TORRENTULA VALVE™

Bambi Bucket®

With Model B electrical controls

OPERATOR'S MANUAL

Issue date: SEPTEMBER 2004
REVISION J.2

SEI INDUSTRIES

SEI International

Bambi BUCKET®
Driven by Innovation

TORRENTULA VALVE™

Bambi Bucket®

With Model B electrical controls

Models: 2732, 3542, 4453, 5566, 5870
6578, 7590, HL5000, HL7600, HL9800

OPERATOR'S MANUAL

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TABLE OF CONTENTS

TABLE OF CONTENTS

1. INTRODUCTION TO THE BAMBI BUCKET

This manual provides helicopter operators with information on the operation and maintenance of the Bambi Bucket with the Torrentula valve.

Since its introduction in 1983, the Bambi Bucket has become the industry standard for helicopter firefighting for over 1000 commercial operators and government agencies worldwide. This acceptance by the industry is a result of the effectiveness, reliability, simplicity and ease of use of the Bambi Bucket. Adding the new Torrentula Valve model to the already renowned Bambi Bucket family boosts fire suppression capabilities, thus making it an indispensable tool for attacking wildland and urban fires.

The Bambi Bucket with the Torrentula Valve features revolutionary new dump control technology. By simply actuating a switch to open or close the Torrentula Valve the operator can get a variable flow and/or multiple drops of water from the bucket. The bucket can be bottom filled easily by holding the valve in the "open position". No prior experience is required to quickly master operation of the Torrentula valve. The bucket requires no assembly. Once airborne, the operator quickly becomes familiar with the flight characteristics of the bucket. Several fills will provide familiarity with the variable fill capability of the bucket as well as with the variable, multiple dump capability of the Torrentula Valve.

Introduced in June 2003 are the new Model B electrical controls for the operation of the dump valve. Model B controls feature a number of upgrades, including: microprocessor-based control logic, all aluminum enclosure, Mil-W-22759/16 wiring, Mil-C-5809 Circuit protection and convenient, all unique, Mil-C-5015 wire harness connections.

Available for retrofit or factory installation on all Torrentula Valve Bambi Buckets is the new PowerFill I shallow draft pumping system. The addition of the PowerFill I pumps gives the operator the ability to perform rapid and complete bottom fills from sources a shallow as 18" (0.46m) deep. The new Model B electrical controls have accomodations for the modular addition of the PowerFill I system.

Please read this manual prior to flying the bucket, particularly the sections on deploying, filling and dumping. If you experience problems, please refer to the manual. Sections 11 and 12, Maintenance and Troubleshooting, may be especially helpful.

For your own protection and for longer bucket life, always read the instructions and warnings. Ignoring them could result in personal injury, bucket or aircraft damage. The warning notices are divided by the severity of the outcome into WARNING and CAUTION.

WARNING: Hazards or unsafe practices which could result in personal injury or death

CAUTION: Hazards or unsafe practices which could result in minor personal injury or property damage

SEI offers complete parts supply and repair facilities for the Bambi Bucket. For maintenance and repair purposes, parts diagrams and descriptions are provided in Sections 15 to 22. SEI also offers the Bambi Bucket Repair Assessment Manual as a guidline for determining the ongoing operational status of the Bambi Bucket.

When ordering parts, please provide the Model and Serial number of your Bambi Bucket.

Additional copies of this manual are available from SEI Industries Ltd.

2. PREFLIGHT SAFETY CHECK

Just as the pilot preflights his aircraft, he should also preflight his Bambi Bucket each day.

1) Check the bottom chain and look for any tears in the fabric straps; check the lockwire or tie wraps on the shackles

2) Check for loose bolts around the bucket shell: IDS brackets at the top, FCAS (Cinch Strap) brackets at the mid point, wear strips at the bottom.

3) Check the diagonal “M-straps” that connect the suspension cables to the top of the bucket and examine for any wear.

4) Visually check the multi-dump valve, particularly the seals.

5) Visually check valve guard structure for bending or cracks.

6) Check the internal or external Frusto-conical Arrest System (FCAS or “cinch strap”).

7) Check the suspension cables for frays, kinks or loose swages.

8 Check that the solid metal ballast bars are securely attached.

9) Check the control head for secure fittings.

CAUTION: Make sure the Bambi Bucket shell does not rub against the valve on the inside of the bucket. This may impede the movement of the valve, and may damage the valve and/or control head.

CAUTION: Never operate the bucket with the control head cover removed.

3. DEPLOYING THE BAMBI BUCKET

3.1 Attaching to Cargo Hook

The Bambi Bucket is rigged for a lateral cargo hook. Correct attachment is indicated when the serial number plate on the control head faces REARWARD in flight: this ensures that the ballast on the Bambi will face forward in flight.

WARNING: It is essential that the ballast faces forward in flight. This will avoid twisting of the suspension lines.

WARNING: If using a second shackle it must have a load rating equivalent to the top shackle supplied with the head. Using a shackle with a lower load rating could result in a shackle failure. If using a swivel hook, operate in the "locked" position to assure that the ballast is always facing forward.

CAUTION: The Bambi Bucket may not be suitable for a direct hook-up to the cargo hook. The actual hook-up will be different for various aircraft, and operators must comply to all instructions and bulletins supplied by the aircraft manufacturer. It is the operator's responsibility to ensure that the Bambi Bucket is correctly fitted to the helicopter.

3.2 Interfacing with the Aircraft Power Supply

Please refer to Fig. 3.1 *Bambi Bucket with the Torrentula Valve, suggested helicopter installation diagram* on Pg 7.

Connection to the aircraft power supply should be done in accordance with AC43.13-1B and AC43.13-2A and any applicable aicraft manufacturers instructions.

Warning: Do not connect the Torrentula Valve system to any aircraft bus bar that is used for emergency or essential loads. After installation, ammend the aircraft electrical load analysis to ensure that the generator capacity is adequate to operate the system.

Prior approvals issued for the operation of the Bambi Bucket and related systems may have precedence over and may supersede information contained in this manual.

Power supply requirements
Voltage: 28 Volts DC
Current: 30 Amps
Duty Cycle: 2 seconds, intermittent.

Power suplly input is through Receptacle R1 on the Torrentula Valve Controller box. A suitable plug may be installed on the bare end of Wire Harness H1 to connect to the aircraft power circuit.

3.3 Operator's control interface

As standard equipment, all Torrentula Valve Controllers are equipped with an Operator's Control Grip that contains all the switches and indicators required for full operation of the dump valve and optional PowerFill I pump system.

The control grip is designed to fit comfortably in either the left or right hand and is fully labelled as to the the function of each switch.

The control grip wire harness connects to receptacle R4 on the Torrentula Valve Controller box face panel.

If pilot-operated controls are specified, the standard control grip should be kept available for maintenance checks when the bucket system is removed from the aircraft.

3.4 Installation of non-standard breakaway connectors

SEI Industries supplies a single type of breakaway electrical connectors for the connection of the Torrentula Valve electrical controls to the Bambi Bucket Control Head. The considerations for selection of these connectors included: availability, cost, ease of assembly and durability. Operators of Bambi Buckets may specify and install other types and makes of breakaway connectors to suit their own specific operating requirements and conditions, provided:

1) The connectors are of a sufficient capacity to accept the wire gauge as originally supplied with the equipment, and/or larger wire gauges, as may be required for extension of the electrical conductors for long line operations.

2) Where installed adjacent to and in conjunction with the load release mechanism, that they can separate cleanly and with minimal force in the event of an emergency jettison.

It is the responsibility of the operator to record, maintain and monitor any operator-specified modifications to SEI Industries product.

3.5 Pilot-operated controls

Where pilot control of the systems is specified, the operator may wish to utilize existing switches on the flight controls, or have them installed for ease of use by the pilot. SEI Industries can supply an optional Pilot Controls Wire Harness for interface with the Torrenula Valve Controller if desired.

Before installation of pilot-operated controls, it is recommended that you review the information contained in section 19.

