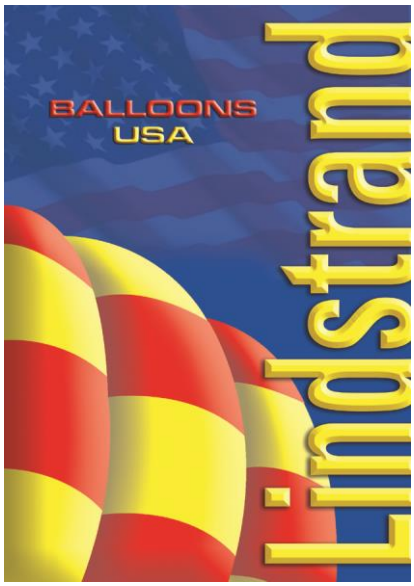
LINDSTRAND BALLOONS USA

MANUAL FOR CONTINUED AIRWORTHINESS



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Record of Amendments

No.	Date	Affected Pages	Approved
1.0	11.20.98	Original Issue	
1.1	04.16.01	ii, Sect. 3-1	
1.2	11.01.02	ii. Sect. 3-1	
1.3	04.01.03	ii, Sect. 1-1	
1.4	08.14.06	ii, Sect. 3-1	
1.5	03.01.07	Entire Contents of Manual	
1.6	11.02.09	Sect. 0-2, Sect. 5-3, Sect. 6-2, Sect. 6-3, Appendix A	
1.7	12-10-10	Sect 0-2 Sect, 5.1.1.1	
1.8	12-01-11	Entire Contents of Manual	
1.9	07-18-12	0-2, Appendix B 1-4	
2.0	02-15-13	0-2 Appendix B 1-4	
2.1	03-07-13	0-2 Appendix B 1-4	
2.2	01-02-14	0-1, 0-2, 0-3 Sect 2 Page 1 Sect 2.2, Sect 2.5 Sect 5.1.1.1 Sect 5.4.1, Sect 6.1.4.2 c, Sect. 6.1.4.6, Appendix A 1-10	

Amendments

This manual is kept up to date by amendments consisting of loose-leaf pages, required to add new information or amend existing information. Pages affected by an amendment and the effective date are shown above. The pages themselves are identified by a change of the issue number at the bottom of each page. The number after the point in the issue number represents the amendment level of that page, e.g. the page marked Issue 1.4 is at Issue 1, modified by Amendment 4.

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

Throughout this manual you will find the following messages:

NOTE: Offers information or instructions of special interest to the reader pertaining to a particular procedure or condition.

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

WARNING! Denotes information which if ignored could result in injury or death to persons.

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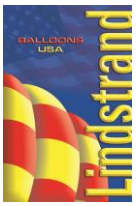

SECTION 5 - REPAIR AND MAINTENANCE

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B-1 Appendix “B” Envelope Repair and Damage Record
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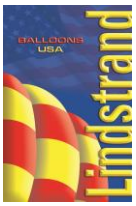


SECTION 1
INTRODUCTION

1.1 Purpose of this Manual

This Maintenance Manual provides information on the following aspects of a U.S. registered Lindstrand Balloons hot air balloon:

Airworthiness Limitations
Technical Description
Preventative Maintenance
Repair and Maintenance Instructions
Inspection Programs

In total, this information is intended to provide an owner, operator, or repairman, with sufficient guidance so that the balloon may be preserved in an airworthy condition. If any detailed information cannot be found in this manual, then the factory should be contacted at the address shown on Page 1.

All relevant parts must meet the requirements specified in this manual. Use of un-approved parts or sub-standard materials will invalidate the Certificate of Airworthiness. Deviation from the repair instructions and material specifications contained in this manual, are not permitted without prior written consent from Lindstrand Balloons USA.

1.2 Applicability

The information contained within this manual applies to all hot air balloons manufactured by Lindstrand Balloons USA under Type Certificates B00010CH, B82EU or B87EU. (See Section 3, Technical Description, for a comprehensive list of models covered.)

1.3 Identification of Systems

A serial number and a description identify all major components of Lindstrand hot air balloons. These are located as follows:

Envelope - Engraved on the crown ring and on an identification plate, which is situated on the top side of the envelope mouth.

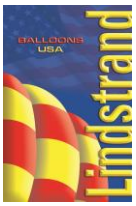
Burner - Engraved onto the top of the crossover valve, or the stainless steel burner can support bracket.

Single Burner - Engraved on coil support bracket.

Basket - Engraved onto a plate attached onto the basket sidewall.

Cylinder - Engraved on the bottom foot ring or on a plate, which is fixed to the bottom foot ring of the cylinder.

It is important that the relevant part number and serial number is quoted when communicating with Lindstrand Balloons.



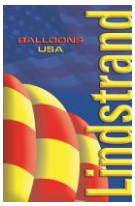
1.4 Qualification

This manual has been segmented so that the preventative maintenance which may be undertaken by the owner/operator, in accordance with FAR Part 43, Appendix A, Paragraph c, and any other servicing instructions which have no effect upon the airworthiness status of the balloon, are included within Section 4, Preventative Maintenance. All other maintenance and repair, including the annual/100 hour inspection, must be accomplished by an appropriately rated certified repair station or a certified mechanic.

SECTION 2
AIRWORTHINESS LIMITATIONS

Record of Amendments

NO	Date	Affected Pages	Approved
2.2	2-15-2014	Sect 2, 1-2	2/7/14



2.1 Approval Statement

The Airworthiness Limitations section is FAA approved, and specifies maintenance required under Sections 43.16 and 91.403 of the Federal Aviation Regulations.

2.2 Mandatory Replacement Time

All fuel hoses, main burner and manifold must be replaced after 10 years in service

2.3 Inspection Interval

The inspection interval for Lindstrand balloons is 100 hours of operation, or one year; whichever is the sooner.

2.4 Inspection Procedure

The inspection procedure can be found in Section 6 of this manual.
The inspection checklist is specified in Appendix "A" of this manual.

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2.5 Fabric Replacement

For all models of balloons manufactured by Lindstrand Balloons under Type Certificates B82EU, B87EU and B00010CH, replacement of envelope fabric is limited to a one time replacement of up to 65% of the original fabric at the time of manufacture, except for minor patches or repairs.

SECTION 3
TECHNICAL DESCRIPTION

3.1 Envelopes

Lindstrand Balloons manufactures 12, 20, 24, 28 and 32 gore envelopes.

Envelope Size (1,000's cu.ft.)		No. of Gores
42-180		24
-		
210-310		28
-		
69-105		12
-		
210		20
Can-90		32
Sphere-105		24
LBL Box		24

Basic envelope types are illustrated in Figure 3.1.1. The nomenclature of Lindstrand envelopes is shown in Figure 3.1.2. Envelopes are manufactured from high tenacity nylon or polyester base cloth, which is coated with either polyurethane fluorocarbon elastomer or silicon based elastomer. The base cloth is the load-carrying element of the fabric.

The coating produces an airtight membrane and the coating material contains an anti-fungal ingredient to inhibit the growth of mold.

A network of vertical and horizontal polyester or nylon webbing, called load tapes, encapsulates the envelope and provides a further load-carrying element. The vertical load tapes are attached to an aluminum apex, or crown ring, at the top of the balloon. They extend down to the mouth of the envelope where they turn back on themselves to form a loop. There is always a minimum of one vertical load tape per gore. Horizontal load tapes do not appear on every horizontal seam and are provided to increase resistance to tears or rips. There are at least three horizontal tapes, although this number increases with larger sizes of envelope.

A gore is the section of fabric that lies between two vertical load tapes. Each gore is constructed from individual panels. Panels may be oriented horizontally or vertically. Vertical panels are longer vertically than they are broad and visa versa for horizontal panels.

The first panel above the mouth of the balloon is made from heat resistant fabric, such as Nomex, which gives greater burn damage resistance for inflations and tethered flights. Balloons may also be fitted with a skirt or scoop. Scoops are made from Nomex or equivalent, and skirts can be made from nylon or nomex fabric. These devices are attached between the mouth and the load frame, outside of the envelope cables, thus providing protection for the burner flame from gusts of wind.

The envelope is attached to the burner frame using stainless steel or non-metallic envelope cables.

In-flight venting of hot air and the final envelope deflation is achieved using a parachute valve which is situated at the crown of the envelope (see Figure 3.1.2). It consists of a large disc of material that is retained in position laterally below a hole in the envelope. The hole in the envelope is spanned by the vertical load tapes which prevent the parachute from being forced through the hole.

Radial cords that attach to the outer rim of the parachute and the main envelope control the lateral position of the parachute. These are called centralizing lines. Pulling on a red and white (candy-striped) line in the basket operates the parachute. This transfers a vertical downward force to a pulley, which is at the confluence point of a number of pull-down lines attached to the edge of the parachute disc. The parachute disc is removed from the hole and hot air escapes from the envelope. When the operating line in the basket is released, the parachute reseals itself under the action of internal pressure.

An optional center-pull parachute (Q-vent), is activated by a solid Red line pulling from the center of the parachute. The vent may be re-sealed by pulling on the afore mentioned Candy Stripe line. A velcro rip panel can be fitted as well (see Figure 3.1.3).

Envelopes can also be equipped with rotation vents (see Figure 3.1.2). These vents are located around the envelope equator and consist of a break in the fabric that can be opened to allow air to be ejected tangentially. Operation is by a control line running up to a pulley that is fixed to the side of the envelope. The line then runs across to the rotation vent. In larger balloons, vents are often arranged in matched pairs and in this case, the pulley is attached to the operating cords of the second vent to permit them to be operated together. Once the force is released from the operating line in the basket, the internal air pressure causes the vents to reseal.

3.2 Baskets

All Lindstrand baskets are made from wicker (see Figure 3.2.1), and have either a solid plywood floor or a wicker woven floor. This floor is strengthened and protected on the underside by the addition of three or four runners, depending upon the size of basket.

In plywood floor baskets, the wickerwork is woven between two tubular stainless steel frames. These frames provide strength and stability to the wickerwork. The marine plywood floor is laced onto the lower stainless steel frame. This permits the basket floor to be replaced if necessary. All loads are carried by ¼" (6 mm) stainless steel wires which form a continuous sling around the basket. These wires are of 7x19 construction. The wires are attached to the burner frame by a carabiner. They then pass down to the top of the basket, running adjacent to a nylon pole, through a sleeved hole in the top frame. The wires pass through the wickerwork and then through sleeved holes in the bottom basket frame. They pass through and across the wooden floor, under the runners. The wires are locked into one of the runners by providing a recessed hole in the runner in which sits an extra swaged ferrule. The portion of the basket wires above the top frame is protected by a PVC covering.

The joint between the bottom basket frame and the floor is protected by rawhide or bottom scuff leather that is stapled and/or laced onto the floor and wickerwork respectively. Extra rawhide or leather strips are stapled over the basket wires where they run across the bottom of the plywood floor to provide protection.

Smaller baskets have a minimum of two stainless steel wires, which run down the vertical walls and across the bottom of the basket. In larger baskets, there are four separate stainless basket wires. The top basket frame has four upward facing sockets welded in place. Four nylon rods are inserted into these sockets and into similar downward facing sockets on the burner frame. This provides a rigid support for the burner frame and burner. The nylon rods, basket wires and burner hoses are covered with padded covers to prevent damage.

The top basket frame is covered with dense foam and then finished with suede or leather, which is laced on.

Within the weave of the basket are included rope handles, both internally and externally. The internal handles are provided for occupants to hold onto during landings.

Larger baskets are internally segmented to provide greater comfort for occupants. Partition walls are normally made from wicker and may be reinforced with large nylon verticals or wicker stakes. The lightweight partitions are formed by a matrix of webbing anchored into the steel top frame and bolted through the wooden floor and runners covered by padded walls. All Lindstrand solid plywood basket floors have a minimum of two holes drilled to permit fluids to drain through the floor. On larger baskets, the internal walls are often padded. Internal padding sections are laced into place. The top basket frame has four or eight upward facing sockets welded in place. Nylon rods are inserted into these sockets and into similar downward facing sockets on the burner frame. This provides a rigid support for the burner frame and burner. The nylon rods, basket wires and burner hoses are covered with padded covers to prevent damage.

Strengthened belt holes are created within the wickerwork to permit various items such as fuel cylinders, instruments and flight bags, to be restrained in position during flight.

2 Cylinder straps are used to restrain each fuel cylinder in place

A wide variety of sizes of baskets are available. Smaller open baskets may have a straight top or swept profile with either sunken or protruding nylon pole sockets. All partitioned baskets are straight topped with protruding nylon pole sockets and have plywood floors. (see Figure 3.2.2).

The easy access basket variants have a vertical hinged, outward opening door introduced in the side of the basket and may have an upward swinging top bar in the upper stainless steel basket frame. (see Figure 3.2.3) The door is constructed from a stainless steel tubular frame with standard woven wicker fill. Two footstep holes are provided within the door to permit entry and exit only when the door and top bar are fully shut and latched. The top bar is hinged on one side and latched by the use of a push / pull release pin at the other end (see Figure 3.2.4). To rotate the top bar the release pin is removed and the bar is rotated upwards. Once in the upright position another stopping release pin is provided at the hinge end of the top bar. This pin is inserted through the hole provided close to the hinge to prevent the top bar from dropping down unintentionally (see Figure 3.2.4). Note that the push pull release pins are operated by pushing or pulling on the figure eight shaped ring. The reaction of pushing or pulling releases the locking ball mechanism.

The door is secured in the closed position by an upper and lower drop latch. The drop latch is retained in the closed position by the addition of an upper and lower drop latch. The drop latch is retained in the closed position by the addition of a safety hook which should be inserted through the lower part of the latch (see Figure 3.2.4).

3.3 Fuel Systems

The LPG (Liquid Petroleum Gas) fuel is stored within special lightweight cylinders for in-flight use. The fuel is stored under sufficient pressure to ensure that it is in the liquid form. (see Figure 3.3.1).

3.3.1 Equipment Fitted to all Flight Cylinders

3.3.1.1 Liquid Withdrawal System

This consists of a tube that descends almost to the bottom of the cylinder. It is attached to a valve boss and connector at the top of the cylinder. When the valve is open and with a suitable supply hose connected, the internal pressure forces liquid out of the cylinder. The liquid valve may be a screw type or a ball type (Quarter-turn) valve. The connector is either the hand-threaded or hydraulic hose type.

3.3.1.2 Contents Gauge

The contents gauge is centrally mounted in the top dome of the cylinder. There is a float attached to a rotating arm. Changing levels of liquid in the cylinder cause the arm to rotate. A geared system links this movement to a magnet mounted in the top of the gauge. This magnet causes the needle within the dial to register the remaining contents. The length of gauge is different for differing sizes of cylinder.

