FIREFLY BALLOONS 2010, Inc.

REPAIR AND MAINTENANCE MANUAL

INSTRUCTIONS FOR CONTINUED AIRWORTHINESS

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INSTRUCTIONS FOR CONTINUED AIRWORTHINESS

The Balloon Works & FireFly Balloons TCDS A14SO
Galaxy Balloons TCDS A10NM

REVISION 1.0

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LOG OF REVISIONS

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AMENDMENTS, CHANGES AND REVISIONS

The contents of this manual will be revised, corrected and updated periodically, as required. In general, when a revision is made a new page(s) will be issued and the obsolete page(s) discarded. The revision numeral designator will appear at the bottom of the page. A new LOG OF REVISIONS page will also be supplied at this time to replace the old one, which will be discarded. ICA changes will be made available via www.fireflyballoons.net and all owners on record will be notified via mail and/or e-mail of available changes.

NOTE: REVISED TEXT ON THE AFFECTED PAGE(S) INDICATED BY A VERTICAL BLACK LINE ALONG THE MARGIN. THE REVISION (1.0) OF THE MANUAL IS A MAJOR REFORMAT WITH MINOR UNIT AND GRAMMAR CORRECTIONS. THIS IS ALSO THE FIRST RELEASE OF A NUMERICAL REVISION. ALL PRIOR REVISIONS (A THRU N) ARE SUPERSEDED BY THIS RELEASE.

The following definitions apply to NOTES, *CAUTIONS* and WARNINGS found throughout this manual. With the different font, shades and border this manual may be printed in Black & White or Color.

NOTE: OFFERS INFORMATION OR INSTRUCTIONS OF SPECIAL INTEREST PERTAINING TO A PARTICULAR PROCEDURE OR CONDITION.

CAUTION: PROCEDURES OR TECHNIQUES, WHICH COULD RESULT IN DAMAGE TO EQUIPMENT IF NOT CAREFULLY FOLLOWED.

WARNING: PROCEDURES OR TECHNIQUES, WHICH COULD RESULT IN PERSONAL INJURY AND/OR LOSS OF LIFE IF NOT CAREFULLY FOLLOWED.

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1. INTRODUCTION

1.1. SCOPE AND APPLICABILITY OF THIS MANUAL

This manual includes maintenance, inspection and repair procedures as well as airworthiness standards for The Balloon Works, FireFly and Galaxy model manned hot air balloons manufactured under the authority of FAA Type Certificates A14SO (The Balloon Works and FireFly Balloons) and A10NM (Galaxy Balloons). This manual is written under the assumption that the user has available, adequate facilities and skills to perform balloon repairs and inspections and is NOT designed to teach basic skills of balloon repair. Inspection criteria and repair procedures in this manual are based on normal conditions and do not cover every possible scenario that may be encountered. For items not addressed in this manual, contact FireFly Balloons. The names FireFly Balloons, The Balloon Works and Galaxy Balloons are used synonymously throughout this manual. (See Section 2 for a comprehensive list of models covered.)

1.2 REQUIRED QUALIFICATIONS

The work described herein is to be completed in strict compliance with all applicable FAR's and be performed by repairmen or mechanics having adequate skill, facilities and knowledge to perform competent balloon repairs and meet FAA qualifications as outlined in FAR Part 145 and FAR Part 65.

Annual and 100 hour inspections may be accomplished by properly certificated repairman under the authority of an FAA certificated repair station rated for The Balloon Works, FireFly and/or Galaxy Balloons or may be accomplished by an Airframe and Powerplant Mechanic that holds an Inspection Authorization, and who is also qualified to inspect balloons.

Section 4 of this manual contains preventive maintenance tasks that may be undertaken by the owner/operator, in accordance with Appendix A of FAR Part 43.

1.3 REQUIRED DOCUMENTATION

The FAA requires repair stations to have available other documents, including (but not limited to) FAR Part 39, Part 43, Part 65, Part 145, Airworthiness Directives (AD) and Type Certificate Data Sheets (TCDS). Factory Service Letters and Bulletins and applicable Supplemental Type Certificates (STC) are also to be available.

Model specific operating limitations as well as instructions for operation, preflight, inflation, refueling and emergency procedures are found in the aircraft flight manual. The flight manual must be present during annual inspections and maintenance along with a valid airworthiness certificate, registration certificate and the aircraft logbook.

FireFly Balloons strongly recommends that a library of additional maintenance information be assembled. Good sources for this information are the Balloon Federation of America and regional newsletters but this shall not constitute automatic endorsement of any such material.

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2. TECHNICAL DESCRIPTION

2.1. GENERAL

The FireFly hot air balloon system is comprised of three major components; the envelope assembly, the carriage assembly and the burner assembly. Major components are easily separated from each other and therefore replaceable as assemblies, each identified by its own model and serial number. Fuel cylinders and flight instruments are minor components that are identified by serial number as well.

2.1.1 MODEL DESIGNATION

2.1.1.1 ENVELOPE

There are currently 28 type-certified FireFly models on Type Certificate Data Sheet (TCDS) A14SO. They are designated FireFly 5, 6, 6B, 6B-15, 7B, 7B-15, B7, C7B, C7, 7, 7-15, 8B, 8B-15, 8, 8CUBE, C8, 8-24, 9B-15, 9, 10, 11B, 11, 12B, BOTTLE, BOOT, JC-9B, 8B SPHERE, and TV-180 referring to the FAI size category of envelopes. Additionally, there are 11 type-certified Galaxy models on TCDS A10NM. They are designated Galaxy 7, 8, 9, 6, 7B, 8B, 9B, 10, 11, 11B, and 77. The model number of the system is the model number of the envelope. For example, a FireFly or Galaxy 7 balloon system has a size 7 envelope. The envelope bears the system serial number as well as the registration number ("N" number).

Some envelopes have appendages attached to them, appendages that are large enough to alter flight characteristics are authorized for use under a Supplemental Type Certificate held by FireFly Balloons.

ENVELOPE SIZE	VOLUME CUBIC FEET	MAX. DIAMETER FEET	ENV. HEIGHT FEET	MAX HEIGHT FEET	ENV WEIGHT POUNDS	SKIRT WEIGHT POUNDS		GROSS WEIGHT POUNDS	# OF GORES	42.5" FABRIC # OF PANELS		58" FABRIC # OF PANELS	
						NOMEX	FABRIC			90°	45°	90°	45°
5	42,000	50.0	40.0	56.0	130-140	20	12	900	12	-	-	-	8
6B-15	56,000	51.2	41.0	56	135-140	18	11	1200	12	-	-	12	9
6B	56,503	50.1	41.9	56.9	130-134	20	12	1050	12	16	13	12	9
6	56,503	50.1	41.9	56.9	130-134	20	12	1050	18	16	12	12	9
7B	64,979	52.1	44.2	59.2	137-142	20	12	1050	12	17	13	13	10
7B-15	65,000	53.8	42.4	57.4	153-182	20	12	1300	12	-	-	14	10
7	77,692	55.8	47.3	62.3	160-175	20	12	1660	18	19	14	14	10
7-15	77,000	57	47	62	163-193	20	12	1750	18	-	-	14	10
8B	91,818	58.9	50.3	65.3	175-197	20	12	1660	18	20	15	15	11
8B-15	90,000	60.4	48.2	63.2	183-215	20	12	1900	18	-	-	16	11
8-24	105,943	61.8	53.1	68.1	197-222	22	12	2020	24	21	16	16	12
8	104,740	64	52	67	212-242	22	12	2450	24	-	-	16	12
9B	120,000	66.5	55.1	70.1	259-284	22	12	2800	24	-	-	16	12
9	141,256	68	58.1	73.1	296-320	25	-	3285	36	-	-	17	13
10	180,000	74.4	65.2	80.2	396-405	28	-	3600	36	-	-	19	14
11B	210,000	78	68.7	83.7	400-455	28	-	3600	36	-	-	21	15
11	240,000	84.2	69.9	84.9	400-455	28	-	2940	36	-	-	22	16
12B	280,000	87.8	71.2	86.2	475-550	28	-	3940	36	-	-	23	17

Figure 2-1 *All numbers are approximate for reference only

2.1.1.2 CARRIAGE

There are currently 8 triangle carriages in production. They are designated as 3.9, 4.0, 4.5, 4.9, 5.0, s5.0, 5.9, and 6.0. This designation generally indicates the distance in feet from the center of a side to the opposite corner. There are also 6 rectangular carriages in production. They are designated as 4048, 4860, 6072, 6096, 60120, and 5468. This designation indicates the nominal dimensions in inches of the carriage length and width. See Figure 2-2 for carriage data. Some carriage model numbers contain the suffix "A1." The carriage models 3.9, 4.0, 4.5, 4.9, s5.0, and 5.0 are identical to the carriage models 3.9A1, 4.0A1, 4.5A1, 4.9A1, s5.0A1, and 5.0A1 respectively, and may be used interchangeably.

Additionally, some carriage models will come with either one burner or two burners depending on customer preference. These carriages containing the optional second burner are denoted with a "DB" suffix after the model number. These carriages are 4.9DB, s5.0DB, 5.0DB, and 4860DB. Some triangle carriages were equipped with a throttle valve on one of the panels, these models have a "T" suffix on the model number. Some triangle carriages were made with adjustable uprights, these are known as the Barnestormer models and have a "B" suffix on the model number. The 6072 model carriage can be made with or without a partition, the partitioned carriage has a "T" suffix on the model number and is called the 6072T.

There are also several carriages from other manufacturers which are approved for installation under FireFly Balloons Supplemental Type Certificates. For more information, contact FireFly Balloons.

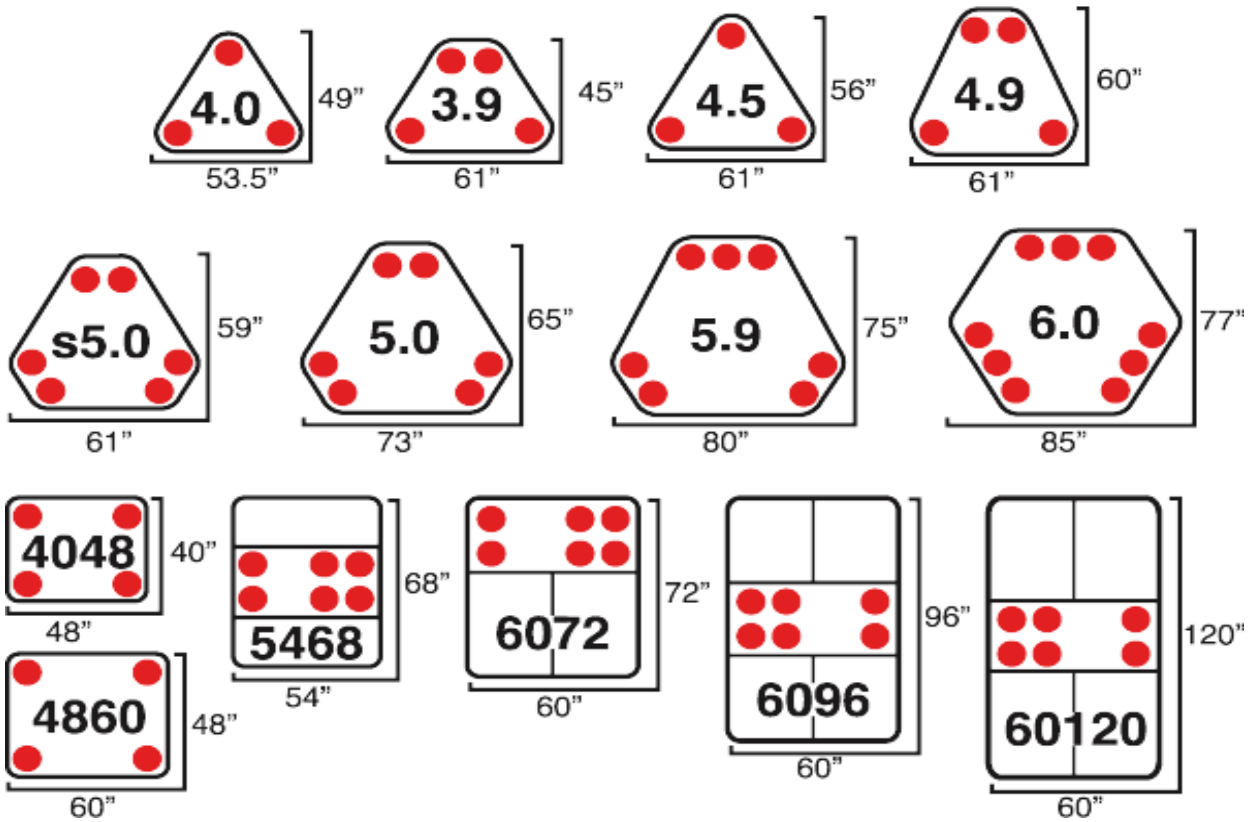


Figure 2-2

2.1.1.3 BURNER

There are two burners currently being manufactured and used by FireFly Balloons. They are designated the T3-017 and the F1 Mirage. Although all T3-017 burners are similar in appearance, the output was increased by an orifice change in August 1986 and by a blast valve change in January 1990.

2.1.2 SERIAL NUMBERS

The system serial number, the combination of envelope, carriage and burner, is assigned by the factory. It is etched on a 2 ¼" x ¾" (5.7 cm x 1.9 cm) metal identification plate which is attached to the top girdle of the envelope (on gore 1) in compliance with FAR Part 45 and contains identification data required by FAR Part 45.

- The envelope serial and model numbers are recorded in permanent ink on the top girdle near the identification plate.
- The carriage serial and model numbers are etched on a metal plate, fixed to the bottom of the floor on the tie plate. Some older carriages may only have the serial number burned into the bottom of the floor in lieu of a metal plate.
- The burner serial number and model number is engraved on the lip of the triangular bottom plate of the T3-017 burner or on the casting of the base plate of the F1 Mirage burner.

2.1.3 DIMENSION SYSTEM

Dimensions in factory drawings and references are typically given in SI (metric) units; however some dimensions are given in Standard English units. Both units of measure are referenced in this manual. In most instances, the unit associated with the measurement is provided with the alternate unit and appropriate conversion shown next in parentheses.

2.2 ENVELOPE

2.2.1 GENERAL

The FireFly envelope is of a modular design. That is, individually replaceable panels are connected together to form vertical balloon segments called gores. The envelope is formed by connecting all of these gores. A pocket is formed between the gores through which a load cord is fitted. The load cord is stitched top and bottom to high-strength webbings called girdles, which define the circumferences of the mouth and valve seat of the envelope.

Firefly balloon envelopes are made of coated polyester, coated nylon or coated lightweight nylon fabric.

Envelope panels have two parallel sides and two cut sides. Balloons built before 1981 are known as Non-FlexNet (standard) construction balloons, the panels are overlapped and sewn together. Non-FlexNet envelope gores are overlapped and sewn together to form the gore seam pocket. Most balloons built after 1981 are known as FlexNet construction balloons, fabric panels are not attached directly to each other. Between panels there is a strong but lightweight tape (panel tape), which can be installed either inside or outside the envelope, depending on customer preference. Fabric panels are overlapped on this tape to reduce air permeability. Between gores in a FlexNet envelope there is a fabric tape assembly called a gore seam. The gore seam consists of a pocket made by gore tapes and cover tapes through which the load cord is fitted.

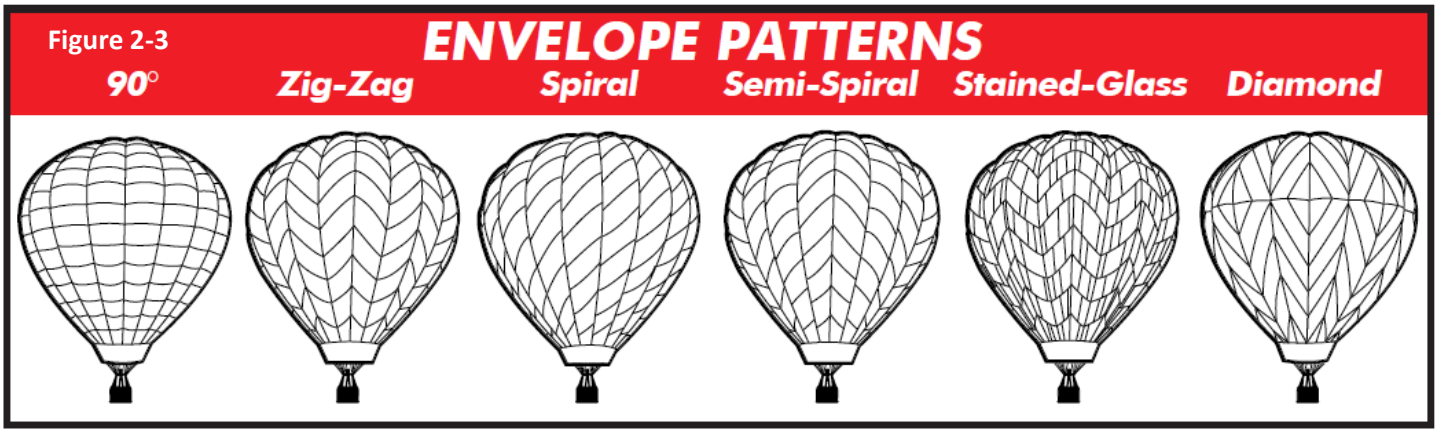
If a fully inflated balloon can be visualized with all of the fabric removed, the panel tapes and the gore seams form a netlike structure; hence the name FlexNet which is given to this method of construction.

A parachute deflation valve is installed at the top of the envelope. This re-sealable valve is actuated to allow hot air to escape for maneuvering and for envelope deflation.

2.2.2 PANEL DESIGN

Current envelope panels are cut from 58" (147.3 CM) wide fabric; however some older envelopes were manufactured using different width fabrics. The fabric is slit to this width by the fabric finisher, so there are no selvedges. All panels in the gore, except for the top and bottom panels are formed by making two straight, non-parallel cuts at either end. The panel is therefore trapezoidal in shape. All panel edges are straight. There are no curved panel edges.

Figure 2-3



2.2.3 GORE AND PANEL NUMBERING AND IDENTIFICATION

The gores on FireFly balloon envelopes are numbered from left to right as the observer faces the envelope. With the observer looking up from below the numbering increases in a clockwise direction; facing down from the top of the balloon the numbering increases in a counter-clockwise direction. The gore seam is numbered so that the seam on the right side (when viewed from the bottom looking up) carries the number. Panels are numbered from bottom to top with panel 1 at the bottom of the balloon, adjacent to the bottom girdle.

Gore numbers are marked on the top and bottom girdles in permanent ink, adjacent to the corresponding seam number.

2.2.4 ENVELOPE PRIMARY STRUCTURE

The envelope assembly consists of a chain of load bearing elements. This chain begins with the attachment of the suspension ropes at the bottom of the carriage and follows through to a ring at the top and center of the envelope crown.

Each element is designed to carry the full ultimate loads. The structural integrity of each element is extremely important since the weakest element in the chain determines the overall strength. This fact should be kept in mind when making inspections or repairs to any of these components.

Starting at the base of the envelope, the load-carrying components are as follows:

The envelope assembly is connected to the carriage assembly by three (or 4, depending on carriage) sets of suspension cables. Suspension cables can be made of 3/32” (2.4 mm) stainless steel cables (envelopes built up to 1986) or 3/16” (4.8 mm) polyester-sleeved Kevlar (Kevlon). Suspension cables are attached to wooden toggles which are reinforced with aluminum or steel rods through their centers. Each toggle has a groove around the center of it to accept the loops of the Kevlon or steel cables.

These cables run from the wooden toggles up to the bottom of the envelope and connect to the envelope in one of several ways (see Figure 5-8, 5-9 & 5-10):

- Steel cables with aluminum toggle to load tape webbing via slit in webbing
- Steel cables with aluminum toggle to polyester load cord loop
- Kevlon cable to load tape webbing with a shackle type assembly
- Kevlon cable to polyester load cord loop with D-shackle (Loop-to-loop interface) – *current production standard*

ENVELOPE

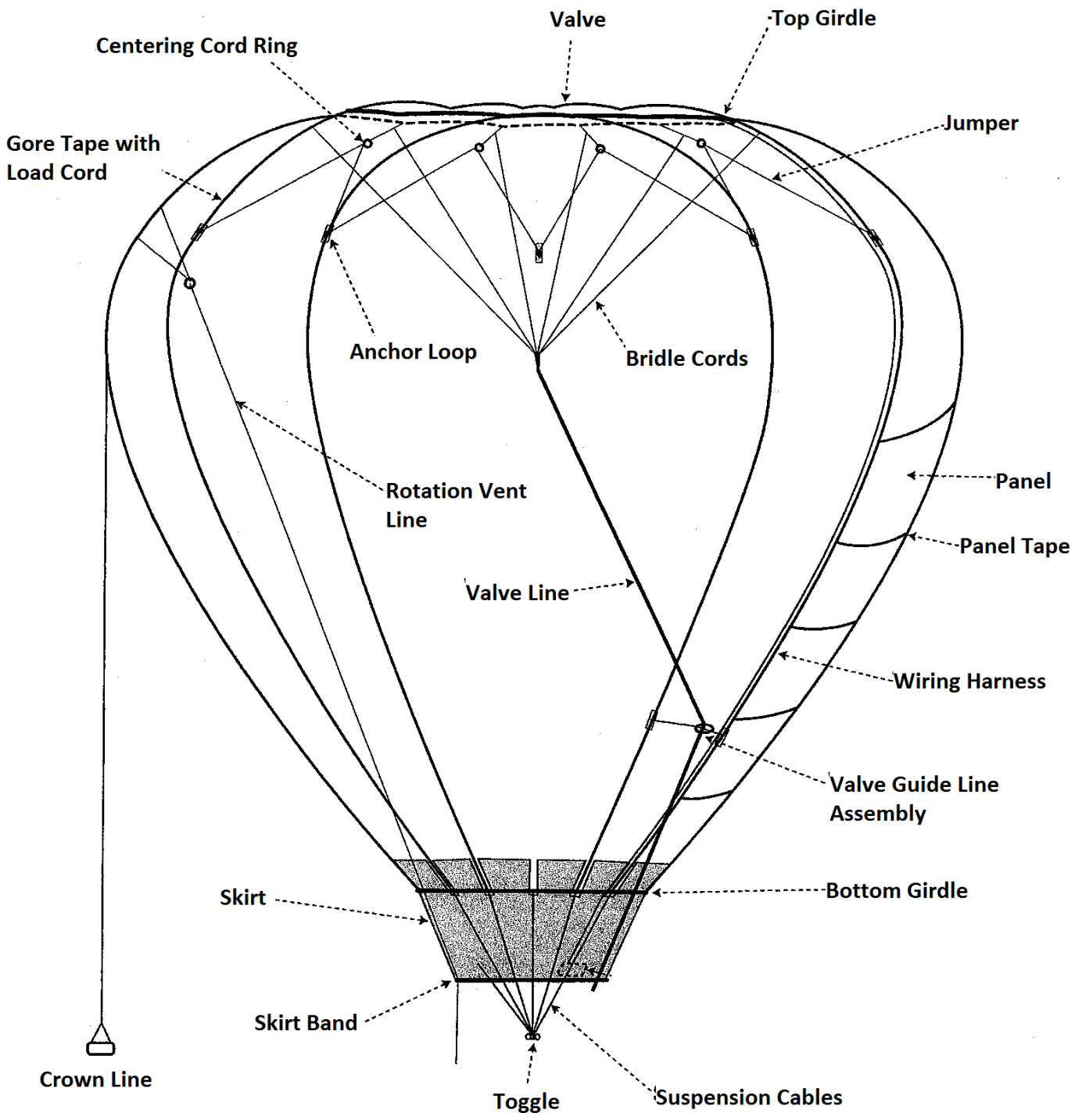


Figure 2-4

The polyester load cords are stitched to the bottom girdle above this interface. They run up the balloon through a gore seam pocket, which is constructed of tapes and across the top girdle webbing, to which they are stitched. The cords continue to the top center of the crown where they are connected to a forged steel ring (top tie ring) by an eye splice.