All pilot controls wiring connected to receptacle R4 should be #18 AWG or larger.

Required wiring

The function of the valve can be controlled with one +28 volts DC common lead, one lead for "open" and one lead for "close" (3 total). The switch configuration can consist of either a SPDT toggle switch with center off, (on)-off-(on), or two push button switches.

Valve position indicator lights

The wire harness may also include, where desired, leads for the indicator lights that indicate when the valve is in the full "open" (green) or full "closed" (amber) positions.

PowerFill I controls

As standard equipment with all Torrentula electrical controls are accommodations for the operation of the optional PowerFill I pump system. If you are not operating a PowerFill I system, you do not need to install the wiring specific to the operation of the pumps. However, you may want to consider the future addition of the pump system when doing the initial installation for the operation of the valve.

3.6 Longline conductor specifications

Many operator's of bucket systems use longline lifting cables. For assistance in specifying the conductor cable assemblies for operating on longlines, see fig 19.4 in Section 19.

3.7 Conversion of Model "A" electrical Controls to Model "B" protocol

The Model "B" version of the Torrentula Valve electrical controls was introduced in June of 2003. Many operators of Torrentula Bucket systems, who still operate with the Model "A" controls may wish to upgrade their systems to be able to interface the buckets with the new Model "B" controls. This is a simple procedure that involves replacing the original breakaway connectors with the new type, and modifying the pin protocol to match.

The power requirements and operational procedures are the same for both the old and the new systems.

The information in this manual pertaining to the electrical controls **does not apply Model "A" systems**. If you are operating a bucket with Model "A" controls, please refer to the operator's manual originally supplied with the bucket.

Identification

All **Model "A"** controls are equipped with a grey PVC electrical enclosure, with attached power leads.

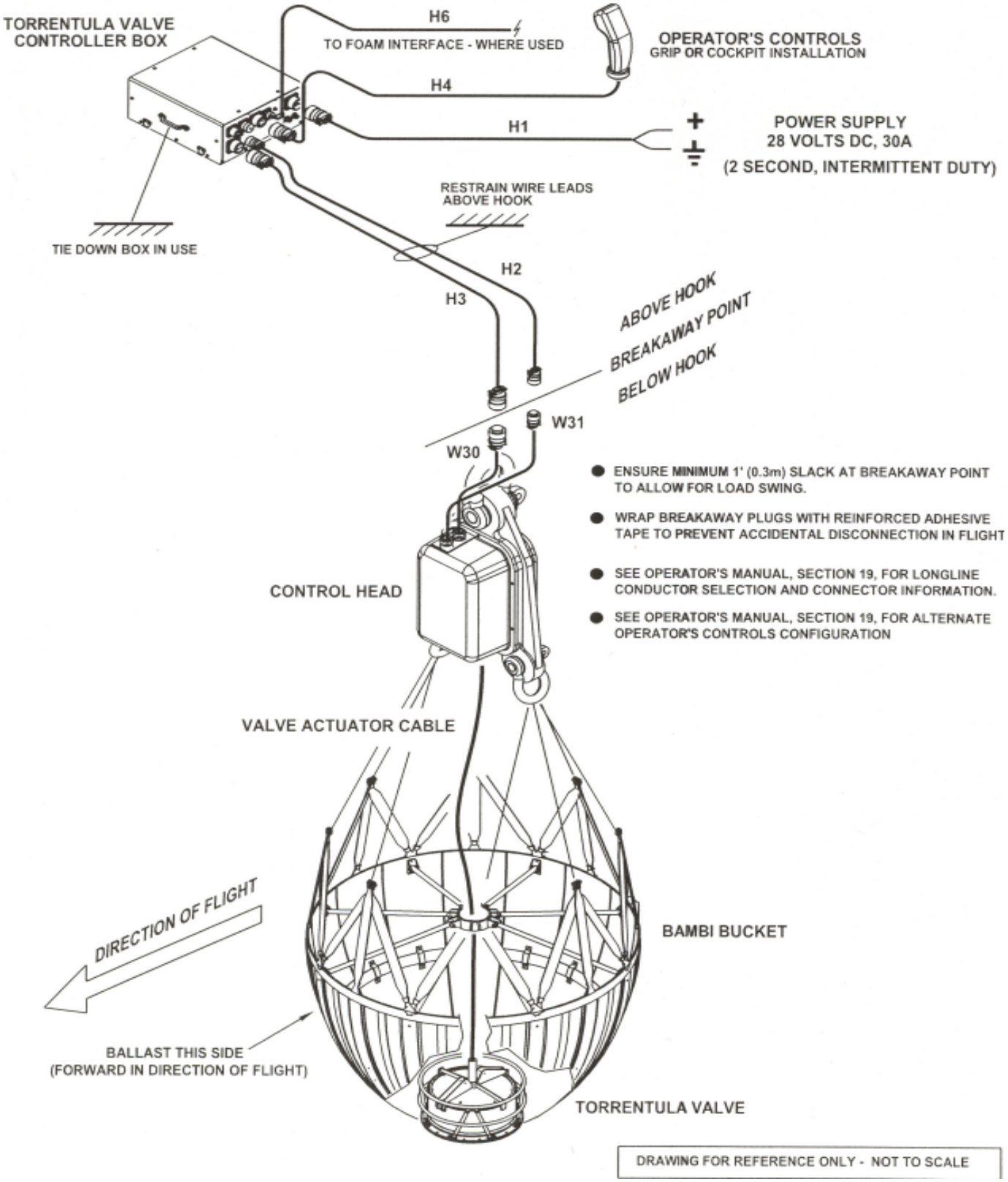
Model "B" controls have a black aluminum enclosure with all detatchable wire leads.

With the exception of the breakaway connectors, there are no differences on the "bucket end" of the system.

See figure 19.5 in Section 19 for details on the conversion.

3. DEPLOYING THE BAMBI BUCKET

Fig 3.1 Bambi Bucket with the Torrentula Valve, suggested helicopter installation



3.8 Checking suspension cable length

Fig. 3.2: Measuring overall length of Bambi

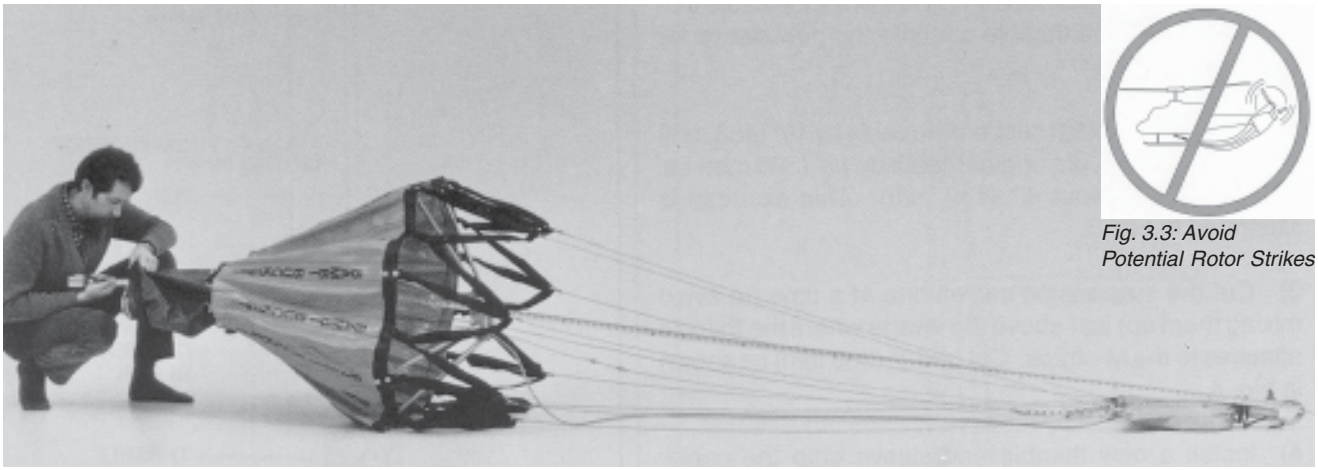


Fig. 3.3: Avoid Potential Rotor Strikes

WARNING: Using a Bambi Bucket with a greater overall length than the distance from the cargo hook to the front tip of the tail rotor on your helicopter could result in a tail rotor strike and possible loss of control of the helicopter.