3.3.1.3 Pressure Relief Valve

The pressure relief valve may be integral within a vapor withdrawal valve, or separately mounted in a boss on the top dome of the cylinder. Irrespective of the type, the principle of operation is the same. A powerful spring holds a cone type valve in place, preventing any leakage. When the internal pressure of the cylinder reaches a pre-determined level, the cone valve is forced away from the sealing surface, thus allowing the pressure to escape. The set level for all cylinders is 25 bar (375 psi) and this prevents the cylinder rupturing explosively when the pressure increases.

3.3.1.4 Maxfill (Ullage) Valve

This is a small screw valve attached to a long tube, which extends into the top dome of the cylinder. It is opened when the cylinder is being refueled to permit the operator to determine when the cylinder is full. This is achieved by watching for the presence of liquid escaping from the valve. The length of the attached dip tube varies with the size and type of cylinder, to ensure that a 15% of volume vapor space is left when the cylinder is full.

3.3.2 Optional Equipment

3.3.2.1 Cylinder Jackets

Each different size and type of cylinder may be covered with a padded cordura fabric jacket. This jacket protects the cylinder and also provides cushioning for the occupants in an open type basket. The cylinder jacket may also have resistance heating wire incorporated into it, or heat tapes may be attached directly to the tank. When this heating wire is connected to a suitable supply source (either 240V or 110V), it heats the outside of the cylinder, causing the vapor pressure of the fuel to increase. This aids burner performance in low ambient temperature conditions.

3.3.2.2 Fuel Manifolds

Fuel manifolds may be used for the convenience of the pilot to provide interconnection between cylinders in the basket. This allows changing from one fuel supply to another without disconnecting the burner hoses from a cylinder to re-connect to another cylinder in-flight.

The manifolds consist of female connectors appropriate to the type of cylinders being used, and in the number of cylinders which require interconnection. Hoses and adapters provide the connection between the cylinders. A male connector is provided in a suitable location for connection to the burner hose.

Only manifolds manufactured by Lindstrand Balloons may be used with their balloons.

3.4 The JetStream Burner

The JetStream burner comes in a variety of configurations ranging from a JetStream Single to JetStream Quad burner. The JetStream burner is a device for heating and directing air into a hot air balloon envelope. It can be fueled by any aliphatic hydrocarbon, provided there is sufficient pressure in the fuel storage vessels to provide the required fuel flow. The preferred fuel is commercial quality liquid propane (BS 4250 1975).

Fuel is supplied in the liquid form, from the cylinder to the main burner block, via an armored hose. It enters a chamber in the main distribution block. The chamber provides fuel supply to the main vaporizing coil valve, the liquid fire valve, the pilot light regulator and the pressure gauge. On the downstream side of the main blast valve is another valve which when turned on, allows fuel to flow into a multi-orificed jet. The burner is also fitted with a high voltage piezo electric spark igniter.

The larger burners suitable for larger envelopes, as described in Section 1 of the Lindstrand Balloons Flight Manual, are essentially multiple copies of the single and/or double burners.

For convenience, the most common burner sizes, the single (see Figure 3.4.1) and the double (see Figure 3.4.2), will be described.

3.4.1 Overview of the Single Burner

The JetStream Super Single Burner is based on the JetStream Double, but differs in that only one vaporizing coil is provided. However, all the primary functions i.e. main burners, liquid fire burners, pilot lights, fuel feeds, pressure gauges and piezo igniters are duplicated such that essentially two independent burner systems are provided within a single unit.

3.4.1.1 Main Vaporizing Coil

One coil is fitted and is common to both main burner valves (see item (3) Fig. 3.4.1). The coil is manufactured from 7 meter of 12.7 mm OD stainless tubing, arranged in a two start winding. It is of the conventional flow direction, with the fluid rising to the top of the coil and then descending into the square section jet ring. The jet ring is equipped with 28 jets, 21 of which are 1.3 mm diameter and the remainder are 1.6mm diameter.

3.4.1.2 Main and Liquid Fire Valves

These two valves are of an identical basic design, but produced so that the valves are of differing lengths, in order to distinguish between the two different functions. The valves are of a plunger type with a handle attached by a rotating joint to a spindle. When the handle is moved from a horizontal plane into a vertical plane, the spindle is lifted. The spindle is attached to a valve seat by another rotating joint. When the spindle is lifted, this lifts the valve seal away from the valve seat, allowing fluid to flow through the valve. The fluid is prevented from leaking to atmosphere by the presence of a spring energized TEFLON piston seal, situated on the spindle.

This type of seal has low friction and the internal spring ensures that even at low temperatures and pressures, there is sufficient radial compression to achieve 100% sealing. The design of the seal body itself is such that with increasing differential pressure, the radial sealing force increases. An extra seal is also provided further up the spindle which prevents the ingress of contamination.

Due to the action of the handle on the spindle, there are forces that act in a radial direction on the spindle. For this reason, a bush is included at the top of the spindle to resist these horizontal forces. The bush is manufactured from a composite metal matrix, including a sintered bronze base filled with a TEFLON lead mixture. This bearing provides excellent lubrication and does not require servicing. The valve spindle can be rotated independently of the valve seal, thus permitting the handle to be positioned as required by the pilot.

The position of both the valve handles is on the lower base of the burner. This allows either handle to be used from any position in the basket with an operating action that does not cause excessive pilot fatigue. The difference in general size, texture and color of the handles permits the pilot to select the type of burner that is required during flight, without having to look upwards.

3.4.1.3 Single Burner Main Burner Valves

The valve bonnets are smaller in diameter and have a different external profile. The valve handle design is significantly different in that squeeze grip controls are fitted instead of the more familiar toggle handle (see item (19) fig. 3.4.1.1).

The squeeze grips are recessed into a 'T' bar handle, which also acts as the main means of maneuvering the burner.

3.4.1.4 Pilot Light Valve and Regulator

The pilot valve handle has been designed for easy operation, even when wearing heavy gloves. The outer rim of the handle and the main block have both been engraved, clearly showing the function of the valve and its position. (I = ON and O = OFF).

In principle, the operation of the regulator has been arranged to provide high reliability with compactness. The function of the pilot valve and regulator have been combined so that the valve operates by over-riding the open/close action of the regulator.

The regulator is of the piston type to ensure small size. Two cleanable filters are also included in the regulator design, with a filtration size of 50 micron. One is situated before the inlet to the regulator and the other is positioned just before the pilot light jet. These filters prevent jet blockages.

The pilot light itself is of the "Bunsen Burner" type, which has excellent resistance to wind gusts and good high altitude performance.

3.4.1.5 High Voltage Ignition System

Two piezo igniter assemblies are fitted. A high voltage igniter is provided in the burner, contained within a waterproof heat resistant housing. The electrode is made from special steel which is highly resistant to prolonged high temperatures. The complete igniter assembly is sealed on the main block to prevent the entry of water.

3.4.1.6 Pressure Gauges

Two pressure gauges are fitted. The gauges are completely isolated from each other and as such monitor the fuel pressure only in the fuel circuit to which it is dedicated.

A tailor-made pressure gauge is fitted into a recessed cavity within the main block, to provide an indication of the fuel pressure. It is connected into the main liquid feed and thus will provide an indication of pressure as soon as the cylinder valve is turned on. The gauge dial has a green sector marked upon it, which shows the correct operating pressure of the burner. A flow restrictor is included in the passageway that feeds the pressure gauge. This prevents damage to the gauge and tends to reduce vibration of the pointer, allowing for improved readability.

3.4.1.7 Liquid Fire Nozzle

Two liquid fire nozzles are situated inside the can (see items (4) fig. 3.4.1). The liquid fire nozzle is situated adjacent to the pilot light inside the burner can. It is operated by opening the appropriately marked valve on the main burner block. It produces a stream of liquid propane which burns slowly, thus producing less noise than the main burner. It provides redundancy on all burners and serves as a quiet burner when flying close to livestock.

3.4.1.8 Main Burner Block (Single Burner)

A tapered circular valve block is mounted below the burner can. The block is so designed that two independent and isolated fuel distribution circuits are provided. All valves, the coil assembly & the fuel supply lines attach to this block.

3.4.2 Overview of the Double Burner (Series 1)

The double burner is a variation of the single burner where the independent fuel circuits are separate and each feeds its own vaporizing coil. This allows true doubling of the power output of the single burner. (see Fig. 3.4.2)

3.4.2.1 Main Vaporizing Burner Coil

The design and function are as detailed in section 3.4.1.1 of the Maintenance Manual.

3.4.2.2 Main Burner Valve and Liquid Fire Valve

The design and function are as detailed in section 3.4.1.2 of the Maintenance Manual.

3.4.2.3 Pilot Light Valve and Regulator

The design and function are as detailed in section 3.4.1.4 of the Maintenance Manual.

3.4.2.4 High Voltage Ignition System

The design and function are as detailed in section 3.4.1.5 of the Maintenance Manual.

3.4.2.5 Pressure Gauge

The design and function of the gauge is as detailed in section 3.4.1.6 of the Maintenance Manual.

3.4.2.6 Liquid Fire

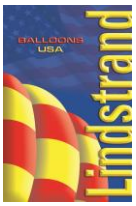
The design and function of the nozzle is as detailed in section 3.4.1.7 of the Maintenance Manual.

3.4.2.7 Cross Over Valve

This is a highly reliable "sandwich" type ball valve. The handle used is of the same design as the pilot light valve, to permit easy use even when wearing gloves. It is engraved with the internationally recognized symbols O = Off and I = On. These are aligned with a triangular datum marking on the valve block itself. The reverse face of the cross over valve may be engraved with the burner serial number.

3.4.2.8 Main Burner Block (Double Burner)

The burner is designed around a pair of distribution blocks. These blocks may be joined be a cross-over valve. Keeping the number of connections as low as possible contributes significantly to high reliability and simple maintenance.



3.4.3 Overview of the Double Burner (Series 2) Toggle Action (see fig. 3.4.3)

3.4.4 Overview of the Double Burner (Series 2) Squeeze Trigger (see fig. 3.4.4)

3.4.4.1 Main Squeeze Action Valve (Details) (see fig. 3.4.4.1)

3.4.5 Optional Commercial Liquid Fire (CLF)

The Commercial Liquid Fire burner is a more powerful version of the liquid fire, producing approximately 3.7 MW of power at a supply pressure of 7 bar.

It consists of a modification to a standard burner, involving the removal of the main vaporizing coil and the insertion of a special 12 jet nozzle which fits onto the main coil post in the center of the burner. In association with this, the operating valve handle is colored red and the relevant engraving on the burner block changes to "CLF". In most cases, the normal liquid fire assembly is removed from the CLF burner in its entirety, and special machined blanks are inserted into the resulting holes.

The basic burners that the CLF may be fitted into are the JetStream Triple and Quad burners, in which they are described as the JetStream Double plus CLF and JetStream Triple plus CLF, respectively.

The CLF burner is normally situated in a burner that is close to the pilot, to permit easy operation.

3.4.6 Triple Burner

The JetStream Triple burner is based upon the Double burner, with the addition of a specially manufactured third burner, to form a delta shape. The third burner is normally "slaved" to one of the other burners, in that there is a mechanical linkage which is provided between the main valve handle on one of the master burners, and the valve handle on the slave burner. This permits the slave burner to be operated in concert with one of the master burners. When the Triple is fitted with a Double-T basket, this mechanical linkage is optional.

If the cross-over valve is opened on the master burner which has the mechanical cross linkage attached to it, then all three burners may be operated from one handle. Two liquid fire units are provided on the master burners.

The mounting arrangement for both the Triple burner and the Double plus CLF variant is slightly modified to take account of the natural weight imbalance. One axis of rotation is provided in a central hub, while the other axis of rotation is achieved at the ends of an offset support tube. There are two settings provided at the ends of the support tube. One is for the Triple burner and the other for the Double CLF burner.

3.4.7 Quad Burner

The JetStream Quad burner is a straightforward duplication of the Double burner, with a few additions. As for the other multi-burners, mechanical linkages which may be selected off or on are provided to connect the main blast valve of each burner unit. By using these linkages in association with the standard cross-over valves, all four burner coils may be operated from one burner handle. The mounting arrangement for the burner is modified so that both axes of movement are provided on a central hub. The force required to move the burner is adjustable by a variable friction housing incorporated within the central hub.

3.4.8 Hydraulic Remote Burner Control

The hydraulic remote control enables the Lindstrand range of burners to be operated in the conventional manner or by a remote hand held lever. The system includes a low spill quick release coupling which enables the lever assembly to be removed for storage.

3.5 Instruments

3.5.1 Ball M55 Instrument Pack

This is a combined instrument package comprising of a two-scale electric variometer, an electric digital altimeter and a digital envelope temperature pyrometer. The case is made of black plastic, with a removable back cover which allows simple access to the two independent power supply batteries. The M55 may also have the optional barograph recording feature.

The electric analog variometer contains a small silicon absolute pressure transducer, with an output voltage proportional to altitude. This voltage is differentiated to give the rate of climb reading.

The altimeter is a digital voltmeter calibrated to read the transducer's voltage in either 1 foot or 1 meter steps from sea level up to 19,999 ft or 6095 m. The altimeter may be switched to read out the corrected barometer setting at the launch site. The barometer setting is adjustable with a set knob. (see Figure 3.5.1.)

3.5.2 Flytec 3040 Instrument Pack

The Flytec 3040 digital instrument package consists of two parts, transmitter and receiver (see figure 3.5.2). The transmitter is housed in a 5" x 2 1/2" x 1" shock-resistant ABS case which is attached to the outside of the balloon envelope on a vertical load tape with a velcro strap. This is a fully automatic high frequency (HF) transmitter with temperature controlled automatic on-off switch. Power is provided by a standard 9 volt alkaline battery, which will provide approximately 200 hours of service. Transmitter may be removed from the envelope or left in place between flights.

The Receiver is housed in a 6.75 " x 3.25" x 2" shock-resistant ABS case which may be attached in any convenient place in the basket via a velcro strap. It contains a variometer with both analog and digital display, as well as an audible sink alarm. The variometer range is up to 2,000 ft. per minute climb or descent. The sink alarm is adjustable and can be switched on and off.

The LCD digital-display altimeter has a range of up to 24,000 ft. MSL, and the display can be toggled between altitude in feet, altitude in meters, or barometric pressure. A third display can be toggled between envelope temperature, ambient temperature, and a variety of stopwatch functions. There is also an adjustable audible temperature alarm which can be set at any temperature below 275°F. Power is provided by a 9 volt alkaline battery with second 9 volt battery in-reserve. Power can be switched between the two batteries as necessary.

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SECTION 4
PREVENTATIVE MAINTENANCE

WARNING!

