INSTRUCTIONS FOR CONTINUED AIRWORTHINESS

This manual specifies repair and inspection procedures for **conventional and special shape aircraft** built under U.S. Type Certificates B1GL, B2GL, B3GL, B4GL and B1EU by Cameron Balloons U.S. This manual is a re-issue of previous manuals.

NOTE:
This manual does **not** apply to balloons for which the Airworthiness Certificate shows Cameron Balloons **Ltd.** as the manufacturer. Maintenance and inspection procedures for British-built Camerons ("Cameron Balloons **Ltd.**" shown as manufacturer on Airworthiness Certificate) are specified by the Cameron Balloons Ltd. *Free Flight Hot Air Balloon Maintenance Manual, Issue 10, Amendment 3 or a subsequent issue.*

This manual also specifies maintenance and inspection procedures for baskets, burners, tanks and instruments built by Cameron Balloons **U.S.,** under one of the above five Type Certificates, when these components or parts are used with another certified balloon system or with a balloon system carrying an Experimental Airworthiness Certificate.

NOTE:
This manual does **not** specify maintenance and inspection procedures for components manufactured by **other** balloon manufacturers and installed on a Cameron with a Supplemental type Certificate (STC). Refer to the Cameron Balloons US Flight Manual Supplement for the required maintenance and inspection criteria for non-Cameron components.

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INSTRUCTIONS FOR CONTINUED AIRWORTHINESS

REVISION LOG

REVISION DATE	LETTER	PAGES	APPROVAL BY	APPROVAL DATE
Complete manual re-issued May 01,1997. Replaces all previous issues of Instructions for Continued Airworthiness.				
Nov. 01, 1999	A	1, 2, 3, 11, 16, 17, 32, 76, 77, 83, 84, 152-154, 157-159, 165-168, 193 Appendix A, B, E & F		
Jan. 01, 2001	B	1, 2, 3, 11 Appendix B, G, H, I		
Jan. 01, 2004	C	2,3,11,30,41,67,68,76,77,153,157,188, 189,190,194, Appendix A38-on, Appendix B, Appendix K, Appendix L		
Nov 12, 2007	D	2,3,11,12,14,16,17,19,33,34,42,43,46, 55,59,63, 64,65,67,76,77,83,84,89,92, 93,96,97,152, 153,154,157,158,160, 163,165,166,173, 177, 188,196 Appendix A2 thru A62, Appendix B, Appendix D, Appendix E, Appendix G17, G18, G31 & G32, Appendix H, Appendix J Appendix K3 & K4, Appendix M	DRM	Nov 30, 2007
Jan 01, 2009	E	1, 2, 3, 11, 14, 77, 100, 119,122,123, 158, 175 Appendix A17, A20, A22, A24, A26-A29, A49-A61 Appendix B, Appendix C10-C20, Appendix E1, Appendix I1-I6, Appendix N	DRM	Jan 14, 2009

NOTE: Revised text on the affected page(s) indicated by a vertical black line along left margin.

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INSTRUCTIONS FOR CONTINUED AIRWORTHINESS

REVISION LOG

REVISION DATE	LETTER	PAGES	APPROVAL BY	APPROVAL DATE
November 01, 2012	F	Replace: 1, 2, 4, 5-12, 18, 19, 23, 25, 27,	DRM	Nov 01, 2012
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		152-154, 164-168, 180, 181,189, 194,		
		Appen A, Appen B, Appen D, Appen E.		
		Add: Appen O, Appen Q thru X		

This manual uses the following cautionary messages:

WARNING! DANGER!: Denotes hazardous procedure or condition which, if ignored, could injure or be fatal to the person performing the work indicated.

CAUTION: Denotes a hazardous procedure or condition, which, if ignored, could damage or destroy a part of the balloon.

IMPORTANT: Denotes a procedure or condition, which is the correct and efficient method of completing a procedure.

NOTE: Specifies supplementary and perhaps essential information which should be recognized in relation to a particular procedure or condition.

TABLE OF CONTENTS

APPENDICES

SECTION 1
GENERAL

1.1 INTRODUCTION

The maintenance of a Cameron hot air balloon is relatively simple. Applying common sense to maintenance and inspection procedures is always wise. If an item does not look right, or if the envelope contains repairs that cause wrinkles or are sloppily done, even if the repairs were performed by another person, question their acceptability. If in doubt about the integrity of the system, contact Cameron Balloons U.S.

WARNING! DANGER!
HAZARDOUS CONDITIONS WHICH COULD RESULT IN INJURY OR DEATH MAY OCCUR FROM: **A. THE INSTALLATION OF NON-APPROVED PARTS OR MATERIALS** **B. MODIFICATION OF ANY PART** **C. IMPROPER REPAIR PROCEDURES** **D. IMPROPER OPERATION OF THIS AIRCRAFT** **APPROVED REPLACEMENT PARTS, MATERIALS AND REPAIR PROCEDURES ARE DOCUMENTED IN THIS MANUAL**

When signing off a balloon as airworthy after an annual or 100 hour inspection, the repair person is verifying that **ALL repairs and modifications, including those done by other persons prior to the annual/100 hour inspection,** are airworthy **AND** the repairs conform to the specifications outlined in this manual. Different standards are required by different manufacturers. Carefully read the instructions in this manual and carefully inspect the balloon for conformity.

Supplemental Type Certificate (STC) Any modification, addition or installation of any component which does not conform to approved Cameron data requires a Supplemental Type Certificate (STC). This requirement for a Supplemental Type Certificate **INCLUDES** any component which *may or may not* be certified by another balloon manufacturer. For example, propane tanks, tank belts, non-Cameron balloon fabric, fuel manifolds, burner, baskets, fuel hoses, load tape, suspension cables, attachment carabiners and all other structural parts or power/fuel system (burner/hoses/tanks) parts acquired from another manufacturer or source. These parts may **NOT** be added to a Cameron Balloon without an STC. *An STC requires a Flight Manual Supplement, which must be approved by the FAA rather than by a repair station or owner.*

If the balloon being inspected, includes parts and equipment not outlined in this manual, check that the modification has been properly recorded both in the aircraft logbook and by an appropriately certificated person, and on a Supplemental Type Certificate, a copy of which must be in the Aircraft Flight Manual or FAA Form 337 (Major Repair or Alteration), a copy of which must be in the Aircraft Logbook. If in doubt about the legality or the airworthiness of the balloon, consult with Cameron Balloons U.S.

Whenever a structural or fuel system component is replaced, installed, modified or repaired the component must be an approved part, **APPROVED ACCORDING TO THE CAMERON BALLOONS US APPROVED DRAWINGS AND TYPE DATA**. **An FAA Form 337** must be filed whenever a major repair or major alteration is performed on the aircraft.

1.2 SCHEDULE OF INSPECTION

The **100 HOUR & ANNUAL INSPECTIONS ARE IDENTICAL** (See Appendix B). Per FAR 91.409, a Cameron balloon must be inspected per the annual/100 hour inspection requirements herein within every 12 month period or 100 hours of operation, whichever comes first.

NOTE:

Regardless of whether or not the balloon is used to carry paying passengers, it must be inspected per the annual/100 hour inspection requirements and checklist herein within every 100 hours of operation or annually, whichever comes first. This additional requirement has been established by Cameron Balloons U.S.

Since the 100 hour and Annual Inspections are the same, Cameron Balloons recommends that the log book entry for the 100 hour inspection signify that an Annual Inspection was performed. This would indicate that the next annual/100 hour inspection will be due in 12 months or after 100 hours of operation, whichever comes first.

1.3 MANUAL UPDATES

The current Instructions for Continued Airworthiness manual and all updates are available for download, at no charge, on the Cameron Balloons U.S. website, www.cameronballoons.com

Notification of updates to this manual will be provided to all FAA Certified Repair Stations who register with Cameron Balloons U.S..

Please send a letter of request to add yourself to the list of Certified Repair Stations for update notifications. Please include the name of the repair station, FAA Number, phone number and name of the General Manager. Send this information IN WRITING to:

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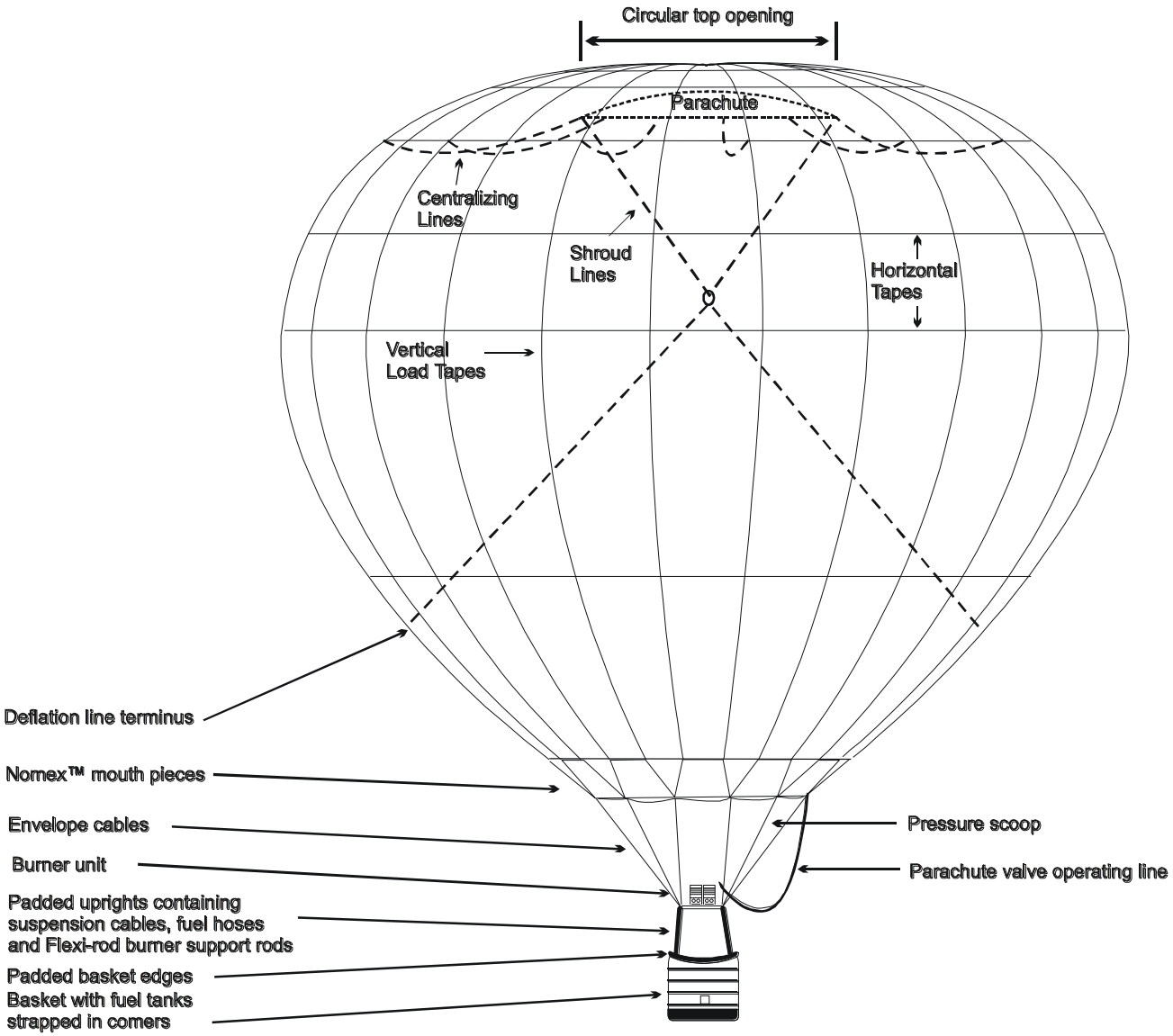

FIG. 1.1
GENERAL SCHEMATIC OF A CAMERON BALLOON
("N" TYPE SHOWN)

1.4 GENERAL

Cameron balloons manufactured in the United States are built under one of five Type Certificates: B1GL, B2GL, B3GL, B4GL or B1EU. These certificates cover the eight basic Cameron envelope types: "Concept", "O" and “M” series, "A" series, "N", “Z” and “ZL” series and "V" series and U.S. certified special shape balloons. These certificates also cover envelopes built with STC’s for other manufacturers baskets, burners and tanks.

Regardless of the series in question, the baskets, burners, fuel tanks and instruments are interchangeable from model to model with three notable exceptions:

(1) Some envelope sizes require a double, triple or quadruple burner (see the Type Data Sheet or the Operating Limitations in the Flight Manual for required burners for each model).

(2) Only CB250A or CB250B aluminum fuel tanks (MAST or STD) may be used in baskets having serial numbers less than 8800.

(3) Only certain baskets may use 20 gallon fuel tanks (see the Type Data Sheets Note 8 for specific lists.

NOTE:
Cameron Balloons assigns a part number and a serial number to each of the major components: envelope, burner, basket, instruments and fuel tanks. In addition, fuel manifolds are marked with a part number, but no serial number. The part number refers to an engineering drawing number and (usually) starts with "CB" or "CBUS" followed by several digits. After the digits is a letter code which specifies the drawing issue letter. In this manual and on the FAA Type Data Sheets, the issue letters are omitted. The issue letters are present as part of the identification in the aircraft flight manual and on the component itself. Unless the instructions provided call out a specific issue letter (as all the envelope gore charts in Appendix A), the description applies to all components carrying the drawing number, regardless of the issue letter. When making specific log book entries include the issue letter whenever possible.

1.5 ENVELOPES

The following applies to all model series:

Deflation Systems: The normal deflation system is the parachute valve, with a Smart-Vent™, Easy Vent or Velcro™ rip panel offered as options. Single or double rotational (turning) vents may be fitted on most models.

Scoops and Skirts: Nomex™ or nylon or Nomex™/nylon scoops or skirts may be attached at the mouth of the envelope. A scoop or skirt is normally attached at the mouth, but is not required equipment. These items are optional and have no mandatory maintenance or inspection standard provided the materials used for repair conform to the Maintenance Standard listed in Section 4.

Mouth panels: Mouth panels are from five inches to 60 inches in height. The mouth panel is normally made of Nomex™, but may be nylon or other approved fabric.

Turning (Rotational) Vents: Most Cameron Balloons standard shape and some special shape envelopes may be fitted with turning vents which cause the balloon to rotate about its vertical axis. These vents are located from just above to just below the envelope equator and in various gore locations depending on model.

Model Series

"Concept" Series: (Type Certificate B1GL)

The "Concept" series envelope is made of vertically-oriented panels. Each gore has left and right mirror-image panels. There are usually twelve panels in each gore, starting with panel "A" just above the Nomex™, and ending in panel "D" adjoining the parachute opening. The entire balloon is made up of 12 or 16 full gores. A 12-gore "Concept" series incorporates 12 suspension cables and a 16 gore "Concept" incorporates 16 cables. The suspension cables are rigged in groups of three or four at the corners of the burner frame.

"O" Series: (Type Certificate B1GL and B1EU)

The "O" series envelope has 12 moderately bulbous gores. Each gore is made of numerous horizontally-oriented panels. The twelve envelope suspension cables are rigged in groups of three at each corner of the burner frame.

"A" Series: (Type Certificate B2GL and B1EU)

The "A" series envelope has 20 slightly bulbous gores and is available in larger sizes only. Each gore is made of numerous horizontally-oriented panels. The 20 envelope suspension cables are rigged in groups of five at each corner of the burner frame.

"Z" & "ZL" Series: (Type Certificate B3GL)

The "Z" & "ZL" series envelopes have 24 slightly bulbous gores. Each gore is made of numerous horizontally-oriented panels. On 12 or V'd suspension cable models pairs of adjacent vertical load tapes converge at the envelope base to attach to one suspension cable. The twelve envelope suspension cables are rigged in groups of three at each corner of the burner frame. On 24 envelope suspension cable models they are rigged in groups of six at each corner of the burner frame.

"N" Series: (Type Certificate B3GL and B1EU)

The "N" series envelope is made of narrow vertically-oriented panels. Each gore has a left and a right mirror-image panel. There are usually eight panels in each gore, starting with panel "A" just above the Nomex™, and ending in panel "D" adjoining the parachute opening. The entire balloon is made up of from 24 to 36 gores. Pairs of adjacent vertical load tapes converge at the envelope base to attach to one suspension cable; for example, a 24-gore "N" series incorporates 12 suspension cables, a 28 gore "N" incorporates 14 cables, etc. The suspension cables are rigged in groups of three and/or four at the corners of the burner frame. Where groups of both three and four cables are used on a model, these alternate on adjacent burner frame corners.

"V" Series: (Type Certificate B4GL and B1EU)

The "V" series envelope has eight bulbous gores. Each gore is made of numerous horizontally-oriented panels. The eight envelope suspension cables are rigged in pairs at each corner of the burner frame.

Special Shapes: (Type Certificates B1GL, B2GL, B3GL, B4GL)

Cameron Balloons US manufactures a variety of special shape balloons. Most special shape balloons delivered by Cameron Balloons US have a U.S. standard airworthiness certificate. The rules of inspection applying to the "Concept", "O", "A", ‘M”, "N", “V”, “Z” & “ZL” series balloons also apply to special shapes, but additional inspections must be made of all the interior baffles, panels, air tubing, deflation port openings and stitching. **All special shape balloons MUST be Test Inflated as part of each annual/100 hour inspection**. A Test Inflation means, the envelope is fully upright with all appendages fully inflated.

1.6 BURNER AND FUEL SYSTEM

Cameron balloons, in the United States, have been approved with single, double, triple and quadruple burners. Refer to Section 6 for a complete list of part numbers and descriptions. The part number and serial number of these burners can be found etched into the side of a corner bracket on the MK III burners, the side of a burner can on the MK IV Standard, MK IV Super and MK IV Ultra burners and on a coil bracket on the Sirocco burners.

The burners have zero, one or two Whisper™ burners, which are auxiliary burners used to supplement the main burner, provide redundancy on all burners and serve as a quiet burner near livestock. All MK IV burners have the Whisper™ burner; the MK III burner may have a retrofit of a Whisper™ burner (Cameron part no. F193) which must only be installed by a repair station and documented via FAA Form 337.

1.7 BASKETS

A wide range of basket models are certified for use on Cameron balloons. These include the current Sport baskets, a selection of sizes of the more elegant Aristocrat baskets and several sizes of large partitioned baskets for passenger ride businesses. The open style baskets use the Cameron FlexiRigid™ burner support system or a fixed corner socket, which incorporates flexible nylon, lexan or other approved burner support poles. A few older balloons have baskets which incorporate flexible basket suspension cables only, without burner supports. All of the partitioned baskets use fixed corner socket burner frame

All Cameron baskets incorporate stainless steel suspension cables, which form continuous support cables woven through the floor of the bottom of the basket. The cable ends attach to carabiners (snaplinks) at the burner frame corners. The side walls of all Cameron baskets are woven. The floor of all Cameron baskets are either woven or made of marine grade plywood. An optional interior CushionFloor™ may be installed in the basket.

1.8 INSTRUMENTS

The instrument package fitted on most Cameron balloons is either the Ball Model 655 or Model M55 or the Flytec Model 3040 or Model 6040. The Ball instrument packs have digital altimeter and temperature, and analog variometer (VSI). The Flytec instrument packs have digital altimeter, digital wireless temperature and digital variometer (VSI). The M55 may also have the optional barograph recording feature. Also available was the Ball Model M59 or M53, which incorporate a wireless thermistor. Older balloons use an oak box instrument package with an analog variometer (VSI), analog thermistor device and analog altimeter. Some balloons (mostly older ones) use hanging "thermometer" style dial thermometers.

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SECTION 2

PREVENTIVE MAINTENANCE

WARNING! DANGER!
HAZADOUS CONDITIONS WHICH COULD RESULT IN INJURY OR DEATH MAY OCCUR FROM: **A. THE INSTALLATION OF NON-APPROVED PARTS OR MATERIALS** **B. MODIFICATION OF ANY PART** **C. IMPROPER REPAIR PROCEDURES** **D. IMPROPER OPERATION OF THIS AIRCRAFT** **APPROVED REPLACEMENT PARTS, MATERIALS AND REPAIR PROCEDURES ARE DOCUMENTED IN THIS MANUAL**

2.1 DOCUMENTATION OF WORK

Some repair and maintenance work may be completed by the owner/operator of the balloon, provided they hold a current FAA Pilot Certificate. The work which may be performed is listed under Sections 2.2 thru 2.7 below. All repair/maintenance items MUST be recorded in the aircraft log book. The entry must include (1) the date, (2) name and pilot certificate number of person who made the repair or who approved it, (3) the source of materials used in the replacement (with invoice number, if possible), (4) a description of work done and (5) the total hours on the balloon when work was performed. Samples of logbook entries are as follows:

Gore 5-6 panel F green, Pliobond patch 2" diameter. near tape 6. Fabric from original repair fabric kit. TT=105 hr. James Hendrix, Pilot Cert. # XXXXXXXX, 9-25-70

Reshaped basket with ropes; washed down basket, tanks. Replaced batteries in Ball variometer. TT=320.5 hr. Elvis Costello, Cert. # XXXXXXXXX, 3-29-96

Added banner ties on vertical load tapes 5, 6, 7 at seams G/H and L/M. Work done by Marty Smith using 3/4" flat tape, Cameron Balloons invoice # 12100. TT=22 hr. Kelly Ortel, Aug. 27, 1973, Pilot Certificate # XXXXXXXXX

Replaced Kevlar suspension cable #6 per Maint. Manual instructions. New cable from Cameron US, invoice # 100345. Cable Batch No. #89065 Stacy Collins, Sep. 20, 1974, certificate # XXXXXXXXX

All other work not specifically listed in Sections 2.2 thru 2.7 and completed in the U.S. on a Cameron Balloons U.S. balloon must be inspected and approved by an FAA Certified Repair Person:

2.2 CLEANING

Envelope: The envelope may be washed with clean water and mild soap (such as Woolite or other non-detergent soap) and **MUST BE DRIED COMPLETELY BEFORE PACKING AND STORING.** Drying **should not** be completed by adding heat. Heating the fabric while wet may cause coating damage. Load tape, internal rigging, Nomex™ and ropes will take considerably longer to dry than fabric. Even slightly damp load tape will cause severe mildew problems in the fabric in the area near the tape when the balloon is stored with damp tapes. Balloon fabric and load tape are susceptible to mildew, which changes the coating structure and causes porosity. Coating separation is caused by moisture combined with elevated temperatures, also increasing porosity.

CAUTION:
PACKING A BALLOON WET FOR AN EXTENDED PERIOD OF TIME (OVER ONE DAY) OR FLYING A WET BALLOON AT TEMPERATURES EXCEEDING 160°F WILL DO PERMANENT DAMAGE TO THE FABRIC and/or COATING.

Velcro™: The Velcro™ closure on Velcro™ deflation systems and the Velcro™ tabs on parachute deflation systems may be cleaned. The hook side may be cleaned by soaking in clean water and rubbing gently with hands. Stringy debris can be removed by brushing with a bristle brush, so as not to damage the hooks. Both sides may be cleaned with water only or water and a mild soap (as Woolite or Ivory), followed by thorough rinsing with clean water and **must be dried completely before packing or flying.**

Basket: The basket may be washed with clean water without detergents.

Tanks: The tanks may be washed, provided the liquid withdrawal valve is covered or plugged, the vapor quick release fitting is covered, and the excess pressure relief valve is covered.

Burner: The burner can, coils and corner brackets may be washed and polished using any commercially available stainless steel, brass or copper cleanser, providing that any metal brush or pad used is made of STAINLESS STEEL. If the stainless steel burner is polished with a non-stainless steel metal brush or scouring pad, metal particles may deposit onto the burner and will cause rust or corrosion to form on the burner coils. This rust or corrosion is not from the burner itself, but is nonetheless unsightly. Do NOT use abrasive cleaning compounds on the highly-polished stainless steel parts of the burner as these will destroy the mirror finish. Currently at the Cameron Balloons Factory in Michigan we use a product called Peek to clean burners. Peek is a product of Tri-Peek International Inc. of Conyers Ga. and is widely available throughout the country. DO NOT use any caustic cleanser on any enameled or anodized part as damage will result.

2.3 ENVELOPE

SCOOPS: Repairs to scoops may be made by a non-certified repair person providing sewn repairs utilize nylon or Nomex™ thread and nylon or Nomex™ fabric and nylon load tape for the perimeter. *Nomex thread may NOT be used in the envelope* because it is below minimum strength for structural parts. The owner-operator is required to inspect the repair and enter it in the balloon logbook per Section 2.1.

SUSPENSION CABLES: Existing Kevlar™ suspension cables may be replaced by the owner/operator as per instructions in Appendix E of the Flight Manual or Section 4 of this manual. We refer to this as "field replacement" of Kevlar™ envelope cables. Again, it is **mandatory** that suspension cables be replaced **BEFORE THE NEXT FLIGHT** if the outer cover is damaged enough to expose the interior Kevlar™ (milky yellow filament) core.

Kevlar™ and stainless steel envelope cables MUST **Not** be mixed on the same envelope.

NOTE:
Conversion from stainless steel to Kevlar™ cables MUST BE PERFORMED by a certified repair person. This manual refers to this as "retrofitting" of Kevlar™ envelope cables. Certificated Repair Persons should see Section 4 for instructions on replacing stainless cables with Kevlar Cables.

CAUTION:
Not all Hook and Loop Fasteners ("Velcro™" is the most commonly used term, although this is a brand name) are compatible and not all Velcro™ is acceptable in the balloon. Some Velcro™ closures have hooks which are sufficiently abrasive to damage the fabric in the balloon, and can pull out the sewing threads near the hooks. For selection of Velcro™ brands, contact Cameron Balloons U.S.

VELCRO™ TABS: Owner/operators may replace the Velcro™ tabs, which hold the parachute closed during inflation. Replacement should be done with identically sized and identically positioned Velcro™ tabs to those removed, paying attention to the position of the stitch line on the Velcro™, and how much "edge" is left on each side of the stitch line. For Velcro™ replacement instructions, see Section 4.25 and Appendix K.

PARACHUTE (RED) LINE (ROUND ONLY): The round parachute (red) line may be lengthened at the "pull" end by using the excess stored in the large loop at the end in the envelope (permanently tied off end) as outlined in Section 4.19. It is **not** permitted for a non-certified person to **splice** the deflation (red) line or to **tie** additional pieces to the deflation line. **IT IS NOT PERMITTED TO SHORTEN THE PARACHUTE LINE**. See discussion of parachute line length in Section 4.21. Repairs must be inspected and logged in the aircraft logbook by the owner-operator.

TURNING VENT CONTROL LINES: In order to replace a damaged lower end, a turning vent line (yellow, green, blue, or black line) can have a new section spliced in extending up to 25 feet from the end that attaches to the burner.

TURNING VENT FINGER LINES: The 1/8" lines that connect the control lines from the basket to the turning vent flaps are called Finger Lines. These lines may be spliced, providing the overall length remains approximately the same as before splicing (+/- 3 inches).

FABRIC: The fabric parts which can be repaired or replaced by the owner-operator do not have to be repaired in order for the balloon to remain in airworthy condition. However, it is strongly recommended that repairs be completed before the next flight if possible, to prevent extension of the hole to a size, which then requires a certified repair person to make the repair.

Repairs to the fabric portion of the envelope within 10 feet of the base Nomex™ panel or mouth opening (whichever is higher) may be made by a non-certified repair person, provided:

The repair is made using approved fabric, thread and techniques as outlined in Section 3 and Section 4;

The repair in no way requires replacing or unstitching any of the vertical or horizontal load tapes or any of the control devices, such as the pulley attachments or deflation line terminus, (with the exception that the thermistor line ties may be removed and/or replaced);

There is no damage to the vertical or horizontal load tapes or any control mechanism. Damage includes any cuts or abrasions in the vertical load tapes or control lines, or any hardening or melting of the vertical tapes caused by heat.

The repair is inspected by the owner-operator, and entered in the aircraft logbook.

Repairs higher in the envelope which may be made by uncertified persons are limited to the application of adhesive patches to cover holes not larger than 3/4" in diameter (See Section 4.4 and 4.5). **Larger holes MUST be repaired *BEFORE THE NEXT FLIGHT* by a certified repair person.**

Straight-line tears not exceeding two inches in length and not closer than two inches from a vertical load tape may be temporarily patched using a self-adhesive fabric tape (sticky-back fabric) which is sewn around the perimeter (hand-stitching is sufficient) according to directions in Section 4.5. These patches may be completed by a non-certified person (and inspected by the owner-operator, who must log the repairs in the aircraft logbook). **THE REPAIRS MUST BE INSPECTED AND POSSIBLY REPLACED DURING AN ANNUAL OR 100 HOUR INSPECTION BY A CERTIFIED REPAIR FACILITY. THE REPAIR FACILITY MUST INSPECT EACH OF THESE PATCHES FOR CONFORMITY TO REQUIRED STANDARDS.**

BANNER LOOPS and BANNER VELCRO™: Non-certified persons may sew small attachment tapes on the vertical load tapes for attaching banners. The attachment loops may be sewn by hand or by machine. Velcro™ may also be sewn on the horizontal tapes, which are on the interior, provided the stitch length is very long and thread tension very light, so that the new stitching does no significantly reduce the length of the panel. All stitching must be limited to the area of the load tape **between** the rows of stitching that attach the load tape to the fabric, and it is advisable to use a single row of stitching for both loops and Velcro™. The owner-operator is required to inspect and log these additions in the balloon logbook.

2.4 BURNER AND FUEL SYSTEM

Non-certified persons may replace fuel hoses and hose end fittings, which have been purchased as original equipment replacement parts from Cameron Balloons U.S., according to instructions in Section 6.7. The owner-operator is required to inspect the parts and log them in the balloon logbook.

Blast valve stems may be lubricated by spraying silicone lubricant onto the valve stem, where it protrudes from the bonnet. The stem area should be cleaned of any dust or debris prior to lubrication. In order to work the lubricant down into the stem seal, open and close the valve while spraying on the lubricant.

The lubrication portal on the Cameron MK IV Super, MK IV Ultra & Sirocco blast valve may be opened and lubricant introduced as described in Section 6.9. (Recommended approx. each 20 hours of operation).

The MK IV ULTRA burner Whisper™ valve may be lubricated as described in Section 6.9. (Recommended approx. each 20 hours of operation).

The MK IV ULTRA burner has a fuel filter attached either to the vapor fuel hose-manifold block interface (vapor fed) or to the blanking plug (liquid fed). This filter may be removed and cleaned with a solvent such as trichloroethane as described in Section 6.25. The SIROCCO burner has a filter screwed directly into the manifold block. See Appendix G, Figs. 1 & 2. It may cleaned as above, see Appendix G Section H.

The MK IV ULTRA & SIROCCO burner Pilot Light Jet may be removed and cleaned as described in Section 6.25 & Appendix G Section I.

Burner jets may be tightened or replaced as outlined in Section 6.8.

Bolts, friction washers and nuts connecting the inner frame to the burner, the outer frame to the inner frame or any aprt of the Gimbal Block may be replaced using original equipment replacement parts from Cameron Balloons U.S. See Section 6 for appropriate part numbers. The tightness of the gimbal may be adjusted.

All components of the piezoelectric ignitor may be replaced using parts provided by Cameron Balloons U.S., as outlined in Sections 6.26, 6.27, 6.28 or Appendix G.

Methanol may be added, via the refueling hose, to the fuel tanks between flights.

CAUTION:
The fuel tank must be completely evacuated before methanol may be added. As an alternative method, an adaptor may be fabricated to introduce methanol during refueling.

The stem and check valve parts of the liquid withdrawal valve on the tanks and the hose end fitting interior may be lubricated with silicone spray.

Electric tank heaters and tank jackets may be installed according to directions in Section 6.38. If tank heaters other than 168 or 180 watt units provided by Cameron Balloons US are installed, the heating time chart in this manual and the Flight Manual is inaccurate. The pilot must otherwise determine safe heating times and update the Flight Manual heating times accordingly.

2.5 SUSPENSION SYSTEM

Non-certified persons may replace the snaplinks (carabiners #B111) with snaplinks (carabiners) provided by Cameron Balloons U.S. as original equipment replacement parts. The owner-operator is required to enter the installation of the new carabiners in the balloon logbook. **SUBSTITUTION OF CARABINERS EXCEPT AS SPECIFIED IN THE TYPE DESIGN MAY BE DANGEROUS, IS ILLEGAL, AND IS PROHIBITED.**

Non-certified persons may replace or remove the rubber or nylon grommets between the FlexiRigid™ pole retaining sleeve and the corner bracket on the burner frame. The bolt in this position may be replaced with a quick-pin, Cameron Balloons part No. B037. The entire retaining sleeve and bushing assembly may be removed completely, and the balloon may be operated without FlexiRigid™ poles. Replacement of the grommets or the retaining sleeve must be inspected and entered into the balloon logbook by the owner-operator.

FlexiRigid poles **MUST** be replaced with Cameron Balloons supplied FlexiRigid poles **ONLY**. Non-shouldered FlexiRigid poles, used in most partitioned baskets, may be fabricated from stock material provided by Cameron Balloons ONLY.

2.6 BASKET

The basket may be varnished using a polyurethane varnish diluted to about 50% normal strength. The exterior of the basket may be varnished, but the interior should not be varnished (varnishing the entire basket prevents re-moistening of the rattan). The basket must not be used until the flammable solvent has completely evaporated and the varnish is completely dry. Generally the lack of **any** residual solvent odor is a good indicator of this.

The basket may be re-shaped by using tensioning ropes to pull in bulges in the wicker, soaking the wicker with water, and allowing it to dry before removing the ropes which are holding it in the correct shape. When adjusting the ropes, slightly over correct the distortion to allow for spring back when the ropes are later removed. The basket will retain the shape in which it dries, except that it will spring back slightly in the direction it had been distorted by use.

The basket wicker should be soaked with water every few months, and more frequently in arid climates.

Repairing or replacing the leather or fabric bolster on the top edge of the basket, and repairing or replacing the leather or rawhide scuff piece at the bottom edge of the basket is permitted, provided that the skids on the floor are not removed, and provided that there is no modification or damage to the suspension cables.

Broken vertical wicker may be reinforced with nylon rods as outlined in Section 7.5, provided there are no more than two vertical pieces of wicker broken between three pieces, which are unbroken on each side. If more than three contiguous vertical pieces are replaced in the repair, the repair work must be inspected and certified by an FAA Certified Repair Station.

Broken horizontal wicker pieces may be replaced as outlined in Section 7.6. Replacement of a section larger than 12 inches in the horizontal direction and 1 inch in the vertical direction must be inspected and certified by an FAA Certified Repair Station.

Broken skids **MUST** be replaced by a certified repair person. If the break occurs AT or INSIDE the outermost bolts, or if the break exposes a bolt that could impinge on the bottom of a tank, the skid **MUST** be replaced before the next flight.

Single skids with a break outside the outermost bolts **MUST** be replaced during the annual or 100 hour inspection, but need not be replaced between inspections. If more than one skid is broken, whether an interior or exterior skid, regardless of the location of the break, the skids must be replaced before the next flight by a Certified Repair Person.

External toggle style handles on Sport Baskets may be replaced or repaired with rope and wooden toggles supplied by Cameron Balloons U.S.

2.7 INSTRUMENTS

Any battery in any instrument may be replaced. The owner-operator is required to enter the replacement of the batteries in the balloon logbook.

Owner-operators may clean or dry the instrument case and instruments.

Owner-operators may remove and replace the thermistor line from the envelope or basket per instructions in Section 4.17.

SECTION 3

ENVELOPE: MATERIALS SPECIFICATIONS

WARNING! DANGER!
HAZADOUS CONDITIONS WHICH COULD RESULT IN INJURY OR DEATH MAY OCCUR FROM: **A. THE INSTALLATION OF NON-APPROVED PARTS OR MATERIALS** **B. MODIFICATION OF ANY PART** **C. IMPROPER REPAIR PROCEDURES** **D. IMPROPER OPERATION OF THIS AIRCRAFT** **APPROVED REPLACEMENT PARTS, MATERIALS AND REPAIR PROCEDURES ARE DOCUMENTED IN THIS MANUAL**

The envelope consists of: (1) fabric, which keeps the air from escaping, (2) vertical load tapes and Kevlar™ or stainless steel envelope cables, which support the weight of the system, (3) the envelope controls, which are used to maneuver the balloon and (4) a PressureScoop™ ("scoop", for short) or skirt attached to the base of the envelope, made from Nomex™ and/or nylon. The fabric portion is by far the most commonly damaged part of the balloon system.

CAUTION:
As with all aircraft, repairs to the balloon, in general, require that the same standards of airworthiness be applied after a repair as after original equipment manufacturing. Therefore, the same fabric, thread and sewing techniques used during construction **MUST** be used during repairs. It is also mandatory that repairs result in the *same shape and stressing* of the original design.

3.1 FABRIC

Fabric used to repair a balloon envelope must: (1) be acquired from Cameron Balloons U.S. or (2) meet the Cameron Balloons U.S. materials specifications. If Cameron-supplied fabric is used for repairs requiring more than 50 yards of fabric, the Cameron Balloons U.S. invoice number and fabric batch number for the replacement fabric must be entered in the balloon log book. For all repairs done in fabric not acquired from Cameron Balloons U.S., a copy of the required tests results must be attached to the **FAA SUPPLEMENTAL TYPE CERTIFICATE (STC) OR FAA FORM 337, WHICH MUST BE FILED TO CREATE A LEGAL REPAIR**. The required reports are fabric tensile and tear strengths, yarn composition, weave specification, thread count, porosity, heat and ultraviolet resistance. The test results must be from a Certified Testing Laboratory or a certified laboratory associated with a fabric mill or fabric finishing company and approved by Cameron Balloons US.

Details of the tests required will be furnished on request by Cameron Balloons U.S., as they are variations of Federal Test Method Standards too lengthy to reproduce here. Fabric specifications undergo revisions frequently.

3.2 THREAD

All envelope sewing must be done using nylon size 69 thread, twisted. For ease of stitching inspection, the color of thread should be of contrasting color to the fabric and load tapes. The tensile strength of thread must be 6 pounds or greater. Polyester thread, of 6 pounds or greater tensile strength, commonly used by other balloon manufacturers may also be used if absolutely necessary, however Cameron U.S. does not offer polyester thread.

Nomex™ thread may be used on scoop and skirt repairs, but **MUST NOT** be used elsewhere in the envelope, **INCLUDING** the Nomex™ area at the base of the envelope.

UNDER NO CIRCUMSTANCES USE COTTON, POLYESTER/COTTON OR MONOFILAMENT NYLON THREAD.

3.3 LOAD TAPE-VERTICAL (VLT)

Load tape used for repairs of vertical load-bearing tapes in the envelope **MUST** be the same specification, width and strength as the load tape being repaired. Further, it **MUST** meet minimum strengths specified by Cameron Balloons for that width load tape. Load tape ordered from Cameron Balloons U.S. should include envelope serial number (or registration number) to match the specification of the tape used on the balloon to be repaired. Nylon tubular load tape purchased from any source other than Cameron Balloons U.S., must have a Certificate of Compliance with Military Specification MILW5625 obtained from the supplier. A copy of the Certificate of Compliance and a copy of the supplier's invoice relating the Certificate of Compliance to the load tape shipment must be filed with the repair records and the FAA Form 337 for the balloon being repaired.

Load tape patching is rarely necessary but when necessary, is usually part of an otherwise time-consuming repair. It is best to order necessary load tape, when needed, by envelope serial number directly from Cameron Balloons U.S. All necessary load tapes are stocked in large quantities by Cameron Balloons and can be shipped to arrive at most places in the U.S. the next day. This process assures that you have the correct load tape for the repair at hand.

3.4 LOAD TAPE - HORIZONTAL (HLT)

Horizontal load tapes are placed in the balloon to (1) prevent tears from propagating over large sections, and (2) to reinforce attachment points and other points which have higher stress than surrounding unloaded fabric. All horizontal load tapes used must meet Military Specification MILW4088 Type Ia or Type II for nylon tape or Cameron specification CBL/SPEC/DCB/27. Either 3/4" or 1" tape is used on all Cameron model envelopes. The width of load tape used for the repair must be the same as the width of the tape being repaired. Nylon flat load tape purchased from any source other than Cameron Balloons U.S. must have a Certificate of Compliance with Military Specification MILW4088 or Cameron specification CBL/SPEC/DCB/27 obtained from the supplier. A copy of the Certificate of Compliance and a copy of the supplier's invoice relating the Certificate of Compliance to the load tape shipment must be filed with the repair records and the FAA Form 337 for the balloon being repaired. ***CAUTION*:** Tape weave largely determines the shrinkage of tape. Tape shrinkage causes wrinkles and non-standard size for panels, which can increase stress loads in adjacent fabric.

3.5 SUSPENSION CABLES - STAINLESS STEEL

Stainless steel suspension cables (E015B for black heat-shrink covering, or E015R for red heat-shrink covering) are 4 mm stainless steel 7 x 7 construction. The thimbles in the ends of the cables are for 6 mm cable so that the eye of the thimble is large enough to easily fit onto the carabiner. The cable is attached with a sewn load tape backsplice or "turnback", as described in Section 4.10 and in Fig.4.10. This joint is protected with a 3" to 4" wide nylon web tape cover that greatly reduces chances of heat damage to the load tape/cable joint. Damaged stainless steel cables should be replaced only with pre-assembled stainless steel envelope cables acquired from Cameron Balloons U.S. (If multiple cables have been damaged, it may be an appropriate time for the owner/operator of the balloon to consider having the envelope retrofitted with Cameron Kevlar envelope cables).

The 4 mm stainless steel 7x7 wire can be swaged using the Nicopress ferrule 428-5-VP (E132) and three equally-spaced compression's using Nico tool 51-P-850.

CAUTION:
DO NOT USE ANY OTHER SIZE OF CABLE, SLEEVE, OR SWAGING TOOL. Because incorrect cable assembly -- especially swaging -- can create a most critical hazard to occupants of the basket during balloon operation, you should acquire factory-assembled envelope cable assemblies from Cameron Balloons when envelope cables need to be replaced.

3.6 SUSPENSION CABLES - KEVLAR™

The Cameron Kevlar™ suspension cable consists of a 1/4 inch braided Kevlar™ core covered with a braided polyester sheath to protect the core from ultraviolet light and abrasion. These cable assemblies are available **ONLY** from Cameron Balloons U.S. **KEVLAR™ CABLES MUST BE REPLACED IF THE INNER CORE (A SOFT YELLOW COLOR FIBER) IS VISIBLE IN ANY LOCATION OR ANY OF THE LOCK STITCHES AT EITHER END OF THE CABLE ARE BROKEN**. Damaged Kevlar™ cables may be replaced by the owner/operator. Because the removal of the stainless cables can easily damage the load tape attachment loop, **RETROFITTING OF THE KEVLAR™ CABLES IN PLACE OF STAINLESS STEEL CABLES MUST BE PERFORMED BY A CERTIFIED REPAIR STATION**.

Each Kevlar™ cable from Cameron Balloons is shipped with an identification tag, which contains information which will be useful if there were a subsequent problem with the cable. When installing the cable, note **on the tag** which vertical load tape this cable is being installed on and attach the tag to your repair record for the balloon. The retrofitted or replacement cable batch number **MUST** be entered in the log book with the specific vertical load tape (VLT) to which it is attached. For example: **"Cameron Balloons cable #88202 installed on VLT #12, Signature, Pilot Certificate # and Date".**

3.7 PARACHUTE ACTIVATION ("RED ROPE") LINE

The parachute activation ("red") line (E023, sold “per foot”) is constructed of an inner core of braided 1/4" or 3/16" Kevlar™ with an outer cover of 5/16" or 1/4" red-dyed soft spun polyester. In the event that the parachute activation line is exposed to direct flame, the Kevlar™ will likely retain adequate strength to operate the parachute system, although the outer cover may be melted away. It is mandatory before the next flight to recover or replace the exposed Kevlar™ if the yellow core is exposed. If the Kevlar™ core is undamaged a temporary solution (until the Annual Inspection is performed) is, the damaged rope can be covered with nylon adhesive tape (available as first aid tape in drugstores), provided the total length of the damaged section does not exceed 6 feet and provided the damage is ONLY in the lowest 20 feet of the line. Damage above this point MUST be repaired by a repair person before the next flight. The outer cover (E124) over the Kevlar™ core, may be replaced (it’s very time-consuming) provided the core is essentially undamaged and the area is small. **NO ALTERNATIVE LINE IS APPROVED AS THE PARACHUTE ACTIVATION LINE**. The only splices or knots permitted in the deflation line are specified in Section 4.16 and 4.18.

3.8 SMART VENTTM & EASY VENTTM ACTIVATION ("RED FLAT") LINE

The Smart Vent™ & Easy Vent™ activation ("red flat") line (E127, sold "per foot") is constructed of an flat inner core of Kevlar™ woven with a Nomex™ cover. In the event that the Smart Vent™ & Easy Vent™ activation line is exposed to direct flame, although the outer cover may be burned away, the Kevlar™ will likely retain adequate strength to operate the Smart Vent™ or Easy Vent™ parachute system. It is mandatory before the next flight to recover or replace the exposed Kevlar™ if the yellow core is exposed. If the Kevlar™ core is undamaged a temporary solution (until the Annual Inspection is performed) is, the damaged rope can be covered with nylon adhesive tape (available as first aid tape in drugstores), provided the total length of the damaged section does not exceed 6 feet and provided the damage is ONLY in the lowest 20 feet of the line. Damage above this point MUST be repaired by a repair person before the next flight. **NO ALTERNATIVE LINE IS APPROVED AS THE SMART VENT™ & EASY VENT™ PARACHUTE ACTIVATION LINE**. The only splices or knots permitted in the Smart Vent™ & Easy Vent™ deflation line are specified in Section 4.22.

3.9 PRE-VENT LINE

The line for the **Pre-Vent** is a white 3/16" or 1/4" polyester line (E032, sold "per foot") with a braided spun polyester cover.

The vent line is permitted to have a knotted splice up to 10 feet from the terminus and 6 feet below the lower pulley. The only splicing knot which may be used is the water knot (See Section 4.16), however; if the line is damaged, it is best to entirely replace it with a new line acquired from Cameron Balloons U.S.

3.10 TURNING VENT LINES

Turning vent lines are spun polyester-covered 1/4" lines, color coded for direction. Blue (now obsolete) or Black (E032B, sold "per foot") are interchangeable. Yellow (now obsolete) or Green (E032G, sold "per foot") are interchangeable.

The turning vent lines may be spliced from the pull end upwards no more than 25 feet. The only splicing knot which may be used is the water knot (See Section 4.16), however; if the line is damaged, it is best to entirely replace it with a new line acquired from Cameron Balloons U.S.

The upper lines, "finger lines", in the turning vent are constructed of 1/8 inch braided polyester line (E067, sold "per foot") which has been pressure-heated to 275˚F for complete shrinkage. Alternatively, 3/32 inch or 1/8 inch braided Kevlar™ line (E130, sold "per foot") is used. These lines may be spliced with a matching type of line at any point in their length, provided the overall length remains the same (plus or minus 3 inches). The only knot which may be used to splice the turning vent upper lines is the water knot, Section 4.16.

3.11 PULLEYS - DEFLATION AND VENT SYSTEMS

Only Cameron Balloons U.S. pulleys part numbers E010, E011, E011M, E011S and E011V may be used. These pulleys have been tested for strength, heat resistance, and function.

Pulleys E011S and E011V are for Smart Vent™ & Easy Vent valve centering lines ONLY. These pulleys are designed to withstand the conditions which are likely to exist in a hot air balloon envelope and take the load to which they are likely to be subjected to in use. Experience has shown that other types of pulleys are unable to withstand heat and may bind or break, either of which could create a serious hazard to occupants of the balloon or to others.

CAUTION! DANGER!
Substitution of other pulleys is not approved and may create the risk of a control line jamming in flight, resulting in serious injury or death to balloon occupants.

3.12 VALVE CENTERING LINES AND SHROUD LINES - PARACHUTE, SMART VENT™ & EASY VENT™

The valve centering lines (VCL's) and shroud lines are either 1/8 inch braided polyester line which has had the sizing removed and has been pressure-heated to 275˚F, (E067, sold "per foot") or 3/32 inch to 1/8 inch braided Kevlar™ line (E130, sold "per foot").

KEVLAR™ LINE MUST NOT BE USED WITH THE SMART VENT™ & EASY VENT™ DEFLATION SYSTEM. Kevlar™ is not designed for small-radius bending as is required by the Smart Vent™ & Easy Vent™ pulleys. **VALVE CENTERING/SHROUD LINES ON SMART VENT™ & EASY VENT™ MUST NOT BE SPLICED**. Since the Smart Vent™ & Easy Vent™ uses pulley activation, splices in the line may bind in the pulleys.

Valve Centering Lines on standard parachutes may be spliced by using a water knot. A water knot may be used to splice standard parachute shroud lines or valve centering lines at any point, provided the length is unchanged (plus or minus 2 inches on shroud lines; plus or minus 1 inch on valve centering lines). Repair of a damaged line may require splicing in a short new piece using a water knot at each end of the new piece. For water knot see (See Section 4.16).

3.13 CROWN RING

If the crown ring (E001, E001C or E001T) shows any sign of roughness or has burrs which could damage the vertical load tapes, it must be sanded completely smooth or replaced. The crown ring may be used to attach top tether lines (NOT RECOMMENDED FOR SMART VENT™ EQUIPPED BALLOONS), **provided NO METAL PARTS ARE USED IN THE ATTACHMENT**. Up to three additional loops of load tape may be sewn, equally spaced, onto the crown ring. Metal fasteners may then be attached to the extra load tapes for top tethering, provided the metal attachments will not come into contact with the crown ring itself.

3.14 ENVELOPE TEMPERATURE INDICATOR LABELS

NOTE:
NEVER REMOVE OLD TEMPERATURE LABELS FROM THE ENVELOPE OR PARACHUTE. REMOVAL OF THE TEMPERATURE LABELS WILL VOID THE WARRANTY! RECORD THE HIGHEST TEMPERATURES OF MOST RECENT LABELS *AND THE HIGHEST TEMPERATURE EVER REACHED* INTO THE LOG BOOK AS PART OF THE DOCUMENTATION OF THE INSPECTION.

The temperature indicator labels indicate whether the following temperatures have ever been reached at the location of the indicator label: 225°F, 250°F, 275°F and 300°F. The temperature indicator dot remains silver until it has been heated to the temperature shown. When the temperature shown is reached, the dot turns and remains black. The labels (E012 or E012N) may be purchased from Cameron Balloons U.S. or directly from the label manufacturer. Only labels with the above temperature range may be used.

Each envelope must have **TWO LABELS ADDED AT EACH ANNUAL OR 100 HOUR INSPECTION**. One each, adjacent to the labels already installed at these two locations: (1) the edge of the center patch in the parachute or rip panel; (2) on Vertical Load Tape #3 (#3R on "N", "Z" and "ZL" series balloons) approximately 6-10 feet below the opening of the parachute/rip panel and near the label installed by the factory. The back side of both newly installed labels must be identified with (1) the date of installation, (2) name and number of the repair station and (3) total hours on the balloon at the time the new label is installed. The labels must be wrapped in a porous white or light-colored fabric (acceptable: a piece of nylon hosiery). The fabric is then sewn to the envelope in a manner which allows the label to hang freely, i.e. the label must not be sewn directly to the envelope. A repair station is required to *enter into the aircraft log book* as part of the requirements of the 100 Hour/Annual Inspection the highest turned temperature dots (one temperature from each of two locations) on the most recent previously installed labels (along with the date of the previous installation), and the HIGHEST temperature recorded on all the labels. Example: "*Temperature label on VLT 3R = 250°F, on center patch = 250°F, dated 12/10/95. Highest temperature recorded = 275°F, label dated 11/10/92*"

3.15 THERMISTOR WIRE

The cable for the Telemax meter-type thermistor (I033C) is no longer available from Cameron Balloons U.S. but may be purchased at an electrical supply center. Unlike thermocouple-type temperature cables, the length is **not** critical to the accuracy of the instrument. The cable used is two conductor and must be able to withstand 300°F temperatures without failure or rapid deterioration. If you use locally obtained wire, be cautious to obtain a wire with good tensile strength to resist possible mechanical damage in ground handling.

