

REPORT #1002

SUPPLEMENTAL MAINTENANCE MANUAL

AND

INSTRUCTIONS FOR CONTINUED AIRWORTHINESS

FOR MODELS: W-140-X, W-175-X, W-210-X and W-300-X

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TABLE OF REVISIONS

Rev No.	Description Of Revision	Page	Date
1	General rewording of previous document throughout. Deletion of tear test and cap enlargement procedure.	All	10/29/90
2	Changed fabric pull test to fabric seam pull test. Reduced seam test minimums to 26.25 lbs.	7	10/29/90
3	Deleted use of Kevlar. Use of 1/8" 375 lb. cord on vent lines. Major repairs. Repairs to V-ring splice at throat.	4 4 9 10	01/27/93
4	Included use of Mil-W-4088, Type 17 webbing on W-175-X & W-210-X.	3	02/10/94
5	Added porosity limits and standards. Added inspection of all preventive maintenance repairs.	8	10/10/97
6	Referenced airworthiness limitations supplement for all W-140-2, W-140-4, and W-175-4 models. Added supplemental airworthiness limitations section.	7 11	03/18/01
7	Added W-210-4 to first paragraph and identified OEMs in second paragraph Deleted the word "urethane" in description of fabric weight. Changed "must" to "should" on 24 hour wait for adhesive rip-stop material. Added "when practical" for wait on 4" repairs using adhesive rip-stop tape. Removed everything pertaining to Rev. 6. Added paragraph 10 on page 8. Changed requirements for major repairs. Alternate method for V-ring splice. Changed requirements for logbook entries. Created Airworthiness Limitation section and divided manual into two sections.	ii 3 6 6 7 & 11 8 9 10 10 ii & 11	12/15/02
8	Added model designation - W-300-X. Clarification of throat repair procedures.	ii 10	09/15/17

This manual is not a substitute for the original maintenance manual which was supplied with the type certified balloon system. It is intended as a supplement for the purpose of providing continued airworthiness information and guidelines to be used with the following envelope models: W-140-2, W-140-3, W-140-4, W-140-5, W-175-4, W-175-5, W-210-4, W-210-5, and W-300-5.

This maintenance information applies only to these envelope systems and must be appended to the maintenance manual of the original equipment manufacturers which include Raven/Aerostar for models W-140-2, W-140-4, W-175-4, and W-210-4, Balloon Works for model W-140-3, Cameron for model W-140-5, W-300-5, and Thunder & Colt for models W-175-5 and W-210-5.

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SECTION ONE

GENERAL INFORMATION

Proper care of a balloon envelope is the best form of maintenance an owner can provide to avoid the more time consuming and expensive repairs which result from abuse or neglect. It is suggested that both the owner/operator and each pilot become familiar with this supplement and take the time to reread and review the material herein on an annual basis.

The balloon fabric has an initial weight of 1.9 ounces per square yard. In addition, a 1/2 to 3/4 oz. coating of urethane has been applied to one side as a gas barrier. In any quantity, urethane coating is subject to a certain amount of chemical and mechanical damage during normal operations. It is now generally accepted that the life of a balloon envelope is directly related to the condition of the fabric coating. This not only relates to the difficulty of flying a porous envelope, but is also a condition of fabric strength. As the coating deteriorates, the fabric is subject to greater temperature stress and a subsequent loss of tensile strength.

With respect to chemical deterioration caused by wet envelope fabric, it was earlier believed that mildew was the only concern when this condition existed. However, it has now become known that the short term effect of acidic breakdown of the fabric coating is of primary consideration. During normal flight, exhaust particles and gases from the burner flame combine with the urethane to form an acid base compound. When moisture is added, the resulting mild acid causes the urethane coating to deteriorate.

Mechanical damage to the urethane coating is simply the result of shearing one layer of coated fabric against another while spreading the envelope for inflation.

