type of repair is a viable alternative to carpet replacement.

Approvals

U. S. DEPARTMENT OF TRANSPORTATION FEDERAL AVIATION ADMINISTRATION			DATE 2010 JUL 19
STATEMENT OF COMPLIANCE WITH THE FEDERAL AVIATION REGULATIONS			
AIRCRAFT OR AIRCRAFT COMPONENT IDENTIFICATION			
MAKE Boeing	MODEL NO. 737-900 & 757-300 Series Airplanes	TYPE (Airplane, Radio, Helicopter, etc.) AIRPLANE	NAME OF APPLICANT AmSafe Bridport
LIST OF DATA			
IDENTIFICATION	TITLE		
C.W.C. Story Engineering Report No. CWCS-2010-07-01, Rev. A, Dated 2010 JUL 19 AmSafe Bridport Process Specification PS-28, Revision 0, Dated 6/2010	C.W.C. Story Fire Properties Test Plan/Report – Repair of Sliding Carpet Conveyor Belt installed on 737/757 Series Airplanes Repair of Carpet on Telair Sliding Carpet Loading System Note 1: Authority to approve the test plan and test results for Flammability was delegated to Charles W. C. Story FAA DER by Mr. Richard Beckwith of the NYACO per e-mail message dated 2010 JUL 12. Note 2: This 8110-3 form is in support of the AmSafe repair process specification PS-28, Revision 0, Dated 06/2010 for the Repair of Carpet on Telair Sliding Carpet Loading System for Boeing 737/757 series airplanes only. Note 3: The repair procedure does not alter the installation or design of the sliding carpet. Note 4: This is not an installation approval. <div style="border: 1px solid black; padding: 5px; font-size: small;">This approval indicates the data listed above demonstrates compliance only with the regulations specified by paragraph and subparagraph listed below as "Applicable Requirements" Compliance to additional requirements not listed may be required. This form does not constitute FAA approval of the entire alteration. Final FAA approval of the alteration is made when a FAA Inspector stamps and signs FAA form 337.</div>		
PURPOSE OF DATA TO SHOW COMPLIANCE WITH APPLICABLE REGULATIONS IN SUPPORT OF FLAMMABILITY TESTING FOR AMSAFE BRIDPORT AND APPROVAL OF REPAIR PROCESS SPECIFICATION.			
APPLICABLE REQUIREMENTS (List specific sections) 14 CFR 25.855 (d), Amdt 25-123, Appendix F Part I (a)(1)(v)			
CERTIFICATION - Under authority vested by direction of the Administrator and in accordance with conditions and limitations of appointment under Part 183 of the Federal Aviation Regulations, data listed above and on attached sheets numbered <u>NONE</u> have been examined in accordance with established procedures and found to comply with applicable requirements of the Federal Aviation Regulations. I (We) Therefore <input type="checkbox"/> Recommend approval of these data <input checked="" type="checkbox"/> Approve these data			
SIGNATURE(S) OF DESIGNATED ENGINEERING REPRESENTATIVE(S)	DESIGNATION NUMBER(S)	CLASSIFICATION(S)	
 Charles W. C. Story (Original Signed in Blue Ink)	DERT-955112-NE	Systems & Equipment and Structures	



U.S. Department
of Transportation
**Federal Aviation
Administration**

Allegheny Flight Standards District Office
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Suite 201
Pittsburgh, PA 15227

412-886-2580, Fax: 412-886-2591

April 15, 2011

Mr. Ken Bunting
Chief Inspector
AmSafe Bridport
1317 W. 12th Street
Erie, PA 16501

Dear Mr. Bunting:

This office has reviewed and approved revision #2 to Process Specification PS-28; "Repair of Carpet on Telair Sliding Carpet Loading System". The revision is a minor change to Section "F", Paragraph 2(f) and to Figure 2, that adds the term "min" to Item 5, thereby enhancing clarity of the stitch rows required on this product.

When submitting future maintenance document revisions or changes for FAA approval and/or acceptance, please prepare a revision transmittal document or letter that describes the submission (including the document title, revision number, and effective date) and that is signed by the appropriate manager.

Please contact me at (412) 886-2580 extension 212, if you have any questions on this matter.

Sincerely,

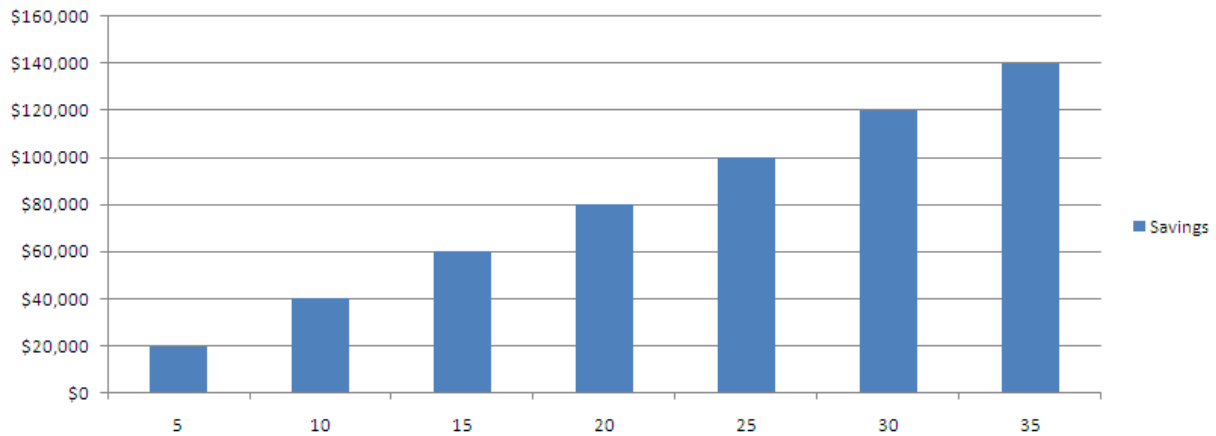
W. Dean Glasser
Principal Maintenance Inspector

Economics

The Sliding Carpet repair process developed by AmSafe functions well within the normal operating conditions of the carpet system. However, when the weight (of the baggage) is not evenly distributed across the width of the floorboard, the carpet is liable to tear out of its structure. When the carpet tears, there is either damage to the guide rail, the carpet or both. Since the carpet tear is due to improper loading, 'meantime-between-failures' can be as high as multiple years or as low as weeks or months.

The following model assumes a spares cost of \$10,000 and an overhaul rate of \$6,000.

Projected Annual Savings of Repair over Replacement Using AmSafe's Repair Process



***Annual Removals**
*AmSafe is happy to customize savings estimates upon review of actual removal rates

Annual Removals	5	10	15	20	25	30	35
Annual Replacement (\$10,000 spares)	\$50,000	\$100,000	\$150,000	\$200,000	\$250,000	\$300,000	\$350,000
"Typical Overhaul Rate" (60% of New)	\$30,000	\$60,000	\$90,000	\$120,000	\$150,000	\$180,000	\$210,000
Savings	\$20,000	\$40,000	\$60,000	\$80,000	\$100,000	\$120,000	\$140,000

Alteration Program Coverage

The following part numbers have either been confirmed or could be supported under the AmSafe alteration program. Additional part numbers could also be supported under this program, please contact us for further information.

Part Number	Fleet
793351	B737
793244	B737
790544	B737
791194	B757
791338	B757
791339	B757
792005	B757
792207	B757
792209	B757
794008	B757
794054	B757
792229	B757
390075	A319
390045	A320
390196	A320
390106	A320
390285	A321
390291	A321
450849	MD-80

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