The thermistor wire for the Ball 655 & M55 (I0012, 90 ft.) or (I0029, 120 ft.) is a teflon insulated, two-conductor shielded cable with an additional outer layer of teflon insulation. The length is not critical to the accuracy of the instrument, however this is a shielded cable and must be replaced with a similar shielded, heat-resistant cable. Complete replacement cable assemblies and/or connectors only (I0019 for the connector at the top of the basket cable, I0015 for the connector that attches the internal temperature probe to the envelope cable, or I0026 for the connector at the base of envelope cable) may be obtained from Cameron Balloons U.S..

3.16 NOMEX™ - BASE PANELS

The fabric used in the base panels of the envelope is approximately 6 ounce poplin or twill weave Nomex™ fabric. Damaged Nomex™ does NOT need to be repaired to make the balloon airworthy. Damage to adjacent load tapes, however, will make the balloon un-airworthy, and therefore damaged Nomex™ areas should be carefully inspected to see if the load tape near it is brittle or burned.

Repairs to the Nomex™ which DO NOT INVOLVE UN-STITCHING THE FABRIC FROM THE LOAD TAPE(S) may be completed by non-certified persons. Repairs can include cutting holes in the Nomex™, patching holes in the Nomex™, or applique of Nomex™ or Nylon over the Nomex™. The repair or patch specifications, however, must conform to the Envelope Repair Methods described in Section 4.

Some decorative paint or ink may be put onto the Nomex fabric by non-certified persons, provided the paint or ink is non-flammable after solvents are dried out.

UNDER NO CIRCUMSTANCE MAY NOMEX™ THREAD BE USED IN ANY PART OF THE ENVELOPE ITSELF. Only the Nylon or polyester thread approved for the envelope may be used in this part of the envelope.

3.17 SCOOP AND SKIRT

The Nomex™ fabric used in the scoop or skirt is approximately 6 ounce poplin or twill weave Nomex™ fabric. The skirt or scoop may be sewn with Nomex™ thread, but UNDER NO CIRCUMSTANCE MAY NOMEX™ THREAD BE USED IN ANY PART OF THE ENVELOPE ITSELF.

THE SCOOP OR SKIRT IS OPTIONAL EQUIPMENT. Damage to a scoop or skirt may remain unrepaired as long as the damage does not allow the scoop or skirt to interfere with burner operation. For example, a rip which allows fabric to come too close to the burner must be repaired or the scoop or skirt must be removed before the flight. Repairs to a scoop or skirt may be done by non-certified people.

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SECTION 4

ENVELOPE REPAIR METHODS

WARNING! DANGER!
HAZADOUS CONDITIONS WHICH COULD RESULT IN INJURY OR DEATH MAY OCCUR FROM: **A. THE INSTALLATION OF NON-APPROVED PARTS OR MATERIALS** **B. MODIFICATION OF ANY PART** **C. IMPROPER REPAIR PROCEDURES** **D. IMPROPER OPERATION OF THIS AIRCRAFT** **APPROVED REPLACEMENT PARTS, MATERIALS AND REPAIR PROCEDURES ARE DOCUMENTED IN THIS MANUAL**

4.1 NEEDLE SIZE

All fabric-to-fabric stitching must be done with a size 120 or smaller needle. The preferred size is 110.

4.2 SEAM TYPE

A) ORIGINAL SEAM TYPE

All original fabric-to-fabric seams used throughout the Cameron balloon are French-fell (also called double lap seam). This seam appears in Fig. 4.1.

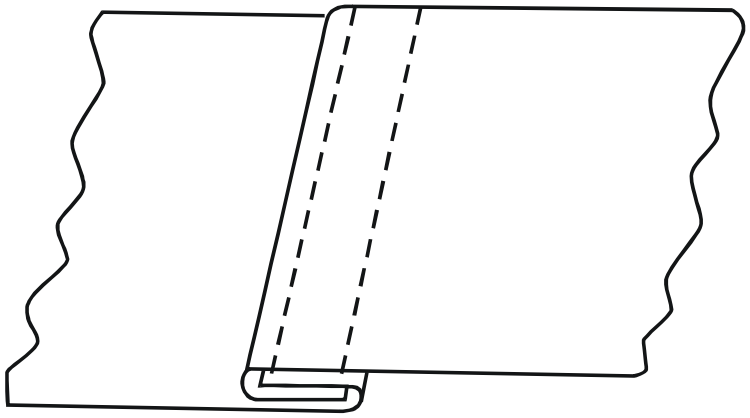


FIG. 4.1
FRENCH-FELL SEAM (Double Lap Seam)

Full and partial panel repairs must be made using a French-fell seam or the partial-fell seam as detailed in Fig. 4.2(a) and 4.2(b) below.

B) ALTERNATIVE REPAIR SEAM

Cameron Balloons allows a seam style which leaves the original French-felled seam intact and uses the replacement fabric, sewn in a folded attachment method, to protect the new fabric edge against fraying. This seam type is approved for partial and full panel replacements, provided **NO RAW FABRIC EDGES** are exposed in the process of creating these seams or joints with existing seams. Requirements for stitch length, stitch type and stitch separation remain the same as for all Cameron sewing.

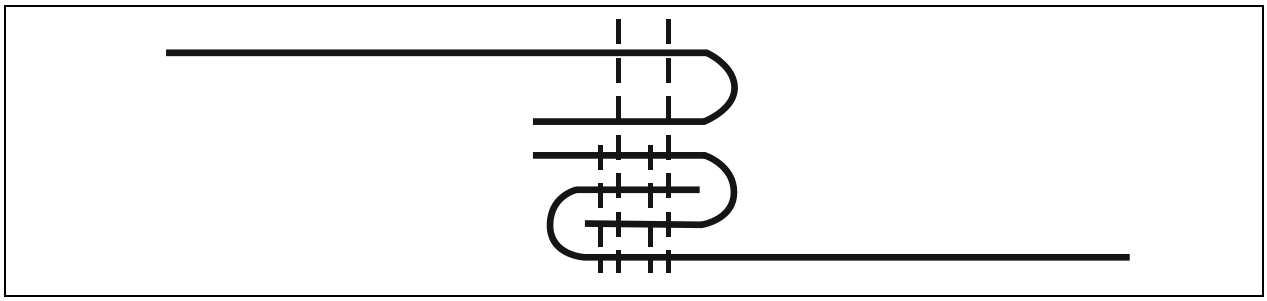


FIG. 4.2(a)
CUT-AWAY FRENCH-FELL SEAM
WITH NEW FABRIC FOLDED AND
SEWN ONTO BACK OF FRENCH-FELL SEAM

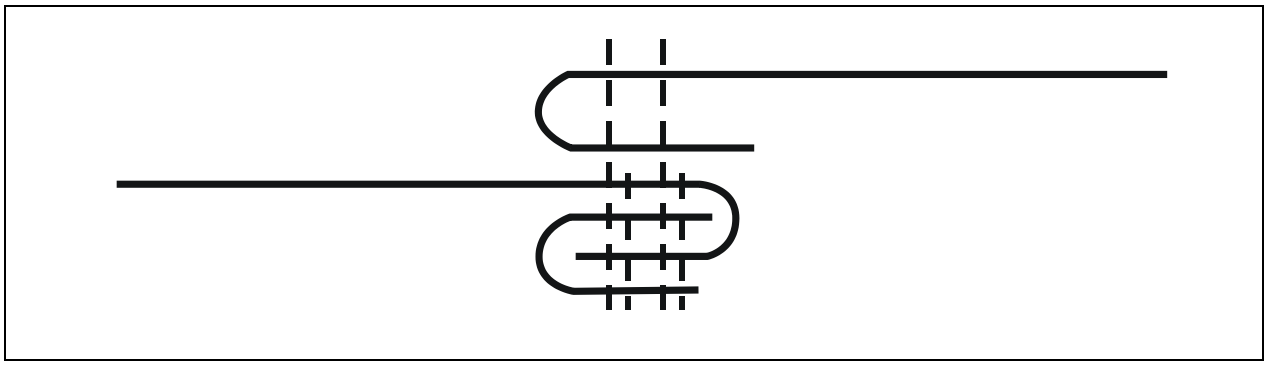


FIG. 4.2(b)
CUT AWAY FRENCH-FELL SEAM
WITH NEW FABRIC FOLDED AND
SEWN ONTO FRONT OF FRENCH-FELL SEAM

The sewing described here permits only ONE layer of fabric be attached in this method. If a patch is created and then a second patch needs to be created over the first patch, the stitching and fabric from the first patch **must** be removed before creating the seam described here. In other words, the original French-fell seam is created from two separate pieces of fabric. The repair described here adds a third piece of fabric. No more than three pieces of fabric can be involved in any single seam which is not French-fell.

4.3 STITCH TYPE

A lock stitch, 6-10 stitches per inch (6-8 stitches per inch preferred), **MUST** be used in all repairs. See Section 3.2 THREAD for the specification of the thread which must be used. The lock stitch appears in Fig. 4.3.

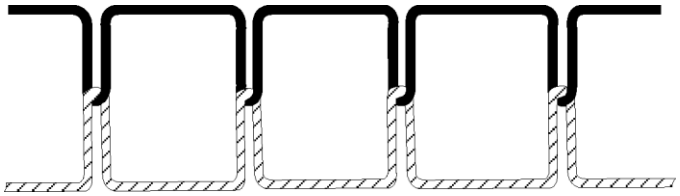


FIG. 4.3
LOCK STITCH (Profile view)

4.4 ADHESIVE PATCHES - RIPSTOP AND HYPERLAST FABRIC

Fabric tears and holes less than 1/2" in any one direction may be repaired by cementing a patch over the hole.

NOTE:
Contact cement patches will not stick to Hyperlast™ or other slippery fabrics. Hyperlast™ must have these holes repaired with a silicone based adhesive patch as described below (Section 4.4 B) or by using balloon fabric (non-adhesive) cut to the same size as the adhesive patch described in Section 4.5 and stitched around the perimeter.

Adhesive patches may be used for patching holes up to 2" in diameter or straight-line cuts up to 2 feet in length. The adhesive-backed fabric patch must overlap the damaged area by at least 1 inch in each direction. Adhesive patches larger than 1/2” in any one direction MUST be sewn with a single or double row of stitching within 1/8" to 3/8" of the outer perimeter, and MUST also be sewn close to the damage edge.

A) Duraflight & Caliber - Contact Cement Patches

Contact cement patches should be cut with a 3/4" border formed around the farthest point of damage. If the tear is so close to a seam or vertical load tape that the 3/4" overlap is not possible, the patch should be applied on the interior of the envelope and sewn along the edge where it cannot make a sufficient overlap. If sewing is necessary, the stitching should begin approximately 2" from the edge of the patch and continue approximately 2" beyond the other patch edge. No backstitching is necessary unless it can be done without causing puckering of the fabric. Contact cement type patch applications may be completed by hand sewing when a machine is not available.

The contact cement patch should be cut from (matching) balloon fabric. The cement should be applied to both the balloon fabric and the patch, per the instructions of the adhesive manufacturer. Any flexible contact cement intended for use on nylon fabric may be used. Commonly available nylon fabric cement or cement made for rubber patching, such as Pliobond™ (a Goodyear product), may be used.

The patch should be applied with a smooth, hard surface underneath the fabric. When the patch is positioned correctly (the ripstop pattern of the patch and the balloon fabric are aligned) the patch should be rolled over with a small wallpaper seam roller. The patch may be applied on either the inside or the outside of the envelope.

B) HYPERLAST - SILICONE ADHESIVE Patches

Silicone Adhesive patches should be cut with a 3/4" border formed around the farthest point of damage. If the tear is so close to a seam or vertical load tape that the 3/4" overlap is not possible, the patch should be applied on the interior of the envelope and sewn along the edge where it cannot make a sufficient overlap. If such sewing is necessary, the stitching should begin approximately 2" from the edge of the patch and continue approximately 2" beyond the other patch edge. No backstitching is necessary unless it can be done without causing puckering of the fabric. Silicone Adhesive type patch applications may be completed by hand sewing when a machine is not available.

The silicone adhesive patch should be cut from (matching) balloon fabric. A thin layer of adhesive should be applied to both the balloon fabric and the patch. Any clear non-hardening silicone based adhesive may be used. This adhesive is obtained at any hardware store.

The patch should be applied with a smooth, hard surface under the fabric. When the patch is positioned correctly the fabric pattern of the patch and the balloon fabric should be aligned. The patch should then be sandwiched between two pieces of high density foam rubber and a heavy weight placed on top of it. The weight should remain on the patch until the adhesive has cured. The patch may be applied on either the inside or the outside of the envelope.

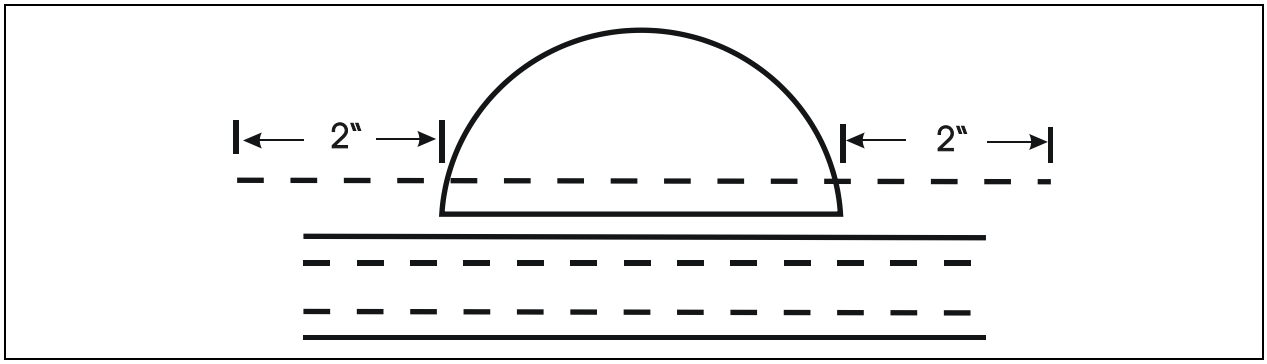


FIG. 4.4
CONTACT CEMENT AND SILICONE ADHESIVE TYPE PATCH WHEN CLOSE TO SEAM
(SEWING REQUIRED)

4.5 ADHESIVE-BACKED FABRIC PATCHES - DURAFLIGHT & CALIBER FABRIC

Adhesive backed nylon or polyester fabric ("stickyback" fabric) may be used for patching holes up to 2" in diameter or straight-line cuts up to 2 feet in length. The adhesive-backed fabric patch must overlap the damaged area by at least 1 inch in each direction.

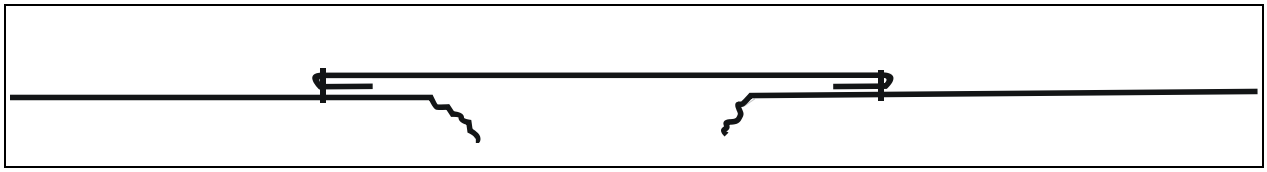
NOTE:
Adhesive-backed fabric patches larger than the size allowed in Section 2, *Preventive Maintenance* MUST be sewn with a single or double row of stitching within 1/8" to 3/8" of the outer perimeter, and MUST also be sewn close to the damage edge.

4.6 BALLOON FABRIC SEWN INLAY PATCHES

Holes of any size and contained within a single panel may be repaired by a patching technique which requires a single needle sewing machine. The ripstop or weave in the patch applied must align with the ripstop or weave in the panel being repaired. Use the rip-stoppers or other identifiable straight yarns as a guide. Install the patch as shown below in figures 4.6(a) thru 4.6(d).

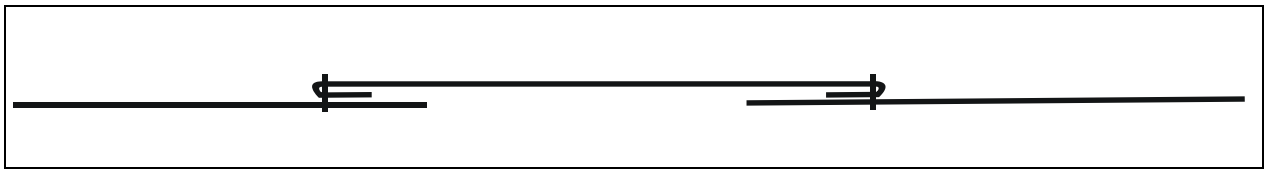
The seam technique is as follows:

A) Cut the patch to shape, fold the edges over 1/2" and sew: - FIG. 4.6(a).



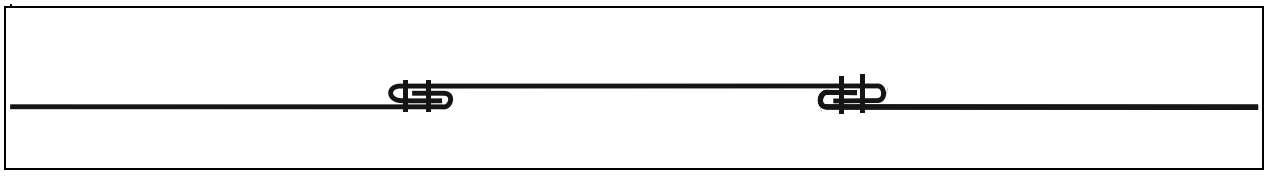
ATTACH PATCH WITH SINGLE NEEDLE
FIG. 4.6(a)

B) Cut out the damaged area from the inside surface, leaving a further 1/2" excess as shown: - FIG. 4.6(b).



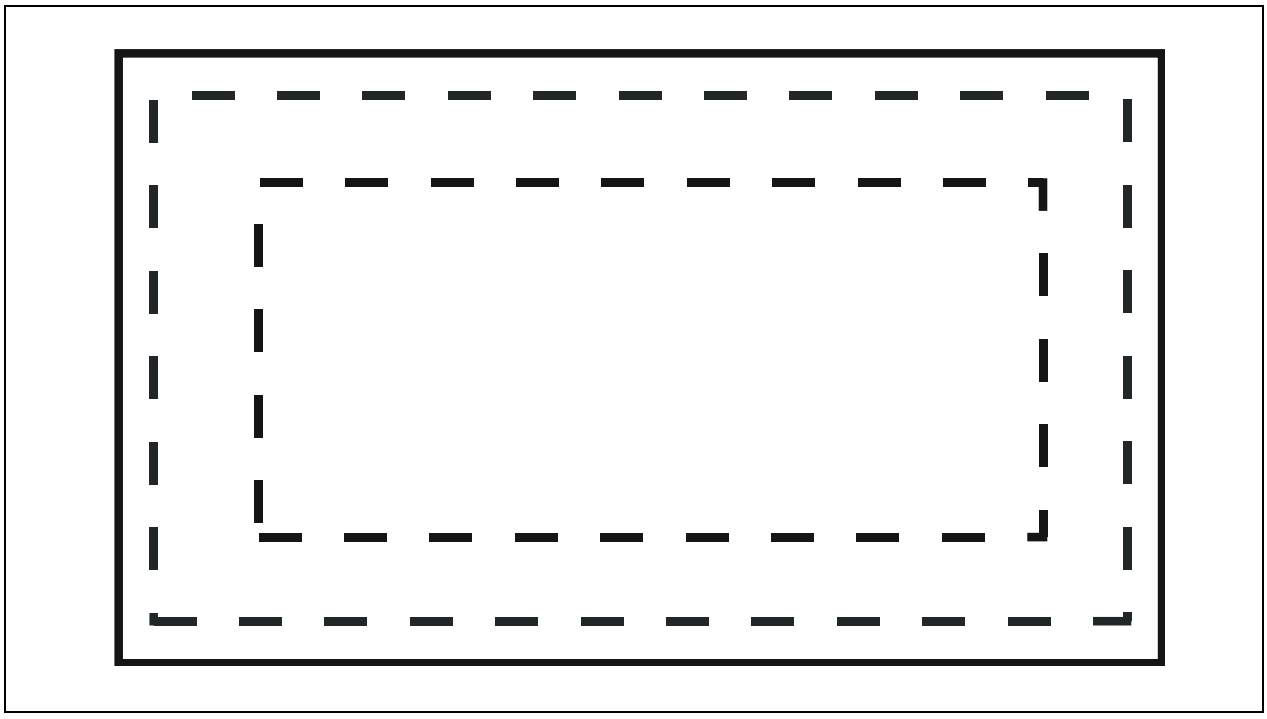
REMOVE DAMAGED AREA FROM BALLOON SURFACE
FIG. 4.6(b)

C) Fold the 1/2" excess fabric under, making small diagonal cuts at the corners, and sew around the inside of the previous rows of stitching: - FIG. 4.6(c)



FOLD UNDER THE EDGE, SEW A SECOND ROW OF STITCHING
FIG. 4.6 (c)

D) The completed patch will appear like the one illustrated in FIG.4.6 (d)



COMPLETED BALLOON FABRIC SEWN PATCH
FIG. 4.6(d)

4.7 PARTIAL PANEL REPLACEMENT

Replacement partial panels in "O", "V" and "A" series balloons will extend between two adjacent horizontal seams and will have one or two new vertical seams created in the panel. Partial panels in "N" and “Concept” series balloons will extend from one vertical seam to an adjacent vertical seam (one of the vertical seams may have a load tape on it) and will have one or two new horizontal seams created. In either case the new seams **MUST** be either French-fell, as illustrated in FIG. 4.1, or Partial-fell as illustrated in Section 4.2 (a)or (b).

The removed fabric edges should, if possible, be intact and not deformed on all four sides. The removed fabric will be used as a "template" in creating the patch.

A) Determine type of damage to be fixed.

1) **TEAR DAMAGE:** unpick the seams beyond the tear damage, then cut out the hole using a straight edge. This method will leave the fabric edge in the balloon ready to receive the new fabric patch.

2) **MELT DAMAGE:** it may be necessary to count ripstops in the folded area of the seam to determine what the original size of the destroyed fabric was. If the melt damage does not extend to the edges of the fabric, use the existing fabric as a template, but before measuring from it, cut out the melted area so that the shrinkage caused by the heat does not prevent an accurate measurement. It is also wise to check the length of the fabric edges which are still in the balloon to verify the results of the "template" method.

All Cameron Balloons U.S. constructed balloons incorporate *Balance Marks* on the fabric edge to align the fabric during construction and repair work. These marks are found about every 2 feet on "O", "V", “Z”, “ZL” and "A" balloons. The distance between marks on "N" and “Concept” series varies, but is approximately every 24-40 inches. These marks are very useful when installing a new panel, which has been pre-cut and pre-marked by the Cameron Balloons U.S. factory. Using balance marks is also very useful when making partial panel replacements. Balance marks on contiguous panels should match +/- ¼ inch during original balloon construction, and during repairs it is useful to stay within +/- ½ inch.

B) Outline the patch on a new piece of matching balloon fabric. For each new seam being added to the balloon, add 1 1/2" of fabric to the appropriate edge to allow formation of the new French Fell seam (the fold you will use is 1/2" wide).

C) Reconstruct the balloon in the same sequence that it was originally built:

1) Recreate the whole fabric panel by sewing the newly-added seams. At this point stop to check that the panel will FIT properly:

2) Confirm that the length of the edges of the recreated whole fabric panel match the edges of the adjoining section of balloon to which it will be sewn.

3) Confirm that the length of the fabric and the length of any adjacent load tape will be correct.

If the new fabric piece is too short, which would create unacceptable stress and wrinkling in the envelope, it must be replaced with a fresh piece of fabric.

If the new fabric piece is too long (not more than 1/2 inch over the length of the seam if the seam is less than two feet in length, or not more than 1 inch if the seam is more than two feet in length), ease the fabric in over the entire length of the seam. You must not create folds in the fabric when installing panels or patches. A method for "easing" includes making a stitch line with fairly high tension on the edge of the "too long" fabric. This stitch line acts as a "gathering" stitch, and it should eventually be covered in the fold of the French-fell.

D) Complete the patch and sew up the original seams and load tape seams. When joining two pieces of fabric and a vertical load tape, it is accepted (and much easier) to sew the fabric to fabric without the vertical tape, and make a second pass to sew the vertical tape onto the pre-joined fabric.

4.8 FULL PANEL REPLACEMENT

NOTE:
Cameron Balloons will provide pre-cut panels for all balloon models. The charge for the pre-cut panels is the cost of the fabric plus a cutting charge. The cutting charge is applicable only *once* for each UNIQUE panel ordered. If multiples of the same panel are cut at the same time, the CUTTING charge is the same as if only ONE pre-cut panel were ordered. **Dimensions on Cameron panels are not reproduced in this manual nor are engineering drawings available**, as the creation of the curvature in the top and bottom of the panels requires special tools, a computer program and training in the use of these items. The time to create a panel template from the engineering drawing is approximately two hours. Repair persons are encouraged to purchase pre-cut panels from Cameron. Tyvek panel patterns may be ordered for any panel at the same cost as a precut ripstop fabric panel. These patterns include all markings and identification as the original factory patterns, and are useful in repair or making banners.

On a few models, where there is no curvature in the lower panels, specific dimensions of panels close to the mouth may be obtained from Cameron Balloons U.S.. If you call for this purpose, have the serial number of the balloon. The serial number will allow confirmation of the exact engineering drawing to which the envelope was built.

A) **MELT DAMAGE:** the new panel should be obtained from Cameron Balloons U.S. The reconstruction of the correct shape of the panel is impossible from the melted fabric. An alternative method would be to remove an undamaged identical panel to use as a template.

B) **TEAR DAMAGE:** When creating a new panel from an existing torn one, remove the torn panel, carefully tape closed the torn area, lay the panel FLAT on a cutting surface, then copy the seam and panel numbers (at the four corners of the old panel) and balance marks (about 24"-40" apart along the edge of the fabric) onto the new panel.

C) **INSTALLING THE NEW PANEL:** *BEFORE starting to sew in the new panel*, be sure the seam numbers match (see Section 5, ENVELOPE MARKINGS SYSTEM) and the balance marks match within ½" or can be "stretched" or "squeezed" to get within the ½" tolerance.

When installing an original size factory pre-cut panel, you may find the replacement panel is slightly larger or smaller than the hole into which it must be sewn. This size mismatch is due to unavoidable changes in dimensions caused by stress and high temperatures which occur in panels and/or load tapes in use in hot air balloons.

Most factory pre-cut panels are cut from the same patterns from which the original panel was cut. The factory patterns are marked with the serial number of every envelope cut from that template. The serial number of the balloon being repaired is checked when cutting repair panels. Therefore there is little or no chance that the factory pre-cut repair panel is not the correct size. **The pre-cut panel MUST be used as is.** In subsequent use the same shrinkage and/or elongation which occurred in the original panel will soon occur in the replacement panel and the stress distribution in the envelope will be as designed.

If the panel is obviously the wrong size (6" +/- the original panel), the chance is very great that the wrong specification was requested or the incorrect pattern was used. Check the Parts Tag code attached to the replacement panel to see which Engineering Drawing # and ISSUE NUMBER panel was cut. Check in the balloon log book (front page) to verify the Engineering Drawing # and ISSUE NUMBER used to construct the balloon. Check that the panel LETTER received matches the panel LETTER of the torn panel -- the panel letters are usually stamped in the corners of the panels (on older balloons this stamping may have worn off, but it is worth checking the 4 corners of the removed panel, and also the exposed corners of the adjacent panels which are still in the balloon).

When new and old panels do not match in length you must **(WITHOUT TRIMMING FABRIC, CUTTING LOADS TAPES OR ADDING ADDITIONAL MATERIAL)** expand or reduce the lengths of the panel edges and/or tapes to be sewn together so they match. Various techniques may be used to accomplish this. These techniques are described below.

CAUTION:
NEVER TRIM ORIGINAL-SPECIFICATION PANELS OR CUT LOAD TAPES TO MAKE THE FABRIC EDGES AND LOAD TAPES FIT TOGETHER. Doing so may result in incorrect and dangerous stress distribution in the improperly repaired envelope.

1) **SHORTENING FABRIC EDGE:** If a fabric edge is too long to sufficiently mate with the other fabric edge or load tape to which it is being sewn, the longer fabric edge should be presewn with a double row of stitching. The thread tension should be set high enough to cause the fabric edge to shorten enough to fit properly. A combination of stay-stitching the long edge and stretching the short edge makes sewing the actual seam easy. When recreating a vertical or horizontal load-taped seam sew the two fabric edges together first, then sew the fabric seam to the vertical load tape in a separate pass. This method makes a quality, finished result easy to obtain. Before sewing the two fabric edges together, take care to assure the resulting fabric seam will be short enough to match the length of the load tape to which it will be sewn.

2) **SHORTENING LOAD TAPE:** If the load tape is too long for the fabric seam to fit, use one of the following two techniques to shorten the length of the load tape.

CAUTION:
NEVER CUT THE LOAD TAPE TO MAKE IT FIT!

a) Sew just the load tape with a double row of stitching. The thread tension tight should be tight enough to shrink the load tape the required amount.

b) Carefully dip the load tape into water hot enough to shrink it the necessary amount. It may be necessary to use boiling water to accomplish enough shrinkage. Be careful to avoid burning yourself or damaging the envelope with the heat source. Squeeze out the water and pat the load tape dry with a soft dry cloth or paper towel. Be careful not to pull the load tape and restretch it.

4.9 LOAD TAPE REPAIRS - 3/4" AND 1" HORIZONTAL

The horizontal load tapes (3/4" or 1") are spliced by one of two methods.

Before sewing by either method, cut the ends of the tape by melting through with a hot knife to prevent fraying.

NOTE:
METHOD NUMBER TWO MUST NOT BE USED WHEN REPAIRING SPECIAL SHAPE BALLOONS.

A) All models including special shapes: overlap the tape for 20"; sew at least eight parallel rows of stitching over its length followed by three passes of two rows of stitching across each end.

B) All models excluding special shapes: overlap the tape for 24"; sew two rows of stitching beginning 6" before the overlap and ending 6" beyond the overlap for a total of 36".

4.10 LOAD TAPE REPAIRS - 9/16", 3/4" AND 1" VERTICAL, MOUTH AND PARACHUTE OPENING

The vertical load tapes, mouth tape and parachute opening tape may be repaired by splicing. Cut the ends of the tape with a hot knife to prevent fraying.

NOTE:
There must be at least two feet of separation between adjacent splices on the same load tape or between a splice and a turnback at the mouth or crown ring.

The overlap must be 21" to 23" prior to sewing. After sewing the splice this dimension will be reduced, due to sewing shrinkage, to between 19.5" and 21". **The splice must be made in the load tape alone, without the fabric attached**. After the splice has been completed, sew the load tape to the fabric. One exception to this method is the turnback at the mouth cables. These may, depending on the year of manufacture, have fabric sandwiched between the load tape pieces as they are sewn. When sewing the load tape splice, as noted above, leave enough **excess** load tape length to allow for the shrinkage which will occur when the splice is sewn. If estimated correctly, this will result in the length of the spliced load tape being the same length as the fabric seam or fabric edge which subsequently must be sewn to it. This precaution will make sewing of the final seam easier.

1" tubular nylon or polyester load tape must be sewn with 14 parallel rows of stitching.

9/16" and **3/4"** tubular nylon or polyester tape must be sewn with 8 parallel rows of stitching.

9/16", 3/4" and **1"** tape must have three passes of two rows of stitching across each end of the splice (in other words, sewn across the tape, back and across again).

The needle size for splicing tubular load tape may be up to 140.

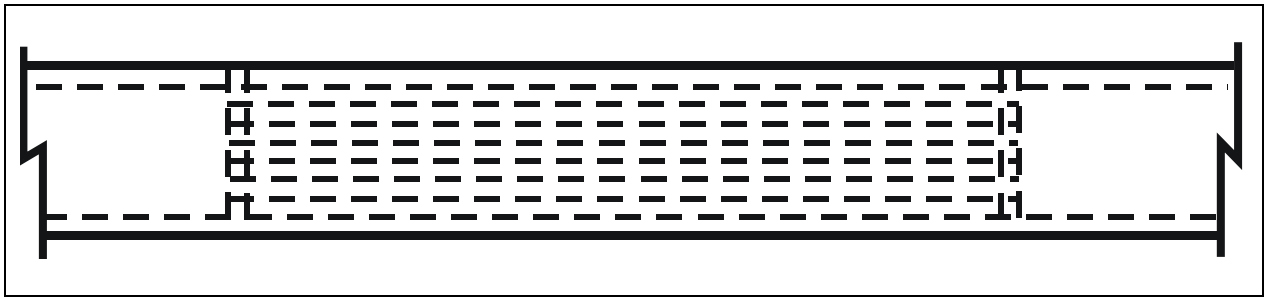


FIG. 4.10
TURNBACK AND SPLICING STITCH PATTERNS
(9/16" and 3/4" tape illustrated)

4.11 KEVLAR™ SUSPENSION CABLE REPLACEMENT

Pre-assembled suspension cables are available **ONLY** from Cameron Balloons U.S.. Kevlar™ cables are installed on the vertical load tape loop at the mouth of the envelope by the following method.

GENERAL DESCRIPTION:

Cameron Kevlar™ envelope cables part number, E015K, may be replaced on any Cameron Balloons U.S. envelope which is **already fitted with Kevlar™ envelope cables** by either (1) the Cameron Balloons U.S. factory (2) an FAA-certificated balloon repair station authorized to work on Cameron Balloons U.S. balloons or (3) by an FAA-certificated private or commercial hot air balloon pilot.

This section describes the procedure which **MUST** be followed when replacing these Kevlar™ envelope cables.

The Cameron Balloons Kevlar™ envelope cable is an assembly made from a braided Kevlar™ core with a braided polyester cover. The cover is to provide protection from abrasion and from extended exposure to ultraviolet light.

A 3 1/2" long loop is spliced into the envelope end of the cable assembly. A stainless steel thimble is spliced into the other end. The thimble end attaches to a snaplink (carabiner) at the burner frame.

INSTALLATION INSTRUCTIONS:

PARTS REQUIRED:

Cameron Kevlar™ envelope cable assembly part number E015K.

IF ENVELOPE CABLE #2 IS BEING REPLACED, two (2) one-inch-long pieces of heat shrink tubing for reattaching thermistor line to new cable. Plastic electrical tape may be used instead.

TOOLS REQUIRED:

Normally, none. IF ENVELOPE CABLE #2 IS BEING REPLACED, a heat gun is necessary if heat shrink tubing is to be used to reattach the thermister line to the envelope cable (plastic electrical tape may be used instead).

A) CONFIRM that all parts are present.

B) CONFIRM that all tools are present. If heat gun for shrinking tubing is not available, plastic electrical tape may be used for attaching the thermister line to the new #2 envelope cable.

C) IF ENVELOPE CABLE #2 is being replaced, carefully CUT the existing heat shrink tubing off the thermister line, UNWIND the thermister line from cable #2, and SET aside.

D) REMOVE existing envelope cable by loosening the cable where it passes back through its end loop at the mouth of the envelope.

NOTE:
The following text uses the term "vertical load tape loop(s)". Cameron Balloons A, O, V and Concept series envelopes have a single vertical load tape loop at each envelope cable attachment at the mouth. N series envelope have two vertical load tape loops at this point.

E) INSERT the new Kevlar™ envelope cable **loop** end several inches through the vertical load tape loop(s). PASS the thimble end of the cable through the envelope cable loop end and SNUG up. NEATEN the vertical load tape loop(s) and Kevlar™ cable loop so that stress is evenly spread throughout the junction.

CAUTION:
The vertical load tape loop(s) and Kevlar™ cable loop in the completed connection should be neatened as much as possible in order to result in even stressing and maximum strength of the joint.

F) PASS the thimble end of the Kevlar™ cable through the protective webbing boot and pull all of the cable slack through.

G) RECORD on the Kevlar™ cable inspection tag the **envelope serial number** and **vertical load tape number** on which the cable is installed. Document in the aircraft logbook the installation which was done and staple or tape this tag into the aircraft log book adjacent to the entry.

H) IF ENVELOPE CABLE #2: PASS the thermister line **through** the slit in the protective webbing boot and WRAP neatly around envelope cable #2. Using a heat gun (DO **NOT** USE A TORCH OR FLAME AS THIS MAY DAMAGE THE POLYESTER COVER ON THE KEVLAR CABLE ASSEMBLY, THE WEBBING BOOT OR THE LOAD TAPE LOOP), SHRINK the heat shrink tubing onto thermister line and Kevlar cable close to envelope attachment and close to stainless steel thimble. Be sure that the line is snugly wrapped onto the envelope cable and extends about 6" beyond the end of the envelope cable. If a heat gun is not available electrical tape may be used to tape the thermister line on at each end.

INSPECTION:

After completing the replacement, INSPECT each envelope cable replaced, vertical load tape loop(s) and protective boot for completion of each of the above steps with no damage.

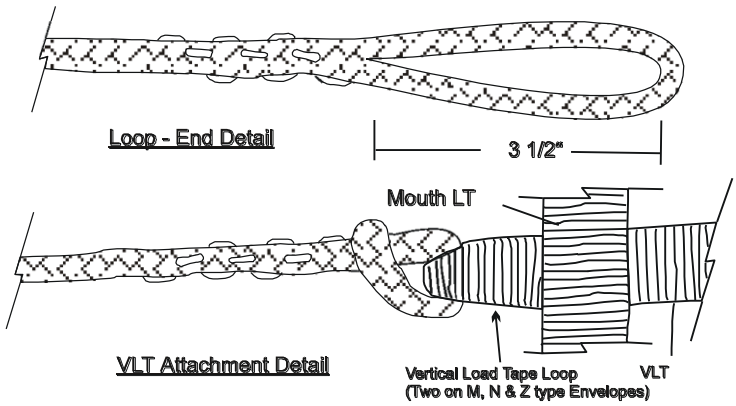


FIG. 4.11
KEVLAR™ SUSPENSION CABLE ATTACHMENT LOOP

4.12 STAINLESS STEEL SUSPENSION CABLE REPLACEMENT

Pre-assembled suspension cables are available only from Cameron Balloons U.S. and **MUST** be used.

A) Unpick the stitching of the vertical load tape mouth turnback and the 3-4" protective load tape boot. Care must be taken to not damage the vertical load tape in any manner.

B) Feed the separated vertical load tape end through the end of the suspension cable.

C) Leave a 1" long loop of unsewn vertical load tape at the attachment point.

D) Sew the load tape with the stitching specification for splices, as stated in Section 4.10.

E) Sew the 3-4" load tape boot to the envelope mouth load tape to complete the installation.

4.13 MISCELLANEOUS ATTACHMENTS

The following attachments **MUST** be sewn with a single or double needle method as illustrated in Fig. 4.13 and Fig. 4.13a. These attachment methods apply to both flat and tubular load tape.

A) The parachute activation & Pre-Vent line lower pulley.

B) The parachute activation & Pre-Vent line terminus.

C) Smart Vent™ & Easy Vent line activation line lower ring.

D) The Smart Vent™ , Easy Vent & Pre-Vent terminus.

E) The valve centering line, Easy Vent & Pre-Vent line attachment points on the envelope.

F) The valve centering/shroud line & Easy Vent & Pre-Vent attachment point on the parachute.

G) Turning vent activation line pulley.

H) Rip panel lock hook attachment.

I) Rip panel activation line pulleys.

J) The attachment point for the hanging thermometer.

K) The scoop attachment points on the envelope and scoop.

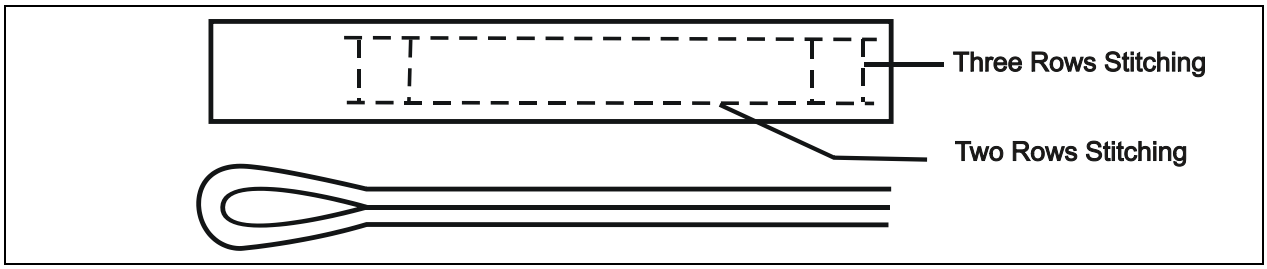


FIG. 4.13
CURRENT - ATTACHMENT STITCH PATTERN
9/16”, 3/4” & 1” FLAT & TUBULAR LOAD TAPE

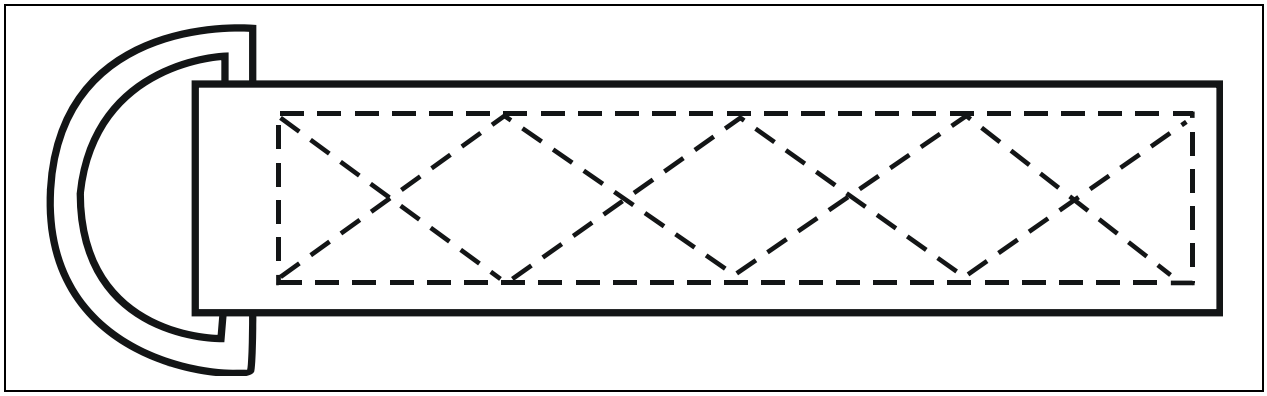


FIG. 4.13a
PAST-ATTACHMENT STITCH PATTERN
1" FLAT & TUBULAR LOAD TAPE ONLY

NOTE:
Aluminum "D" rings were used on many older Cameron envelopes. These "D" rings have been replaced with an enlarged loop of flat or tubular load tape. Omitting "D" rings in replacing scoop attachment positions, etc. is permitted.

4.14 MOUTH HORIZONTAL LOAD TAPE ASSEMBLY

The horizontal load tape at the edge of the mouth hole (called the "Opening Tape" on the envelope schematics in Appendix A) is 3/4" or 1" tubular load tape of the same specifications as tubular vertical load tapes. The ends of these tapes must be spliced the same as the vertical load tapes, specified in Section 4.10. The splice will be stitched through the Nomex™ fabric. The vertical tapes pass entirely under the horizontal mouth tape (when envelope is viewed from outside). The Nomex™ fabric is slit for the bottom 1.5" to allow the vertical load tape to pass through. The Nomex™ raw ends are then tucked around and under the horizontal mouth tape thereby fully enclosing it in the Nomex™.

4.15 PARACHUTE OPENING LOAD TAPE ASSEMBLY

The horizontal load tape at the edge of the parachute hole (called the "Opening Tape" on the envelope schematics in Appendix A) is 3/4" or 1" tubular load tape of the same specifications as tubular vertical load tapes. The ends of this tape must be spliced the same as the vertical load tapes, specified in Fig. 4.10. The vertical load tapes pass under the parachute hole tape. The length of the parachute hole tape is important for the proper fit of the parachute. The dimensions of this tape should be verified with Cameron Balloons U.S. if any splicing will be done on this tape.

NOTE:
ORDER PRE-CUT, PRE-MEASURED AND PRE-MARKED PARACHUTE HOLE TOP TAPES FROM CAMERON BALLOONS TO ASSURE THE CORRECT REPLACEMENT OF TOP TAPES DURING TOP FABRIC REBUILDS.

4.16 WATER KNOT

The water knot is used exclusively in all rigging line and rope splicing in a Cameron Hot Air Balloon. **NO OTHER KNOT MAY BE USED FOR THIS PURPOSES**.

The shock cord which is used on the Scoop is difficult to tie because the cord is so stretchy. The knot used on the Scoop shock cord is not critical, however, the water knot works best.

Figure 4.16 illustrates a proper water knot.

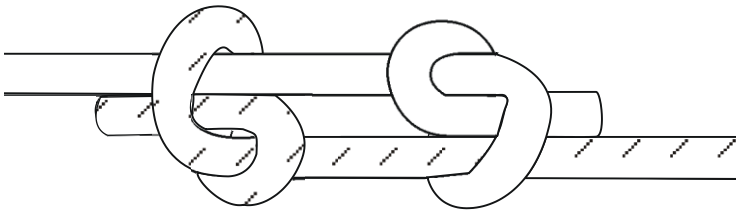


FIG. 4.16
WATER KNOT

4.17 THERMISTOR LINE INSTALLATION

The square knot is used to tie all thermistor line ties. The thermistor line is tied at various points along the #2 (or #2R) vertical load tape. Begin the procedure at the top of the envelope where there are two closely-spaced ties about 6-8 ft. below the parachute hole. Tie the thermistor sensor snugly against the skin of the balloon with the uppermost tie. The thermistor cable should be looped and then tied with the tie straps being knotted around two parts of the thermistor line. This method is illustrated in FIG. 4.17. The thermistor line should then tightened around the tie knot.

Match the length of the thermistor line and the vertical load tape between tie-off points by passing equal lengths of both the thermistor line and the vertical load tape through your hands simultaneously. **Add** about 16" of extra thermistor line between each set of attachment points. This procedure prevents tension from being transferred to the thermistor line. It also prevents the line from being stretched and possibly broken when the vertical tapes elongate slightly under load.

When the envelope mouth is reached, there will very likely be an excess of line. Leave only enough line hanging free to reach the end of the envelope cable plus the amount needed to reach the instrument box or the connector at the burner, depending on the model of instruments fitted. The excess thermistor line should be coiled and tucked into the storage pouch sewn onto the Nomex™ between vertical tapes #2 and #3.

If the thermistor line is damaged, it is likely the damage will be in the exposed portion of the wire below the envelope mouth. The length of the wire is not critical to the accuracy of the instrument (unlike thermocouple devices). To repair the thermistor wire in this lower section. Remove the damaged part of the wire, pull enough excess wire from the storage pouch and install a new connector (I0026).

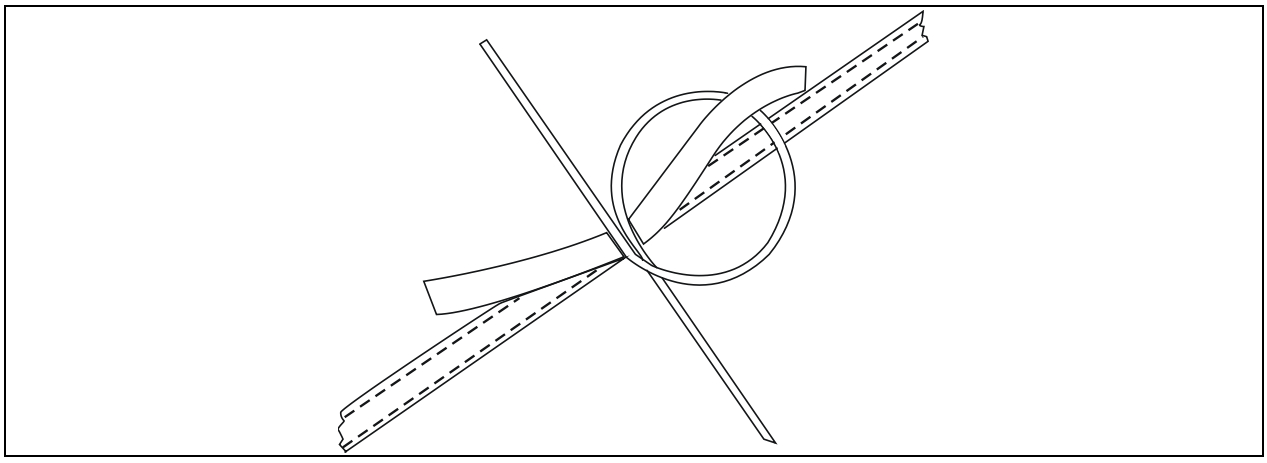


FIG. 4.17
THERMISTOR LINE TIE-OFF LOOPS

4.18 LOOP OR "CAMERON" KNOT

All lines in the Cameron envelope incorporate a knot that has become known as the "Cameron Knot" (historically known as the "loop knot"). This knot **MUST** be used for the following purposes:

A) To tie the end of the parachute activation line, Smart Vent™ , Easy Vent & {re-Vent activation line and dead leg line to the terminus attachment loop, ring or "D" ring.

B) To tie all valve centering lines to the valve centering line attachment points on the envelope.

C) To tie the valve centering line/shroud line to the load tape loop on the parachute edge.

D) To tie the turning vent line to the finger lines.

E) To tie the rip panel activation line to the rip lock.

F) To tie the crown line to the crown ring.

G) Create the loop at the pull-end of the following lines: crown, parachute activation, side vent, rip panel and turning vent.

The only exceptions to the use of this loop knot is the knot that ties in the thermistor wire (square knot), the knot that ties off the shock cord for the attachment of the scoop clips (water knot) and the knot used to splice lines in repairs (water knot).

CAUTION:
THE BOWLINE KNOT IS NOT ACCEPTABLE FOR ANY PART OF THE ENVELOPE RIGGING

The Cameron knot (loop knot) can be formed by turning the end of the piece of line back against itself and then tying a simple overhand knot in the doubled-over section. When tied properly, the knot appears as in Fig. 4.18.

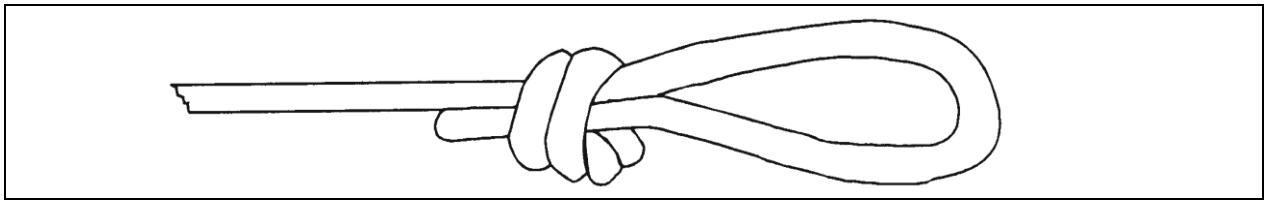


FIG. 4.18
CAMERON KNOT (Completed)

To create the Cameron knot (loop knot) through an anchored end, such as ring or attachment loop, however, is more complex. Refer to Fig. 4.18a.