The following procedures and practices are recommended to insure greater fabric strength and longer envelope life:

- 1) As much as possible, avoid spreading the envelope fabric on the ground by manually pulling on the fabric or load tapes. After emptying the envelope from the bag in a long streamer, begin cold inflating immediately with the fan. This method not only makes spreading the fabric easier, but the in-flowing air cushions the two layers of fabric from shearing effect.

- 2) During each flight, note the average envelope temperature. If possible, just before deflation, raise the envelope temperature to at or above the average flight temperature and keep it there for at least two minutes. Then deflate the envelope as rapidly as possible. This technique requires relatively calm wind conditions. However, in a windy situations a rip landing and rapid deflation will achieve the same results. Never deflate the balloon immediately after it has been

allowed to stand and cool for a long period of time. Doing so allows moisture to condense on the inner fabric wall. Reheating just before deflation will re-vaporize this moisture, allowing it to properly vent.

3) When deflating on wet grass, reduce the envelope to a streamer as quickly as possible. Sealing the top under such conditions is of lower priority and should be left to a subsequent inflation. Pack the envelope in the bag as soon as possible thereafter. Turn the bag upside down in the chase vehicle to allow the bottom of the bag to dry. Store the envelope and bag upside down on a pallet until the next flight.

4) If the envelope should become damp, spread it open indoors as much as possible, periodically turning the fabric over until it is dry.

5) If the envelope should become excessively wet, hot inflate as soon as possible and allow the load tapes to dry completely.

REPLACEMENT MATERIALS

General

All materials used for major repairs and replacements must be itemized in a work order describing their use. All receipts for purchases of such materials must be permanently attached or filed with the work order.

Load Tapes

Replacement of vertical load bearing members, horizontal rip-stoppers, and maneuvering vent crown tapes, is restricted to the use of 1 inch wide MIL-T-5038F, Type IV, 1000 lb. webbing on the W-140-X models and MIL-W-4088, Type 17 on the vertical members for the W-175-X, W-210-X and W-300-X models. Replacement of maneuvering vent cap structural tapes is restricted to the use of 1" and 1/2" MIL-T-5038F, Type III webbing as appropriate.

Envelope Fabric

Envelope fabric purchases for minor repairs should be made directly from the manufacturer. For major repairs and replacements, purchases may be made from either the manufacturer or another vendor of balloon fabric. If another vendor is chosen, the fabric must be designed specifically for use in manned hot air balloons, and the use of the vendors product must be FAA approved. In addition, the vendor should provide the FAA mechanic or repair station performing all major repairs and replacements with a dye-lot lab report for all fabrics being used. The fabric should meet the following minimums as outlined in the vendor's lab report:

Fabric construction - First quality rip-stop nylon with silicone or urethane coating, and ultraviolet inhibitor. Minimum warp threads 95/inch. Minimum fill threads 85/inch.

Fabric weight - 2.3 oz. to 2.9 oz. including coating.

Tensile warp (grab)	120 lbs.
Tensile fill (grab)	110 lbs.
Tear strength warp and fill	6.0 lbs.

UV, DWR and mold inhibitors added.

Thread

With the exception of the vertical load bearing members, all repairs to the envelope must be made using V-T-285, Type I or II, class 1 or 3, Size E or F polyester thread. Vertical load bearing members should be repaired with type F thread.

Suspension Cables

Any suspension cable may be replaced with 7 x 19 x 1/8", Mil-W-83420, Type I, comp. B, 2000 lb. galvanized aircraft cable or a comparable stainless steel aircraft cable.

Hook And Loop Tape

All hook and loop tape should be similar in construction to Velcro #80 hook and woven loop, 1" and 1 1/2" wide as appropriate.

Parachute Vent Lines

The cap centering and shroud lines should be replaced with Mil-C-5040. Type II, 1/8" dia., 375 lb. tensile nylon parachute suspension line.

PREVENTIVE MAINTENANCE

As provided in Sections 43.3, through 43.9 of the FAR, preventive maintenance of the following type may be performed by an owner/operator who holds a pilot certificate issued under FAR Part 61:

- 1) Removing dirt and foreign particles from the hook and loop fastener tapes of the deflation cap.
- 2) Repairing damaged areas of the envelope skirt.
- 3) Repairing holes and tears in the envelope fabric.