NOTE: LOAD CORDS ARE NOT FASTENED TO THE ENVELOPE FABRIC IN ANY WAY. THEY ARE AND MUST BE FREE TO SLIDE IN THE GORE SEAM POCKET, FROM THE BOTTOM GIRDLE TACK TO THE TOP GIRDLE TACK.

2.3 CARRIAGE

The carriage assembly consists of the carriage itself, all of the mounted fuel system components (except for the burner itself), instrumentation and accessories. See Figure 2-5.

The floor is constructed of 9 ply hardwood birch and related bracing. The frame is made of either rattan or glass fiber tubing. The sidewalls are of woven wicker. Partitioned carriages have a partition wall that is made of either plywood or woven wicker. A rope suspension system passes from its attachments beneath the floor, up through and vertically, to loops which are toggled to the envelope. The burner is mounted above the carriage utilizing a removable rigid burner support made of either rattan or a steel/fiberglass combination.

In the FireFly carriage, all major loads are carried by the suspension ropes, the floor assembly and the rattan/glass fiber tubing frame. The wicker sidewalls are not primary load carrying members.

The corners of the carriage are numbered for identification. A master fuel cylinder is mounted in the #1 corner, typically also labelled as #1 fuel cylinder. Looking down from the top and counting in a counterclockwise direction, the fuel cylinder numbers increase.

2.3.1 RATTAN FRAME CARRIAGE

The standard carriage frame is constructed of rattan structural members that are fastened together using bolts and nyloc nuts. Rattan is a natural solid fibrous material with all the fibers running parallel, it is light brown in color and has an irregular surface. The ends of rattan poles are solid and there may be loose fibers around the edges.

The floor assembly in this style carriage is laced to the frame using steel braided wire that is secured with a nicopress sleeve.

2.3.2 GLASS FIBER FRAME CARRIAGE

The FireFly glass fiber carriage is constructed of high tensile glass fiber members with composite joints. Glass members are hollow and tubular and either yellow with translucent resin coatings or another color. Large diameter tubing, which runs around the perimeter of the top and perimeter of the compartments at the top of the carriage, is filament wound and resin coated. The triangulated members that run from the top to the bottom rails and across the floor are made of pultruded glass. The bottom rail, which runs around the perimeter of the carriage, is also made of pultruded glass.

The top rails are joined together by large crosses or elbows. These fittings may be tapered or straight through and the tubing sections, which attach them, will have the mating configuration. At each joint, the tubing is secured by epoxy resin.

All other structural fittings in the carriage are composite and are also secured to the tubing with epoxy. Most of these fittings have two parts, which are bolted together for quick assembly/disassembly.

The carriage structure is secured to the floor by metal (rubber cushioned) straps. If compartment dividers are supplied, they are also secured to the structure this way.

CARRIAGE

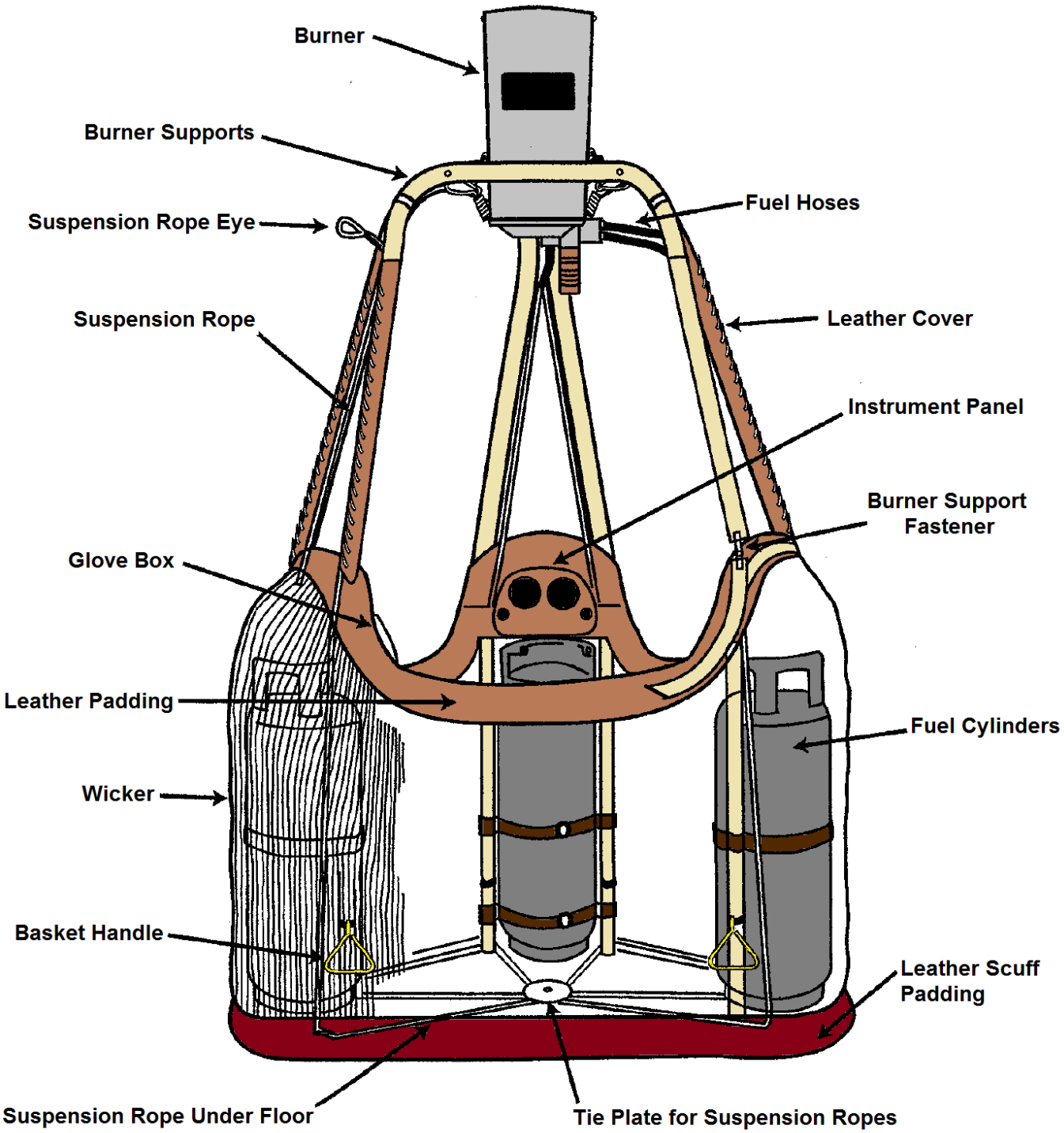


Figure 2-5

2.4 FUEL SYSTEM

2.4.1 FUEL CYLINDERS

FireFly Balloon systems are capable of using 10 (37.8) and 15 (56.8) gallon (liter) fuel cylinders that are either aluminum or steel. See Type Certificate Data Sheets A14SO and A10NM for more details on where these cylinders can and cannot be installed.

A master fuel cylinder has a pilot light regulator and Fire2 valve (if installed) mounted in it and is mounted in the #1 corner of the carriage.

All fuel cylinders have a pressure relief valve that is life limited to 10 years in service. DOT inspections must also be up kept on all fuel cylinders. See Service Bulletin B-24 for more information on these inspections.

2.4.2 FUEL HOSES

All fuel cylinders in a FireFly Balloon are connected together by a common manifold of hoses and steel fittings. Double burner systems have one manifold per burner with a crossover valve to tie the two systems together. Fuel hoses utilize POL fittings to attach them to the fuel cylinders

Fuel hoses are life limited parts and must be changed after 9 years in service. See Sections 3 and 5 of this manual as well as Service Bulletin B-24 for more information.

2.4.3 OTHER FUEL SYSTEM COMPONENTS

A pressure gauge is installed on each fuel manifold (mounted in the carriage corner panels) to show manifold pressure. Some 4.0A models may have the pressure gauge mounted to the corner pole on a metal bracket.
Fire2 is an auxiliary heater that gets its fuel directly from the master fuel tank. There is a valve on the master tank that is colored red, this is the Fire2 valve. It is not connected to the main fuel manifold in any way.

The pilot light system is separate system from the main fuel manifold. There is a shut off valve and pressure regulator mounted on the master tank to feed vapor to the pilot light system.

2.4.4 QUICK DISCONNECT REFUEL ADAPTER

The quick disconnect refuel adapter is an optional installation on all FireFly Balloons carriages. There are several quick disconnect refuel adapters authorized for use on FireFly Balloons. One style incorporates a quick disconnect fitting in the fuel system manifold located at a fuel cylinder fitting. The other style incorporates a quick disconnect fitting on the main fuel hose at the burner.

2.4.5 FIRE EXTINGUISHING SYSTEM

A fire extinguishing system is an optional system that may be installed. If installed, there will be a fire extinguishing bottle mounted in the carriage with plumbing that parallels the fuel system hoses. There are nozzles at each fuel cylinder and burner.

2.5 BURNER ASSEMBLIES

2.5.1 T3-017 (Figure 2-6)

The burner consists of three main jets fed through a common manifold, with three separate pilot lights. Liquid fuel from the main fuel line enters the system through a modified quick-acting toggle valve. The fuel flows through a pipe nipple into a hexagon-shaped manifold which feeds the three, intertwined inconel vaporizing coils. Vaporized fuel exits the coils vertically through 3 main jet orifices. After leaving the manifold there are three separate flow circuits, although the coils are intertwined there is no connection between them.

The pilot light operates on vapor, through a regulator at the master fuel cylinder. The vapor enters the burner through a ¼" (.64cm) flare fitting through the bottom plate and into a hexagonal-shaped manifold that is held in place between the trigger valve and the main fuel manifold. Three orifices are screwed into the manifold. In the inlet side of the orifice is a press-fitted, sintered metal filter, which prevents dirt from plugging the tiny orifice.

As propane vapor jets out of the orifice, it entrains air. This mixture begins to burn below the top of the pilot light tube and the flame exits the top. A rectangular metal block is press-fitted into the tube near the end to increase the resistance to flashback (burning at the orifice.)

The burner assembly is mounted to the burner support by spring/lever assemblies on its three corners. The springs allow the burner to be gimbaled in order to direct the flame during inflation or in flight.

The Fire2 backup burner is a liquid propane nozzle mounted on the base plate of the burner, which directs a jet of liquid propane upward. After it exits the orifice it partially vaporizes and then, mixing with air, it burns. The burner may or may not have a fast acting toggle valve for the Fire2 system located on the burner.

An aspirator tube is installed in the burner with the bottom end aligning in a divot on the bottom plate to aid in removing condensation build up in the burner.

2.5.2 F1 MIRAGE (Figure 2-6)

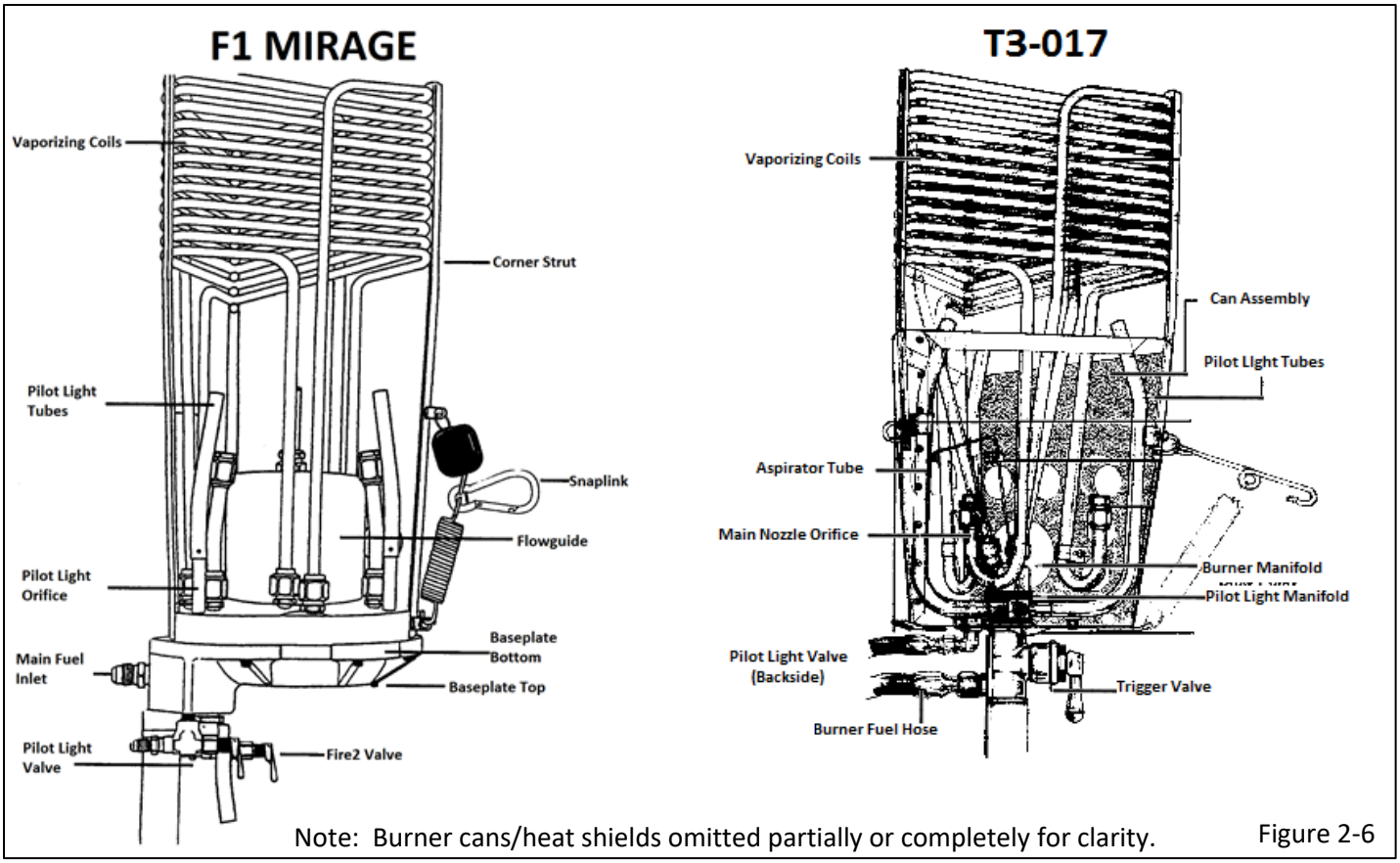
The F1 Mirage burner is quite different from the previous T3-017 burner. All fuel for the pilot lights, Fire2 and main burner is routed to the respective points through four separate (not connected) channels machined between two cast alloy plates which form the base of the burner. The main fuel supply enters through the bonnet assembly, is directed to the three intertwined inconel vaporizing coils and then flows back into the base for delivery to the flow-guide. The pilot light vapor enters the baseplate through a switch valve, is directed through its channel and exits through the top of the plate into the pilot light orifices and tubes. Fire2 fuel enters the baseplate through a trigger valve assembly. It is directed through its channel and out the top of the plate through 3 orifices.

The two cast alloy plates are very carefully fitted together and torqued in place. There are no replaceable parts and no service which can be performed on the plates in the field. It is imperative that no attempt is ever made to open this assembly in the field, FireFly Balloons/Triangle Balloon Services CRS# 6T8R838B are the only authorized facilities to service burner plates.

There are heat shields installed around the coils on each side of the burner, older burner assemblies have separate upper and lower heat shields while newer assemblies have one heat shield per side.

The burner assembly is mounted to the burner support by spring/link assemblies on its three corners. The springs allow the burner to be gimbaled in order to direct the flame during inflation or in flight.

An aspirator tube is fitted into the flow-guide opening of this burner. It has 3 to 4 tubes to aid in removing condensation buildup on the base plate.



Note: Burner cans/heat shields omitted partially or completely for clarity.

Figure 2-6

2.6 INSTRUMENTS

FireFly Balloon systems are certified with and must contain an operable altimeter, rate of climb indicator and envelope temperature indicator. There are several makes and models that are approved for installation in FireFly Balloon systems. See Appendix B of this manual.

2.7 INFLATION INSTRUCTIONS

Inflation instructions, as well as pre-flight procedures, can be found in “Section 3 – Normal Procedures” of each Balloon Works, FireFly and Galaxy model hot air balloon flight manual.

2.8 BALLOON STORAGE

FireFly Hot Air Balloon systems may be stored indefinitely; however, care must be taken to prevent damage to components during storage. The components should be stored in a dry environment that is free of pests, preferably climate controlled. Ensure the envelope is completely dry prior to storage. Cover the carriage. Elevate the envelope bag and carriage so that air is free to circulate underneath. Store fuel cylinders full of propane to prevent corrosion. Remove and store instruments in a safe, dry place. Cap or plug open fuel lines and place burner in its storage bag to prevent bugs from inhabiting and clogging any openings. Ensure the system has been thoroughly inspected and tested prior to first flight after extended storage. Periodically inflate the balloon, if possible, to help prevent the fabric coating from breaking down due to extended storage.

Burner supports should be installed on the carriage, inverted inside the carriage or the legs should be tied with string to prevent them from becoming distorted and affecting proper fit after storage.

Try to avoid strapping the carriage down with straps across the side bows as this can distort the sides of the carriage.

2.9 FLIGHT MANUAL SUPPLEMENTS

There are several flight manual supplements that must be present if applicable. The following is a partial list of the most common flight manual supplements. For any questions regarding flight manual supplements, contact FireFly Balloons.

- Tether Restraint Harness
- F1 Burner
- Valve Line Pulley
- Rotation Vent
- DT21, Ball 655, M55 & E1B Temperature Gauges
- QD Refuel System
- 15 Gallon (56.8 liter) Fuel Cylinders
- 10 Gallon (37.8 Liter) Steel Fuel Cylinders
- JY Taylor Fuel Cylinder Gauges
- STC's for Carriages not listed on TCDS A14SO and A10NM

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3. AIRWORTHINESS LIMITATIONS

3.1 GENERAL

The Airworthiness Limitations Section is FAA approved and specifies maintenance required under 14 CFR §§ 43.16 and 91.403 of the Federal Aviation Regulations.

The inspector, when approving a balloon for return to service after an annual/100 hour inspection, is assuming responsibility for the complete system. They are certifying that the aircraft meets all applicable FAA regulations and directives and all applicable manufacturers' standards, this includes the airworthiness of all prior repair work. This is an important point, particularly if repairs have been made without proper documentation and entries in the aircraft records. It may be difficult to determine the methods and materials used for the repair and the identity and qualifications of the person making the repair. If the inspector finds that prior repairs were not made in a legal and safe manner, the repairs must be redone.

3.2 MANDATORY REPLACEMENT ITEMS

Mandatory replacement items are components that require replacement after a specified length of time. The Balloon Works, FireFly Balloons and Galaxy Balloons have the following life limited parts:

1. Fuel hoses require replacement after 9 years in service (See Service Bulletin B-24).
2. Fuel cylinder pressure relief valves require replacement after 10 years in service (See Service Bulletin B-24).
3. "O" rings on REGO Valves model 7553 require replacement annually (See AD 75-12-08, Service Bulletin B-2 and TCDS A14SO and A10NM).

Replacement parts must be obtained from FireFly Balloons or the holder of an appropriate Parts Manufacturer Approval (PMA).

3.3 INSPECTION INTERVAL

The inspection interval for The Balloon Works, FireFly and Galaxy Balloons is 12 months or 100 hours of operation from last inspection, whichever occurs first.

3.4 INSPECTION PROCEDURE

Inspection procedures, as well as acceptance and rejection criteria, are found in Section 6 of this manual. A sample Annual/100 Hour Inspection checklist, which conforms to FAR Part 43, is included in Appendix A of this manual. Inspectors should use this as a guide when performing inspections.

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4. PREVENTIVE MAINTENANCE

This section contains preventive maintenance tasks that may be undertaken by the owner/operator, in accordance with FAR Part 43.

4.1 REPLACE CARRIAGE AND/OR BURNER ASSEMBLY

Most FireFly and Galaxy balloons may interchange carriages and/or burners under envelopes per TCDS A14SO and A10NM.

Balloon burner/carriage assemblies specifically designed for quick removal and installation from one envelope to another may be accomplished by the pilot/owner who holds at least a private pilot certificate. Appropriate entries must be made in the balloon records noting the removal and/or installation of burner/carriage assemblies.

This is the correct way to document these changes:

1. The pilot/owner who holds at least a private pilot certificate, repairman or certified mechanic makes a logbook entry as follows (or similarly worded statement):

   Removed carriage s/n _____ Date _____
   Carriage s/n _____ has been installed in this aircraft.
   Date _____ Total hours on this carriage are _____ Hrs.
   Last annual on this carriage was (date) _____
   Signed _____Pilot/Repairman#_____

   The removed carriage and/or burner must have records with the following information:

   Date Removed _____
   Removed from envelope s/n _____
   Total Hours _____ Last Annual (date) _____
   All AD Compliance records

   If burner is changed with the carriage, the same information must be entered for the burner. In FireFly balloons, the original (system) logbook always stays with the envelope.

2. If it is intended to change back and forth with a carriage and/or burner under different envelopes, the above logbook entries must be made in the envelope logbook and a new separate logbook must be kept for the carriage and burner.

   The new carriage and/or burner logbook must have a simple notation when envelopes are changed. Entries on total time (flight time and tether time), AD compliance, repairs and annual/100 hour inspections must be included.

3. In all cases, total time on each appliance must be tracked and logged if ever removed from their respective system configuration

4.2 REPLACE SKIRT ASSEMBLY

The skirt is attached to the envelope using rope ties or plastic 2-piece clips.

The #1 gore of the skirt typically has the FireFly logo attached and toggle storage loops sewn to the band. This panel lines up with the #1 gore of the envelope. Ensure suspension lines are properly routed through slots in skirt. If envelope is equipped with plastic clips, clip the 2 corresponding loops through the clip. If envelope is equipped with rope ties, route rope through 2 corresponding loops, tie a half hitch followed by an overhand knot.

4.3 REPLACE SKIRT STIFFENER/BAND

There are 2 styles of skirt bands used. The older style is a spring steel material, the newer style is a flexible plastic material. Both are inserted through the small triangular opening in the skirt band channel. Both are overlapped by at least 1 foot. The spring steel bands must be clamped together using 2 clamps. The plastic style overlaps and does not clamp together

4.4 REMOVE/INSTALL FUEL CYLINDERS

Fuel cylinders may be replaced at any time with serviceable Balloon Works, FireFly or Galaxy cylinders that have a current DOT certification. Ensure cylinder POL connections are tight and leak free. Ensure all 3 cylinder straps are cinched down tightly. 2 straps go across the front and 1 strap goes across the lip on top of the cylinder. Ensure fuel hoses are not rubbing on the cylinders or any other part of the carriage. Cylinders are serially controlled and a log book entry must be made when replacing fuel cylinders to ensure serial numbers match the logbook.

4.5 ADHESIVE BACKED PATCHES (STICKY PATCH)

For small repairs, adhesive-backed fabric patches may be used. **Only FireFly Balloons part #2312 adhesive-backed patches are FAA-approved for use in The Balloon Works, FireFly and Galaxy Balloons.** Repair tapes approved by other manufacturers ***must not*** be used. No other adhesive patch is approved for this use. It should be noted that some adhesives may be damaging to the coating and the fabric itself.

These patches can eliminate the necessity for a more costly sewn in repair if the damage being covered falls within certain parameters. Patches come in 3 types: 3" (7.6 cm) round, ½" (1.3 cm) linear and 1" (2.5 cm) linear. A maximum of 10 patches of either kind may be used manual in any one panel.

3" Round Patches:

- Must be at least 1 (2.5 cm) inch (edge to edge) from each other (they may not overlap).
- The edge must be at least ½" (1.3 cm) from any seam.
- May be placed over holes up to 1 ¼" (3.2 cm) in diameter and tears which are "L-shaped" and no greater than 1 ¼" (3.2 cm) by 1 ¼" (3.2 cm).