1) Tie a simple overhand knot in the line.

2) Feed the end of the line through the attachment loop.

3) Parallel the line in the reverse direction completely through the knot. The line must follow the path completely, not cross or twist.

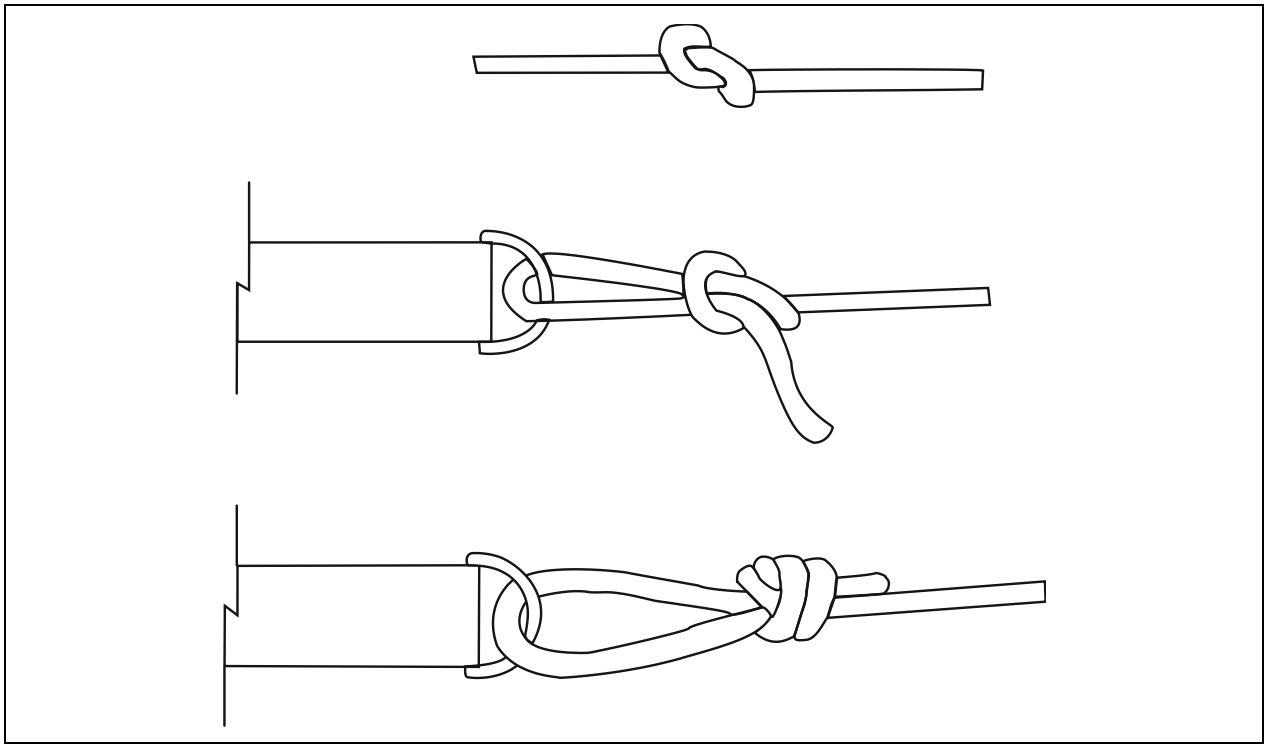


FIG. 4.18a
CREATING CAMERON KNOT WITH ANCHORED END

4.19 PARACHUTE ACTIVATION (ROUND RED) LINE

On all except some large envelopes, the parachute red line extends from a tie-off point on the side of the balloon (the parachute red line terminus) up and through a pulley at the base of the parachute shroud lines, down and through a pulley attached on Vertical Load Tape #1 or #1R (directly opposite the tie-off point) and exiting at the mouth of the envelope. This particular routing of the parachute red line creates a mechanical advantage of about 1.7 to 1.

On most large envelopes, 160 and up, the parachute red line terminates at a becket on the becket-pulley at the shroud lines, extends downward to and through a pulley on the side of the envelope (the parachute line terminus position for the standard rigging), up and through the becket pulley at the base of the parachute shroud lines, down and through a pulley attached on Vertical Load Tape #1 or #1R (directly opposite the pulley at the standard rigging tie-off point) and exiting at the mouth of the envelope. This particular routing of the parachute red line creates a mechanical advantage of about 2.5 to 1.

THE INSTALLATION AND ROUTING OF THE PARACHUTE RED LINE MUST NOT BE ALTERED. The mechanical advantage reduces the force required to open the parachute and complies with Federal Aviation Regulations for deflation panel activation.

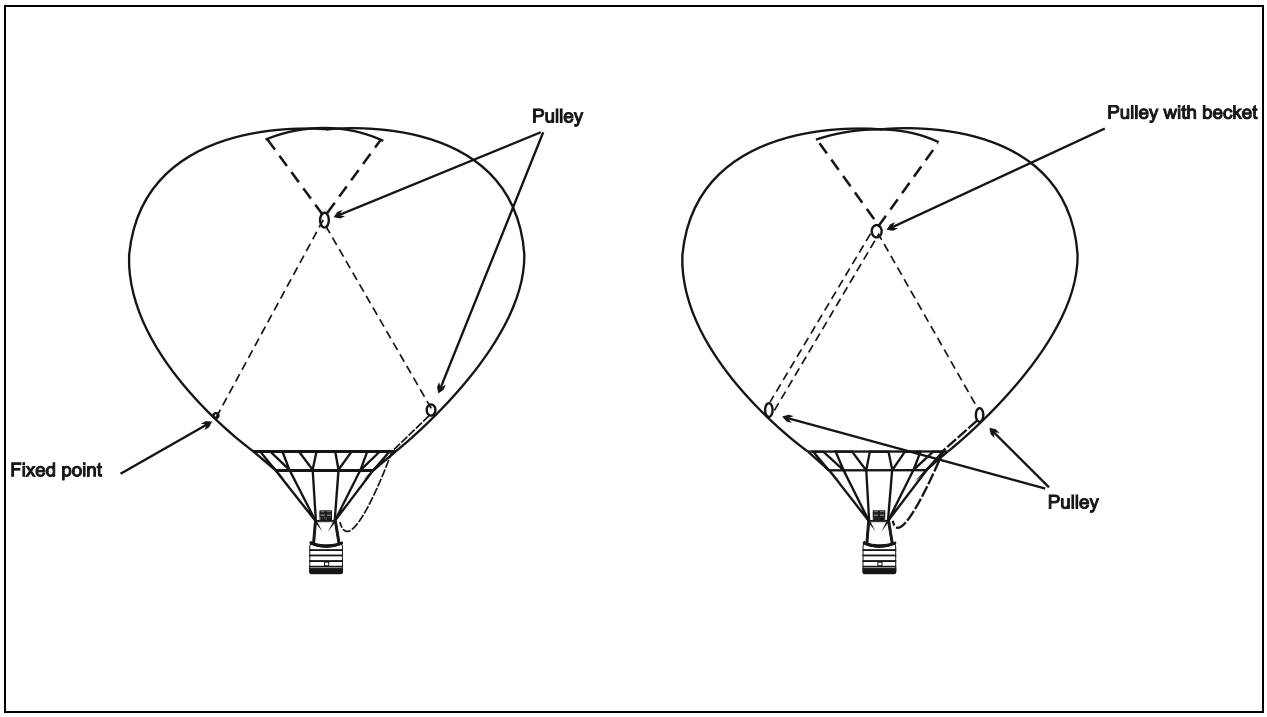


FIG. 4.19
PARACHUTE ACTIVATION LINE ROUTING

The parachute activation red line is made of a braided Kevlar™ core covered with a spun polyester outer sheath. Melt damage to the cover is rarely accompanied by damage to the interior Kevlar™ core. A small portion of the cover may generally be repaired without repairing or replacing the Kevlar™ core.

The parachute activation red line termination is tied with approximately eight feet of extra length, in the form of a loop, at the tie-off side of the rigging. Some or all of this extra line may be let out in order to cut an equal amount of severely damaged line from the pull end.

If this extra loop has been used for a previous repair, a new piece (not in excess of 10 feet) may be added **AT THE TERMINATION END ONLY**. This, in effect, allows two opportunities to repair damage at the pull end before replacement of the entire parachute activation red line is necessary.

NOTE:
The knot shown in Fig. 4.16 "Water Knot" is the **ONLY** knot authorized for addition of red line at the termination point. **NO KNOT TIED IN THE PARACHUTE RED LINE MAY EVER BE MORE THAN 10 FEET FROM THE TIE-OFF OR TERMINATION POINT**. A knot farther from the termination point (nearer the pulley on the parachute) may interfere with the movement of the red deflation line through the parachute pulley in normal or extreme circumstances.

4.20 PARACHUTE ACTIVATION (ROUND RED) LINE OUTER COVER

A short section (4" or less) of the polyester outer cover of the parachute activation line may be replaced by cutting away the melted or abraded covering and sliding the good sections together. The junction of the two should be carefully melted and then hand stitched together.

Longer sections may be repaired by a similar method. Carefully measure and cut away the damaged cover. Slide the good sections together. This may be accomplished by applying tension to the interior Kevlar core and inching the two good sections of red cover together. Attach both ends of the existing cover together using the technique described above. A new section of red polyester cover may now be slide over the bare end. This repair is very time consuming and difficult.

CAUTION:
These repairs should only be done in an area of the red line which will never pass thru one of the red line pulleys.

In any case where none of the above repair methods will work, replacement of the entire parachute activation line is necessary. Only line as described in section 3.7 is allowed.

4.21 PARACHUTE ACTIVATION (ROUND RED) LINE LENGTH

The length of the parachute activation (Round Red) line in all Cameron Balloons is critical. Under no circumstances may the length be shortened. The length as designed, constructed and delivered has been carefully calculated to allow for extreme envelope distortion to occur without the parachute valve inadvertently being pulled open. The calculated length allows for easy access by the pilot under the full range of possible inflight conditions without creating an extraordinary risk of being snagged by passing trees or other objects. In addition, when a Smart Vent™ or Easy Vent deflation system is installed, extra red line length is added to take into account the deployment of the Smart Vent™ or Easy Vent.

A) STANDARD PARACHUTE ONLY DEFLATION SYSTEM

The length should be checked in either of two ways.

1) WHEN INFLATED:

Pull and release the parachute activation line to separate the parachute Velcro™ tabs. With the balloon buoyant and the lower end of the red parachute activation line attached to the carabiner at the burner frame corner, there should be enough red line below the mouth of the envelope so that the parachute activation line droops down to the top edge of the basket. See Fig. 1.1 "General Schematic of a Cameron Balloon".

2) WHEN DEFLATED:

Install the parachute, seal the Velcro™ tabs and get all the interior lines (valve centering lines, shroud lines, activation (red) lines, and turning vent lines) untangled and able to slide easily inside the balloon. After the envelope is completely untangled and streamered out lengthwise, unseal the Velcro™ tabs but leave the parachute against the body of the balloon as if the tabs were still sealed. With the center patch of the parachute held against the crown ring, pull from both the crown ring and the envelope cables to streamer the envelope. With the envelope streamered, pull any slack from the deflation line. The end of the deflation line must reach **at least to** the end of the envelope cables. If the red line is too short by this test, then it must be lengthened.

NOTE:
On some of the larger balloons, this test may result in **slightly** greater parachute activation line lengths than absolutely necessary.

B) SMART VENT™ & EASY VENT DEFLATION SYSTEM

1) WHEN INFLATED:

Pull and release the round red parachute activation line to separate the parachute Velcro™ tabs. With the balloon buoyant and the lower end of the round red parachute activation line attached to the carabiner at the burner frame corner and the excess round red line stuffed into its storage bag, there should be enough round red line below the mouth of the envelope so that it droops down to the top edge of the basket. Next, fully deploy the Smart Vent™ or Easy Vent. As the Smart Vent™ or Easy Vent is deployed the excess round red line will be pulled from its storage bag. There has to be enough excess round red line to not hinder full deployment of the Smart Vent™ or Easy Vent.

2) WHEN DEFLATED:

Install the parachute, seal the Velcro™ tabs and get all the interior lines (valve centering lines, shroud lines, activation (red) lines, and turning vent lines) untangled and able to slide easily inside the balloon. After the envelope is completely untangled and completely spread out horizontally and vertically, unseal the Velcro™ tabs. With two people, one each holding the envelope at oposite sides at the equator, and another person holding the crown ring, pull the Smart Vent™ or Easy Vent deflation line until the top limit line strings are fully extended. The end of the round red line must reach **at least to** the basket top bolster. If the red line is too short by this test, then it must be lengthened.

4.22 SMART VENT™ OR EASY VENT ACTIVATION (FLAT RED) LINE LENGTH

The Smart Vent™ and Easy Vent activation (flat red) line is a 1" flat strap constructed of an inner core of Kevlar™ webbing and covered with either red or blue Nomex. If the strap is blue then the lower portion will have a additional red Kevlar™ outer covering sewn on.

THE ONLY WAY TO PROPERLY CHECK THE LENGTH OF THE SMART VENT™ & EASY VENT ACTIVATION LINE IS WHEN THE ENVELOPE IS DEFLATED.

Install the parachute, seal the Velcro™ tabs and get all the interior lines (valve centering lines, shroud lines, activation (red) lines, and turning vent lines) untangled and able to slide easily inside the balloon. After the envelope is completely untangled and streamered out lengthwise, unseal the Velcro™ tabs but leave the parachute against the body of the balloon as if the tabs were still sealed. With the center patch of the parachute held against the crown ring, pull from both the crown ring and the envelope cables to streamer the envelope. With the envelope streamered, pull any slack from the Smart Vent™ or Easy Vent deflation line. The end of the deflation line must reach **at least to** the end of the envelope cables. If the Smart Vent™ or Easy Vent line is too short by this test, then it must be lengthened.

The Smart Vent™ & Easy Vent activation line may be spliced anywhere below the stainless steel ring. Splices must be no closer than 24" to each other.

Use the following method **ONLY**:

A) Overlap the strap 12"

B) Sew the overlap along its length with 6 rows of stitching

C) Sew 6 rows of stitching across both ends of the overlap

4.23 TURNING VENTS

Cameron Balloons envelopes may be fitted with turning, also know as rotation vents, which may be used to rotate the balloon about its vertical axis. These vents are located from just above to just below the envelope equator and in various gore locations, depending on the model (See Appendix A, ENVELOPE PANEL CHARTS).

NOTE:
In some balloons the turning vent locations noted in Appendix A may be different due to special considerations, such as avoidance of art work, inflated appendages, etc. In such cases, contact the Cameron Balloons factory for guidance.

Although usually installed in pairs in order to rotate in either direction, some envelopes may have only one turning vent and its associated rigging.

In its simplest form, the turning vent is made by splitting a panel or panels vertically, adding an extra flap to cause overlap and providing rigging to pull the flap inward and away from the envelope surface. This action exhausts the inside air horizontally and tangentially to the surface of the envelope to provide rotation.

Figure 4.23 shows a typical turning vent as viewed from inside the envelope. In this diagram the turning vent CONTROL LINE (color combinations of blue or black or yellow or green) is shown passing through the turning vent PULLEY and attaching to the finger lines. These lines in turn attach to triangular vent BAFFLES and pull the vent flap open.

On the outside of the envelope are one or more pieces of flat load tape (usually wrapped in balloon fabric to match the color of the underlying fabric) which run horizontally across the vent and act as limit tapes to maintain the overall dimension of the envelope gore. These limit tapes must be in place and must not be altered in length.

There should be very little turning vent maintenance needed other than inspection of all lines and inspection of the perimeter of the vent for damage to fabric or stitching in stressed areas. **At Annual/100 hour inspections all parts of the turning vents must have a minimum pull strength of 30 lbs.**.

The control line is made of polyester and is subject to damage from the burner. It is permissible to splice this line using the water knot, provided the knot is in a location where it will not pass through the turning vent pulley at any time.

In the event of damage in an area where splicing with the water knot is not possible, replacement of the entire vent control line will be necessary.

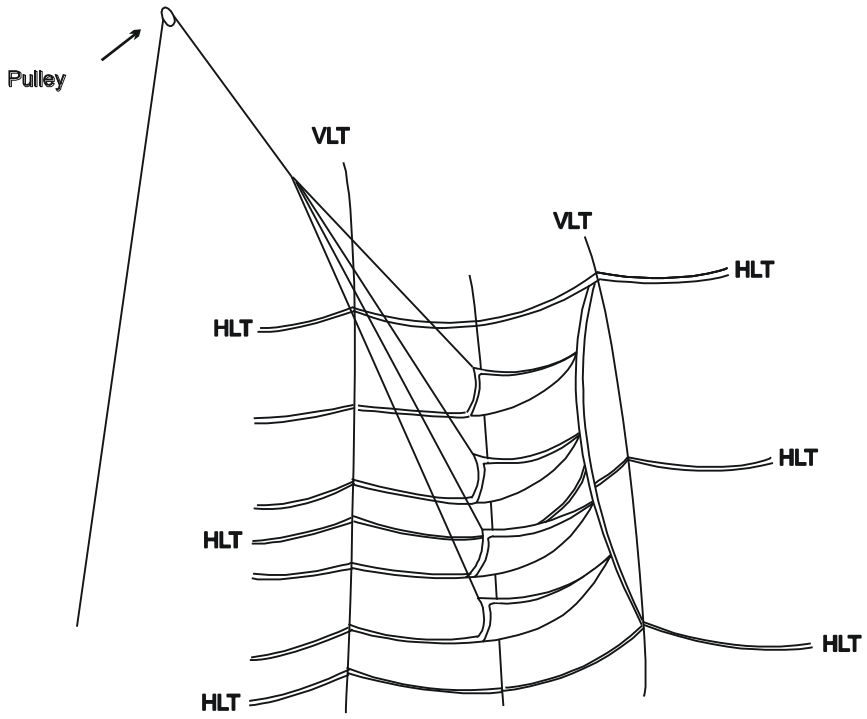


Fig 4.23
Turning Vent

4.24 SCOOP OR SKIRT REPAIRS

The scoop and skirt are optional equipment. **A scoop or skirt need not be repaired in order to pass an annual or 100 hour inspection**. However, if the damage is such that it could allow fabric to become closer to the burner in flight than otherwise possible, then it must be repaired or removed before subsequent flights. **Repairs to a scoop or skirt may be completed by non-certified persons**.

4.25 PARACHUTE VELCRO™ TAB INSTALLATION

There are currently three styles of parachute Velcro™ tab installation. The old style is illustrated in Fig. 4.25. The second old style is illustrated in Fig. 4.25a. See Appendix K for the current style.

CAUTION:
Not all Hook and Loop Fasteners ("Velcro™" is the most commonly used term, although this is a brand name) are compatible and not all Velcro™ is acceptable in the balloon. Some Velcro™ closures have hooks which are sufficiently abrasive to damage the fabric in the balloon, and can pull out the sewing threads near the hooks. For selection of Velcro™ brands, contact Cameron Balloons US.

A) The Old Style:

1) The **Velcro™ (hook)** tabs on the **ENVELOPE** should be installed by stitching through the Velcro™ and the parachute opening tape. A double row of stitching should run off the sides of the Velcro™ and be backstitched on both sides.

CAUTION:
LENGTH OF THE ENVELOPE VELCRO™ TAB INNER TAIL
If the inner tail exceeds 1/2 inch, the SHEAR strength of the Velcro™ in this area will be too great to meet the FAR Part 31 deflation panel opening force requirements. If the inner tail is too small, the parachute may fall open during inflation, since the Velcro™ **not** in the inner tail can easily be PEELED open by the force applied to it by the valve centering line .

2) The **Velcro™ (loop)** tabs on the **PARACHUTE** should be installed by stitching through the Velcro™ and the parachute reinforcing tape. A double row of stitching should extend off the ends of the Velcro™ with back stitching on both ends. All stitching must stay completely on the reinforcement tape under the Velcro™ tab.

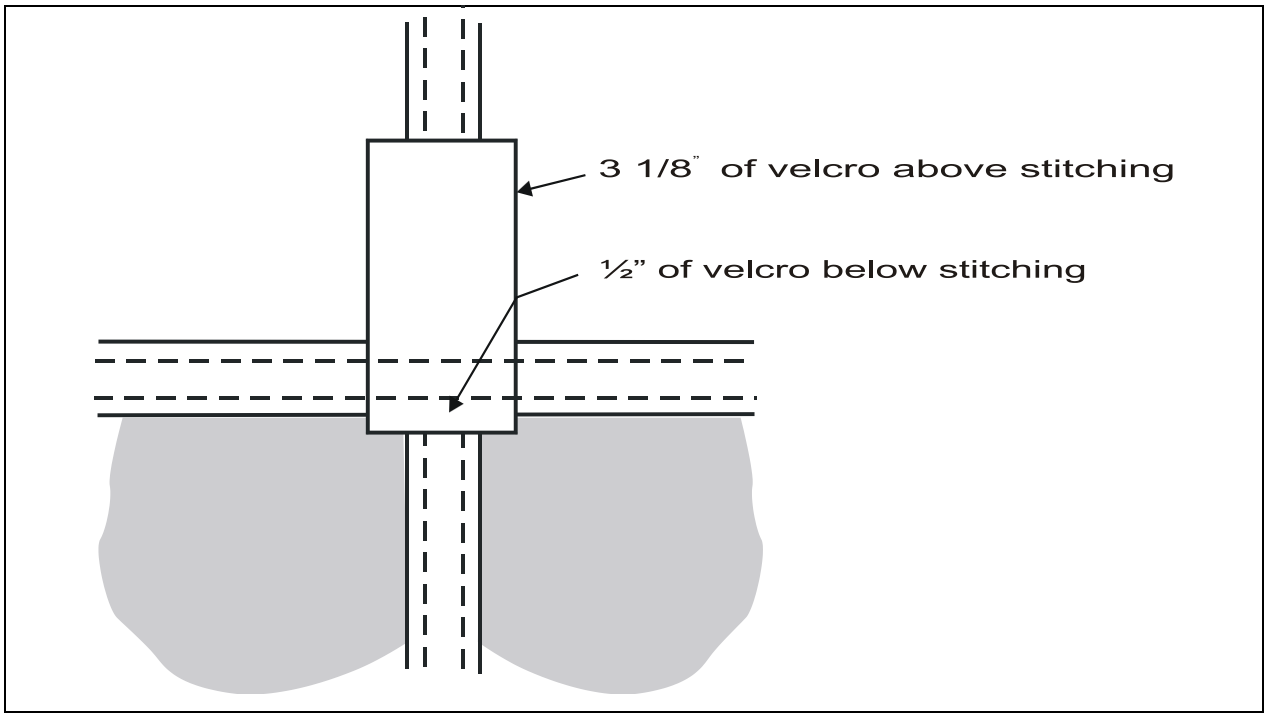


FIG. 4.25
Velcro™ Tab Installation (Old Style)

B) The Second Old Style:

This style of attaching the Velcro™ tabs differs from the old style in two ways. First, the both tabs have been rotated 90°. Second, the tab on the envelope has been offset to the right of the vertical load tape.

1) The **Velcro™ (hook)** tabs on the **ENVELOPE** should be installed by stitching through the Velcro™, an identical size flat webbing (for reinforcement), envelope fabric and the parachute opening tubular tape as illustrated in Fig. 4.25a. A double row of stitching should be sewn around the inside perimeter of the Velcro with backstitching at the beginning and end.

2) The **Velcro™ (loop)** tabs on the **PARACHUTE** should be installed by stitching through the Velcro™, an identical size flat webbing (for reinforcement), parachute fabric and the parachute reinforcing flat tape. A double row of stitching should be sewn around the inside perimeter of the Velcro with backstitching at the beginning and end.

CAUTION:
Not all Hook and Loop Fasteners ("Velcro™" is the most commonly used term, although this is a brand name) are compatible and not all Velcro™ is acceptable in the balloon. Some Velcro™ closures have hooks which are sufficiently abrasive to damage the fabric in the balloon, and can pull out the sewing threads near the hooks. For selection of Velcro™ brands, contact Cameron Balloons US.

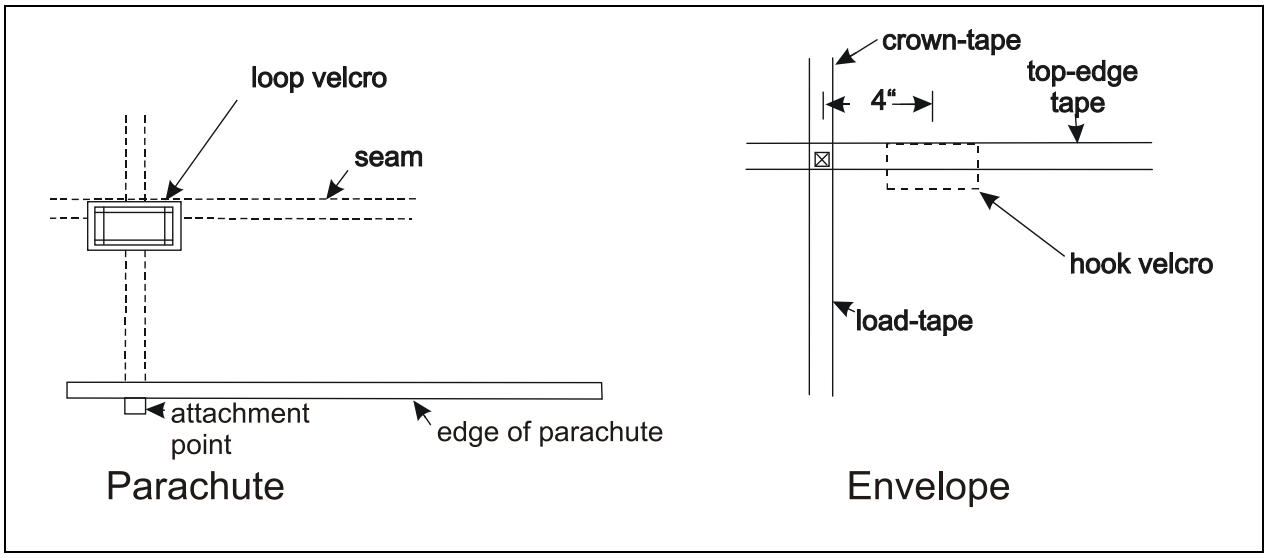


FIG. 4.25a
Velcro™ Tab Installation (Current Style) O, Concept, A, N & V Series
A-Series Illustrated

4.26 KEVLAR™ SUSPENSION CABLE RETROFIT:

GENERAL DESCRIPTION:

Cameron Kevlar™ envelope suspension cables may be retrofitted in place of the original stainless steel envelope suspension cables on envelopes manufactured by Cameron Balloons U.S. and having serial numbers of 5000 or greater.

This section describes the parts and equipment needed plus the procedure, which **MUST** be followed to retrofit Kevlar™ envelope suspension cables.

KEVLAR™ SUSPENSION CABLES MAY BE RETROFITTED **ONLY** BY THE CAMERON BALLOONS U.S. FACTORY **OR** BY AN FAA CERTIFIED REPAIR PERSON AUTHORIZED BY THE FAA TO WORK ON CAMERON BALLOONS U.S. BALLOONS (**After Kevlar™ envelopes cables have been properly installed** on an envelope, damaged Kevlar™ cables may be replaced by an FAA-certificated private or commercial hot air balloon PILOT in accordance with the Cameron Balloons U S field replacement instructions, Sec. 4.11).

A special cable cutter is required for successfully removing the existing stainless steel cables from the envelope without damaging the vertical load tape loops. Shipment of cables purchased for retrofitting will be accompanied by one of these cable cutters for which the purchaser will be billed a deposit of $50. The tool must be returned within 14 days of the shipping date for full credit.

RETROFITTING INSTRUCTIONS:

TOOLS REQUIRED:

Knife or scissors for removing existing heat shrink tubing from thermistor line on cable.

Medium-size screwdriver for prying protective-boot metal grommets open.

HIT HWC9 cable cutter for removing existing stainless steel cables.

Hot knife for extending grommet hole in protective boot webbing.

Heat gun for shrinking heat shrink tubing. (Optional)

A) Carefully CUT the existing heat shrink tubing off the thermister line on cable #2.

B) UNWIND the thermister line from cable #2 and SET aside.

C) For each envelope cable:

1) PRY the grommet apart and pull both pieces free from protective boot webbing.

2) CUT the cable at envelope end THROUGH THE PRESSED-ON FERRULE about 1/16" from the envelope end of the ferrule, carefully REMOVE the resulting 3"-long cable section, CHECK the thimble for sharp burrs which could cut the load tape loop(s), and REMOVE the thimble

CAUTION:
Burrs on the thimble caused by the cutting tool can damage the vertical load tape loop(s) when the thimble is removed. Damage to the VLT loops compromise the airworthiness of the envelope and make expensive repairs necessary. Before removing the thimble, check carefully for any sharp edges. If sharp edges are found, twist the thimble open and tape over sharp edges before withdrawing the thimble through the vertical load tape loop(s).

3) SLIP the envelope cable stub out through the protective webbing boot, and discard.

4) EXTEND the hole in the protective webbing boot by cutting a slit outward towards each side of the webbing tape to form an overall width of 1". This will allow the larger Kevlar™ envelope cable to pass through the protective boot. Neatly SEAL the edges of the existing hole by melting slightly with the hot knife.

5) Install the new Kevlar™ envelope suspension cables per instruction in Section 4.11.

D) DOCUMENT modification in aircraft logbook and PREPARE and FILE FAA Form 337.

INSPECTION:

After completing the installation, INSPECT each envelope cable, vertical load tape loop(s) and protective boot for completion of each of the above steps with no damage.

4.27 BANNER BUILDING AND BANNER VELCRO INSTALLATION

For ease of reading, we have chosen to use here the term "velcro" to apply to all brands of hook and loop fastener, not specifically to Velcro™ brand.

NOTE:
Not all brands of hook and loop fastener are compatible. If one brand is used for a banner and another for the balloon, the banner may peel off too easily. Verify the brand of hook and loop fastener used for a balloon or banner before constructing the mate.

A) WHERE MAY VELCRO™ BE SEWN ONTO THE ENVELOPE

Banner velcro may be sewn onto any vertical load tape or horizontal seam. The horizontal seam may or may not have a horizontal load tape sewn onto it. Banner Velcro™ **MAY NOT** be sewn onto fabric without an existing French-fell seam or alternative seam as listed in Section 4.2 unless it is reinforced with horizontal load tape.

B) BANNER TIES (OPTIONAL)

Banner corner TIES are very useful, but not mandatory. Ties do eliminate the corner-peeling problem common with banners. It is preferred to have a top and bottom tie at each vertical load tape bordering the banner and, on an "O", "A" or "V" series, at each vertical tape underneath the banner. On "N" series balloons, it is preferred to have a tie at least at every third vertical tape that is covered.

Banner ties should be sewn onto the vertical load tape (a loop of 3/4" or 1" flat load tape is the preferred material). Loops should be sewn on just above the top point of the banner, with the loop facing down, and the end of the loop about 1 inch or less above the top edge of the banner. The bottom ties should be sewn on just below the bottom edge of the banner, with the loop facing up and with the end of the loop about one inch or less below the bottom edge of the banner.

C) VELCRO™ SEWN ONTO VERTICAL LOAD TAPE

During flight the vertical load tape is under tension and may stretch up to 10%. This means the **banner should be oversized**, as the banner does not get tension applied during flight. See instructions in Section 4.27 E “Banner Construction” and Section 4.27 G “Banner Installation”.

Velcro™, on the other hand, does not stretch significantly. Velcro™ sewn onto the vertical tape should be put on with two rows of stitching. Do not put more tension on either the load tape or the Velcro™ during the sewing process. Approximately 4-6 stitches per inch should be used.

D) VELCRO™ SEWN ONTO HORIZONTAL SEAM

The balloon will expand in the horizontal direction during rapid ascents and descents. When a banner is cut exactly the same size as the structural balloon fabric is cut, the banner will not be placed under the same tension as the balloon during flight and as the balloon "stretches" the banner peels off.

The Velcro™ on the horizontal seams should be sewn with two rows of stitches, approximately 4-5 stitches per inch. Apply the same tension to both the fabric and the Velcro™ during sewing.

E) BANNER CONSTRUCTION

Banners constructed from the same pattern template used to create the balloon will be too small. This is because of in-flight tension as described above. To enlarge a banner, add HEIGHT to the banner of about 3/4 inch for each 50 inches of vertical height. Add WIDTH to the banner of about 1 inch for each 120 inches of horizontal length.

The addition of fabric for banners should come at the widest point of the pattern.

For an "O", "A" or "V" balloon, the WIDTH should be added at the WIDEST POINT of the panel. The HEIGHT should be added as much as possible at the WIDEST POINT of the panel. The overall width of the fabric prevents very much fabric addition in an panel that is nearly the full fabric width to begin with, but at least the panel should taper less towards the ends to give more vertical height on the load tapes.

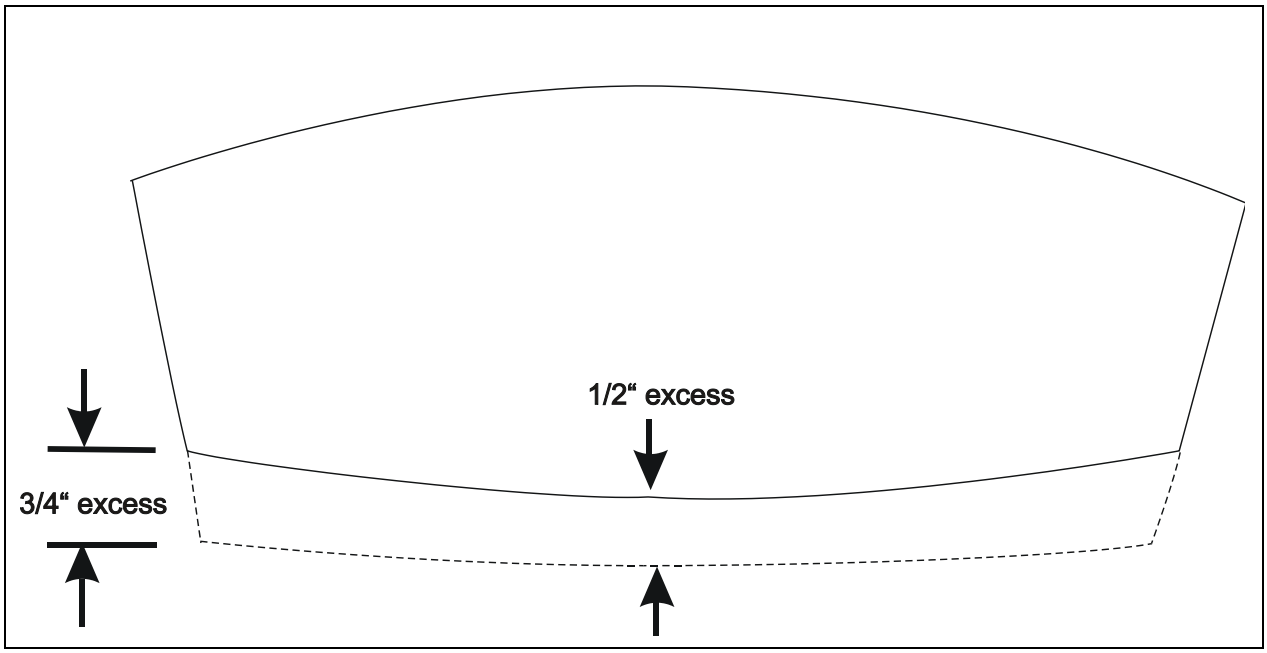


FIG. 4.27
ADDING FABRIC IN BANNER PANELS FOR "O", "A" AND "V" SERIES
NOTE: ADD EXCESS ONTO WIDEST EDGE OF PANEL AND IN CENTER OF PANEL

For an "N" series balloon, the WIDTH should be increased by 1/4 inch along the full height of the panel. The HEIGHT should increased at the WIDEST point of the banner, normally at the TOP of the "B" panel or the BOTTOM of the "C" panel (at the equator). Since the equator has curvature, the actual addition of fabric should be about 8 inches away from the end of the panel. Once again, add 3/4 inch of extra fabric for every 50 inches of height (Example: on an N-77, CB143-1D, a "B" panel banner should have 3.56 inches in overall height added, all of it at about 8 inches below the B/C seam line).

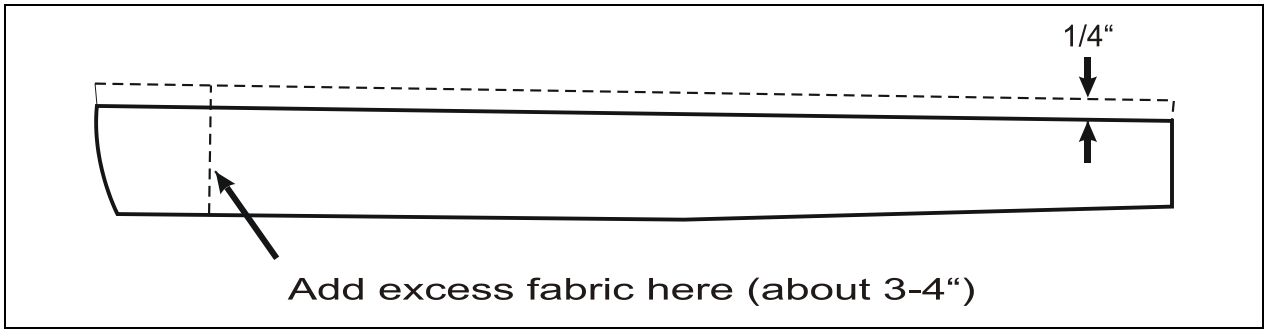


FIG. 4.27a
ADDING FABRIC IN BANNER PANELS FOR "N" SERIES

F) SEWN ARTWORK INSTALLED ON BANNERS

Adding sewn artwork onto banners causes the fabric to gather (pucker) and effectively reduces the banner size. Be aware that lots of small letters and graphics, or the use of sticky-back fabric, will cause more banner shrinkage than either larger graphics or painted graphics. Also be aware that, in the process of laying graphics onto banners, the base banner fabric can get wrinkled, which effectively reduces the banner size as well.

G) BANNER INSTALLATION

The banner should be oversized in both directions for the area it will cover. Start with one BOTTOM CORNER point and TOP CORNER POINT on a vertical load tape. Have two people PULL VIGOROUSLY (to the point that one person is almost pulling the other person over) on the vertical tape while a third person attaches the Velcro™. The person attaching the Velcro should start in the middle of the banner, and create small "bubbles" in the banner Velcro™ as that person moves up and then down from the center point. It will appear that the banner is too long, and that it does not fit correctly. The excess is smoothed out during flight as the vertical tape comes under tension.

Remember that in flight the vertical tape will have anywhere from 150 to 200 pounds of tension in it, and the banner will not. Allowing the excess velcro to be spread along the length of the vertical tape prevents the banner from peeling off (usually starting from the bottom).

Attach the next vertical side in the same way, again starting from the middle and working towards the ends. After the two vertical pieces are attached, use the same method of pulling to attach the top, starting from a center point and distributing the excess banner equally on both sides. (Banners made by the Cameron factory usually have a center mark on the horizontal seam and on the banner) and finally along the bottom, again starting from the center. Move on to the next gore, and repeat the sequence.

TIE the banner corners to banner loops. This is essential to prevent peeling from the corner, which is the weakest point.

4.28 ALLOWABLE DAMAGE

GENERAL

The following specific conditions do NOT make the balloon un-airworthy. Although operation of the balloon is allowed, it is best to repair these conditions at the earliest convenient opportunity, preferably no later than the time of the next Annual/100-hour inspection.

Consult Cameron Balloons if questions arise on the airworthiness or legality of a repair, installation, or equipment damage.

A) CROWN RING

No un-repaired damage is permitted to the crown ring. The only damage which can be repaired is minor damage to the surface of the crown ring which makes it rough, creates a sharp edge or creates any condition which could abrade the vertical load tapes where they attach to the crown ring. Minor surface roughness, burrs or abrasiveness can be removed by careful filing or sanding with fine emery cloth. Be careful to remove no more than 5 per cent of the cross-sectional area of the ring.

B) FABRIC

Holes in the lowest 10 feet of the envelope nylon fabric, or any Nomex™ in the envelope need not be repaired. If the damage to the fabric is accompanied by damage to load tapes in excess of the allowable defined below, the load tape **MUST** be repaired or replaced by a certified repair person before the next flight.

Allowable holes or tears above the 10 feet nylon fabric height mark are limited to smaller than 3/4 inch in the longest direction. Larger holes **MUST** be repaired before the next flight.

Repair of holes or tears less than 1/2 inch in the longest direction is optional during Annual/100 Hour Inspection. All larger holes or tears **MUST** be repaired.

C) VERTICAL LOAD TAPES

Breaks of fewer than two filaments (vertical or horizontal) is permitted, provided that no more than one vertical tape is damaged.

D) HORIZONTAL LOAD TAPES

A cut or abrasion which involves fewer than 25% of the filaments in a horizontal tape is permitted.

E) SHROUD LINES, VALVE CENTERING LINES, EASY VENT & PRE-VENT LINES

Damage to the valve centering lines and shroud lines which does not exceed one quarter of the total filaments of the rope is permitted.

F) TURNING VENT & PRE-VENT LINES

There is no limitation on the damage to the turning vent lines as long as the damaged is such that it could not interfere with operation of the deflation line, Smart Vent™ line, Easy Vent line or parachute line.

G) DEFLATION SYSTEM PULLEYS - SMART VENT™ EASY VENT AND PARACHUTE

Pulleys must be fully operational. Uneven wear spots or deep grooves in the pulley wheel render the pulley un-airworthy and must be replaced.

H) PARACHUTE ACTIVATION (ROUND RED) LINE, SMART VENT™ OR EASY VENT ACTIVATION (FLAT RED) LINE

The outer cover of the parachute activation line may be damaged. The inner Kevlar™ core may be damaged, but at least three quarters of the fibers in the Kevlar™ core must be intact. If the damaged area hinders the line from running smoothly through the pulley, it must be repaired before the next flight.

I) SCOOP or SKIRT

There is no limit on the damage allowed on the skirt or scoop, except that the damage must not be such that it could interfere with the operation of the burner or visibility by the pilot.

J) SUSPENSION CABLES, STAINLESS STEEL

One single strand (single stainless steel filament) of a single stainless steel envelope suspension cable may be broken. To protect the envelope from tears, the damaged area should be taped.

K) SUSPENSION CABLES, KEVLAR™

Damage, which does **NOT** expose the milky-yellow inner Kevlar™ core and does **NOT** make the polyester cover brittle enough to crack is acceptable.

4.29 VALVE CENTERING LINES - ADJUSTMENT

In late August of 2006 the N, Z & ZL parachutes were rigged with 24 valve centering lines (VCL). See Appendix N for adjustment gaps and procedures.

The Smart Vent™ & Easy Vent are self adjusting and need no manual adjustment.

Follow the steps below to properly adjust the standard parachute. The proper gaps between Velcro™ tabs for O, A, V, C, N, Z & ZL are listed in the following chart.

O-31 thru O-105	3” to 4”	ZL-56 thru ZL-65	3” to 4”
O-105 60” Panels	1/2” to 1”		
A-105 thru A-120	1 1/2” to 2”	A-140 thru A-400	3” to 4”
N-31 thru N-120	1 1/2” to 2”	N-133 thru N-210	3” to 4”
V-31 thru V-90	3” to 4”	see Fig. 4.29c & d for center gore measurement	
C-60 thru C-100	1 1/2” to 2”		
Z-31 thru Z-120	1 1/2” to 2”	Z-133 thru Z-250	3” to 4”

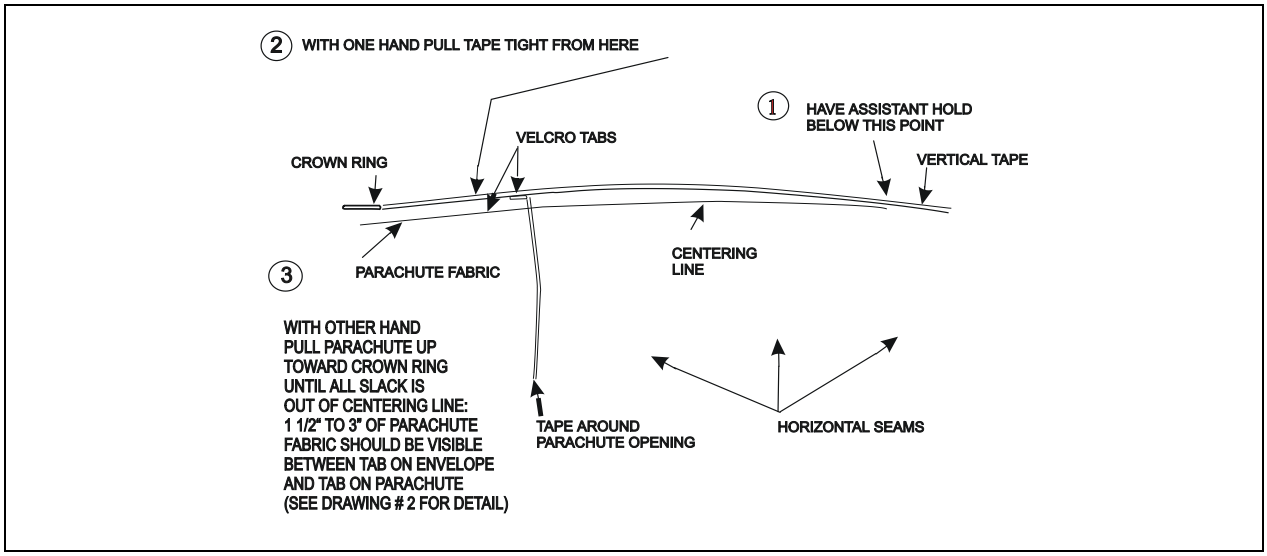


Fig. 4.29
VALVE CENTERING LINE ADJUSTMENT (CROSS SECTION)

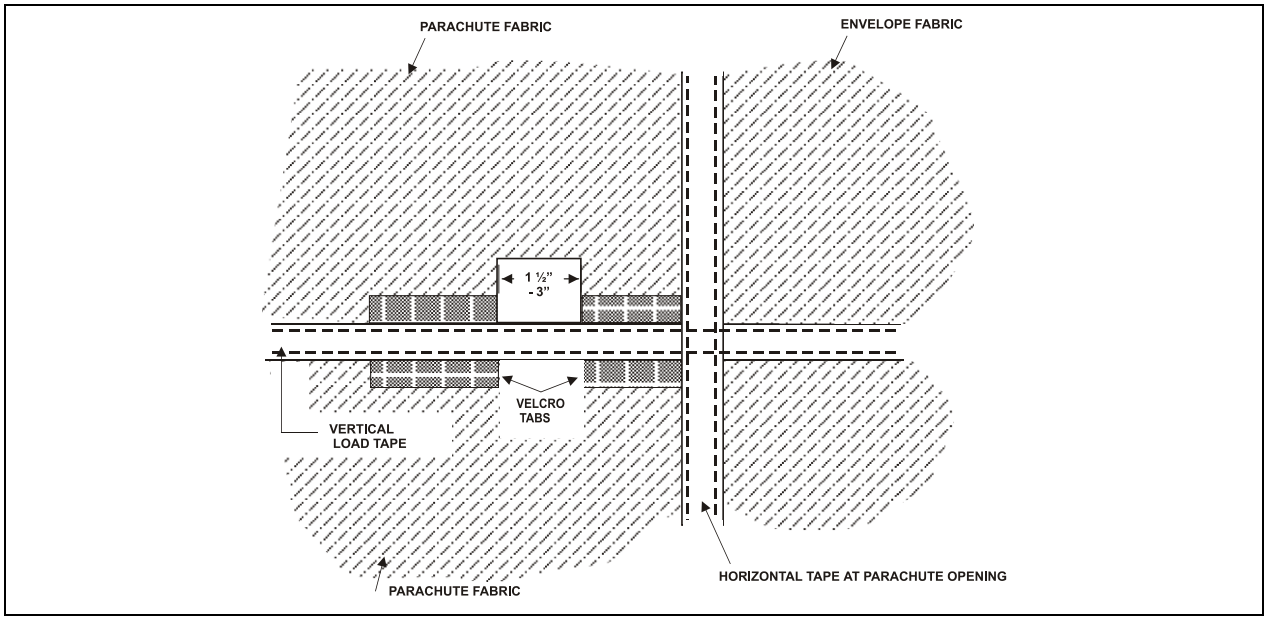


FIG. 4.29a
VALVE CENTERING LINE ADJUSTMENT (OLD STYLE)

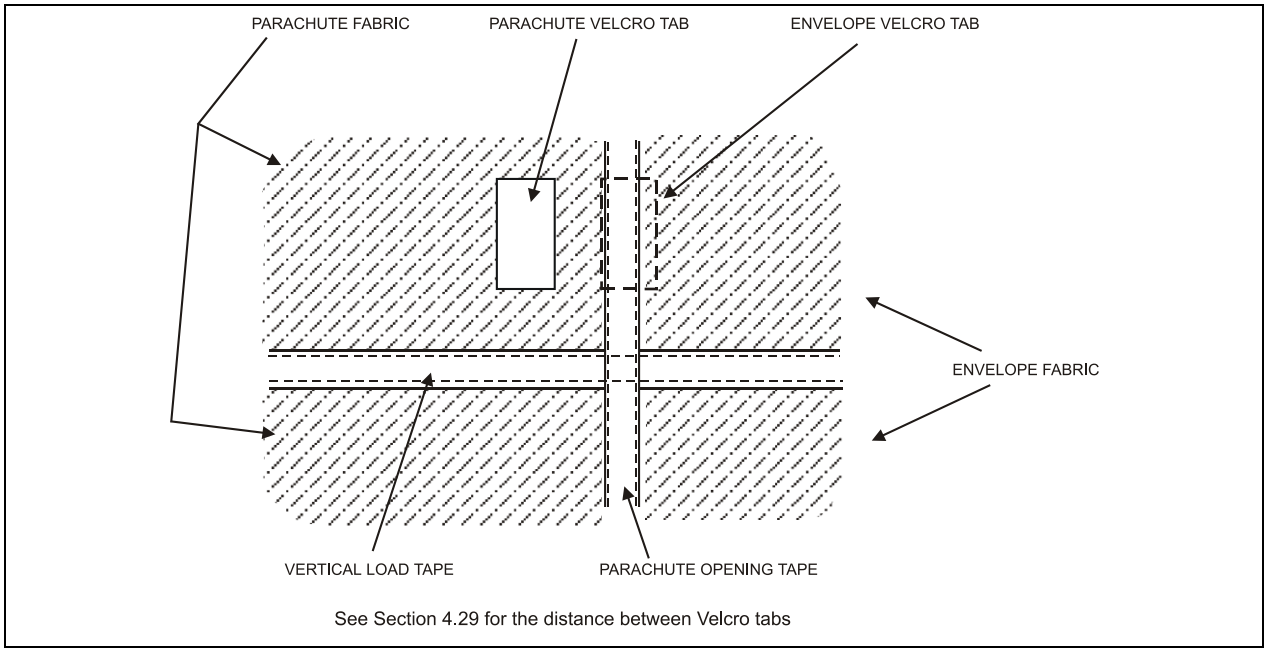


FIG. 4.29b
VALVE CENTERING LINE ADJUSTMENT (CURRENT STYLE)

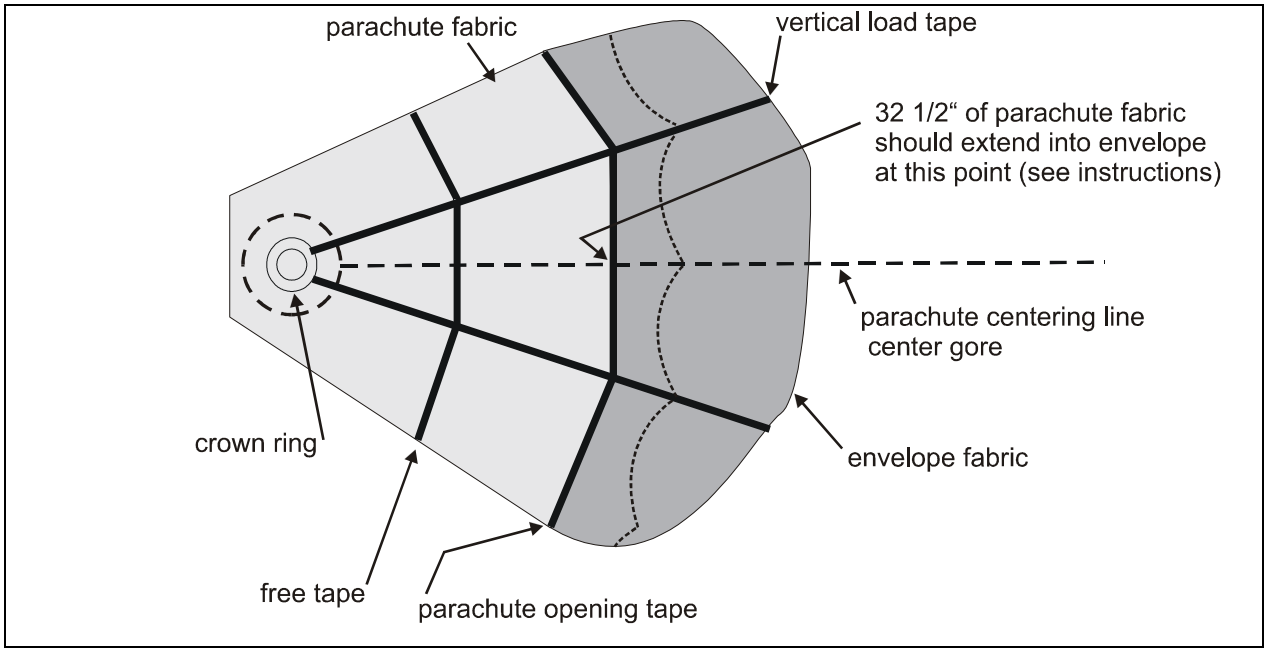


FIG. 4.29c
VIVA CENTER GORE VCL ADJUSTMENT (OLD STYLE)

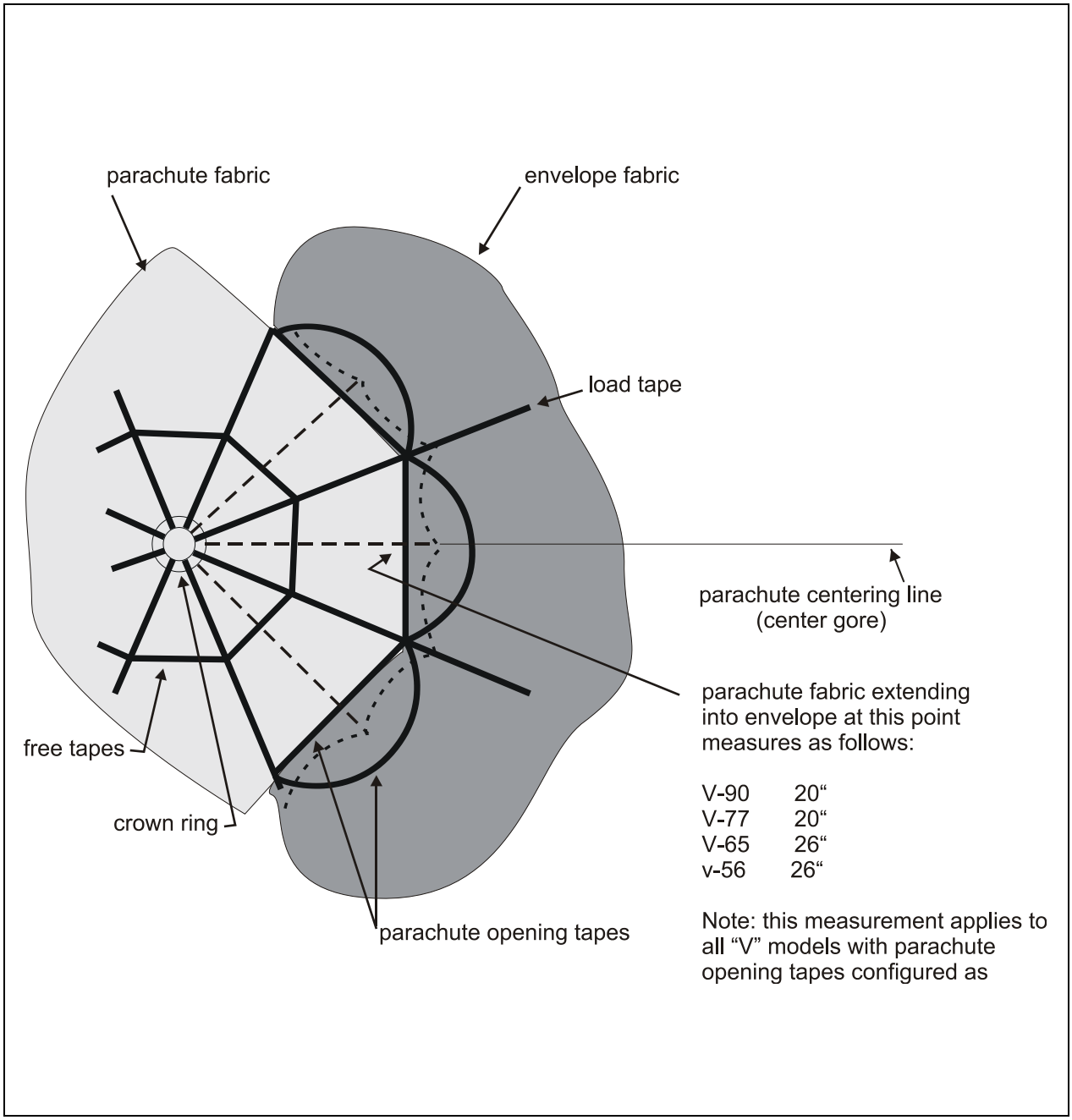


FIG. 4.29d
VIVA CENTER GORE VCL ADJUSTMENT (CURRENT STYLE)

4.30 FABRIC TENSILE STRENGTH TEST

The clamps must be made so that loads are centrally aligned as shown. Clamps should be tightened so there is no movement of cloth between the jaws. It is permitted to line the jaws with a cloth or soft material to prevent slippage.