INSTALLATION OF ANY NON-APPROVED PARTS OR MATERIALS, THE MODIFICATION OF ANY AIRCRAFT PART, OR THE UTILIZATION OF A NON-APPROVED REPAIR METHOD COULD RESULT IN A HAZARDOUS CONDITION, WHICH COULD RESULT IN DEATH OR INJURY.

4.1 Paperwork Documentation

Any preventative maintenance work carried out by the balloon owner or operator, in accordance with the instructions contained within this section of the Maintenance Manual, or within FAR Par 43, Appendix A, Paragraph c, must be documented with an entry in the balloon logbook, which includes the following information:

a. A description of the work performed
b. The date of completion of the work performed
c. The name and pilot certificate number of the person who made the repair or approved it
d. The total number of hours on the balloon when the work was performed

It should be noted that the owner or operator of the balloon must hold a current pilot certificate issued under FAR Part 61, in order to undertake preventative maintenance and to sign the aircraft logbook. For further details, refer to FAR 43.

4.2 Envelopes

4.2.1 Cleaning and Storage

Cleaning of envelopes should be accomplished using a mild soap (such as Woolite or other non-detergent soap). This should be diluted with water and wiped onto the fabric. A vigorous scrubbing action must be avoided, as this can remove the fabric coating. Any abrasive cleaning fluid must not be used, neither should brushes, for the same reason. Under no circumstances must the balloon be washed in any type of washing machine.

Once cleaning is complete, the balloon must be dried out completely before packing and storing. Drying should not be completed by adding heat. Heating the fabric while wet may cause coating damage. The simplest method of drying out the balloon is to cold air inflate it. Load tapes, nomex, ropes will take considerably longer to dry than the fabric. Even slightly damp load tape will cause severe mildew problems in the fabric packed around it. Mildew changes the coating structure and causes porosity. Coating separation is caused by moisture combined with elevated temperatures, also increasing porosity.

Balloons can be stored overnight in a slightly damp condition, but leaving them packed wet for any longer will cause rapid fabric degradation. Dry as soon as possible.

CAUTION:

STORING A BALLOON WET FOR LONGER THAN 24 HOURS MAY DO PERMANENT DAMAGE TO THE FABRIC AND/OR COATING.

4.2.2 Care of Velcro

Although not always convenient, it is best to reseal the velcro tabs after every flight. The effectiveness of velcro joints can be prolonged by regular cleaning of both sides. Carefully remove all pieces of grass and other materials that tend to get trapped.

4.2.3 Crown Ropes

Crown ropes frequently become damp during inflation and after landings and will retain moisture. If this occurs, it is better to untie the knot at the crown ring and store the crown rope separately from the envelope in a dry location.

4.2.4 Envelope Handling

If possible envelopes should only be handled by the load tapes. This avoids fabric damage.

Care should be taken with clothing worn by the pilot and the crew, so that sharp objects like badges, jewelry or pins do not cause tears. Boots fitted with hook-type eyelets should be avoided for the same reason.

When laying out the envelope, carefully inspect the ground for hidden sharp objects. If an inflation directly on tarmac or gravel is necessary, avoid dragging the balloon across the surface and minimize the number of people treading on the fabric. If an internal inspection is necessary in this situation, it is best to remove your shoes.

4.2.5 Lubrication of Pulleys

The O/O may lubricate pulleys with either a silicone spray or dry lubricant such as graphite, as needed. It is suggested that Q-vent/Smart Vent pulleys be lubricated every 5-10 hours of operation, or if there is noticed increased effort in operation. This is particularly important in dusty or desert environments.

4.2.6 Owner/Operator Envelope Repairs

Any damage in fabric in the lower two nylon panels may be repaired by the O/O, provided the repair is made using approved fabric, thread and technique as outlined in Section 5.1.2.2.1. Additionally, there must be no damage to the vertical or horizontal load tapes or any control mechanism. Repairs to load tapes anywhere on the envelope must be undertaken by a qualified repairman or facility.

4.2.6.1 Sticky-Backed, Contact Cement or Silicone Patches

If the longest dimension of a hole or tear is less than 3" (75 mm), then the hole can be repaired using sticky-backed fabric or a contact cement patch (Standard or Diamond Weave Fabric) or a Silicone Patch (Hyperlife Fabric)

The size of patch must be such that there is a minimum of 1" (25 mm) overlap all around the damaged portion of fabric. The damaged panel should be laid out on a flat smooth surface so that there are no wrinkles in the fabric. A patch should be cut to cover the hole with required overlap. The patch should be placed inside the envelope covering the damaged portion, and a second patch may be applied so that it is covering the first patch precisely on the outside of the envelope. Ensure that the resulting repair has not caused any distortion of the panel (see Figure 5.1.2.2.1.a.).

Note that this repair method may not be employed if the damaged section of fabric extends to within 1" (25 mm) of any load tape or seam.

a) Contact Cement Patch (Standard or Diamond Weave Fabric)

A contact cement patch should be cut from matching balloon fabric and may be applied on the inside or the outside of the envelope making an effort to align the ripstop fabric pattern. The cement product should be applied to both the patch and the envelope per the adhesive manufacturer's instructions. The same 1" (25mm) overlap beyond the damaged area as specified above applies. Any flexible contact cement intended for use on nylon fabric may be used.

b) Silicone Patch (Hyperlife Fabric)

Adhesive patches for silicone coated fabric (Hyperlife) should also be cut from matching fabric and applied on the inside or outside of the envelope. Any clear non-hardening silicone based adhesive may be used following the adhesive manufacturer's instructions. Unlike contact cement patches, silicone adhesive patches need to be compressed by weight until fully cured. Depending on the adhesive brand curing could require several hours.

4.2.6.2 Nomex Scoop & Nomex

Damage in the Nomex panel may be repaired by the O/O, provided the repair is made using approved fabric, thread and technique. Additionally, there must be no damage to the vertical or horizontal load tapes or any control mechanism. Repairs to load tapes anywhere on the envelope must be undertaken by a qualified repairman or facility.

4.2.6.3 Envelope Suspension Cables:

Existing non-metallic envelope cables may be replaced by the owner/operator. If the outer cover is damaged and the interior core is exposed, the cable must be replaced before the next flight. See Section 5.1.2.4 for instructions.

4.2.6.4 Red & White (Candy Stripe) Parachute or Solid Red Q-Vent Deflation Line :

There is excess deflation line stored in the large loop at the tied-off end in the envelope which may be let out assuring the existing knot is duplicated. Only a certified repair person may splice the deflation line or tie additional pieces to it. It is not permitted to shorten either line.

4.2.6.5 Banner loops:

Non-certified persons may sew small attachment tapes on the vertical load tapes for attaching banners.

4.3 Baskets

4.3.1 Cleaning, Storage and Re-varnishing

The best method of preserving the basket in good condition, is to ensure that it is stored correctly between flights. The preferred storage environment for baskets is in a cool, dry area. Hot dry areas should be avoided as the wickerwork tends to dry out and can crack more easily. Equally, damp areas should be avoided as this can cause rot. If hot temperatures are unavoidable, it is recommended that the wicker is regularly soaked with water.

Cleaning the wicker is best achieved in the same way. Mud which has dried onto the exterior can be removed using a garden hose washer from inside the basket. The padding on the baskets can be cleaned using a suitable suede or leather cleaner as appropriate. It is best to keep the basket free of dirt. This is simply achieved by removing all basket equipment, cylinders, cushion floor, etc. and removing any collected debris by a vacuum cleaner. Pay particular attention to the joint between the bottom basket frame and the plywood floor. The cushionfloor foam can be cleaned using detergent and water.

The baskets may be re-varnished to renew the protective layer. A good quality flexible varnish should be brushed on to the exterior wickerwork. Avoid varnishing over the rope handles or suede/leather covering.

NOTE:

AVOID HIGH PRESSURE SPRAY WASHERS, THEY MAY DAMAGE THE NATURAL RATTAN AND POSSIBLY STRIP THE NATURAL PROTECTIVE OUTER LAYER OFF. TO AVOID TRAPPING MOISTURE, DO NOT REPLACE THE CUSHIONFLOOR AND FUEL TANKS UNTIL THE BASKET IS COMPLETELY DRY.

4.3.2 Basket Upholstery

If the suede or leather trim covering the padding on the top frame is torn, it can be repaired as follows:

Remove the damaged section of leather by carefully unlacing the cord holding the trim on to the basket. Cut a patch of replacement leather of the correct color, which is $^{5}/_{8}$" (15 mm) larger than the damaged section. Glue and/or stitch the patch on to the underside of the damaged section. Also, stitch the edges of the hole or tear on to the patch to avoid fraying at the edges. Replace the leather on the basket, lacing into place. Another option would be to remove the covering and sew a replacement piece and re-lace the bolster into place.

4.3.3 Suspension System

Non-certified persons may replace the carabiners with parts provided by Lindstrand Balloons USA (EN1000 OR EN1907) as original equipment replacement parts. Substitution of carabiners except as specified in the type design is prohibited.

Nylon poles must be replaced with Lindstrand Balloons supplied poles only. No other material may be substituted.

4.4 Fuel Systems

4.4.1 Fuel Cylinders

Generally, the flight cylinders require little specific attention throughout their service life, provided that the following instructions are followed.

4.4.1.1 Handling Cylinders

Although the cylinders are strong, care should be taken when moving them. Ensure that when the cylinders are placed on rough, uneven ground, that the cylinder is resting on the footring and not on the dome of the cylinder itself. Since the footring on titanium tanks is strapped to the body of the cylinder rather than welded extra care should be taken when handling.

CAUTION:

AVOID DROPPING CYLINDERS ON HARD SURFACES AS THIS MAY DENT OR DISTORT THE FOOTRING.

4.4.1.2 Transportation of Cylinders

It is best to transport the cylinders standing upright. Transporting cylinders on their sides should be avoided and could cause irreparable damage to their internal components. Cylinders should always be restrained from movement during transportation.

4.4.1.3 Cleaning of Cylinders Externally

Cylinders may be washed using detergent and water. Remove tank covers prior to washing.

4.4.1.4 Protection of Connectors

Both threaded and hydraulic hose types of liquid connectors are provided with dust caps. These should be fitted over the male half of the connector which is situated on the cylinder to prevent the accumulation of dirt in the connector. Both styles of connector have an integral seal that prevents the flow of liquid propane if the female half of the connector is not connected. The connector is situated downstream of the main on/off liquid valve and there is the possibility of liquid becoming trapped between the valve and the connector seal if the fuel hoses are disconnected without bleeding the lines. If this trapped liquid is not vented, subsequent temperature increase will cause expansion, which tends to cause the seals within the connector to fail. It is a good habit to depress the connector nipple before the cylinder is stored.

To prolong the life of the seals within the connector and to ease the connection process, it is a good habit to regularly lubricate the whole connector (both male and female halves). The recommended lubricant is silicon grease, in either the solid or spray form. However, if the balloon is operated in a dusty or sandy environment, the recommended lubricant is a dry type such as graphite powder.

4.4.2 Replacing Pre-Fabricated Fuel Hose

If a section of fuel manifold requires replacement, the first action is to measure the hose length, as shown in (see figure 4.4.3.) Dismantle the manifold by unscrewing the various connectors from each end of the hose. Carefully note the types of end fittings on the hose and into which connectors the end fittings were screwed. Order a pre-fabricated replacement hose from the factory, specifying the measured length and the required end fittings. When reassembling the replacement hose, new sealing washers must be used with the $^{3}/_{8}$" BSP male threads. 1/4" NPT threads should be sealed using medium thread lock compound or teflon tape applied to the male thread only. Once the assembly is complete, the whole manifold should be carefully tested for pressure integrity.

4.5 Burners

4.5.1 Storage and Handling of Burners

The burners are the engine of the hot air balloon, and consequently should be stored with care. Ideally it should be stored suspended within the basket so that it cannot hit other items. A padded burner bag is available for small and medium framed burners. You should avoid traveling for long distances, or short distances over rough terrain, with the burner erected on its nylon rods.

CAUTION:

TRAVELING WITH THE BURNER ERECTED ON THE NYLON RODS IS NOT ADVISED. IT WILL SUBJECT IT TO REPEATED JARRING AND CAN DAMAGE THE BURNER. THE BURNER FRAME, ASSOCIATED CONNECTORS TO THE BURNER, AND THE UPPER BASKET FRAME. IF THIS IS UNAVOIDABLE, A THOROUGH INSPECTION OF THE BURNERS, ALL CONNECTORS, TOGGLE VALVE HANDLES, BURNER-TO-FRAME INTERFACE, FRAME-TO- ROD INTERFACE AND ROD-TO-BASKET INTERFACE IS ADVISED PRIOR TO THE NEXT FLIGHT.

The burner may be placed on soft ground, resting on the burner coils, to assist in the insertion of the burner rods. Hard surfaces should be avoided wherever possible at this stage.

Care should be taken when dismantling the basket and burner assembly to avoid dragging unprotected connectors on the ground. It is recommended that the connector dust cap is always fitted to the connector before the burner is taken down.

4.5.2 General Cleaning

During the operation of the burner, there is inevitably an accumulation of carbon deposits (soot) within the coil and can of the burner. Regularly available aerosol glass cleaners with ammonia (i.e. Peek, Windex) wiped with a soft cloth will remove these deposits. Heat discoloration of the coils can be removed using products such as Blue Away and Semi-Chrome designed for cleaning of motorcycle exhaust systems.

4.5.3 Adjustment of Slurper Tube

See instructions in Section 5.4.8.

4.5.4 Piezo Ignition Unit Adjustment

See instructions in Section 5.4.7.

4.6 Hydraulic Remote Burner Control

4.6.1 Handling and Storage

The hand held lever assembly should be removed and stored in a manner, which prevents damage to the assembly and hoses when not in use.

During normal operation, the lever assembly can be adjusted to give the most comfortable feel and to remove any slack in the system by tightening or loosening the two set screws on the lever.

4.7 Instruments

In general, there are no serviceable items within any of the instruments used with Lindstrand balloons, with the exception of battery replacement. If any difficulties are experienced, the instruments should be returned to the manufacturer:

BLUE SKY AVIONICS, LLC
701 West National Guard Drive
Suite 105
Sioux Falls, SD 57104-0100
Tel: 605-977-3608
www.blueskyavionics.com

FLYTEC USA
1126 Seminole Drive
Indian Harbor Beach, FL 32937

Tel: 321-773-2307
www.flytec.com

4.7.1 Battery Replacement

The batteries in the Ball instrument pack are located within the casing. Unscrew the two retaining knobs on the rear of the casing. Lift off the back cover to reveal the two batteries. It is advised that both batteries are replaced at the same time.

Flytec has 9 volt batteries in both the sender and the receiver which are accessible by removing the back of the transmitter and small battery door on the receiver.