NO HOLE OR TEAR MAY BE REPAIRED AS PREVENTIVE MAINTENANCE IF IT REQUIRES REMOVING, REPAIRING, OR REPLACING ANY VERTICAL OR HORIZONTAL LOAD BAND, OR UNSTITCHING ANY LOAD TAPE SEAM.

For the purpose of this section, a "hole" in the balloon fabric is defined as an area in which an obvious amount of balloon fabric is missing as a result of being melted by the burner or torn away, or where a series of two or more parallel tears are within 6 inches of each other. A "tear" is defined as a separation in the fabric in which no material is missing with the exception of minor fraying along the edges.

All holes in the balloon fabric must be repaired before flight, regardless of size. Holes in the balloon fabric may be repaired as preventive maintenance provided that they are not in excess of 6 inches in any one direction above the equator, or 12 inches in any one direction below the equator. These dimensions must include any scorched or damaged fabric which must be cut away before repairing the hole as described below. Holes in excess of these dimensions must be repaired with half or full gore panel replacement by a qualified mechanic or repair station. Repairs to fabric holes less than 1/2" in diameter may be accomplished as preventive maintenance by using two layers of rip-stop nylon tape, faced on opposite sides of the hole and allowing the glue to set for at least 24 hours before flight. The repair tape must overlap all sides of the hole by at least 1/2". Such repairs are best made at the end of a flight.

Repairs to fabric holes greater than 1/2" but less than the above defined limits may be accomplished as preventive maintenance by patching both sides of the hole with two sheets of pressure sensitive adhesive rip stop nylon repair material faced on opposite sides of the hole. Before applying the material, all scorched, frayed, or otherwise damaged material must be cut from the edges of the hole. The edges of the repair material must overlap the edges of the hole by at least 2" all around on both the inside and outside repair patch. Once applied, there may be no lumps, elongations, stretch marks or other irregularities in the area of the patch or surrounding fabric. Two rows of stitching shall be sewn all around the patch edges as shown in Appendix A. A third row of stitching shall be sewn on the extreme

edges of the patch to prevent lifting, as shown in Appendix A. All stitching will be terminated with a 1" minimum back-stitch or overrun. The glue should be allowed to set for at least 24 hours prior to flight when practical.

All tears in the balloon fabric must be repaired regardless of size. Tears smaller than 4" in length may be repaired as preventive maintenance by applying two layers of adhesive rip-stop repair material faced on opposite sides of the tear and allowing the glue to set for at least 24 hours before flight when practical. The repair tape on the inside and outside of the envelope fabric must overlap both edges of the tear by at least 3/4" and the opposite ends by at least 2".

A tear in excess of 4" may be repaired as preventive maintenance provided that it follows approximately a straight line, is not in excess of 40 inches, and is not within 6 inches of another tear on a parallel run. In addition, there may be no damage to the adjoining load tape requiring repair or replacement. All tears must be repaired with two layers of 2" wide pressure sensitive rip-stop nylon adhesive repair tape, applied to both sides of the balloon fabric. When applied, the repair tape must lay flat on the envelope fabric, allowing approximately 1" of overlap on each side of the tear. If the tear does not follow a straight line, the repair tape may be cut once and angled along the tear, provided that the change in angular direction does not exceed 10 degrees. In such cases the tape must be spliced where cut, and overlapped 2" on both the inside and outside runs. The tape must extend beyond the ends of the tear by 2". Two rows of stitching must be applied on either side of the tear plus a single row along the extreme edges to prevent lifting as shown in Appendix B.

All repairs being made as preventive maintenance must be sewn with a lock stitch machine using either size E or F polyester thread with a #18 or #20 sewing needle at eight stitches per inch.

Approval of fabric tests is not permitted as a preventive maintenance task, however, it is highly recommended that the owner/operator obtain a set of test clamps and become competent in performing the seam test as shown in Appendix C.