Fabric must be gripped with jaw edges exactly aligned on the fabric fibers so that the same fibers are being pulled from each end.

Breaks which occur AT THE JAW EDGE are invalid tests and must be repeated.

Tensile tests required:

30 pounds in envelope and parachute
20 pounds in outermost edge of parachute

TESTS MUST BE CONDUCTED ON THE OLDEST FABRIC IN THE ENVELOPE AND IN EACH COLOR IN THE TOP HALF OF THE ENVELOPE.

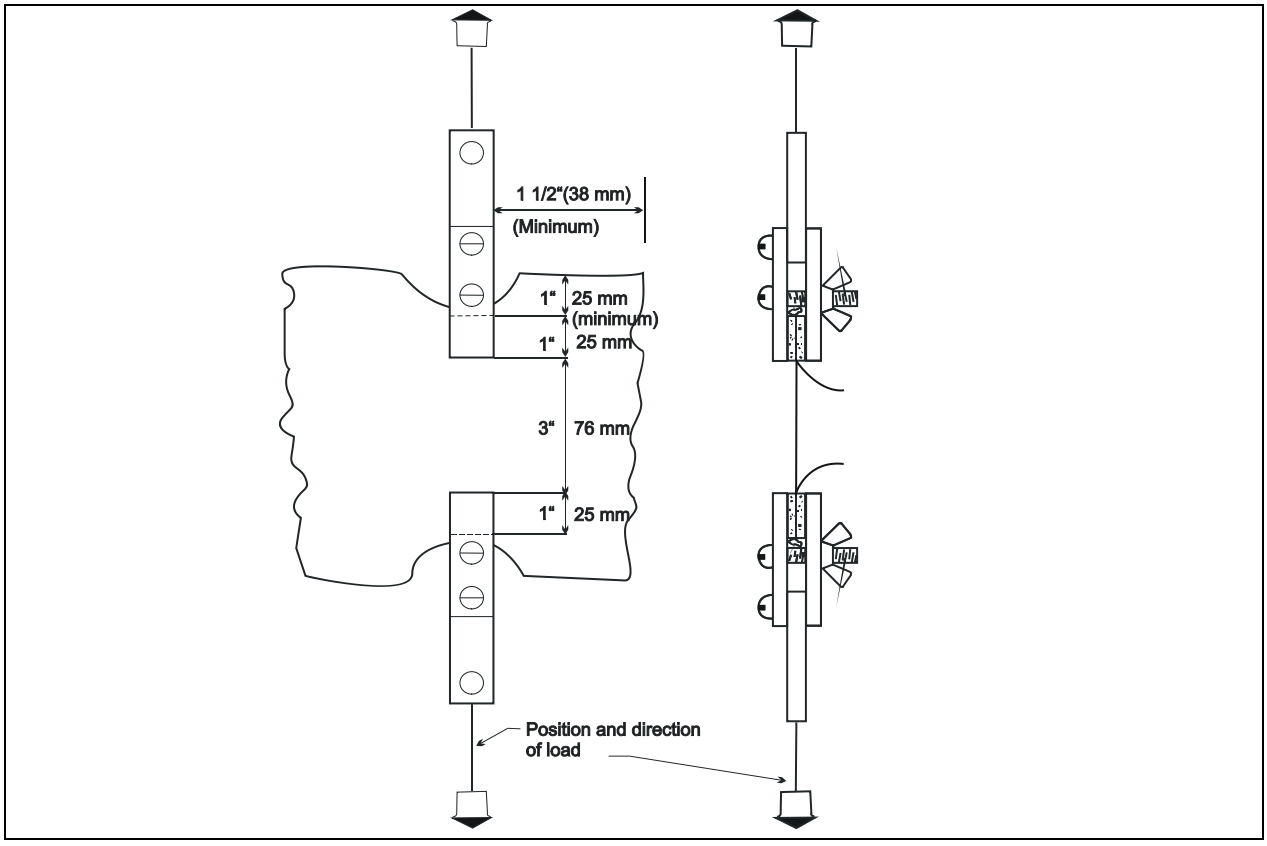


FIG. 4.30
Fabric Tensile Test

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SECTION 5

ENVELOPE MARKINGS AND IDENTIFICATION SYSTEM NOMENCLATURE

This section explains the identification system and specific model schematics of standard model Cameron balloons.

This identification system should be used to record, in the balloon log book and other documents related to repairs, all repairs and maintenance performed on the balloon. It should also be used when communicating with the Cameron factory on any subject pertaining to the envelope.

The model schematics show the location of: horizontal load tapes, parachute attachment points, internal pulleys, deflation line terminus points, turning vent line attachment points and thermistor line ties. The schematics may be reproduced and used for inspections and repairs. The schematics should be used for marking repairs needed/completed on all Cameron models. The schematics also show the correct number of panels per gore on that specific model as well as the amount of fabric required per panel.

See Appendix A for a complete listing of all conventional shaped Cameron Balloons.

All Cameron balloons use alphabetical characters to identify the panels. Numbers only or numbers with L(eft) or R(ight) are used to identify the load tapes.

5.1 IDENTIFICATION SYSTEM NOMENCLATURE: "O", "A", "V", "Z" AND "ZL" SERIES

The mouth panel on O, A, V and V'd or 24 cable Z and ZL's are always NX (for NOMEX™). 12 cable Z and ZL's have 2 piece Nomex™, NXA and NXB. The panel just above the NX (mouth) panel is the A, or NXB in some "Sport" models, continuing through each alphabetic character (including "O" and "I") as high as necessary in the alphabet. Envelopes which have gores with more than 26 panels continue in the following sequence, X, Y, Z, AA, AB, ... etc.

The parachute lettering system starts with the parachute outer edge panel being called "AP". The next panel inward is "BP", the next "CP" etc. The center circle is called " The Patch".

In parachute valve or Smart Vent™ & Easy Vent balloons, if the panel or panels in the body of the envelope adjacent to the parachute opening are not a full height panels they are given the same letter it would normally receive in sequence, followed by "PB". For example, the second from the top panel in the envelope body of a model O-77, part CB112-H, is not a full height panel and therefore is identified as "PPB". On many models there is a partial circular panel, called the "lens panel", which attaches to the upper most full or partial panel and is always referred to as panel "APB".

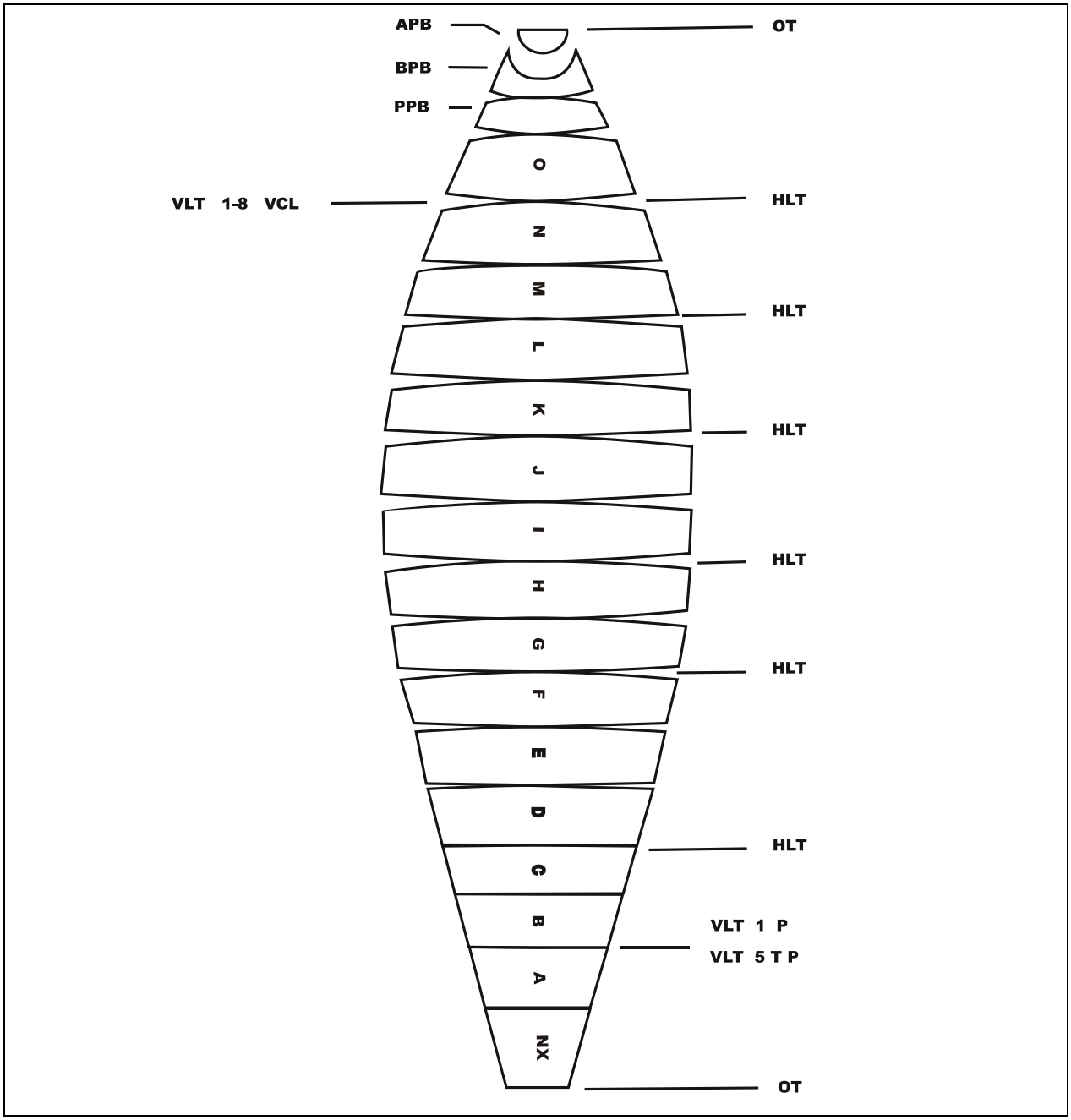

Fig. 5.1
MODEL SCHEMATIC WITH PANEL IDENTIFICATIONS
"O, A, V, Z & ZL" SERIES BALLOONS
(EXAMPLE SHOWN: MODEL V-90 Drawing CBUS817 Issue C)

5.2 IDENTIFICATION SYSTEM NOMENCLATURE: "CONCEPT" SERIES

The "Concept" series balloons incorporate as many vertical load tapes as mouth cables. The "Concept" series identification system nomenclature is similar to the O, A and V series but more complicated. The panels contained between two vertical load tapes are considered one gore. Within a gore are, from bottom to top are: one nomex panel "NX"; two "A" panels, one left (AL) and one right (AR); four "B" panels, two lefts (one BXL and one BYL) and two rights (one BXR and one BYR); four "C" panels, two lefts (one CXL and one CYL) and two rights (one CXR and one CYR); two "D" panels, one left (DL) and one right (DR).

Examples of "Concept" Series panel designations are:

Panel AL, gore 12-1
Panel BXR, gore 2-3
Panel CYL, gore 6-7
Panel DR, gore 9-10

The parachute of an "Concept" Series balloon is made of 24 or 36 vertical panels (two parachute panels per envelope gore). The parachute "A" and "B" panels are mirror images of each other. The Velcro™ tabs are numbered identically to the mouth cables and sequentially around the edge of the parachute in a counter-clockwise direction. The panel to the right of the Velcro™ tab is the "P-A" panel. The panel to the left of the Velcro™ tab seam is the "P-B" panel.

To identify a parachute panel, use the numbers on the parachute under the Velcro tabs and identify the panel as "P-A" or "P-B".

Examples of "Concept" Series parachute panel designations are:

Panel P-A, Velcro tab 5
Panel P-B, Velcro tab 6

(In the above examples, the two panels would be between Velcro™ tabs numbered "5" & "6").

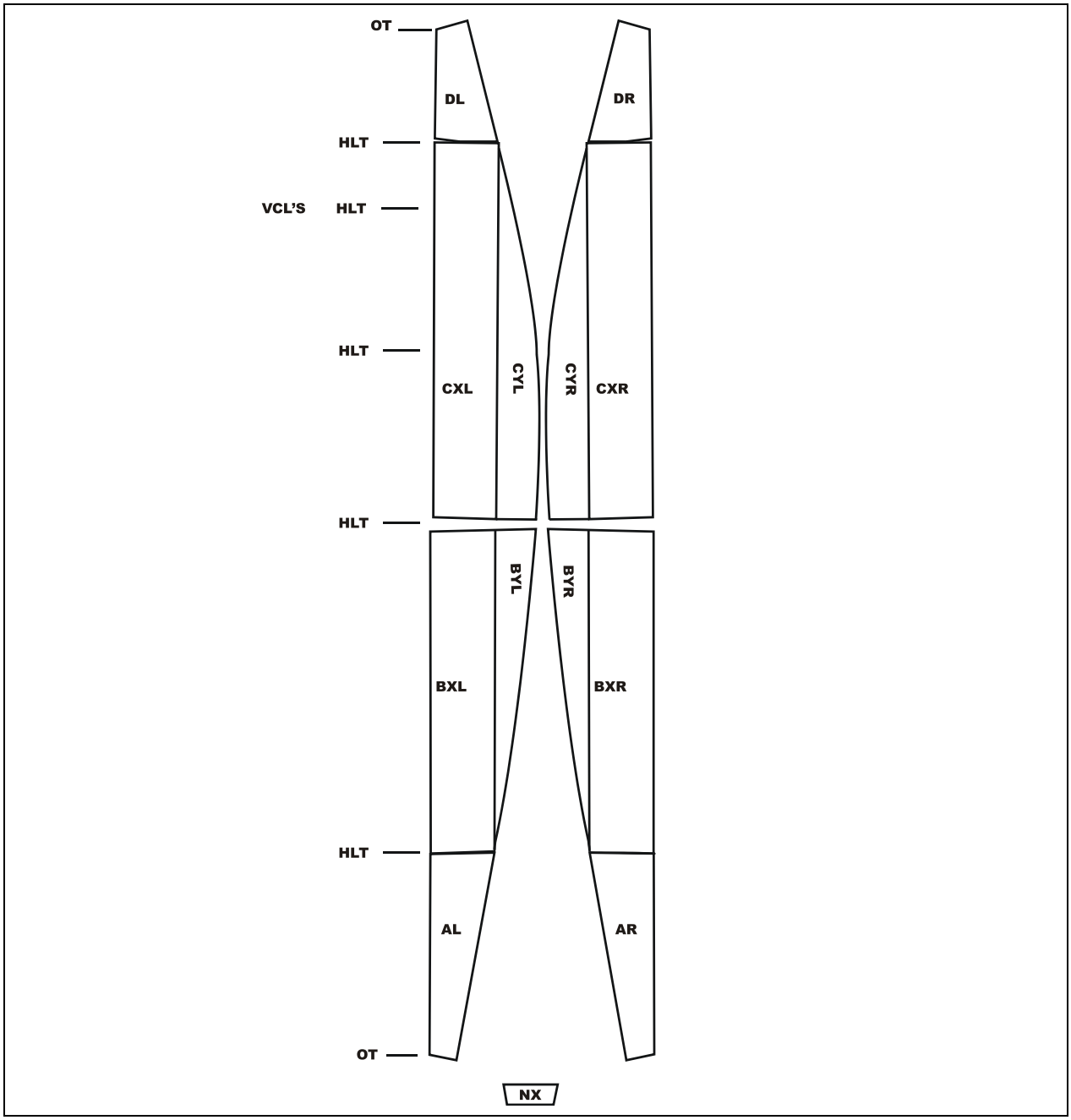

Fig. 5.2
MODEL SCHEMATICS WITH PANEL IDENTIFICATIONS
"Concept" SERIES BALLOONS
EXAMPLE SHOWN: MODEL Concept-80, Drawing CBUS1025 iss.B

5.3 IDENTIFICATION SYSTEM NOMENCLATURE: "N" SERIES

The "N" series balloons incorporate twice as many vertical load tapes as mouth cables. The "N" series therefore has a more complicated identification system nomenclature. Pairs of adjacent vertical tapes are joined together in a "V" at the mouth. When facing the balloon from the outside, the vertical tape on your left hand side is given the suffix "L", while the vertical tape on your right hand side is given the suffix "R". (The fabric panels contained between the vertical load tapes are similarly designated as "lefts" or "rights"). The two vertical load tapes on an N-77 attached to envelope cable 1, for example, is gore 1L-1R (the fabric contained within the arms of the "V") while gore 1R-2L is the next gore to the right of gore 1L-1R.

The Nomex™ panels at the mouth are cut in one of two ways:

(1) A triangle shape (NXB) which fits inside the "V" created by the vertical load tapes at the mouth, plus a trapezoid shape (NXA) which fits adjacent to the "V"s.

or

(2) (Older style) Two identical trapezoid shaped pieces (NX) which ignore the path of the vertical load tape at the mouth.

A gore consists of eight vertical pieces (4 lefts & 4 rights) of nylon fabric above the Nomex™ mouth. The bottom-most nylon panels, just above the Nomex™, are called "AL" and "AR", for "A" left and "A" right. The next higher panels are "BL" and "BR" (also called the "banner area"), next higher, starting at the equator and going up, are "CL" and "CR", and the highest panels in the balloon are "DL" and "DR". There are horizontal load tapes on the horizontal seams connecting A,B,C, and D panels, plus additional horizontal load tapes in "C" and "D" in most balloons.

Examples of "N" Series panel designations are:

Panel AR, gore 12R-1L
Panel BL, gore 2L-2R
Panel DL, gore 3R-4L

The parachute of an "N" Series balloon consists of half as many vertical panels as the main body of the balloon (one parachute panel per envelope gore). The parachute "A" and "B" panels are mirror images of each other. The Velcro™ tabs are numbered identically to the mouth cables and sequentially around the edge of the parachute in a counter-clockwise direction. The panel to the right of the Velcro™ tab, between the Velcro™ tab seam and the non-velcro seam, is the "P-A" panel. The panel to the left of the Velcro™ tab seam is the "P-B" panel.

To identify a parachute panel, use the numbers on the parachute under the Velcro tabs and identify the panel as "P-A" or "P-B".

Examples of "N" Series parachute panel designations are:

Panel P-B, Velcro tab 5
Panel P-A, Velcro tab 5

(In the above examples, the two panels would be on opposite sides of the Velcro™ tab numbered "5").

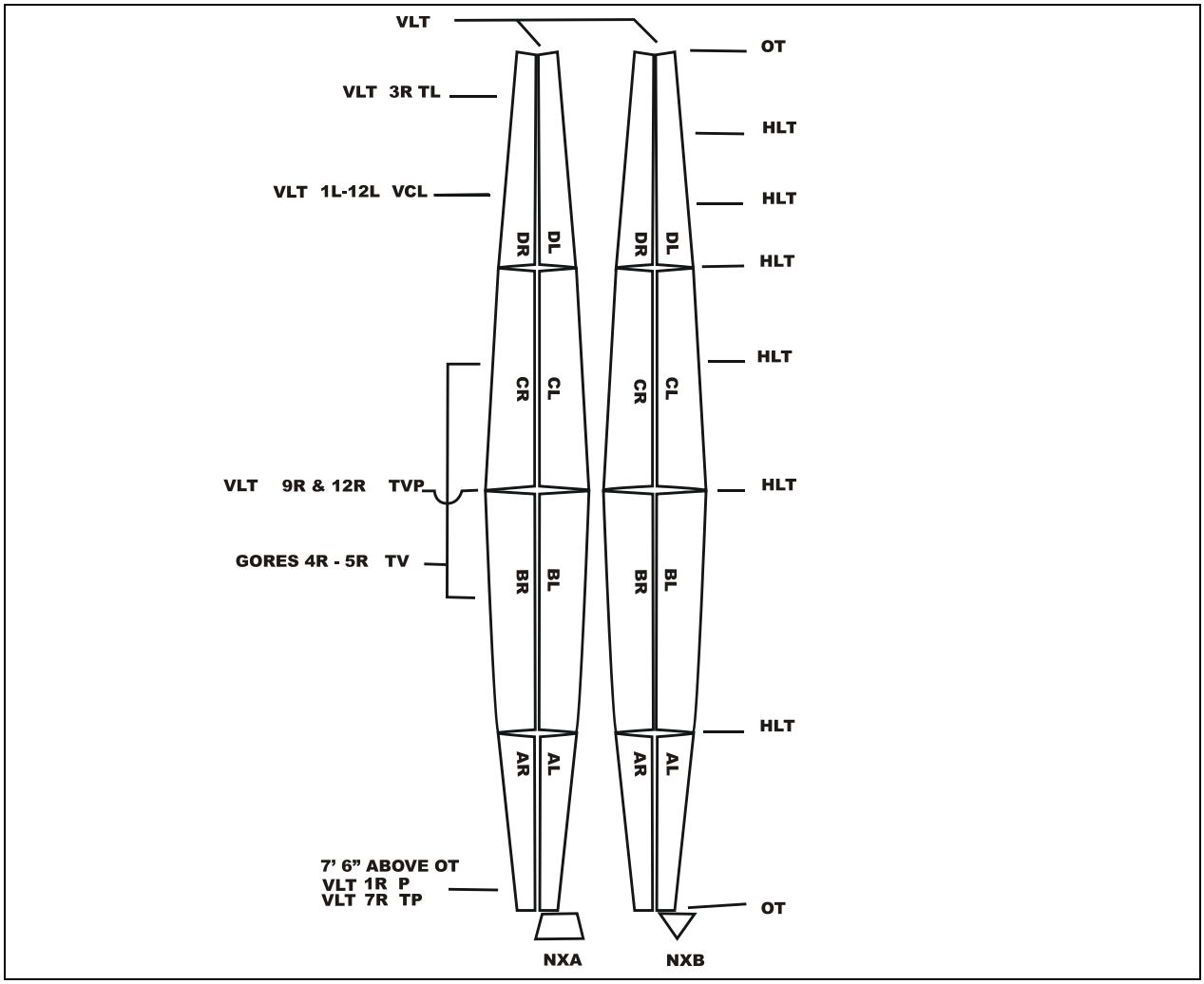

Fig. 5.3
MODEL SCHEMATICS WITH PANEL IDENTIFICATIONS
"N" SERIES BALLOONS
EXAMPLE SHOWN: MODEL N-77, Drawing CB143-1D

NOTE:
The nomenclature for Cameron Balloons U S balloons is the same for Cameron Balloons Ltd. balloons, however, older Cameron Balloons Ltd. balloons may not have the same panel configuration. There have been design changes over the years which are not reflected in this manual.

5.4 MARKINGS USED IN MANUFACTURING PROCESS

During the manufacturing process, each corner of each fabric panel is marked with a letter and number. The letter is the same as the letter code explained previously. The number is the horizontal seam number, and need not be of concern during repair work.

5.5 KEY TO ABBREVIATIONS

HLT	**H**orizontal **L**oad **T**ape (3/4” OR 1” flat webbing)
VLT	**V**ertical **L**oad **T**ape (9/16", 3/4" or 1" tubular webbing)
P	Red Line **P**ulley
EVR	Smart **V**ent & Easy Vent **R**ing
EVT	Smart **V**ent & Easy Vent **T**ermination **P**oint
TV	**T**urning **V**ent
TVP	**T**urning **V**ent **P**ulley
VCL	**V**alve **C**entering **L**ine Attachment Point
TL	**T**empil **L**abel
TP	Red Line **T**ermination **P**oint
OT	Mouth or Parachute **O**pening **T**ape (Circumferential tape at parachute and mouth openings, 3/4" or 1" tubular webbing)
SEAM	*letter/letter*: Seam between panels with letters as shown

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SECTION 6

BURNER AND FUEL SYSTEM

WARNING! DANGER!
HAZADOUS CONDITIONS WHICH COULD RESULT IN INJURY OR DEATH MAY OCCUR FROM: **A. THE INSTALLATION OF NON-APPROVED PARTS OR MATERIALS** **B. MODIFICATION OF ANY PART** **C. IMPROPER REPAIR PROCEDURES** **D. IMPROPER OPERATION OF THIS AIRCRAFT** **APPROVED REPLACEMENT PARTS, MATERIALS AND REPAIR PROCEDURES ARE DOCUMENTED IN THIS MANUAL**

The MK III double burner (Cameron drawing no. CB205) consists of welded coils into which a stainless steel tee fitting is screwed. The tee fitting joins the pre-heat coil to the blast valves and pressure gauge. Each blast valve connects the tee fitting to a liquid fuel hose. Each liquid fuel hose connects its blast valve to a fuel manifold or fuel tank via steel-reinforced hose and a hose end connector.

The MK IV Standard single burner (Cameron drawing no. CB391 or CBUS391), MK IV Standard double burner (Cameron drawing no. CB392 or CBUS392), MK IV Super double burner (Cameron drawing no. CB579-1 or CB579-2 or CBUS579-1 or CBUS579-2), MK IV Ultra single burner (Cameron drawing no. CB2130-1 or CB2130-2), MK IV Ultra double burner (Cameron drawing no. CB2075-1 or CB2075-2), MK IV Ultra triple burner (Cameron drawing no. CB2081-1 or CB2081-2) and MK IV Ultra quadruple burner (Cameron drawing no. CB2083-1 or CB2083-2) use Inconel coils with corner straps that hold the coils firmly but allow movement of the coils within the corner brackets.

The MK IV Standard burners use a steel tee fitting similar to that used on the MK III double burner. The tee fitting(s) joins the pre-heat coil(s) to the blast valves and pressure gauge(s). A Whisper™ Valve is attached to the blast valve. The blast valves connect the pre-heat coil(s) to the fuel tank or basket fuel manifold via a steel-reinforced hose and a hose end connector.

The MK IV Super burner coils and can are very similar to the MK IV Standard burner. The Cameron Manifold blocks replace the stainless steel tees and integrates the blast valve, pilot light on/off valve and piezoelectric ignitor in a single machined unit. A Whisper™ Valve is attached to the mainfold block. A lubrication port is incorporated into each blast valve. The Cameron Manifold block connects the burner coil to the fuel tank or basket fuel manifold via a steel-reinforced hose and a hose end connector.

The MK IV Ultra burners have similar coil and can assemblies as the MK IV Super burner (although the jets may be configured in a round rather than square pattern). The MK IV Ultras have the Whisper™ valve as an integral part of the Cameron Manifold block and the blast valve handles may be connected by the "Ultragrip" handle. The "Ultragrip" handle allows the blast valves to be operated via a trigger action. The blast valve handles may alternatively be rotated through 180° and operated in the traditional manner. Liquid pilot lights are standard, with vapor pilot lights available as an option. Each blast valve and Whisper™ valve has a provision for lubrication (recommended approx. each 20 hours of operation), as described in Sec. 6.9.

See Appendix G for the Sirocco burners.

PARTS ARE NOT INTERCHANGEABLE

CAUTION:
WHERE PART NUMBERS ARE GIVEN FOR FUEL SYSTEM FITTINGS SPECIFYING BRITISH REGO, THE AMERICAN REGO FITTING IS NEITHER EQUIVALENT NOR PERMITTED, EVEN IF THE FITTING HAS THE SAME NUMBER. BRITISH AND AMERICAN REGO PARTS ARE IN THESE INSTANCES NOT INTERCHANGEABLE. IF THE DESCRIPTION STATES ONLY "REGO" THEN EITHER THE BRITISH REGO FITTING OR THE U.S. REGO FITTING MAY BE USED.

6.1 BURNER SYSTEM: MAJOR PARTS AND SUBASSEMBLIES

BURNER COIL, MK III double burner: (Cameron Balloons U.S. Drawing no. CB201) The stainless steel coil is constructed of 16 SWG stainless steel tubing.

BURNER COIL, MK IV STANDARD burner (Cameron Balloons U.S. Drawing no. CB371) The coil is Inconel high-temperature stainless alloy with corner brackets.

BURNER COIL, MK IV SUPER burner: (Cameron Balloons U.S. Drawing no. CB584) The coil is Inconel high-temperature stainless alloy with corner brackets. The jets may be configured in either a square or circular pattern.

BURNER COIL, MK IV ULTRA burner: (double, triple and quadruple burners - Cameron Balloons U.S. Drawing no. CB2076) (single burner - Cameron Balloons U.S. Drawing no. CB2132). The coil is Inconel high temperature stainless alloy with corner brackets. The jets may be configured in either a square or circular pattern.

THREE-WAY TEE FITTING: (F057) For use on MK III double burners. This part is designed and custom fabricated for this purpose. Replacement fittings must be obtained from Cameron Balloons U.S. NO OTHER FITTING IS APPROVED.

FOUR-WAY TEE FITTING: (F059) For use on MK IV Standard single and double burners. This part is designed and custom fabricated for this purpose. Replacement fittings must be obtained from Cameron Balloons U.S. NO OTHER FITTING IS APPROVED.

LIQUID HOSE: Hose assemblies **MUST** be obtained from Cameron Balloons. Specify which burner and basket the hose will be used with, so the proper length can be provided. For older systems, be ready to provide the overall length of the fuel hose needed, as this may be necessary (It is a good idea even on newer systems to provide the overall length of the hose being replaced, since this is a good cross-check that you are really ordering what you need).

NOTE:
FUEL HOSES MUST BE REPLACED AFTER 10 YEARS IN SERVICE.
Cameron Balloons U.S. requires liquid, vapor and manifold hoses to be replaced if they have been in service for 10 years or are damaged. If the outer rubber cover is cut, cracked or sliced enough to expose the inner steel braid, the hose **MUST** be replaced at the next 100/Annual Insp.

VAPOR HOSE: Hose assembly **MUST** be obtained from Cameron Balloons. As above, it is a good idea to measure the overall length of the hose being replaced and to provide this measurement when ordering a replacement hose as a cross-check that you are really ordering what you need.

FUEL PRESSURE GAUGE: Pressure gauges are custom made specifically for Cameron Balloons. There are several versions depending on the specific burner. No other gauge is approved. Other than lens replacement, damaged gauges **MUST** be replaced.

BLAST VALVE: (F128 or F901) American REGO 7553S or 7553T or 7901T quick-acting valve.

HOSE END FITTING: (F006S) (REGO 7141F or BMV 344) are BRITISH 1 1/4" Female ACME fitting, (F06) is assembled by Cameron U.S. and is also a BRITISH 1 1/4" Female ACME fitting or (F075) TEMA 3800 coupler.

WHISPER VALVE: Three different whisper valve styles have been used. The first, installed on early MK IV Standard burners, is a "Nupro" (F181) stem and seat valve, which is screwed into the side of a modified blast valve and is activated by turning a green or red knob. The second, installed on later MK IV Standard burners and all MK IV Super burners, is a modified "Waverly" (F180W or F740) ball valve which was either screwed into the side of a modified blast valve (MK IV Standard) or screwed into the Cameron Manifold block (MK IV Super) and activated by turning a blue plastic covered handle. The third is a specifically designed valve, which is incorporated into all MK IV Ultra & Sirocco burner manifold blocks and activated by turning a blue anodized handle.

PILOT LIGHT ON/OFF VALVE: Two different vapor pilot light valve styles have been used. The first, installed on all MK IV Standard burners, is a "Waverly" (F180) ball valve which is in line between the vapor hose and the pilot light cup and activated by turning a red plastic covered handle. The second is three specifically designed valves which are incorporated into the MK IV Super, Ultra & Sirocco burners manifold blocks and activated by turning a flat aluminum (Super) or round red anodized handle.

CROSS FLOW VALVE: Two different crossflow valve styles have been used. The first, installed on all MK IV Standard double burners, is a "Dynaquip" ball valve which is activated by turning a dull gray metal handle. The second, installed on all MK IV Super and MK IV Ultra Double, Triple and Quadruple burners is a "Waverly" ball valve which is activated by turning a yellow plastic covered handle.

LIQUID PILOT LIGHT REGULATOR: Two different liquid pilot light regulators are used. The MK IV Super burner uses a specifically designed manually adjustable needle and seat valve regulator which is externally mounted to the Cameron manifold block, (the same position where the vapor hose is installed on vapor fed pilot light burners). All MK IV Ultra & Sirocco burners use a specifically designed piston and seat non-adjustable regulator which is mounted inside the burner can between the Cameron manifold block and pilot light torch body.

BURNER FRAME: Many frames have been used. The styles and configurations vary depending on the burner and basket sizes.

BURNER FRAME CORNER SHACKLE: Loop shackle at burner corner is AGS-194E. The shackle pin is AGS-196E. The nut is 1/2 BSF Nyloc. The three pieces are Part no. F011.

BURNER GIMBAL BOLT ASSEMBLY BETWEEN INNER FRAME AND BURNER UNIT: 8mm x 40 (F309) or 45 (F309M) or 50mm (F309L) stainless steel bolt, with or without a brass or fiber (F053) friction washer, saddle block (F056), curved washer (F304), thin locking nut (F306) and a cap nut (F305).

BURNER GIMBAL BOLT ASSEMBLY BETWEEN INNER AND OUTER FRAME: 8mm x 65mm (F307) (10mm on T & TT frames) stainless steel bolt, a curved washer (F304), a fiber washer (F053) sandwiched between two brass saddles (F056), a curved washer (F304), thin lock nut (F306) and hex nut (F310).

CARABINER: Stubai 982002 (B111)

BURNER JET SCREW: (MK III) Drilled screw size OBA (F342)

MAIN BURNER JET: (ALL MK IV's) Amal Size 1020 (F00XJ) is standard on all MK IV's except the MK IV Ultra single. Various other sizes are used for special applications. Multi-hole jet (F923) is standard on MK IV Ultra singles and as an option on all other MK IV's.

WHISPER JET (removable models): (ALL MK IV) Amal Size 2640 (F182) or Multi hole "Quiet" jet (F922 or F924)

6.2 REQUIRED MAINTENANCE - MK III BURNERS

1) Tighten burner jet screws with a flat blade screw driver. These jets rarely loosen.

2) The Rego blast valve must be rebuilt (refer to Section 6.17) during each annual and 100 hour inspection.

6.3 REQUIRED MAINTENANCE - MK IV STANDARD BURNERS

1) The burner jets must be checked with a torque wrench to 60-100 **pound-inches**. Over-torquing can break the jets.

If star washers are not present, you may optionally install the washers before tightening. Star washers are not required, but if a jet is found to be missing during the inspection, it may be wise to install star washers on all jets.

2) The Rego blast valve must be serviced during each annual and 100 hour inspection (refer to Section 6.17).

6.4 REQUIRED MAINTENANCE - MK IV SUPER BURNER

1) The burner main jets must be checked with a torque wrench to 60-100 **pound-inches**. Over-torqueing can break the jets.

If the jet, star or crush washers are not present, you may optionally install the washers. Washers are not required, but, if a jet is found to be missing during the inspection, it may be wise to install lock washers on all jets.

2) "O" ring **replacement** is not a required Annual/100 Hour inspection procedure on the MK IV Super burners, but the blast valve must be disassembled (refer to Section 6.18), all internal parts of the valve cleaned and inspected and the two valve stem "O" rings lubricated with a silicone grease.

6.5 REQUIRED MAINTENANCE - MK IV ULTRA BURNERS

1) The burner main jets must be checked with a torque wrench to 60-100 **pound-inches**. Over-torqueing can break the jets.

If the jet star or crush washers are not present, you may optionally install the washers. Washers are not required, but, if a jet is found to be missing during the inspection, it may be wise to install lock washers on all jets.

2) Blast valve "O" ring **replacement** is not a required Annual/100 Hour inspection procedure on the MK IV Ultra burners, but the blast valve must be disassembled (refer to Section 6.19), all internal parts of the valve inspected and cleaned and the two valve stem "O" rings lubricated with a silicone grease.

3) The MK IV Ultra burners are equipped with a liquid fuel fed pilot light as standard equipment (vapor pilot optional). A fuel filter is located in the manifold block (refer to FIG. 6.19), remove and clean the pilot filter (refer to Section 6.25 I).

4) If fitted, disassemble and clean pilot light regulator (refer to Section 6.25 III)

5) Remove and clean the pilot light jet (vapor or liquid supplied system) (refer to Section 6.25 II).

6) Lubricate the whisper valves (refer to Section 6.9 B)

6.6 REPAIR OF BURNER COIL - ALL MODELS

The MK III burner coil may be repaired by welding in a new curved section of tubing. The burner **MUST** be pressure tested to 400 psi after welding. To accomplish this, the orifices must be replaced with undrilled OBA screws for the test. The coil must be submerged during the pressure test. Any small bubbles of gas escaping the burner indicate a flawed weld, which must be corrected before returning burner to service.

Contact Cameron Balloons US before undertaking any coil repair, as this would best be done by the factory.

The MK IV, MK IV Super, MK IV Ultra & Sirocco burner coil must be replaced with a Cameron Balloons US supplied coil assembly if damaged in such a way as to cause leakage of fuel or alteration of flame pattern.

6.7 FUEL HOSE REPLACEMENT - ALL MODELS – BURNERS & MANIFOLDS

Replacement may be completed by the owner/operator.

NOTE:
FUEL HOSES MUST BE REPLACED AFTER 10 YEARS IN SERVICE.
Cameron Balloons U.S. requires hoses to be replaced if they have been in service for 10 years or are damaged. If the outer rubber cover is cut, cracked or sliced enough to expose the inner steel braid the hose **MUST** be replaced.

Both liquid and vapor fuel hoses **MUST** be replaced using replacement hose assemblies supplied by Cameron Balloons US. The fuel hoses are removed and re-installed using simple open end wrenches.

NOTE:
During hose replacement, care should be taken to support the 7553T or 7901T Rego blast valve to prevent rotation or excessive side forces to the valve.

The threads on the fuel hose should be wrapped with two turns of Teflon tape. This is a steel to brass or aluminum connection and caution should be taken to not over-tighten these parts.

6.8 BURNER JETS - ALL MODELS

Replacement may be completed by owner/operator.

In all Cameron Balloons MK III Burners, pilot light jets and main burner jets are drilled British OBA screws. They are removed and replaced using a flat blade screwdriver. These jets are available from Cameron Balloons US.

The standard main burner jets in the MK IV, MK IV Super, and MK IV Ultra burners are AMAL screw-in brass jets. The standard size is 1020, although some early MK IV burners used size 1690. Various other sizes have been used in special applications. Some MK IV Standard, Super and Ultra burners have Cameron Balloons manufactured Multi-hole main jets similar to the Whisper™ jets. NOTE: The very earliest MK IV burners do not have removable jets. In these burners the jets consisted of holes drilled in the "S" coil assembly.

Removal and replacement of the AMAL jets should be done using a 5/16" Whitworth socket wrench (available from Cameron Balloons US)(multi-hole jets require a 9/16" SAE socket). Since the introduction of the MK IV burner, the AMAL jets have been installed with either Teflon tape, thread locking compound or several types of lock washers. An inside "Star" lock washer or copper crush washer is the current and recommended standard. These lock washers prevent loosening of the jets from any vibration, such as that incurred when transporting a balloon system. The star or crush washers are also better able to withstand overheating when the burners are operated on vapor.

When installing **new** jets and washers, torque them to **150 lb. inches. Always use a torque wrench and the recommended torque setting when installing new jets; otherwise you will either break them or not tighten them enough.**

6.9 BLAST VALVE AND WHISPER VALVE LUBRICATION - OWNER/OPERATOR PERMITTED: MK IV SUPER & MK IV ULTRA

This routine lubrication **(NOT SUFFICIENT FOR THE BLAST VALVE AT ANNUAL/100 HOUR INSPECTION)** may be completed by owner/operator and is recommended every 20 hours of operation.

A) BLAST VALVE:

1) LUBRICATION:

a) The lubrication port on the side of the MK IV Super (refer to FIG. 6.18) and MK IV Ultra (refer to FIGS. 6.19 & 6.19a) blast valves may be opened using a flat blade screwdriver. Silicone spray lubricant may then be introduced through this port directly to the O-rings on the valve stem. Use caution not to over-tighten the screw or lose the small O-ring around this screw as it seals this area against propane fuel leakage. **(This procedure is recommended every 20 hours of operation)**.

B) WHISPER VALVE:

1) LUBRICATION:

a) The Whisper valve on the MK IV Ultra burners (refer to FIG. 6.19 & 6.19a) may be lubricated by removing the 2.5mm Allen screw in the center of the valve stem. Silicon grease should be squeezed into the hole and the Allen screw replaced and tightened. The tightening of the Allen screw will force the grease into the space between the three O-rings on the valve stem. **(This procedure is recommended every 20 hours of operation)**.

At ANNUAL/100 HOUR INSPECTION the Blast valves must be disassembled, all internal parts cleaned, inspected and the two O-rings replaced and/or lubricated with a silicone grease which is compatible with propane fittings. (refer to Section 6.5 and 6.19)

6.10 DISASSEMBLY OF MK III BURNER

Refer to FIG. 6.10.

There is no stainless steel can on the MK III burner. The round coil connects directly to the 3 way Tee (F057), as does the blast valve (F128 Not Available, replace with F901) and fuel pressure gauge (F125). There is no piezo ignitor. The pilot light assembly and, if retrofitted, Whisper™ valve tube and jet each pass through the open bottom of the burner. Each of these is held to the burner in its own manner and common sense and experience will dictate which parts must be removed and in what order to effect a given repair.

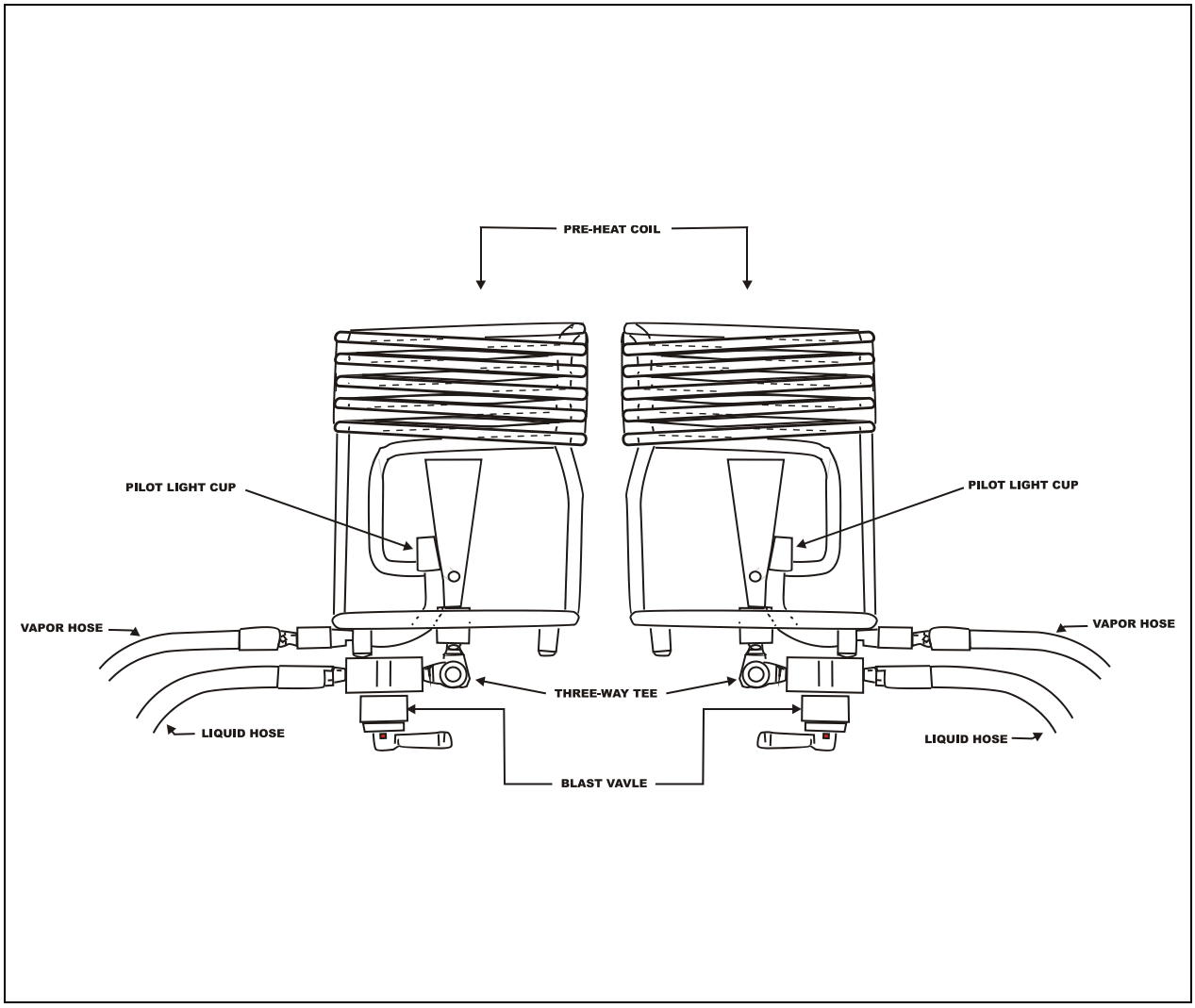

FIG. 6.10
MK III DOUBLE BURNER

6.11 DISASSEMBLY OF MK IV STANDARD BURNER

Refer to fig. 6.11 & 6.11a

The coil assembly is held in place by either 4 or 8 machine screws through the burner can and four corner coil support straps. The coil connects to the 4 way tee (F059) via a Swagelok fitting (use 7/8" crowfoot to remove) on the inside of the burner can. The piezo ignitor actuator (F153), pilot light assembly (F335) and Whisper™ valve tube (F182T), each pass through their own holes in the burner can (refer to FIG. 6.11 and 6.11a. Each of these is held to the can in its own manner and common sense and experience will dictate which parts must be removed and in what order to effect a given repair.