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SECTION 5
REPAIR AND MAINTENANCE

5.1 Envelopes

5.1.1 Envelope Construction Materials

It is important to ensure that any repairs performed on the envelope are achieved by using the correct material. This section describes the materials to be used. In case of doubt, please consult the factory.

CAUTION:

IT IS CRITICAL THAT ALL REPAIRS MAINTAIN THE INTEGRITY OF THE ORIGINAL DESIGN OF THE AIRCRAFT. CONSEQUENTLY THE SAME MATERIALS (FABRIC, THREAD, LOAD TAPE) AND SEWING TECHNIQUES USED DURING MANUFACTURE MUST BE USED FOR REPAIR AND MAINTENANCE OF THE AIRCRAFT.

5.1.1.1 Envelope Fabric

There are four primary fabrics available for use in the construction of the envelope:

The standard fabric is high tenacity woven ripstop nylon with a soft polyurethane fluorocarbon elastomeric coating. The fabric is supplied on 55" and 60" wide rolls and this complete width will be required for some panel replacements. This fabric can be used in conjunction with Hyperlife

An alternative to the standard ripstop is a high tenacity nylon fabric which is woven in a diamond pattern with a polyurethane coating. This fabric can be used in conjunction with Hyperlife.

Hyperlife is a taffeta weave heavier nylon base cloth with a silicone elastomeric coating.

Optional lightweight ripstop nylon base cloth with a silicone coating.

When replacement fabric is not obtained from Lindstrand Balloons, there must be documentation showing the fabric used to be of equivalent specification. An STC (Supplemental Type Certificate) or 337 Form whichever is appropriate must be completed to create a legal repair. Use of non-Lindstrand supplied parts will void the warranty on the aircraft. If Lindstrand-supplied fabric is used for repairs requiring more than 50 yards of fabric, the Lindstrand invoice number and fabric batch number for the replacement fabric must be entered in the balloon logbook.

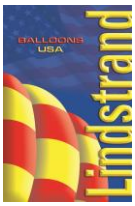
WARNING:

FOR ALL MODELS OF BALLOONS MANUFACTURED BY LINDSTRAND BALLOONS, REPLACEMENT OF ENVELOPE FABRIC IS LIMITED TO A ONE TIME REPLACEMENT OF 65%OF THE ORIGINAL FABRIC AT THE TIME OF MANUFACTURE, EXCEPT FOR MINOR PATCHES OR REPAIRS

5.1.1.2 Load Tapes

Several of the load tapes used are common to all Lindstrand envelopes. The top rim tape is always 1" (25 mm) wide. The bottom rim tape is always 2" (50 mm) wide tape. This wider tape is used mainly to provide greater tolerance to burn damage in the mouth area.

There are three weights of ¾" (20 mm) vertical load tape used depending on the size of the envelope. On all envelopes 310 and larger, vertical load tapes are 1" (25 mm) wide. During construction one of the heavier weight load tapes may be substituted for a lighter tape.



5.1.1.3 Sewing Threads

The thread that is used on the needle is Metric 30 (V69 or TEX 70), three strand continuous filament polyester, of bonded construction. The thread used on the bobbins is Metric 30 (V69 or TEX 70), three strand continuous filament polyester, of twisted construction. Both threads should be treated to provide increased resistance to ultra-violet exposure. Nomex thread is recommended for sewing the envelope components made in Nomex (i.e. nomex pockets, nomex Scoop or skirt), but it must not be used elsewhere. No other thread types are permitted.

5.1.1.4 Envelope Cordage

5.1.1.4.1 Parachute Centralizing Lines

$^{1}/_{16}$" (2 mm) diameter braided kevlar rope (EN1853).

5.1.1.4.2 Parachute Pull Down Lines

2.7 mm diameter polyester braided cord (EN1869). In 60,000 cubic ft. envelopes and smaller without a reversible center-pull deflation system, the lines are $^{1}/_{16}$" (2mm) diameter braided kevlar rope (EN1853).

5.1.1.4.3 Parachute and Q-Vent Operating Line

$^{5}/_{16}$" (8 mm) diameter kevlar core with polyester overbraiding. The polyester outer covering of the parachute operating line must be a red and white (candy-stripe) 50/50 spiral. The polyester outer covering of the center-pull deflation line or rip panel operating line is solid red. No deviation from this color scheme is permitted.

5.1.1.4.4 Q-Vent combination lines

Centralizing and pull-down lines are combined 2.3 mm diameter kevlar core with polyester overbraiding. (EN3370)

5.1.1.4.5 Rotation Vent Lines

$^{1}/_{8}$" (3.5 mm) kevlar core with polyester overbraiding is used for the upper portion of the line. The outer covering is green for right rotation and black for left. The lower portion of the rotation vent line is either ¼" or $^{5}/_{16}$" polyester braid with either a polyester or kevlar core.

5.1.1.4.6 Center Pull Parachute Lines (Rip, SuperChute, SmartVent, Lines)

The center-pull deflation line or rip panel line has a solid red polyester outer covering with either a polyester or kevlar core. The arming line for a SuperChute is 8mm diameter, kevlar core with a yellow and black spiral polyester overbraiding. Centralizing and pull-down lines are combined and may be 3.2 mm polyester in SmartVent systems.

5.1.1.5 Envelope Suspension Cables

Stainless steel envelope cables are either $^{1}/_{8}$" (3 mm) or $^{5}/_{32}$" (4 mm) diameter 7 x 19 RHOL construction, made from AISI 316 stainless steel. The minimum strength, including the swaged ends, must be 480 kg (1056 lbs) for the 3 mm wires, and 900 kg (1980 lbs) for the 4 mm wires.

Replacement wires must meet the above specification. If imperial sized wires are used, then it is important that the correct ferrule is used in the swaging process. All ferrules must be copper. The thimble size must fit over a ½" (12.7 mm) diameter bar. It is recommended that any damaged stainless steel cables should be replaced only with pre-assembled cables acquired from Lindstrand Balloons USA.

The swaging process used in original manufacture is the Talurit system. The Nicopress system, as described by FAA document EA-AC 43.13-1A and 2A, is a suitable alternative. The cut end of the wire and the ferrule may be covered with thick PVC heatshrink with impregnated bonding. If this is not available, the cut ends of the wire must be covered with an adhesive tape to avoid damage to the envelope when packing.

Once the swaging process is completed, the resulting wire rope assembly must be proof tested to 60% of the minimum strength quoted above, for the particular size of wire, for three minutes.

Non-metallic envelope suspension cables are manufactured using 1/4" diameter braided Kevlar or Technora core covered with a braided polyester sheath to protect the core from ultraviolet light and abrasion. Configuration can be either a single length cable or “v-d” pair cables. These cable assemblies are only available from Lindstrand Balloons USA. Non-metallic Cables must be replaced if the inner core (a yellow or grey color fiber) is visible in any location.

5.1.1.6 Fiber Joint Fabric (Velcro)

The only size of fiber joint fabric used structurally is the 2" (50 mm) wide standard strength version. This is used on both parachute retaining patches and velcro rip panels. High strength versions must not be used.
Three-quarter or one inch soft pile is used for attaching banners to the outside of the envelope.

5.1.2 Envelope Repairs

5.1.2.1 Sewing Machines

The sewing machine used must make a Federal Specification 751 type 301 lock stitch. Chain stitching is not permitted anywhere on a Lindstrand envelope. The needle size used is 110 or 120 (18/19 Singer System). The stitch length is between (5-to-7 stitches/inch) with 6 stitches-to-the-inch being preferred. The only structural seam used in original manufacture is the French Fell seam; a modified French Fell seam as described in 5.1.2.2.3 may be used for panel replacement. This seam is best achieved using a twin needle machine with a needle spacing of $^{5}/_{16}$" (8 mm). For this needle spacing a $^{7}/_{16}$" (11 mm) folder may used to help create the seam. Alternatively, a twin needle machine with a $^{3}/_{8}$" needle spacing may be used.

5.1.2.2 Fabric Repairs

The type of fabric repair that must be achieved is dependent upon the size of hole or damaged section of fabric.

5.2.2.1 Sticky-Backed,Contact Cement or Silicone Patches

If the longest dimension of a hole or tear is less than 3" (75 mm), then the hole can be repaired using sticky-backed fabric or a contact cement patch (Standard or Diamond Weave Fabric) or a Silicone Patch (Hyperlife Fabric).

Holes up to 10" (250 mm) in any dimension may be repaired using the following methods provided that after curing of the adhesive product a double row of stitching is run around the resulting patch with a 1" (25 mm) stitching overlap (see figure 5.1.2.2.1.b.).

The size of patch must be such that there is a minimum of 1" (25 mm) overlap all around the damaged portion of fabric. The damaged panel should be laid out on a flat smooth surface so that there are no wrinkles in the fabric. A patch should be cut to cover the hole with required overlap. The patch should be placed inside the envelope covering the damaged portion, and a second patch may be applied so that it is covering the first patch precisely on the outside of the envelope. Ensure that the resulting repair has not caused any distortion of the panel (see figure 5.1.2.2.1.a.

Note that this repair method may not be employed if the damaged section of fabric extends to within 1" (25 mm) of any load tape or seam.

a. Contact Cement Patch (Standard or Diamond Weave Fabric)

A contact cement patch should be cut from matching balloon fabric and may be applied on the inside or the outside of the envelope making an effort to align the ripstop fabric pattern. The cement product should be applied to both the patch and the envelope per the adhesive manufacturer's instructions. The same 1" (25mm) overlap beyond the damaged area as specified above applies. Any flexible contact cement intended for use on nylon fabric may be used.

b. Silicone Patch (Hyperlife Fabric)

Adhesive patches for silicone coated fabric (Hyperlife) should also be cut from matching fabric and applied on the inside or outside of the envelope. Any clear non-hardening silicone based adhesive may be used following the adhesive manufacturer's instructions. Unlike contact cement patches, silicone adhesive patches need to be compressed by weight until fully cured. Depending on the adhesive brand curing could require several hours.

5.1.2.2.2 Stitched Patch

A single stitched patch can be used to repair any size of hole or damage in a panel, provided that the damage is not present on two adjoining panels and does not cross a seam. If the damage is within 1" (25 mm) of a seam, the seam must be unpicked and the patch inserted so that it extends to the edge of the panel. The main fell seam can then be re-stitched as normal.

Damage that crosses a seam can be patched by adding separate patches onto both panels and then re-creating the fell seam. It is recommended that if a hole covers more than half a panel area, or if there are more than three separate holes in a panel, then the panel should be completely replaced.

a. Inlaid Patch

Draw a rectangle around the damaged area. Ensure that the sides of the rectangle are aligned with the weave of the fabric. Measure the rectangle dimensions and then cut out the rectangle from the envelope. Each corner of the rectangle should be cut to a depth of ¾" (19 mm). Lay out the new replacement fabric and mark out a rectangle that is 2 ¼" (57 mm) larger in all directions than the original rectangle. Beginning at the center of one edge, carefully fold the envelope fabric and patch fabric together to give the correct fell seam. Stitch the resulting seam together. This process is repeated for each edge. If one edge of the fabric patch is part of another seam, this edge is left until the seam is re-stitched together. This type of repair is best performed using a double needle machine.

b. Overlaid Patch

Cut a rectangle around the damaged area (see Figure 5.1.2.2.2). Cut a replacement patch that is 1 ½" (39 mm) larger than the hole cut, in all directions. On the damaged panel, cut the corners of rectangle area and fold 3/4" (19mm) of rectangle over, securing with a single pass of a single or double needle machine. Take the patch material and fold the edges of the patch under to create a 3/4" seam. Pin the patch into position, centering over the sewn rectangle area. Secure with a single pass of a double needle machine, or two rows of stitching with a single needle machine. Ensure that there is at least ¾" of stitching overlap to prevent the stitching unraveling.

5.1.2.2.3 Panel Replacement

Unpick all the seams on the panel, carefully removing any horizontal or vertical tapes. Unpicking is best achieved by breaking every third or fourth stitch with a seam ripper or scissors and then carefully pulling the seam apart. The remaining threads should be completely removed from the fabric.

The damaged panel should be kept as a pattern for the replacement. This is done by spreading the panel out flat and drawing around it. If the damaged panel is too distorted from burn damage to provide a good pattern, then a pre-cut panel can be purchased from the factory.

The new panel is stitched into position using the structural fell seam already described. It is simplest to sew the fell seam before sewing the load tapes onto the resulting seam.

CAUTION:

NEVER TRIM A FACTORY REPLACEMENT PANEL OR CUT THE LOAD TAPES TO MAKE THE FABRIC EDGES AND LOAD TAPES FIT TOGETHER.

5.1.2.2.4 Modified French Fell Seam

A modified french fell seam is allowed for the perimeter of partial and full panel replacement. The damaged panel may be cut away as close as possible to the original folded seam. The replacement panel is folded as it would be in a true french fell, but the panels do not actually interlock.

The replacement panel will overlay the original panels which surround it and no raw fabric edge may be exposed. The stitching must comply with section 5.1.2.1, and must penetrate two layers of the replacement panel as it would in a true french fell seam (see figure 5.1.2.2.3). This repair method may introduce only two additional layers at the seam area. For a subsequent replacement of the same panel, the fabric must be removed back to the original layers.

5.1.2.3 Load Tape Repairs

There must be no damage to load tapes.

To repair load tapes, unpick the damaged section and 12" (300 mm) beyond each end of the damaged section. Measure the length of the damaged load tape and cut with scissors. The ends of tape remaining on the envelope must be sealed with a hot knife to prevent fraying. Cut a length of the correct type of tape, so that the total length is 20" (500 mm) longer than the damaged section. Heat seal the ends of the replacement tape. Pin the tape into position so that there is a 10" (250 mm) overlap at each end. Stitch the replacement tape to the original using either of the stitch patterns shown in (see figure 5.1.2.3.) Complete the load tape splices before attaching the load tape to the balloon to avoid shrinkage of the fabric. Re-stitch the fabric onto the new section of tape using a double row of stitching.

5.1.2.3.1 Overlying Tape Repairs

If any of the tapes, which are overlying the parachute require replacement, this is achieved as follows:

Cut the damaged tape at the point where it joins the top rim tape. Carefully unpick the tape from the locating tape and remove. Measure the removed length of tape and as a check, also measure an adjacent tape. All tape lengths should be identical. Cut a length of replacement tape, which is 10 inches longer than the measured length of damaged tape. Stitch the replacement tape onto the original tape, as shown in Figure 5.1.2.3.1 (if the zig zag stitch is used it must be a 3 step stitch).

Ensure that the stitching of the positional tape to the new overlying tape is in the same position as the removed tape. This is important for spreading the localized crown line loads.