ANNUAL, 100 HOUR AND 50 HOUR INSPECTION AND MAINTENANCE

The following procedures must be accomplished for all 100 hour and annual inspections:

1) Inspect the envelope tell-tale located near the deflation panel. If the 280 degree tab has been darkened, indicating an envelope over-temp, particular attention should be paid to the area in and around the maneuvering vent since this is the area which will be most effected by an envelope heat stress. The fabric in this area should be compared with the fabric at the lower end of the envelope in terms of texture. Any comparative stiffness or discoloration would indicate fabric heat damage.

2) Test the 1 1/2" hook and loop tape on the deflation cap perimeter. Mate a 6" length of hook and loop together. Clamp a 35 pound weight to the hook tape and lift the weight off the floor by lifting the loop tape only. Perform this test on 5 different areas of the hook and loop, reducing the weight where necessary to the point where the test sample will remain joined. If all five test samples hold at 35 lbs., the hook and loop is considered airworthy for another 100 hours or one year, whichever comes first, after which time the test must be repeated. If the average holding strength of the 5 samples is between 25 and 35 pounds, the hook and loop is considered airworthy for another 50 hours or one year, whichever comes first. If the average of the tests is less than 25 pounds, the hook and loop must be replaced.

3) Tests to the envelope fabric may be conducted on the vertical half-gore seams in accordance with the procedure outlined in appendix C. Seam tests will be conducted on the upper half of the envelope, unless new fabric panels have been sewn into this area. In this case where large amounts of fabric have been replaced, tests should be conducted on the uppermost and oldest fabric, and on the new fabric. A total of 10 tests will be conducted on a balloon which has not undergone numerous fabric panel replacements, in which case all tests will be conducted on older fabric seams. A total of 20 tests will be conducted on a balloon which has undergone top half replacement, in which case 10 tests will be conducted on each of the old and new panel seams. If all seams (old and new) pass a pull test of 30 pounds, the envelope fabric is considered airworthy for another 100 hours or one year, whichever comes first, after which time the tests must be repeated. Otherwise an average of the total seam tests will be determined. If the average of the seam tests yields a value of 26.25 lbs. or more, the envelope is considered airworthy for another 50 hours or one year, whichever comes first. For an envelope which has undergone a top half replacement, the old and new fabric seam tests must be averaged separately. Fabric panels with seams which cannot withstand a pull test of 26.25 lbs. must be replaced before the balloon can be returned to service.

- 4) Inspect steel support cables for broken strands and heat damage. If cables have more than 3 broken strands along any one foot length, they must be replaced. If discoloration from direct exposure to the burner flame is apparent, bend the cable in that area into a teardrop shape having an approximate size of the swaged end. If when released, the cable does not open without kinking, the cable has been heat stressed and must be replaced.
- 5) Inspect maneuvering vent centering lines, cap shroud lines, and pull cord for abrasions and replace where needed.
- 6) Inspect the deflation panel rip line and attachment point on the crown cap. Inspect the reinforcing pad at the equator through which the rip line runs. If the envelope fabric surrounding this pad is worn or broken, enlarge the perimeter of the pad by sewing 2" wide adhesive nylon material all around, on the inside and outside of the envelope.
- 7) Inspect the length difference between the deflation cap hook and loop tape for each gore interval along the crown. The average length of loop tape for each gore interval should be a minimum of 1 1/4" longer than the corresponding hook tape. If this is not the case, the deflation cap must be replaced.
- 8) Inspect top envelope fabric for excessive porosity. Using an industry approved porosity tester (e.g. Aerostar), test all fabric above the equator (approximate widest area of half-gore) for air permeability rates. Any fabric showing an air flow rate between 50 and 75 CFM must be replaced in order to meet a 100 hour return to service. Otherwise a 50 hour limit is approved. Any fabric showing an air flow rate greater than 75 CFM must be replaced. Fabric below the equator need not be tested.
- 9) Inspect all preventive maintenance repairs. All hole repairs in excess of 4 inches above the equator or 6 inches below the equator must be removed by seam to seam panel replacement. All tear repairs in excess of 12 inches must be similarly removed. All smaller repairs which are considered substandard in quality must be removed by panel replacement.
- 10) All annual, 100 hour and 50 hour inspections must include a thorough overall inspection and evaluation of the envelope for poor condition as required by FAR 43, Appendix D(b)(3).