IMPORTANT: It is recommended that operators who choose to use the Bambi Bucket with a longline, ensure the longline is at least 50' (15.25 m) long.

Overall lengths of Bambi Buckets with standard rigging are given in Table 1. Before using the Bambi Bucket, check for MAXIMUM TOTAL LENGTH. To determine it, measure the distance from the cargo hook to the front tip of the tail rotor on the helicopter you will be using and subtract 6" (152 mm). To determine overall bucket length:

1) Stretch out the bucket on the ground; secure the control head. See Fig. 3.2.

2) Measure the distance from the shackle on the control head to the bottom of the dump valve. This measurement should be less than the MAXIMUM TOTAL LENGTH determined above.

IMPORTANT: To avoid potential rotor strikes when using the Bambi Bucket the operator must measure the extended length of the Bambi Bucket and the distance from the belly hook to the closest possible point of the tail rotor.

A) Always measure the overall, extended length of your Bambi Bucket.

And

B) Measure the distance from the belly hook to the closest possible point on the tail rotor. "B" must always exceed "A" by at least six (6) inches.

Model	Overall Length	
2024	19'5"	5.92 m
2732	23'0"	7.01 m
3542	23'5"	7.29 m
4453	23'8"	7.14 m
5566HD	24'7"	7.49 m
6578HD	25'1"	7.65 m
7590HD	30' 6"	9.30 m
HL5000	32'0"	9.75 m
HL7600	33'1"	10.08 m
HL9800	34'5"	10.49 m

Table 3.1: Bambi Bucket Overall Length
NOTE: For Bambi Bucket Models 6578 sold prior to May 2001 the overall length of the bucket is 31'2". Please specify model size and serial number when ordering parts.

3.9 Instant Deployment System (IDS)

The instant deployment system (IDS) uses a hub and spoke mechanism to automatically expand the mouth of the bucket as soon as the suspension cables take the weight of the Bambi.

On Torrentula Valve-equipped buckets, it is recommended that the IDS should be deployed before flight so that a full function check of the valve can be performed.

CAUTION: Operating the Torrentula valve with the bucket collapsed may cause damage to the valve and/or control head.

When the bucket is full, the IDS Deployment Cable and hub Restrainer Cables should be slack; they should not bear any load. Their function is to position the hub and spoke mechanism to hold the bucket open.

The main parts of the IDS are illustrated in Fig. 3. To deploy the IDS System on the ground, reach into the bucket, grasp the hub of the IDS and pull outward fully until the two cables from the hub to the lower bucket shell are tight.

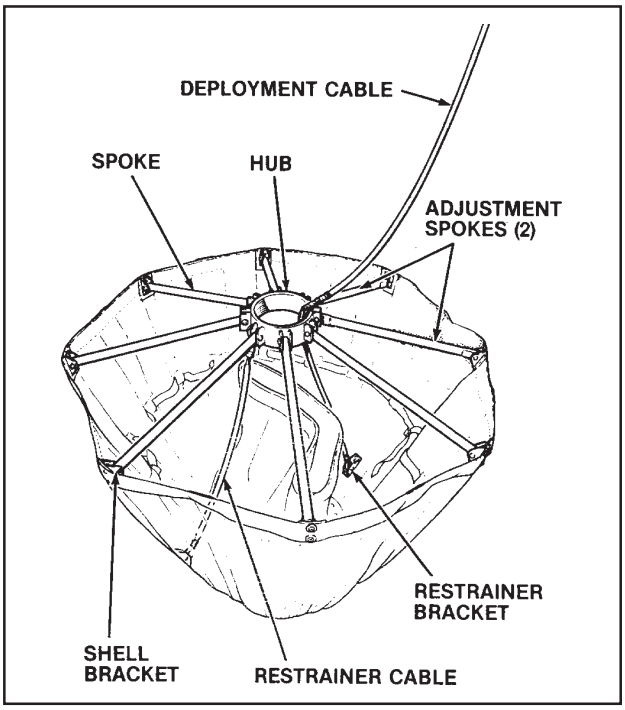


Fig. 3.4: Instant Deployment System, Main parts

4. FLYING THE BAMBI BUCKET

You may fly with the Torrentula Valve in the “open” or “closed” position, depending on your preference.

CAUTION: To protect the bottom valve seal, we recommend that the valve is closed during take-off and landing procedures.

4.1 Flying empty

The Bambi Bucket Has been flown at speeds to 110 mph (176 kph) and has proven stable at all speeds. Nevertheless, we suggest you build up to speed slowly with your Bambi Bucket on your helicopter under the prevailing operating conditions to determine a safe maximum speed.

4.2 Flying full

The dead weight of the load ensures different handling characteristics than when flying empty. You will notice that the Bambi Bucket does not “pulse” or “throb” under load in flight.

5. FILLING THE BUCKET

The Bambi Bucket with the Torrentula Valve can be filled either by tipping the bucket with the valve “closed”, or by filling from the bottom up with the valve “open”. The method used is based on operator preference, speed of fill and the water source.

The Torrentula Valve must be “closed” prior to lift-out from the source.

On the control panel, the green light will be on when the valve is in the “open” position; the amber light will be on when the valve is in the “closed” position.

It is not necessary to tow the Bambi Bucket to make it sink.

WARNING: When filling the Bambi, do not execute an abrupt 90 degree pedal turn with the helicopter close to the water while towing the bucket. In this attitude there is the danger that the Bambi suspension lines (as with any other load) could get caught on a rear skid resulting in a dynamic rollover on liftout. This could cause personal injury and helicopter damage. Check the load and suspension cables with your mirrors before liftout.

WARNING: Do not allow too much slack to occur on the Bambi Bucket suspension lines when dipping. Lines could snag on submerged objects or parts of the bucket.

5.1 Variable fill capability

The pilot can vary the bucket’s volume, up to the maximum rated capacity, by the speed at which it is pulled from the water. As the submerged bucket is lifted, water pressure bends the bucket shell outward, increasing the bucket‘s volume. The greater the upward velocity, the greater the volume of the bucket.

FCAS system

The Frusto-Conical Arrest System, **FCAS,** allows the operator to reduce the volume of the bucket to a preset percentage of maximum capacity.
The FCAS is composed of a cinch strap attached to the waist (vertical mid point) of the bucket.
The cinch strap is marked with one or more load levels.

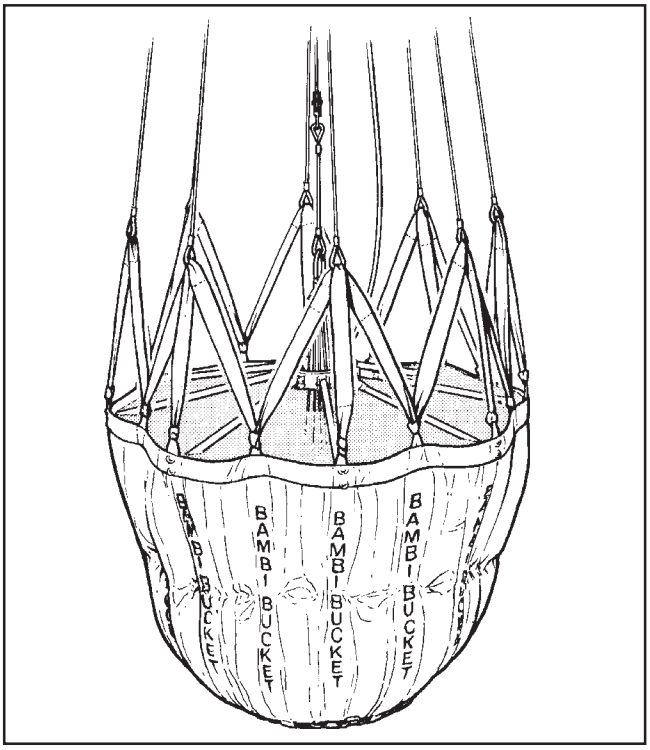


Fig. 5.1: Cinched Bucket, internal cinch strap

CAUTION: Do not tighten the cinch strap past the smallest load marking. Overtightening can damage the bucket shell.