5.1.2.3.2 Envelope Cable Attachment Loops

If the envelope cables are damaged and are to be replaced with pre-made replacement cables, which are to be attached directly to the load tape without the use of quicklinks, then attachment is achieved as follows:

a. Unpick and remove the nomex pocket over the affected tape.
b. If there is any damage to the tape itself, then this must be unpicked 10” beyond the damaged area.
c. Cut a new length of correct tape 10” mm longer than the length removed.
d. Stitch the new section of tape onto the existing tape, as shown in Section 5.1.2.3.
e. Pass the new tape through the nomex pocket.
f. Turn the tape inside the envelope and stitch through both layers of tape and the sandwiched fabric with the stitch patterns shown in Figure 5.1.2.3.
g. The resulting repair will look like Figure 5.1.2.3.2. Restitch the nomex pocket into place.

5.1.2.3.3 Internal Loops

There are three types of internal loops. All loops are made from ¾" (19 mm) wide tape. The differing types of loops are shown in Figure 5.1.2.3.3.

5.1.2.4 Envelope Cables (Stainless or Non Metallic)

Stainless steel cables that are slightly discolored due to overheating are safe provided they have not become too flexible. Localized excessive flexibility in a flying wire indicates a weakening due to loss of strength and wire temper. Wires affected in this way should be replaced. Wires that are badly kinked or frayed should be replaced. If the wire doesn't spring back, it must be replaced. If only one strand of an envelope cable has broken, it need not be replaced, provided that the broken section is covered with heat resistant tape to prevent the ends of the wire causing damage to other parts of the balloon.

If a stainless wire requires replacement, it must first be measured for length, as shown in Figure 5.1.2.4. For Lindstrand A type envelopes, the following wire sizes are used:

42,000 cu.ft up to and including 150,000 cu.ft = 3 mm diameter wire (min. breaking strength 320 kg (704 lbs))

180,000 cu.ft up to and including 310,000 cu.ft = 4 mm diameter wire (min. breaking strength 650 kg (1430 lbs)

Most wires are arranged in pairs around the lower thimble. This reduces the number of thimbles on the carabiner. If one leg of a pair is damaged, then both must be replaced. When the wires are attached directly to the load tape loop and swaging facilities are available, then the simplest method of flying wire replacement is to cut the thimble of the flying wire where it attaches to the tape. This can be achieved using a pair of bolt cutters.

The new wire is then swaged around the load tape loop. The thimble size must be large enough to fit over a ½" bar (13 mm). If ready-made flying wires are supplied, the fitting process is described in Section 5.1.2.3.2.

When replacing non metallic cables you must first determine which replacement cable is needed, along with specifying cable color (see figure 5.1.2.4.1). Cable sets vary depending on burner frame size (small, medium, and large) as well as number of gores in the envelope.

Note the number near the eye-splice on the upper end of the damaged cable. Typically on 42,000 cubic ft. - 180,000 cubic ft. envelopes, there will be staggered cable pairs labeled 1 and 2 and an equal length cable pair with no markings or labeled 3.

Twenty-eight gore balloons will have cable pairs and single length cables numbered near the eye-splice on the upper end of the cable. Because of the nature of the woven construction of non metallic envelope cables, a tolerance of +/- 1 inch (25 mm) in length is allowed during construction and inspection.

For ease of replacement, non metallic cables and some stainless cables are attached to the envelope by using a quicklink (Lindstrand Part No. AC1166) through the eye of the thimble on the cable and the load tape loop. Replacement of cables utilizing this attachment method is simple. Remove the quicklink (part # AC1166) and envelope cable. Insert quicklink through the thimble of the replacement cable along with the load tape attachment and close the quicklink. The screw gate of the quicklink must be fixed in the closed position by using medium strength thread locking compound.

5.1.2.5 Parachute Centralizing Lines

It is rare that parachute cords require adjustment or repair. If attention to the parachute lines is required, first remove damaged cords. Measure the length of the relevant cord, or if it is broken, measure the length of the cord adjacent to it. Mark each end of the cord with five marks spaced 2" (50 mm) apart. The marks are used as a reference when re-tying lines.

The kevlar cords should be cut with a pair of scissors, or sharp knife, and an overhand knot tied at the end to prevent fraying. When refitting the cords, note which mark is aligned with the loop on the parachute and on the envelope. Hold the correct mark in place and secure the line by tying an overhand loop knot as shown in Figure 5.1.2.5. Once complete, the parachute positioning is checked by pulling the vertical tape very tight between the parachute opening and the centralizing line attachment point. While the vertical tape is held tightly, pull the parachute toward the crown ring until all slack is out of the centralizing line. This requires very little tension, line should not be stretched. There should be 10" (25cm) of overlap of parachute inside the envelope.

5.1.2.6 Parachute Pull Down Lines

In the unlikely event that these lines require repair, remove the damaged line from the edge of the parachute. One length of cord runs from a loop on the edge of the parachute down to the pulley and back up to the adjacent loop on the parachute edge. Once removed, measure the overall length of the line. Cut a replacement length of polyester cord (EN1869) and heat seal the ends with a hot knife or lighter. Fold the line into two equal lengths and tie a loop at the mid point. Retie the resulting ends of the pull down lines to the loops on the edge of the parachute and re-attach the loop to the quicklink. Ensure that the screw gate of the quicklink is secure using medium strength thread locker.

5.1.2.7 Parachute, Q-Vent Deflation Line

The polyester outer covering of the parachute operating line must be a red and white (candy-stripe) 50/50 spiral. The polyester outer covering of the center-pull deflation line operating line is solid red. No deviation from this color scheme is permitted. Lindstrand envelopes are only fitted with a $^{5}/_{16}$" (8 mm) kevlar cored polyester braided covering line. Replacement line must be of this specification.

For damage near the basket end, an additional loop of line is provided at the termination side in the envelope. This loop can be let out to compensate for damage in approximately the lower 5-8 feet of line. If the parachute or Q-Vent deflation line becomes excessively frayed or burnt, then it should be replaced in its entirety.
Undo all knots in the line and withdraw the line from the envelope. Contact the factory for the original length installed. Replacement of the line is the reverse of removal (see Figure 5.1.2.7 for rigging formats). The final securing to the loops sewn onto the envelope should be with a knot as shown in Fig. 5.1.2.5).

5.1.2.8 Rip Lines

Operating lines for both the velcro rip panel and the center-pull parachute deflation systems (SmartVent) are $^{5}/_{16}$" (8 mm) kevlar-cored polyester braided line, or 1/4 poly or nylon braid-on-braid line, either which is solid red in color. The replacement line must be of this specification. Undo all knots in the line and remove the line from the envelope. Use the old line to size the replacement line. Fit the new line in exactly the same way as the old line. Once complete, inflate the envelope and deflate it using the replaced line to ensure that it operates correctly.

5.2 Baskets

5.2.1 Basket Wires

If more than ten strands of a basket wire are broken, or if the wires are badly kinked, then a new section of wire must be spliced into the structure. The swaging process used in original manufacture is the Talurit system, using copper ferrules code no. 6.5 and stainless steel thimbles code no. 11-46. Alternatively, the Nicopress process, described in FAA document EA-AC 43-13-1A and 2A may be used, provided that the wire and ferrules are compatible.

5.2.1.1 Damage Above Basket Top

If the damaged portion of wire is at least 2" (50 mm) above the top level of the basket, a new section of wire can be added as follows:

a. Cut off the existing eye of the wire, just below the ferrule.

b. Remove the PVC covering by sliding it off.

c. Cut a length of replacement wire that is sufficient, remembering to add approximately 8" (200 mm) to create a new eye.

d. Cut away the damaged section of wire.

e. Swage the new section of wire onto the remaining existing wire. Cover swaged area with heat shrink.

f. Slide a new section of PVC tubing over the wire.

g. Erect the burner frame and attach all other basket wires. Form an eye using the correct thimble and ferrule. Adjust the length with the assembly in its correct position. Mark the wires next to the ferrule. Remove the wire from the frame and swage.

h. Apply heat shrink tubing over the ferrule.

5.2.1.2 Damage Below Basket Top

If a basket wire is unacceptably damaged below the level of the top frame, you can either splice in a wire or install a complete new wire. A splice as described above can be made within the woven portion of the basket, or, the procedure for installing a complete new wire is as follows:

a. The top bolster and rawhide/scuff leather may have to be removed as well as any clamps securing the cable within the weave. Two are located at the bottom curve of the nylon uprights and one at floor center.

b. Cut away the damaged cable below the damaged area. Butt weld a length of new cable to the old. File welded area so diameter will pass through guides in the stainless basket frame/s.

c. Lubricate the entire length of both old and new wires with silicone spray.

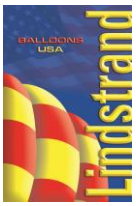
d. Pull undamaged swaged end of old cable, which will in turn pull new cable with it throughout basket. It is helpful to secure the basket or place a large amount of weight in the basket.

e. With new cable in place, cut away old cable, clean cable of lubricant and swage a new eye, following the procedures in Section 5.2.1.1.

f. Replace the top bolster and/or rawhide or bottom scuff leather.

5.2.2 Basket Top Frames

If the top frame of a basket becomes distorted, it may be repaired by using hydraulic jacks to straighten it. If rod sockets become distorted, these can be straightened by inserting a close fitting steel bar into the socket and bending straight again. If the top frame is cracked, it should be re-welded using a TIG welding set (Heliarc). The padding must be removed completely and the wicker moved aside to permit access.



5.2.3 Basket Floors - Plywood

If a floor is damaged so that a 10" crack is visible on both sides of the floor, i.e. the floor has cracked through, then it either must be patched or replaced totally. Patching is achieved by cutting a piece of similar thickness plywood, which covers the cracked area and bonding it over the crack from the underside, using wood glue. Note that any protective varnish must be completely removed from the damaged area by sanding, prior to bonding the patch in place. Small tacks may be used to hold the patch in place while the glue is drying.

The wooden runners may be bonded to the basket floors for greater damage resistance. The bond strength is always greater than the wood strength, so removing runners from the floor is difficult. If a runner is damaged to the extent where it is no longer providing strength, then another runner may be placed alongside and attached to the floor in a similar manner as the original.

Replacement of the floor is achieved by the following procedure:

a. Remove all rawhide or bottom scuff leather from the basket cables across the underside of the floor.

b. Pull the basket cables back through the floor so that there is 4" (100 mm) of slack in each wire.

c. Unlace or cut the lacing holding the bottom frame onto the marine plywood floor.

d. Cut slots into the sides of the plywood floor to release the wires from the floor.

e. Cut slots into each of the runners to remove the wires from under the runners. Alternatively, the runners can be removed from the floor.

f. Slide floor out from under the wires.

g. If a replacement floor is being manufactured, it is best to use the old floor as a pattern for the hole positions. The holes through the floor which accept the basket wires, must be elongated into slots towards the edge of the floor to allow the existing wires to be replaced.

h. New ash, oak or maple runners must be fitted in the same positions as the old. The underside face must be cut away with a router to provide a passageway for the wires. The runners may be bonded onto the floor of the basket using wood glue and are also bolted together into recessed holes in the runners. The bolt pattern should be taken from the old runners.

i. The remainder of the rebuild process is essentially the reverse of dismantling. Rawhide should be soaked in water for at least 24 hours so that it is sufficiently pliable to ensure a close fit around the edges of the basket and over the basket wires.

5.2.4 Wicker Repairs

Distortion of wickerwork does not affect the airworthiness of a basket. Excessive distortion can be removed by soaking the wicker in water for 48 hours and then placing a weight on the distorted area. The weight should be sufficient to remove the distortion. The wicker is then allowed to dry for another 48 hours with the weight in position. Once the wicker has dried for four or five days, it can be re-varnished using a good quality flexible varnish. Hard coating varnish should not be used as it cracks off the wicker quickly.

In the case of the woven wicker floors the runners are bolted through the wicker and interior plywood surface. The runners may be removed to facilitate repairs to the floor area. All runners have nylon UHMW strips on their bottom surface held in place by stainless steel screws.

Sometimes wickerwork will crack or break leaving sharp ends or edges which could cause injury. Inspect the interior and exterior of the basket for any damage to the wicker. If more than 4 vertical strands of wicker out of 12 consecutive vertical strands are broken they must be repaired. If more than 12 horizontal strands in a 24 inch by 24 inch area are broken they must be repaired. If a hole in the wicker exists larger than 2.5 inches at the widest dimension, it must be repaired. In woven floor baskets, any broken primary rattan (approx. 3/4 inch) supports must be replaced

If any reweaving is necessary, soak the area around the damage and any new cane. Use a dull pointed tool to assist in feeding the new cane into the old. Copy the weaving pattern from the surrounding area to provide a neat repair. The cane should be cut to length as close as possible to the outside wall using side-cutters. Quite often, repaired sections of wicker are lighter in color than the surrounding cane. Once the repair is complete, allow the cane to dry. The wicker can then be varnished locally around the repair.

5.2.5 Rope Handles

If the rope handles become excessively frayed or are broken, they can be replaced by reweaving either an individual or complete set of handles. Removal is achieved by first marking the rope at the ends of each area to be replaced and cutting the damaged handle in the middle. Extract the rope handles from the weave using a dull pointed instrument, such as a screwdriver. Completely remove the handle rope and use it as a guide to cut a new length of rope, adding 4” (100 mm) to each end. Reweave the rope into the basket, taking care not to damage the wicker. The rope terminations are fed vertically up into the weave, normally in one of the basket corners. Interior handles are $^{5}/_{8}$" (16 mm), exterior handles are 1" (25 mm). When replacing only a section, the same 4’ (100 mm) tail should be left on the remaining rope and this too is fed vertically into the weave. A portion of the core may be removed to lessen the bulk of these tail ends.

5.2.6 Easy Access Basket Repairs

If it becomes difficult to remove the top bar release pin, the basket top frame can be gently pushed back with the door open such as the two holes in the machined fork end and plate re-align. The four hinge points should be lubricated with a light lubrication oil whenever necessary

5.3 Fuel Systems

5.3.1 Fuel System Safety

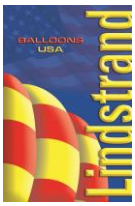
When considering any work on fuel cylinders or fuel manifolds, it is important to ensure that there is no fuel remaining anywhere in the system. Fuel manifolds can be evacuated by connecting to a burner and operating the blast valve to expel any remaining liquid, or by depressing the sealing valve in one of the manifold connectors.

Fuel cylinders may be emptied by either burning off all remaining fuel or transferring fuel to another cylinder.

Once the cylinder is empty of liquid, open the bleed valve and leave the cylinder in an open, well-ventilated area until all remaining pressure has been removed. At this point fuel level gauges and or valves may be removed and replaced as needed.

WARNING!