HALF AND FULL GORE PANEL REPLACEMENT

A full gore panel is defined as the fabric within any two vertical load bearing webbings, laterally, between any two horizontal rip-stopper load bands, vertically, comprising two half gores. A half gore panel is the fabric within any vertical load bearing webbing and adjacent LSc-2 vertical seam, laterally, between any two horizontal rip-stopper load bands, vertically.

When a hole or tear is larger than the dimensions allowed for preventive maintenance, either half or full gore panel replacement must be accomplished by a qualified FAA airframe mechanic or repair station. If the hole or tear is restricted to one half panel (between a vertical load tape and center seam) half panel replacement is recommended. If the damage extends to both half panels or includes the center seam, full gore panel replacement is required.

For half panel replacement, unstitch the main LSc-2 seam at the center of the gore panel one inch beyond the horizontal load bands, and cut out the three remaining sides as close as possible to the load tapes, without trimming away the material under the tapes. Using a small flame or hot knife, melt the edges of the cut material under the load tapes to prevent fraying. Using the removed half panel as a template, cut out a matching panel of material, adding 1 1/2" seam allowance for the sides of the material which will be sewn to the load tapes. Singe all cut edges except for the side which will be sewn as the center seam. Begin by pinning the entire panel in place with one pin every three inches to the underside of the load tape. Care must be taken in pinning the center together as an LSc-2 seam. Once this is accomplished, run a double row of stitches all around. If the half panel to be replaced is too damaged to be used as a template, the adjoining side may be used by facing the repair material coating side up when cutting. All stitching must be type 301 at eight stitches per inch using a double needle 3/8" gage with E or F polyester thread and a #18 needle.

Full gore panel replacement is similarly accomplished, and in most cases is an easier task. Whenever possible, repair the damaged fabric so that it can be used as a template for cutting out the replacement material.

MAJOR REPAIRS AND REPLACEMENTS

Due to degradation of vertical load tapes from sewing breakage, it is recommended that major repairs such as total top half replacement be accomplished only once, when accomplished panel by panel as opposed to splicing an entire top to the bottom half.

LOAD TAPE REPLACEMENT

Worn or broken load tape may be repaired by simply sewing additional webbing on top, leaving a 14 inch minimum overlap on both sides of the

break or damaged area. Vertical load tapes must be sewn with five double needle passes using Size E or F thread at eight stitches per inch of a type 301 stitch. Before sewing the splice together, the underlying balloon fabric should be unstitched and moved out of the way for the first four passes. This fabric may then be sewn to the load tape on the fifth pass. Horizontal load bands are similarly sewn, but require only three double needle passes. Load tape repairs must be accomplished by a person qualified under FAR Part 43.

When replacing fabric at the throat in older envelopes which do not have a 30" turn-back insertion, it is best to create a full-gore panel and sew it directly onto the damaged area, on the inside, from load tape to load tape, without opening the turn-back(s). For envelopes with turn-backs which include a 30" reinforcement insertion, the usual procedure of opening the turn-back may be followed.

LOGBOOK ENTRIES

As required by Section 43.9 of the FAR, logbook entries must be made for all repairs to the balloon envelope. These entries must include not only the record of inspections and repairs accomplished by a qualified mechanic or repair station, but must also include all preventive maintenance repairs made by the aircraft operator. Repairs to the envelope must be documented with the following information:

- 1) A description of the work performed.
- 2) The date of completion of the work performed.
- 3) The name of the person performing the work.
- 4) The signature and pilot or mechanic certificate number of the person performing the work. The signature of such person denotes an approval for return to service of the aircraft and an approval of the work described.