Linear Patches:

- ½" (1.3 cm) wide patches are used for gore seam abrasion repairs (not tears).
- 1" (2.5 cm) wide patches are used for tear repairs or gore seam abrasion repairs.
- 1" (2.5 cm)may overlap only at the corners of "L-shaped" tears if the legs of the tear are no more than 3" (7.6 cm) long.
- A linear gore seam abrasion patch may run parallel and adjacent to a seam with one edge of the patch touching the stitch line. All other linear patches must be at least ½" (1.3 cm) away from any seam.

Installation procedure:

1. Be sure that the tear or hole meets the limitations stated above.
2. Clean an area on the surface of the fabric around the hole or tear; it is recommended but not necessary that it be installed on the INSIDE of the balloon. A low detergent and water cleaning solution or alcohol cleaner (not mineral spirits) may be used but be exceptionally careful to ensure that there is sufficient ventilation to apply it safely.
3. Peel the backing from the patch and align its fibers with those of the envelope, firmly press and smooth it down.

4.6 FABRIC CLEANING

Fabric may be cleaned using a non-detergent soap such as Woolite and a soft cloth. Ensure the fabric is rinsed thoroughly and completely dried prior to repacking in the bag. Cold inflation/use of inflation fan can help speed up the drying process along with direct sunlight. Avoid hot inflation until after most of the water has evaporated from the envelope fabric. Failure to do so could cause super-heating of the fabric as the water boils and evaporates away.

4.7 FABRIC RE-COATING

If fabric coating has broken down or deteriorated (porous fabric) then it may be possible to recoat the fabric. First, a pull test of all colors must be accomplished in accordance with Section 6.2.3 of this manual and pulled to at least 50lbf (23N) without failure. Then fabric may be coated on the inside of the envelope using FireFly Balloons fabric coating part #2340.

4.8 CARRIAGE CLEANING/REFINSIHING

The carriage assembly may be cleaned using clear water. Ensure instruments have been removed from carriage as well as any paperwork or pouches that you do not wish to get wet. Lay carriage over and spray with garden hose inside and out. It may be necessary to use brushes to agitate heavily soiled areas and/or caked on dirt and debris. Avoid using high pressure water (i.e. pressure washer) as the force may break the wicker and lead to costly repairs. Allow to dry. Softly brush leather or suede with a soft bristle brush during drying to revitalize it. Regular cleaning and dressing of leather and suede will help prolong their life. Polyurethane varnish may be applied to wicker, uprights and floor assembly after cleaning and the carriage has dried.

4.9 REPLACE CARRIAGE POUCHES

Carriage pouches may be replaced at any time and may be installed anywhere the owner chooses. The only mandatory pouch is one that displays the airworthiness and registration certificates.

The factory installs all carriage pouches using leather lacing because it is aesthetically pleasing, however, owners may choose to install pouches using leather lacing, zip ties, or any kind of string they find suitable.

4.10 PILOT LIGHT CLEANING

After extended use, residue collecting in pilot light tubes may restrict the flow of air and/or propane vapor and cause the flame to be reduced in efficiency and strength. It may be possible to clean the pilot lights and restore them to full strength without disassembly.

1. First, check pilot light tube alignment with pilot light manifold (T3-017 only).
2. Attempt to clean pilots by blowing compressed air through the tube at the top then through the fitting several times. **-If this does not correct faulty pilot lights:**
3. Place the burner in the upright position. For T3-017 only, plug the 3 air inlet holes at bottom of can by placing masking tape over them or by other means.
4. Drip approximately 10 drops of solvent (FireFly Balloons Part #DSL) down each pilot light tube.
5. Allow the solvent to remain in the tube for 3 minutes and then unplug air holes (T3-017 only) and blow compressed air down the tubes (T3-017 and F1 Mirage).
6. Using cold water, wash out any residue containing solution from the bottom of the burner can. Do not allow water to enter pilot light tubes.
7. Invert the burner and allow to dry.
8. Connect vapor supply to burner and inspect pilot light flame.

WARNING: BECAUSE OF THE CAUSTIC NATURE OF THE SOLVENT, IT IS NECESSARY TO USE PROTECTION TO PREVENT CONTACT WITH EYES AND SKIN. IF CONTACT TO THE SKIN OR EYES OCCURS, FOLLOW MANUFACTURERS INSTRUCTIONS ON THE SOLVENT CONTAINER.

9. If pilot lights are still not restored to normal, the orifice must be replaced. This must be done by an appropriately rated repair station or mechanic in accordance with Section 5 of this manual.

4.11 REMOVE/INSTALL CROWN LINE

Crown lines are installed on the top tie ring between load ropes using a larks head type knot or bowline knot. Crown lines are installed between the following load ropes:

12 gore: 6 & 7
18 gore: 9 & 10
24 gore: 12 & 13
36 gore: 18 & 19 also 19 & 20

Should the crown line become wet or damp during use, it may be removed from the top tie ring and stored in a separate bag from the envelope.

4.12 FLIGHT INSTRUMENTS

Instrument panels are designed for quick removal and installation from carriage corner panels using 2 thumb screws. Instruments may be replaced in these panels provided a certified and serviceable instrument in installed. Instruments are serially controlled; proper log book entries MUST be made to reflect the removal and installation actions of individual instruments. See Appendix B of this manual for a list of approved instruments.

Instrument batteries may be changed as needed per manufacturers' instructions.

4.13 CARE OF VELCRO

Velcro installed on the balloon envelope has a tendency to pick up grass and other debris during use. Regular inspection and cleaning of Velcro is recommended to prolong its service life. Velcro may be cleaned by gently removing any debris from the hook side, take care not to damage the hooks during cleaning.

4.14 WICKER REPAIRS

Sections of wicker up to 10" (25.4 CM) at the widest point may be repaired or replaced using Section 5.3.6 of this manual. Sections larger than 10" (25.4 CM) must be repaired or replaced by a certificated mechanic.

4.15 LEATHER/SUEDE PADDING

Leather/suede padding along the top edge of the basket, on the burner support legs and/or on corner panels may be repaired or replaced as necessary. Lace the leather/suede to the carriage edge and burner support using leather lacing.

4.16 CARRIAGE HANDLES

Carriage handles may be replaced using the procedures in Section 5.3.8 of this manual

4.17 BURNER SUPPORT ATTACH FITTINGS

Lynch pins may be replaced provided the lug of the pin faces the interior of the carriage and the ring is installed below the free end of the pin. The ring must have a spring action when properly installed. Preferred method is to install lynch pins on the carriage square pins, not the burner support. See illustration in Figure 6-1 of this manual.

5. REPAIR OPERATIONS

5.1 GENERAL

CAUTION: IT IS ESSENTIAL THAT ALL REPAIRS BE MADE WITH APPROVED MATERIALS (FABRIC, THREAD, FLEXNET TAPES, ETC).

NOTE: REPAIR TASKS OUTLINED IN THIS SECTION ARE TO BE PERFORMED BY APPROPRIATELY RATED REPAIR STATIONS, CERTIFICATED REPAIRMEN OR AIRFRAME AND POWERPLANT MECHANICS WHO ARE QUALIFIED TO SERVICE HOT AIR BALLOONS.

The 'signing off' of an aircraft for return to service is a certification by the inspector that the aircraft meets all applicable FAA regulations and directives and all applicable manufacturers' standards for the maintenance performed.

The most important consideration regarding the repair of a balloon system or component is airworthiness. Other considerations such as repair cost, ease of repair, and cosmetics should be taken into account but the primary consideration must always be IS IT SAFE AND IS IT LEGAL?

5.1.1 MATERIAL SPECIFICATIONS

IT IS ESSENTIAL THAT ALL REPAIRS BE MADE WITH APPROVED MATERIALS. Parts and materials used to repair a FireFly Balloon systems must be acquired from FireFly Balloons or the holder of a Parts Manufacturer Approval (PMA). **If replacement parts or materials are not obtained from approved sources, an FAA Supplemental Type Certificate (STC) *must be held* or an FAA Form 337 *must be filed to create a legal repair*.**

NOTE: USE OF PARTS NOT SUPPLIED OR APPROVED BY FIREFLY BALLOONS WILL RENDER THE AIRCRAFT UN-AIRWORTHY AND VOID ANY WARRANTY REMAINING.

NOTE: IT IS PERMISSIBLE TO INSTALL NYLON REPLACEMENT PANELS AND PATCHES ON POLYESTER BALLOONS, AND VICE VERSA, AS LONG AS THE FABRIC USED IS APPROVED FOR INSTALLATION IN A FIREFLY BALLOON AND FABRIC WEAVE DIRECTION IS MAINTAINED.

5.1.2 SEWING SPECIFICATIONS

FireFly envelopes use several different stitch types. For repair work, it is always preferable to replace stitching by exactly duplicating original specifications. However, it is possible to use alternate stitching and have an airworthy, safe repair. Approved stitching is listed in Section 5.2 of this manual.

All threads used in FireFly balloon envelopes are bonded polyester. **Nylon and cotton thread are not approved and must not be used.** Two sizes of thread are used, #30 (white – minimum break strength 3 lb. (1.3 N)) and #16 (black – minimum break strength 10 lb. (4.5 N)). The skirt, when constructed of Nomex fabric, will also have Nomex thread in the stitching. This thread is #69 (green – minimum break strength 6 lbf (2.7 N))

Thread tensions should be adjusted equally with locks at or in needle holes. Neither needle nor bobbin thread should be loose. Maximum skips are 4 stitches in a 10 cm (3.93") length with no other skips from same or adjacent needle. All observed skips in excess must be re-sewn or over-sewn with same stitch overlapping at least 2 cm (0.79") on each side of skip. All observed skips in a straight chain not exceeding above standard and not repaired by sewing must be sealed by a drop of FireFly part #A2226-1 glue, or equal, applied to the looper threads opposite the directions of succession stitch formation. Material sewn should not be puckered across width of zig zag stitches.

5.1.2.1 STRAIGHT CHAIN STITCH

Federal Standard 751 stitch type 401 with 3 to 4 stitches per cm (6 to 11 stitches per inch).

Seam ends must be locked to prevent raveling. Usually this will be done with a cross seam. Where there is no cross seam, alternate methods must be used such as back sewing, cross-stitching, and/or gluing.

5.1.2.2 STRAIGHT LOCK STITCH

Federal Standard 751 stitch type 301 with 3 to 4 stitches per cm (6 to 11 stitches per inch).

5.1.2.3 GIRDLE STITCH

Federal Standard 751 stitch type 304 with a width of .4 to .7 cm (0.16” to 0.28”), length of .3 to .5 cm (0.12” to 0.2”) and 5 to 8 zig zags per inch with one stitch per throw.

5.1.2.4 REGULAR ZIG ZAG STITCH

Federal Standard 751 stitch type 308 with a width of .25 to .35 cm (0.1” to 0.14”), length of .4 to .8 cm (0.06” to 0.3”) and 4 to 6 zig zags per inch with one stitch per throw.

5.1.2.5 SECURE STITCH

Federal Standard 751 stitch type 304 with a width of .3 to .4 cm (0.12” to 0.16”), length of .1 to .2 cm (0.04” to 0.08”) and 13 to 25 zig zags per inch with one stitch per throw.

No skips are permitted in a secure stitch.

5.1.2.6 ARTWORK STITCH

Federal Standard 751 stitch type 308 with a width of .5 to .7 cm (0.2” to 0.28”), length of .7 to 1.0 cm (0.28” to 0.39”) and 2.5 to 3.5 zig zags per inch with 3 stitches per throw.

5.2 ENVELOPE

5.2.1 FABRIC REPAIRS

5.2.1.1 EQUIPMENT REQUIRED

For repair use, a 4 needle [¼” ½” ¼” (6.4, 12.8, 6.4 mm) spacing] chain stitch machine is recommended because removing needle(s) will give the required spacing for every chain-stitch in the envelope. A 2 needle [¼” (6.4 mm) spacing] or even a single needle machine can be used. These machines must be set up to reproduce the Federal Stitch Type 401 and 301 Specifications.

It is strongly recommended that the chain stitch machine be equipped with a mechanical puller. If a chain stitch machine is not available, a straight lock stitch machine may be used in accordance with operation to be performed.

Additionally, a medium-duty zig-zag machine is needed that is capable of handling #30 (light) and #16 (heavy) polyester threads as well as #69 Nomex thread. This machine is used for girdles, the valve top cap and load cord secure stitching, for which the machine foot must be capable for 3/8” (9.5 mm) lift. This machine must be set up to reproduce the Federal Stitch Type 304 and 308 Specifications.

5.2.1.2 FLEXNET CONSTRUCTION SEAM SPECIFICATIONS

Panel seams in factory construction are 4 rows of straight chain stitch in Section 5.1.2.1 of this manual with #30 polyester thread on FlexNet tape with a spacing of ¼" ½" ¼"(6.4, 12.8, 6.4 mm). The panels overlap each other but are not sewn together. The overlap is 0.6 cm +/- 0.4 cm (0.24" +/- 0.16").

The margin of the tape (distance from stitch line to the edge of tape) is 0.2 cm (0.08").

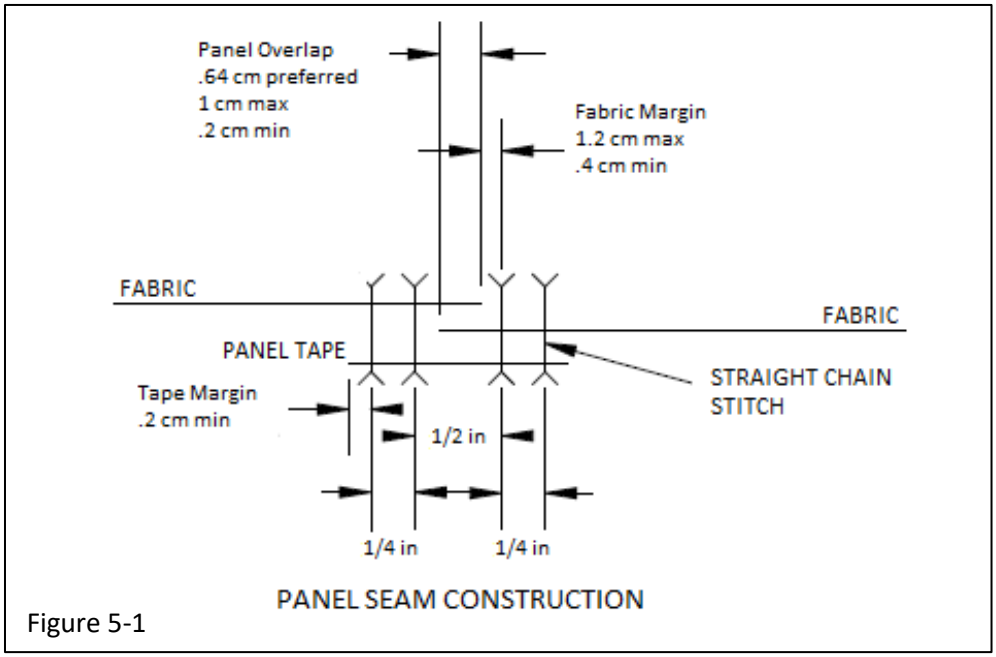


Figure 5-1

Gore seams in factory construction are 6 rows of straight chain stitch in Section 5.1.2.1 of this manual with #30 polyester thread and spacing of ¼" ½" ¾" ½" ¼" (6.4, 12.8, 19, 12.8, 6.4 mm)on a 3 inch(7.6 cm) gore tape (2 7/8" (7.3 cm) on older FlexNet). A 1 ¼" (3.2cm) cover tape (1 1/8" (2.8cm) on older FlexNet) is stitched to the center of the gore tape and forms a pocket in which the load cord is located. Panels are stitched to both sides of the gore tape where they are captured by 2 rows of stitching, with a margin of 0.9 cm +/- 0.3 cm (0.35"+/- 0.12").

The margin of the gore and panel tape (distance from stitch line to the edge of tape) is 0.2 cm (0.08"). The margin of the cover tape is 0.1 cm (0.04").

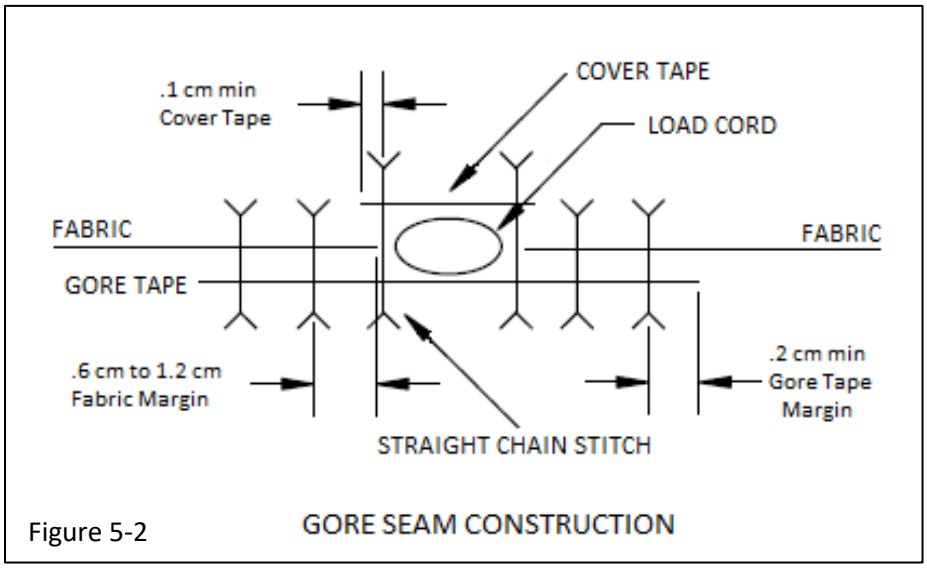


Figure 5-2

5.2.1.3 FLEXNET CONSTRUCTION PANEL REPLACEMENT

With FlexNet construction, replacement of an entire panel is the suggested method of damage repair. Patching of small tears is also recommended if the repair will be small enough to be cosmetically acceptable.

Removal of FlexNet panels is easily accomplished because the tapes form a semi-rigid frame. Using a seam ripper, separate the fabric from the panel and gore tapes, being careful to cut only the attaching threads. Completely remove the panel from the panel and gore tapes.

If possible, save the damaged panel to be used as a template for cutting the new panel if a factory precut panel is not available and uncut yardage is to be used. This may greatly ease the repair, as the fabric may have shrunken or stretched under load and/or high temperatures. A factory precut panel may not always be an exact fit due to these influences.

If the damage to the removed panel is too extensive, a panel may be fabricated using the 'hole' in the envelope as a template. Place the coated side of the fabric in or out and maintain fabric weave in the same direction as the original.

Once the new panel has been obtained, lay it in place on the topside of the gore and panel tapes, which have previously been stretched flat. Check once again for the necessary overlap. With the panel in place on all four sides, (where it will be when stitched into the balloon) place index marks on the tape and panel approximately every 50 cm (19.7"), to act as a stitching guide. Install the new panel using one of the following stitches from Section 5.1.2 of this manual: 2 rows of straight chain stitch (Section 5.1.2.1) or straight lock stitch Section (5.1.2.2) with ¼" (6.4 mm) spacing using #30 polyester thread while maintaining margins in Figures 5-1 and 5-2.

When stitching, remember to place the panel on the same side of the panel tape as it was originally (inside or outside). Gore tapes are always placed inside the balloon, with only the narrow cover tape visible.

5.2.1.4 PATCHING

Fabric may be patched at any location on the envelope, to include the envelope valve and skirt. Patches may be in any location on any panel and may be of any size or shape.

If a patch incorporates a panel edge, the panel edge must be removed from the gore seam, panel seam, or girdle then the patch installed and trimmed, then reinstalled on the gore seam, panel seam, or girdle. Panel seams are not to be sewn down to gore tapes.

A structural seam, one in which the fabric load is placed across it, may be made at any location or direction across the panel using the following stitches from Section 5.1.2 of this manual: artwork stitch (Section 5.1.2.6), 2 rows of straight chain (Section 5.1.2.1) or 2 rows of straight lock stitch (Section 5.1.2.2) using #30 polyester thread. When two rows of stitches are used, spacing at any point must be maintained at 0.5 to 0.7 cm (0.2" to 0.28"). A margin (distance from fabric edge to nearest row of stitches) of 0.9 cm (0.35") minimum must be maintained.

An inlaid patch is one in which the original fabric has been cut away from underneath the repair fabric. An overlaid patch is one in which the original fabric is still present and the repair fabric is laid over it. In either type patch, the repair fabric MUST be placed on the outside of the balloon. Previous manual revisions allowed inlaid patches to be installed on the inside of the balloon. While this is not the current approved method of patching, existing interior patches are acceptable provided margins and edge distances are within allowable tolerance.

Both styles of patches are made in the same way. First, an inspection is made to determine the area of damage. This is very important because damage may extend out farther than is evident. Burn damage may extend past the scorch marks and discoloration, as the overheated fabric adjacent to these areas may have greatly reduced strength. Areas with tears may have scrapes and abrasions nearby which could weaken the fabric although it does not have more holes in it.

Then, cut a piece of fabric which is large enough to cover the damaged area (remember the fabric margin) with weave aligned with the original fabric.

The easiest way to get a patch to lie flat and remain aligned is to sew around it completely before trimming away the damaged material. If the damage is due to a burn and there is severe wrinkling or buckling, it may be necessary to trim away some of the damaged material before sewing.

If a patch is to be placed over a clean straight tear with undamaged edges, it should be cut so that the normal fabric margin (distance from edge of fabric to the nearest row of stitches) of 0.9 cm (0.35") may be maintained on either side of the stitch line. Remember that there are two fabric edges, the one of the tear itself and the one of the patch.

For straight tears or small L-shaped tears, no further action may be necessary after sewing around the outer edge of the patch. For larger overlay or jagged patches, it is cosmetically nicer to sew down the edge of the tear to the patch fabric. Although this stitching is non-structural (the load is carried by the new stitching around the edge of the new fabric) the normal margin should be maintained.

If an inlaid patch is used, the fabric behind the patch should be trimmed away, leaving the normal margin between the fabric edge and the nearest row of stitches.

NOTE: WHEN TRIMMING FABRIC FROM BEHIND PATCHES, IT IS VITAL THAT THE CORNERS ARE TRIMMED CURVED; THERE SHOULD BE NO POINTED INTERSECTIONS OR TRANSITIONS.

5.2.1.5 NON-FLEXNET SEAM SPECIFICATIONS

Panel seams in Non-FlexNet construction envelopes are flat seams with 3 cm (1.18") overlap; sewn with 2 rows of straight chain stitch in Section 5.1.2.1 of this manual with ½" (12.8 mm) spacing and #30 polyester thread (same as Valve Seam construction in Figure 5-3). The margin (distance from the stitch line to the edge of the fabric) is 0.9 cm (0.35"). If the artwork stitch Section 5.1.2.6 is used for repair work, the seam overlap may be reduced to 2 cm (0.78") if necessary with a minimum margin of 0.5 cm (0.21").

Gore seams are created in the same way, the load cord channel is formed between the 2 stitch rows.

NOTE: THESE SPECIFICATIONS MUST BE MAINTAINED FOR AIRWORTHINESS

5.2.1.6 NON-FLEXNET PANEL REPLACEMENT

Panel replacement is the preferred method of repair if extensive damage has occurred. When replacing panels, the diagonal or horizontal panel edges should be sewn first followed by the vertical gore seams.

It is very important to remember that the new panel may not be the same size as the old one because of shrinkage or stretch. After removing all of the old stitching, check the dimensions of the new panels against the adjacent panels ON ALL 4 SIDES. Adjust the size of the new panel to achieve a good fit and place index marks all around the panel every 50 cm (19.7") to give you a reference as you sew. This reference is important as the fabric may gather and pucker almost imperceptibly as you sew.

When replacing the panel the coating should be on the same side as the original.

2 rows of the straight chain stitch in Section 5.1.2.1 of this manual with ½" (1.3 cm) spacing and #30 polyester thread are recommended for panel replacement. The straight lock stitch in Section 5.1.2.2 of this manual using #30 polyester thread is an acceptable alternate. The artwork stitch in Section 5.1.2.6 of this manual using #30 polyester thread may be used for diagonal or horizontal panel-to-panel seams within the gore.