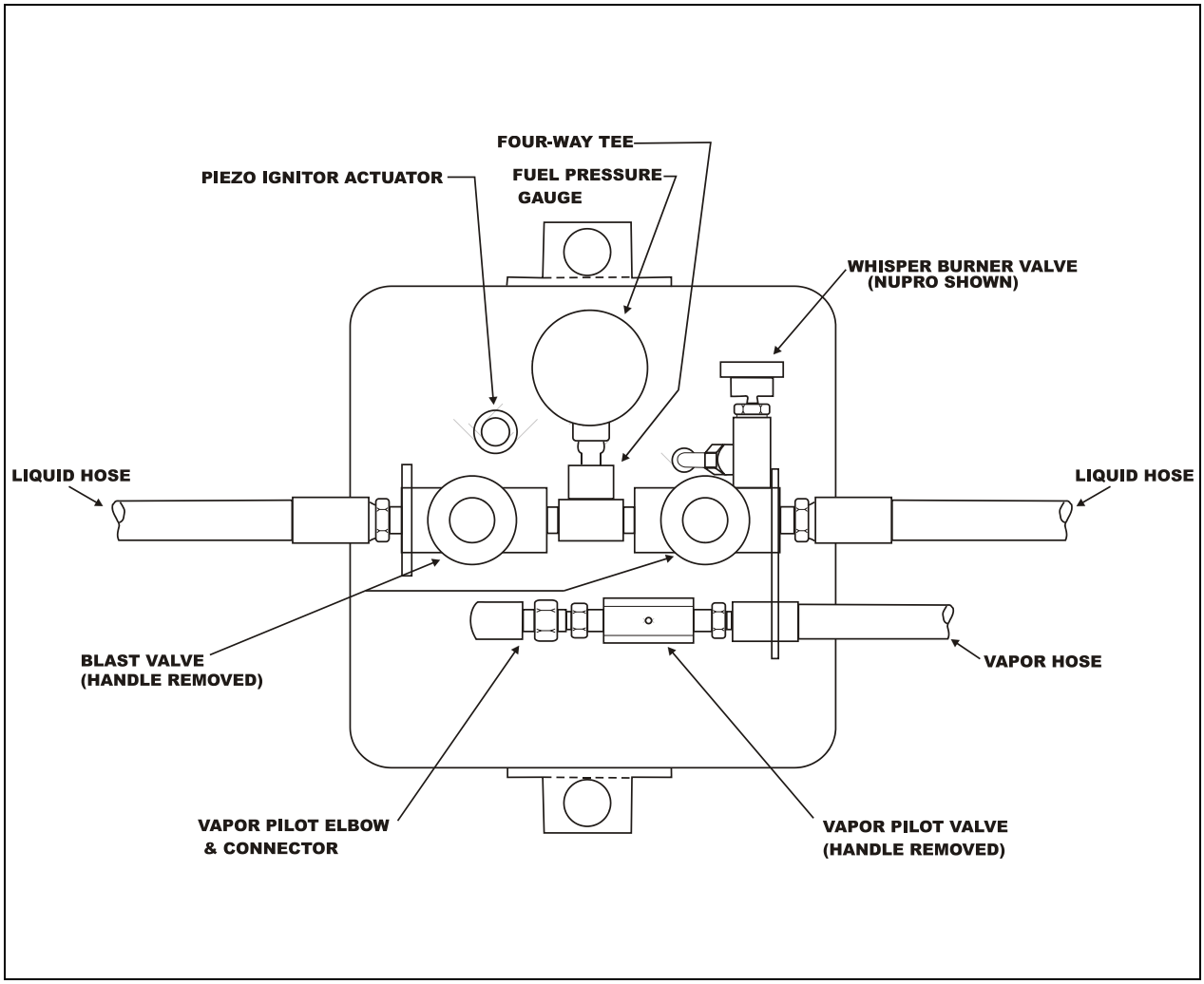

FIG. 6.11
MK IV STANDARD SINGLE BURNER

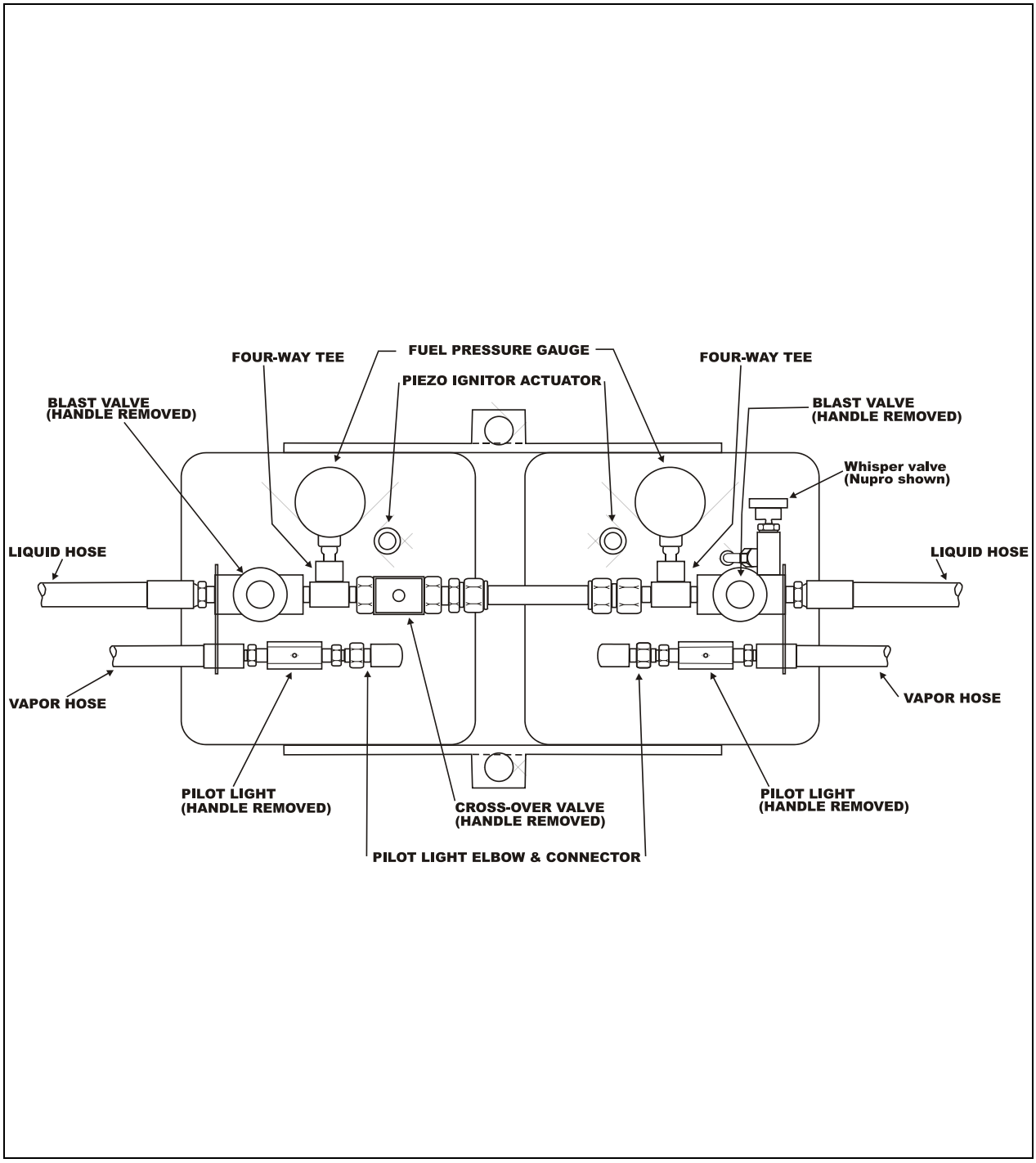

FIG. 6.11a
MK IV STANDARD DOUBLE BURNER

6.12 DISASSEMBLY OF MK IV SUPER BURNER

All systems, **except the fuel pressure gauge**, may be serviced without total disassembly of this burner.

A) COIL REMOVAL:

1) Remove the eight corner bracket screws (2 on each corner) with a straight blade screwdriver.

2) Remove the vent tube (refer to FIG. 6.18) with a flat blade screwdriver, to allow access to the Swagelok fitting.

3) Loosen completely the swagelok fitting (7/8" crowfoot) that connects the coil to the manifold block.

4) Pull the coil from the can to remove.

B) MANIFOLD REMOVAL:

Refer to FIG. 6.18

1) Remove the vent tube (flat blade screwdriver) to allow access to the Swagelok fitting.

2) Loosen completely the swagelok fitting (7/8" crowfoot) that connects the coil to the manifold block.

3) Loosen one side of the crossflow valve (refer to FIG. 6.12) by holding the crossflow valve securely with a 19mm wrench and completely loosen one swagelok fitting. (19mm wrench).

4) Each can is held to the handle by either 2 (very early models) or four bolts or screws. On each can, remove the inner most bolts (two on each side) and loosen the outer most bolts (two on each side).

5) Now each can unit may be pivoted to separate from each other at the crossflow valve.

6) Remove the pilot light cup by loosening the set screw (3mm hex wrench) (refer to FIG. 6.18 item F728).

7) Remove the Whisper™ valve jet and if present, the jet connector.

8) Remove three hex socket screws (5mm hex key) that hold the manifold to the burner can.

9) Remove the complete manifold assembly from its burner can. Take care not to damage the gasket that's between the manifold and burner can.

10) Assemble in reverse order.

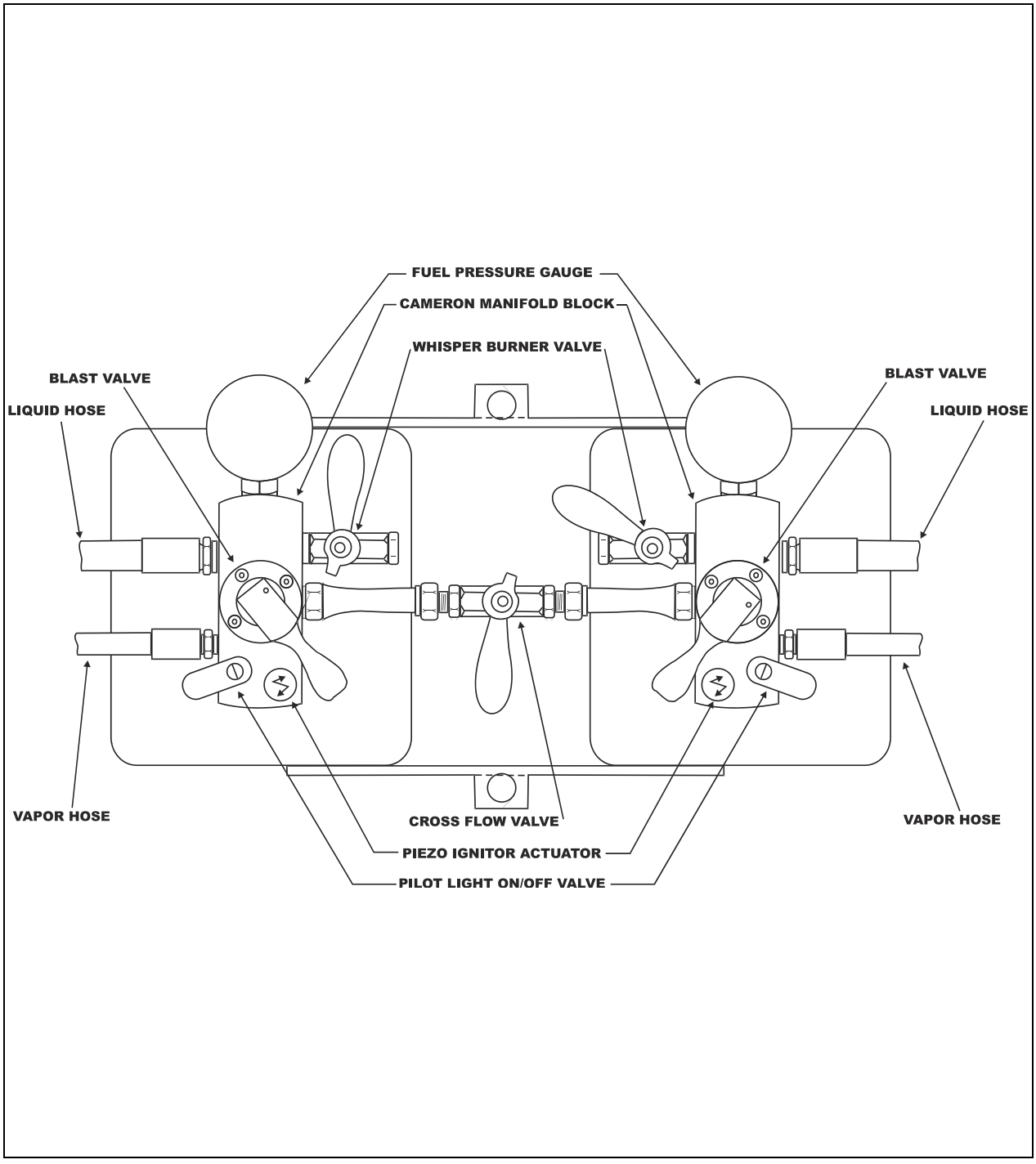

FIG. 6.12
MK IV SUPER BURNER

6.13 DISASSEMBLY OF MK IV ULTRA SINGLE BURNER

The MK IV Ultra Single burner is equipped with, as standard, a red and green anodized "Ultra Grip" Lever Action handle which spans the blast valves. Optionally available is an all green anodized "Ultra Grip" Squeeze Action handle. Refer to FIG. 6.13a.

All systems may be serviced without total disassembly of this burner.

A) COIL REMOVAL:

1) Refer to Section 6.12 A, except use FIG. 6.19a.

B) MANIFOLD REMOVAL:

Refer to FIG. 6.19a

1) Remove both vent tubes (flat blade screwdriver) to allow access to the Swagelok fitting.

2) Loosen completely the Swagelok fitting (7/8" crowfoot) that connects the coil to the manifold block.

3) Remove the five hex socket screws (5mm hex key) that attach the burner can to the manifold block.

4) The entire manifold block may now be separated from the burner can.

5) Assemble in reverse order.

C) ULTRA GRIP HANDLE REMOVABLE:

Refer to FIG. 6.19b

1) Break loose the lock ring on each blast valve assembly by inserting a drift of the appropriate size into a lock ring hole.

2) Place both blast valve handles in the vertical position (perpendicular to the red and green handle end caps).

3) Simultaneously unscrew the lock rings and lift the entire handle, handle end caps and lock rings off of the valve body.

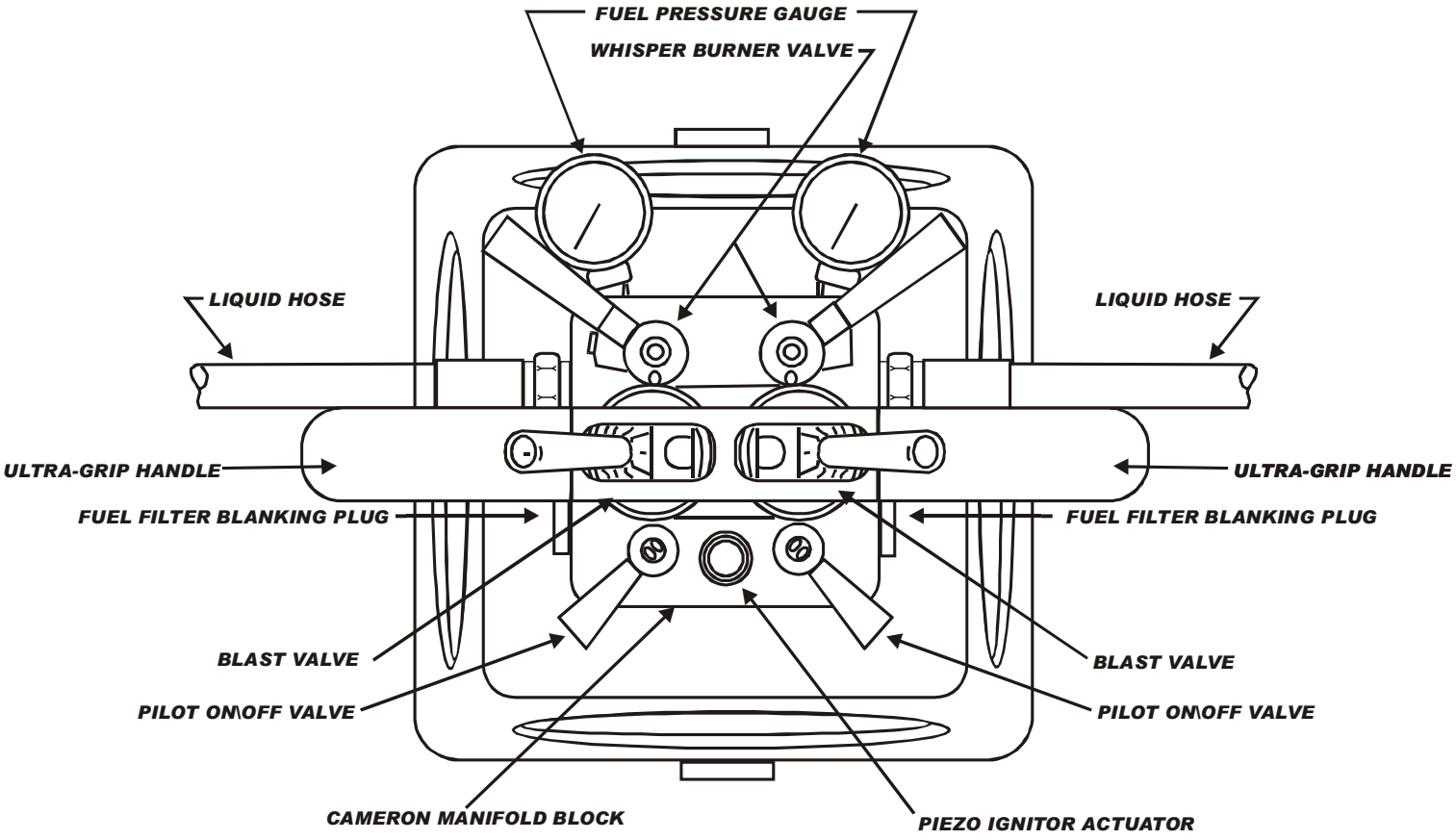

FIG. 6.13
MK IV ULTRA SINGLE BURNER

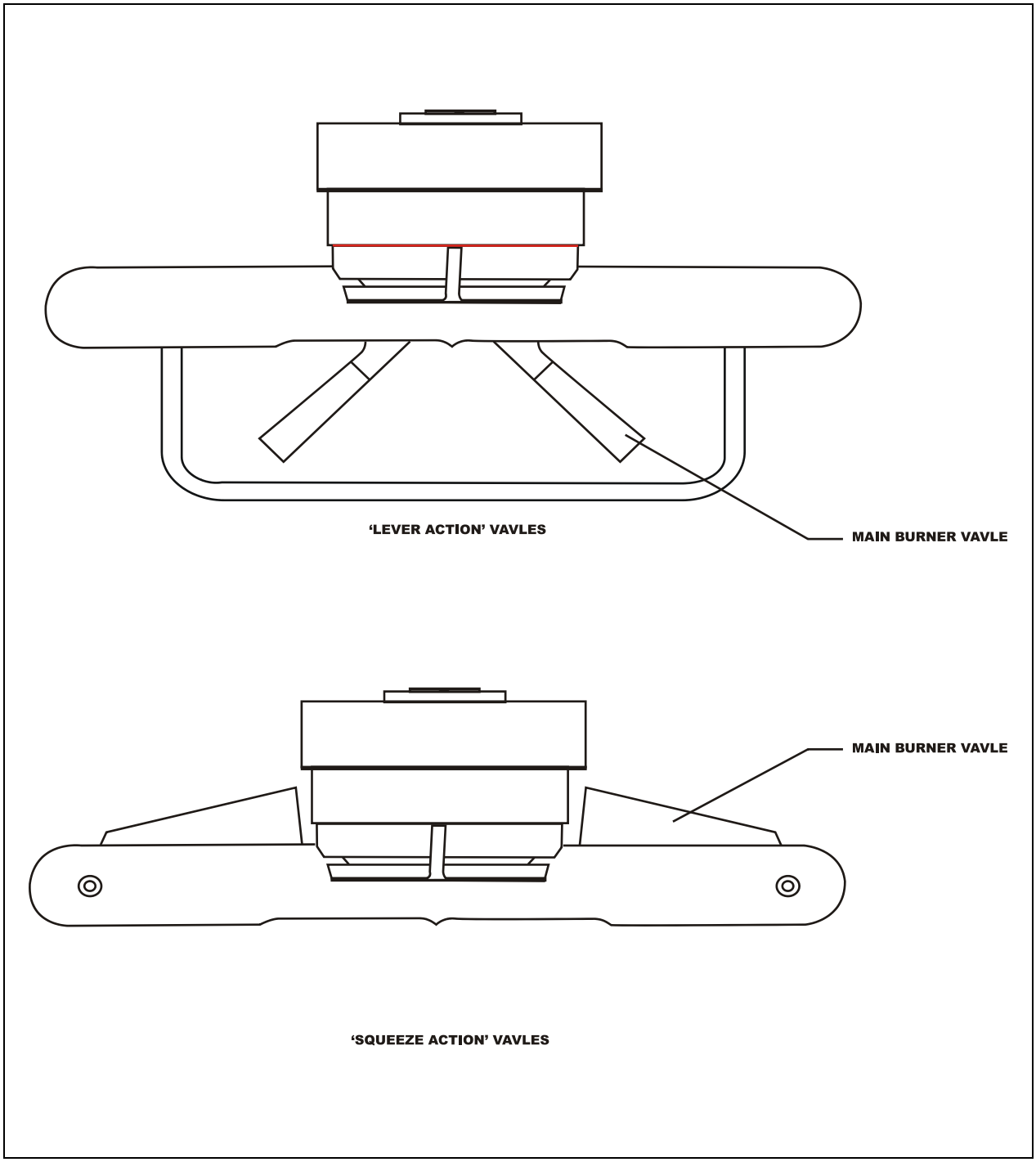

FIG. 6.13a
MK IV ULTRA SINGLE HANDLE CONFIGURATIONS

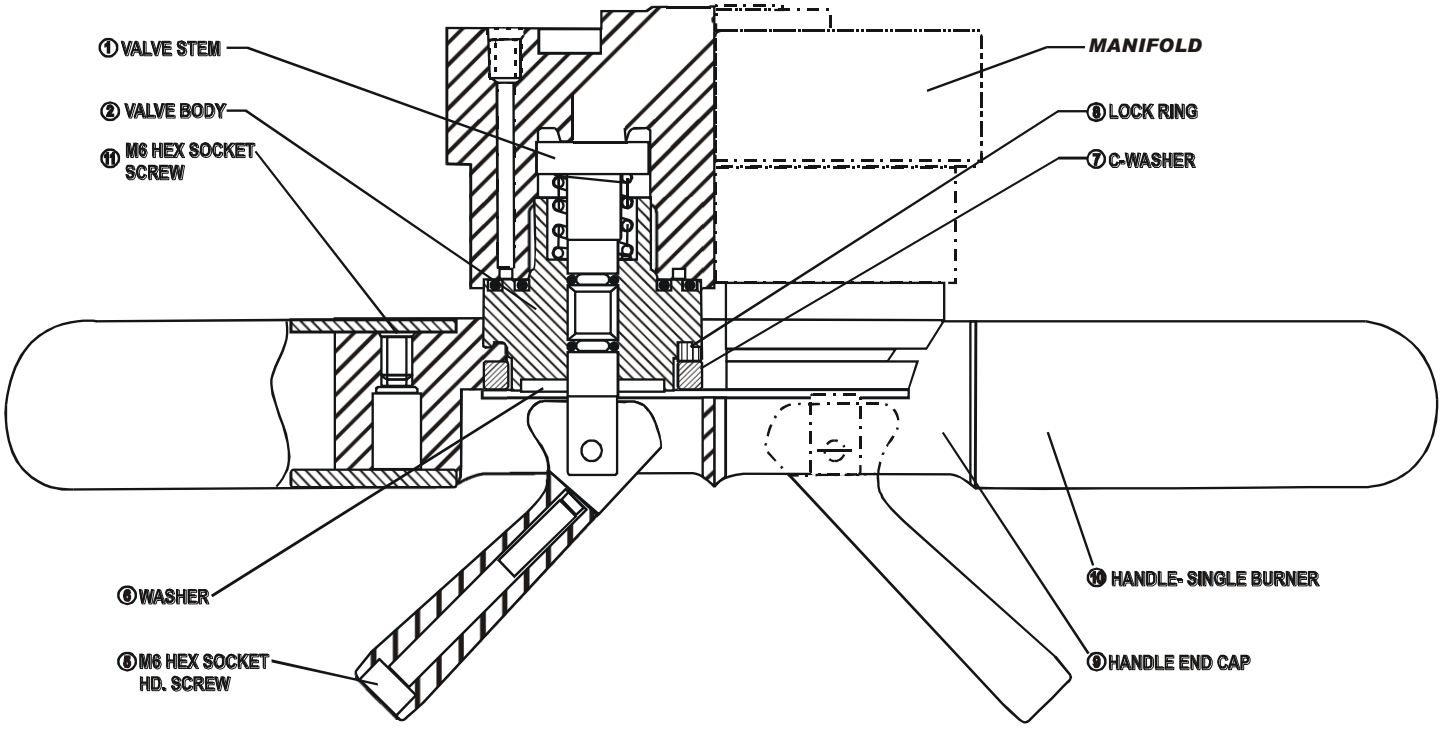

FIG. 6.13b
MK IV ULTRA SINGLE BLAST VALVE

6.14 DISASSEMBLY OF MK IV ULTRA DOUBLE BURNER

The MK IV Ultra double burner is equipped with, as standard, a red anodized "Ultra Grip" handle which spans the blast valves. Optionally available is a blast valve configuration similar in appearance to the MK IV Super burner. (refer to FIG. 6.19b)

All systems may be serviced without total disassembly of this burner.

A) COIL REMOVAL:

1) Refer to Section 6.12 A, except use FIG. 6.19.

B) ULTRA GRIP HANDLE REMOVAL:

Refer to FIG. 6.19

1) Loosen both hex socket set screws (Ultra tool or 3mm hex key) which are accessed through the holes in the Ultra Grip handle.

2) Break loose the lock ring (refer to FIG. 6.19b) on each blast valve assembly by inserting the Ultra tool spanner wrench pin into the corresponding lock ring hole. They should be snug, however, a tap with a rubber mallet on the Ultra tool may be necessary to loosen them.

3) Place both blast valve handles in the vertical position (perpendicular to the crossflow valve).

4) Simultaneously unscrew the lock rings and lift the entire handle, handle end caps and lock rings off of the valve body.

C) MANIFOLD REMOVAL:

1) Remove the vent tube (refer to FIG. 6.19) with a flat blade screwdriver to allow access to the coil Swagelok fitting.

2) Loosen completely the Swagelok fitting (7/8" crowfoot) that connects the coil to the manifold block.

3) Loosen one side of the crossflow valve by completely loosening one swagelok fitting (refer to FIG. 6.14).

4) Each can is held to the burner can strap by four bolts. On each can, remove the inner most bolts (two on each side) and loosen the outer most bolts (two on each side).

5) Now each can unit may be pivoted to separate from each other at the crossflow valve.

6) Loosen completely the fuel pressure gauge feed tube at the manifold block end.

7) Remove the three hex socket screws (5mm hex key) that attach the burner can to the manifold block.

8) The entire manifold blocks may now be separated from the burner can.

9) Assemble in reverse order.

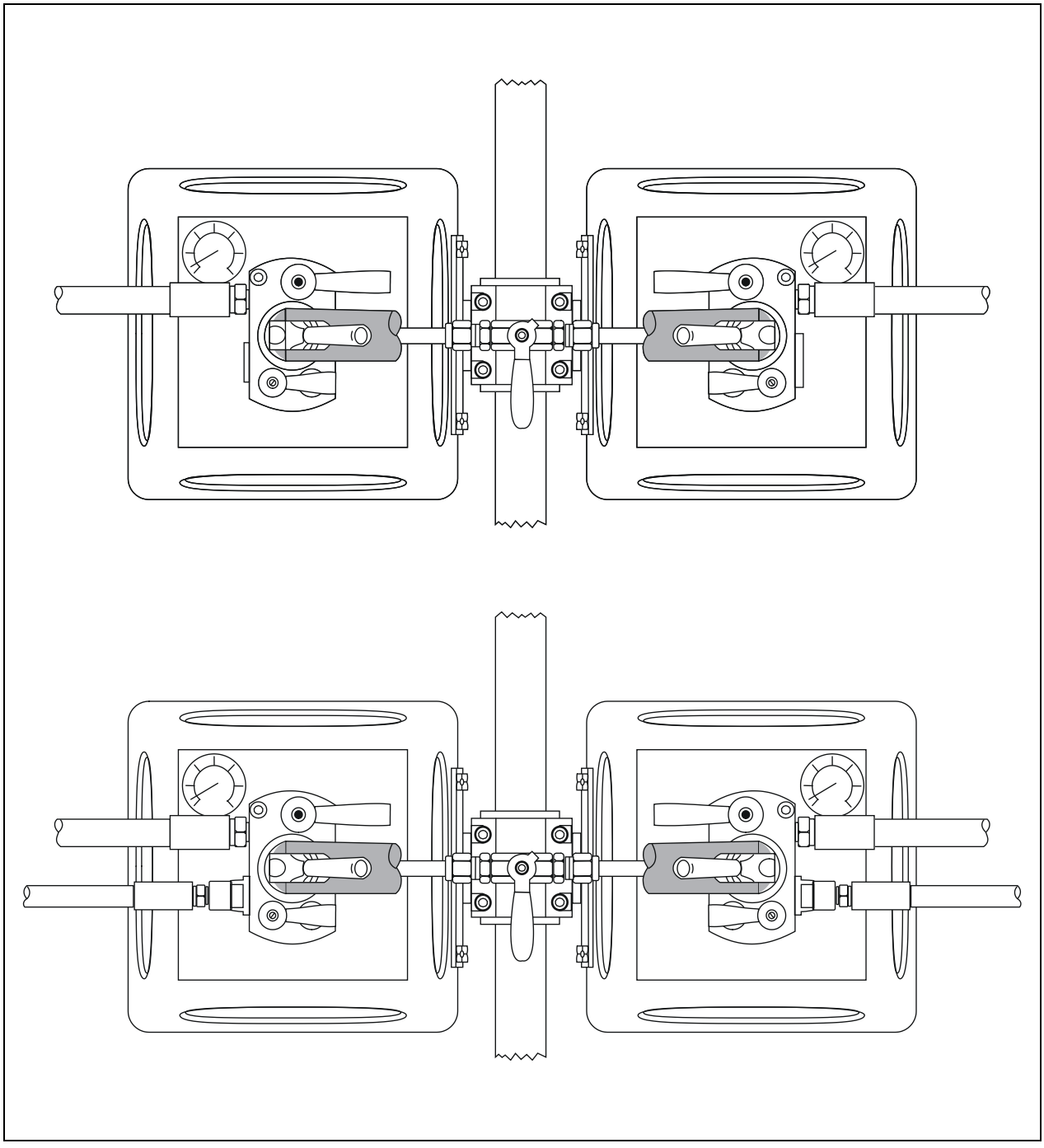

FIG. 6.14
MK IV ULTRA DOUBLE BURNER
LIQUID & VAPOR PILOT LIGHTS SHOWN
GIMBAL BLOCK FRAME SHOWN

6.15 DISASSEMBLY OF MK IV ULTRA TRIPLE BURNER

Refer to FIG. 6.15.

The MK IV Ultra triple burner is available in two configurations. The first is one Ultra double burner and 1/2 of a Ultra double burner with the Ultra-T Grip handle. The second configuration is an Ultra double burner without the Ultra Grip handle and 1/2 of a Ultra double burner without the Ultra Grip handle. For complete disassembly instructions refer to Section 6.14.

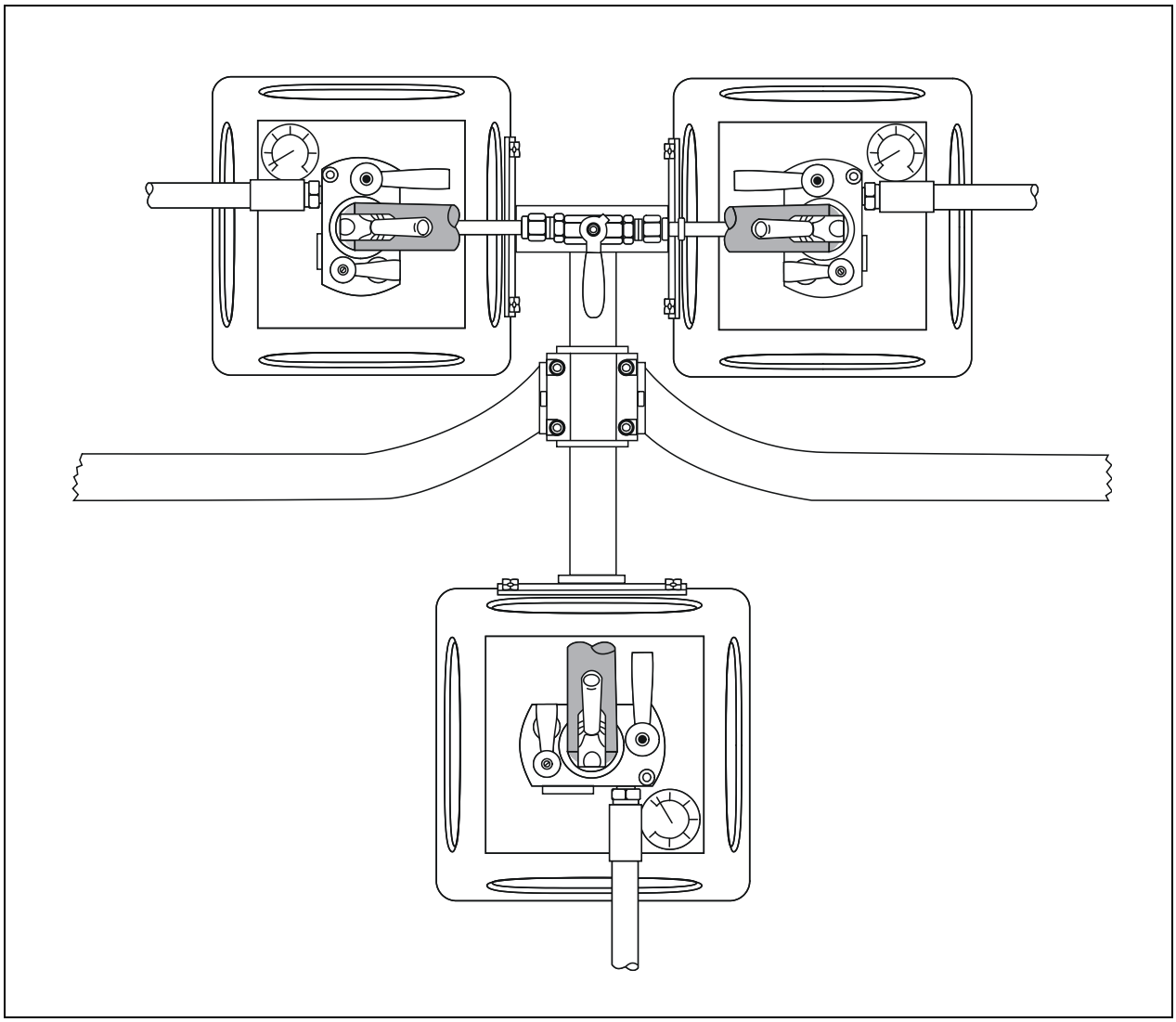

FIG. 6.15
MK IV ULTRA TRIPLE BURNER
GIMBAL BLOCK FRAME AND T-HANDLE SHOWN

6.16 DISASSEMBLY OF MK IV ULTRA QUADRUPLE BURNER

Refer to FIG. 6.16.

The MK IV Ultra Quadruple burner is available in two configurations. The first is two Ultra double burners with the Ultra-H Grip handle. The second configuration is two Ultra double burners without the Ultra Grip handle. For complete disassembly instructions refer to Sections 6.14.

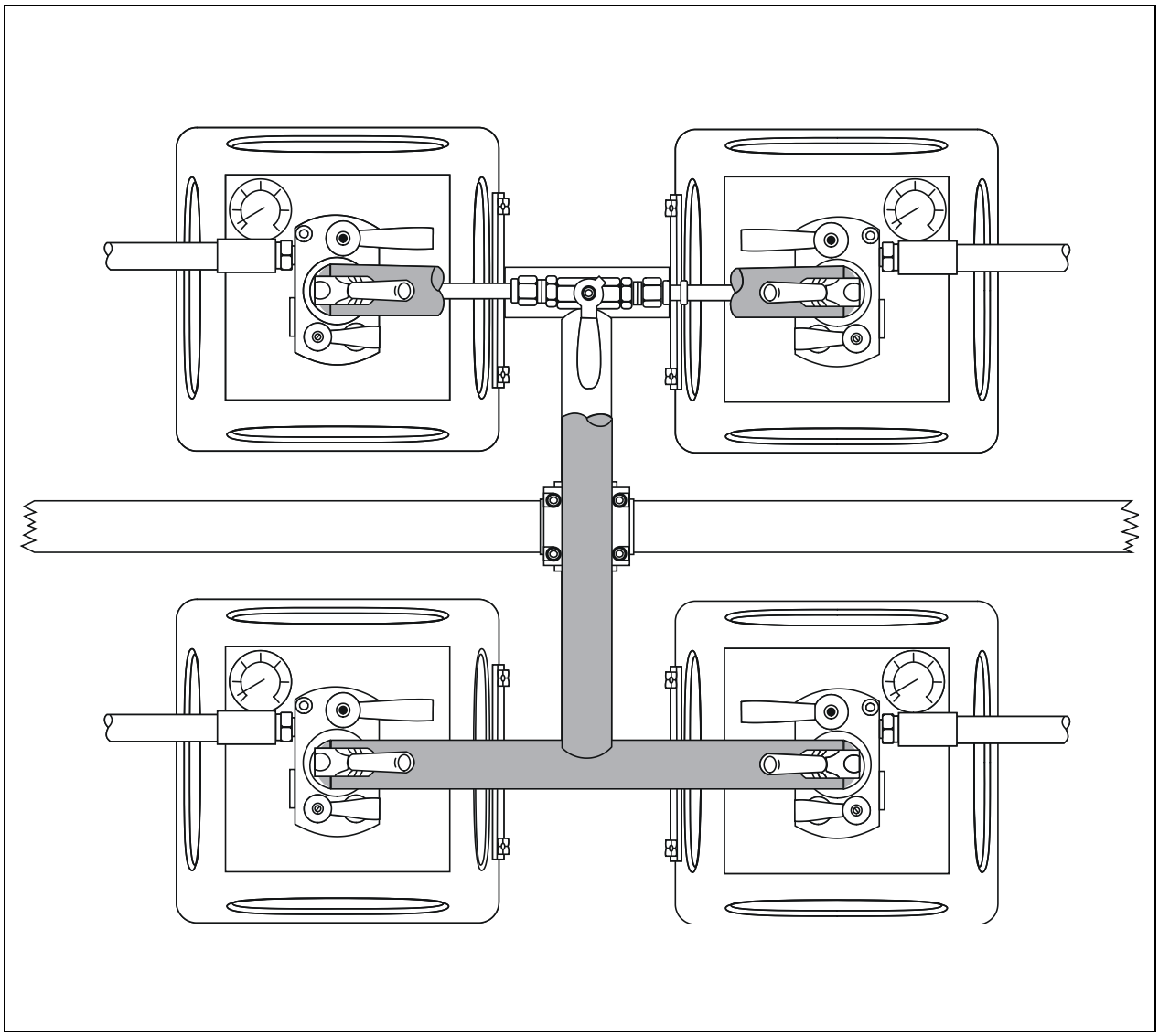

FIG. 6.16
MK IV ULTRA QUADRUPLE BURNER

6.17 BLAST VALVE DISASSEMBLY & MAINTENANCE - MK III & MK IV STANDARD BURNERS

The REGO 7901T valve (F901) is used on all current MK IV Standard single burners. The REGO 7553T (F128) or 7553S were used on all MK III & early MK IV Standard single and double burners. The complete 7553T & S valves are no longer available, however, internal replacement and rebuild parts are. The REGO blast valves, Rego part no. 7553T and 7901T, are illustrated in FIG. 6.17.

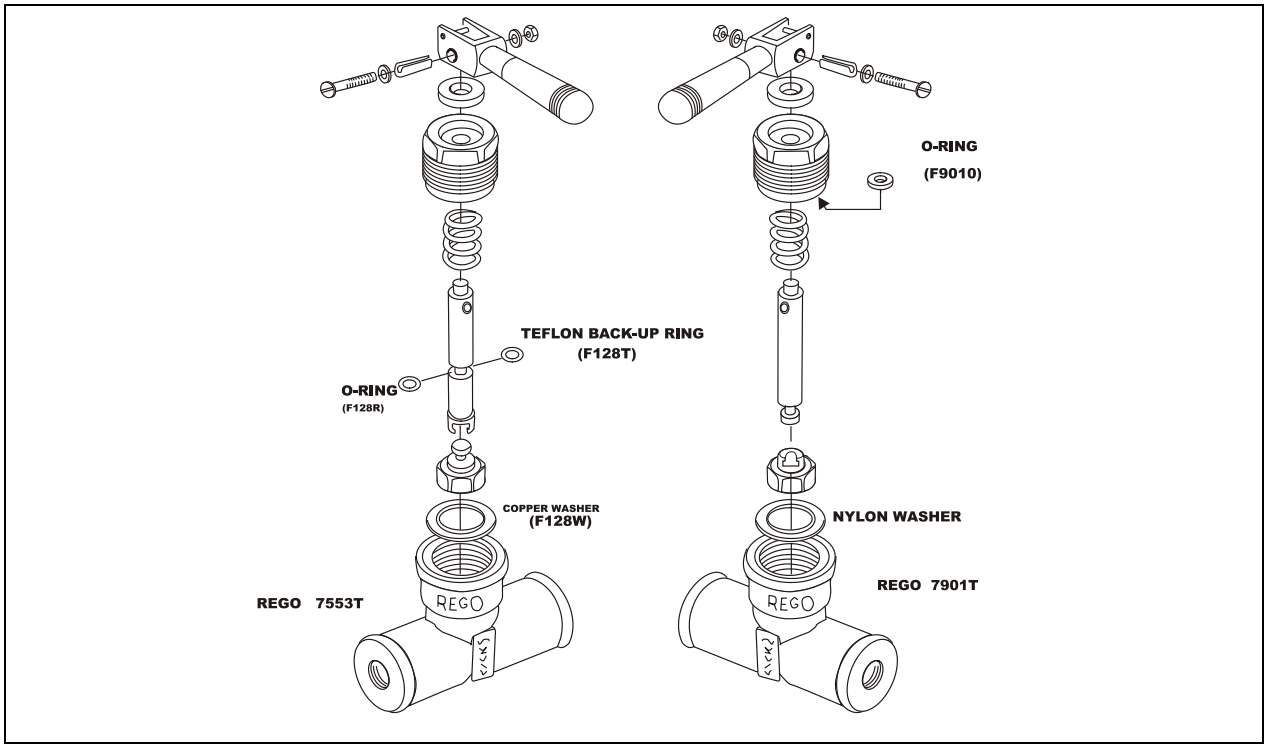

FIG. 6.17
REGO 7553T and 7901T BLAST VALVES

The 7553S valve is similar to the 7553T valve EXCEPT the 7553S valve does not incorporate the Teflon Backup Ring, the Seat Retainer Assembly is attached with a screw rather than a rivet, and the shaft is a single piece. The 7553T bonnet assembly (F128B) may be obtained from Cameron Balloons US and includes all parts except the blast valve body. The bonnet assembly will have had performed on it all the maintenance items specified below. The bonnet assembly for the 7553T may be installed in the body of the 7553S, but if this is done, the exterior marking of the blast valve should be altered to change the designation from "7553S" to "7553T".

When a NEW bonnet assembly is screwed into the valve body, the handle of the bonnet assembly **MUST** be in the locked open position.

A) MK III - PREPARATIONS BEFORE REBUILDING:

The tee fitting and blast valve assembly must first be removed from the coil.

1) First remove the fuel hoses by using common open end wrenches.

2) Remove the stainless steel support screw clamps from around the blast valves.

3) Unscrew the entire blast valve, pressure gauge and 3-way or 4-way tee fitting assembly from the burner coil.

4) This assembly of components can now be supported by the blast valve body in a vise for further disassembly and/or rebuilding of the blast valves.

B) MK IV STANDARD - PREPARATIONS BEFORE REBUILDING:

Rebuilding of the Rego blast valve may be accomplished without removal of the valve from the burner, in part due to the support brackets at either side of the burner cans. **THE VALVE BODY MUST BE SUPPORTED WITH A LOCKING CHAIN WRENCH TO PREVENT UNDUE TORQUE AND STRESS ON THE 4-WAY TEE FITTING**.

1) Attach a chain wrench in a way which transfers the torque of valve assembly or disassembly to the stainless steel burner handle located between the valves. This will prevent damage to the very expensive, custom machined tee fitting (F059).

C) DISASSEMBLY, INSPECTION AND MAINTENANCE:

1) Remove the safety wire or machine screw from the blast valve handle. Remove the roll pin from the handle. Remove the handle.

CAUTION
BEFORE UNSCREWING THE BONNET ASSEMBLY, REMOVE ANY SHARP EDGES AROUND THE HOLE IN THE VALVE STEM WITH FINE EMERY CLOTH OR A ROUND FILE TO PREVENT SCORING OF THE BONNET.

When the bonnet is removed, a sharp edge or dirt on the valve stem can score the inside of the bonnet, destroying the bonnet.

2) (NOTE: see Section 6.17 B 1) Use a 1 1/4" (7553T) or 1 1/16" (7901T) box or socket wrench on the hex section of the bonnet, remove the bonnet assembly.

3) Inspect the inside of the blast valve body. Look particularly for hairline cracks in the body, scoring or debris in the seat area. If abrasive residue is found, it may indicate contaminated fuel, and may require that all tanks be purged and cleaned to remove damaging material from the fuel system.

4) Remove the **CLEANED** valve stem form the bonnet.

5) Inspect the interior walls of the bonnet, looking for scoring or abrasion marks. Clean the interior walls of the bonnet with a clean soft cloth and inspect for roundness. Inspect the stem. It must be unbent, and must not have any flat spots or scoring. The roll pin hole must be free from sharp edges.

6) Check the retainer rivet or screw in the base of the seat retainer assembly.

7) In the 7553T valve remove the "O" ring and Teflon backup ring from the valve stem. In the 7901T valve remove the "O" ring (there is no Teflon ring in the 7901T valve) from the bonnet. Clean the stem and bonnet, and lubricate with silicone or fluorinated grease or a petroleum grease commonly used for propane fitting lubrication.

8) In the 7553T valve manually install a new "O" ring (F128R) and Teflon backup ring (F128T) on the valve stem (Teflon ring nearest roll pin hole in stem). Do not use any tools to move the "O" ring over the stem as the "O" ring is soft and may be damaged. In the 7901T valve manually install a new "O" ring (F901) in the bonnet.

9) After the "O" ring and Teflon backup ring (7553T) or "O" ring only (7901T), are installed, lubricate the stem and bonnet again.

10) If servicing the 7553S valve, the Teflon backup ring will not be present and the screw in the base of the seat retainer should be checked for tightness. If this screw can be turned, remove it, clean the threads and reinstall using a thread locking compound.

11) If servicing the 7553T valve, remove and inspect the copper gasket (F128W) and gasket seat area.

12) If rebuilding the 7901T valve, remove and inspect the nylon gasket and gasket seat area.

D) ASSEMBLY:

1) Insert the valve stem through the spring and then through the bonnet.

2) Install the copper or nylon gasket. It is normally not necessary to install a new copper or nylon gasket during each annual inspection.

3) (NOTE: for MK IV Standard burners see Section 6.17 B 1) Screw the bonnet assembly into the blast valve body. The bonnet assembly should be torqued to 115 **lb.-ft.** (If optional Teflon tape is used on the bonnet threads, torque to 80 **lb.-ft.**). Take extreme care to support the valve body while torquing the bonnet assembly.

4) Install the handle on the stem, insert the roll pin into the handle and safety wire or bolt the roll pin.

6.18 BLAST VALVE DISASSEMBLY & MAINTENANCE - MK IV SUPER BURNER

Refer to FIG. 6.18 & 6.18a

A) DISASSEMBLY:

1) Remove the outer hex socket set screw (1.5mm hex key) from the handle.

2) Loosen the inner hex socket set screw (1.5mm hex key) in the handle.

3) Remove the handle pivot pin by unscrewing it from the handle.

4) Ensure that there are no sharp edges at the pivot hole on the valve stem to mar the bonnet.

5) Remove the four hex socket bolts (4mm hex key) which secure the bonnet to the manifold.

6) Pull the main seal, valve stem and spring from the bonnet.

B) MAINTENANCE AND ASSEMBLY:

1) Clean all internal components in solvent.

2) Inspect the two valve stem "O" rings (F712). If either is damaged it must be replaced. Use no metal tools when installing the "O" rings as the tools may mar the valve stem.

3) Inspect the valve seat in the manifold block for damage.

4) Inspect all other internal components.

5) Ensure that the screw (F716) securing the rubber main seal (F714) is tight. If it is loose, remove it, apply thread locking compound to the screw threads and screw it back in.

6) Lubricate the valve stem "O" rings with a silicone or fluorinated grease.

7) Inspect and lightly lubricate the body junction "O" ring (F705) that seals the bonnet to manifold junction.

8) Inspect the lubrication screw "O" ring (F718) and lightly lubricate.

9) Assemble in reverse order.