Water volume can be adjusted on a Torrentula Valve Bambi Bucket by opening and closing the valve to release water. See Section 7: “Dumping the Bucket”.

5.2 Adjusting the IDS adjustment chain

An IDS adjustment chain is fitted to all Torrentula valve buckets. This chain must be adjusted when using the cinch strap to reduce bucket volume. The chain is lengthened for lower fill settings (eg. 70%) to allow the IDS to rise and thereby reduce IDS stresses. This will avoid possible damage to the IDS. The chain is shortened for higher fill settings (eg. 90%) to retain the maximum bucket mouth diameter and hence allow maximum filling efficiency. The recommended chain adjustments are summarised in Fig. 5.2.

CAUTION: The lowest fill setting for all models is 70%. Overtightening the cinchstrap could damage the bucket.

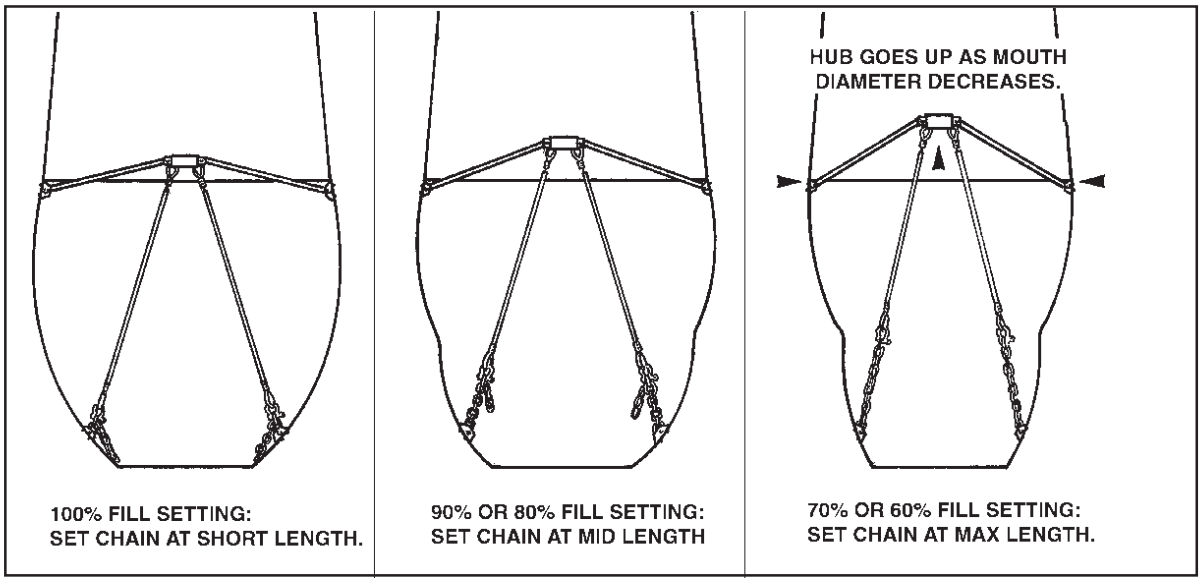


Fig.5.2: Adjusting the IDS Adjustment Chain

5.3 Shallow Fill Capability

Filling the bucket from the bottom is an advantage of the Torrentula Valve model that the Standard models do not offer.

With the addition of the PowerFill I shallow draft pumping system, many previously inaccessible water sources such as ditches, ponds, streams, rivers, swamps, and relay tanks, can be utilized.

CAUTION: Snagging the Bambi on submerged objects could result in bucket shell damage.

5.4 Filling From a Fireflex or Heliwell Tank

The Heliwell tank is a transportable, field erected water tank of sufficient size to dip all models of the Bambi Bucket. The tank consists of ten aluminum panels with an internal vinyl fabric liner. There are 3 different sizes of Heliwell tanks: 5,650; 9,425 and 14,900 USG.

The Fireflex Tank™ is a self-supported open top tank that can be used as a dip tank for helicopters equipped with the Bambi Bucket. See Table 5.1 for recommended tank sizes for different models of the Bambi Bucket.

Bambi Bucket Model No.	Empty Bucket Height (in/mm)	Recommended Fireflex Tank	
		Tank Model	Full Height
2024	39/.099	FFTF-2530	48/1.22
2732	43/1.09	FFTF-4048	60/1.52
3542	52/1.32	FFTF-5060	68/1.73
4453	52/1.32	FFTF-5060	68/1.73
5566	57/1.45	FFTF-80100	79/2.00
6578	58/1.47	FFTF-80100	79/2.00
7590	59/1.50	FFTF-80100	79/2.00
HL3800	72/1.83	FFTF-120144	93/2.36
HL5000	72/1.83	FFTF-120144	93/2.36
HL7600	86/2.18	FFTF-120144	93/2.36

Table 5.1: Fireflex Tank sizes for Bambi Bucket

6. USING FOAM

The Bambi bucket is designed to be used with foam. All materials used in the manufacture of the Bambi Bucket are resistant to the chemical action of foam.

CAUTION: After using foam or retardant, cycle through several dumps with water only or hose down with fresh water. This will prolong the bucket's life.

6.1 SACKSAFOAM Foam Injection System

The Sacksafoam is SEI Industries' state of the art foam dispensing system for use with your Bambi Bucket. This system, exclusive to the Bambi, allows foam to be dispensed into the bucket en route from the filling source to the fire site.

There are four models of Sacksafoam to fit the full range of Bambi Buckets. The operation of the Sacksafoam is controlled by the pilot through a Control Unit, which is mounted in the cockpit. The original model of the Sacksafoam contains the foam reservoir directly installed inside the bucket.

Also available is the Sacksafoam III unit, which is a self-contained unit stowed onboard the helicopter. The system is all housed in a foam-resistant case. With the Sacksafoam III, designed for medium and heavy lift helicopters equipped with larger Bambi Buckets, the operation of the system is performed by crewmembers in the back. The Control Unit is mounted directly on the case of the Sacksafoam III. See Table 2 for Sacksafoam size requirements.

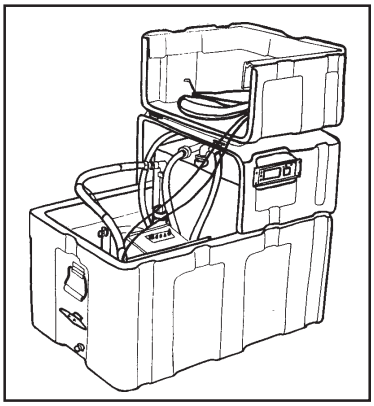


Fig. 6.1: Sacksafoam III self-contained foam injection unit

For further instructions on operating the Sacksafoam units, please refer to the applicable Sacksafoam Operator's Manual.