CAUTION: DO NOT, UNDER ANY CIRCUMSTANCES, CAPTURE THE LOAD CORD WITH PANEL OR GORE SEAM STITCHING. THE LOAD CORD MUST BE FREE TO SLIDE IN THE GORE SEAM POCKET.

5.2.1.7 OVERLAP REPAIRS – NON-FLEXNET CONSTUCTION ENVELOPES AND ALL SKIRTS ONLY

An overlap repair is made by pulling the edges of a rip together, overlapping them and sewing. It can be done only with straight; clean-edge tears where all of the original fabric is present and structurally sound and the accumulated overlap repairs will not reduce any dimension of one panel by more than 5 cm (1.97") or the length of the gore by more than 10 cm (3.9").

To make this repair, trim all ravels and loose threads. Use only the artwork stitch in Section 5.1.2.6 of this manual with #30 polyester thread. Overlap the edges to make a flat seam 2-3 cm (0.78" – 1.2") wide. At the end of the tear, pleat the fabric for an additional 20 cm (7.9"), tapering to zero width and sew down to give a smooth transition which will not create stress concentrations.

CAUTION: DO NOT USE OVERLAP REPAIRS WITH FLEXNET CONSTRUCTION ENVELOPES AS THEY WILL RENDER THE ENVELOPE UN-AIRWORTHY.

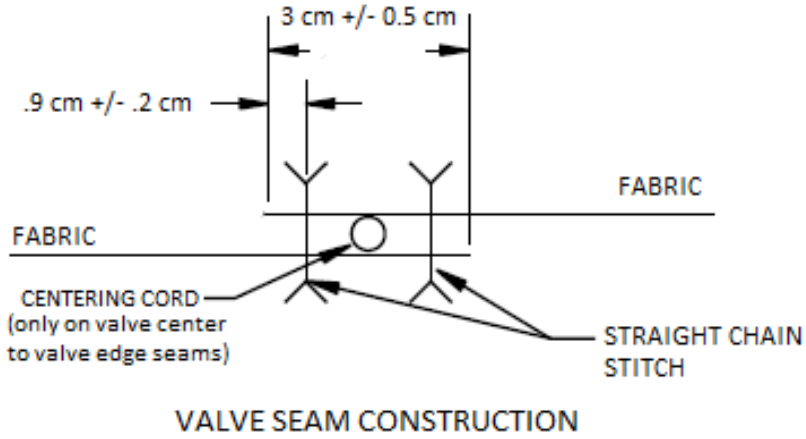
With FlexNet envelopes, any reduction on panel dimensions within the tape perimeter will create a localized stress point which could stretch and tear under load.

5.2.1.8 VALVE CONSTRUCTION

Valves are constructed using the straight chain stitch in Section 5.1.2.1 of this manual with #30 polyester thread and ½" (1.3 cm) spacing (see Figure 5-3). Nomex cord material is routed across the valve through a pocket created by the stitch spacing. These cords are secure stitched to the valve webbing which runs around the perimeter of the valve using the secure stitch in Section 5.1.2.5 of this manual and #16 polyester thread. These cords must not be stitched to the valve in any other places.

Velcro tab patches are sewn to the valve to position the valve during inflation. These tabs are sewn to a small piece of webbing which is in turn sewn to a small square piece of fabric that has been cut on the bias. This assembly reduces the load on the valve fabric when pulling it free of the Velcro inflation tabs after inflation. These Velcro tab patches are replaceable as whole assemblies. If only the Velcro piece is to be replaced, it must **not** be sewn directly to the valve fabric as this will place undue stress on the valve fabric. In this case, the patch may be taken loose from the valve, old Velcro *completely* removed, a new piece of **approved** Velcro installed and then the patch re-secured to the valve.

Velcro tab patches are installed using the artwork stitch in Section 5.1.2.6 of this manual with #30 polyester thread.



VALVE SEAM CONSTRUCTION

Figure 5-3

5.2.1.9 SKIRT CONSTRUCTION

Skirts may be constructed of polyester, nylon, nomex, fabric with Kynol lining, or nomex with polyester or nylon overlay. They are constructed using the straight chain stitch in Section 5.1.2.1 of this manual with ½" (1.3 cm) spacing and nomex thread for nomex skirts or polyester thread for fabric skirts (see Figure 5-4). A 3" (7.6 cm) pocket, skirt band channel, is sewn along the bottom of the skirt with the girdle stitch in Section 5.1.2.3 of this manual to accept a stiffener made of either spring steel or plastic.

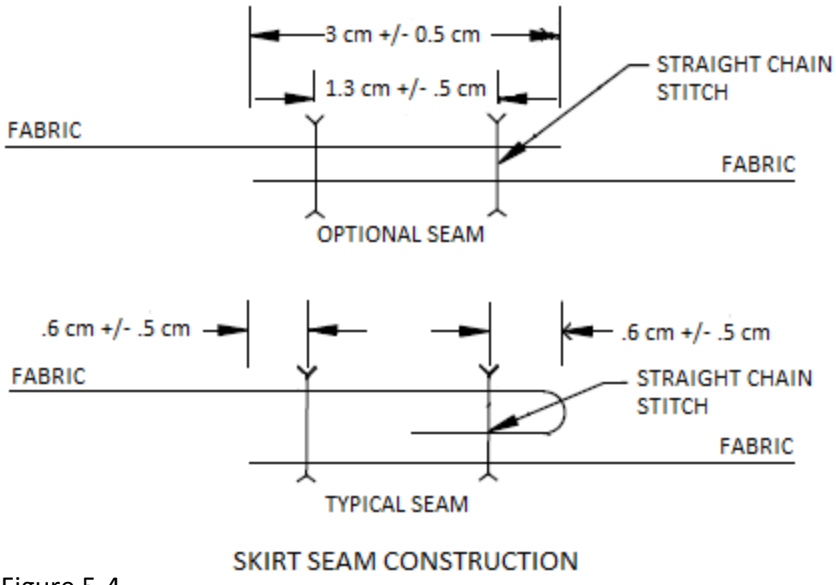


Figure 5-4

5.2.1.10 ROTATION VENTS

Envelopes may be fitted with rotation vents to rotate the balloon in a clockwise (CW) or counter-clockwise (CCW) direction. These vents are installed in panels on the sides of the envelope. Pull cords are routed from the vent through guide rings at the bottom of the envelope then into the carriage. Panel edges are reinforced with panel tapes. Should repairs (other than minor stitching repairs) to rotation vents be necessary, contact FireFly Balloons.

5.2.1.11 SPECIAL SHAPES AND APPENDAGES

Special shape balloons and balloons with appendages are all engineered differently. Should the need arise to repair a special shape balloon or an appendage (other than minor sewing repairs) contact FireFly Balloons.

5.2.1.12 ARTWORK BALLOONS

Some balloons will contain artwork; artwork can be either inlaid or overlaid depending on size, color and nature of the artwork. It can range from simple to very complex. All artwork is installed using the artwork stitch in Section 5.1.2.6 of this manual and #30 polyester thread. Repairs to these balloons should be done taking aesthetics into account. Where artwork crosses a gore seam, there may be a piece of stripping installed for a visually seamless effect. Stripping is sewn to the gore tape through the fabric panels with the girdle stitch in Section 5.1.2.3 of this manual and #30 polyester thread. Care must be taken to NOT include the load rope in any stitching.

5.2.2 WEBBING, FLEXNET TAPES AND ENVELOPE ATTACHMENTS

5.2.2.1 GIRDLES

The top and bottom fabric panels are sewn to the top and bottom girdles with the girdle stitch in Section 5.1.2.3 of this manual with #30 polyester thread. Girdles will be stitched over twice at intersections of gore tapes and anywhere that the girdle is spliced. 1" (2.5 cm) top and bottom girdles will have one row of stitching. 2" (5.1 cm) girdles (some newer construction balloons) will have 3 rows of stitching. A straight lock stitch in section 5.1.2.2 is not an approved stitch to attach fabric to any girdle; however, it may only be used to attach the sleeve that holds temperature wires.

The top girdle also contains Velcro inflation tabs to hold the valve in place during inflation. These tabs may need to be cleaned periodically to stay effective. If these tabs should need to be replaced, only approved Velcro must be used. The old piece should be removed from the girdle and the new one installed in the same location using the secure stitch in Section 5.1.2.5 of this manual with #16 polyester thread. Ensure that envelope fabric is not involved in the stitch.

5.2.2.2 VALVE ANCHORS

Valve anchor straps are sewn to gore tapes with single rows of the regular zig zag stitch in Section 5.1.2.4 of this manual with #30 polyester thread; back stitched both ends, on either side of the load cord. Some older balloons were manufactured using "X" style valve anchors, if questions arise regarding repairs to the "X" style valve anchors, contact FireFly Balloons.

5.2.2.3 SKIRT TIES

There are two types of skirt ties. These are rope ties and plastic 2-piece clips. The webbing backing material is the same in both cases; as is the method of attachment to the gore seam. The ties are sewn to the gore tapes with single rows of regular zig zag stitch in Section 5.1.2.4 of this manual with #30 polyester thread, back-stitched both ends, on either side of the load cord.

5.2.2.4 GUIDE RING ANCHORS

Guide ring anchors are sewn to gore tapes with single rows of regular zig zag stitch in Section 5.1.2.4 of this manual with #30 polyester thread, back-stitched both ends, on either side of the load cord.

Only 2 guide ring anchors are installed on an envelope. They are located 47.5cm (18'7") from the bottom girdle on the following gore seams:

12 gore: 6 & 7
18 gore: 9 & 10
24 gore: 12 & 13
36 gore: 18 & 19

5.2.2.5 ROTATION VENT PULL CORD RING ANCHORS

These anchors are sewn to the gore tapes with single rows of regular zig zag stitch in Section 5.1.2.4 of this manual with #30 polyester thread, back-stitched both ends, on either side of the load cord. They are located directly above the skirt ties on selected gores.

5.2.2.6 FLEXNET TAPES

In case of damage to FlexNet tapes, panel, gore, or load-cord cover, it is not necessary to replace the entire length. Repairing the tape is done by first removing the affected area, if shredded or abraded and covering with a new length of the same material obtained from FireFly Balloons. The new tape must cover the old by at least 15 cm (5.9") at either side of the replaced section. So, if a damaged area of 15 cm (5.9") were to be replaced, the new FlexNet tape would be a minimum or 45 cm (17.2") long.

In some older FlexNet envelopes, the load cords exit the gore tapes through 3/8" (9.5mm) diameter heat-formed holes, just above the bottom girdle. If repair of chafed holed or parted tapes is required, repair should include heat-cutting ¾" (1.9 cm) slits running up from the top and down from the bottom of each hole. Terminate each slit with a small heat-cut spot (or hole) to deter further splitting. Be **very careful** not to damage the load cord – use some form of shield while heat-slitting the gore tape. Repair parted or damaged tapes by sewing on overlaid tape patches. Tape patches should extend at least 15 cm (5.9") past the damage. Gore tape repairs terminating at a girdle will be a minimum of 15 cm (5.9") in length.

5.2.2.7 BANNER TIES AND VELCRO

Banner ties may be installed; they must be sewn to gore tapes only using the girdle stitch in Section 5.1.2.3 of this manual. **Do not** include the load rope or cover tape in the stitching.

Banner Velcro may be installed; it must be sewn to gore tapes and/or panel tapes using the girdle stitch in Section 5.1.2.3 of this manual with #30 polyester thread. Care must be taken **not** to include the load rope or cover tape in the stitching.

5.2.3 LOAD CORDS

WARNING: DAMAGED LOAD CORDS MAY NOT BE SPLICED!

If it is necessary to replace load cords, replacements must only come from FireFly Balloons as the indexing marks are placed on them under very specific tension. Use of any cord other than factory replacement renders the balloon un-airworthy and may be dangerous. Stretch in load cords may load the gore seams to the point where the gore tapes tear away from the bottom girdle and destroy lower panels.

New load cords may be pulled into place through the gore seam pockets by temporarily attaching them to the old ones and pulling them through. Remove and discard the old load cord.

5.2.3.1 FLEXNET LOAD CORDS

The intersection of the load cord and top and bottom girdle is made with the secure stitch in Section 5.1.2.5 of this manual with #16 polyester thread. When making this secure stitch, do not extend vertically above the edge of the girdle as this can cause premature wear of the gore tape. Some envelopes incorporate an optional tab that sandwiches the load cord between the tab and the top or bottom girdle for intersection strength. These tabs will have an additional 2 rows of secure stitch (Section 5.1.2.5) on either side of these tabs. Some older envelopes will have the load cord installed inside the girdle, this style will not use the girdle tabs.

NOTE: 36 GORE 4 POINT ENVELOPE LOAD CORDS ARE NOT SECURE STITCHED TO THE BOTTOM GIRDLE. THEY ARE ONLY SANDWICHED BETWEEN THE GIRDLE AND GIRDLE TABS. STITCHING THESE LOAD CORDS TO THE GIRDLE COULD CAUSE DAMAGE TO THE ENVELOPE.

There are 4 index marks on the load cords, the center of the splice on the top tie ring, intersection with the top girdle, intersection with the bottom girdle and the center of the splice on the interface loop. The eye splice at the top tie ring must capture at least 15cm (5.9”) of load cord in the splice.

In a FlexNet envelope, there are no load tapes; load cords carry the lifting loads. FlexNet gore tapes are not load tapes and cannot be expected to carry lifting loads.

FlexNet design includes excess-length gore tapes gathered on shorter-length segments of load cord. As long as load cord segments (top girdle to bottom girdle) are shorter than the gore tapes, then gore tape will be gathered as necessary on load cords and the load cords – not the gore tapes – will carry the lifting loads.

Under very severe conditions, especially if an envelope is very heavily loaded and/or flown very hot and/or tethered extensively, load cords can stretch and gore tapes can shrink.

If a load cord length becomes equal to or greater than the gore tape length, tapes will assume lifting loads for which they are not designed. First indication of this condition is absence of any gore tape gather on the load cords. If not corrected, this condition can progress to produce parted gore tapes and torn fabric, usually just above the bottom girdle.

It is unusual – but possible - for only one or two load cords to stretch. To examine for this:

1. With the load cord placed under 50 lbf (222 N) of tension, measure between the stitching that secures the load cord to the top and bottom girdles.
2. Using consistent techniques, measure enough cords to show the required comparison.
3. While measuring, observe the amount of gore tape gather on the tensioned load cord.

Shortening overlong load cords will prevent gore tapes from assuming lifting loads:

1. Remove:
   a. Stitching that secures load cord to top girdle.
   b. Stitching that stabilizes eye splice around top tie ring.
   c. Eye splice around top tie ring.
2. Unless careful measurement shows that some load cord(s) should be shortened more than others, make new marks (top girdle mark, eye-splice mark, and end cutoff mark) the same distance down the load cord. 10 to 30 cm (3.9” to 11.8”) is usually sufficient. Cut off at new end-cutoff mark.
3. Using the new marks, reinstall the load cord so that stitching and eye splice duplicate original factory installation.

5.2.3.2 NON-FLEXNET LOAD CORDS

In Non-FlexNet balloon envelopes, the load cords are marked and attached to the top tie ring and the top girdle in the same manner as in FlexNet envelopes. However, in Non-FlexNet envelopes the load cord terminates at a 1” (2.5 cm) webbing load tape. The load tape creates a loop below the bottom girdle for suspension cable attachment then runs 219.2 +/- 5cm (86.3” +/- 1.9”) up the gore seam using the girdle stitch in Section 5.1.2.3 of this manual with #30 polyester thread. Load cords are sewn to these vertical load tapes using the secure stitch in Section 5.1.2.5 of this manual with #16 polyester thread and overlap the load tapes by approximately 21cm (8.3”).

5.2.4 TELATEMP RECORDING STRIP

There are two types of Telatemp recording strips found in FireFly Balloons. Polyester fabric envelopes will have a recorder strip marked with the envelope serial number and are made for a temperature range of 270°F to 350°F (132.8°C to 176.7°C) . Nylon fabric envelopes will have a recorder strip marked with the envelope serial number and are made for a temperature range of 260°F to 310°F (126.7°C to 154.4°C).

Figure 5-5

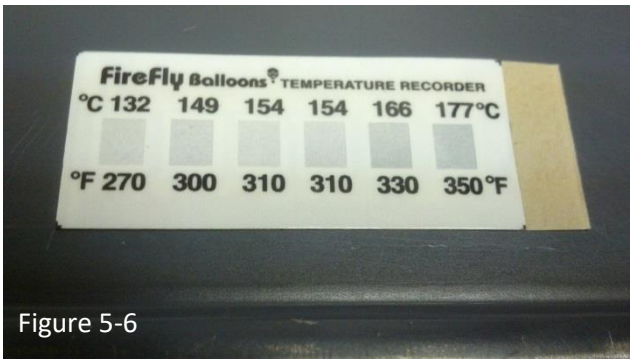


Figure 5-6

NOTE: VARIATIONS IN THE SILVER-GRAY COLORING OF THE WINDOWS DO NOT AFFECT THE TEMPERATURE RECORDER PERFORMANCE. THE WINDOW WILL BECOME JET BLACK AFTER EXPOSURE TO THE RATED TEMPERATURE.

Most pre 1988 envelopes will have the recording strip sewn to the center of the envelope valve. Most post 1988 envelopes will have the recording strip located where the electronic temperature sensor, if fitted, would be. 60 cm (23.6”) down from the top girdle on gore seam 10 (all 12 gore envelopes), gore seam 15 (all 18 gore envelopes), gore seam 20 (all 24 gore envelopes), and gore seam 30 (all 36 gore envelopes). Some newer envelopes may have 2 recorders installed, one on the gore seam and one in the valve center cap.

If, upon inspection, the recorder is found to have tripped the maximum allowable temperature limit an envelope overheat inspection must be accomplished in accordance with Section 6.2.2 of this manual. An additional recorder must be installed. **Removal of a tripped recorder is not permitted.**

If, upon inspection, no recorder is found, assume that is has been removed and that the envelope has been over-temped. An envelope overheat inspection must be accomplished in accordance with Section 6.2.2 of this manual. A new recorder must be installed.

The new recorder will be marked with the envelope serial number and numbered sequentially (i.e. #2, #3, etc…). Ensure that the correct recorder for fabric type is being installed. Logbook entries must indicate the date of installation of new Telatemp recorders, maximum temperature previously recorded.

If a new Telatemp is to be installed on the valve center cap, it will be sewn directly to the fabric next to the old recorder. Use 2 single rows of straight lock stitch in Section 5.1.2.2 of this manual with #30 polyester thread, one along the top and one along the bottom. Do not expose the adhesive backing on the recorder, leave the backing cover intact.

If a new Telatemp is to be installed on the gore seam, it will be sewn to the gore tape taking care to sew it only to the gore tape and not include any fabric in the installation of the recorder. Use 2 single rows of straight lock stitch in Section 5.1.2.2 of this manual with #30 polyester thread, one along the top and one along the bottom. Do not expose the adhesive backing on the recorder, leave the backing cover intact.

5.2.5 ENVELOPE VALVE FITTING

CAUTION: IT IS VERY IMPORTANT FROM SAFETY-OF-FLIGHT AND FUEL USAGE STANDPOINTS THAT THE ENVELOPE VALVE FIT, CENTER AND SEAL PROPERLY.

All cords used in the valve system are manufactured from Nomex or Kevlar. If replacement is necessary, use only those cords supplied by FireFly Balloons. Some older model balloons may have polyester cords installed in the valve rigging. See Service Letters L2 and L4 for additional information on these cords

5.2.5.1 FLEXNET ENVELOPE VALVES

There are three sets of cords in the valve system which act together to control the fit. These are the centering cords, bridle cords and jumper cords. There are several different variations of the valve rigging; the current rigging used in new balloons is explained here. For questions about older valve rigging configurations, contact FireFly Balloons.

The centering cord passes through a seam pocket in the valve and is stitched with the secure stitch in Section 5.1.2.5 of this manual with #16 polyester thread to the valve webbing at both ends with the black mark just visible below the edge of the webbing. It progresses downward to a loop formed using a bowline knot, with the green mark at the apex of the loop. A forged ring is tied into the loop using a larks head type knot.

The bridle cords are bundled and tied at the bottom end to the valve line cable with an overhand knot. The top ends of the cords are tied to the forged rings at the ends of the centering cord with a bowline knot.

Inverted 'v' jumper cords pass from gore seam to gore seam through the forged ring and are free to slide through the ring. When inflated, the sliding action allows the valve to automatically self-center

Newer 12 gore valves may have a perimeter cord installed around the perimeter of the valve. The valve will have perimeter tabs installed on the webbing in the center of the valve gore. The perimeter cord will run from these tabs to the forged rings around the perimeter of the valve. The panels on these valves are larger than on other models, the perimeter cord provides a means to keep the centers of these panels from exiting the opening near the top girdle. This cord is marked with a single dot on one end and several dots at 10 cm (3.9") intervals on the other end. A bowline knot is tied is tied on the single dot end and the other end is tied through that loop with a bowline knot as well. This cord can be adjusted in 10 cm (3.9") increments to provide a proper valve fit.

The peripheral seal of the valve fit is adjusted by lengthening or shortening ONE SIDE ONLY of the inverted 'v' jumpers. If the jumpers are too tight the valve will not contact the top girdle around the periphery and there will be a hazy view of the girdle through the fabric. If the jumpers are too loose, the valve will not be centered, will puff up through the load cords and may reduce the valve apron overlap to the point where air will leak out past the girdle.

The jumpers are marked with a single dot on one side [20 cm (7.9") from the end] and a series of dots on the other side. The series of 13 dots is placed at intervals of 5 cm (1.9") with the center dot at 40 cm (15.7") from the end and colored differently from the other 12 dots. Adjustments should always be made in even increments on all jumpers. Never make unequal adjustments to the cords. Any deviation in symmetry may produce a 'leaky' spot and unequal envelope stress. Even if the valve is off-center, never attempt to move the valve over by tightening one side more than the other. Uneven loading of the envelope fabric in the valve will result in an oval-shaped valve that may never fit properly again.

If a repair is done which necessitates removal of the valve or loosening of the jumpers, centering cords or bridle cords the cords should be retied to the factory setting using a bowline knot as in the original. If, after test inflation it is determined that the jumpers are tied off too long or too short, the tie point should be advanced by only one dot at a time while doing test inflations until valve fits properly.

It is strongly recommended that when a repair or adjustment has been done, that the gather on the load cords above the valve anchor loops be 'feathered out' to distribute it to the equator area. This will reduce the likelihood of 'bunching' of fabric which can make the correct fitting of the valve difficult. In extreme cases, bunching above the anchor loops will cause the fabric and gore seam tapes at the bottom girdle to tear.

NOTE: IN SOME EARLY FLEXNET BALLOONS, THE VALVE LOCATION AND FITTING WAS ACCOMPLISHED THE SAME WAY AS NON-FLEXNET BALLOONS. LARGE 'X' MARKERS WERE USED IN THE CENTER OF THE FABRIC PANELS AND THE CENTERING CORDS WERE CONNECTED TO THEM. IN THESE BALLOONS, THE VALVE FIT IS ADJUSTED BY SHORTENING OR LENGTHENING THE CENTERING CORD IN EXACTLY THE SAME MANNER AS DESCRIBED FOR NON-FLEXNET BALLOONS.

5.2.5.2 NON-FLEXNET ENVELOPE VALVES

There are two sets of cords in the valve system of a Non-FlexNet balloon envelope. These are the centering cords and the bridle cords. The centering cord passes through a seam pocket in the valve and is stitched with the secure stitch with #16 polyester thread to the valve webbing at both ends with the black mark just visible below the edge of the webbing. It is anchored to 2 "X" markers located in the center of opposing envelope panels. The bridle cord is tied to loops on the centering cords on geometrically opposite sides of the valve. A bundle of these cords is tied with an overhand knot and is loop-connected to the steel/Kevlon cable of the valve line.