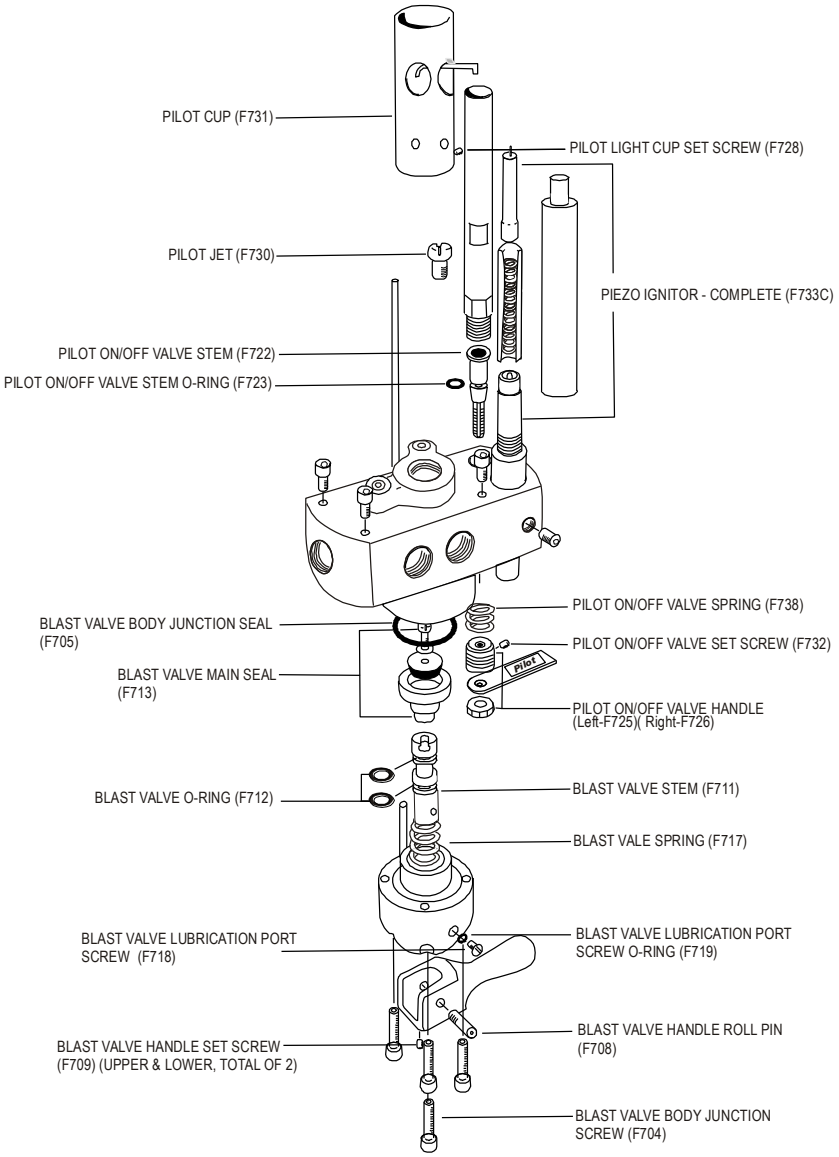

FIG. 6.18
MK IV SUPER MANIFOLD ASSEMBLY

6.19 BLAST VALVE DISASSEMBLY & MAINTENANCE - ALL MK IV ULTRA BURNERS

Refer to FIGs. 6.19, 6.19a & 6.19b

A) DISASSEMBLY:

1) Remove the Ultra Grip handle if present. (Single - Section 6.13 C, Double - Section 6.14 B, Triple - Section 6.15, Quadruple - Section 6.16)

2) Remove the blast valve handles:

a) Ultra Grip handle: push out the handle pivot pins.

b) Non Ultra grip handle: Refer to Section 6.18 A 1 through 4.

3) Break loose the blast valve bonnet assembly by inserting the Ultra tool C-spanner wrench pin into the corresponding blast valve bonnet hole. It should be snug, however, a tap with a rubber mallet on the Ultra tool will loosen it.

4) Unscrew the bonnet assembly and remove it from the manifold block.

5) Withdraw the valve stem and spring from the bonnet.

B) MAINTENANCE:

1) Clean all internal components in solvent.

2) Inspect the two valve stem "O" rings (F712). If either is damaged it must be replaced. Use no metal tools when installing the "O" rings as the tools may mar the valve stem.

3) Inspect the valve seat in the manifold block for damage and all other internal components.

4) Ensure that the screw (F716) securing the rubber main seal (F714) is tight. If it is loose, remove it, clean the threads and apply A suitable thread locking compound to the screw threads.

5) Lubricate the valve stem "O" rings with a silicone or fluorinated grease.

6) Inspect and lightly lubricate the bonnet junction "O" rings (inner F501 and outer F502) that seals the bonnet to manifold junction.

7) Inspect the lubrication screw "O" ring (F718) and lightly lubricate.

8) Assemble in reverse order.

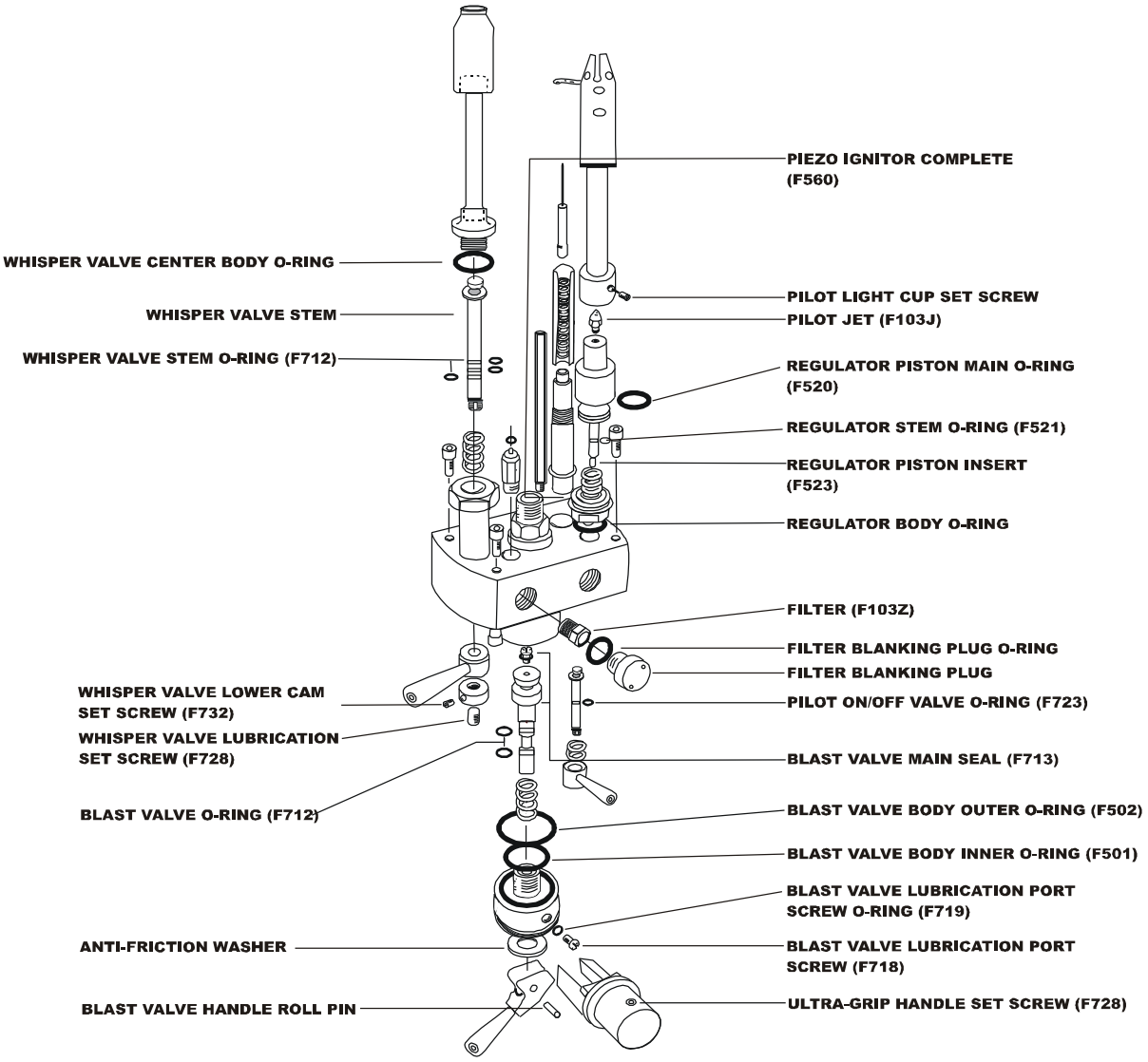

FIG. 6.19
MK IV ULTRA DOUBLE, TRIPLE & QUADRUPLE
MANIFOLD ASSEMBLY

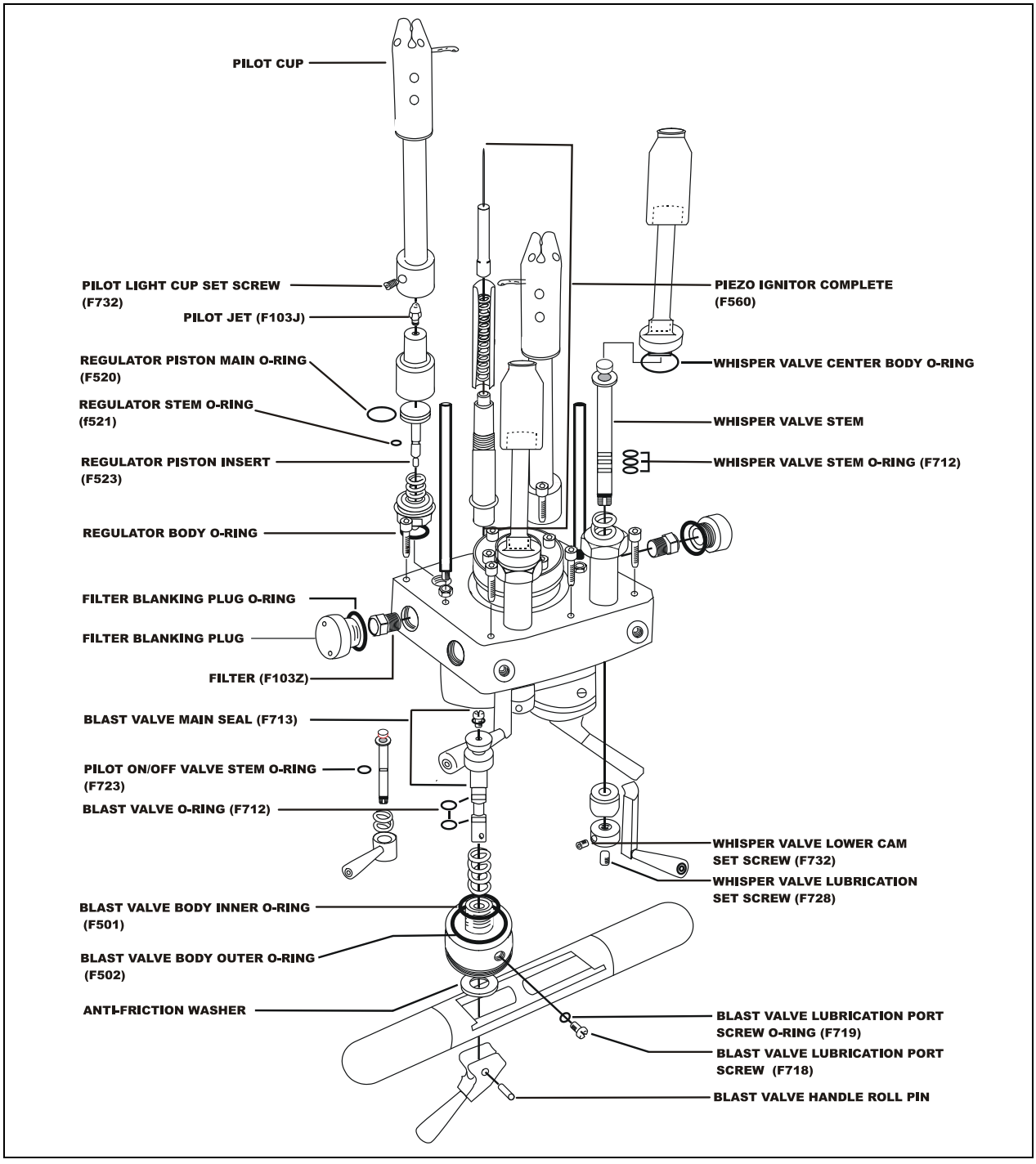

FIG. 6.19a
MK IV ULTRA SINGLE MANIFOLD ASSEMBLY

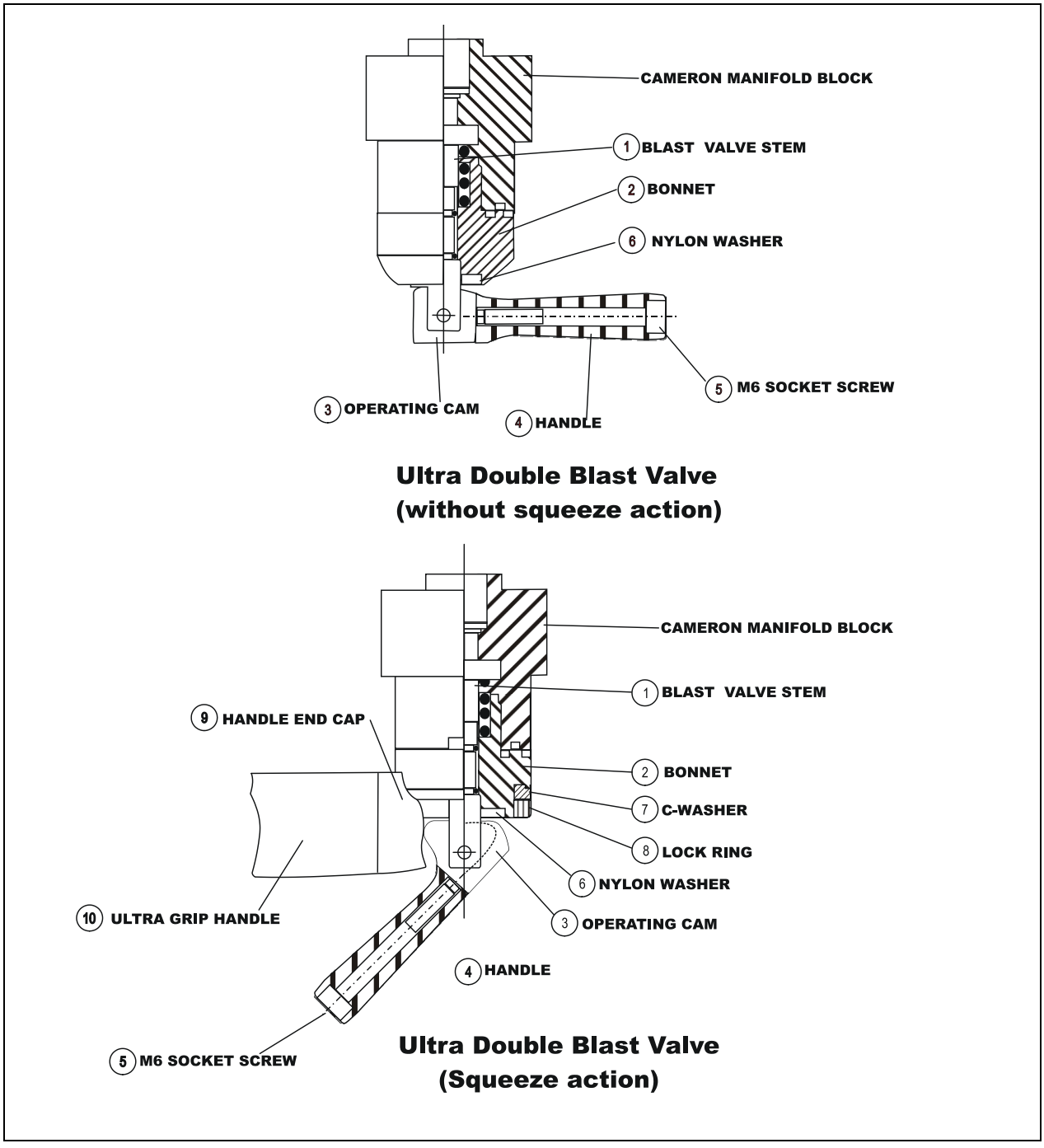

FIG. 6.19b
MK IV ULTRA DOUBLE, TRIPLE & QUADRUPLE MANIFOLD
BLAST VALVE ASSEMBLIES

6.20 WHISPER VALVE - DISASSEMBLY & MAINTENANCE - MK III & MK IV STANDARD BURNERS

A) NUPRO VALVE:

Refer to FIG. 6.20

Early MK IV Standard burners used a "Nupro" stem and seat valve (F181) which is screwed into the side of a modified Rego blast valve and is activated by turning a green or red knob. Nupro valves are not serviceable and if they fail they must be replaced.

1) REMOVAL:

a) Disconnect the compression nut that affixes the copper tube (F182T) to the valve (9/16" wrench).

b) Pull the copper tube out of the valve and slide it out of the way. The compression nut will stay with the tube.

c) Unscrew the whisper valve from the blast valve (5/8" wrench).

d) Assemble in the reverse order reusing the compression nut from the old whisper valve.

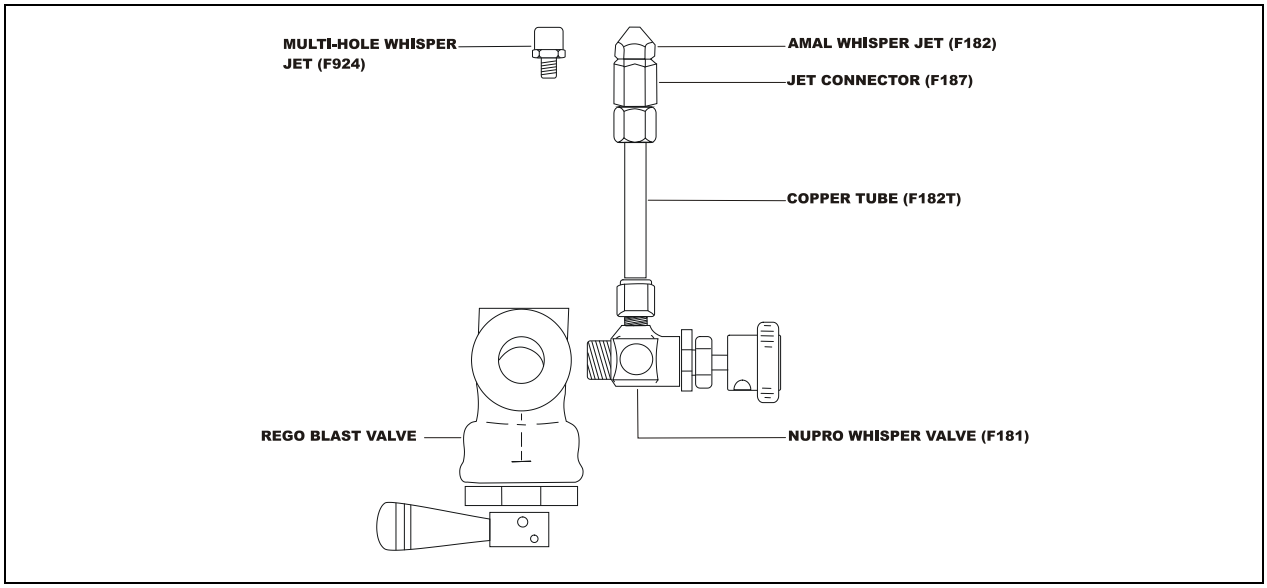

FIG. 6.20
NUPRO WHISPER VALVE

B) WAVERLY VALVE:

Later MK IV Standard burners use a modified "Waverly" ball valve (F180W) which is screwed into the side of a modified blast valve and activated by turning a blue plastic covered handle.

1) REMOVAL:

It is not necessary to remove the Waverly valve from the burner to service it, however, it may make the service process easier.

a) Refer to Section 6.20 A 1. This procedure is identical except substitute a 14mm wrench for the 9/16" wrench and a 17mm wrench for the 5/8" wrench.

2) DISASSEMBLY:

Refer to FIG 6.21

a) Close the valve fully and remove the handle retaining nyloc nut (item 12), handle (item 10), conical washers (item 8 & 9) and top spindle seal (item 7).

b) Remove the blanking plug (item 14) with a 17mm wrench.

c) Remove the ball retainer (item 6) with a 5mm hex key.

d) Remove the ball outer main seal (item 2), ball (item 5) and ball inner main seal (item 2).

e) Remove the spindle (item 3) by pushing it from the outside down and out the blanking plug hole.

f) Clean all components with a solvent.

3) REPAIRING:

A repair kit (F180K) containing all necessary renewable parts is available through Cameron Balloons U.S.

a) Renew the spindle bottom seal (item 4) by placing it on the stem of the spindle.

b) Install the spindle by pushing it through the hole in the top face of the valve, stem first from the inside of the valve body. Configure the spindle so it will accept the ball by placing its tongue parallel to the valve body.

c) Install the inner ball seal.

d) Lightly lubricate the ball with silicone spray and install it into the valve body taking care to ensure that the recess in the top face of the ball is located on the tongue of the spindle.

e) Apply pressure to the ball with a blunt instrument, taking care not to damage the ball. This will ensure that the spindle is forced into the recess and that the ball is correctly seated.

f) Install the outer ball seal.

g) Lightly lubricate the retainer with silicone spray and screw it into the valve (5mm hex key) with the retainer face having the largest chamfer being outermost.

h) Make sure that the ball is in the **fully closed** position. Torque the retainer to 150 **lb. inches**.

i) Install the top spindle seal on the spindle stem.

j) Install the conical washers on the spindle stem with the first washer convex face down and the second washer convex face up.

k) Install the handle and after placing a drop of thread lock compound on the threads of the nyloc nut, screw it onto the spindle and torque to 30 **lb. inches**.

l) Renew the Teflon gasket on the blanking plug and screw the plug into the valve and torque to 30 **lb. feet**.

m) Install in reverse order. Refer to Section 6.20 B 1.

n) Test for leaks and proper function.

6.21 WHISPER VALVE™ - DISASSEMBLY & MAINTENANCE - MK IV SUPER BURNER

MK IV Super burners use a modified "Waverly" ball valve which is screwed into the Cameron manifold block and activated by turning a blue plastic covered handle. It's very similar in appearance to the "Waverly" Whisper™ valve used on later MK IV Standard burners. Both valves use the identical interior and exterior parts (excluding the handle).

A) REMOVAL:

It is not necessary to remove the Waverly valve from the burner to service it, however, it may make the rebuild process easier.

1) Remove the Amal Whisper™ jet (5/16" Whitworth socket) and connector (9/16" socket) or Multi-hole Whisper jet (9/16" socket) from the valve tube.

2) Remove the manifold block from the burner can. Refer to Section 6.12

3) Unscrew the Whisper™ valve from the manifold block (17mm wrench).

B) DISASSEMBLY:

1) Refer to Section 6.20 B 2 for complete disassembly instructions.

C) REPAIRING:

1) Refer to Section 6.20 B 3 for complete repairing instructions.

2) Install in reverse order. Refer to Section 6.21 A.

3) Test for leaks and proper function.

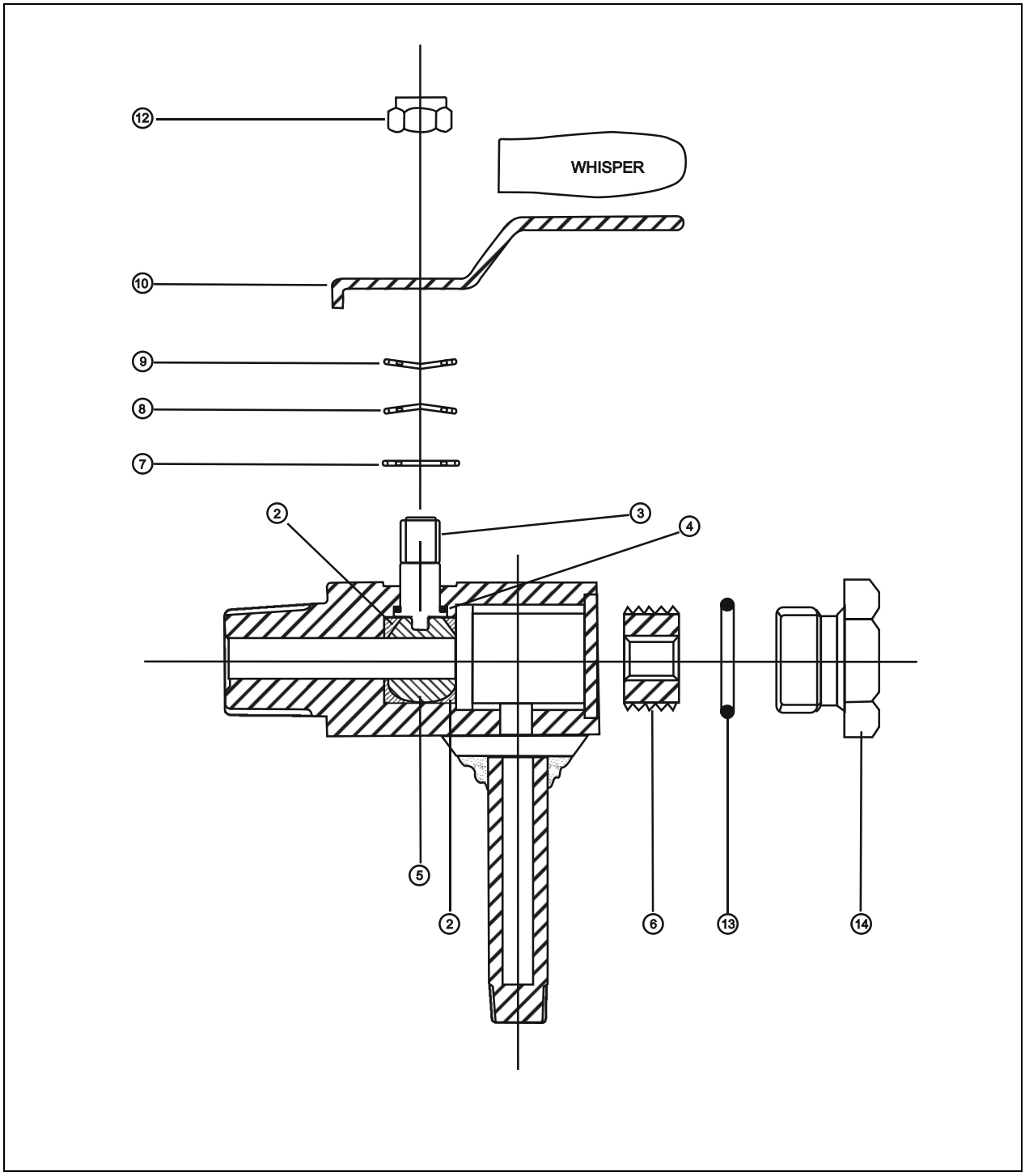

FIG. 6.21
WAVERLY WHISPER™ VALVE

6.22 WHISPER™ VALVE - DISASSEMBLY & MAINTENANCE - MK IV ULTRA BURNERS

MK IV Ultra burners use a purpose built, ramp activated, spring assisted plunger and seat Whisper™ valve which is an integral part of the Cameron Manifold block and activated by turning a blue anodized handle.

This valve may be lubricated without disassembly by following the procedures in Section 6.9 B 1.

Refer to FIG. 6.22a

A) DISASSEMBLY:

1) Turn the valve handle (item 11) to the fully **ON** position.

2) Remove the blue middle body (item 2) and upper body (item 1) assembly as one unit by holding the black Lower body (item 3) with either a 27mm or 1 1/16" wrench and unscrewing the Middle assembly with a 12mm crowfoot or wrench.

3) Turn the valve handle to the fully off position.

4) Remove the hex socket set screw in the side of the Lower cam (item 9) (3mm hex key).

5) Use an appropriate size flat blade screwdriver (8mm or 5/16" blade width. (A screwdriver may have to be modified to the correct size - refer to FIG. 6.22). Take care not to mar or destroy the threads inside the Upper cam (item 7). Screw the valve stem (item 4) down through and out of the manifold block and Lower body.

B) MAINTENANCE:

1) Clean all components with a solvent.

2) Inspect all components. If any of the three "O" rings (F712) are damaged it must be replaced.

3) Pre-pack the valve stem with lubricant until the lubricant oozes from the middle "O" ring. (Refer to Section 6.9 B 1 for this procedure)

4) Lubricate the "O" rings and valve stem with a silicone or fluorinated grease.

5) Assemble in reverse order taking extreme care not to damage the threads in the Lower cam.

CAUTION:
The threaded Whisper™ valve stem has 4 flats. A flat **MUST** align with the set screw in the Lower cam or damage **WILL** occur to the Stem and/or Lower cam.

C) ADJUSTMENT:

1) Turn the valve handle (item 11) to the fully ON position.

2) Remove the set screw in the side of the Lower cam (item 9) (3mm hex key).

3) The threaded valve stem (item 4) has four flats one of which must now be aligned with the set screw hole in the Lower cam.

4) Adjust the valve stem 90º to the next flat **IN** (**if** the valve is **not shutting off**) or **OUT** (**if** the valve is **not turning on**). Use an appropriate size flat blade screwdriver (8mm or 5/16" blade) (Refer to FIG. 6.22 for screwdriver modifications).

5) Replace and tighten the set screw in the Lower cam ensuring that it locates squarely on a valve stem flat.

CAUTION:
The threaded Whisper™ valve stem has 4 flats. A flat **MUST** align with the set screw in the Lower cam or damage **WILL** occur to the Stem and/or Lower cam.

6) Repeat steps 4 and 5 if necessary until correct operation is achieved.

A screwdriver may have to be modified to the correct size to service some vapor on/off valves and/or whisper on/off valves. Follow this procedure: Grind the thin edges of the blade until they are parallel to each other and perpendicular to the blade edge and narrow enough to fit inside the handle but wide enough not to damage the valve stem.

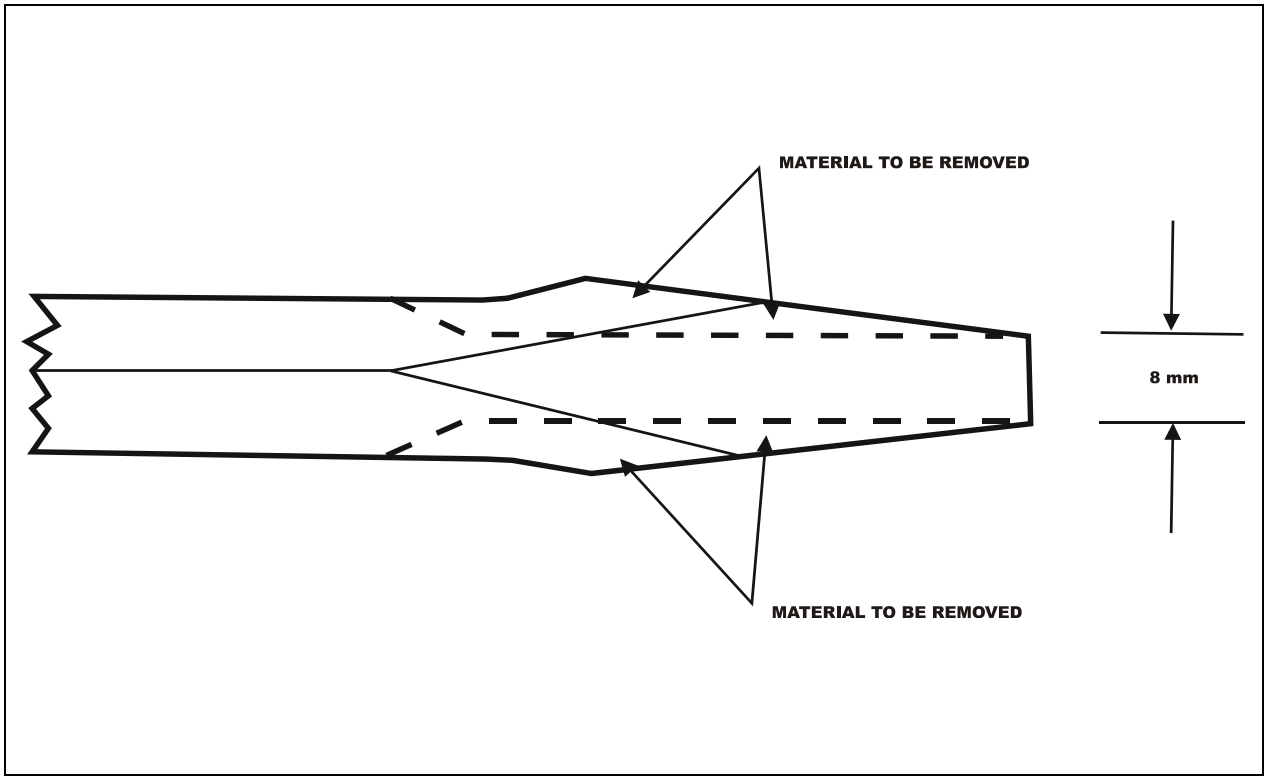

FIG. 6.22
SCREWDRIVER MODIFICATION

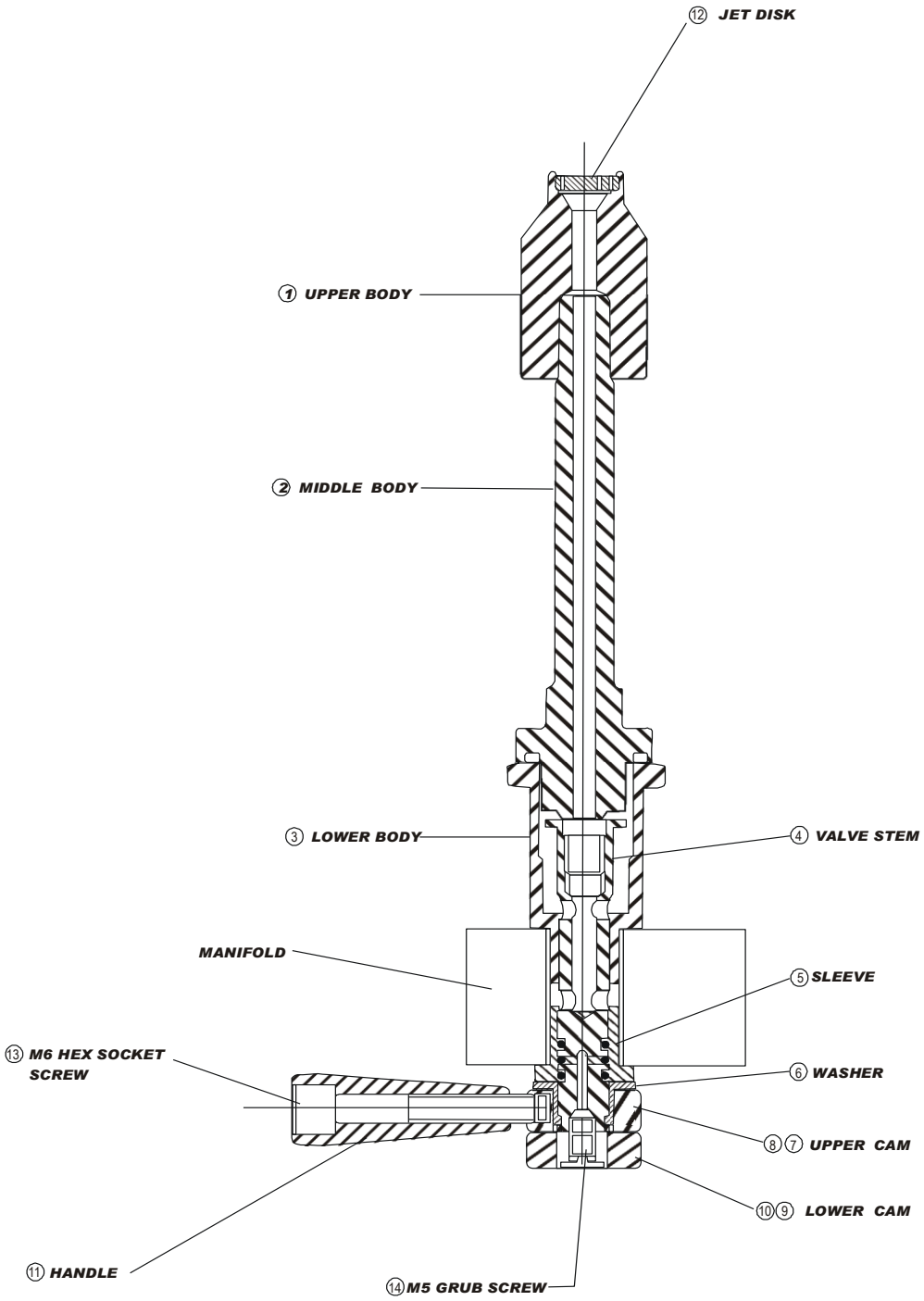

FIG. 6.22a
MK IV ULTRA WHISPER™ VALVE

6.23 PILOT LIGHT ON/OFF VALVE - DISASSEMBLY & MAINTENANCE - MK IV STANDARD BURNERS

MK IV Standard burners use a "Waverly" ball vapor valve (F180) which is installed between the vapor delivery hose (F140) and a connector (F186) elbow (F185) assembly. The elbow attaches to the pilot light flame cup (F335). The valve is activated by turning a red plastic covered handle.

Refer to FIG. 6.11 & 6.11a

A) REMOVAL:

It is not necessary to remove the valve from the burner to service it, however, it may make the rebuild process easier.

1) Disconnect the vapor delivery hose (14mm wrench) from the valve (17mm wrench). It is important that the valve be supported with a wrench to reduce lateral torque on the connector and elbow.

2) Unscrew the vapor valve from the connector (14mm wrench). It is important that the connector be supported with a wrench to reduce lateral torque on the connector and tee.

B) DISASSEMBLY:

1) Refer to Section 6.20 B 2.

C) REPAIRING:

1) Refer to Section 6.20 B 3 a through l.

2) Install in reverse order. Refer to Section 6.23 A.

3) Test for leaks and proper function.

6.24 PILOT LIGHT ON/OFF VALVE & REGULATOR - DISASSEMBLY & MAINTENANCE - MK IV SUPER BURNER

Vapor pilot lights are standard equipment on the MK IV Super burners (liquid pilot lights are optional, refer to Section 6.24 II). The pilot light cup, which is the same on both vapor and liquid fed systems, is screwed into the top of the Cameron manifold block. The on/off valve, also the same on both systems, is a purpose made plunger and seat, spring assisted valve.

I) VAPOR FED PILOT LIGHT:

Refer to FIG. 6.24

The vapor supply in this pilot system is regulated manually by a diaphragm type regulator attached to the vapor withdrawal valve on the fuel tank. Vapor fuel is passed from the regulator, via the vapor supply hose, to the manifold block where it goes directly to the pilot light stem, jet and flame cup.

A) ON/OFF VALVE - DISASSEMBLY:

1) Turn the valve to fully ON position.

2) Remove the piezo ignitor button. (Refer to Section 6.27 A).

3) Remove the pilot light cup from the stem by loosening the hex socket set screw in the side of the flame cup and slipping the cup off the stem. (3mm hex key)

4) Remove the pilot light stem by unscrewing it from the manifold block. (14mm crow foot).

5) Remove the hex socket set screw from the handle (3mm hex key).

6) Use an appropriate size flat blade screwdriver (a screwdriver may have to be modified to the correct size - refer to FIG. 6.22). Take care not to mar or destroy the threads inside the handle. Screw the valve stem down through and out of the manifold block. Be aware that the spring between the handle and manifold block is under tension and when the tension is released becomes very active.

B) ON/OFF VALVE - CLEANING & ASSEMBLY:

1) Examine the "O" ring (F723) on the valve stem, replace and/or lubricate with silicone or fluorinated grease as necessary.

2) Clean and lubricate the bore of the valve sleeve.

3) Assemble in reverse order taking extreme care not to damage the threads in the handle.

CAUTION:
The threaded vapor valve stem has 2 flats. A flat **MUST** align with the set screw in the handle or damage **WILL** occur to the stem and/or handle.

II) LIQUID FED PILOT LIGHT:

Refer to FIG. 6.24a

The liquid fuel supply in this pilot system is regulated manually by a needle and seat type valve attached to the manifold block where the vapor supply hose is connected on vapor pilot light burners. The liquid fuel is fed, via an internal passage, to a vaporizing tube which loops through the pilot light flame cup. As the liquid fuel passes through this tube it is vaporized, then passed back into the manifold block and finally through the pilot light stem, jet and cup.

A) ON/OFF VALVE - DISASSEMBLY:

1) Refer to Section 6.24 I A except before step 4 the vaporizing tube must be removed. (12mm crow foot).

B) ON/OFF VALVE - CLEANING & ASSEMBLY:

1) Refer to Section 6.24 I B for maintenance instructions. Refer to Section 6.24 I A for assembly instructions, except prior to installing the pilot light cup the vaporizing tube must be installed.

C) MAINTENANCE:

1) The thumb wheel and lock, needle and outer needle housing may be removed by unscrewing the needle housing (17mm wrench).

2) The only maintenance is to inspect and lubricate the "O" ring on the needle and "O" ring behind the silver washer against the inner needle housing with a silicone or fluorinated grease.

3) Before assembly unscrew the thumb wheel several turns.

4) Assemble in reverse order.

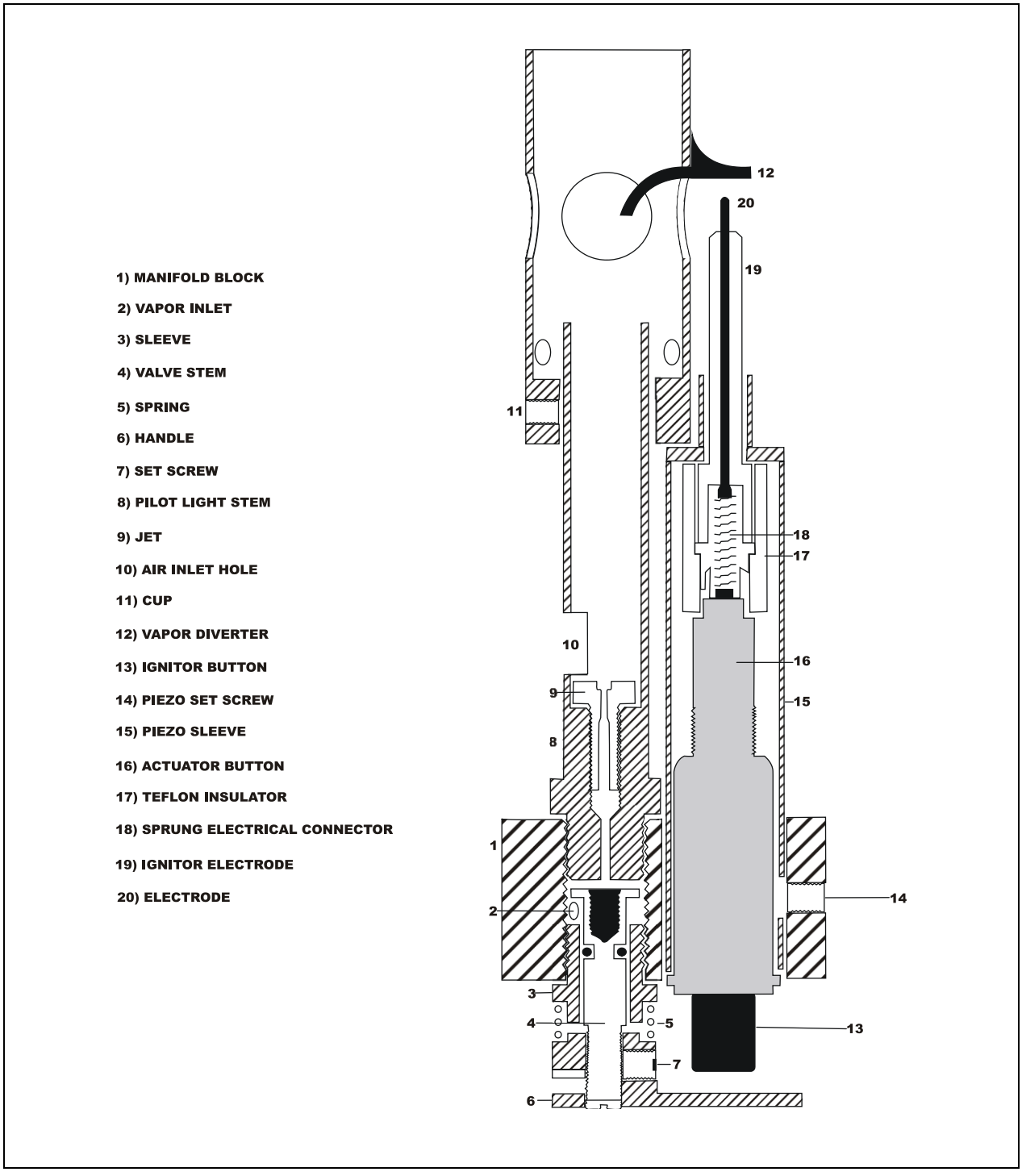

FIG. 6.24
MK IV SUPER VAPOR PILOT LIGHT ASSEMBLY

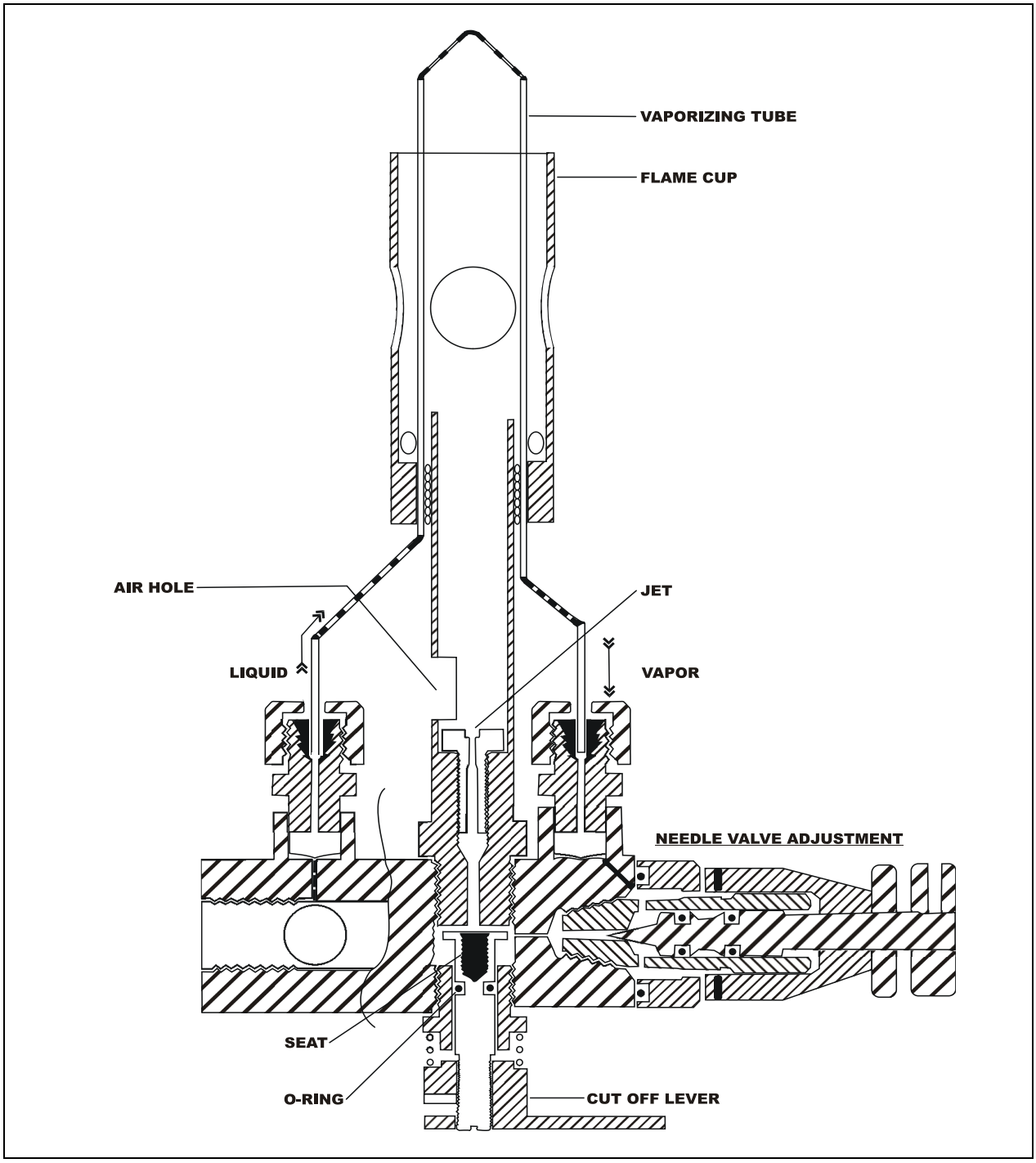

FIG. 6.24a
MK IV SUPER LIQUID PILOT LIGHT ASSEMBLY

6.25 PILOT LIGHT ON/OFF VALVE AND REGULATOR - DISASSEMBLY & MAINTENANCE - MK IV ULTRA BURNERS

A self regulating liquid pilot light is incorporated as standard equipment on the MK IV Ultra burners (vapor pilot lights are optional, refer to Section 6.25 IV D). The pilot light cup installs above a pressure regulator which is screwed into the top of the Cameron manifold block. The regulator automatically maintains a constant pilot light flame regardless of the fuel pressure.

Any contamination of the liquid pilot light system may result in the progressive reduction of pilot light flame size. When the flame size decreases, the pilot jet and/or regulator must be disassembled and cleaned before the next flight.

It is very important that any of the following maintenance procedures be carried out in clean conditions as the presence of dirt may reduce the ultimate performance of this system.

Procedures I and II **ONLY** may be performed by the owner/operator.

I) LIQUID PILOT LIGHT FILTER - REMOVAL AND CLEANING:

Refer to FIG. 6.19, 6.19a & 6.25

Liquid propane is filtered by a replaceable filter before it passes into the pilot light regulator. The filter may be accessed by unscrewing the filter blanking plug (item 1) from the side of the manifold block with the Ultra wrench. The filter may now be carefully removed, inspected and cleaned with a solvent or replaced.

II) PILOT LIGHT JET - REMOVAL AND CLEANING : LIQUID AND VAPOR PILOT LIGHT BURNERS

Refer to FIGs. 6.19, 6.19a & 6.25

A) REMOVAL:

1) Loosen the hex set screw (item 3) in the side of the pilot light cup (item 4) with either the Ultra tool or a 3mm hex key. Remove the pilot light cup by reaching down through the burner coil and pulling the pilot body straight up and out.

2) Unscrew the pilot light jet (item 6) using a 1/4" socket or nutdriver.

B) INSPECTION - CLEANING - ASSEMBLY:

1) Inspect the jet for any blockage and clean with a solvent and/or a fine wire of the proper size or replace. Do not use any large sharp objects to clean the jet as this may damage it.

2) Assemble in the reverse order taking care to align the pilot light cup ignitor grounding electrode on center and directly above the piezo ignitor electrode.

III) LIQUID PILOT LIGHT REGULATOR - REMOVAL, DISASSEMBLY AND CLEANING:

It may be beneficial **NOT** to remove the entire regulator to disassemble and clean it. This may be accomplished in the following manner.

Before removal of the regulator is possible, several steps must be taken.

A) REGULATOR - REMOVAL:

Refer to FIGs. 6.19, 6.19a & 6.25

1) Turn the pilot handle to the full ON position.

2) Remove the pilot light body. (refer to Section 6.25 II A 1)

3) Remove the piezo ignitor assembly (refer to Section 6.28 A),

4) Remove the vent duct tube with a straight blade screwdriver.

5) Remove the 5mm hex socket bolt, nearest to the regulator, that holds the manifold block to the burner can.

6) Remove the slurper tube if it blocks access to the regulator lower body. (refer to Section 6.29)

7) Remove the regulator by fitting a 22mm crowfoot (a 7/8" crowfoot may be used if absolutely necessary) around the lower half and unscrewing. The 22mm slot on the regulator lower half is 7mm thick, therefore, modification of the crowfoot may be necessary.

B) REGULATOR - DISASSEMBLY:

It may be beneficial **NOT** to remove the entire regulator to disassemble and clean it. This may be accomplished in the following manner.

1) Separate the regulator halves by unscrewing the upper body (item 5) from the lower half (item 7). Use a 12mm wrench on the flats just below the jet (item 6) on the upper body and a 22mm wrench on the lower half flats (if the regulator is still installed in the burner it may not be necessary to hold the lower half to separate the upper half). Remove the spring (item 8) and piston assembly (item 9).