SECTION TWO

AIRWORTHINESS LIMITATIONS

NOTE

The Airworthiness Limitations section is FAA Approved and specifies maintenance required under sections 43.16 and 91.403 of the Federal Aviation Regulations.

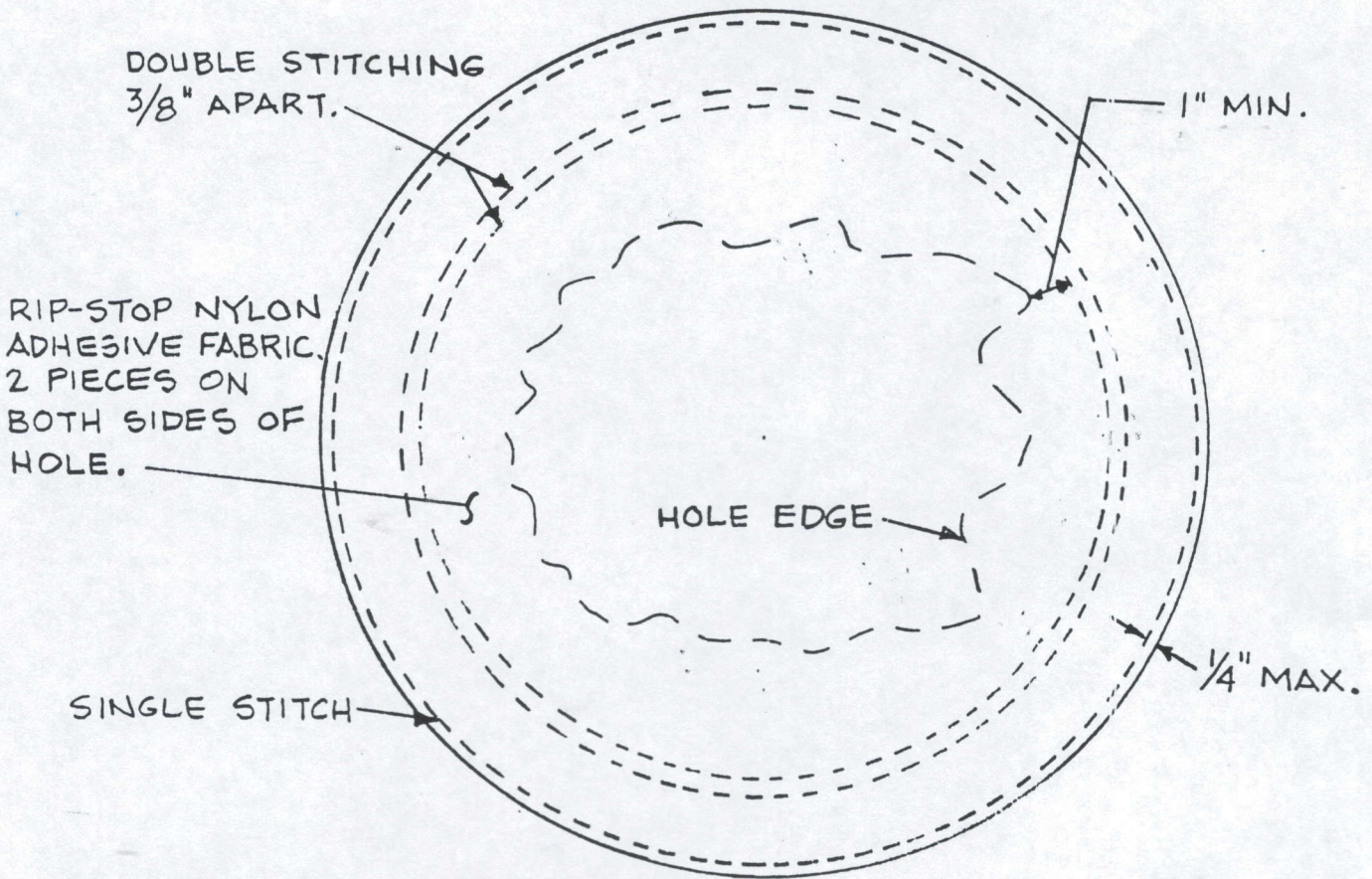
Revision Number	Effective Date	FAA Approved
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AIRWORTHINESS LIMITATIONS