Valve fit is adjusted by changing the length of the centering cords by untying them from the "X" markers and retying them at the proper length. The centering cords are marked with a red or green dot at the center position and green or black dots on the cord at 10 cm (3.93") intervals on either side of this position. To adjust the fit of the top, change all cords by one or two (at the very most) dots. Retie each knot carefully with a bowline knot as was the original. Critical adjustment may require retying at ½ dot intervals. Re-inflate the envelope and check for valve centering (in the hole) and fit against the girdle. It may take more than one retying operation to obtain a perfect fit but it is unlikely that this operation will have to be duplicated unless major repairs are done or a new valve is fitted.

It is essential that all cords be changed an equal amount. Unsymmetrical tie-off of the center cords will produce leaks, premature fabric deterioration and point stress on the envelope.

5.2.5.3 BOWLINE KNOT

The bowline knot is the only approved knot to use with valve rigging. The desired mark on the cord must always be at the center of the loop created by tying the bowline knot to ensure the proper tied length of the cord.

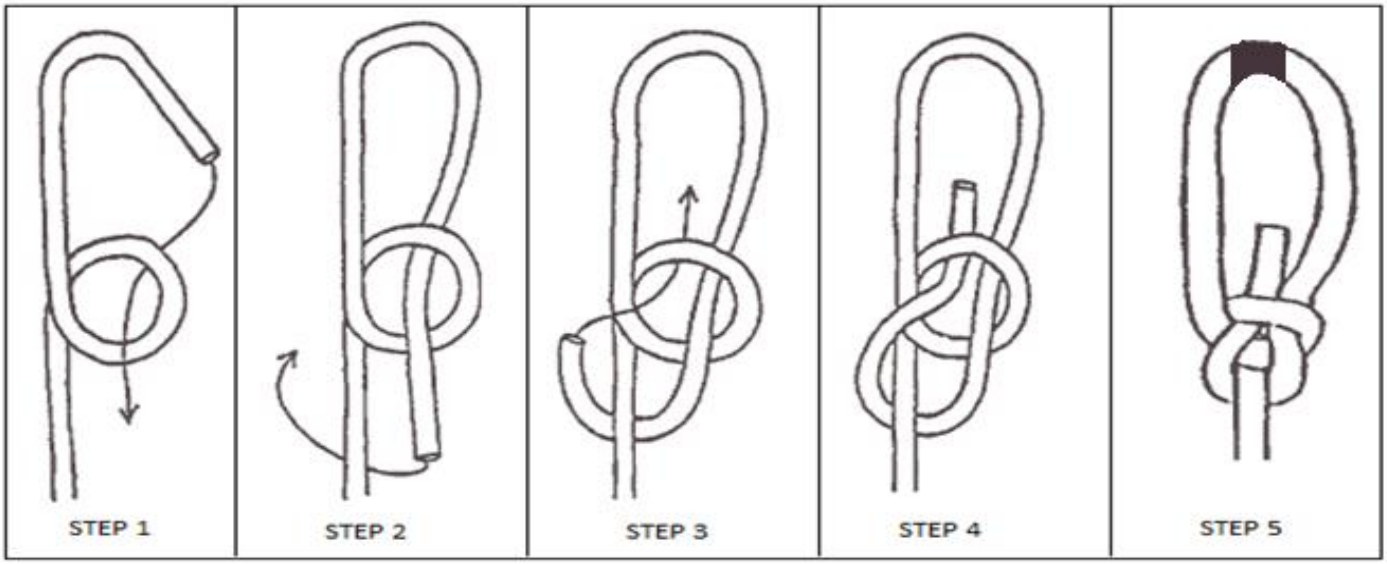


Figure 5-7

5.2.6 VALVE LINE

The valve line in a FireFly envelope is a two piece assembly. The top section which connects to the bridle cord assembly was made of stainless steel until early 1992 when Kevlon was substituted. The bottom section is made of ½" (1.3 cm) preshrunk rope; it connects to the top section and runs into the carriage.

If the valve line becomes damaged or unusable to the point of replacement, it must be replaced ONLY with a certified part from FireFly Balloons. This line has been pre-stressed and pre-shrunk to make it dimensionally stable. Both the top and bottom sections of the new style valve line are replaceable.

In some balloons the Kevlon valve line terminates at a pulley that the bottom ½" (1.3 cm) section routes through. A system of several pulleys may also be used to ease with the opening of the valve in larger balloons. The Kevlon line passes through a guide ring or pulley that is attached to the guide ring anchors via load rope material. The ring or pulley must allow for free travel and proper routing of the valve line. The stainless steel style valve line utilizes a guide ring only.

5.2.7 SUSPENSION CABLES

Suspension cables should be replaced when they show evidence of overheating, rust, corrosion, and fraying, kinking or other damage. Steel cables must be replaced if damaged, these are not repairable. Kevlon cables may be repaired with a procedure listed below. Cables are replaceable in single assemblies (connect to 2 gores) and may be replaced on the wooden toggle by driving out the roll pin and separating the toggle. Assembly is done by reversing this procedure. Be very careful to replace the cables with the same color coding as the original, as the cables are of unequal length and will load the gore unevenly if replaced in an incorrect position.

CAUTION: NEVER MIX STEEL AND KEVLON CABLES ON THE SAME TOGGLE ASSY.

Kevlon suspension cables consist of a Kevlar core, sheathed with polyester for UV and abrasion protection, with a finish diameter of 3/16" (4.8mm) and a tensile strength of 2150 lbf (9,564 N). Kevlar has a destruct point of 900° F (482.2°C) and the sheathing material has a melting point of 492° F (255.6°C). A blast from the burner will destroy the covering and give an immediate indication that the cable must be inspected. The normally light yellow Kevlar does not melt but it does char. Any visible damage to the Kevlar from heat or abrasion necessitates immediate replacement. If the polyester sheath is damaged but the Kevlar core is not, the damage can be repaired by covering it with 3/8" (9.5 mm) heat-shrink tubing. A suitable temporary repair for damaged sheath with no damage to Kevlar core in the field may be accomplished using heat shrink wrap, this must be removed and repaired using procedure in Section 5.2.7.1 of this manual no later than the next annual/100 hour inspection.

When reassembling a D-shackle interface, engage the D-shackle pin 4 threads minimum using a thread locking compound and install the retaining tie. Cut the tail of the tie flush with the head to eliminate sharp edges at the cut end.

Envelopes built up to 1986 may be equipped with stainless steel suspension cables. These cables are 3/32" (2.4 mm) diameter, 1000 lbf (4,448 N) tensile strength aircraft steel. Because of the difficulty of judging retained strength in a cable with broken strands, it is recommended that any cable with broken strands be replaced. In addition to the reduction in structural integrity, broken strands in the cable increase the likelihood of damage to the envelope and personal injury.

5.2.7.1 POLYESTER SHEATH DAMAGED/KEVLAR UNDAMAGED

1. Disengage cable eye spliced end at the load cord interface (see Figure 5-8) by cutting the retaining tie and disassembling. Disconnect the envelope temperature sensor lead at the split bolt connector if applicable.
2. Trim away damaged/melted sheathing taking care not to damage the Kevlar core.
3. Cut sections of FireFly part #A5519 shrink tubing long enough to overlap the undamaged sheathing by at least 4”(10.2 cm).
4. Flatten the eye splice and slip the shrink tubing sections over the eye splice and position as required.
5. Activate the shrink tubing with a heat gun or other hot air source capable of delivering 250 ° F (121°C). **Do exceed the melting point of the sheath, 492 ° f (255.6°c).**
6. Reconnect the suspension cable to the load cord as shown in Figure 5-8. One leg of each cable pair is color coded. Be sure to replace the cables per the color coding shown in Figures 5-9 or 5-10. Reconnect temperature sensor leads if applicable, duplicating the required slack in the lead.
7. Install a new retaining tie on the load cord suspension cable interface.

5.2.7.2 REPLACING INDIVIDUAL CABLE PAIRS

1. If individual cables are to be replaced, refer to Figures 5-9 or 5-10 to verify which pairs will be involved.
2. For each cable pair to be replaced, disengage cable at the load cord interface (see Figure 5-8) by cutting the retaining tie and disassembling. Disconnect envelope temperature sensor lead at the split bolt connector if applicable
3. Disassemble the wooden toggle by driving out the roll pin and separating it. **Spray roll pin to be removed with penetrating oil before removing**
4. Replace cable pairs on the wooden toggle and reassemble the toggle by reversing previous step.
5. Reconnect the suspension cable to the load cord as shown in Figure 5-8. One leg of each cable pair is color coded. Be sure to replace the cables per the color coding shown in Figures 5-9 or 5-10. Reconnect temperature sensor leads if applicable, duplicating the required slack in the lead.
6. Install a new retaining tie on the load cord suspension cable interface.

5.2.7.3 REPLACING TOGGLE ASSEMBLY

1. A toggle assembly is one third (or one fourth) of a suspension cable set as shown in Figures 5-9 & 5-10.
2. Disengage cable eye spliced end at the load cord interface (see Figure 5-8) by cutting the retaining tie and disassembling. Disconnect the envelope temperature sensor lead at the split bolt connector if applicable
3. Reconnect the suspension cable to the load cord as shown in Figure 5-8. One leg of each cable pair is color coded. Be sure to replace the cables per the color coding shown in Figures 5-9 or 5-10. Reconnect temperature sensor leads if applicable, duplicating the required slack in the lead.
4. Install a new retaining tie on the load cord suspension cable interface.

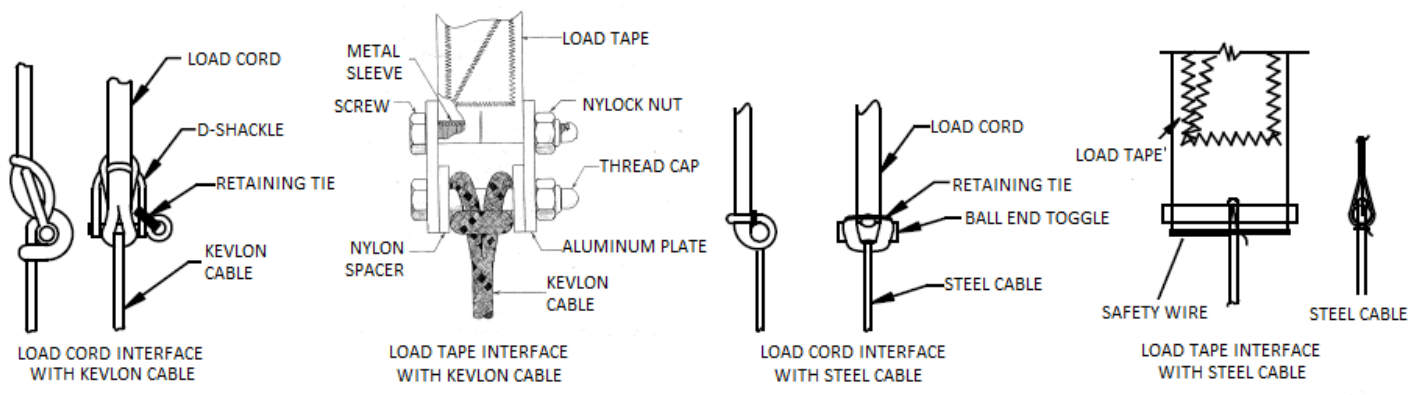


Figure 5-8 SUSPENSION CABLE INTERFACES

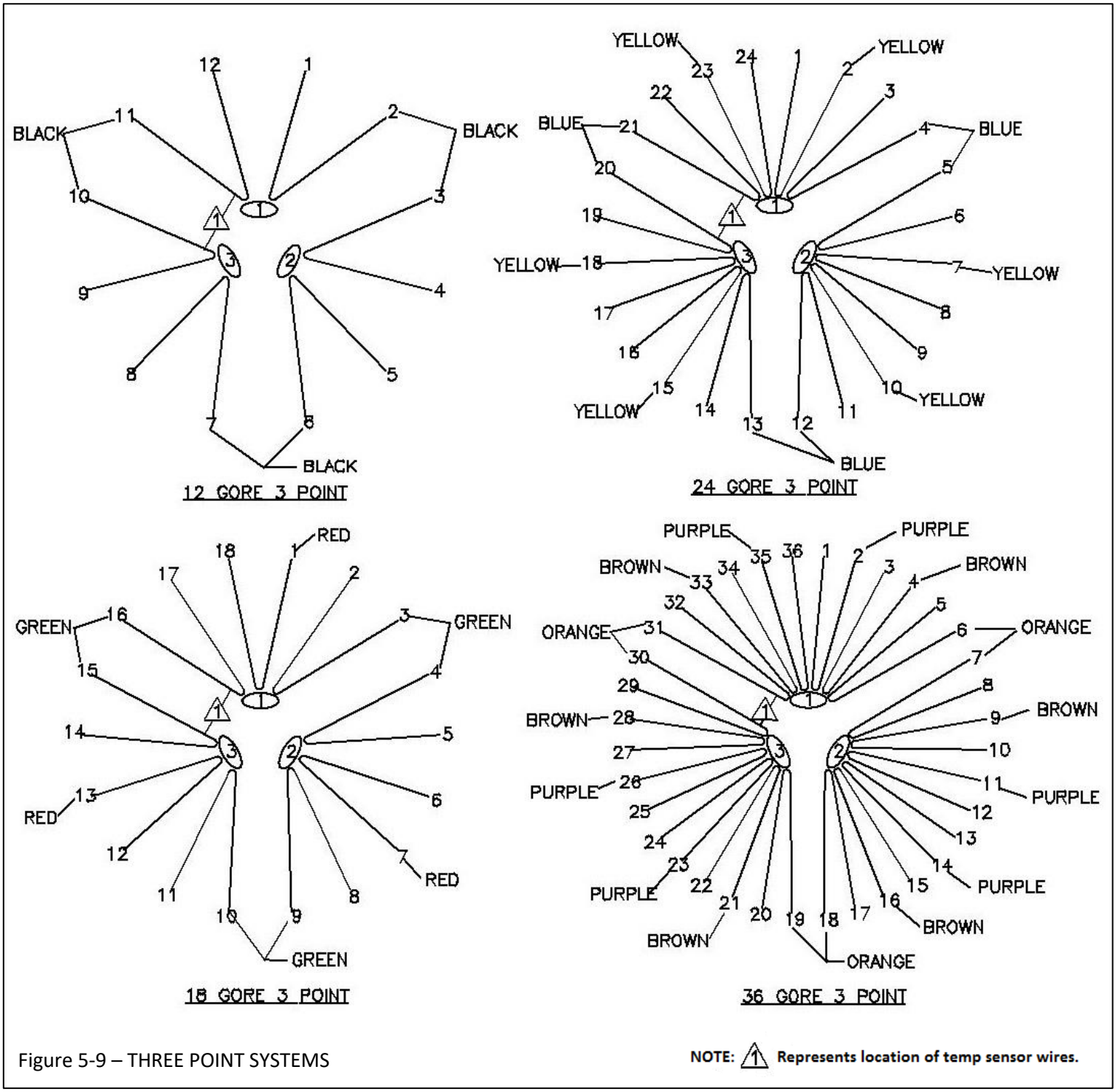


Figure 5-9 – THREE POINT SYSTEMS

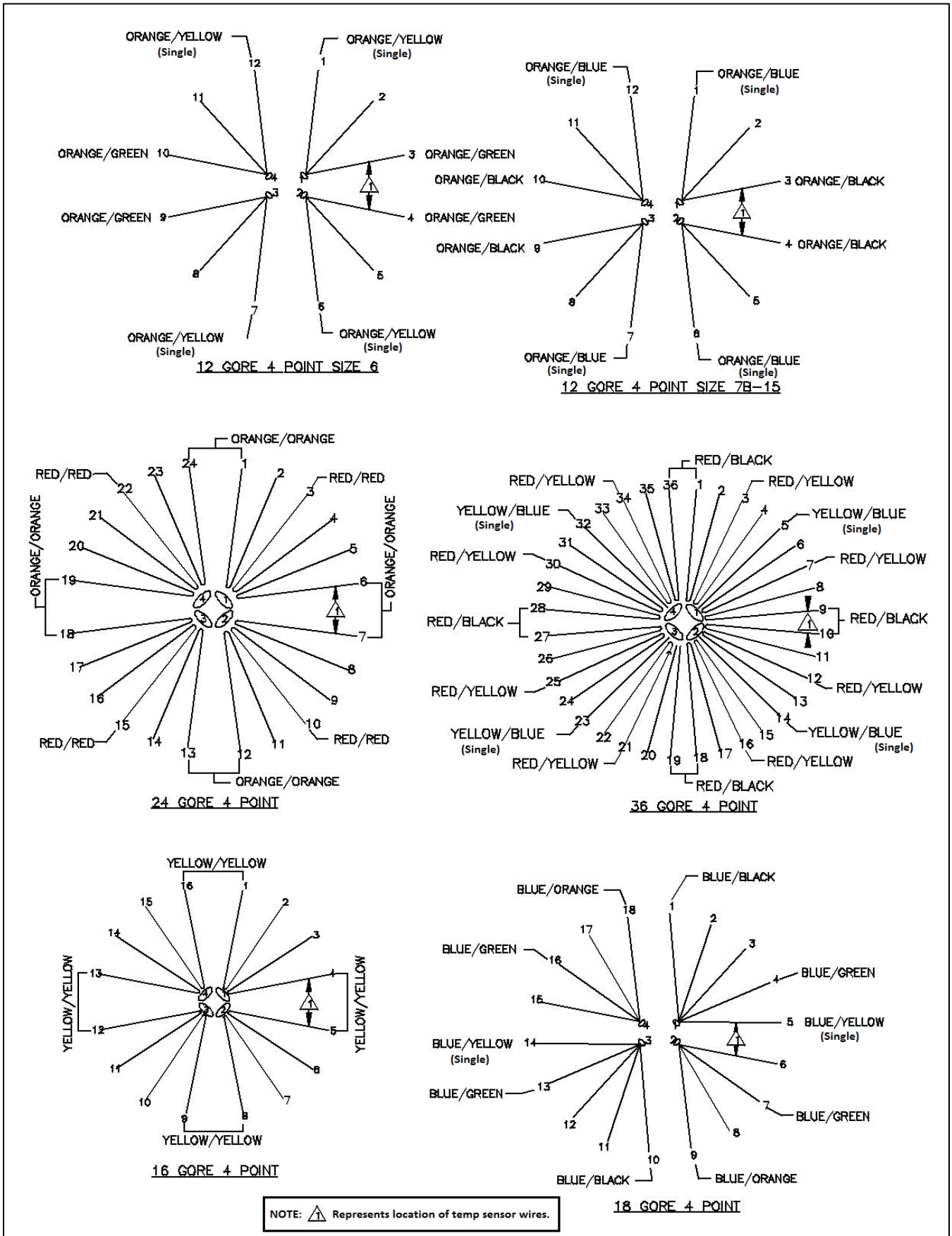


Figure 5-10 – FOUR POINT SYSTEMS

5.3 CARRIAGE

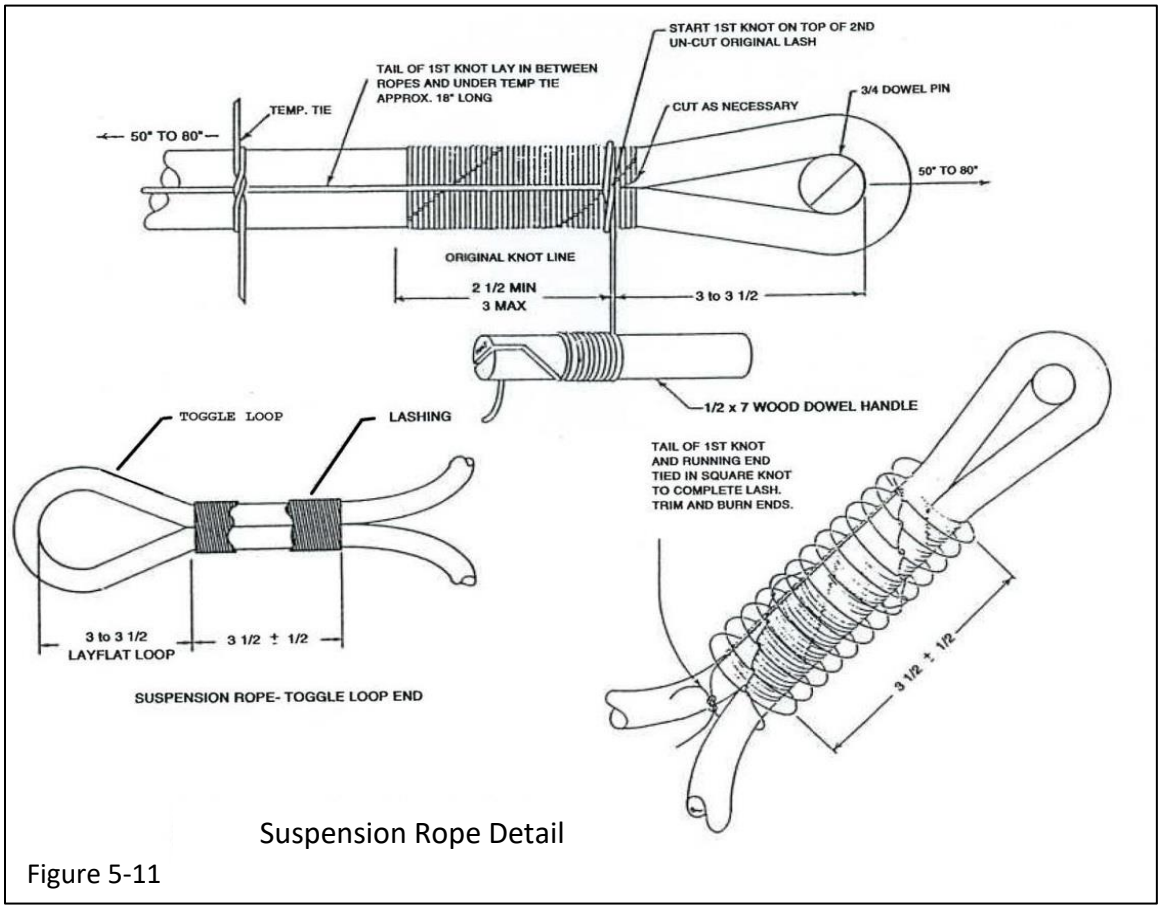
The primary structure of the carriage is a combination of the suspension ropes, floor and tie plate assembly, and rattan frame. In order to maintain the mechanical integrity of the carriage, these structural members must be in airworthy condition. The carriage secondary structure consists of the woven wicker and carriage padding/trim.

5.3.1 SUSPENSION ROPE

There is no repair for damaged suspension ropes; ropes showing damage in excess of limits in Section 6.3 of this manual must be replaced. When installing a new rope assembly, the plastic sleeve should cover the rope right up to the eye splice on one end and make a turn and pass through the floor at the other. Be sure to inspect bolts and tie plates and replace any parts showing damage. It is vitally important that the nylon bushings which are installed between the tie-plates are intact and in good condition.

Suspension rope loops have been known to shrink over time and make it difficult to install the toggles through the loops. The original lashing can be cut slightly and a new layer of lashing installed to make the loop slightly larger. The lashing may also be completely removed and re-lashed. If the lashing is to be completely removed, mark the center of the loop then pull the rope to 50 to 80 pounds force (222 to 356 N) of tension and re-lash using Figure 5-11.

If a FireFly carriage is used with an envelope that uses carabineers, then the suspension ropes must be modified to add a thimble in the loop. Carabineers will damage the suspension ropes over time if operated with no thimble. The lashing may need to be cut back and re-lashed to install the thimble. If the carriage is to be used with both carabineers and toggles (2 separate envelopes) then the thimble must be removed to use toggles and reinstalled to use carabineers. The lashing may have to be re-accomplished to allow for easy installation and removal of a thimble for this purpose.



Suspension Rope Detail

Figure 5-11

5.3.2 RUNNERS AND SLIDERS

There is no repair for a damaged runner; runners showing damage in excess of limits in Section 6.3 of this manual should be replaced. When unbolting the runner to be replaced, a careful inspection should be done of the bolts and hardware. It is strongly recommended that all hardware showing rust or damage be replaced. Do not re-use nyloc nuts. When replacing runners, make sure that the sleeved suspension ropes are properly aligned in the notches. Plastic sliders may be mounted to runners with countersunk wood screws.