REMOVE FUEL BEFORE INSPECTING THE INTERIOR OF A TANK. COMPLETE THE INSPECTION OUTDOORS AWAY FROM ANY POSSIBLE IGNITION SOURCES.



5.3.2 Inspecting Cylinders Internally

a. Internal Inspection

The most effective way of conducting an internal inspection on a cylinder is through the contents gauge hole using a flashlight or a small battery powered light, which can be lowered into the tank. Inspect all the internal welds. If there is any evidence of corrosion or pitting of the surface surrounding the welds, a hydrostatic pressure test must be conducted to ensure the integrity of the cylinder.

b. Once the cylinder has been inspected, put 8 oz. of methanol into the cylinder. Refit the contents gauge using a new rubber seal. Lubricate the rubber seal with silicon grease to ease the assembly.

5.3.3 Liquid Withdrawal Valves

5.3.3.1 Screw Valves

There are several types of screw valves that are used on cylinders and although they all operate in the same way, care must be employed when obtaining replacement parts because the components are not always interchangeable.

There are two seals within the 1¼" ACME (Rego type) screw connector which seal the connection when the male half of the connector is in position, and if any leaks occur when the two are joined, these seals should be replaced. The outer seal is square in section and the inner round. The inner seal is removed using a piece of wire to hook behind it, taking care not to scratch the housing. Prior to replacement, the seals should be lubricated with silicon grease. Both seals must be present and in good condition in order to achieve a leak tight connection.

If a leak occurs when the valve is open but the hose is disconnected, this means that the self-sealing nipple is faulty. Sometimes, connecting the male half in order reseat the nipple can stop the leak. However, if this does not stop the leak, the self-sealing nipple must be replaced. (The self-sealing nipple is not available as a spare part for some makes of screw valves). The retaining disc is unscrewed and the nipple removed.

Replacement is the reverse of this process. Any other faults with the valve cannot be repaired and the whole valve must be replaced. The cylinder must be completely emptied to achieve this.

When replacing the screw valve, ensure that any excess flow device is removed prior to fitment.

5.3.3.2 Ball Valves

Only one type of ball valve is used on the cylinders, the Worcester W44 valve. It may be configured with either a 1¼" ACME screw connector (commonly called the 'Rego' connector, after the original manufacturer), or a Tema $^{3}/_{8}$" connector. In both cases, servicing of the valve itself is identical. There are two potential areas to be serviced with this valve:

a. Stem Leaks This can be recognized by liquid propane leaking out beside the nut, underneath the handle. Commonly, it can be rectified by removing the handle and holding the stem still using an open-end wrench. With another wrench, the nut on the stem is tightened by $^{1}/_{8}$ - ¼ of a turn. If this stops the leak, the valve handle is replaced and no further action is necessary. If the leak cannot be stopped, or the movement of the handle is unacceptably stiff, the valve must be disassembled and new seals inserted.

b. Ball Seal Leaks The ball valve must be dismantled to replace the ball seals or the stem seals and the cylinder must first be completely emptied.

Unscrew and remove the four retaining bolts. Carefully separate the faceplate from the valve. Remove the two seals situated on both sides of the ball, taking care not to scratch the body of the valve. Inspect the ball carefully for any dents or scratches. The ball can be removed from the valve by turning the handle into the off position. Unscrew both nuts on the valve stem and remove the handle. The stem can now be removed by withdrawing it into the valve and out one side. This reveals the glands on the stem, which can be replaced. The ball seals are simply placed on either side of the ball during reassembly. Silicon grease should be applied onto the seals and the ball, the grease assisting to hold the seals in place while the two sides of the valve are replaced. The nuts on the four retaining bolts should be tightened in a diagonal pattern to a torque of 9 lbs ft (12.2 Nm). The stem nut should be tightened to a torque of 3.5 lbs ft (4.75 Nm).

5.3.3.3 Liquid Connectors

Two types of liquid connector are used, the Rego or Tema types.

The procedure for servicing the Rego 7141M type of connector is identical to the repair of the 1¼" ACME screw valve, as described in Section 5.3.3.1.

The Tema 3800M connector has no serviceable components and should be replaced if found to be faulty. This is a simple matter of unscrewing the old and screwing on the new. New gaskets must be used. Ensure that the liquid valve is turned off before unscrewing the connector.

5.3.4 Vapor Valves

If a vapor valve malfunctions it is necessary to replace the whole valve as there are no serviceable components with the valve. The cylinder must be completely emptied prior to removal of the valve.

5.3.5 Vapor Regulators

The outlet of the vapor valve is fitted with a left-hand POL thread. The regulator is screwed into this outlet. Regulators are set to 8 psi at the factory. The pressure setting can be altered in the following manner:

a. BMV Type Regulator

Remove the blue plastic blanking plug on the regulator. Insert the suitable size of hexagonal wrench (allen key). Turning the wrench clockwise increases the pressure, and anti-clockwise reduces the pressure.

b. Calor Type Regulator

Unscrew the locking nut situated on the threaded thumbscrew. Turn the thumbscrew clockwise to increase the pressure. Re-tighten the locking nut when the correct delivery pressure is reached.

For normal flight conditions, the regulator delivery pressure should not need adjustment. If poor delivery is causing a weak pilot light flame, it is more likely that the regulator has malfunctioned and should be replaced in total.

5.3.6 Bleed Valve (15% Valve)

The bleed valve controls the maximum amount of fuel that the cylinder can carry. If it leaks, it must be replaced in total, for which the cylinder must be emptied. The dip tube length for V20 is 170mm; V30 is 190mm; and V40 cylinders is 225 mm. When replacing the bleed valve use either teflon tape or Medium thread locking compound on the thread.

5.3.7 Contents Gauge

Each different type of cylinder is fitted with a different gauge and care must be taken to ensure that the correct type is fitted. The indicating dial on top of the cylinder can be replaced by unscrewing the two retaining screws and fitting a replacement. Any other work on the gauge requires the cylinder to be completely vented. If problems are encountered, it is best to check whether the float is moving by inverting the cylinder and listening for the movement of the float. If the float is moving and there is no indication, replace the dial and re-test. If there is still no movement of the pointer, the gauge must be removed and replaced with a new one. There are no serviceable items on the gauge itself.

5.3.8 Cylinder Bodies

If the cylinder pressure vessel body is damaged in any way, it must be submitted to the factory or a qualified inspector for assessment. Damage to the top and bottom protective rings is not important provided that there is no damage to the join between the cylinder body and the rings. Under no circumstances must welding be performed on the cylinders to repair damage, unless undertaken by the manufacturer.

5.3.9 Cylinder Straps

Cylinder (Tank) straps are used to restrain the fuel cylinder in place. Special care must be taken to place cylinder straps in the appropriate position on the cylinder to avoid ejection of the cylinder in a hard landing. (upper tank strap over top shoulder of tank) (See Figure 5.3.9)

5.4 Burners

When any work is performed on the burners, it is very important to ensure that a high standard of cleanliness is achieved. Components should be cleaned and dried with soft lint-free cloth, or left to dry naturally.

Once any type of service work has been performed on the burner, a functional test must be conducted to ensure there are no fuel leaks within the burner. Each burner function is tested to ensure correct operation. A soap solution or commercial leak detector may be applied to all threaded connections to detect very small leaks.

5.4.1 Hose Replacement

All hoses, main burner and manifold, must be replaced after 10 years in service.
With the burner held steady; unscrew the hose at the entry point into the burner block. Once loosened, it is best to unscrew the hose by holding it straight and turning the connector on the end of the hose. If the connector is serviceable, it may be removed by unscrewing from the other end of the hose. Pre-fabricated hose replacements are available from the factory in differing lengths. Measure the length of the existing hose and order a replacement (see Figure 4.4.3). Ensure that the correct hose end fittings are selected to suit the particular type of liquid connector.

	Hose End Fittings	
Connector Type	Burner End	Cylinder End
Rego 7141 F	$^3/_8$" BSP Male	¼" NPT Male **or** $^3/_8$" BSP Male
Tema 3800 F	$^3/_8$" BSP Male	$^3/_8$" BSP Male

When reassembling the replacement hose, new sealing washers must be used with the $^3/_8$" BSP male threads. 1/4" NPT threads should be sealed using medium thread lock compound or teflon tape applied to the male thread only. Once the hose has been fitted, the hose must be pressure tested for integrity.

5.4.2 Servicing Valve Assemblies

These instructions apply to all the toggle type valve assemblies, which control the flow to either the main vaporizing coil or to the commercial liquid fire (CLF), or the normal liquid fire unit. The only difference between the two types of valve assembly is the length of the valve stem.

There are 3 different styles of handles associated with the valve assemblies. The first is the "T" bar handle on the JetStream single burner. The second is the standard toggle action style found on the JetStream double, triple and quad. The third type is the squeeze trigger found on the JetStream double, triple and Quad.

5.4.2.1 Single Burner "T" bar handle.

Servicing the main burner valves in the Single Burner requires removal of the burner “T” bar handle. The numbers indicated in brackets ( ), refer to the ballooned item numbers on Fig.5.4.2 and Fig.3.4.1.1.

To remove the Main Valves proceed as follows:

a) Using a 5mm allen key, undo and remove the two-hexagon drive cap head screws (21) fig.5.4.2. Lift away the handle (12) fig. 5.4.2.

b) Carefully remove the 4 keep plates (14) fig.3.4.1.1 from the handle post (13) Fig.3.4.1.1.

c) Remove the two pivot pins (16) fig. 3.4.1.1, using a suitable narrow probe accessed through the two holes in the side of the handle post (13) Fig. 3.4.1.1.

d) Lift away the handle post. Note that the two main valve squeeze triggers (19) and (20) will lift away with the handle post.

e) Remove the pivot pin (17) fig 3.4.1.1 from the handle post (13) fig 3.4.1.1, using a narrow probe accessed from the central hole in the side of the handle post.

f) The squeeze triggers (19) and (20) fig 3.4.1.1 may now be lifted away.

g) Undo the two main valves (15) fig 3.4.1.1 using a 28 mm open-ended wrench and remove from the valve block.

Further valve maintenance is as described in Section 5.4.2.2 of the Maintenance Manual. Re-assembly is generally the reversal of the dismantling process taking care to align the dowels in the handle (12) with the dowel holes in the handle post (13). Apply Medium thread locking compound to the cap head screw threads (21) before re-assembly.

5.4.2.2 Toggle Action (found on all three styles of burner handle)

All the numbers in brackets refer to the item numbers on Figure 5.4.2.

Use a 28 or 32 mm wrench to unscrew the complete valve assembly from the burner. It is recommended that the faces of the valve bonnet be covered with masking tape or balloon fabric to prevent scratches on the valve assembly.

a) Move the valve handle (1) into a vertical position so that the valve is in an open position.

b) On the underside of the valve handle (1) are two set screws (2).

c) Loosen these two set screws but do not remove them.

d) Close the valve handle again and gently push the pivot pin (3) out to one side of the handle. This will release the handle from the valve stem (4). The pivot pin does not need to be completely removed from the handle.

e) Once the handle has been released, re-tighten one of the set screws onto the pivot pin to retain the pivot pin in the correct alignment.

f) Remove the nylon thrust washer (5) from on top of the valve assembly and store safely. It should be noted that these thrust washers (5) are not always interchangeable between valve assemblies. It is recommended that only one valve assembly be dismantled at any time.

5.4.2.3 Squeeze Trigger

To remove the main squeeze action valves, proceed as follows:

a) Using a 4 mm Allen Key, undo and remove the four hexagon drive cap head screws and crinkle washers, Items 14 and 16, Figure 5.2.

b) Using a 2 mm AF Allen Key, undo and remove the eight hexagon drive counter sink screws, Item 13, Figure 5.2.

c) Remove the handle tube, Item 2, Figure 5.2, from the upper valve posts, Item 3, Figure 5.2.

d) Remove the upper and lower valve posts.

e) Using a pair of circlip pliers, remove the circlip, Item 12, Figure 5.2 NOTE: It is very difficult to remove the circlip without damage to the circlip. It is a good idea to have replacement circlips available before you start the service (BU2094).

f) Remove the pivot pin, Item 11, Figure 5.2, from the blast trigger cam.

g) The blast trigger may now be removed. Take care to retain the spring and spring cap, Items 10 and 9, Figure 5.2, respectively, within the blast trigger cam

h) Remove the main valve assembly, Item 8, Figure 5.2, from the valve block using a 32mm wrench. It is recommended that the faces of the wrench are covered with masking tape to prevent scratch damage to the valve bonnet.

i) Remove the thrust washer from the recess in the top of the valve bonnet. Note that the thrust washers are not always interchangeable between valve assemblies. It is recommended that only one valve assembly is dismantled at any time.

Further valve maintenance is as described in Section 5.4.2.2 of the Maintenance Manual. Re-assembly is generally the reversal of the dismantling process. Reference Figure 3.4.4 and Figure 3.4.41

Further valve maintenance is as described in Section 5.4.2.2 of the Maintenance Manual.

5.4.2.4 Replacing Valve Seals

Carefully withdraw the valve stem (4) and seals from the valve bonnet (6). Gently push the stem seal (7), washer (8), spring (9), and seat carrier sleeve (10), up the valve stem (4). This permits the removal of the seat carrier (11) from the valve stem (4). Inspect the sealing surface of the valve seat for any damage or foreign bodies.

Normally, there is a circular indentation where the seat rests on the main valve block. Inspect this area in particular, for any cuts or damage. If the sealing surface is damaged, the complete seat carrier (11) must be replaced.

Remove the stem seal (7), washer (8) and spring (9) from the valve stem (4), taking care not to scratch the valve stem. The quad ring seal (12) is removed by carefully sliding a piece of wire down the side of the seal and hooking it under the seal. Lift the seal out of the recess on the stem and slide it off the stem. Note that if this seal (12) is removed, it must not be replaced. A new seal must always be fitted on re-assembly.

Inspect the valve stem (4) for any signs of scratches or damage. Scratches are best detected by running a fingernail over any marks. If the scratch can be felt, then the stem must be replaced. Frequently there are slight wear marks along the shaft where the stem seal (7) contacts the shaft. These wear marks do not necessarily mean that the shaft or stem seal require replacement.

If a valve stem leak is experienced, then the stem seal (7) and quad ring seal (12) must be replaced. If the leak continues, then the valve stem should be replaced.

Re-assembly is generally the reversal of the dismantling process. Ensure that the stem seal (7) and the quad ring seal (12) are lubricated with grease prior to installation. There is no particular orientation for the quad ring seal, but the lip seal must be mounted on the valve stem so that the helical spring, visible inside the seal, is facing towards the seat carrier end of the valve stem.