None

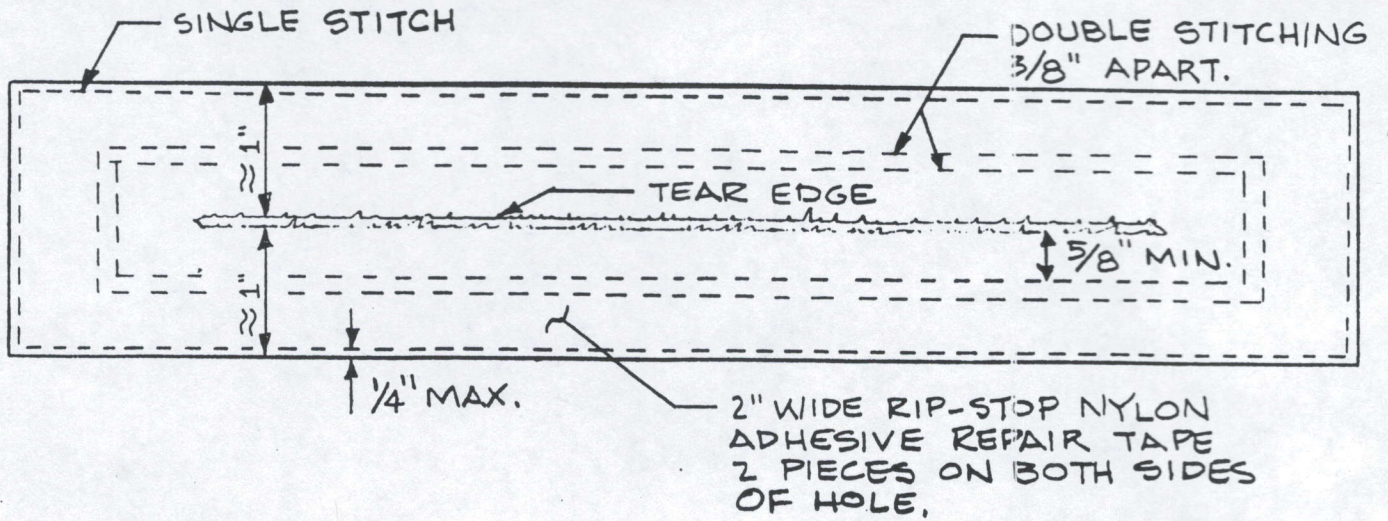
APPENDIX A

Repair To Fabric Holes



APPENDIX B

Repair To Fabric Tears



APPENDIX C

Envelope Fabric Strength Test

The purpose of this test is to evaluate the tensile strength of the envelope seams. The test minimums, as described in the 100 hour and annual inspection procedures, were established to insure that the envelope fabric seams should have sufficient strength to withstand both ground handling stresses and all flight stresses which may be encountered from the time of the test to the time of the subsequent retesting.

In order to grab the proper amount of fabric, two 1" wide clamps must be constructed as a test device. A simple and practical test device can be made using four 1" x 1" flat steel plates of 3/32" to 1/8" thickness. All four plates must be faced with rubber, measuring approximately the same thickness as the plates. Two common C-clamps may be used to compress the test samples between the plates. The weight of one of the C-clamps and plates should be determined to within .5 lbs.

The test specimen will usually involve one of the upper envelope center gore seams. Using the lines of heavy rip-stop weave as a guide, the plates should be squared off at a distance of 3 inches apart straddling a center seam as shown in the diagram below. The appropriate amount of weight, including the weight of one clamp, is attached to the lower clamp. The weight is then lifted clear of the floor by the upper clamp. If the fabric strength is in doubt, the weight should be increased on the lower clamp in increments of 1 pound, starting with a total weight of 19 lbs. Weight should be added until the maximum weight is reached or until total seam failure occurs.