5.3.3 FLOOR REPAIRS

Floors are constructed of 9-ply hardwood birch. **Use of any material other than the original for repairs renders the balloon un-airworthy.** Because the floor is part of the load-carrying structure of the carriage, it is necessary that it be replaced if cracks or damage which penetrate more than 2 of the 9 plies appear.

Surface patches of one layer may be made using the same material as the original and waterproof glue. If the surface patch is inside the carriage, sand the edges smooth to prevent hazard to occupants.

It is permissible to plug bolt holes in a floor if a fitting, such as a pulley, has been removed. The maximum size hole that may be plugged is 3/8" (9.5mm). No more than 4 holes may be plugged in a floor and the holes may not be closer than 1" (2.5 cm) from a runner bolt or wire-lacing cable hole. The plug to be used must be of hardwood and it must be cemented into place with waterproof glue. The ends must be coated with urethane to prevent moisture from wicking into the floor laminations.

5.3.4 FLOOR REPLACEMENT

To replace the floor, remove the rawhide scuff leather and the steel lacing cable. Remove runners, suspension ropes and all other hardware. After inspection, these may be reinstalled on the new floor. Lace the new floor into place using cable supplied by FireFly Balloons. Draw the cable tight and secure the ends with the correct size nicopress sleeves. Reinstall the scuff leather after soaking it in cold water. It is preferable to staple it in place along the bottom edge of the floor before lacing.

5.3.5 RATTAN POLE REPAIRS

If a rattan pole has a clean break, gain access to adjoining edges, drill 3/8" (9.5mm) holes in each end and connect the ends with a metal dowel rod. Wrap the joint with 2 layers of fiberglass cloth and resin and allow to cure.

Broken rattan may be repaired using glass fiber tubing splints, provided they are secured using steel bands. Metal tubing must not be used as a reinforcing method.

If a pole is damaged to the point that it will require a replacement piece, contact FireFly Balloons.

5.3.6 WICKER REPAIRS

Carriages can easily be rewoven, after cutting away broken strands. Weaving is best done after soaking the wicker in hot water. It is important for aesthetic and strength reasons, that the same diameter material be used for repair. After reweaving, the carriage should be allowed to dry thoroughly before having a coating of polyurethane varnish applied. It is not necessary to re-soak coated wicker. New wicker used for repairs may be significantly brighter than the old wicker, new wicker can be stained to match old wicker prior to application of polyurethane.

Carriages which have been stored in such a manner as to distort them may be returned to shape by soaking them (remove instruments first) and pulling the wicker into shape with lightweight cords which are tied off. Allow the wicker to dry and then coat with polyurethane.

5.3.7 GLASS FIBER STRUCTURE REPAIRS

If there is any question about inspection or repair of these carriages, contact FireFly Balloons.

5.3.8 CARRIAGE HANDLES

The preferred method of handle attachment is the Band-It clamp. Alternate attachment methods are a bolt with nyloc nut (for carriage corner poles with existing holes for this purpose – **Do not drill a new hole in any corner pole to attach a handle**. **If a stainless steel hose clamp is used it must be of an appropriate size and positioned so that the lug and tail do not interfere with the suspension rope or tank straps.**

5.3.9 SQUARE PIN REINSTALLATION

Should a square pin come loose from its pole, clean out any loose resin and insert the square pin in the hole. With square pin aligned properly, drill a 1/8" (3.2 mm) hole approximately 2" (5 cm) from the end of the pole. Take care not to drill completely through the pole. Install 1/8" by 1 1/8" (3.2 mm x 2.9 cm) steel roll pin in this hole. Fill in around the square pin with fiberglass resin and allow to cure.

5.4 FUEL SYSTEM

5.4.1 FUEL SYSTEM LEAK DETECTION

WARNING: LEAK DETECTION SHOULD NEVER BE DONE WITH AN OPEN FLAME!

The preferred method of detecting and locating leaks is to pressurize the system with air, nitrogen or propane (careful) and observe the 'leak-down' rate. The test must be conducted after allowing the pressurized system to stabilize, as variation in temperature during the test can give false leak detection.

After leak-down test has indicated a fault, the location of the leak can be determined by listening for hissing and applying foaming agents to suspected areas. Although soap solutions made with household detergents can be used, it is recommended that a commercial gas leak detection solution or window cleaner be used, as they will leave no residue.

5.4.2 FUEL CYLINDERS

5.4.2.1 REMOVAL AND REPLACEMENT OF FUEL LEVEL INDICATORS

WARNING: IT IS EXTREMELY IMPORTANT THAT THE CYLINDER BE COMPLETELY EMPTY OF FUEL BEFORE ATTEMPTING SERVICE. OPEN ALL VALVES AND LEAVE THEM OPEN.

Loosen the screws a little at a time in a cross pattern until the gauge can be removed. Take note of the orientation of the gauge for reinstallation. When reinstalling the gauge, replace the rubber gasket if it is not in good condition. Orient the gauge as originally fitted. Tighten the screws a little at a time in a cross pattern. Check for leaks.

5.4.2.2 CYLINDER VALVES

WARNING: IT IS EXTREMELY IMPORTANT THAT THE CYLINDER BE COMPLETELY EMPTY OF FUEL BEFORE ATTEMPTING SERVICE. OPEN ALL VALVES AND LEAVE THEM OPEN.

CAUTION: DO NOT ATTEMPT TO REMOVE THE CYLINDER VALVES UNLESS YOU HAVE THE SPECIAL WRENCHES NECESSARY TO DO SO. THE VALVES ARE INSTALLED VERY TIGHTLY AND ANY OTHER METHOD OF REMOVAL IS LIKELY TO DAMAGE THEM.

Most problems with cylinder valves occur with the stem seals or main seat seal. These can both be solved by replacing the valve bonnet, leaving the main valve body installed in the cylinder. To replace the bonnet, remove the screw that holds the handle, and the handle. Remove the bonnet with a socket, noting that the grooves denote a left hand thread. If there is evidence that the leak was caused by dirt or solids (such as scoring of the valve seat or seal) then all valve parts, dip tube and cylinder must be thoroughly cleaned. Access to the inside of the cylinder is through the liquid level cylinder gauge hole.
Coat stem threads and "O" ring with DuPont Krytox®™ Grade 240AZ or GPL 206.
Reassembly of the valve is accomplished in the reverse order, but the valve stem should be in the open position before installing it to ensure that the bonnet tightens before the valve seats. Torque REGO and Sherwood valve bonnets to 25 ft-lb (34 N-M) Torque Fisher valve bonnets to 65 ft-lb (88 N-M).

5.4.2.3 PILOT LIGHT VALVE AND REGULATOR

The pilot light valve and regulator are installed inline on the master fuel cylinder. The pilot light valve may be serviced as required; however, the pilot light regulator cannot be serviced in the field and must be replaced with new units supplied by FireFly Balloons. Abnormally tall pilot light flames are an indicator of a faulty pilot light regulator.

5.4.2.4 PRESSURE RELIEF VALVES

Pressure relief valves must be changed every 10 years. The replacement procedure is as follows: remove old valve, install a new valve using PTFE Pipe or PLS2 Thread Sealant (NEVER Teflon tape), install directional tube on valve, install rubber cap on tube.

5.4.3 FUEL HOSES AND END FITTINGS

Fuel hoses and end fittings currently used are not repairable or reusable. Fuel hoses are a life limited part and must be replaced after 9 years in service. Fuel hoses are tied into the carriage along the side bows. Padding may need to be loosened to remove and install fuel hoses. Ensure hoses are not rubbing carriage structure or fuel cylinder rings as they will wear during transport.

When fuel hoses are installed in the manifold, care must be taken to ensure the hoses connect to the proper port. Hoses are different lengths, while the flow of propane will not be affected, the fit of the hoses will be incorrect if the hoses are installed on the wrong manifold ports. Additionally, when installing hoses in the manifold PTFE Pipe sealant (NEVER Teflon tape) must be used on the pipe thread fittings. Do not use any sealant on flare fittings (noted by the swivel type connector on the hose end). Leak check all fittings and connections after installing new fuel hoses.

5.4.4 THROTTLE VALVES

Throttle valves are blast valves mounted in a carriage panel. Very few (if any) of these valves are still in service. See Service Bulletins #1 and #2 in Appendix E of this manual for throttle valve servicing information.

5.4.5 CYLINDER JACKETS/HEAT TAPES

Cylinders may be covered with jackets made of cordura or burlap. They may also have heat tapes installed directly to the cylinder or sewn into the jacket. If heat tapes are installed directly to the cylinder they should be installed on the bottom half only. Do NOT heat propane above 125°F (51.7°C) 240 psi (1.65MPa). Do not heat tanks inside buildings or enclosed vehicles.

5.4.6 FIRE SUPPRESSION SYSTEM

An optional fire suppression system may be installed on the carriage. If installed there will be plumbing routed from the fire bottle to all fuel cylinders and burners. The bottle may be replaced if emptied. Hoses and fittings must be replaced if damaged.

5.5 BURNER ASSEMBLIES

5.5.1 T3-017

5.5.1.1 GENERAL

The burner is critical to flight. If there is any doubt as to how to accomplish a repair, the burner should be returned to FireFly Balloons or sent to a qualified repair shop.

NOTE: FOR T3-017 BURNERS WITH THE FIRE2 TRIGGER VALVE, THE FIRE2 VALVE HANDLE WILL BE RED AND THE PILOT LIGHT SWITCH MUST BE CHANGED TO BLACK.

5.5.1.2 PILOT LIGHTS

Correct operation of the pilot lights depends on gas flow through the orifice, alignment of the gas jet on the venturi cover and a clean venturi.

The most common causes of erratic or improper pilot light operation are plugged or partially obstructed pilot light orifices, filters or venturi. If a faulty pilot light cannot be corrected by cleaning in accordance with Section 4.10 of this manual, then the orifice should be replaced.

To replace the orifice assembly, remove the two #6 (3.4 mm) screws and nuts which hold the pilot light tube to the bottom plate of the burner can. Tilt the top of the tube toward the center of the can. It may be necessary to cut some of the sealing material away from the venturi assembly to ease its removal. The venturi assembly can now be removed by gently working it away from the soft sealing material which holds it to the base plate. Unscrew the old orifice assembly and screw in the replacement which has been obtained from FireFly Balloons. Making sure that the new orifice “O” ring is undamaged and that the sintered bronze filter is in place, reassemble the venturi and pilot tube and check for proper pilot light operation.

If satisfactory, complete assembly, including reapplication of sealant around the venturi air intake and to manifold and pilot tube joints. Use ONLY solvent clean up type clear silicone sealant which can be obtained from FireFly Balloons if not available locally. After the sealant cures, trim it around the air intake on the bottom of the burner can to ensure that it does not obstruct the incoming air. Retest the burner after final assembly.

Occasionally, a pilot light will not operate properly because the tiny orifice hole does not align with the venturi hole. It may be necessary to experiment by screwing the orifice in or out slightly or by replacing it with another.

5.5.1.3 MAIN NOZZLE ALIGNMENT

Main nozzles must be aligned for proper operation. If a functional test of the burner in very calm wind conditions (in low light levels, if possible) reveals that the flame shape is not thin and pointed or that some part of the flame is exiting the burner through the vaporizing coils in extreme conditions, the nozzles should be realigned.

In order to align nozzles, a jig will have to be fabricated as per the drawing in Figure 5-14. The alignment of the nozzles is checked and adjusted by running a stream of water through the burner/jig.

Support the jig in a horizontal position so that the water can flow through the target holes. Place the burner upside down in the jig. Open the trigger valve and turn on the water supply. Gently bend the tubes on which the nozzles are installed so that the water jets are passing through the corresponding holes. After completing the alignment, drive compressed air though the burner to dry it.

NOTE: IMPROPER NOZZLE ALIGNMENT RENDERS THE BURNER UN-AIRWORTHY.

5.5.1.4 FIRE2 NOZZLE ALIGNMENT

If a functional test of the Fire2 system reveals that flame is exiting through the vaporizing coils, it will be necessary to check its alignment and adjust, if necessary. Adjustment of the Fire2 nozzle is done on the jig (Figure 5-14), using a jet of water.

NOTE: FIRE2 CONNECTION IS COLORED RED AND HAS THE SAME THREAD AS THE PILOT LIGHT CONNECTION WHICH IS NOT COLORED. DO NOT CONNECT A WATER LINE TO THE PILOT LIGHT CONNECTION. IT IS EXTREMELY DIFFICULT TO REMOVE WATER FROM THE PILOT LIGHT CIRCUIT.

Place the burner upside down in the jig and turn on the water supply. The jet of water should pass through hole "F" of the jig, hitting the alignment cross-hairs.

If realignment is necessary, loosen the tubing nut inside the burner and rotate the nozzle. The hole in the nozzle is drilled at a slight angle, so that the direction of the flow can be changed. Do not loosen the clamp nuts holding the Fire2 assembly to the bottom of the can after rotating the nozzle as this will change the alignment. After this alignment, drive all water out of the system with compressed air. Perform a functional test of the Fire2 burner.

5.5.1.5 FIRE2 TRIGGER VALVE ON BURNER (Optional) (See Service Letter L-19)

This valve uses the same valve body and valve stem as the pilot light valve with 2 distinct differences.

1. The actuating handle MUST be red in color to distinguish between Fire2 and the pilot light (pilot light valve actuating handle MUST be black in color if Fire2 trigger valve is installed).
2. The valve stem seal is a butyl rubber seal made for liquid whereas the pilot light seal is made for vapor. **The valve stem seal is lubricated with DuPont Krytox®™ Grade 240AZ or GPL 206.**

5.5.1.6 TRIGGER VALVE SEAL REPLACEMENT PROCEDURE

When installing a new "T" ring, DuPont Krytox®™ Grade 240AZ or GPL 206 must be applied. This lubricant is available from multiple sources, including FireFly Balloons. Do not use Teflon tape or sealant of any type on the bonnet.

Disassembly sequence:

Remove cotter pin, roll pin and valve actuating handle. Carefully remove burrs from roll pin hole in stem with emery cloth. Tap top of stem with cushioned mallet. (NOTE: Stem should move freely). Remove bonnet from body using 1 ¼" (32 mm) box wrench. DO NOT USE PIPE WRENCH. Remove copper washer(s) and spring. Remove and discard "O" or "T" ring. Clean stem and housing with solvent.

Assembly sequence:

Install new "O" or "T" ring onto stem and into groove and install backup ring(s). **Coat stem and "O" ring or "T" ring with DuPont Krytox®™ Grade 240AZ or GPL 206.** Reinstall spring and copper washer(s) into bonnet housing. Reinstall bonnet assembly in valve body. USE NO SEALANT OR TAPE. Torque bonnet to 80 ft. lb.(108.5N-M). Reinstall valve actuating handle using roll pin and a new 3/32" (2.4 mm) stainless steel cotter pin.

NOTE: A #6 (3.4 mm) machine screw with stop nut or 0.040" (1 mm) steel safety wire through the hole of the roll pin are acceptable alternate securing methods.

5.5.1.7 T3-017 BURNER TROUBLESHOOTING

1. TRIGGER VALVE LEAK - If a leak develops in the trigger valve, the "O" ring or "T" ring must be replaced with one obtained from FireFly Balloons, made from the correct material. Replacement procedure is found in Section 5.5.1.6 of this manual.

2. PROPANE FLOW DOES NOT STOP WHEN MAIN BLAST VALVE IS RELEASED - Check that there is at least (0.3 mm) (0.012") clearance between the trigger and bonnet and that the stem travel is at least 1.3 mm (0.05"). Adjust by adding or subtracting copper washers under the bonnet. Adding washers reduces the gap. **There must be minimum of one or maximum of three copper washers under the bonnet.**

   Remove bonnet assembly and inspect for foreign object on rubber seat. If the seat has been deformed, replace it.

   Bonnet assembly may be removed in accordance with parts of the procedure in Section 5.5.1.6 of this manual.

3. FIRE2/PILOT VALVE STEM LEAK (See Service Letter L-19 for Fire2 Valve) - Replace bonnet assembly or "O" ring using only parts from FireFly Balloons.

4. LEAK AT COIL ADAPTER - Inspect adapter for cracks. If it is cracked, replace adapter. If it is not cracked, tighten coil adapter nut ¼ turn.

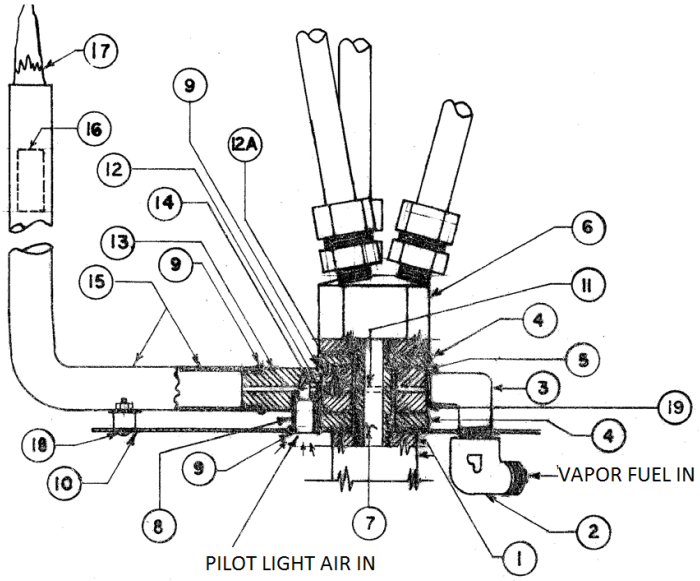
5. PROPANE FLOW DOES NOT STOP WHEN FIRE2 TRIGGER VALVE IS RELEASED - Check that there is clearance between the switch and bonnet. Remove bonnet assembly and inspect for foreign object on valve seat. If the seat has been deformed, replace valve stem.

6. KINKS OR DENTS IN COIL - Replace coil assembly if kinks or dents are deep enough to restrict propane flow.

7. LOW OR WEAK PILOT LIGHT FLAMES - Clean pilot lights in accordance with Section 4.10 of this manual. Change orifices if cleaning does not restore weak pilot lights.

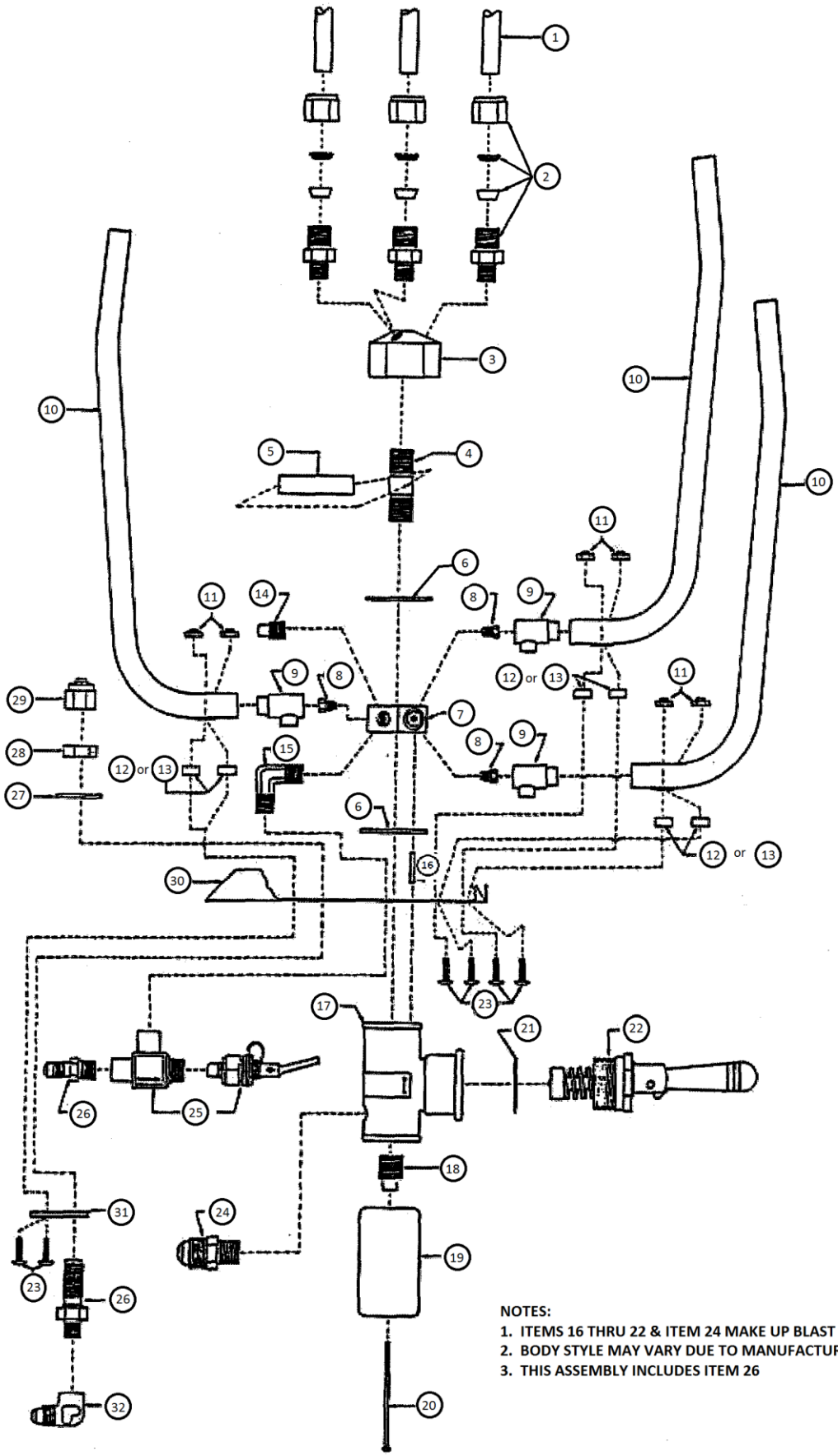
8. ABNORMALLY TALL PILOT LIGHT FLAMES - Check pilot light regulator on master fuel cylinder for proper operation.