When replacing the valve assembly into the block, one or two wraps of teflon tape should be applied to the valve assembly threads and ensure that the copper sealing washer (13) is present. When replacing the pivot pin (3) in the handle, make sure that the set screws (2) are screwed down on to the machined flat of the pivot pin (3).

5.4.3 Servicing the Pilot Light

The pilot light is supplied with vapor from the pilot light regulator. It is situated within the burner can. If a pilot light failure is experienced, it is usually due to debris blocking the pilot light jet. To prevent this happening, a small filter is inserted into the feed to the jet.

The numbers in brackets refer to the item numbers on Figure 5.4.3.

The pilot light is removed by first withdrawing the igniter assembly (1) down into the burner block. Unscrew the igniter retaining set screw (2), which is located in the side face of the main burner block (3). Push the complete igniter assembly (1) out through the bottom of the burner block (3). Remove the pilot light cup (4) by loosening the set screw (12). Insert a screwdriver, which has a thin shaft, through two opposite holes in the pilot light assembly (5). Unscrew the pilot light assembly (5) to reveal the pilot light jet (6). Unscrew the pilot light jet (6) using a ¼" socket.

If the pilot jet is held up to a bright light, the hole should appear round. If not, clean the jet in a solvent such as kerosene and blow it clean with compressed air to clear the jet of any blockage. If this procedure does not dislodge the blockage, a very fine piece of wire may be inserted into the jet and used to push any obstruction out.

The pilot light filter (7) is accessible by unscrewing the jet adapter (8) from the burner block, using a (19 mm) socket. The filter is situated in the upstream end of the adapter and is a sintered bronze filter. It is possible to clean this filter by soaking the complete adapter in kerosene and then blowing back through the filter with an air hose. However, if the filter is heavily blocked, it is recommended that this filter be replaced.

Re-assembly of the pilot light system is the reverse of the dismantling process.

Ensure that there is a copper washer (9) under the pilot light jet (6) when it is screwed into the jet adapter. Once the complete pilot light assembly has been fitted, replace the igniter unit (1). The pilot light cup (4) should be repositioned so that the grounding tab (10) for the igniter is positioned directly above the igniter electrode (11). The gap between the electrode and the grounding tab should be $^{3}/_{16}$" (4 mm). A slightly larger gap usually results in a stronger spark than a gap that is less than indicated.

5.4.4 Servicing the Pilot Valve and Regulator Unit

All numbers in brackets refer to the item numbers on Figure 5.4.4.

5.4.4.1 Removing the Pilot Light Regulator from the Burner

There are two holes (1) in the handle (2) facing into the machined block. At the bottom of these holes there are two socket head screws visible. Undo and remove these screws using a 3 mm allen key (hexagon wrench). Rotate the pilot light handle (2) through 90º and two more screws will be visible. Undo and remove these screws as well. Grasp the pilot light handle and gently remove the complete regulator assembly from the burner block. Care should be taken because there is a fuel filter situated at the end of the regulator. This is not retained in position and may be lost when the regulator assembly is removed. Transfer the complete regulator assembly into a clean environment.

5.4.4.2 Servicing the Pilot Light Valve

If difficulties are experienced with the pilot light valve not functioning properly, then proceed as follows:

Ensure valve handle is in the ON position. Unscrew the spring retaining screw (3) using a $^{3}/_{8}$" wrench. Take care when removing this screw because there are some small spring loaded components retained by it. Remove the spring guide (4), spring (5) and the sealing ball (6) from the housing. If the regulator is inverted, the piston pin will also fall out. This item is very small and easily lost, so take care. Insert the spring (5) back over the spring guide (4) and try to compress the spring to ensure that it is not binding. Carefully inspect the sealing ball (6) for signs of any scratches or embedded material. If any material is present, carefully remove it. The sealing ball should be washed with soapy water if necessary, and allowed to dry naturally.

The valve seat (7), upon which the sealing ball seals, should be inspected for any evidence of scratches or marks. Inspection is simplified by shining a light into the bore. If any scratches are present, the complete regulator body (8) must be replaced.

Re-assembly is achieved by inserting the piston pin, dropping the sealing ball into the housing and placing the spring guide (4) and spring (5) on top of it. Insert the end of the spring guide (4) into the hole in the spring retaining screw (3) and tighten. This thread should not be locked with any type of thread locking compound.

Turning the valve handle off and on can then test the basic function of the valve. By watching the end of the spring guide (4) where it protrudes out of the spring retaining screw (3), the valve operation is functioning correctly if the spring guide moves up and down.

Before replacing the regulator assembly into the burner block, the fuel filter should be cleaned. It should be cleaned in Trichloroethane, MEK or kerosene and dried off before replacing it into the block.

5.4.4.3 Replacing the Pilot Regulator

Lightly grease the two “O” ring seals on the outside of the regulator body with silicon grease. Carefully insert the regulator assembly into the burner block. Rotate the assembly so that all four holes in the regulator body line up with the holes in the burner block. The hole pattern is asymmetric, so there is only one correct orientation. Carefully insert the four retaining screws and tighten. Use the allen key to install these screws in a crisscross pattern being careful to prevent over-tightening.

5.4.4.4 Testing the Pilot Valve for Correct Operation

Connect a fuel supply to the burner and turn on. Turn on the pilot light valve and light the pilot light. Check the pilot flame for stability and strength by trying to blow it out. This should be difficult to achieve.

Turn the pilot valve off and watch the pilot light flame. It should extinguish itself within five seconds as a maximum. If the flame does not go out, the sealing ball and/or the regulator body must be replaced.

5.4.4.5 Servicing Regulator Unit

Remove the regulator, as described in Section 5.4.4.1, and place in a clean environment.

Unscrew and remove the three-socket head screw (21), which are located around the circumference of the pilot valve handle. Remove the circlip (9) situated on the center shaft in the center of the handle. This should only be achieved by using circlip pliers. Care should be used to ensure that this circlip is not over-stretched during the removal process. If the circlip is twisted at all, it must be replaced. Gently ease the handle (2) off the regulator assembly. Remove the handle spring (11) and the washer (10), which is revealed, and store safely.

Using a peg wrench or similar tool, insert the pegs into the two holes of the spring retainer (12) and unscrew. Remove the main regulator spring (13). Gently pull the shaft of the piston (14) to remove the piston assembly from the regulator body (8). Take care not to damage the teflon piston seal (15), which is situated on the piston, while withdrawing the piston (14) over the threaded portion of the regulator body (8). If the piston pin (16) in the end of the piston assembly has not already been removed, it now should be, and stored.

Be careful to avoid putting the piston assembly down on a surface because it will naturally sit on the edge of the piston seal (15), which may be damaged as a result.

Unscrew the three screws (17) on the end of the piston and remove.

Remove the piston cap (18) to reveal the Piston seal (15). Note the orientation of the piston seal (15). The spiral spring must face towards the piston cap (18). Inspect the outer edge of the seal for any scratches or marks that may cause a leak. If in any doubt, replace with a new seal.

Also inspect the bore of the main regulator body (8) for any scratches or marks. If any are detected, the complete body must be replaced.

Before replacing the piston seal (15), lightly grease the barrel of the piston (14) over which the piston seal is fitted. Gently push the piston seal onto the piston until it is against the shoulder. Ensure that the seal is facing in the correct direction. Re-fit the piston cap (18) over the piston. If a Lindstrand regulator seal kit is used, then three new cap screws (17) are provided. If this kit is not available, the existing cap screw threads must be carefully cleaned, to remove all of the sealant. Prior to installation, the screw threads must be coated with a small quantity of thread sealant, a medium strength thread locker, such as Loctite blue is preferred. Screw the three screws (17) until tight against the piston cap (18), then put the piston pin (16) into the hole in the middle of the piston cap.

Lightly grease the bore of the regulator body (8) and insert the piston assembly, again taking care not to damage the piston seal on the threaded portion. Place the main regulator spring (13) over the shaft on the rear of the piston.

Place the spring retainer (12) over this shaft and press down to over-compress the main spring. Note that the recessed side of the spring retainer (12) must be facing outwards. Screw the spring retainer (12) into the regulator body (8) using the peg wrench, until it will not go any further. Be careful to ensure that the thread is correctly engaged.

Spread a little grease on the washer (10). Place the washer into the center recess on the inside of the pilot valve handle (2). On the outside of the regulator body, there are three machined sloping tracks. One of these tracks has its' innermost end located on a recessed groove. During re-assembly, this point must be aligned with the engraved "1" on the outer surface of the pilot valve handle.

Screw two of the three-handle retaining screws (21) into the regulator main body (8) through the pilot valve handle (2). Leave one screw out to allow the handle to be aligned correctly. The handle retaining crews have a plain portion at the end of the thread and should not be confused with the regulator retaining screws, which are similar. Place the handle spring (11) over the piston shaft (14) so that it sits upon the recessed hole in the spring retainer.

Install the pilot valve handle (2) and locate the other end of the spring against the washer located in the handle. Align the marks on the regulator body (8) and the pilot valve handle (2), as described, and compress the spring (11). Look through the hole of the omitted handle retaining screw and move the handle so that the hole is positioned above the recessed track in the regulator body. Screw both of the other handle retaining screws until they are tight, while keeping the handle steady. Insert and tighten the remaining handle retaining screw (21). Replace the circlip (9) on the end of the piston shaft (14).

Remove the larger "O" ring (19), which is positioned next to the shoulder on the outside of the main regulator body. Another, slightly smaller "O" ring (20) is positioned at the bottom of the regulator cavity in the main burner block. Replace the regulator unit into the burner by following the instructions in Section 5.4.4.3.

5.4.5 Servicing of the Cross Over Valve

This is the valve, which is situated between the two halves of the burner on Double, Triple, Quad models. Malfunctions of this valve will be observed in one of the following ways:

a. Propane leak through the stem of the valve or around the handle area.

b. Propane leaking from one or two of the valve side faces.

c. Propane appearing at the jets of the second burner with the cross over valve closed and the main blast valve open on the first burner.

Stem leaks can often be eliminated by adjustment, but the other two type of leak (b and c) are usually corrected by installing a new sealing kit.

All numbers in brackets refer to the item numbers on Figures 5.4.5.1 and 5.4.5.2.

5.4.5.1 Correcting Stem Leaks

While holding the valve handle (1) steady, unscrew the self-locking nut (2) in the center of the handle using a $^{9}/_{16}$" socket, and remove. Remove the handle (1) and the locking clip (3) from the valve stem (4). While holding the stem still by placing a wrench on the two flats on the shaft, tighten the lower plain nut by ½ a turn.

Replace the handle (1) and nut (2) and test fire the burner to ensure that there is no further leakage. If leakage is still detected, then repeat the above process and tighten the plain nut by another half turn.

5.4.5.2 Replacing Valve Seals

Turn the valve into the "on" position. Loosen, but do not remove the eight screws, which attach the cross mounting bracket to the burner cans. Unscrew and remove the four cap head screws, which clamp the two halves of the burner together. Take care when removing the last screw that the complete valve body (5) does not fall out. Remove the valve body (5) by withdrawing the valve downward from between the two burner halves.

It is essential to perform any service work on the valve in a clean environment. Tip the two ball seals (6) out of the valve. Lift the body connector seals (7) away from the valve body, being careful not to mark or scratch the body. Turn the valve handle (1) to the off position to allow the ball (8) to be removed out of the side of the valve.

Remove the valve handle (1), as described above. Remove the locking clip (3) and unscrew and remove the plain gland nut (9). Turn the valve stem so that the two flats on the stem are aligned with the two longest sides of the valve. Gently push the stem (4) into the valve body (5) and remove the stem (4) through the side. Take great care not to scratch the body of the valve itself, while removing the valve stem. Remove the two disc springs (10), the spacer (11) and the three gland seals (12) from the outer recessed position around the valve stem. Remove the single gland seal (13) on the inside of the valve. This seal (13) is normally retained on the valve stem (4), so it may have been removed already.

Discard all the old components for which replacements are provided in the seal repair kit (3, 6, 7, 9, 10, 12 and 13).

Clean and inspect the valve body (5) and valve ball (8) for any marks or scratches. If any scratches are detected, the items concerned must be replaced. Remove the four new gland seals from the seal kit. These four seals are identical and therefore interchangeable. Apply a small amount of grease over each of the seals. Install one seal over the threaded end of the valve stem. Carefully re-insert the threaded end of the valve stem (4) through the valve body (5), in the same way as it was removed. Install the remaining three gland seals (12) onto the valve stem (4), along with the spacer ring (11), two disc springs (10) and the plain gland nut (9).

A wrench should be used on the two valve stem (4) flats to hold it steady. Tighten the plain gland nut (9) to a torque of 3.5 lbs ft (4.75 Nm). Install the locking clip (3) over the plain gland nut. Rotate the valve stem several times and re-adjust the plain gland nut as necessary. Note that over-tightening the plain gland nut (9) causes an unduly stiff action to the valve and reduces the life of the valve stem seals (12 and 13). Turn the valve into the closed position and slide the ball (8) onto the end of the valve stem (4). Open the valve to retain the ball in position. The new ball seals (6) and body connector seals (7) may now be fitted. Apply silicone grease to each of the seals prior to installation. The grease helps to hold the ball seals in position during reassembly of the valve. Clean the two end faces of the burner blocks, which seat onto the cross over valve assembly. Insert the valve into position and tighten the four valve retaining cap head screws in a diagonal pattern to a torque of 9 lbs ft (12.2 Nm). Re-install the valve handle (1) and tighten the self-locking nut (2) to retain the handle.

Re-tighten the eight screws, which hold the cross bracket to the burner cans, and test fire.

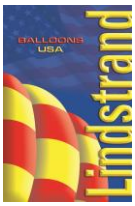
5.4.6 Servicing of the Pressure Gauge

One pressure gauge is provided for each separate supply system in the burner. Pressure gauge malfunctions are most commonly caused by a lack of, or insufficient venting of propane, prior to shutting the burner down. In this situation, liquid can become trapped within the burner and as it warms up it will expand. This expansion is normally achieved in the pressure gauge. Eventually, the pressure gauge is extended beyond its operating range and the bordon pressure tube is permanently deformed. When this occurs it will result in the pressure gauge not returning to zero when there is no pressure in the burner (a non-zero error). The pressure gauge must be replaced to rectify this fault. All numbers in brackets refer to the item numbers on Figure 5.4.6.

5.4.6.1 Replacing the Pressure Gauge

Carefully place the long end of a 1/8" (3 mm) allen key (hexagon wrench) across the face of the pressure gauge and engage it in the two slots on the bezel ring (1). Undo the bezel ring (1) and remove. Insert two bent pieces of stiff wire down opposite sides of the gauge (2) and carefully pull the gauge away from the block.