2) Remove the jet (item 6) with either the Ultra tool or a 1/4" wrench, socket or nutdriver. Inspect the jet. (refer to Section 6.25 II B 1).

C) REGULATOR - CLEANING AND ASSEMBLY:

1) Inspect the "O" rings for wear and damage and replace if necessary. Carefully clean the inside of the regulator and the piston assembly using a soft lint free cloth. If the regulator housing and/or piston are heavily soiled, the following generic cleaners may be used:

a) Chlorinated solvents (Trichloroethylene)

b) Hydro carbon solvents (petroleum fractions or citrus based oil)

c) Aqueous based detergent

CAUTION:
The O-ring and rubber seal must be removed prior to the application of any of these cleaners. The piston and seal must be dried thoroughly before reassembly.

2) Check that the rubber seal (item 10) on the end of the piston does not project more than .5mm (.02") below the metal housing. If the seal projects excessively it should be pushed back into the housing. If the seal still projects by more than .5mm the excess may be trimmed flat with a razor blade or very sharp knife.

CAUTION:
Normally no lubrication is necessary on reassembly. If difficulty is experienced inserting the piston in the regulator bore, lubricate **LIGHTLY** with silicone spray only. **DO NOT GREASE**.

3) Assemble in reverse order.

4) Test the pilot light system.

IV) PILOT LIGHT ON/OFF VALVE - ADJUSTMENT & DISASSEMBLY: LIQUID AND VAPOR PILOT LIGHT BURNERS

If the pilot light on/off valve fails to function properly by not opening or not fully closing it may be adjusted. If leaks around the valve stem occur, the stem "O" ring needs service.

Refer to FIG. 6.25a

A) PILOT LIGHT ON/OFF VALVE - ADJUSTMENT:

1) Turn the pilot handle to the full on position.

2) Loosen the locking hex socket bolt (5mm hex key) in the end of the gold handle.

3) **Not shutting OFF** - screw the valve stem 1/2 turn **IN**.

4) **Not turning ON** - screw the valve stem 1/2 turn **OUT**.

5) Re-tighten the locking bolt onto the flat on the valve stem. **IMPORTANT:** If the bolt is not tightened onto the flat, damage will occur to the valve stem.

6) Repeat if necessary until correct operation is achieved.

B) PILOT LIGHT ON/OFF VALVE - DISASSEMBLY: LIQUID PILOT LIGHT BURNER

1) Turn the pilot handle to the full on position.

2) Remove the regulator. (refer to Section 6.25 III A)

3) Loosen the locking hex socket bolt (5mm hex key) in the end of the gold handle.

4) Use an appropriate size flat blade screwdriver (A screwdriver may have to be modified to the correct size - refer to FIG. 6.22). Take care not to mar or destroy the threads inside the handle cam. Screw the valve stem down through and out of the manifold block. Be aware that the spring between the sleeve and cam is under tension and when the tension is released becomes very active.

C) PILOT LIGHT ON/OFF VALVE - CLEANING & ASSEMBLY

1) Examine the "O" ring (F723) on the valve stem, replace and/or lubricate with silicone or fluorinated grease as necessary.

2) Clean and lubricate the bore of the valve sleeve.

3) Assemble in reverse order.

D) PILOT LIGHT ON/OFF VALVE - DISASSEMBLY: VAPOR PILOT LIGHT BURNER

1) Turn the pilot handle to the full ON position.

2) Remove the spacer tube. The spacer is removed with the same tools and in the same manner as the liquid pilot regulator (refer to Section 6.25 III A).

3) Loosen the locking hex socket bolt (5mm hex key) in the end of the gold handle.

4) Use an appropriate size flat blade screwdriver (A screwdriver may have to be modified to the correct size - refer to FIG. 6.22). Take care not to mar or destroy the threads inside the handle cam. Screw the valve stem down through and out of the manifold block.

E) PILOT LIGHT ON/OFF VALVE - CLEANING & ASSEMBLY

1) Refer to Section 6.25 IV C

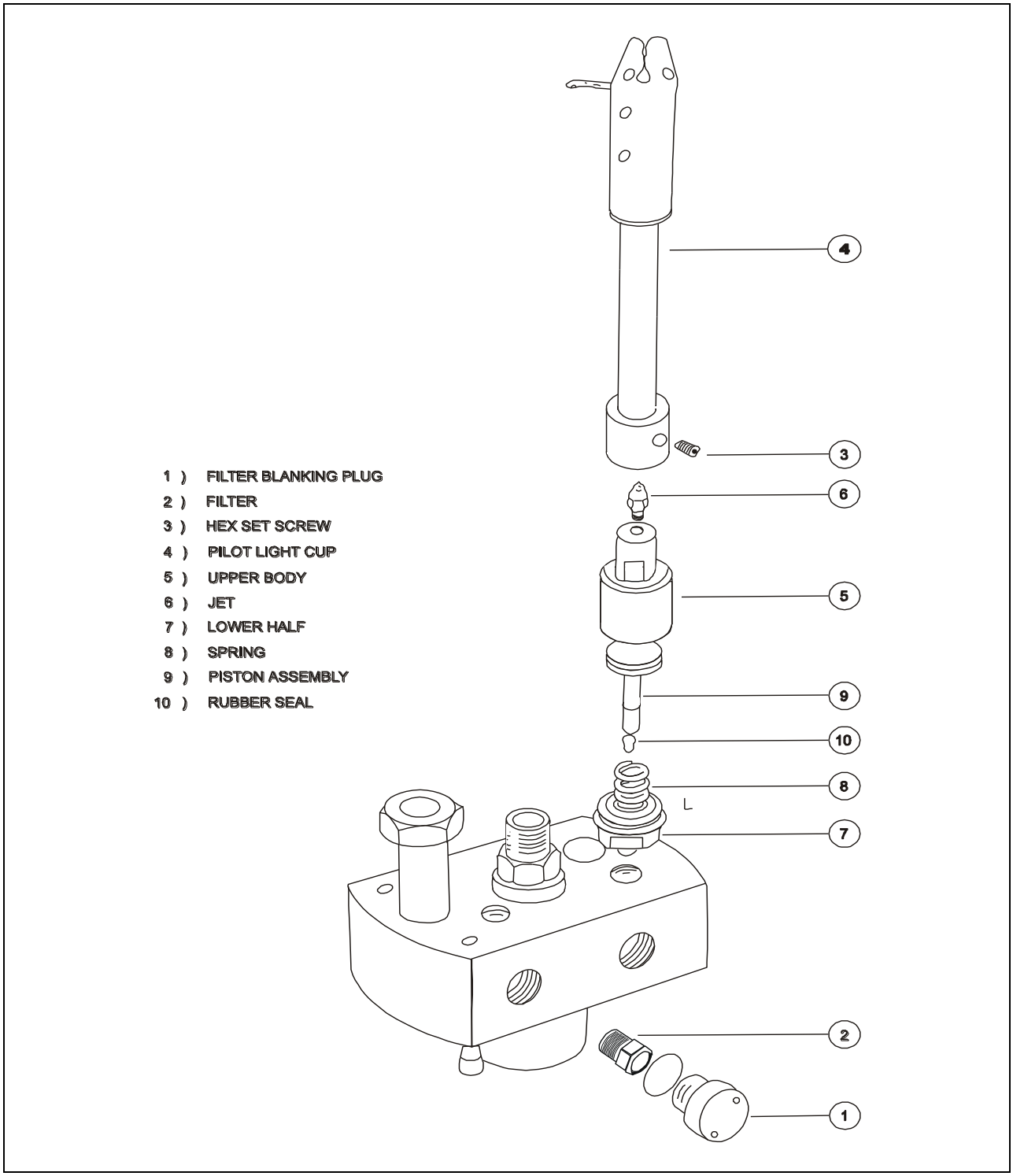

FIG. 6.25
MK IV ULTRA PILOT LIGHT AND REGULATOR

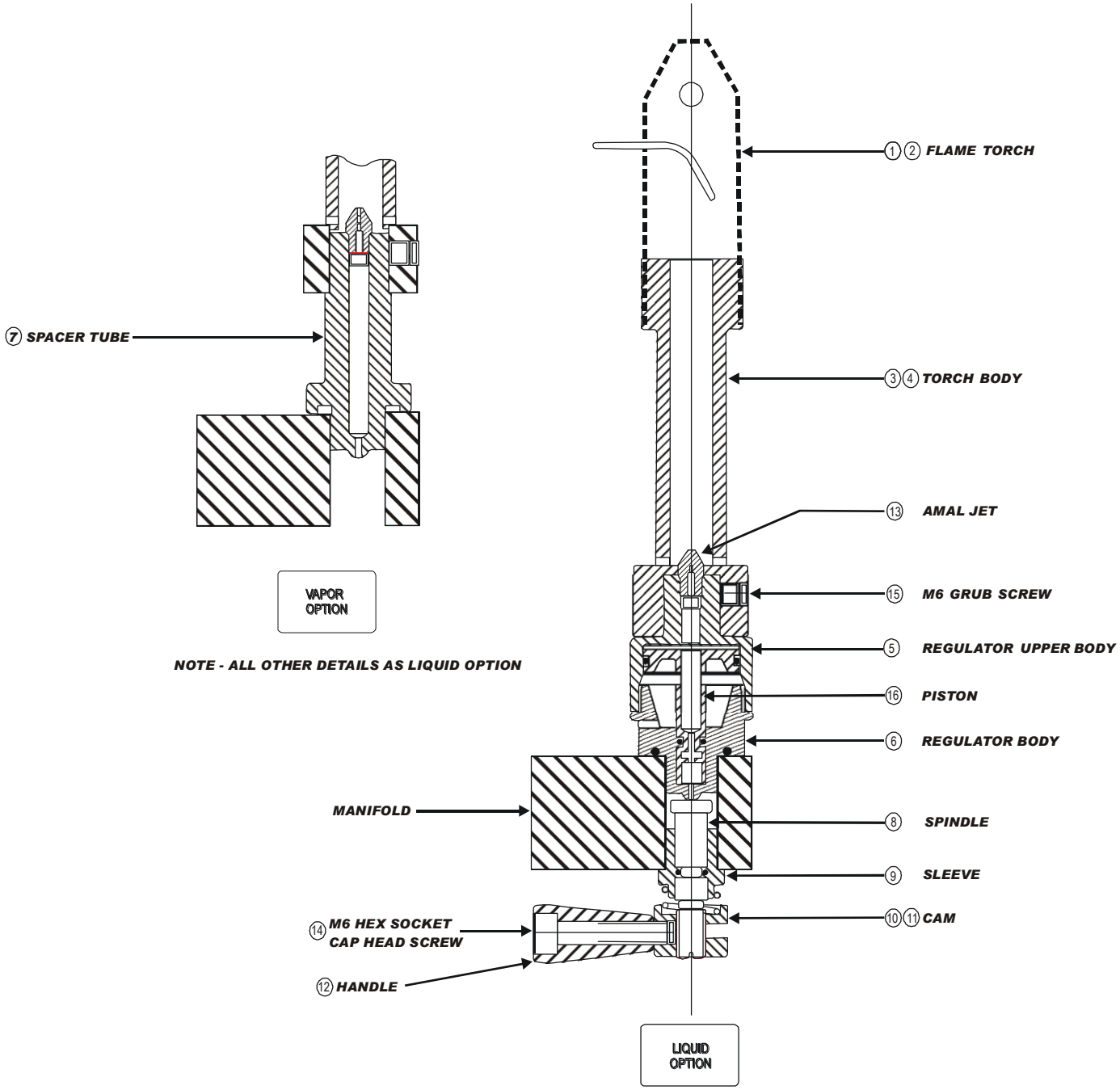

FIG. 6.25a
MK IV ULTRA LIQUID AND VAPOR PILOT LIGHTS

6.26 PIEZOELECTRIC IGNITORS - DISASSEMBLY & MAINTENANCE MK IV STANDARD BURNERS

Replacement may be completed by owner/operator.

All MK IV Standard burners have built-in pilot light ignitors. These ignitors use a piezoelectric crystal which generates a high voltage pulse when struck, and thus require no batteries.

Refer to FIG. 6.26

The MK IV Standard burner piezoelectric actuator button (F153) and its protective heat cover (F157) are located remotely to the piezo electrode (F154). The electrode is attached to the pilot light cup (F335) via a #35 stainless steel clamp (F156). The actuator and electrode are connected by a wire (F155).

The MK IV Standard burner piezo ignitor actuator and brass spacer (F158) are inserted from the outside through the bottom of the burner can and held in place with a hex-nut inside the can. The piezo ignitor wire is press fitted onto the blade connector at the top of the actuator assembly. The protective heat cover slides over the button and wire and is folded over against itself. It is secured with a nylon wire tie. The ignitor wire is routed along the bottom inside of the burner can to the pilot light cup where it attaches to the ignitor electrode with a small hex nut. The ignitor's electrode is encased in ceramic. The ceramic acts as an insulator and has a brass sleeve around its exterior. The ignitor electrode is clamped to the pilot light cup with a stainless steel clamp. The clamp should bear on the brass sleeve to avoid cracking the ceramic insulator. The curved portion of the electrode protrudes slightly into the pilot cup and it is from this curved end to the inner edge of the pilot cup that the spark jumps when the actuator button is pressed.

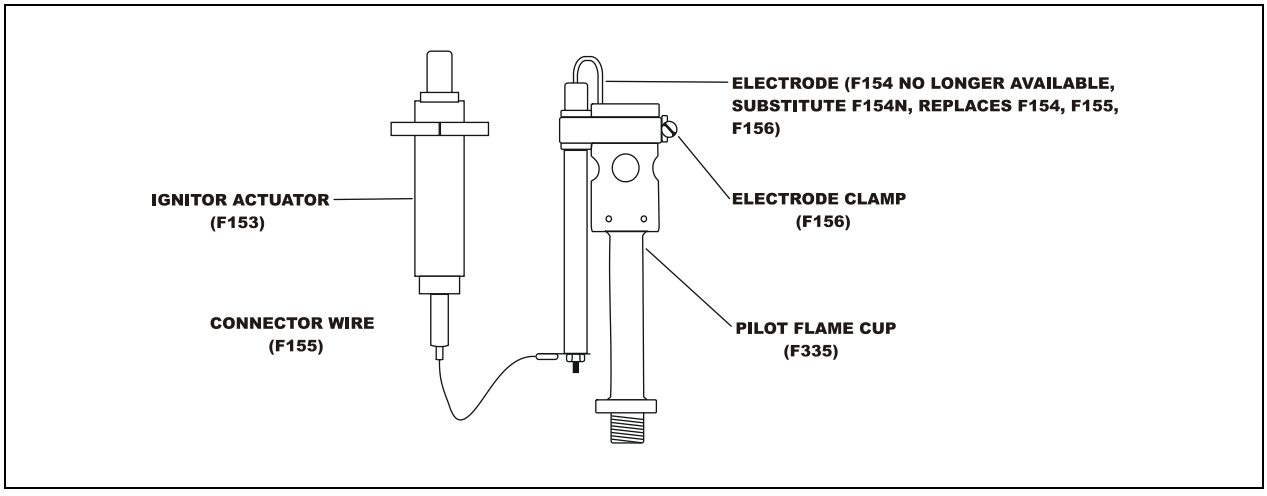

FIG. 6.26
MK IV STANDARD BURNERS PIEZO IGNITOR

6.27 PIEZOELECTRIC IGNITORS - DISASSEMBLY & MAINTENANCE MK IV SUPER BURNER

Maintenance may be completed by owner/operator.

MK IV Super burners have built-in pilot light ignitors. These ignitors use a piezoelectric crystal which generates a high voltage pulse when struck, and thus require no batteries.

Refer to FIG. 6.24

A) REMOVAL:

1) Loosen the set screw (3mm hex key) on the side of the burner manifold.

2) Pull the ignitor assembly free of the block.

B) DISASSEMBLY & ASSEMBLY:

1) The actuator button is press-fit into the piezo sleeve. To separate them, hold the piezo sleeve, twist and pull the actuator button out. All the other components are now easily removed.

2) Refer to FIG. 6.24 for the proper components order for the piezo assembly.

3) Reverse the above procedure to assemble the components into the sleeve.

C) INSTALLATION:

1) Align the hole in the side of the piezo sleeve with the set screw in the manifold block. (NOTE: Misalignment may create a bad ground, thereby reducing or preventing optimal performance).

2) Tighten the set screw to secure the ignitor. (NOTE: Over-tightening the set screw may crush the actuator housing which may render it non-functional).

3) Slide the pilot light cup against the piezo sleeve. (NOTE: The ignitor assembly must be properly grounded against the pilot light cup to function properly).

6.28 PIEZOELECTRIC IGNITORS - DISASSEMBLY & MAINTENANCE MK IV ULTRA BURNERS

Replacement may be completed by owner/operator.

MK IV Ultra burners have built-in pilot light ignitors. These ignitors use a piezoelectric crystal which generates a high voltage pulse when struck, and thus require no batteries.

A) REMOVAL:

1) Refer to Section 6.27 A.

B) INSTALLATION:

1) Refer to Section 6.27 B except use FIG. 6.28 for proper components order.

C) INSTALLATION:

1) Refer to Section 6.27 C 1 through 2.

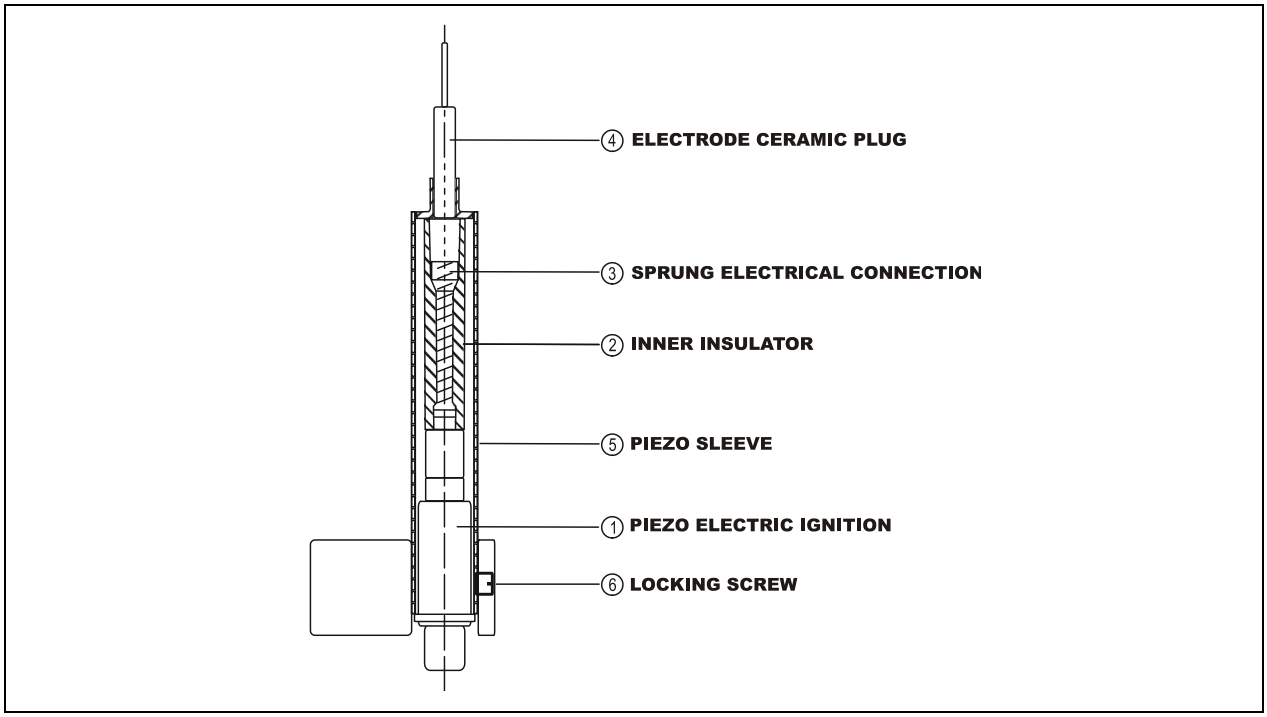

FIG. 6.28
MK IV ULTRA BURNERS PIEZO IGNITOR

6.29 SLURPER - DISASSEMBLY & MAINTENANCE - ALL MODELS

There are no maintenance requirements for the slurper except proper alignment and non-blockage of the tube. Slurpers are not required and have been standard equipment since late 1994 on MK IV Ultra burners. Slurpers function with Amal jets ONLY, they will not work with multi-hole jets.

Refer to FIGs. 6.29a & 6.29b

A) REMOVAL, MAINTENANCE AND ASSEMBLY:

1) Remove the Slurper tube from the Slurper mounting bracket by loosening the hex socket set screw in the side of the mounting bracket with a 1.5 mm hex key.

2) Inspect the tube ensuring that it is not clogged.

3) Install the tube per 6.29 B 4.

B) RETROFIT INSTALLATION:

These instructions are written for installation of slurpers if they are to be retrofitted. They may also be used to assemble the slurpers after removal and maintenance.

1) Separate the Slurper tube from the Slurper mounting bracket by loosening the hex socket set screw in the side of the mounting bracket with a 1.5 mm hex key.

2) Remove the correct main burner jet(s) and washer(s) from the jet ring(s), as indicated in FIG. 6.29a, using a 5/16 Whitworth socket.

3) Install the slurper mounting bracket, main burner jet and jet washer as per FIG. 6.29b. Torque the jet to 150 inch pounds.

4) Insert the slurper tube into the mounting bracket, taking care to rest the bottom of the slurper tube onto the floor of the burner can (no gap) and aligning the top of the slurper tube so it is centered on the jet orifice. Apply thread locking compound to the hex socket set screw. Tighten the hex socket set screw in the side of the mounting bracket.

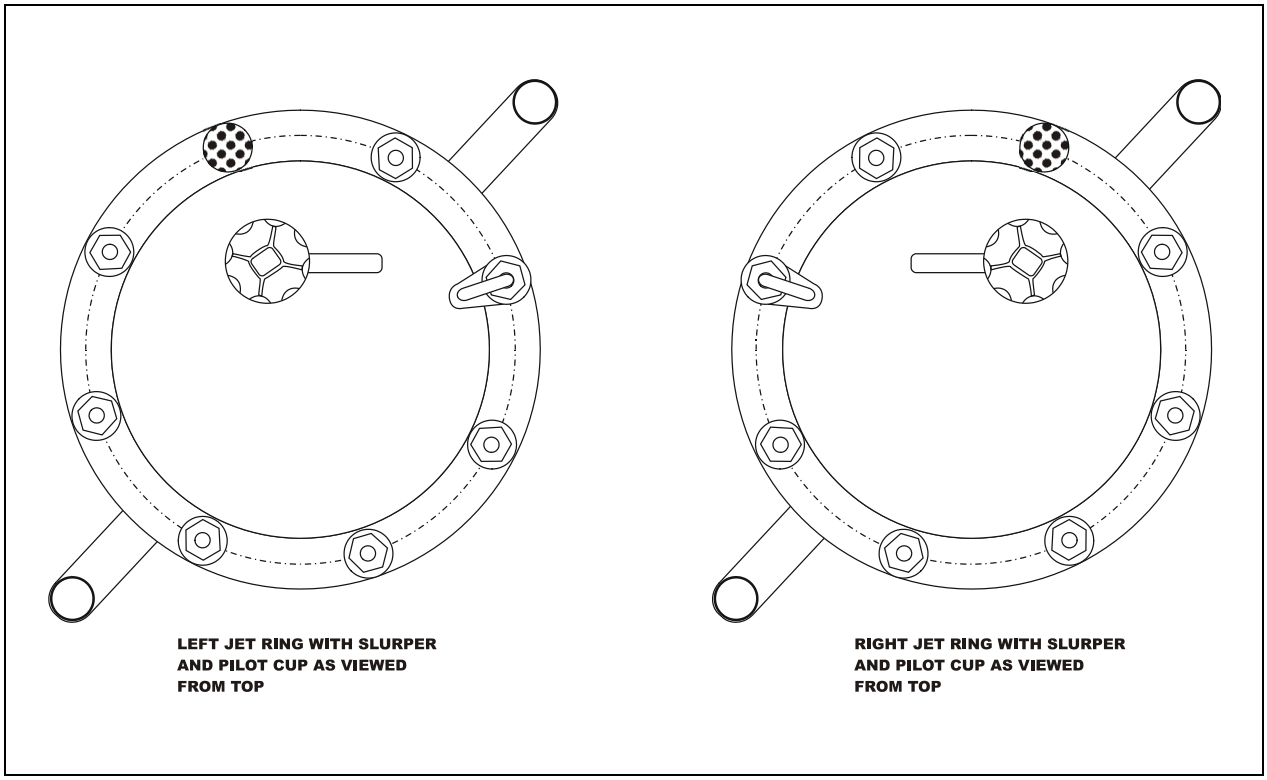

FIG. 6.29a
MK IV ULTRA JET RING & SLURPER POSITION

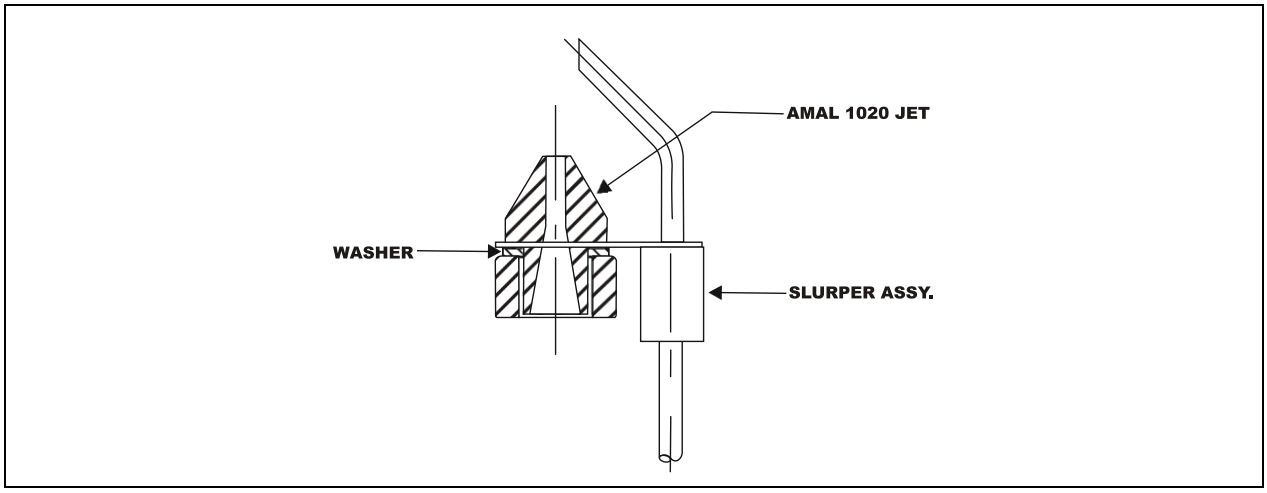

FIG. 6.29b
SLURPER COMPONENTS PROFILE

6.30 FUEL TANKS: MAJOR PARTS AND SUBASSEMBLIES

WARNING! DANGER!

HAZARDOUS CONDITIONS WHICH COULD RESULT IN INJURY OR DEATH MAY OCCUR FROM:

A. THE INSTALLATION OF NON-APPROVED PARTS OR MATERIALS
B. MODIFICATION OF ANY PART
C. IMPROPER REPAIR PROCEDURES
D. IMPROPER OPERATION OF THIS AIRCRAFT

APPROVED REPLACEMENT PARTS, MATERIALS AND REPAIR PROCEDURES ARE DOCUMENTED IN THIS MANUAL

TANK BODY:

10 gallon aluminum:

No. CB250 is a Worthington 4100-U4 43½ lb. aluminum cylinder with 5-boss head, which meets DOT standard 4E-240. This Worthington cylinder is modified to be used specifically in a Cameron Hot Air Balloon.

11-15-20 gallon stainless steel & titanium:

11 gallon cylinder: No. CB599, CB2902 are Stainless Steel.
15 gallon cylinder: No. CB426, CBUS1050 & CB2901 are Stainless Steel
15 gallon cylinder: No. CB2380 is Titanium
20 gallon cylinder: No. CB959, CBUS1060 & CB2903 are Stainless Steel
20 gallon cylinder: No. CB2383 is Titanium

These stainless steel or titanium cylinders are custom manufactured by Cameron Balloons to be used specifically in a Cameron Hot Air Balloon.

Tanks with part No. **CBUS1050C were available as Master Tanks ONLY**. Tanks part No. CBUS1050C may now be converted to Standard Tanks if a special Pressure Relief Valve (F320T) is installed. All other tanks are available as Master or Standard Tanks. All US built tanks are DOT approved.

All tanks **MUST** be equipped with the following components (Part numbers are Cameron part numbers):

Liquid withdrawal valve:

British Rego 8180 (F005) or modified Muller 344 (F825) or
Quick Shut Off Worcester (F671 or F671T)

Fuel quantity gauge:

10 gallon - Livello, Rochester or Taylor gauge (F302G).
11 gal (CB599 & CB2902) and 15 gal (CB426, CB2380 & CB2901)-Livello or Rochester gauge (F302T)
15 gallon (CBUS1050) - Rochester gauge (F302U)
20 gallon (CB959, CB2383 & CB2903) - Livello or Rochester gauge (F302X)
20 gallon (CBUS1060) - Rochester gauge (F302W)

Pressure relief valve:

American Rego 8545 AK or Sherwood PV 435A or Fisher H349 or Muller Type 91 (all are F320) or Sherwood PV 435L (F320T)

NOTE:
All pressure relief valves part number F320 & F320T **MUST** be replaced after ten years of service.

Fixed liquid level gauge:

American Rego 3165F or Sherwood T12 or Fisher J410 or Seeco 10 R (F330, F330A or F2480). All fixed liquid level gauges have to be trimmed to a specific length to accommodate each series of tank.

MASTER tank only:

Vapor valve:

American Rego 901P5H, 901P5HV, 9101P5H and 9101P5HV (F008) or Sherwood PA1425AM (F008S).

CBUS1050, CBUS1060, CB2380 and CB2383 ONLY - Muller BMV 043 with incorporated pressure relief valve.

Vapor regulator:

British Rego B367 or M367 (F004R) or Calor 147P (F250) or Lorch (F2595).

NOTE:
If the vapor valve is installed, a regulator and quick release **MUST** be properly installed on its outlet.

Vapor Regulator Quick Release:

Stillcraft DM-321-E or Dyna-Quip D3 or DM3 for Rego regulator: (F004Q).
For Calor and Lorch regulator: (F004C).

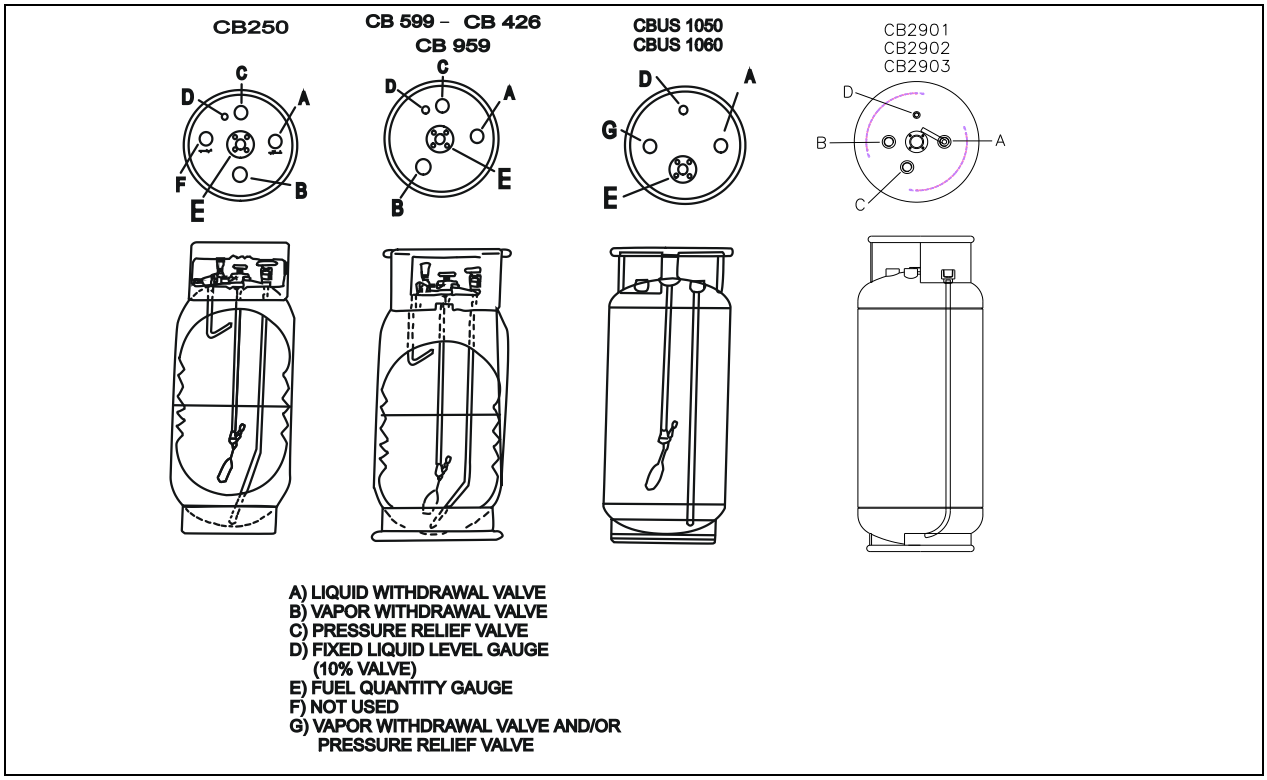

FIG. 6.31
TANKS
RELATIVE POSITIONS OF DIP TUBE,
FUEL QUANTITY GAUGE AND VALVES

6.31 FUEL TANK INSPECTION

Cameron Balloons are equipped with one or a combination of the following fuel tanks:

10 Gallon Aluminum Part no. CB250
11 Gallon Stainless Steel Part no. CB599 or CB2902
15 Gallon Stainless Steel Part no. CB426 or CBUS1050 or CB2901
15 Gallon Titanium Part no. CB2380
20 Gallon Stainless Steel Part no. CB959 or CBUS1060 or CB2903
20 Gallon Titanium Part no. CB2383

NOTE:
Not all tanks are approved for installation in every Cameron basket. Check the most recent Type Certificate Data Sheets for the proper application.

A) TANK BODY VISUAL INSPECTION:

Inspect the tank body for evidence of dents, cuts, gouges, bulges, surface cracking, weld integrity and damage from external heat tapes. Inspect the base of the tank for dents or deep scratches

NOTE:
If the tank is equipped with heat tapes and covers, **THE HEAT TAPES, COVERS AND TAPE DEBRIS MUST BE REMOVED**. Inspect the tank body for signs of electrical shorting and inspect the length of the heat tape for any damage to the insulation of the heat tape which could cause electrical arcing damage to the tank body or could cause a fire.

B) LIQUID WITHDRAWAL (DIP) TUBE INSPECTION:

The integrity of the dip tube is important. Dip tubes can be damaged by dropping the tank on its side, or transporting an empty tank while on its side.

WARNING! DANGER!
DO NOT perform tank inspections indoors or near any possible source of ignition. Tank inspection requires release of flammable propane vapor.

Inspection of the dip tube requires the tank to contain some quantity of fuel (about 2 gallons). Connect a 7141F fitting (preferably with no hose attached) to the liquid valve outlet.

1) Open the liquid valve **very slightly** while the tank is in the upright position. Initially vapor will exit from the outlet, but very soon small droplets of liquid will appear and the vapor will stop completely. This indicates that the dip tube is picking up liquid fuel from the tank bottom, and that there are no leaks in the dip tube which would allow vapor to escape instead of liquid.

2) Close the liquid valve. Invert the tank. As the tank is inverted inspect the quantity gauge; it should change from reading empty to reading more than 30 per cent full, as the arm of the gauge swings up during the inversion process.

3) Once the tank is inverted, open the liquid valve **very slightly**. In the first 30 seconds or so liquid droplets will appear, then suddenly the liquid droplets will turn to vapor only. This test verifies that the tube does not have any leaks where it is welded into the top tank boss (If it did have a leak at this point, liquid fuel would flow through the leak, into the dip tube, and escape from the slightly opened liquid valve).

C) INTERIOR INSPECTION:

If the blast valve, liquid valve or fixed liquid level gauge have any residue that indicates probability of propane contamination, inspect the inside of each tank.

WARNING! DANGER!
Remove all fuel before attempting an inspection of the interior of a tank. Complete the inspection outdoors away from possible ignition sources.

1) Open the fixed liquid level gauge (bleed valve or 10 per cent valve) to assure that there is no pressure in the tank. If gas flows when you open the bleed valve, leave the valve open and wait until it stops flowing before continuing with this procedure.

WARNING! DANGER!
While inspecting the interior of the tank, remember that it still contains flammable, if not explosive, propane vapor. KEEP ALL IGNITION SOURCES WELL CLEAR OF THE AREA!!!

2) Unscrew the 4 corner screws on the fuel quantity gauge. Gently remove the gauge, taking care not to lose the gasket sealing the gauge to the tank.

3) Inspect the interior of the tank by shining a flashlight into the tank.

If debris is found in the bottom of the tank, use a stick with masking tape aimed outwards to pick up the debris. If water is present, pour it out and add methanol: one cup for 10 and 11 gallon tanks, 1 1/2 cups for 15 and 20 gallon tanks.

When replacing the quantity gauge, use caution to insert the gauge in the correct orientation. The top of the gauge should be closest to the pressure relief valve, except on the CBUS1050 15 gallon and CBUS1060 20 gallon tank, on which the top of the gauge is oriented towards the 10% bleed valve.

4) Tighten the bolts following a pattern that will assure the bolts end up with approximately equal force at any point in time during the tightening procedure. Even slight missalignment of the gauge can cause sticking and incorrect readings.

D) FUEL TANK RE-QUALIFICATION:

NOTE:
FUEL TANKS **MUST** BE RE-QUALIFIED BY A PROPERLY D.O.T. AUTHORIZED PERSON ONLY! THE AUTHORIZED PERSON MUST HAVE A D.O.T. R.I.N. NUMBER

DOT regulations require that propane tanks be re-qualified. While the Cameron tanks number CB426, CB959, CB2380, CB2383, CB2901, CB2902 and CB2903 are not DOT approved, Cameron Balloons requires that the same inspection and re-qualification procedure be applied to these tanks as is required for DOT-approved tanks.

Tanks **MUST** be re-qualified twelve years after the initial put into service date. One of three methods is allowable.

1) Complete external visual inspection. This inspection nets 5 years use before another re-qualification is necessary.

2) Modified hydrostatic retest. This inspection nets 7 years use before another re-qualification is necessary.

3) Hydrostatic retest. This inspection nets 12 years before another re-qualification is necessary.

The visual inspection guidelines are detailed in Compressed Gas Association pamphlets C-6 “Standards for Visual Inspection of Steel Compressed Gas Cylinders” and C-6.3 “Guidelines for Visual Inspection and Re-qualification of Low Pressure Aluminum Compressed Gas Cylinders”. Re-qualified tanks must be documented and stamped after testing and inspection.

Refer to Appendix H for more information.

6.32 FUEL TANK LIQUID WITHDRAWAL VALVE

All fuel tanks supplied by Cameron Balloons incorporate the 1 1/4" ACME British Rego 8180, 1 1/4" ACME modified Muller 344 or Worcester Quick Shut Off (1 1/4" ACME or Tema) liquid withdrawal valve. See Appendix F for maintenance and inspection for Worcester QSO valves. The only parts that interchange between the Rego, Muller and Worcester ACME (QSO) are the outlet o-ring and rubber washer.

A) EXTERNAL INSPECTION:

1) Inspect for signs of hairline cracks around the body.

2) Verify that no more than six threads are showing where the valve screws into the tank body.

3) The valve must be oriented such that the hose connector can attach through the opening in the tank collar with the fuel hose not contacting the edges of the tank collar (which could cause abrasion damage to the hose).

4) Verify that the screw holding the handle is tight.

5) Verify that the outlet "O" ring and "washer" (square ring) located in the outlet are each in place and undamaged. Visually inspect these components as well as feel the inner surface of the valve outlet area with a finger. If roughness is apparent, or fuel leakage through the connector when the hose end fitting (7141F) is attached and fuel supply turned on, the "O" ring and "washer" **must** be replaced.

6) Check that the valve main-seal is not leaking when in the fully closed position by connecting a British Rego 7141F connector (with no hose connected to it) to the British Rego 8180 or modified Muller valve and sniff for propane leakage.

7) Check that the outlet self seal does not leak. Apply leak detector solution to the outlet seal self, open the valve and check for leaks.

8) Check that the valve stem does not leak. Apply leak detector solution to the stem-bonnet junction, open the valve and check for leaks.

Lubricate the rubber parts and large external Acme threads of the British Rego 8180 or modified Muller valve with silicone spray. Assure that the dust cap is attached around the body of the valve and installed in or on the valve outlet when a 7141F connector is not in use.

See FIG. 6.32 for British Rego 8180

B) DISASSEMBLY:

1) Bonnet Removal and Disassembly:

a) Remove the hand wheel.

b) Remove the bonnet with a 7/8" wrench (Rego) or 3/4" wrench (Muller)

c) Separate the valve stem-main seal assembly from the bonnet by screwing the stem down through the bonnet.

d) The main seal and valve stem may now be separated.

2) Outlet Check-Valve (Chinese Table) Assembly Removal:

a) Unscrew the check-valve seat with a Notched Spanner Driver or modified Tack Puller.

b) The check-valve and spring may now be pulled free.

NOTE:
The check-valve (Chinese Table) has a conical rubber seal which, if damaged, will cause the check valve to leak. The check valve may also leak if the check valve 'O' ring has been damaged.

C) LUBRICATION:

1) Lubricate the O-Ring on the main seal with a silicone or fluorinated grease.

2) Lubricate the check-valve, outlet O-Ring and washer with silicone spray and assembly in reverse order.

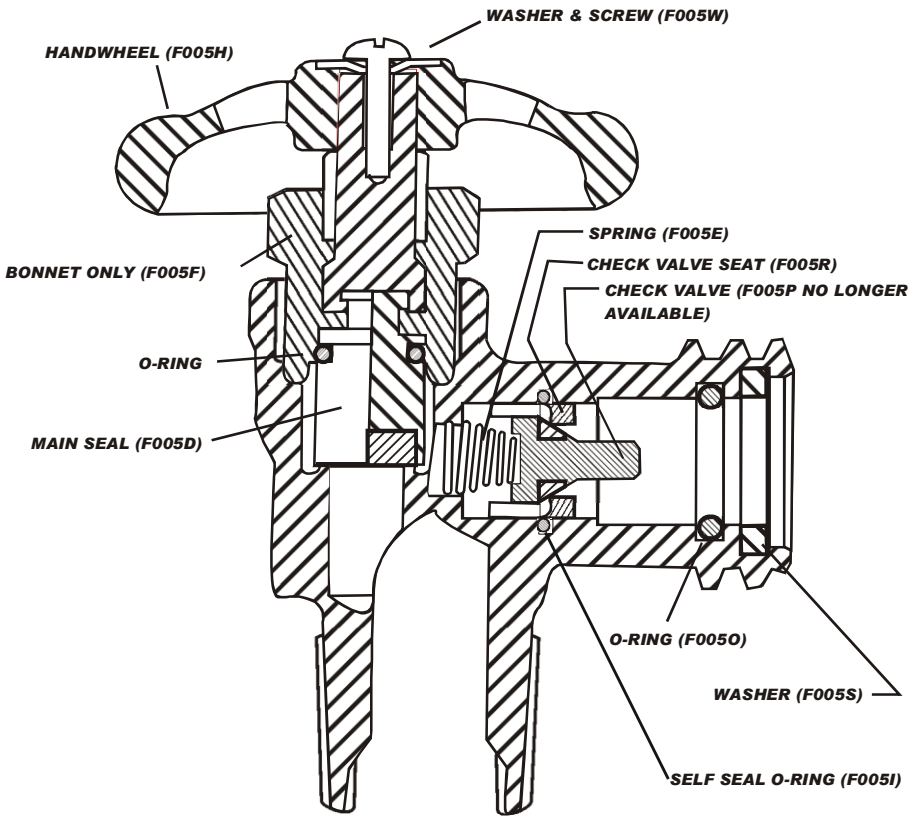

FIG. 6.32
British Rego 8180 Liquid Withdrawal Valve
(Muller 344 is similar)

6.33 FUEL TANK VAPOR WITHDRAWAL VALVE

In addition to the valves fitted in Standard tanks, Cameron Balloons US supplies fuel tanks intended for use as Master tanks incorporating the Rego 901P5HV valve or BMV 043 valve (CBUS1050, CBUS1060, CB2380 and CB2383 ONLY), adjustable pressure regulator (Rego B367 or Calor 1476P or Lorch) and a quick release fitting.

NOTE:
Tanks fitted with vapor valves MUST have a vapor regulator with quick release installed on the valve, or the valve MUST be removed and the boss in the tank plugged.

The vapor valve is fitted in the center bottom opening on the Worthington aluminum tank, **NOT THE HOLE MARKED "VAPOR"** on the tank. By installing the valve into an opening which has no dip tube, the regulator will not be fed liquid fuel for long periods after the tank has returned to an upright position following being laid on its side during inflation.

A) VAPOR PILOT VALVE INSPECTION

1) The Rego 901P5HV or BMV 043 valve should be inspected for hairline cracks in its body.

2) Verify that no more than six threads are showing where the valve screws into the tank.

3) The valve must be oriented such that the tank collar does not interfere with adjustment of the regulator.

4) Verify that no leaks occur through the valve stem-bonnet area by opening the valve half way and checking for leaks.

If a leak occurs in this area it is best to replace the entire bonnet assembly; however, lubrication of the O-ring on the main seal occasionally works.

B) REGO 901P5H BONNET REMOVAL

The BMV 043 valve will require a similar procedure.

Refer to FIG. 6.33.

NOTE:
Repairs must be performed in a clean area. Hands, clothing, tools and work area must be completely free of oil, grease and foreign matter to prevent contamination of component parts and valves.

1) Evacuate all propane from the system before any work is started.

2) Using a screwdriver, remove the handwheel screw and vapor tag by turning counterclockwise - thus allowing removal of handwheel.

NOTE:
The bonnet assembly has left hand threads as indicated by the notches in the hex edge.

3) Remove the bonnet assembly from the valve body by turning **it clockwise** with a 5/8" wrench that can develop at least 500 lb. inches of torque.

4) Inspect the valve body and clean. Be sure the interior is free of dirt, residue and foreign particles.

B) REGO 901P5H BONNET INSTALLATION

NOTE:
To prevent loosening of the valve body from the cylinder, hold the valve body with a second wrench while installing the new bonnet assembly.

1) Thread the new bonnet assembly into the valve body counterclockwise and tighten to 325-375 lb. inches torque using a suitable 5/8" wrench.

2) Reassemble the handwheel to the valve stem and secure with a new self taping screw. Tighten firmly with a screwdriver.

3) Turn the handwheel fully clockwise to close the valve.

4) Pressurize the system. Check the valve for proper operation and check all seal points for leaks by applying a high quality leak detection solution.

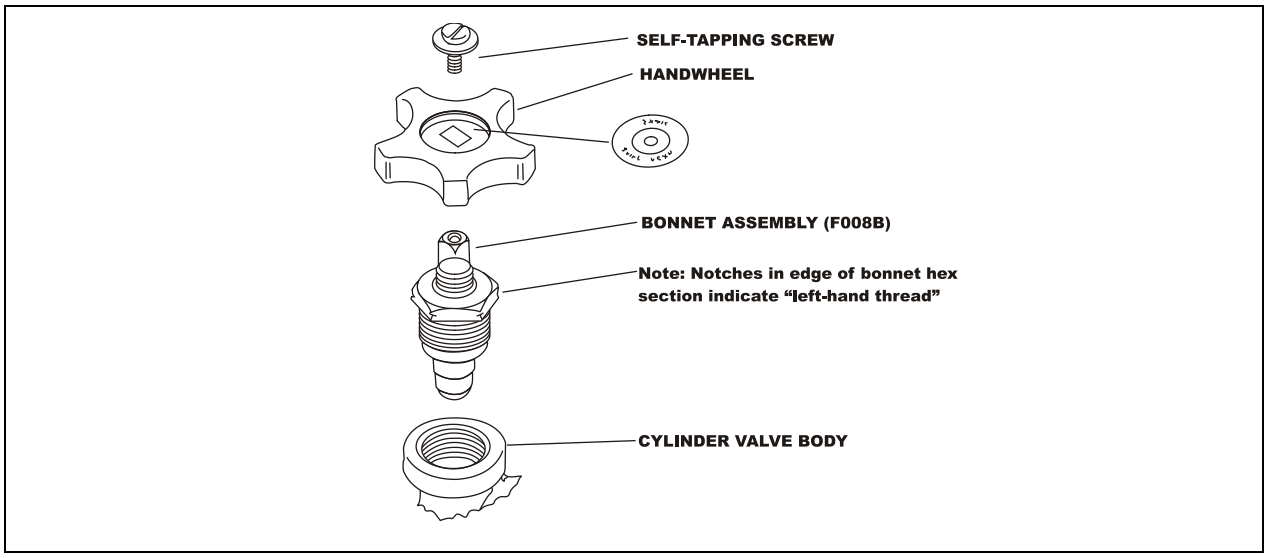

FIG. 6.33
Rego 901P5H Vapor Withdrawal Valve Bonnet Assembly
(BMV 043 is similar)

6.34 FUEL TANK VAPOR WITHDRAWAL REGULATOR

The vapor regulator is Rego (F004R discontinued) or Calor (F250 discontinued) or Lorch (F2595 present) connects to the pilot light vapor hose through a quick release fitting (F004Q or F004C). The regulator reduces the pressure from the tank to operate the pilot light. The regulator is adjustable, however, normally the operator will adjust the flow rate once and leave it set using the locking nut to hold it in place.

A) REGULATOR INSPECTION:

1) Test the adjustment over the full range.

While the pilot light is ignited,

a) Screw the adjustment knob or T-handle all the way in; the flame should increase and sometimes blow itself out.

b) Screw the adjustment knob or T-handle **almost** all the way out; the flame should go out or be very small.

If screwing the adjustment inward does not ultimately result in the pilot light flame reaching well above the top of the burner vaporizing coils, then the orifice in the pilot light assembly is probably clogged. Inspect the orifice for debris.

2) **(Rego ONLY)** Open the vapor valve with no hose connected to the quick release fitting. Check for any flow of propane vapor from the small vent hole on the body of the pressure regulator. If propane is flowing from this hole, it indicates that the vapor regulator diaphragm is leaking and must be replaced.

6.35 FUEL TANK VAPOR HOSE QUICK DISCONNECT

A) INSPECTION:

1) Open the vapor valve and turn the regulator adjustment 3/4 of the way in.

a) Check for leaks around the Quick Disconnect outlet with and without a hose inserted.