PILOT LIGHT SYSTEM SCHEMATIC



1	TRIGGER VALVE
2	FITTING, 1/4" FLARE
3	MALE PIPE "L"
4	SOFT WASHER
5	PILOT LIGHT MANIFOLD
6	BURNER MANIFOLD
7	1/4" STEEL PIPE NIPPLE
8	AIR INTAKE TUBE
9	SEALANT (SILICONE)
10	BOTTOM PLATE
11	INTERNAL GAS PASSAGES
12	ORIFICE
12a	SINTERED METAL FILTER
13	VENTURI ASSEMBLY
14	GAS JET ORIFICE
15	PILOT LIGHT TUBE ASSY
16	FLAME HOLDER BLOCK
17	FLAME BURNS AT END OF TUBE
18	TUBE MOUNTING SCREWS
19	LOCTITE RETAINING COMPOUND

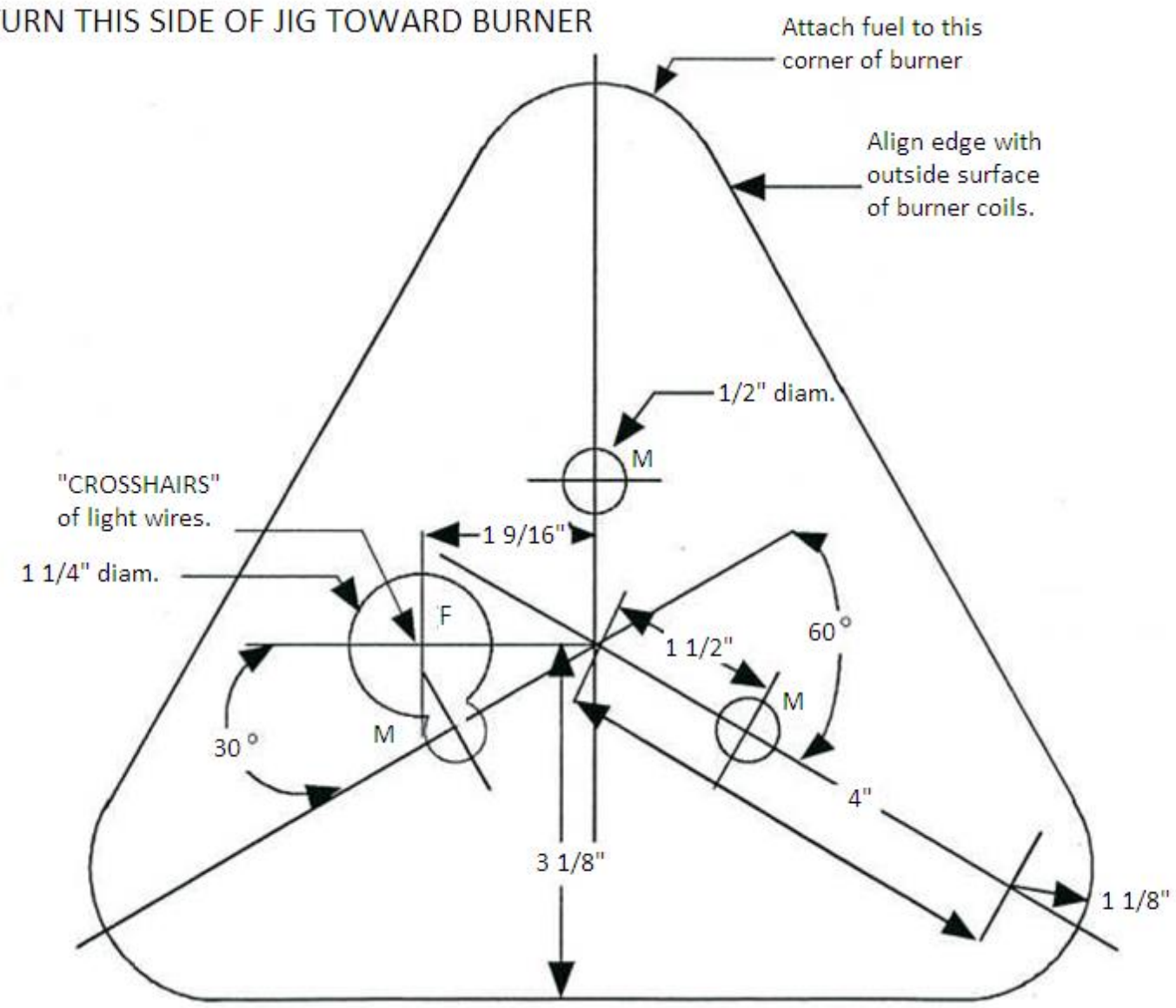
Figure 5-12



1. COIL ASSY
2. 3/8" X 1/8" ADAPTER
3. MAIN MANIFOLD
4. 1/4 STEEL PIPE NIPPLE
5. GASKET MATERIAL
6. SOFT WASHER
7. PILOT MANIFOLD
8. ORIFICE
9. VENTURI ASSY
10. PILOT TUBE
11. #6 NUT
12. SPACER
13. SPACER
14. 1/8" PIPE PLUG
15. 1/8" MALE ELL
16. ROLL PIN (SEE NOTE 1)
17. VALVE BODY (SEE NOTE 2)
18. 1/4" PIPE PLUG
19. WOOD HANDLE
20. #10 X 2.5" SCREW
21. COPPER WASHER
22. VALVE BONNET (SEE NOTE 2)
23. #6-32 X .5" SCREW
24. 3/8" X 1/4" ADAPTER
25. PILOT LIGHT SAFETY SHUTOFF SEE NOTE 3
26. 1/4" X 1/8" ADAPTER
27. 3/8" WASHER
28. BULKHEAD MALE CONNECTOR
29. FIRE 2 NOZZLE
30. BOTTOM PLATE
31. FIRE 2 BRACE
32. 1/4" X 1/8" ELL

NOTES:
1. ITEMS 16 THRU 22 & ITEM 24 MAKE UP BLAST VALVE ASSEMBLY.
2. BODY STYLE MAY VARY DUE TO MANUFACTURER
3. THIS ASSEMBLY INCLUDES ITEM 26

Figure 5-13



*not to scale.

NOZZLE ALIGNMENT JIG

Construct jig from sheet metal or plywood. Water jets from three main nozzles must pass through holes marked "M". Water jet from Fire2 nozzle must pass through center hole "F" hitting the cross hair markers.

Figure 5-14

5.5.2 F1 MIRAGE

5.5.2.1 GENERAL

The burner is critical to flight. Because of its unique design, many of the components are now machined into two cast alloy base plates. There are very few replaceable components and very few repairs can be accomplished outside of the factory. There are no replaceable parts in this assembly. If in doubt as to how to accomplish a repair, return the burner to FireFly Balloons/Triangle Balloon Services CRS# 6T8R838B.

CAUTION: ANYTIME A THREADED PART IS REMOVED FROM THE ALUMINUM BASE PLATE ASSEMBLY, THE THREADS SHOULD BE CHASED WITH A PROPER SIZE TAP TO CLEAN THEM. FAILURE TO DO SO COULD RESULT IN DAMAGED THREADS ON THE BASE PLATE ASSEMBLY AND LEAD TO COSTLY REPAIRS.

5.5.2.2 BURNER CANS/HEAT SHIELDS

To perform certain allowable repairs on the F1 Mirage burner, it may be necessary to remove the heat shields.

Removal:

1. Remove hanger springs by removing the AN eye bolts. Upper has a nut on the back, lower is threaded into the base plate.
2. Remove 6 captive nuts and 3 Inconel spacers from corner struts.
3. Mark shields as to the order they come off and side they came off of (you will need this for reassembly).
4. Shields are held to the base plate with a clear silicone adhesive and must be peeled carefully off the base plate.

Installation:

1. Clean old silicone sealant from base plate and shields.
2. Apply 2 beads of silicone to the side of the base plate.
3. Install shields in the same order they were removed and on the same sides removed from.
4. Install 6 captive nuts and 3 Inconel spacers on corner struts
5. Install hanger springs using AN eye bolts.

5.5.2.3 PILOT LIGHTS

Correct operation of the pilot lights depends on gas flow through the orifice, a clean venturi and an unobstructed air supply.

The most common causes of erratic or improper pilot light operation are plugged or partially obstructed pilot light orifices, filters or venturis. If a faulty pilot light cannot be corrected by cleaning in accordance with Section 4.9 of this manual, then the orifice should be replaced.

To replace the orifice, remove the burner cans and hold the corner strut out far enough to allow the pilot light tube and brass orifice to be unscrewed from the base plate. Replace the orifice and tube, using Loctite 565 on orifice only. Ensure tube alignment is proper (pointing toward Fire2 nozzles) and check for leaks where orifice installs to the base plate. Reinstall the burner cans using procedure in Section 5.5.2.2 of this manual.

5.5.2.4 F1 MIRAGE BURNER TROUBLESHOOTING

1. MAIN BONNET LEAK - For leaks around the stem, remove trigger and handle assemblies. Remove bonnet assembly using socket wrench. **Carefully** remove burr from the roll pin hole with fine sand paper and emery cloth. Remove stem and replace "T" ring. Stagger the joints on the wiper rings on either side of the "T" ring by 180 degrees. **Lubricate with Dupont Krytox®™ grade 240az only.** Reassemble bonnet and reinstall into casting using Loctite 565 on threads; **torque valve bonnet to 80 -85 ft-lb (109 – 115 N-M). Do not over-torque.** Replace handle and trigger assemblies remembering to replace cotter pin through roll pin. Re-inspect for leaks.

2. FIRE2/PILOT VALVE STEM LEAK (See Service Letter L-19 for Fire2 Valves) - Replace bonnet assembly or "O" ring using only parts from FireFly Balloons.

3. FIRE2/PILOT VALVE TO CASTING LEAK - Remove valve, clean threads and coat with Loctite 565. Reinstall valve.

4. LEAK AT COIL ADAPTER - Inspect adapter for cracks. If it is cracked, replace adapter. If it is not cracked, tighten coil adapter nut ¼ turn.

5. PROPANE FLOW DOES NOT STOP WHEN MAIN BLAST VALVE IS RELEASED - Check that there is at least (0.3 mm) (0.012") clearance between the trigger and bonnet and that the stem travel is at least 1.3 mm (0.05"). Adjust by adding or subtracting copper washers under the bonnet. Adding washers reduces the gap. **There must be minimum of one or maximum of three copper washers under the bonnet.**

   Remove bonnet assembly and inspect for foreign object on rubber seat. If the seat has been deformed, replace it. If the casting is damaged, return burner to factory. Reinstall bonnet using Loctite 565 on threads; Torque bonnet to 80-85 ft-lb (109 – 115 N-M)**. Do not over torque.**

6. KINKS OR DENTS IN COIL - Replace coil assembly if kinks or dents are deep enough to restrict propane flow.

7. SCREEN MISSING FROM FLOWGUIDE - Replace with FireFly Balloons part #A4129; do not substitute as flow and mixture may be affected. Do not omit screen, it prevents flash back and keeps foreign objects from passing through flowguide.

8. PILOT LIGHT ORIFICE TO BASE PLATE LEAK - Remove orifice and clean threads. Reinstall using Loctite 565. Ensure proper tube alignment (pointing toward Fire2 Nozzles).

9. LOW OR WEAK PILOT LIGHT FLAMES - Clean pilot lights in accordance with Section 4.10 of this manual. Change orifices if cleaning does not restore weak pilot lights.

10. ABNORMALLY TALL PILOT LIGHT FLAMES - Check pilot light regulator on master fuel cylinder for proper operation.

11. The burner must be returned to Firefly Balloons/Triangle Balloon Services CRS# 6t8r838b if any of the following symptoms exist:

   a. With pilots on, propane flows from Fire2 nozzles or main flowguide.
   b. When main blast valve is operated, fuel flows from Fire2 nozzles and/or pilot lights get very large.
   c. When Fire2 is operated, fuel flows from main fuel flowguide.
   d. Propane leak at seam at bottom edge of can.

5.6 INSTRUMENTS

5.6.1 FLIGHT INSTRUMENTS

The altimeter, rate of climb indicator and envelope temperature indicator are certified aircraft instruments and may not be serviced by field personnel. These instruments must be returned to a qualified aircraft instrument repair station or instrument manufacturer if repair or service is required. There are several makes and models of each of these instruments. See Appendix B of this manual to determine which makes and models are approved for use.

Owner operators may remove instrument panels, install airworthy instruments in those panels and service batteries on installed instruments. Proper maintenance entries must be made in the aircraft logbook.

5.6.2 TEMPERATURE GAUGES

The electronic temperature gauges should be returned to the manufacturer if difficulties are encountered. Perform a continuity test of envelope and carriage wiring and check temperature gauge batteries before returning the instrument.

See Service Letter L-5 for information about retrofitting a system with a DT-20 Temperature Gauge.

See Service Letter L-11 for information about retrofitting a system with a DT-21 Temperature Gauge.

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FOR FUTURE USE

6. INSPECTIONS

This section contains inspection methods and procedures as well as damage limits and acceptance/rejection criteria.

6.1 ANNUAL/100 HOUR INSPECTION

This inspection is to be carried out annually or every 100 hours of operation, whichever occurs first. There is no difference in the parts inspected during an annual or 100 hour inspection. An annual/100 hour inspection must be accomplished by a properly certified and rated repairman under authority of an FAA certified Repair Station rated for The Balloon Works, FireFly and Galaxy Balloons, or may be done by qualified Airframe and Powerplant Mechanics who hold an Inspection Authorization rating, and who are qualified to inspect balloons.

This inspection must include inspection of fabric condition and strength. The Type Design Data related to Type Certificates A14SO (The Balloon Works and FireFly Balloons) and A10NM (Galaxy Balloons) require a minimum tensile strength of 40 in-lb (4.5 N-M) (polyester fabric) and 30 in-lb (3.4 N-M) (nylon fabric) as defined by Test Method 5100 of Federal Standard 191. The fabric should be tested in at least 2 places in the valve, 2 places within 180 cm (70.8”) of the top girdle and 2 places below the equator. Pay particular attention to areas of higher operating temperatures. The envelope material strength is adequate if the material withstands without tearing 40 pounds force (178 N) tension (polyester fabric) or 30 pounds force (133 N) tension (nylon fabric) uniformly distributed along one inch and applied parallel to either direction of the threads (see Section 6.2.3 of this manual).

The inspector, when approving a balloon for return to service after an annual/100 hour inspection, is assuming responsibility for the complete system. They are certifying that the aircraft meets all applicable FAA regulations and directives and all applicable manufacturers’ standards, to include the airworthiness of all prior repair work. This is an important point, particularly if repairs have been made without proper documentation and entries in the aircraft records. It may be difficult to determine the methods and materials used for the repair and the identity and qualifications of the person making the repair. If the inspector finds that prior repairs were not made in a legal and safe manner, the repairs must be redone.

A sample checklist, which conforms to FAR Part 43, is included in Appendix A. Inspectors should use this as a guide when performing inspections. Acceptance and rejection criteria are included in this chapter.

6.2 ENVELOPE

6.2.1 ENVELOPE INSPECTION/ACCEPTABLE DAMAGE LIMITS

IT MUST BE CONSIDERED by repair stations doing repairs and inspectors signing off these repairs that ANY damage to a balloon changes it’s characteristics of flight in a negative way and renders the balloon less safe. The significance of this may be lost on repairmen and inspectors who are not pilots. For this reason, FireFly Balloons, whilst specifying certain damage as acceptable for minimum airworthiness purposes, strongly recommends that no balloon be certified for return to service with damage present.

6.2.1.1 FABRIC

Holes, tear or areas of damaged fabric of 1 cm (0.4”) in maximum dimensions are *acceptable* above the equator and of 2.5 cm (1”) below the equator and a maximum of 30.5 cm (12”) in bottom panel #1 and/or envelope skirt *if:*

1. **They are more than 30.5 cm (12”) apart and more than 30.5 cm (12”) away from a seam**.
2. **There are no more than four in any one panel.**

Damage beyond acceptable specifications must be repaired before further flight. For sew patch repairs, see Section 5 of this manual. For “sticky patch” repair of smaller areas, see Section 4 of this manual.

CAUTION: DAMAGE MAY EXTEND FOR A CONSIDERABLE DISTANCE BEYOND THE AREA WHICH APPEARS ON VISUAL INSPECTION TO BE DAMAGED. THE AREA SURROUNDING A TEAR MAY BE SCRAPED AND ABRADED AND BE STRUCTURALLY UNSOUND AS A RESULT. THE AREA SURROUNDING A FABRIC BURN MAY APPEAR TO BE INTACT BUT MAY HAVE BEEN OVERHEATED AND NOT STRUCTURALLY SOUND. CLUES TO HEAT DAMAGED BUT APPARENTLY INTACT FABRIC INCLUDE:

1. Glossy, melted, wrinkled or scorched appearance.
2. "Stretch marks" which radiate out from a flat, smooth area unlike the surrounding undamaged fabric.
3. Seams with inside or outside edges discolored, wrinkled, melted or rolled.

NOTE: WHILE PORTIONS OF HEAT DAMAGED PANELS MAY BE STRUCTURALLY SOUND, ANY OF THESE SIGNS MAY INDICATE AREAS OF REDUCED STRENGTH. ADJACENT PANELS SHOULD BE INSPECTED FOR VARIATION IN PANEL HEIGHT. A VARIATION OF MORE THAN 1 CM (0.4") IN PARALLEL SIDES MAY INDICATE SHRINKAGE BECAUSE OF HEAT STRESS. HEAT STRESS MAY LEAD TO LATER FABRIC FAILURE. IF IT CANNOT BE ESTABLISHED WITHOUT DOUBT THAT FABRIC IS SAFE, IT SHOULD BE REPLACED BEFORE FURTHER FLIGHT.

NOTE: A RIP, HOLE OR BURN IS THE STARTING POINT FOR A PERIPHERAL SEARCH FOR ADDITIONAL, LESS OBVIOUS DAMAGE!

6.2.1.2 LOAD CORDS

No more than 10% of the fibers may be damaged in any 15 cm (5.9") length of load cords. Current production load cords are woven with 16 fiber bundles. Each bundle is 6.25% of the total. Inspect secure stitches at girdles and eye splice tacks. Ensure the eye splice at the top tie ring captures at least 15cm (5.9") of load cord in the splice.

6.2.1.3 CENTERING, BRIDLE AND JUMPER CORDS

Replace all cords which show any fraying or damage. Inspect for signs of overheating, noted by stiffening, melting or severe discoloration of the cord. Pay particular attention to the overhand knot at the bottom of the bridle assembly. Inspect knots for correct type and security and forged rings (if installed) for corrosion and general condition. Inspect any loop to loop connections for wear.

6.2.1.4 ONE-INCH WEBBING

No more than 10% of the fibers in any 15 cm (5.9") length of webbing in girdles may be damaged. Inspect stitching for proper type, security and integrity.

6.2.1.5 TWO-INCH WEBBING

No more than 20% of the fibers in any 20 cm (7.9") length of webbing in anchor loops and skirt ties and 10% of the fibers in any 20 cm (7.9") length of webbing in girdles and tether restraint loops (of balloons so equipped) may be damaged. Inspect stitching for proper type, security and integrity.

6.2.1.6 FLEXNET TAPES [3" AND 1 ¼" (7.6 cm and 3.2 cm)]

Damage to flex net tapes and fraying may not extend to within 0.2 cm (0.5") from the outer stitch. Inspect stitching for proper type, security and integrity.

6.2.1.7 CROWN LINE ASSEMBLY

Inspect for proper attachment to top tie ring. Ensure it is free of excessive knots and that a proper handle is attached and in good repair. Attaching thong should be in a condition and long enough to attach to the burner support.

6.2.1.8 VALVE LINE

Replace valve lines with steel cable sections showing broken strands, exposure to excessive heat, discoloration, corrosion, fraying and kinks. Also replace those where the steel cable to ½" (1.3 cm) rope connection is loose. Replace Kevlon cable sections showing visible damage to polyester sheath. No repairs are permitted on Kevlon valve line sections. Replace ½" (1.3 cm) rope valve line sections showing more than 10% damage to circumference of the cover and/or any damage to the core. Lower portion of valve line should be free of excessive knots. Attaching thong should be in a condition and long enough to attach to the burner support.

6.2.1.9 SUSPENSION CABLES

Inspect Kevlon cables for integrity of polyester sheath. Any visible Kevlar must be inspected for condition. The normally light yellow Kevlar core does not melt but it does char. Any visible damage to the Kevlar from heat or abrasion necessitates immediate replacement. If the polyester sheath is damaged but the Kevlar core is not, the damage should be repaired. For repair procedures and installation instructions, see Section 5.2.7 of this manual. In addition, lashing at the toggle loop should be inspected to ensure the lashing is tight and the loop is tight around the toggle.

If the steel suspension cables have been exposed to the excessive heat of a direct hit from the burner flame, the temper has probably been removed and the tensile strength reduced. Inspect steel cables for broken strands, exposure to excessive heat, discoloration, corrosion, fraying and kinks. These conditions are all unacceptable and cables exhibiting any of these signs must be replaced. Steel cables are not repairable. Also, metal toggles and swaged balls at the top of the cable as well as the nicopress sleeves at the wooden toggle loop should be inspected for condition.

CAUTION: IT IS NOT PERMISSABLE TO MIX STEEL AND KEVLON CABLES ON THE SAME TOGGLE. ALL CABLES ON A TOGGLE MUST BE OF THE SAME MATERIAL.

Inspect wooden toggles for cracks, chips and security. Inspect carabineers and thimbles for burrs, nicks, corrosion and security. Also, inspect suspension cable to envelope interface for security and proper safety device in accordance with Figure 5-8.

6.2.1.10 TELETEMP TEMPERATURE RECORDING STRIP

If, upon inspection, the recorder is found to have tripped the maximum allowable temperature limit an envelope overheat inspection must be accomplished in accordance with Section 6.2.2 of this manual. An additional recorder must be installed (see Section 5.2.4 of this manual).

NOTE: VARIATIONS IN THE SILVER-GRAY COLORING OF THE WINDOWS DO NOT AFFECT THE TEMPERATURE RECORDER PERFORMANCE. THE WINDOW WILL BECOME JET BLACK AFTER EXPOSURE TO THE RATED TEMPERATURE.

If, upon inspection, no recorder is found, assume that is has been removed and that the envelope has been over-temped. An envelope overheat inspection must be accomplished in accordance with Section 6.2.2 of this manual. A new recorder must be installed (see Section 5.2.4 of this manual).

6.2.2 ENVELOPE OVERHEAT INSPECTION

An envelope that has been overheated, above 300° F (148.9°C), as evidenced by temperature gauge and/or Telatemp recording strip, must be visually inspected for damage. Pay close attention to the fabric condition in the top 1/3 of the envelope as well as the envelope valve. Look for fabric stiffening, crinkling or distortion as well as discoloration and shrinking or curling of the fabric. Inspect valve jumpers, bridles and centering cords for damage, stiffening, severe discoloration or melting. Also inspect top section of valve line for heat damage. The fabric in the upper envelope panels and valve **must** be pull tested to assure airworthiness. Pull test procedures can be found in Section 6.2.3 of this manual. Add an additional Telatemp recording strip in accordance with Section 5.2.4 of this manual.

6.2.3 FABRIC PULL TEST PROCEDURE

This test procedure is to determine airworthiness of The Balloon Works, FireFly and Galaxy Balloon envelope fabric without cutting or removing a test sample from the balloon. It should be conducted in various locations and in various colors in the envelope to detect weakening of the fabric due to heat, exposure to ultraviolet light, abrasion to fabric during ground handling as well as other factors.

This is a pull test and is accomplished by clamping carefully-aligned fabric samples between two smooth-faced 1" (2.5 cm) clamps. It is vital the clamps be precisely aligned along the direction of the fabric weave so that the same fibers are captured in both clamps. All fibers across the face of the clamp must be uniformly stressed to give accurate results. If clamps are improperly positioned, some fibers may break prematurely and give a false indication of the fabric strength, especially in cases where fabric strength is at or near acceptable minimum.

The spacing between the clamps should be 3" (7.6 cm). Tension should be increased as smoothly and uniformly as possible using a calibrated scale. Do not exceed 40 lbf (178 N) for polyester fabric or 30 lbf (133 N) for nylon fabric (see Section 5.2.4 of this manual for help in identifying nylon and polyester fabrics by Telatemp recording strip). This test does not indicate fabric strength. It simply indicates that the fabric meets minimum strength for airworthiness.

In case of any questions arising from field tests of fabric, it is recommended that samples be submitted to a fabric testing laboratory or the engineering department of FireFly Balloons.

The objective of this test is to test envelope fabric for minimum strength by the pull test method by applying and measuring a uniformly increasing load across a 1" (2.5 cm) section of the envelope fabric. Also, to maintain the load in line with the threads of the fabric, equal in each thread and free of sideways distortion. Failure to clamp the test area in line with the weave will give a false low test result.

EQUIPMENT REQUIRED:

1. Scale calibrated zero to 50 pounds or more.
2. Two sets of gripping pads. Gripping pads must:
   - Have one side 1" x 1" (2.5 cm x 2.5 cm) contact area with light radius edges outside the contact area, not to exceed 1/64" (.4 mm). The other side of the gripping pad may be larger than 1" (2.5 cm) but should not exceed 3" (7.6 cm).
   - Be constructed of rigid metal that will apply uniform clamping without distortion under tension. Gripping surface should have a thin cushion (vinyl, hard rubber, neoprene, etc.) to avoid crushing fibers.
   - Apply uniform gripping pressure over the one square inch gripping area (one pad free of pivot without clamping force applied at its center will accomplish this)
3. Provision for applying load to the scale-clamp-fabric-clamp assembly.