Re-fitting is the reverse process of dismantling the pressure gauge. Lubricate the two "O" ring seals (3 & 4) on the back of the pressure gauge before installation. Also ensure that the alignment peg (5) in the burner block is fitted through the drilled hole in the back face of the pressure gauge body. Take care to ensure that the threads on the bezel ring (1) are correctly engaged before applying a tightening force. It should be noted that if these threads are damaged, the complete burner block must be replaced.



5.4.7 Replacing the Igniter Assembly

The numbers in brackets refer to the item number on Figure 5.4.3.

Unscrew the retaining socket head allen set screw (2), using a 3 mm allen key. This retaining allen set screw is situated on the outer facing side of the main block in line with the igniter. It is not necessary to completely remove this allen set screw, just loosen it sufficiently so that the complete igniter assembly may be withdrawn by carefully pushing on the igniter body, inside the burner can.

Upon re-assembly, ensure that the “O” ring situated on the outer body of the new igniter assembly has been lubricated with a small amount of silicon grease.

Insert the new igniter and push it into the burner block until the lower surface aligns with the burner block. Check that the gap between the electrode and the plate attached to the pilot light cup is approximately 4 mm.

Tighten the allen set screw to retain the igniter in position, being careful to not over tighten which could damage the igniter body.

Operate the igniter to ensure there is a spark between the electrode and pilot light cup.

5.4.8 Adjustment of the Slurper Tube

The slurper tube is located within the burner can. It works by the passage of fast flowing propane vapor across the upper end, causing suction in the tube itself. This in turn draws any water present within the burner can up the tube to be ejected into the burner flame. It is therefore important that the upper end of the slurper tube is precisely located within the flow of propane from the main jets. The numbers in brackets refer to item numbers ballooned on Figure 5.4.8.

The slurper tube is located in position on one of the locating screws at the base of the burner can. For adjustment, loosen this screw (1) and rotate the slurper tube (2) into the position shown in Figure 5.4.8. Tighten the screw (1) and again check the positioning of the top of the tube. If it has moved due to the tightening of the screw, then the tube should be fine-tuned by gently bending the top of the tube until it rests in the correct position.

5.4.9 Bleeding of the Hydraulic Remote Burner Control

The following instructions assume that the equipment supplied in an optional service kit is available.

The number in brackets refers to the ballooned item numbers in Figure 5.4.9.

Connect the quick release coupling so that the hand held lever assembly and blast valve are connected. Turn adjuster (1) anti-clockwise as far as it will go. Slacken adjuster (2) until the lever is at the extent of its travel. Remove screw (3) and the washer.

Fill the syringe with oil and attach short tube to the end. Fit the small bleed adaptor to the hole (3). Fit syringe and tube to the small bleed adaptor.

On the blast valve bonnet, remove screw (4) and screw in the other bleed adaptor with washer. Attach long tube to bleed adaptor and place the other end in a suitable container.

Pump the oil from the syringe through the system in one slow continuous movement. Once the oil begins to drain from the blast valve, keep pumping until no more bubbles appear in the tube.

Remove the long tube and bleed adaptor and replace screw and washer. Remove syringe, tube and bleed adaptor from the lever assembly and replace screw and washer. Clean off all excess oil and adjust screws (1) and (2) so that the lever assembly can be operated comfortably and to remove any slack from the system.

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SECTION 6
BALLOON INSPECTION

6.1 100 Hour/Annual Inspection

This inspection is to be carried out annually to meet the annual inspection requirements of FAR 91.409(a)(1). For balloons used in commercial operations, this inspection must be carried out each 100 hours of operation, as described in FAR 91.409(b). There is no difference in the parts inspected during an annual or a 100-hour inspection. Completion of an annual or 100 hour inspection must be completed by an appropriately rated repair station or an appropriately rated person.

6.1.1 Applicability

The Maintenance Schedule applies to all Lindstrand Balloons certificated in any category.

6.1.2 Qualification

Inspection must be carried out by a properly certified and rated repairman under authority of an FAA certified Repair Station rated for Lindstrand Balloons, or may be done by qualified Airframe and Powerplant Mechanics who hold an Inspection Authorization (IA) rating, and who are qualified to inspect balloons.

6.1.3 Documentation

The aircraft logbook must be present for all annual inspections. All maintenance, preventative maintenance and any alterations must be properly recorded in the aircraft logbook. The entries identifying components of the balloon should be checked and verified to ensure agreement with the components actually installed in the balloon presented for inspection.

On successful completion of the inspection, the return to service must be documented with the following or similar entry: "I have inspected this aircraft using procedures approved by the manufacturer for the completion of a (Annual/100 hour) inspection, and find the aircraft is in an airworthy condition. This aircraft is approved for return to service in accordance with a (Annual/100 hour) inspection". The entry must include the aircraft total time, the date of the inspection, the maximum temperature indicated on the temperature label, any airworthiness directives that have been complied with during the inspection and any repairs, installations or replacements made, along with the name, certificate type and certificate number of the person making the entry, as well as the work order number which provides traceability to the pertinent inspection documents on file.

If the aircraft is found to be in an unairworthy condition, the inspector must make note of the discrepancies in the aircraft logbook, and make a statement in the logbook of the unairworthy conditions.

6.1.4 Envelope

It is recommended that inspection of the envelope be achieved by a gore-by-gore fabric inspection. Inspect the following:

a) The optional Temperature Link (Temp Flag) may be installed in the balloon crown. Temperature warning flag is in addition to the required temperature instrument (Pyrometer) and the required temperature labels. Tempil labels may not be removed by operators and should only be removed by repair personnel if being replaced per Sect. B.

b) Check the temperature label for overheating. If the tempil label indicates 275ºF or higher, then a new label should be fitted and the maximum temperature reached noted in the logbook. The overheated label should be removed and kept with the records of the inspection.

c) Check the fabric for holes or tears. Small holes in the nomex are acceptable, but any damage above this level must be repaired in the approved manner.

d) If excessive porosity is suspected, check the fabric for porosity by trying to blow through it. If the porosity of the fabric is high, a flight test should be considered, by the inspector, to assess the controllability.

e) The fabric at the edge of the parachute should be checked for heat damage. If the fabric is weak or obviously discolored, this can indicate that the parachute is not sealing correctly. The parachute should be repaired/replaced and inspected to ensure that the parachute is correctly adjusted.

f) Check all load tapes for security of stitching, especially around the crown ring and where the overlying tapes join the top rim tape.

g) Check the load tape loops that connect the envelope cables to the envelope. There should be no burn damage to the load tape or fraying.

6.1.4.1 Parachute

a) Check the parachute deflation line for fraying. If the kevlar core is visible through the outer coating, this may necessitate complete line replacement. Check that the termination knot is secure.

b) Check that the parachute pulley is running freely and that there is no wear. Check that there are no threads wrapped around the pulley. Lubricate with silicone spray

c) Check that the retaining and pulldown cords are in good condition. Stiffness of the cords indicates overheating.

d) Check the knots and loop stitching to the envelope and parachute.

e) If there is any doubt about the sealing of the parachute, it should be checked by conducting a hot inflation. The overlap should be equal around the circumference and there should be no daylight visible. There should not be excessive tension in any of the retaining lines, or radial stress wrinkles at the parachute edge.

6.1.4.2 Q-Vent

a) Check the parachute (Candy Stripe) and Q-Vent (Red) deflation lines for fraying. If the kevlar core is visible through the outer coating, this may necessitate complete line replacement. Check that the termination knot is secure.

b) Check that the parachute and Q-Vent deflation line pulleys are running freely and that there is no wear. Check that there are no threads or debris wrapped around the pulleys. Lubricate with silicone spray

c) Check that the combination centering/pull down cords are in good condition. Discoloration of the cords indicates overheating. In balloons flown in dusty conditions, the cords may collect dirt causing an increased effort to operate the Q-Vent. It is recommended that in this case the condition of the cords be evaluated for replacement. Additionally, the condition of the pulleys or rings throughout the Q-vent rigging should also be evaluated for replacement.

d) Check the combination centering/pull down cord rings or pulleys at the cap edge for wear. Lubricate pulleys with silicone spray. Check for abrasion at attachment loop

e) Check the knots and loop stitching to the envelope and parachute.

f) In earlier versions of the Q-Vent, verify presence and condition of line stoppers when pulleys are at end of kevlar centering lines

g) If there is any doubt about the sealing of the parachute, it should be checked by conducting a hot inflation. The overlap should be equal around the circumference and there should be no daylight visible. There should not be excessive tension in any of the retaining lines, or radial stress wrinkles at the parachute edge.

6.1.4.3 SuperChute

If the balloon is equipped with a SuperChute, contact Lindstrand USA for inspection and repair procedures.

6.1.4.4 Velcro Rip Panels

Check the operating line for fraying and security of attachment.

Check that the rip locks operate correctly.

Check the condition of the velcro. It should be clean and have good adhesion.

The fit of the velcro should be checked. The velcro on the rip panel itself must not be shorter than the velcro on the balloon.

The overlying tapes of the velcro rip panel must be up to 5% shorter than the corresponding panel seam length. If this is not the case, it should be reported to Lindstrand Balloons.

6.1.4.5 Load Bearing Attachments

Envelope Cables

All suspension wires on Lindstrand Balloons are manufactured from either stainless steel or Kevlar/Technora. Replacement with galvanized mild steel is not acceptable.

For stainless steel envelope cables, check that there are no broken wires or severe kinks. Slight discoloration due to burning is permissible, provided that the flexibility is not reduced. Excessive localized flexibility should not be present as this indicates severe overheating. Cable must spring back to original shape after bending.

Check the thimbles and ferrules for distortion. Check that the quick link is tight and in good condition.

For non-metallic envelope cables, inspect for any signs of heat damage to the outer sheath and for any damage to the outer sheath which reveals the inner core. If the core (Kevlar/Technora) is visible, then the cable must be replaced. The braided cover may not be repaired with tape or heat shrink tubing. Inspect integrity of splice and thimble ends. Replacement non-metallic flying wires may only be obtained from the Lindstrand factory. Replacement of flying wires should be carried out in accordance with Section 5.1.2.4.

Carabiners

Carabiners should be free of distortion and the screw gate should operate freely.

Basket Wires

These should be checked for damage and that the thimble and ferrule are intact. A slight distortion of the thimble is not critical, provided that the wire is not frayed beyond the specified limits.

Load Frame

Check for distortion of the load frame and all the welds.

Check the security of the burner attachment to the inner frame and the inner frame into the outer. The pivot of the burner should be slightly stiff, but not to the extent that movement is prevented.

On a center-gimbal burner, check tightness of center block bolts and tension adjusting bolts.

Ensure that the nylon rods are free from fractures and the steel stubs on basket and burner frame are intact.

6.1.4.6 Burner

Inspect all fuel connectors, pressure gauge, pilot, main and liquid controls. Clean and lubricate per annual / 100 hour inspection checklist.

All fuel hoses, main burner and manifold, must be replaced after 10 years in service

Check condition of fuel hoses, including any manifolds that are fitted and perform functional burner test

WARNING!
ONLY APPROVED LINDSTRAND FUEL HOSES MAY BE USED! INSTALLATION OF ANY OTHER HOSES OR MANIFOLDS IS DANGEROUS AND IS SPECIFICALLY NOT APPROVED. IF UNAPPROVED HOSES ARE FOUND CONNECTED TO THE AIRCRAFT FUEL SYSTEM, THEY MUST BE REPLACED WITH APPROVED PARTS.

6.1.4.7 Fuel Cylinders

Check for external damage to the pressure vessel. Damage to the protective top and bottom rings is not critical, provided there is no damage to cylinder body at points where these rings are attached.

Check the operation of the contents gauge.

Check that when no hoses are connected, the self-sealing function of the liquid connectors is leak-tight by opening the valve. After testing, release the pressure.

An internal inspection of cylinders manufactured by Lindstrand Balloons is required after twelve years, and thereafter every five years. For convenience, cylinder tests may be carried out in advance of the annual inspection and the results noted in the logbook.

6.1.4.8 Baskets

Inspect the interior and exterior of the basket for any damage to the wicker. If more than 4 vertical strands of wicker out of 12 consecutive vertical strands are broken they must be repaired. If more than 12 horizontal strands in a 24 inch by 24 inch area are broken they must be repaired. If a hole in the wicker exists larger than 2.5 inches at the widest dimension, it must be repaired. In woven floor baskets, any broken primary rattan (approx. 3/4 inch) supports must be replaced

On solid floor baskets check the condition of the plywood floor. Any cracks present must not be transmitted to the underside of the floor

Damage to the runners is not critical, provided that they are not broken in two.

Check the condition of the rawhide and scuff leather. This is a protective layer so not critical to structural strength, but if it is damaged, should be repaired at earliest convenience.

6.1.4.9 Easy Access Baskets

Check the top bar operation and check the frame for any distortion which results in any difficulty in inserting the top bar release pin. Check the security of the door latches and for any distortion in the door frame hinges. Lubricate four hinge points with a light lubrication oil such as Tri-Flow

6.2 Fabric Strength Test

If the total number of hours on the balloon envelope is greater than 150, or the time in service is over 3 years, at the time of annual inspection, fabric tests must be performed in the following areas:

At the parachute cap edge. One test warp and one test weft in each color to 20 pounds

In the parachute between the velcro tabs and center patch. One test warp and one test weft in each color to 30 pounds

At the top panel of the balloon. One test warp and one test weft in each color to 30 pounds

At the panel behind each turning vent outer flap. One test warp and one test weft in each color to 30 pounds

In balloons built with Hyperlife fabric, in the first ripstop or Diamond Weave panel below the Hyperlife. One test warp and one test weft to 30 pounds

Special shape balloons, in the area of internal formers. One test warp and one test weft to 30 pounds

6.3 Inspection After Overheating

If the maximum temperature indicated on the temperature tags is less than 275ºF, then no further action is required. If the indicated temperature of the temperature tags is 275ºF or greater, a fabric inspection is required. Pay particular attention to the edges of the parachute fabric and the parachute retaining lines. Excessive heat on fabric tends to cause cracking, due to stiffness. Discoloration is also another sign of overheating. If any signs are visible, then a fabric strength test should be conducted at various positions, both on the top panels and the parachute panels, as described in Section 6.2. If no signs of overheating are visible, and the fabric strength test indicates sufficient fabric strength, record the maximum temperature reached in the log book and install a new tempil label per 6.1.4 (b) and the inspection checklist.

6.4 Inspection After A Hard Landing

Should a hard landing be experienced where damage to the balloon is suspected, an inspection in accordance with the annual inspection guidelines in section 6 of this manual should be carried out. Any damage found that would prevent the balloon from passing a 100 hour / Annual inspection must be reported to Lindstrand Balloons to determine the appropriate action. The balloon must not be flown until it is capable of passing the 100 Hour / Annual inspection.