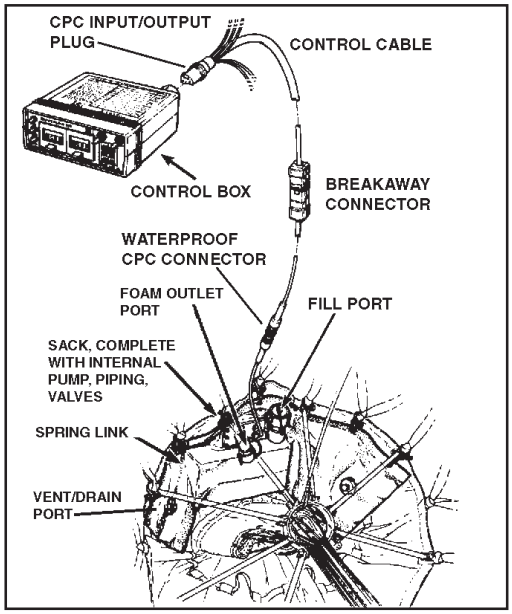


Fig. 6.2: Sacksafoam 1 foam injection system

Table 3: Sacksafoam/Bambi size requirements

Model	For Bambi Bucket Models	Reservoir Capacity USG	L
Sacksafoam I			
SFF01-8018	8096 - 1821	12	45
SFF01-2044	2024 - 4453	30	114
SFF01-5550	5566 - HL5000	72	272
SFF01-7698	HL7600 - HL9800	132	500
Sacksafoam II			
SFF02-8044	6072 - 1821	10	38
SFF02-5598	1821 - 4453	25	94
Sacksafoam III			
SFF03-6698	5566 - HL9800	25	94
Sacksfoam Plus (for additional foam storage for SF II & III)			
SFF-PLUS		40	151

6.2 Interface with Torrentula Valve Controller

The Torrentula Controller has an interface receptacle on the face panel for connection to the Sacksafoam system, via wire harness H6. With the harness connected, the Sacksafoam dispense cycle will be automatically cancelled in the event the dump valve is opened.

7. DUMPING THE BUCKET

7.1 Dump pattern

As with the Standard Valve Bambi Bucket, the dump pattern is affected by height and airspeed. It is most concentrated at lower altitudes above ground level (AGL) and at a hover. The pattern will "spread" with height and speed. Operators can take advantage of these characteristics to maximize assault on the fire line.

WARNING: Never dump onto ground personnel as the water impact could result in injury.

7.2 Dump speed

It is suggested that you get familiar with flight characteristics while dumping from your particular helicopter. Make dumps at slower speeds before progressing to faster dumps.

NOTE: SEI does not recommend dumping at airspeeds above 50 knots.

7.3 Operation of the dump valve

To dump at 100% flow, push the "open" dump switch for one to two seconds. To stop the water flow at any moment during dumping, push the "close" switch for one to two seconds. This operation can be repeated several times until the bucket is emptied. After a few dumps, you will get accustomed to the process.

When the "open" switch is actuated briefly, the valve will open part way. The valve can also be positioned part way closed from the full "open" position. The water flow can be metered in this manner for any desired flow rate up to the maximum.

The approximate time to fully open or close the valve is 0.75 seconds. This speed is fast enough to provide clean "on" and "off" action, yet will allow the operator to establish repeatable partial flow rates as experience is gained.

Valve position indicator lights

When on, the green light on the control grip panel will indicate that the valve is "open".

When on, the amber light will indicate that the valve is "closed".

8. LANDING

The recommended landing procedure is to allow the bucket to touch down ahead of the helicopter and then maintain tension on the suspension lines by backing up slightly, thereby keeping the control head at an angle while landing.

CAUTION: To avoid damage to helicopters with low skids, never land on a vertical control head. This could damage the helicopter and/or the control head. The head is approximately 24" (610mm) in length.

Do not release the control head from the cargo hook while hovering. This could damage the control head. If the control head must be released while hovering, have ground personnel support the control head before releasing.

CAUTION: If the control head has experienced a severe impact, it is necessary to visually examine all three shackle bosses on the control head base to determine if they have been bent or otherwise damaged.

If any of the shackle bosses have been damaged, the control head base requires replacement.

Operating with a damaged control head base casting could result in failure and unintentional release of the bucket.

Do not drag the Bambi over rough surfaces when landing or ground handling or land at high speeds. This may damage the bucket shell, Torrentula Valve, and the control head.

CAUTION: To protect the bottom valve seal, it is recommend that the valve be closed during take-off and landing procedures.

9. PACKING THE BAMBI BUCKET

To pack the Bucket:

See fig. 9.4 for tips on the correct method of collapsing the IDS Hub, Torrentula Valve buckets

1) Collapse the Instant Deployment System by pushing the hub into the bucket. Keep slight tension on the actuator cable to avoid kinking the cable conduit at the connection to the valve. Fig 9.4

2) Grab the control head and pull the suspension lines taut as shown in Fig. 9.1.

3) Gather the suspension lines into a coil and stow inside the bucket as shown in Fig. 9.2. Placing the control head outside and the lines inside prevents the possibility of the lines tangling.

4) Bring the control head back and place on collapsed bucket.

5) Roll the bucket into a bundle and wrap with rope supplied.

6) Take the carrying bag and drape it over the bucket.

7) Roll the bucket over into the open bag and zip up the bag.

The carrying bag with the Bambi Bucket makes a suitable shipping container when shipping via airfreight.

Because of the compactness of the Bambi, many operators carry it aboard the helicopter at all times during the fire season. This allows a very rapid response to a fire call.

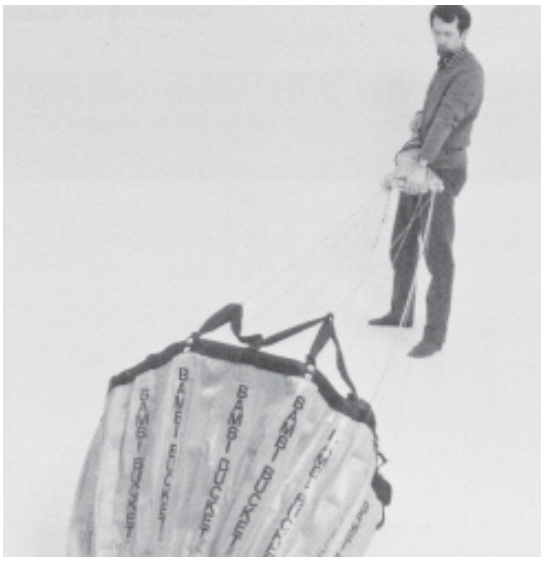
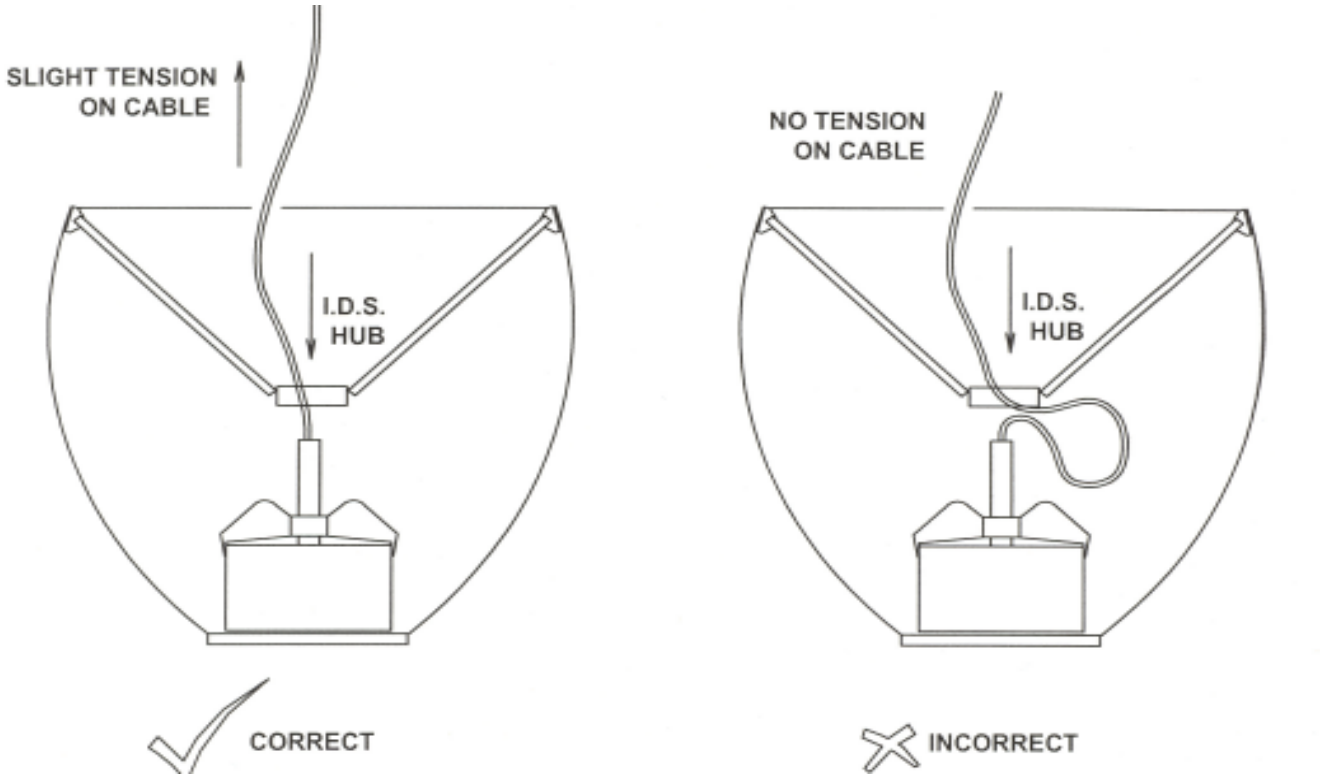