6.36 GIMBAL BLOCK BURNER MOUNTING

Cameron Balloons most recent method of mounting burners into frames utilizes an alloy Gimbal Block. Refer to FIG. 6.36. **See Appendix U for the most current version.**

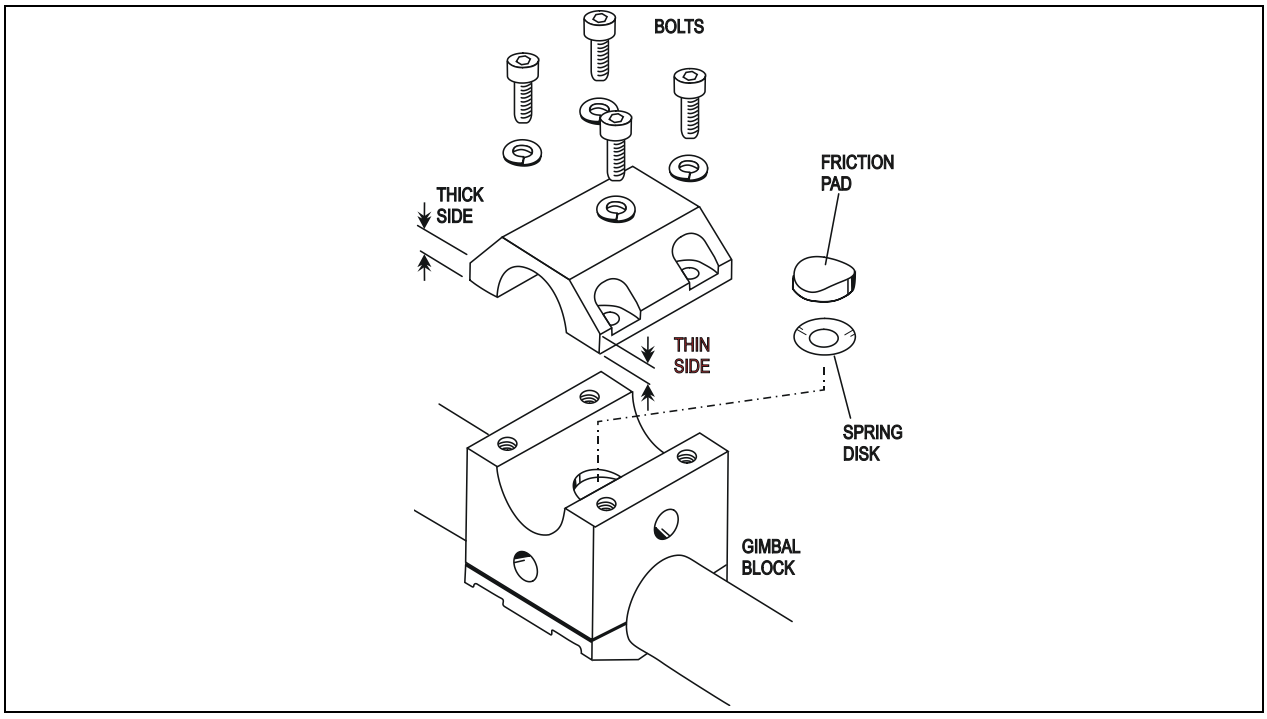

FIG. 6.36
GIMBAL BLOCK BURNER MOUNTING

If the Gimbal Block must be disassembled for any reason the following procedure MUST be used for reassembly.

1) Refit the Spring disc and Friction pad into the Gimbal Block.

2) Relocate the burner into the frame ensuring that it is oriented correctly.

3) Apply a small amount of grease onto the frame journal.

4) Apply thread locking compound to the 2 bolts on the “thick” side of the Cap. Screw down and FULLY TIGHTEN these bolts.

5) Apply thread locking compound to the 2 bolts on the “thin” side of the Cap. Screw down and adjust tightness to give desired burner movement tension.

See Appendix U for the most current version of the Gimbal Block Mounting System.

6.37 FUEL MANIFOLD – OPEN BASKETS

Fuel manifolds are available as optional equipment on every basket Cameron builds. The components used to fabricate the manifolds are serviced in the same fashion as other fuel system parts.

GENERAL DESCRIPTION - TWO TANK MANIFOLD:

Four basic configurations of fuel manifolds are available from Cameron Balloons to accommodate open basket models having inside widths of 37"-39", 41"-43" and 45"-47" and partitioned baskets. A three 10 gallon tank configuration is currently available for the 47"-49" basket and is similar in components and installation procedures.

The part number stamped on the manifold will have an issue letter as a suffix.

See Appendix X for a complete basket, fuel tank and manifold compatibility list plus installation instructions for current style manifolds.

NOTE:
These manifolds are designed to be used with the standard burner liquid hoses. Once installed in the basket, these manifolds may or may not be connected into the fuel system of the balloon for a particular flight. If the manifold is used, **ALL** fittings **MUST** be connected to their respective tanks. **A manifold MUST not be used if one or more fittings are left unconnected**.

NOTE:
MANIFOLD FUEL HOSES MUCH BE REPLACED AFTER 10 YEARS SERVICE

A) INSPECTION:

1) Inspect and service the 7141F fittings the same as the fitting on the end of the burner hose.

2) Inspect the hoses for chaffing and cracks, specifically where the hose may contact the basket wall. If the braided metal interior sleeve is exposed, the hose **MUST** be replaced before the next flight.

3) Inspect and service the 7141M fitting and its rubber or plastic protective cap in the same manner as the liquid withdrawal tank valve. Both valves use the same O-rings and rubber washers. Refer to Section 6.32.

4) Check for leaks around all the screw together fittings and the hose ends with a high quality leak detector.

5) Inspect the plastic cable ties that secure the manifold to the mounting block (old style) and the cable ties that attach the mounting block-manifold assembly to the basket wall. If any are broken then they **MUST** be replaced.

B) INSTALLATION OVERVIEW – EARLY STYLE:

IMPORTANT:
Installation of the manifold into the basket must be done by an FAA certified repair person.

Proper installation is important to prevent damage to the manifold in flight, ground handling, or transport and to prevent failure of the manifold if the system is exposed to high impact forces.

The manifold(s) must be installed according to these instructions. The manifold must be positioned in the basket to prevent stress from ever being placed on the hoses and so the hoses cannot be pinched or rubbed by the tank collars, basket wall or any other part.

The hardwood mounting block and nylon cable ties are integral to the proper function of the manifold. They must be used, and no other parts may be substituted for them. Some of the functions they perform are to provide a degree of electrical insulation to help prevent electrical damage to the fuel system and to intentionally provide a mechanically weak point in the manifold mounting system which will help prevent damage to the fuel hoses caused by basket distortion resulting from high impact forces.

C) PARTS LIST – EARLY STYLE:

1) Manifold assembly

2) Hardwood mounting block

3) 3/16"x8” long nylon wire ties (B069), 2 or 3 Required (old style only)

4) 5/16"x15” long nylon wire ties (B070), 2 Required

D) INSTALLATION INSTRUCTIONS – EARLY STYLE:

1) CHECK for presence of each part listed in above parts list.

2) MEASURE inside width of basket end horizontally between the points where the shoulders of the fuel tanks touch the opposite walls just below the base of the tank collar (non-partitioned basket ONLY).

3) CONFIRM that the basket end width falls within one inch (1") of the rated size of the manifold provided (non-partitioned basket ONLY).

4) INSTALL fuel tanks with covers in the basket.

5) TIGHTEN tank straps tightly (to assure tanks are fitted very snugly into basket corners).

6) CONNECT manifold to both tanks. Rotate the tanks as necessary to avoid kinks or twists in the hoses.

7) POSITION the manifold so that the fuel hoses make smooth bends to the tank valves and MARK the location for hardwood mounting block (the smooth bends in the hoses provide excess hose length which is necessary to protect the fuel system from being damaged as a result of basket flexing from severe impact).

8) MOUNT the manifold to the hardwood block (old style only) using 3/16" wire ties so that two of the large holes in the hardwood block are common to both a large and a small wire tie.

9) MOUNT the manifold in the marked position using two 5/16" nylon cable ties.

10) Trim ends of all nylon cable ties used in steps #8 and #9.

11) INSPECT the installation:

- **a)** No kinks or twists in either hose,
- **b)** Smooth bend in each hose to provide excess for severe basket flexing
- **c)** Hoses not touching anything (tank collar, basket wall, etc.),

d) All cable ties snugly tightened.

11) REPEAT 1 through 10 for other manifold, if present.

12) Add three pounds to the basket weight in the flight manual for each manifold installed.

13) INSTALL flight manual in document display/flight manual case in the basket.

14) MAKE appropriate aircraft log entry documenting the installation.

For assistance or advice relative to the installation of these manifolds, contact Cameron Balloons US at (734) 426-5525 or
email: techsupport@cameronballoons.com.

6.38 ELECTRIC HEAT TAPES:

WARNING:
Incorrect use of electric heat tapes may result in extreme hazard, property loss, injury or death. BEFORE INSTALLING OR USING HEAT TAPES, READ AND FOLLOW ALL INSTRUCTIONS BELOW.

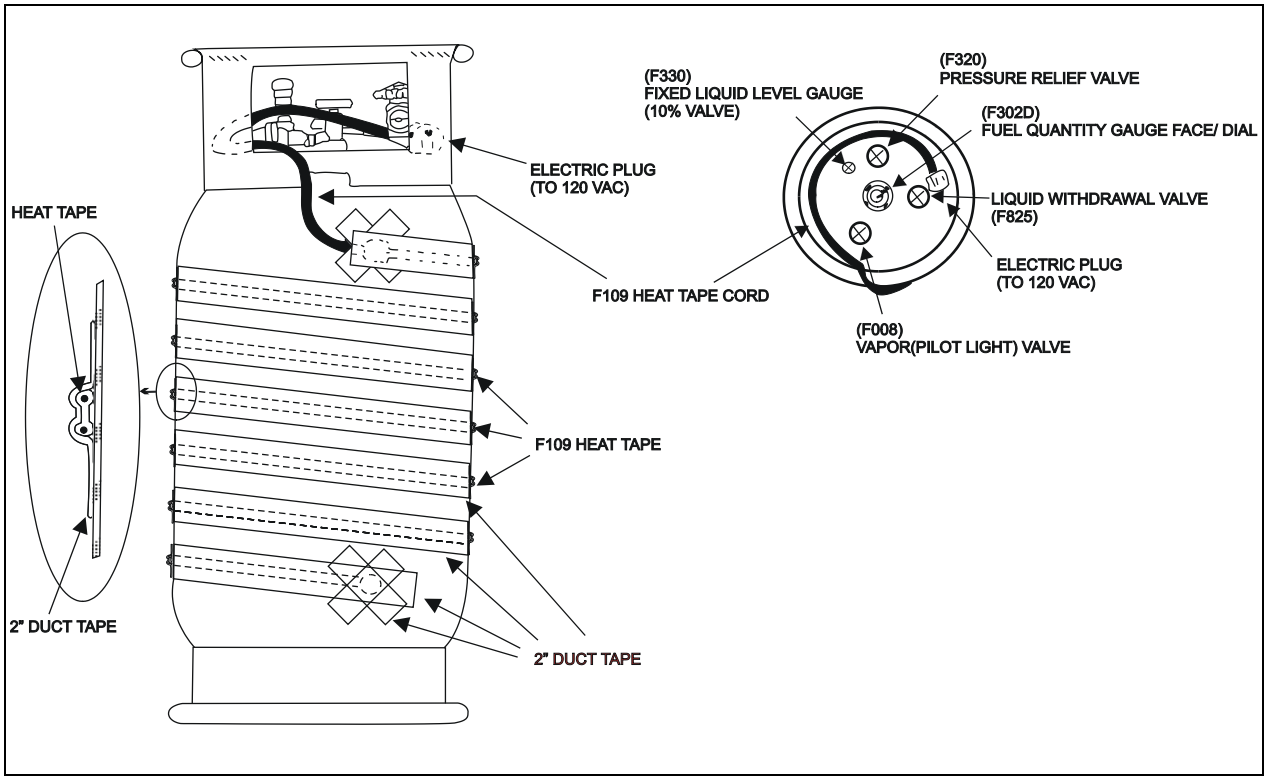

FIG. 6.38
Typical Heat Tape Installation

A) INSTALLATION

1) Assure that outside of tank is clean, so that duct tape will adhere well.

2) Use 2-inch wide duct tape. Tape the plastic connector block between the power cord and the flat heat tape to the tank in the position shown in the FIG. 6.38 above.

3) Wrap the heat tape spirally onto the tank in the position shown. Securely tape the heat tape end to the tank. A consistent, 1 3/4-inch gap must be maintained between wraps of the heat tape.

4) Use 2-inch wide duct tape to secure the heat tape to the tank. Apply the tape along the heat tapes entire length. When properly installed, the heat tape will be totally covered by the duct tape.

5) INSPECT the installation to assure that:

a) the heat tape is not twisted

b) the minimum 1 3/4" gap between the wraps of the heat tape is maintained throughout its entire length

c) the heat tape is securely held against the side of the tank by the 2-inch wide duct tape

6) Lay the electric power cord inside the tank collar as shown in FIG. 6.38.

7) Spray silicone lubricant onto the inside of the tank cover foam to facilitate installation of the fabric/foam cover assembly. From the top of the tank, pull the fabric/foam cover assembly onto the tank and tie the draw ropes at the top and bottom of the cover.

WARNING! DANGER!
Cameron foam-insulated tank covers MUST be installed and at all times remain in place over heat tapes to protect the tapes from damage. Damaged heat tapes could cause fire or electrical shock which could result in injury or death.

B) USE:

WARNING! DANGER!
Do NOT connect heat tapes to an electric power source while tanks are in building, vehicle, or other enclosed space. Overheating may cause release of flammable gas, explosion, and/or fire, which could result in injury or death.

1) ASSURE that each tank to be heated is filled to, but NOT above, fixed liquid level tube (bleed valve) in tank (This amount of fuel allows the use of the table below to plan heating times, results in consistent heating times for all tanks, and assures a vapor space in the tank to allow for liquid fuel expansion during heating without over pressurizing the tank and causing potentially dangerous release of propane through the pressure relief valve).

2) Connect the heat tapes to an electric timer, using an extension cord rated for the total load of the heat tapes you connect (Total power consumption equals the number of heat tapes in use multiplied by 180 watts per tape for blue tapes or 168 watts for orange).

3) Carefully set the timer to apply power to the heat tapes for the length of time specified in the table below. The table shows the MAXIMUM length of time to heat the tank(s) based on the GREATER of fuel temperature or air temperature.

WARNING! DANGER!
The electric power cord on the heat tape must NOT pass under the tank belt (between the tank belt and the tank). Improper routing of the heat tape may cause damage to the insulation resulting in a fire or electric shock hazard, which could cause injury or death.

MAXIMUM TIME TO RUN HEAT TAPES:

Maximum of Fuel Temperature or Expected Air Temperature (^{O}F)	Maximum Duration of Heating (Hrs.)
60	1/2
50	3/4
40	1
30	1 1/2
20	2
10	2 1/2
0	3
less than 0	3

4) Connect the timer to a power outlet rated for the total load of the tapes you are connecting (Most electric circuits are designed for a maximum of at least 1800 watts total electrical load). If it is necessary to use an extension cord, it must be rated for the total electrical load of the tapes you are connecting 168 watts (black & orange tape) or 180 watts (blue tapes) times the number of heat tapes connected to the cord.

5) At the time that the heaters should be shut off, personally disconnect the electric power. **DO NOT** rely on the timer to function correctly. The purpose of the timer is to assure that the tapes are shut off if you for any reason are unable to disconnect them yourself.

WARNING! DANGER!
Tanks must always be kept in a position which keeps the excess pressure relief valve inlet in VAPOR. Assure that the tanks are upright (valves up) during heating and use.

6.39 ALLOWABLE DAMAGE

GENERAL:

The following specific conditions do NOT make the balloon un-airworthy. Although operation of the balloon is allowed, it is best to repair these conditions at the earliest convenient opportunity, preferably no later than the time of the next Annual/100-hour inspection.

Consult Cameron Balloons if questions arise on the airworthiness or legality of a repair, installation or equipment damage.

A) THE PIEZOELECTRIC IGNITOR(S):

May be inoperable.

B) MAIN BURNER JETS:

Four jets per burner coil may be missing, but should be replaced as soon as possible (owner/operator can replace jets).

C) FUEL HOSES:

May have small cracks or abrasion marks in exterior rubber covering, provided the braided steel reinforcement inside cover is not exposed.

NOTE:
CAMERON BALLOONS U.S. REQUIRES FUEL HOSES TO BE REPLACED AFTER 10 YEARS IN SERVICE.

D) TANK JACKETS:

May be torn or damaged.

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SECTION 7

BASKET AND SUSPENSION SYSTEM

7.1 GENERAL DESCRIPTION

Cameron Balloons US offers three different basket styles and in many sizes. The first style is the simple flexible suspension system basket (an older design English-built). The second basket design is the series of baskets using the FlexiRigid™ burner support system. The third design, the partitioned basket, also uses the FlexiRigid™ burner system and is for larger passenger loads. In the logbook, flight manual and on the basket identification plate, the part number is followed by an Issue letter and the last digit indicates the basket size. For example; CB301C-4 is the part number for an Aristocrat 42x58 basket. See Appendix J for solid floor baskets.

The baskets incorporating the FlexiRigid™ burner support system differ from the flexible suspension baskets in the placement of the suspension cables and the addition of retaining tubes woven into the baskets to support the FlexiRigid™ poles.

The partitioned baskets are constructed with a rigid frame around the top edge and incorporate woven partitions to divide the basket into passenger compartments and pilot/fuel compartment.

NOTE:
Unless specified, repair methods described herein are common to all basket styles listed above.

7.2 BASKET SKIDS

Skids are made of Maple, Red Oak or Ash. Maple is the current production standard and the preferred repair/replacement skid material. Pre-drilled and custom fit skids are available from Cameron Balloons US for every basket. The three approved woods may be used interchangeably and are easily purchased from local suppliers. The old skid should be used as a pattern to properly construct a replacement skid. A strip of nylon or UHMW plastic of 1/2" maximum thickness may be added to the bottom edge of each skid. Stainless steel screws inserted in countersunk holes are recommended for installation.

A broken skid must be replaced unless the break is outside the outermost bolt. If the break is at or inside the outermost bolt, the skid must be replaced. Refer to Section 2.6, *Preventive Maintenance* and Section 7.12, *Allowable Damage* for additional damage limits.

The skid can be removed by slightly grinding the nut and bolt, which is countersunk into the inner skid. The nut and bolt has been center punched or peened, in order to lock the nut in place. After the locking burr is ground off, remove the nut in the normal manner using a socket wrench.

Both inside and outside skids are countersunk. The outside skid is countersunk to slightly indent the head of the bolt. If this outside skid countersinking is not done, the entire head of the bolt will be worn off, especially when the basket is moved on an abrasive surface such as concrete. The inside skid is countersunk to prevent the nuts and bolts from coming in contact with either the fuel tanks or the occupants in the basket. If the bolts are allowed to contact the tanks, **a gouge will occur which could render the tank unairworthy**. When replacing a skid that has exposed a bolt, carefully inspect the bottom of the tank for dents and scratches.

The removed skid should be used as a pattern for its replacement, including the angle of cut at the ends and the location of the bolt holes.

Always use new bolts, washers and nuts. Any minor cosmetic damage done to inside skids when grinding off excess bolt length may be repaired by sanding.

Replacement skids are best acquired from Cameron Balloons US and can normally be shipped the same day as ordered. Have ready the basket part number when ordering a replacement skid. Acquiring the skid material locally and fabricating the skids in the field will generally be more expensive and of lower quality than if acquired from Cameron Balloons.

7.3 BOTTOM SCUFF TRIM

The bottom edge of most Cameron baskets are fitted with either tanned leather or rawhide. Older English built baskets usually have rawhide. All baskets built by Cameron Balloons US incorporate tanned leather or TuffStuff™, a polymer plastic coating. The purpose of the scuff trim is to protect the lower edge weave (curve weave) from abrasion. The position of the leather or rawhide should be to provide as much coverage and protection to the bottom edge heavy curve weave as possible.

Scuff leather is a 10 inch wide strip of dyed 9-10 oz. latigo leather or 7 inch wide limed rawhide. The installation techniques described here are the same for rawhide and leather, except that leather should be soaked for about 5 minutes in lukewarm water and rawhide should be soaked for several hours. In the following description, unless otherwise noted, "leather" refers to either rawhide or tanned leather.

The scuff leather is attached to the basket by a lacing method. The old method uses leather lacing to install both the side pieces and corner pieces. The current method uses 1/8" polyester line, dyed to match the leather color, to attach the side pieces. The corner pieces are laced to the side pieces with tanned leather lace. Sport baskets, which are a variation of the Aristocrat basket, do not have corner pieces. The Sport basket skuff leather sides are laced directly to each other with leather lace.

The leather is NOT pre-punched. Punching must be done one hole at a time as the leather is installed. This method is used to align the holes with the spaces between rattan uprights in the basket.

The leather should be installed along the top edge first.

A) SCUFF LEATHER TOP EDGE LACING:

Begin just under the lowest layer of colored weave (on Sport and newer Aristocrat baskets) or one row below the rope handles (on older Aristocrat baskets).

Punch the lacing holes in the leather about 3/8" from the outer edge. The 3/8" at the edge of the leather will prevent the lacing from tearing out after the leather has dried. The 3/8" will also enable you to tuck the edge of the leather into the weave (use a tool such as a dull screwdriver). The leather is not tucked into the weave on the bottom edge.

1) Tie one end of the polyester lace around an upright or horizontal curve weave on the side near the junction of the corner and side.

2) Place the leather piece on the basket with approximately 2-3" (6" on Sport models) extra leather extending towards the corner. Support both ends of the leather piece with spring clamps around the rope handles.

3) Punch the first hole directly above the tie off.

4) Insert the lace through the hole from the back side of the leather, up and through the space between the two uprights directly above the hole and into the basket. The lace must pass between the dyed weave row and highest curve weave row.

5) Guide the lace around the inner side of the upright and pull the lace through the adjacent upright space. The lace must pass between the dyed weave row and highest curve weave row.

6) Punch the next hole half way between the next two adjacent uprights. Insert the lace through the hole from the back side of the leather, up and through the space between the two uprights directly above the hole and into the basket. The lace must pass between the dyed weave row and highest curve weave row. Pull the lace tight. Tuck the leather edge between the row of curve weave.

7) Repeat steps (4) through (6) until the side top is complete.

8) This method is suitable for the end top as well.

B) SCUFF LEATHER BOTTOM EDGE LACING:

Pull the leather down as far as the it will go, usually about 3 inches onto the floor of the basket.

The lace follows a specific route to prevent abrasion damage to the lace and to stretch the leather tightly against the wicker.

The longer sides of the basket require a different route than the shorter ends.

1) LONG SIDE BOTTOM EDGE:

a) Tie one end of the polyester lace around a piece of horizontal curve weave near the junction of the basket corner and side, approximately 1/2" above the lower edge of leather.

b) Pass the lace into the basket.

c) Punch the first hole directly below the tie off and between two floor broomsticks.

d) Pull the lace through the curve weave at a spot directly behind the hole. Insert the lace through the hole from the back side of the leather.

e) Guide the lace down to and through the space between the closest rows of floor weave that will not be covered when the leather is stretched tight. This is usually the first row below the leather edge.

f) Punch the next hole between the next two adjacent floor broomsticks.

g) Route the lace over the adjacent floor broomstick and out through the floor at the same level as step (e). Pull the lace through floor weave and hole simultaneously.

h) Guide the lace through the same space as it was pulled from and repeat steps (e) through (h) as necessary to complete the side lower edge.

2) SHORT SIDE BOTTOM EDGE:

a) Tie one end of the polyester lace around a piece of horizontal curve weave near the junction of the basket corner and side, approximately 1/2" above the lower edge of leather.

b) Pass the lace into the basket.

c) Punch the first hole directly below the tie off.

d) Pull the lace through the curve weave at a spot directly behind the hole. Insert the lace through the hole from the back side of the leather.

e) Guide the lace down to and through the floor weave and into the crevice created by the two end floor broomsticks.

f) Guide the lace along the crevice for about two inches and then out between the floor weave.

g) Punch the next hole in the leather directly above the spot where the lace exited the floor weave.

h) Insert the lace into the new hole from the back side and pull tight.

i) Pepeat steps e through h.

These attachment methods leave almost no exposed lacing on the bottom of the basket. The existing lacing can **and should** be studied as an example.

3) CORNER PIECES - ARISTOCRAT BASKETS:

The corners are installed **after** the adjoining side and end pieces have been installed.

a) The corner piece is centered between the rope handles and laced on along the top through the inner three punched holes first.

b) Use the corner piece as a guide. Trim the edges of the side and end pieces to match the curve of the corner piece plus yield a 1/4" gap.

c) The seam between the long piece and the corner piece is laced like a shoe. Leather lace is used in this application rather than the polyester lace used elsewhere. Start from the bottom edge and lace towards the top.

4) CORNER - STANDARD OR SPORT BASKETS:

The leather on the Standard or Sport basket (some have been delivered with TuffStuff™) is installed without the corner piece. The side and end pieces simply butt together to form a seam at the corner.

a) Locate the third vertical upright from the aluminum "U" tube. This is where the butt-seam is always aligned.

b) Cut the end piece along the line created by the third upright.

c) Use the first cut as the pattern to cut the side piece. Cut this second piece approximately two inches at a time, leaving a 1/4" gap between the two leather pieces.

d) Punch holes and lace as you proceed. In order to avoid a pucker it will be necessary to widen the gap into an "hour glass" shape as you near the center of the curve.

e) End with an odd number of holes, usually 19 or 21, and finish lacing with a square knot. Leave a 1/4" to 3/8" tail.

7.4 TUFFSTUFF™ (PLASTIC COATING)

Some Standard or Sport basket bottom edges are coated with TuffStuff™, a polymer plastic material, in lieu of scuff leather. The plastic used for TuffStuff™ includes a polymer plastic and a catalyst. If this coating is damaged, contact Cameron Balloons US for repair information.

7.5 VERTICAL WICKER REPAIR

Broken vertical rattan pieces ("uprights") (one to two contiguous with three on each side of the broken ones unbroken) may be repaired and reinforced with 3/8" nylon rod (B040) (no other material is acceptable). The rod should extend six inches above and below the damaged area.

A) REPAIR WITH NYLON ROD:

1) Sharpen the rod slightly on one end to ease installation.
2) Spray the rod and the repair area with silicone lubricant.

3) Insert the rod 6 inches or more above the damaged area and drive the rod along the broken vertical member until it reaches the desired location and both ends are inside the weave.

If an excessive amount of vertical uprights (more than two contiguous and less than three on each side of the broken ones unbroken) are damaged **or** the damage is done in such a way that reinforcement with nylon rod is not acceptable, such as at the basket bottom curve, belt holes and step holes, vertical uprights **MUST** be removed and replaced.

B) REPAIR BY REPLACMENT:

1) Remove the top bolster in the area above the damaged uprights.

2) Remove the stainless steel Bandit™ clamps as necessary.

3) Pull the vertical upright out with a vise grip type tool and hammer. This method is aided by the use of silicon spray lubricant.

4) Drive a new piece of the correct size rattan in place, this method is aided by the use of silicone spray.

5) Install NEW Bandit™ clamps. The Bandit™ installation tool is available for loan from Cameron Balloons U.S.

6) Replace the top bolster.

Baskets with serial numbers of 8800 and greater have additional large vertical uprights (18-20mm) at the tank belt locations. These tank supports are necessary for the added stress imposed by the 15 and 20 gallon fuel tanks. Because these pieces do not extend into the floor or top bolster, they may be removed by separating the rope and small weave and pulling with a vice grip type tool. The new upright is installed much the same as the nylon rod.

7.6 HORIZONTAL WEAVE REPAIR

Sections of horizontal weave may be replaced with rattan of a similar size.

Cameron Balloons US baskets are made primarily of a "natural" rattan (i.e. one that does **not** have its natural outer skin removed). Small quantities of stripped rattan ("round reed") are used for accenting stripes. The stripped rattan is easily dyed using common Rit™ dye. The stripped rattan is more brittle and is not as strong as the natural rattan (with natural cover) and should not replace the natural rattan in repair work.

Older English-made baskets have sections woven of willow rather than rattan. Willow has a distinct reddish color and tends to flatten when woven, especially around basket openings such as the steps and belt holes. As used in these baskets, the willow must be woven before it dries after harvesting, and there is no source of willow suitable for balloon baskets in the United States. It is acceptable to replace damaged willow weave with rattan of a similar size.

When replacing horizontal weave it is important that the new woven piece be at least 12" long, plus ends that are bent and tucked down into the weave to hold the piece in place. Pieces shorter than 12" will not span enough vertical members to remain properly positioned in use.

Beginning and ending a splice should be done in the same manner as the rest of the basket in question. In the Aristocrat style basket the ends of horizontal weave are turned down. In the Standard or Sport basket the ends are overlapped for two vertical upright lengths.

7.7 TOP BOLSTER PATCHING

Repairs may be made to the top bolster (suede, smooth leather or cordura) by cementing a patch with contact cement on the underside of the damaged area (Goodyear's Pliobond™ contact cement works especially well for this). In the case of a tear it should be possible to bring the edges together. The reinforcement piece placed under the bolster material should extend at least 1/2" beyond the damaged area in all directions.

Suede may be rejuvenated with the use of commercially available suede brushes and suede stones. It is our experience that dry cleaning solvents and soaps should be avoided as they remove the oil in the suede, discoloring and hardening it. Shoe polish, mink and neat's-foot oil type treatments work well on **smooth** leather. Cordura can be washed with a mild soap solution, rinsed with clear, hot water and allowed to dry before covering.

7.8 BENT AND BROKEN U-TUBE

U-tubes are nonstructural. Their design function is to support the flexi-pole which in turn supports the burner. Cracked or broken U-tubes may or may not have to be repaired as outlined in Section 7.8 A. The only procedures that **MUST** be taken are:

1) **Insure** that in **NO WAY** would this break or crack jepordize the safety of the occupants of the basket.

2) Remove any sharp edges from the break or crack by filing, grinding or removing the broken area totally.

A) BROKEN U-TUBES:

In the unlikely event of a basket U-tube breaking, it may be repaired. The repair requires unweaving a section of the basket around the break and internally sleeving and welding the broken tube.

1) Remove basket weave for approximately four inches on either side of the break.

2) Insert a close-fitting aluminum sleeve at the break point.

3) Weld the break using a welding technique appropriate to aluminum (Heliarc or MIG welding should be used).

4) Re-weave the area to original specifications.

It is also permissible to cut the crack or break out of the U-tube. This will leave an open gap in the U-tube. When this method is used, all edges of the remaining U-tube sections must be smoothed and in NO WAY be a harzard to the occupants.

B) BENT U-TUBES:

The U-tubes can become bent in very hard landings, especially if the landing point is on a corner of the basket. Unwanted bends can occur in two locations: a straight section of the "U" tube can become bent, or the corner bends can become bent to an angle of other than the correct 90 degrees (right angle).

1) BENDS IN STRAIGHT SECTIONS:

Repair bends in sections which should be straight (vertical side sections or horizontal bottom section) by using a small hydraulic jack as follows.

a) Lay a straight edge along the "U" tube locate the point of greatest bend.

b) Construct a steel cable with loops on each end (Nicopress sleeves or cable clamps are suitable for forming loops in the ends). The cable attaches to the U-tube and spans from one side of the bent area to the other. This will normally mean spanning the entire width of the basket side or bottom.

c) Place the jack against the "U" tube at the center of the bend and under the formed cable. Use shims to protect the rattan at the point where the jack contacts the basket and make sure that the cable passes squarely across the extended centerline of the jack's hydraulic cylinder (failing to do this the jacking force will cause the jack to twist out of position).

d) Pump the jack against the cable and the "U" tube, applying pressure in one direction at the bend and in the opposite direction at the ends of the cable. It is usually necessary to slightly over-bend the tube in the opposite direction of the original bend, since the aluminum tube will flex back slightly when the jacking pressure is released.

2) BENDS IN CORNERS:

To correct the angle of a "U" tube corner bend which has been bent **outward**, a length of strong non-stretch rope and a pry bar or piece of strong wood are useful.

a) Sight along the basket sides and ends to confirm that this is the situation. A carpenter's square against the floor and the outside of the basket is useful if the basket is resting on a flat floor.

b) Tie the rope through the weave and around the "U" tube near its top, run it diagonally to and around the corner bend of the "U" tube at the opposite side of the basket and securely tie the two ends of the rope to each other.

c) Place the pry bar or piece of wood between the two parts of the rope. Carefully twist the rope with the pry bar, thus shortening the rope and applying an inward bending force The top of the "U" tube will be drawn in toward the opposite side. It may be necessary to do this at both ends of the basket (both "U" tubes).

WARNING! DANGER!
Tremendous energy is stored in the twisted rope -- the rope and pry bar both must be very strong and you must be careful not to lose your grip on the pry bar. The pry bar may spin violently backwards and seriously injure you.

To correct the angle of a "U" tube corner bend which has been bent **inward** does not lend itself to the above technique. In this case, force must be applied at the same points as in the above case, except it must be applied in the opposite direction. Occasionally it is adequate for a person to brace their back against the inside top of the "U" tube which must be bent outward, place their feet at the inside of the corner bend on the opposite side of the basket, and push hard.

Failing this, a standard hydraulic jack can be rigged to apply the necessary force at these points. Note that the corner bend may need to be overcorrected in order to relax to the correct 90 degree angle when the force is removed.

7.9 REPLACEMENT OF BASKET CABLES

The stainless steel cable (B006) woven through the basket may be spliced or replaced. Replacement is the preferred repair.

CAUTION:
Before starting this process, contact Cameron Balloons US for information on swaging. The necessary tools **MUST** be borrowed from Cameron Balloons US on a loan basis and the proper parts purchased.

A) CABLE REPLACEMENT:

1) Remove the two wire rope clamps attached to the cable. These clamps are found in the floor.

2) Remove the stainless steel Bandit™ clamps at the "U" tube curves.

3) Cut off one end of the cable just below its thimble and swaged compression sleeve.

4) Weld a 24 foot length of new 6mm stainless steel cable (B006) end-to-end with the cable to be replaced.

5) Place heavy weight (sand bags etc.) inside the basket near the corner where the cable will be pulled from.

6) Pull the old cable with an overhead hoist or block and tackle, this in turn will pull the new cable, until the mid-point of the new cable is in the center of the basket floor.

7) Install new wire rope clamps around the cables and stainless steel Bandit™ clamps around the "U" tubes.

8) Install new vinyl cable covering

9) Cut, thimble and swage the cables to the correct length.

7.10 ROPE AT TOP AND BOTTOM OF BASKET

The rope used for the internal passenger handholds and external carrying handles is a 3/4" polypropylene which, for aesthetic reasons, has been colored and finished to have the appearance of natural Manila rope (B045).

The woven rope handles are constructed with three individual strands twisted together. The area between handles is comprised of two strands. The two strand weave runs completely around the basket and only in the actual handle is the third strand incorporated.

A) SPLICING THE TWO STRAND WEAVE:

1) Start at least two vertical uprights from the nearest handle, farther away from the break if possible. Allow six inches of extra rope at the start of the splice (this will later be fused to the existing rope).

2) Separate the coiled three strands into three separate pieces.

3) Use two strands to reconstruct the existing pattern of rope weave. This is best done with two people, one inside and one outside the basket, to facilitate feeding the rope back and forth into and out of the basket between the uprights and through the weave.

7.11 FORMING A HANDLE

A handle is formed by introducing the third strand of rope at the point where the handle extends from the basket wall.

A) FORMING A ROPE HANDLE:

1) Begin with the two rope weave on the inside of the basket so the melted splice is not visible from the outside. It is also preferable to start the weave behind a tank location.

2) The two strand weave rope will be joined by the third independent strand to form the handle. The two strands of the two strand rope weave exit the basket interior and are separated by the handle-edge upright.

3) The third strand is now introduced. Begin at a point approximately six inches from the end of the independent third rope strand.

4) Twist the independent third strand into the first two strands until the length needed for the handle is attained (in production this is 15 twists of three strand).

5) One of the original two strands enters the basket interior through the space between the second and third upright from the original handle starting point, while the second rope strand remains on the exterior..

6) The third rope strand should have a tail about six inches long remaining and "sticking up" after one of the original two rope strands have re-entered the basket. The two original rope strands will continue around the basket.

7) The two 6 inch end pieces of the third rope strand can now be woven in and out of the uprights between the new handle ends to fill that area.

a) Stretch loosely the 6 inch piece of the third rope strand protruding from the handle starting point upright, along the inside of the basket to the handle ending point upright. Twist the rope handle at the ending point in such a fashion as to loosen the rope around the upright. Insert the remainder of the 6 inch piece of the third strand down and through the hole made from twisting the handle and adjacent to the upright.

b) Guide the 6 inch piece of the third rope strand protruding from the ending point upright between the ending point upright and its inner adjacent handle upright, on top of, behind and under the other third strand of rope. Apply a gentle sawing motion to center the intersection between the two uprights. Use care to prevent the rope from untwisting while cinching up the two strands.

c) Repeat step (b) for the two remaining gaps between the handle end points.

d) Twist the rope handle at original beginning point in such a fashion as to loosen the rope around the upright. Insert the remainder of the 6 inch piece of the third strand down and through the hole made from twisting the handle and adjacent to the upright.

The difference between original handle construction and repair construction is the manner in which the third strand ends are tucked into the basket. The third strand ends of the original handle ends are guided up and taped to the wicker uprights at the ends of the handles. For repairs, the ends are tucked into the adjacent two-strand weave and the ends are melted into place to prevent dislocation or fraying.

7.12 ALLOWABLE DAMAGE

GENERAL:

The following specific conditions do NOT make the balloon un-airworthy. Although operation of the balloon is allowed, it is best to repair these conditions at the earliest convenient opportunity, preferably no later than the time of the next Annual/100-hour inspection.

Consult Cameron Balloons if questions arise on the airworthiness or legality of a repair, installation or equipment damage.

A) SKIDS (WOVEN FLOOR ONLY):

A single basket skid may be cracked: (1) if all parts of the crack are within 1/2" from an outside surface **and,** on an inside basket skid, no sharp point is created by the crack where an occupant could come into contact with it or (2) if the crack does not extend lengthwise from the end of the skid to one of the endmost skid bolts.

B) BOTTOM SCUFF LEATHER:

Outside bottom edge scuff leather damage is permitted regardless of extent.

C) TOP BOLSTER:

Top bolster damage is permitted as long as the protective closed cell foam on the basket top edge remains firmly held in place.

D) FLOOR WEAVE:

Heavy floor weave and weave on the bottom curve can be abraded, but no more than one quarter of the thickness of the rattan can be missing.

E) UPRIGHTS:

One or two contiguous uprights may be broken (one break per upright), provided the next three uprights on both sides are not broken. The broken uprights **MUST** be repaired or replaced at the next annual/100 Hour Inspection. Broken uprights at the edge or directly below the step hole and uprights at the belt holes or belt pass throughs **MUST** be repaired before further operation.

F) BELT HOLE UPRIGHTS:

If an upright on which the tank belts bear is broken at any point, the upright **MUST** be repaired. If an upright directly adjacent to a belt hole is broken, it **MUST** be repaired.

G) HORIZONTAL WEAVE:

Broken horizontal weave which does not permit an object larger than 3/4 inch in diameter to pass through the broken section is permitted.

H) BASKET SUSPENSION CABLES:

Basket suspension cables are made up of 6mm stainless steel 6x19 wire. Up to 38 total individual wire strands may be broken in the thimble area (beyond the ferrule) on any single suspension cable. Up to 19 total individual wire strands may be broken on one single basket suspension cable in any location other than the thimble area.

Damaged wire strands in the thimble area should be trimmed of any sharp protruding ends and the area covered with an epoxy cement to protect against the danger of snagging persons or other parts of the balloon. Damaged wire strands in other areas of the cable should be covered with heat shrink tubing or several layers of electrical tape to afford the same protection.

I) SUSPENSION CABLE PLASTIC TUBING COVER:

Un-repaired damage is not permitted. If damaged, the damaged section of the protective vinyl basket cable covering must be wrapped with at least 1/16" thickness of **electrical** tape to at least 1" beyond the damaged area in each direction.

J) U-TUBES:

Any damage to the U-tubes is permitted as long as the damage could not injure an occupant of the basket.

K) PARTITIONED BASKET TOP FRAME & VERTICAL METAL INFRASTRUCTURE:

Slight to moderate bends are permitted to the top frame & vertical metal infrastructure as long as all bends are smooth and there are no cracks, creases or kinks present.

Cracked or broken metal, nylon or rattan infrastructure that could injure basket occupants MUST be repaired before the next flight.

SECTION 8

INSTRUMENTS

NOTE:
Calibration of any function other than envelope or ambient temperature can be done only by an FAA repair facility with an AVIONICS rating or by Blue Sky Avionics LLC.

In 1992 the Ball Model M55 instrument was introduced. It is the standard instrument on all Cameron balloon models. The Ball Model M59 and M53 were introduced as optional equipment in 1997. The Ball Model 665 instrument was the standard instrument delivered with Cameron Balloons U.S. balloons from May 1984 until 1992. Previous to that time, a combination of standard sensitive altimeter, mechanical variometer, Ball electric variometer, Weston dial hanging thermometer and Telemax Thermistor electric envelope temperature gauge were used.

8.1 BALL MODEL 655

DESCRIPTION: See Appendix L

This instrument combines a variometer, a digital altimeter and a digital pyrometer into one housing. Power is derived from two 9V batteries, one battery being for back-up. The case is conduction plastic. The pyrometer cable has an outer shield which is connected to the case. For normal use alkaline or lithium 9V batteries are highly recommended for longer life. If operated below 0° F, then rechargeable Ni-cad batteries should be used. Alkaline batteries last about 20 hours, lithium 30-40 hours and the Ni-cads about 7 hours per charge. Operating current is 15mA.

The variometer has two gains, 600 and 1500 FPM. The upper left switch selects either gain. The power switch up position uses battery 1 and the down position uses battery 2. When first turned on, the variometer will peg and return to zero in about 10 seconds.

The altimeter reads from about 2000 feet below sea level to 19,999 feet above in 1 foot increments. To set the altimeter, turn the upper right switch to ”BAR” and set the barometric pressure on the liquid crystal altimeter. Set the switch on ”ALT” to read the altitude. The ”SET” knob adjusts the barometer or altitude reading. One can also set the altimeter to read zero at takeoff altitude. Above about 2500 feet the “SET” knob adjustment may reach its limit.

The pyrometer reads envelope temperature with a sensor located at the top end of the long Teflon™ insulated cable. An ambient sensor is on a short cable. Pushing the “AMB” button will read out ambient temperature. The sensor cable has a disconnect at the instrument and above the burners.

The instrument will operate from -40 F° to + 360 F° with reasonable accuracy. Below 0° F Ni-cad batteries should be used. When the battery in use falls below 6.5 volts a ”LO BAT” sign will appear on the altimeter window. Switch to a fresh battery if this occurs.

Other than replacement of batteries and cleaning of circuit board contacts, repairs by anyone not holding an avionics rating is limited to the calibration of the envelope and ambient temperature readings. The procedure for accomplishing this is documented below. The procedures for calibrating the altimeter and VSI (variomerter) are for reference ONLY.

CALIBRATION PROCEDURES
BALL MODEL 655 VARIO/ALTIMETER/PYROMETER
See Appendix L for diagrams.
CALIBRATION METHODS:

The variometer is calibrated using the “GAIN” and ZERO” pots on the vario pc board. First set the meter on zero using the “Zero” pot. Then apply a climb pressure from a test bench connected to the .062 brass tube on the altitude transducer. Adjust the “GAIN: pot to calibrate the variometer.

The altimeter is calibrated using the “GAIN” and “SET” pots on the altimeter pc board. Connect a test bench altitude pressure to the transducer. Bring altitude to sea level and with the ”SET” pot on the front face, set the altitude reading to ”0000”. Now raise the test bench altitude to 10,000 feet. Adjust the gain pot on the altimeter pc board to read 10,000 on the altimeter. Check other altitudes if desired and fine tune the calibrations.

A convenient way of adjusting the barometer setting is against a well calibrated sensitive aircraft altimeter. Set the aircraft altimeter’s barometer dial on 29, 30 and 31 inches of mercury and record the corresponding three altimeter dial readings. The Model 655 barometer setting has a gain adjustment and a bias adjustment. The barometer gain is the pot on the vario pc board labeled ”BAR”. The bias adjustment is labeled ”REF”. On Model 655, set the altimeter to read the value for 29 inches barometer. Switch to ”BAR” and it should then read 2900. If not, turn the ”REF” pot until it reads 2900. Switch to ”ALT” and reset the altitude to the value for 31 inches. Back on “BAR” the Model 655 should read 3100. If not, turn the ”BAR” pot until it does. Repeat this procedure several times until adjusted.

NOTE:
The sensor cannot be immersed directly into water. It must be protected against wetness. A closed end copper tube is recommended to hold the sensor and prevent contact with the water/ice.

The pyrometer is adjusted by using ice water at 32 F° and boiling water at 212 F°. At elevations above sea level, the boiling temperature must be obtained from a steam table. At 5000 feet it is 202° F. A closed end copper tube is recommended to hold the temperature sensors and to prevent them from being water soaked. The ice vessel should have crushed ice with a small amount of water and the steam bath should have boiling water at least 8 inches deep. Insert both the envelope and the ambient temperature sensors, on the end of their cables, to the bottom of the copper tubes. It will require at least 30 minutes for the temperature to stabilize in either tube.

For a check of proper calibration, the pyrometer should read 32 F° in the ice water and 212 F° in the boiling water. Inside the Model 655 there are two adjustment pots for each sensor. The "O_E: and "G_E" adjust the zero and gain of the envelope sensor.

To calibrate a new sensor from scratch follow this procedure: When the sensor stabilizes in ice water, turn its zero pot until the pyrometer reads 000. Move the sensor to the boiling pot. When the reading stabilizes, set the gain pot until the reading is 212° - 32° or 180° F. Reset the zero pot to make the reading 212° F. This sensor is now calibrated. Repeat the same procedure for the ambient sensor using the "O_A" and "G_A" pots.

The two temperature sensors used are identical units. They are special transistors selected to have specified temperature characteristics (voltage drop versus current through them versus temperature). Although these sensors are specified to be within 4° F, our experience is that if a new sensor is installed, the pyrometer might be off by 10° to 15°. Therefore, when a new sensor is installed, the calibration should be done. When changing one sensor, it is possible to calibrate it against the remaining undisturbed sensor.

8.2 TROUBLESHOOTING BALL 655

First check the battery. If the "LO BAT" sign is off, the battery should normally be OK, provided the altimeter and the pyrometer have a reading.

If the altimeter is erratic, it often helps to unplug the altimeter pc board, clean its contacts, and reinstall it. The altimeter board may be removed with some force required. When installing the board, be sure that the "SET" knob spring latches into the "SET POT" slots. The variometer pc board may be removed by first taking off the two knobs holding it in. These collet type knobs have a snap cover which can be pried off with a fingernail or knife.

The variometer pc board holds the altitude transducer, the vario circuit and the pyrometer circuit. The battery power is stepped down to exactly 5 volts with a regulator. This 5 V is also split in half with a voltage follower with 2.5 volts used as the neutral reference for the variometer op-amps. Total current drawn is about 15 milliamps.

The altimeter itself is a 2 volt digital voltmeter which reads the altitude voltage from the altitude transducer, 4 volts at Sea Level and 2 volts at 20,000 feet. The pyrometer is a digital voltmeter with high gain to sense the millivolt signals from the temperature sensor. It's input is also 5 volts regulated.

When problems occur in the Ball 655 thermistor, it is helpful to isolate the problem by performing several analytical tests.

Attempt to isolate the problem part. For example, switch envelope and ambient sensors to see if the open circuit continues. If the open circuit is now on the opposite setting, it is a sensor problem rather than a wire, connector or instrument problem.

A common problem is poor contact or a broken connector at the base of the envelope. These connectors are frequently stepped on or improperly connected and disconnected by untrained crew. These connectors should be highly suspect in any open circuit problems.

Is the temperature reading a large negative number?

If yes, there is an open circuit somewhere in the basket or envelope wires or their connectors or sensors.

Does the negative number occur on both ambient and envelope settings?

If yes, the problem is likely the basket wiring harness to instrument pack connector.

If no, the problem is likely either the connector between the envelope wire and basket wire or the sensor to wire connector. Disconnect and reconnect the sensors and wire connectors several times. The connectors are silver plated and sometimes oxidation occurs in the connector. The oxidation prevents good electrical contact. If this does not solve the problem then the envelope and basket wire harness' should be checked with an ohm meter for continuity and repaired accordingly.

8.3 BALL MODEL M55 - M59 AND M53

Other than replacement of batteries, there is no field repair or maintenance, which may be performed on the Ball M55, M59 and M53 instruments. These instrument packages are microprocessor driven. All calibration is performed with the aid of a computer and specialized software. The instruments should be returned to Blue Sky Avionics LLC for any repairs or re-calibration required.

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The procedure outlined in Sec. 8.2, which is used to isolate the location of a problem, is applicable to the M55. The M55 indicates an open circuit as "-SEN" rather than a large negative temperature reading.

SECTION 9

ANNUAL/100 HOUR INSPECTION

9.1 FAR'S AND QUALIFICATIONS

NOTE:
In the United States, Federal Aviation Regulations require the inspection of certified aircraft (including balloons) annually. Regardless if the balloon is used to carry passengers or cargo for hire, the balloon must be inspected each 100 hours of operation or annually, whichever comes first. This inspection must be performed by persons appropriately rated by the FAA.

It is strongly advised that persons performing these inspections be familiar with hot air balloon construction and repair techniques. Specialized knowledge and tools are required for the proper inspection and repair of hot air balloon systems. Many persons qualified and certificated to inspect other types of aircraft may not have access to the special procedures, tools, and knowledge mandated by FAR 43.13 and should not perform inspections on Cameron hot air balloons.

9.2 INVALIDATING THE WARRANTY

IMPORTANT:
Factory installed Tempil labels **MUST NOT BE REMOVED** from the balloon. **Removal of factory installed temperature labels WILL INVALIDATE the balloon fabric warranty**.

9.3 GENERAL INSPECTION PROCEDURE

The inspection **MUST** include all items listed in the "INSPECTION CHECK LIST, ANNUAL/100 HOUR", Appendix B. **This checklist MUST be used for all Annual/100 hour inspections**. The inspector should ascertain that the aircraft log and all required documents are present before beginning the inspection.

The flight manual for the specific balloon (Flight Manual Section 6: Weight and Balance) includes a list of the equipment originally delivered with the balloon. This list includes part numbers, serial numbers and weights. The aircraft logbook for the balloon also lists the original components (including part numbers and serial numbers), which were delivered with the balloon. This group of components comprises the balloon. The aircraft logbook may also contain entries documenting removal and/or installation of components on this balloon. Verify that the equipment being inspected, the equipment listed in the log book, and the equipment listed in Section 6 of the Flight Manual for the balloon being inspected all agree. If you have not inspected all the components which are listed in the logbook or flight manual, you must note in the inspection entry which components listed have **not** been inspected. For example, an inspection which does not include all tanks listed is not complete, and the inspection entry in the log book must note specifically each tank listed in the logbook or flight manual that were missing from the balloon and not inspected.

9.4 DOCUMENTATION OF INSPECTION

NOTE:
Each annual/100 hour inspection **MUST** record **IN THE BALLOON LOG BOOK** the total time on the aircraft, the **MAXIMUM TEMPERATURE** indicated on the most recent temperature labels (parachute and envelope), the **MAXIMUM TEMPERATURE** on any temperature label, any **AIRWORTHINESS DIRECTIVES** that have been complied with during the inspection and any **REPAIRS, INSTALLATIONS or REPLACEMENTS MADE.**

Logbook entries reporting repairs, damage and tests should be made using the nomenclature listed in Section 5 of this manual. Section 6 should be consulted to ensure that the burner and fuel system of the balloon are of the approved manufacturer. Sections 4.28, 6.39 and 7.12 should be consulted to determine maximum allowable damage.

9.5 INSPECTION CHECK LIST REFERENCES

See Appendix M for a complete list of Inspection Check List References

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