TEST PROCEDURE:

1. Determine thread direction in fabric test specimen. Make reference marks with a ruler prior to clamping. Use grease pencil or fine point marker; however, do not damage fibers when making reference marks.
2. Carefully align gripping pads of first clamp so the threads are in line with the direction of the load and tighten first clamp. Good lighting and/or magnification may be necessary.
3. Align pads of second clamp 3" (7.6 cm) from first clamp and tighten second clamp. It is critical that the pads are clamped along the same threads.
4. Slowly apply a uniformly increasing load observing the scale reading as it increases.
5. When scale reaches target reading [40 lbf polyester/30 lbf nylon (178 N polyester/ 133 N nylon)] stop and reverse tension.
6. In FlexNet construction the weave perpendicular to the panel tapes is the fill direction, weave across the width of the panel is the warp direction.

CALIBRATION:

Scales should be calibrated at least annually. Practices and methods of calibration should be in accordance with your Repair Station Manual and FSDO Principle Inspector. FireFly Balloons cannot calibrate scales. However, we can provide you with our independent test results using our Scott Tensile Testing machine. A sample of at least 20" x 24" (50.8 cm x 61 cm) is needed.

FABRIC SPECIFICATIONS

Polyester Fabric: **Airworthiness minimum 40 lbf. (178 N)** warp and fill directions using Federal Test Method Standard No. 191, method 5100 Break Strength of Woven Cloth; Grab Method.

Nylon Fabric: **Airworthiness minimum 30 lbf. (133 N)** warp and fill directions using Federal Test Method Standard No. 191, method 5100 Break Strength of Woven Cloth; Grab Method

Field Test: If field tests give results less than 40 lbf. (178N) polyester or 30 lbf. (133 N) nylon, samples may be removed and sent to an independent testing laboratory for verification testing.

6.2.4 STRENGTH OF OTHER FIBROUS PARTS

Fibrous parts such as thread, ropes, webbing, and FlexNet tapes normally deteriorate at a much slower rate than envelope fabric. Except in the case of damage, it is safe to assume that if the envelope fabric is airworthy, the other parts will be also.

If, however, the envelope has had extensive fabric replacement while retaining the original webbing, ropes, etc. this may not be a safe assumption. Pull testing these components is not required but a close inspection for signs of wear is recommended. You may contact FireFly Balloons with any questions or concerns related to this.

6.2.5 INFLATION TESTS (To be done at the discretion of the inspector)

There are two types of inflation tests used for inspection of the envelope. The simpler one is the lay-down cold inflation in which a fan is used to inflate the envelope. Personnel can easily inspect fabric, seam, stitching and exposed cords. The envelope can be rotated to inspect all sides, preferably in bright sunlight so that defects can be clearly seen. If there are no signs of poor valve fit or porous fabric, then a hot inflation may not be required. Hot inflations should be done at the discretion of the inspector. Should hot inflation be necessary, refer to the balloon's flight manual for inflation instructions.

If there is any doubt as to a proper valve fit or there are signs that the valve may be fitting too tight or too loose, a stand up hot inflation is recommended. If porosity is a concern, perform the fuel consumption test in Section 6.2.6. Extreme amounts of fading around the perimeter of the valve may be a sign that the valve is too tight and leaking. Excessive folds of fabric and creasing near the center may be a sign that the valve is too loose. It is strongly recommended that the gross weight during the test inflation be a common weight the balloon would be flown.

A properly fitted envelope valve will be centered in the hole and in contact with the top girdle on the entire periphery. An unbroken, shapely defined line will be visible through the valve fabric where it is in contact with the top girdle. Should the valve fit need to be adjusted, use the procedure in Section 5.2.5 of this manual.

The valve line must have a greater length than 5 ft. (152 cm) of slack measuring below the top of the burner supports. As a general rule, there should be slack that is at least equal to 10% of the height of the envelope. The crown line should have at least 3 ft. (91.4 cm) of slack, measured from the top of the burner support and should be free of excessive knots.

CAUTION: A CROWN LINE THAT IS TOO SHORT OR TIED OFF TOO TIGHT CAN LOAD THE TOP OF THE ENVELOPE UNEVENLY CAUSING UNEQUAL STRESSES ON THE LOAD CORDS AND TOP GIRDLE, POSSIBLY AFFECTING THE VALVE FIT.

The bottom girdle should be level at equilibrium and the carriage level. The girdle should appear to be in a straight line around the mouth of the balloon with no sharp peaks upward or downward. An abnormality in the girdle shape may indicate suspension cables are incorrectly installed. (See Figures 5-9 and 5-10 of this manual for proper cable color coding). It is possible, although unlikely, that the load cord could be secure stitched to the bottom girdle in an incorrect location.

In addition to the inspections of valve fit and valve line length, the inflation test is a good time to inspect the envelope for general integrity and mapping of damaged areas. It is also a good time to inspect the burner, fuel system and instruments.

6.2.6 FUEL CONSUMPTION TEST (ALSO REFERENCE SERVICE BULLETIN B11 AND SERVICE LETTERS L6 & L7)

This test need only be accomplished if fabric porosity is a concern. The best method for determining porosity in the fabric of a balloon envelope is that of fuel consumption under actual flight conditions. This is best accomplished by tethered flight test under calm wind conditions

NOTE: BEFORE DOING THIS MEASUREMENT, IT IS VERY IMPORTANT TO ENSURE THAT THE PARACHUTE VALVE IS CENTERED AND SEALING PROPERLY, USING THE INFLATION TEST PROCEDURE OUTLINED IN SECTION 6.2.5 OF THIS MANUAL. A LEAKY VALVE WILL GIVE FALSELY HIGH FUEL CONSUMPTION FIGURES.

From the Balloon Flight Manual, determine the system weight of the balloon without fuel. Subtract this from the Maximum Gross Weight (see LIMITATIONS in the Flight Manual). The resulting figure is the payload. Divide this payload figure by 2 to get the desired payload weight to be carried for this test.

i.e. Maximum Gross Weight – System Weight = Payload Weight.
Payload Weight ÷ 2 = Desired Test Weight

Add the weight of the pilot, fuel, and ballast if needed to bring the system up to the desired weight. This may be done with passengers, sand bags, containers or water, etc…

On a calm day, that is one during which winds are less than 2 miles per hour, record the outside temperature and inflate the balloon on tether. Bring the balloon to equilibrium off the ground and switch to a full tank, which has previously been weighed. Apply just enough heat to keep it there for some period of time, preferably 15 minutes. Deflate the balloon and re-weigh the tank that was used for the test. Convert weight to gallons [1 gallon of propane weighs 4.24 lbm at 60°F(1 liter of propane weighs 0.49 kg @ 15.5°C)] per hour.

Apply these factors to the amount of fuel used.

- For every 5°F (2.8°C) over 70°F (21.1°C) multiply the fuel used in gallons by 0.9 [i.e. at 75°F (23.8°C) multiply by 0.9, at 80°F (26.7°C) multiply by 0.81, at 85°F (29.4°C) multiply by 0.73, etc…]
- For every 5°F (2.8°C) under 70°F (21.1°C) multiply the fuel used in gallons by 1.1 [i.e. at 65°F (18.3°C) multiply by 1.1, at 60° (15.5°C) multiply by 1.21, at 55°F (12.8°C) multiply by 1.33, etc…)

Then, take the figure obtained above and multiply it by 0.9 for every 1000 ft. above sea level that the test is conducted. [i.e. multiply by 0.9 from 1000 to 2000 ft. (305 to 610 M), 0.81 from 2000 to 3000 ft. (610 to 914 M), 0.73 from 3000 to 4000 ft.(914 to 1,219 M), etc…].

During the test, if the balloon used fuel at the rate of more than 20 gallons per hour (75.7 L/HR)(corrected) for sizes up to and including 105,000 cubic feet (2,973 cubic meters) and 24 gallons per hour (90.8 l/hr) (corrected) for sizes from 120,000 cubic feet (3,398 cubic meters) and over, the envelope is considered un-airworthy because of excess fuel consumption and inspection is required to determine the cause.

6.3 CARRIAGE INSPECTION/ACCEPTABLE DAMAGE LIMITS

6.3.1. SUSPENSION ROPES

Damage affecting up to 25% of the circumference of the cover is acceptable except where it occurs within 25 cm (10”) of the tie plate. Damage affecting up to 10% of the circumference of the cover is acceptable in those areas. No damage to the core is allowable.

Inspect ropes for proper routing through carriage corner panels. Ensure they are not tangled with fuel hoses. Plastic covers should be inspected for condition, but damage to plastic covers is not automatic cause for rejection.

Inspect rope retainers to ensure that ropes are tied to corner panel eyebolts (single corner) and corner poles (double corner- see Service Bulletin B-26).

Inspect toggle loop lashing for integrity and shrinking. Inspect thimble (if installed) for security, burrs, nicks and condition.

6.3.2 FLOORS AND RUNNERS

Plywood floors and runners showing dents, gouges or other damage which might affect their strength must be repaired or replaced. Separation of plies, rot or similar evidence of decay is cause for replacement of the part. Runners are structural members contributing to the rigidity and strength of the system and must be replaced if cracked, broken or worn down to the level of the fasteners. On plywood floors, damage is typically found in the corners under fuel tanks due to tank movement during travel. Damage in excess of 1 ply must be repaired. Loose runners must be tightened.

If plastic sliders are installed over the runners, they must be secure and in good repair.

6.3.3 STEEL FLOOR LACING

Steel lacing must be repaired if broken. It may be replaced in small sections or in its entirety. Use floor replacement procedure in Section 5.3.4 of this manual to facilitate replacement of steel floor lacing.

6.3.4 TIE-PLATE AND ASSOCIATED HARDWARE

The tie-plates connecting suspension rope ends are heavily loaded and must be replaced if broken, cracked, or gouged. When replacing tie-plates it is recommended that the bolts and nyloc nuts be replaced as well. It is vitally important that the nylon bushings which are installed between the tie-plates are intact and in good condition. If the system is operated with the suspension rope eye-splices bearing directly on the bolts, damage will result to the rope and its strength will decrease.

6.3.5 RATTAN FRAME AND STRUCTURE

Rattan frame and structures include corner bows, side rails, floor poles and burner supports. It is important that its integrity be maintained. Broken rattan in any part of the frame must be repaired or replaced. Frequently, two-part resins or epoxy may be used for repair. Glass fiber tubing splints are acceptable repairs, provided they are secured using steel bands. Metal tubing must not be used as a reinforcing method.

6.3.6 BURNER SUPPORT ATTACH FITTINGS

Burner supports are attached to the carriage frame using Lynch pins, bolts and wing nuts, or a pin with ring. Regardless of the type used, it must provide a secure connection with positive locking features. The attachments must be free of excessive corrosion. Inspect square pins on burner support and carriage for security and condition.

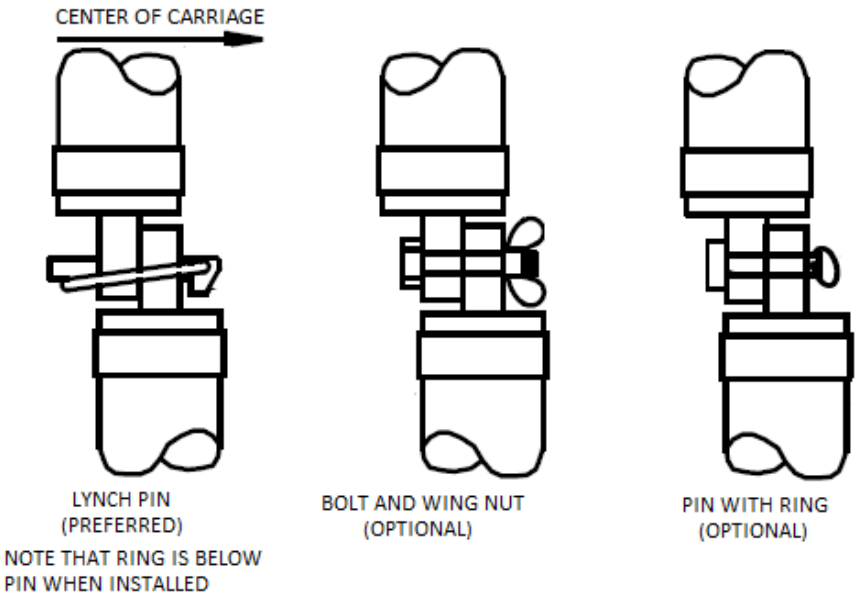

Figure 6-1 BURNER SUPPORT ATTACH FITTINGS

6.3.7 WICKER

The wicker structure is used principally to contain passengers and not as a major strength member. Broken wicker will not affect airworthiness but may endanger passengers if broken or sharp ends protrude into the passenger area. Holes up to 25 cm (10 “) at the widest point may be considered acceptable.

6.3.8 LEATHER/SUEDE PADDING

The condition of the leather/suede padding should be considered from a passenger safety standpoint and repaired or replaced if necessary.

6.3.9 FUEL CYLINDER RESTRAINTS/STRAPS

Damage affecting up to 20% of the cross section of any fuel cylinder strap is considered acceptable for airworthiness. Fuel cylinder restraint buckles, mounts, and rings should be inspected for corrosion and general condition. Corroded buckles, mounts and rings should be cleaned or replaced. Cracked components must be replaced prior to return to service.

6.3.10 CARRIAGE HANDLES

Inspect handles for security, proper installation and general condition.

6.4 FUEL SYSTEM INSPECTION

WARNING: A BALLOON WHICH HAS FUEL LEAKS IS NOT AIRWORTHY AND MUST NOT BE FLOWN UNDER ANY CIRUMSTANCES!

6.4.1 FUEL HOSES

Inspect fuel hoses for installation date. Hoses that have been in service for 9 years or longer require replacement. If installation date cannot be determined, use the hose cure date as basis for date in service.

Because of the catastrophic nature of serious fuel hose leaks; any hose that has any damage whatsoever, except for cosmetic damage to the protective cover, must be replaced.

The most common cause of abrasion damage is that where the hose is in contact with the edge of the fuel cylinder or carriage structure during transportation. Hoses should be tied back as necessary to prevent this condition.

6.4.2 METAL FITTINGS

Fuel hose ends, manifold parts and POL fittings which show significant corrosion or damage or leakage which cannot be eliminated by ordinary methods such as tightening should be considered un-airworthy and replaced immediately. Fittings showing evidence of over tightening should be considered unreliable and replaced.

6.4.3 QUICK DISCONNECT FUEL FITTINGS

There are two different types of quick disconnects used in FireFly fuel systems. These are the Parker (brass) and Swagelok (stainless) fittings. The Parker fitting has a replaceable rubber "O" ring which must be lubricated frequently. Inspect this fitting for leakage and replace the "O" ring if necessary.

Stainless steel POL fittings **must** be used with QD fuel fittings. They are standard equipment with factory supplied QD's but may not be present if the fittings have been retrofitted out in the field.

6.4.4 FUEL CYLINDERS

WARNING: ANY LEAK IN A CYLINDER OR CYLINDER FITTING RENDERS IT UN-AIRWORTHY IMMEDIATELY!

Inspect fuel cylinders for last certification date and pressure relief valve replacement. Cylinders that have exceeded DOT inspection intervals must be recertified before return to service. Pressure relief valves that have been in service for longer than 10 years must be replaced.

Fuel cylinders must undergo the standard Department of Transportation (DOT) testing/inspection at intervals of no more than 10 years by a properly certified DOT inspector. See Service Bulletin B-24 for more information on tank testing and inspection. In addition to DOT certification requirements, FireFly Balloons recommends that the fuel level indicator be removed, lubricated and have seal changed and that all valve bonnets be removed and lubricated when cylinders are recertified.

Fuel cylinders showing dents, deep scratches or gouges or similar damage must not be used in flight and should be drained and tagged before storage.

Fuel cylinders with leaks must be drained and depressurized. It is strongly recommended that faulty cylinders be tagged and the defect noted.

Cylinders which have been exposed to fire should be discarded. No attempt should be made to repair or refurbish them.

Inspection of fuel cylinders should confirm that the "dip tube" under the liquid withdrawal valves are intact and in place.

If the cylinders are empty, rattling noises may indicate that the dip tube has come adrift. These noises are not to be confused with those made by the liquid level float.

With the cylinder empty, removal of the liquid level gauge will allow visual inspection of the dip tube. If the cylinders are full, a burner test may indicate that the dip tube is not withdrawing liquid fuel. The symptoms of burner being fueled with vapor are the "thin" sound and anemic appearance of the flame, the tendency of the vaporizing coils to glow red and excessive drop of fuel pressure (usually 20 psi (138 KPa) or more) when the blast valve is operated.

NOTE: THIS LAST SYMPTOM MAY INDICATE A RESTRICTION IN THE FUEL SYSTEM. DO NOT TAKE THIS ALONE AS AN INDICATION OF A BROKEN DIP TUBE.

6.4.5 PILOT LIGHT VALVES AND REGULATOR

Pilot light valves, regulator and associated fittings should be inspected for proper operation and damage. The pilot light valve on the fuel cylinder should shut off with a positive snap and after a short time, during which the fuel in the line is being drained, should display no leakage. The pilot light shutoff valve on the burner should extinguish the flame instantaneously.

If the regulator is operating normally, a flame of approximately 1" to 3" (2.5 to 7.6 cm) in length should appear above the ends of the pilot light tubes.

6.4.6 FIRE SUPPRESSION SYSTEM

Inspect fire bottle for proper type, security and presence of safety pin. Ensure sufficient pressure exists on the gauge and that inspection is current. Inspect hoses and fittings for condition and security. An empty bottle does not render the balloon un-airworthy as this is not a required system, however, the owner should be made aware that the system is degraded.

6.5 BURNER ASSEMBLY INSPECTION

Burner inspection, T3-017 and F1 Mirage, is best accomplished by close visual inspection and then by performing a functional test.

6.5.1 BURNER VISUAL INSPECTION

Inspect cans and coils for cracks, corrosion, dents and holes. Inspect all connections for security, cracks and leaks. Check pilot light tubes for proper alignment and security. Inspect aspirator/center tube assembly for security and proper installation. Check handle for security and alignment of tab on F1 Mirage burner. Inspect hanger springs and arms/snap links for condition and security.

Airworthiness Directive AD 75-17-36 applies to T3-017 burners with serial numbers 510 through 562. It requires that the brass nipple connecting the trigger valve to the manifold be replaced with a steel one. The best way to detect a steel nipple is with a magnet, since it will be the only magnetic material of significance in the lower part of the burner.

It is necessary for proper operation of the main blast valve to have a gap between the base of the trigger valve handle and the face of the brass bonnet. The gap may be adjusted in accordance with Section 5.5 of this manual.

It is necessary for proper operation of the Fire 2 valve to have a gap between the base of the trigger handle and the nylon face of the brass bonnet. If the gap is too large, the flow of fuel may be restricted. If the gap is too tight, the valve may not fully close. Replacing the nylon washer and/or valve seats will correct these conditions.

6.5.2 REGO VALVE ANNUAL/100 HOUR INSPECTION PROCEDURE

The following maintenance must be performed on the REGO 7553 series throttle or trigger valves at each 100 hours in service or at each annual inspection, whichever comes first: (See AD 75-12-08, Service Bulletin SB#2 and Type Certificate Data Sheets A14SO and A10NM)

1. **All REGO 7553 Series Valves**:

Replace "O" ring stem seal in accordance with Section 5.5.1.6 of this manual.

2. **REGO *7553S* Valves Only**:

Remove bonnet in accordance with Section 5.5.1.6 of this manual. Check the torque of the valve seat retaining screw to 10 to 12 inch-pounds (1.1 to 1.4 N-M) in the loosening direction. If it turns, the screw must be removed, cleaned of lubricant and reinstalled using MIL-S-22473 high strength thread locking compounds, such as two ton (4,000 lbs.(17,8 KN)) epoxy by Devcon or Loctite 271 or equivalent. Recheck torque after thread locking compound is cured. Reinstall bonnet in accordance with Section 5.5.1.6 of this manual.

CAUTION: DO NOT PERMIT THE THREAD LOCKING COMPOUND TO ADHERE TO THE RUBBER SEATING SURFACE.

6.5.3 BURNER OPERATIONAL/FUNCTION TEST

Inspect connections and valves for leaks. F1 Mirage burner only, with all burner systems pressurized, inspect base plate seam and base plate attachments for leaks with window cleaner or soapy water solution.

Inspect for proper operation of pilot lights. Pilot lights can best be inspected in low light conditions, preferably outside in the evening. All three pilot lights should be easily ignited and should display an inner and outer cone. The inner cone should be brighter and no less than 3/8" (9.5 mm) high. The outer cone should be from 1" to 3" (2.5 – 7.6 cm) high. The alignment of the pilots should be such that they are in line with the flow of vaporized propane from the main burner nozzles. It should be impossible to extinguish the pilot lights with a flow of air equal to that from an inflation fan. Should one or more pilot lights be lower than normal, clean them in accordance with Section 4.10 of this manual. If this does not correct the faulty pilot light, replace orifices in accordance with Section 5 of this manual.

The main burner should ignite immediately from the pilot lights. The flame should be a thin blue line with very little yellow at the tips. No flame should exit from the side of the burner can or vaporizing coils. The trigger valve should operate smoothly and the flame should extinguish shortly after the trigger is released.

The Fire2 flame, unlike the main jet flame, is fueled by a direct liquid propane flow. Its flame is a brilliant yellow and is characterized by a large amount of radiant heat. It is important that the flame does not impinge on the burner as this would deflect it out of the sides of the can and coils in an unpredictable manner. Therefore the alignment must be carefully scrutinized. The Fire2 trigger valve on the F1 Mirage burner (and T3-017 burner, if installed) must operate smoothly and shut off immediately upon release. The valve must stay open when locked in that position.

The entire fuel system, including the burner must have no leaks.

6.6 INSTRUMENT INSPECTION

6.6.1 TS ELECTRIC DIGITAL TEMERATURE GAUGE ANNUAL/100 HOUR INSPECTION

In addition to the inspection procedures outlined in the ANNUAL/100 HOUR CHECKLIST, there is another required maintenance procedure for model TS Electric Digital Temperature Gauge, if fitted.

1. Unplug and remove the Model TS from its pocket in the envelope skirt.
2. Remove the instrument face by unscrewing the four corner fasteners.
3. Unplug and remove the nine volt batteries.
4. Connect and install two new alkaline nine volt batteries.
5. Check that the reading on the display is a number 1 with all other digits blanked out.
6. Reinstall the face plate.
7. Plug the instrument back into the envelope wiring harness.
8. Check that the reading is the ambient temperature +/- 4%. If the reading does not fall within this range, un-bag the envelope completely and allow the sensor to reach room temperature.
9. Place the instrument back into the pocket in the envelope skirt.

NOTES:

- A short circuit in the wiring harness will cause the display to indicate numbers in the 500 range.
- An open circuit in the wiring harness, including the sensor itself, will cause the display it indicate a 1 followed by blanked out digits.
- A faulty battery will cause a 'LOW BAT' indication to appear on the display.
- It is not necessary to recalibrate the instrument if the envelope sensor is replaced.

6.6.2 FLYTEC 3040 INSTRUMENT & TT34 TEMPERATURE TRANSMITTER ANNUAL/100 HOUR INSPECTION

Inspect Flytec 3040 instrument pack case for general condition and secure mounting to carriage. Ensure a safety strap is installed. Replace batteries in accordance with manufacturer's instructions. Ensure correct TT34 transmitter serial number is linked to the instrument pack and that the instrument powers up and appears to function normally.

6.6.3 ALL OTHER INSTRUMENTS ANNUAL/100 HOUR INSPECTION

Inspect all other instruments for general condition and ensure they appear to function normally. Altimeters should read close to field elevation when set to the current local altimeter setting. Rate of climb indicator should read zero when not in vertical motion. Temperature gauges should read correctly within 10° F (5.5°C). Change batteries on those instruments that use batteries in accordance with appropriate manufacturer's instructions.

Inspect temperature sensor and wiring in carriage and envelope for continuity, security and proper installation.

6.7 HARD LANDING INSPECTION

Following any hard landing where damage to the balloon is suspected, an inspection in accordance with the annual inspection guidelines in Section 6 of this manual should be performed. Any damage found that would prevent the balloon from passing an annual/100 hour inspection must be repaired and the balloon must not be flown until the damage is repaired.