Fig. 9.1: Stretch out suspension lines

Fig. 9.2: Loop suspension lines and stow inside bucket

Fig. 9.3: Place control head on collapsed bucket

Fig. 9.4 Correct method of collapsing IDS Hub, Torrentula Valve models



10. STORING THE BUCKET

We suggest that you follow these guidelines to ensure the longevity of your Bambi Bucket:

1) Do not pile heavy objects on the bucket.

2) If foam has been used, wash the bucket prior to storing it.

3) Do not store a wet bucket. This will result in the growth of mildew and corrosion of aluminum and steel parts.

4) We recommend that you store the bucket in doors in an unfolded position, preferably by suspending the main shackle from an overhead hook. An alternative is to suspend the bucket upside down from its bottom chain.

5) Before storing the bucket for an extended period, perform the seasonal maintenace procedures as outlined in Section 11.

11. TORRENTULA VALVE SYSTEM MAINTENANCE & TROUBLESHOOTING

11.1 Introduction

The maintenance and repair of the Torrentula Valve system should only be undertaken by mechanics and technicians with a level of competency commensurate with this class of product. Some proficiency with basic hand tools and knowledge of basic mechanical maintenance practices is essential.

If work on the Torrentula valve electrical controls is undertaken, further knowledge and experience in the area of 28 volt DC electric circuitry is necessary. We have included in this manual a wiring diagram to assist operators in troubleshooting the electrical system. Before commencing work, we recommend that technicians familiarize themselves with the wiring diagram and the layout of the major components in the system.

11.2 Description of the Torrentula valve and Actuating Mechanism

System overview

The Torrentula Valve system consists of a variable flow sleeve valve mounted in the bottom of the Bambi Bucket shell. The valve is operated by an electro-mechanical actuator installed in the control head, located at the top junction point of the bucket suspension lines. The control head also serves as the main lifting member of the Bambi Bucket. The valve is linked to the actuator in the control head via a fully-enclosed stainless steel pull cable. The actuator provides the valve opening force, and the closing forces are a combination of gravity, water flow and constant force springs.

Valve operation: The Torrentula valve is essentially a sleeve that moves vertically to expose an open annulus for the water in the bucket to flow through. The vertical position of the valve sleeve and the level of water or “head” in the Bambi Bucket determine the speed at which the water flows through. The vertical position, or the valve opening, is fully controllable by the operator from 0 to 100% of the available valve travel.

The approximate transit time for the valve to move from the full “closed” position to the “full open” position is 0.75 seconds. The fast transit time allows the operator to distribute a single load of water intoseveral full “open” drops. If desired, the operator may also extend the length of a water drop by opening the valve partially.

Valve description

The Torrentula valve is mounted to a steel or aluminum ring that is bolted to the bottom of the bucket shell. This “base” ring supports pillars, at the top of which a round aluminum plate or “top plate” is attached. To the center of the top plate is mounted an aluminum guide tube. The base ring, pillars, top plate, and guide tube form the “fixed” or rigid part of the valve on which the valve tube slides up and down. The large diameter valve tube has dual-durometer seals mounted top and bottom that prevent water leakage when the valve is in the fully “closed” position. The sliding valve tube is supported at three points by engineered polymer bushings that minimize sliding friction when the valve sleeve is in transit. The “top” bushing is mounted centrally in an aluminum spider that is bolted to the valve sleeve, and the two “bottom” bushings are mounted in the lift bar assembly which doubles as the actuator cable attach point. Two of the support pillars in conjunction with the top guide tube serve to keep the valve sleeve aligned with the fixed structure of the valve.

Actuator description

The actuator installed in the control head consists of a motor/gear reducer unit to which an eccentric cable crank is mounted. The stainless steel actuator cable is attached to the cable crank and serves to open and close the Torrentula Valve by partial rotation of the crank in counter clockwise and clockwise directions. The center of the gear reducer shaft is eccentric with the cable crank in order to provide variable leverage and speed to open the valve efficiently.

From the “closed” position, the cable crank has maximum leverage on the actuator cable, to provide the larger opening force to “crack” open the valve. The speed of opening the valve is increased by the progressively longer leverage arm on the crank as it rotates counter-clockwise to the full “open” position.

The control head is designed to withstand moderate shock loads and temporary immersion in water. The front and rear covers are sealed to the control head body, and the electrical and a actuator cables pass into the control head via water-tight strain fittings.

11.3 Torrentula Valve electrical system description

The Torrentula electrical system is designed to run on 28 volt DC electrical power supplied by the helicopter, requiring a 30 amp circuit. The main components of the electrical system consist of: operator’s controls, Printed Circuit card with controller logic, two power relays, three position sensing limit switches and a 28 volt dc actuator motor. The actuator switches are enclosed in an operator’s control grip that also houses indicator lights for valve full “open” and valve full “closed” indication. The printed circuit card and two power relays are contained in an enclosure to which all the electrical connections are made.

The motor and limit switches are located in the control head. A 0.25 second delay is incorporated into the control circuit to prevent sudden control reversals from damaging the actuator motor while under load. Two limit switches in the control head act to stop the actuator motor when the full “open” and full “closed” limits are achieved. The actuator motor can be stopped at any point between full “open” and full “closed” by releasing the actuator switch. A third limit switch in the control head acts as an over-travel safety switch, to prevent damage to the actuator components in the event of failure of one of the other limit switches.

11.4 Routine maintenance procedures

In addition to routine daily preflight inspections as outlined in Section 2, *Preflight Safety Check,* the following should also be performed when the bucket is in use:

Operational inspections
Every 20 hours or 3 days in continous use

1) Check all parts of the control head for visible damage or defects. Clean off all debris
2) Remove the front cover of the control head and check for water ingress and damage to internal components. If water accumulation is apparent, remove the rear cover, wipe and allow to dry completely. Inspect the cover seals for damage and re-secure the covers

See fig. 11.1 for detailed tips on how to prevent moisture accumulation in the control head.

3) Assess the function of the valve by manually sliding the valve open from a fully closed position. Clean off debris
4) Inspect all electrical cables for damage
5) Thoroughly inspect the top and bottom valve seals for wear and damage.

Seasonal inspections
Every 6 months

1) Remove any surface corrosion from aluminum parts with “Scotchbrite” or similar abrasive pad.
2) Thoroughly clean an dry the entire bucket and control head, particularly if the bucket is being put into storage.
3) Remove the rear cover and inspect the motor, gear reducer and electrical connections for corrosion and damage.

Preparation for storage
(In addition to seasonal maintenance)

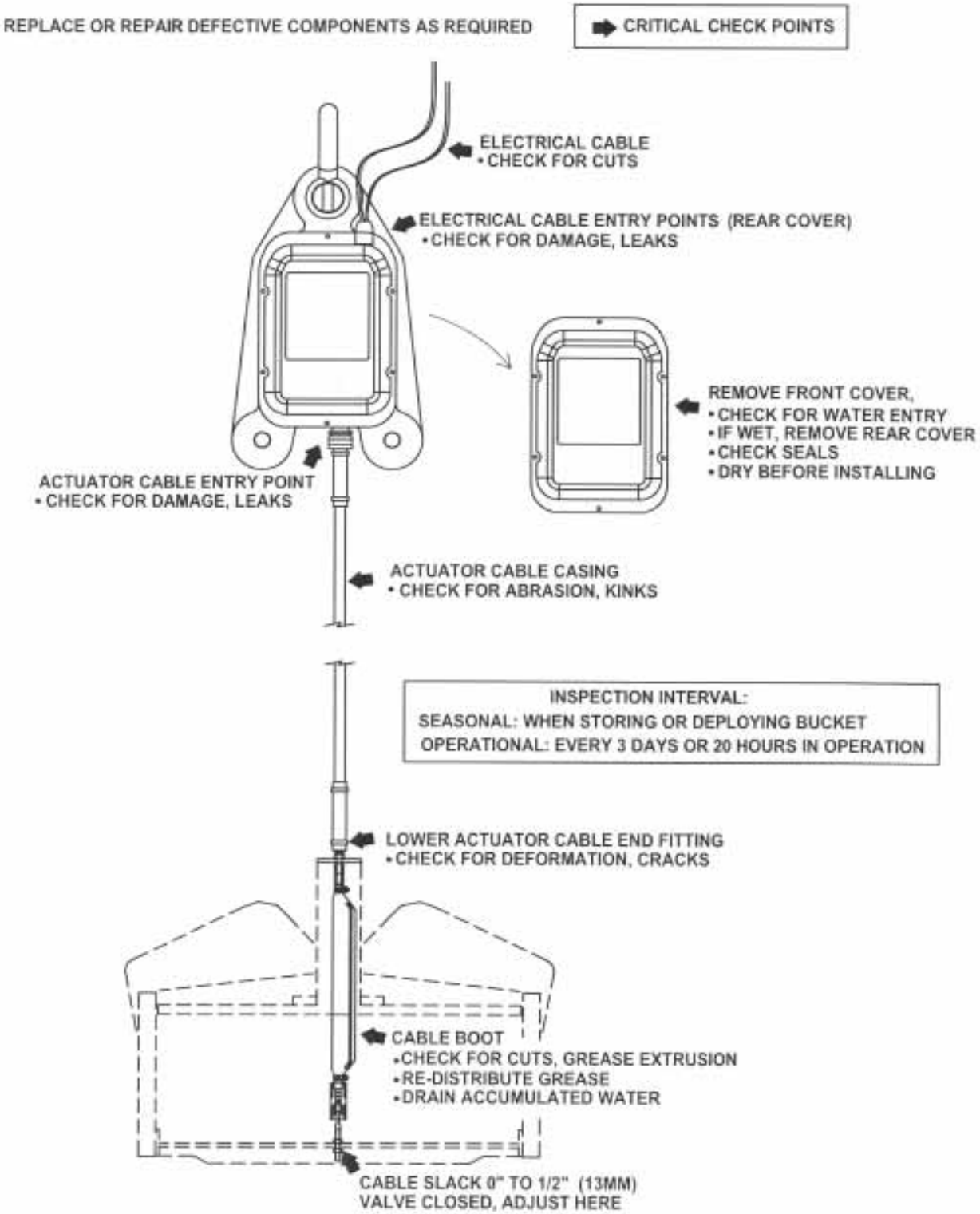
1) Perform all major repairs to the bucket and Torrentula Valve system before storage. This will ensure operational readiness when the bucket is needed next
2) If the bucket is to be stored in a high-humidity environment, it is recommended that all aluminum and steel parts are given a light coat of corrosion preventative compound such as ACF-50^{tm} or WD-40^{tm}
3) Place a small block of wood between the valve lift bar and base ring to lift the valve slightly open. This will prevent the seals from taking a “set” during storage.

It is highly recommended that the bucket be stored indoors when not in use. This will minimize deterioration of the bucket components due to temperature change, UV light, and atmospheric moisture.

4) The bucket should be hung upside down to dry out completely before being folded for storage. For maximum life, store the bucket in the deployed position, away from direct sunlight. This will ensure the bucket components remain dry for the duration of storage.

11. TORRENTULA VALVE SYSTEM MAINTENANCE & TROUBLESHOOTING

Fig 11.1 Maintenance checks: Prevention of water accumulation in the control head



11.5 Unscheduled maintenance

Control head immersion in water

If the control head is repeatedly or continually immersed in water during operation, it will be necessary to remove both front and rear covers of the control head to inspect for water ingress, even if the function of the control head does not appear to be impaired. If water is present inside the control head it is necessary to thoroughly dry the components, with application of heat, for several hours before returning the unit to operation.

Actuator Cable replacement

Removal:

1) Loosen and remove the bottom nut securing the bottom cable fitting to the valve lift bar
2) Remove the two socket head allen screws securing the cable plate to the top slider tube
3) Remove the control head front cover (the one with the serial number plate)
4) Remove cable guard plate
5) Disconnect the top cable end from the cable crank by removing the ¼" bolt
6) Loosen the securing nuts at the top cable adjuster bracket
7) Remove the two bolts securing the cable guide block
8) Using water pump pliers, loosen the watertight strain relief at the bottom of the control head housing
9) Using a 12" crescent wrench, remove the watertight fitting housing from the control head and pull the cable assembly free.

Installation:

Installation is the reverse of removal, with the following additional instructions:

1) Use waterproof pipe sealing compound or silicone sealant to seal the threads of the watertight strain relief housing
2) Tighten the jam nuts on the top cable fitting so that there are an equal number of threads above and below the nuts (in the middle of available adjustment).
3) Check that the actuator cable rides about 1/16" to 1/8" (1.6mm – 3.2 mm) above the limit switch cover when under tension. Adjust the top cable fitting jam nuts to suit.

Actuator cable adjustment:

1) Lay the bucket, suspension lines and control head out in the deployed position with the suspension lines pulled straight
2) Using aircraft power, cycle the valve actuator to the "closed" position (confirm that the closed light is "on")
3) Adjust the two bottom nuts that secure the cable end to the valve lift bar so that there is slight tension it the cable. The valve seal should be contacting the bottom plate, and you will be able to compress the valve seal slightly more by pulling the lift bar towards the bottom of the bucket.
4) Cycle the valve open and closed several times to ensure smooth movement and seating of the valve seals.

After several full load cycles a new cable will stretch approx. ¼" (6mm). A broken-in cable will have a small amount of slack when felt above the lift bar. This is normal. However, excessive amounts of slack will prevent full opening of the valve, and if the cable is too tight, the valve may not shut fully and will cause the valve to leak.

If insufficient adjustment is available on the cable end fitting, an additional 1/2"(13mm) adjustment is available at the upper cable conduit fitting, located in the control head.

11. TORRENTULA VALVE SYSTEM MAINTENANCE & TROUBLESHOOTING

Fig 11.2 Torrentula Valve Troubleshooting Chart

Problem	Possible cause(s)	Check/repair
Valve will not work when first connected to helicopter	Incorrect connection to Helicopter power supply	Check helicopter power supply for correct voltage/polarity. Check circuit rating
Valve will not work when first connected. “Open” and “closed” indicator lights both on	Control cable, H2 not connected.	Connect cables from Controller to control head, H2, H3
Valve moves slowly or roughly when tested	Valve rubbing on inside of Bambi Bucket shell	Ensure valve is free from obstruction by bucket shell when performing ground checks.
Valve does not close fully	1) Actuator cable free length is too short 2) Valve bottom bushings are binding on support rods	1) Adjust cable free length 2) Adjust bottom bushings (See maintenance procedures for cable replacement and bushing adjustment)
Valve operates normally and then stops in full “open” or full “closed” position	1) Limit switch failure or damage 2) Power contactor failure	1) Check limit switches for correct operation. Replace as required 2) Check power contactors for correct operation. Replace as required
Valve operates normally and then suddenly fails to operate	1) Sudden short or circuit overload 2) Actuator cable failure 3) Actuator motor failure	1) Check for obstruction of valve movement, cut or frayed electrical cables. Check rating of aircraft circuit breaker. Inspect condition of electrical components (See maintenance procedures for checking electrical components) 2) Repair/replace actuator cable 3) Replace actuator motor
Valve leaks	1) Valve seal or seals are damaged 2) Valve is not closing fully	1) Repair/replace seal(s) as required 2) Check cable free length and for correct valve seating. (See maintenance procedures)
Valve fails to operate after control head immersion in water	Control head electrical components damaged due to contact with water	Dry out control head. Check function of control head electrical components (see maintenance procedures) Ensure control head seals are in good condition
Valve fails to operate after sudden impact with object or ground	1) Bent or broken valve components 2) Damaged or broken control head components	1) Repair/replace valve components as required 2) Repair/replace control head components as required
Control head actuator motor operates slowly or intermittently	1) Poor electrical connection 2) Actuator motor faulty, may occur if motor is immersed in water	1) Check the cable connections and cables for damage or corrosion 2) Replace actuator motor

Seal repair and replacement

Field repairs

If a top or bottom valve seal has been damaged, it may be possible to perform a sufficient temporary repair, given that the damage is limited to small tears or rips.

1) If the area to be repaired is wet, dry thoroughly with forced hot air
2) Position the two sides of the tear or rip so that the edges line up
3) Apply a small quantity of cyanoacriliate adhesive (SEI Industries will supply Locktite 495, other common Brands include Super Glue, Crazy Glue, Zap!, etc.) along the tear and press gently together until a bond is achieved. Please observe the warning labels on the adhesive container. See Fig. 11.2
4) If the edge of the glue joint is rough or protrudes above the surface of the seal, it may be dressed lightly with medium-grit sandpaper.

Seal replacement is recommended if repairs fail to restore full seal function

Top seal replacement

NOTE: If the replacement valve seal comes prejoined, the seal may be replaced more easily by removing the top spider assembly and spring brackets as one peice. If the seal comes as an unjoined length follow steps 1 through 9 below:

1) Prop the valve tube slightly open by pulling up on the valve spider and placing a block of wood between the spider and the top plate
2) Remove the four seal retaining clips along the top edge of the valve
3) Pull the seal off the retaining ring, cut the seal and remove it from the valve
4) Position the new length of valve seal on the seal retaining ring. It will be necessary to “push” or compress the seal as you install it on the retaining ring. This will ensure the new seal sits tight on the ring and will not slip off.
5) Check that the ends of the seal are pushed together snugly when the seal is fully seated on the ring. If they are too tight, trim the seal back a bit with a sharp knife
6) When satisfied, pull the free ends of the seal several inches inward from the seal ring
7) Carefully mate the two ends of the seal. If the seal ends are not fully square, take the time to trim them, using a very sharp knife.
8) Apply Locktite 495 to one end of the seal and carefully mate the seal ends to make a nearly seamless joint. Apply pressure until a bond is made - approx. 60 seconds. The joint may be dressed with medium grit sandpaper to remove roughness
9) Push the seal fully onto the seal ring and reinstall the seal retaining clips.

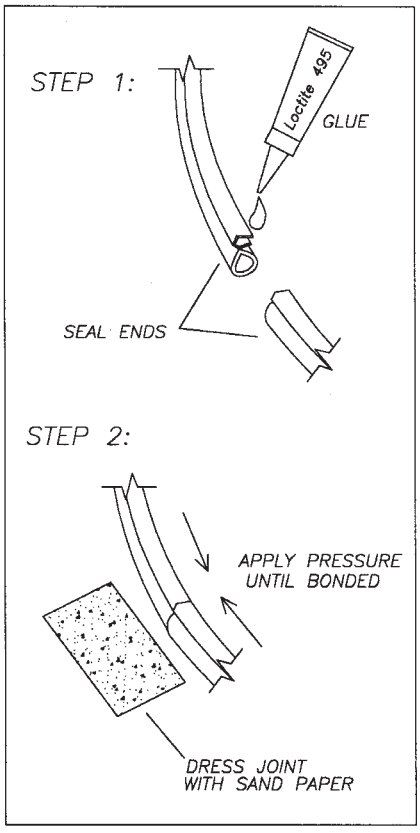


Fig 11.3 Joining Seal Ends

Bottom seal replacement

The bottom seal is held in place on the valve sleeve by a ½" (13mm) square aluminum ring and 13 countersunk retaining screws. The holes in the valve tube are match drilled to the retaining ring. The retaining ring can only be installed in its original position. If the new valve seal comes pre-joined, the four support pillar retaining bolts must be removed to facilitate installation of the seal. If desired, the valve can be easily removed from the bucket shell but removing two IDS spokes and lifting the top portion of the valve out of the bucket.

1) Prop the valve slightly open with a block of wood
2) Mark the orientation of the seal retaining ring on the valve sleeve by match marking a screw location with a point on the valve tube.
3) Starting at the seal ring gap, and working around, remove all 13 retaining screws
4) Trial fit the new valve seal to the valve tube. If the valve seal is not pre-joined, you must join the ends as described in the *Top seal replacement* instructions. It is desirable to make the seal a snug fit around the valve tube, so that you must stretch the seal slightly to slip it onto the valve tube.
5) Remove the valve seal and place the retaining ring onto the tube in its correct orientation. Place the seal back on the valve tube and position the surface of the ring is ½" (13mm) from the bottom surface of the valve tube.
6) Open the retaining ring and place it around the hard part of the seal, so that the bottom surface of the ring, 1/2" (13mm) from the bottom surface of the valve tube.
7) Using a sharp awl or small sharp screwdriver, poke through the alignment hole in the retaining ring (pre-marked at removal) and through the valve seal to find the first screw hole in the valve tube.
8) Reinstall the screw and place a screw clamp onto the valve seal retaining ring to hold it down for the next screw. See Fig 11.4. Locate the next screw hole using the awl and install the screw
9) Replace all the remaining screws in the manner described above, taking care to ensure the seal is evenly placed all the way around.

It is possible to relocate the seal retaining screw holes in the valve tube if some of the original screw holes are stripped. Note: This can only be done on Torrentula Valves that have a plastic (PVC) valve tube. It is recommended that you drill 3/32" (2.4mm) pilot holes for the screws, taking care not to drill all the way through the tube.

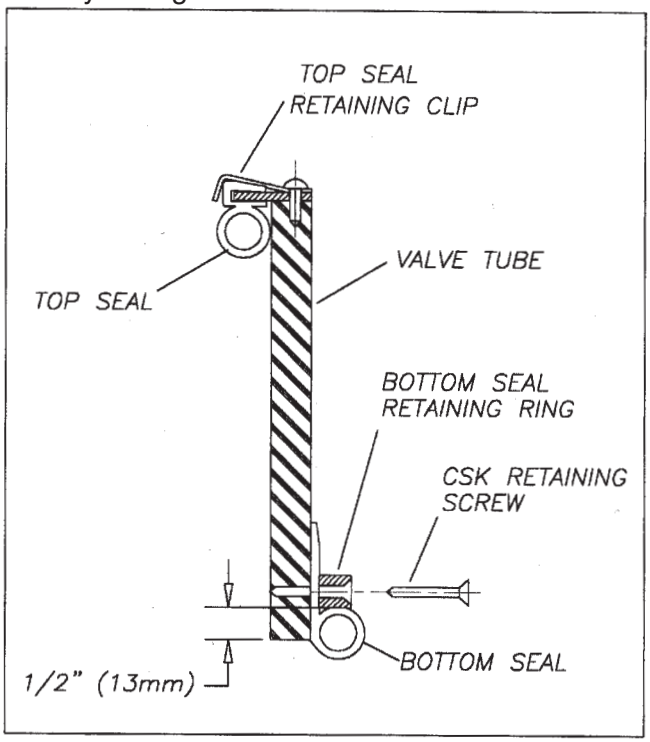


Fig 11.4 Seal Position

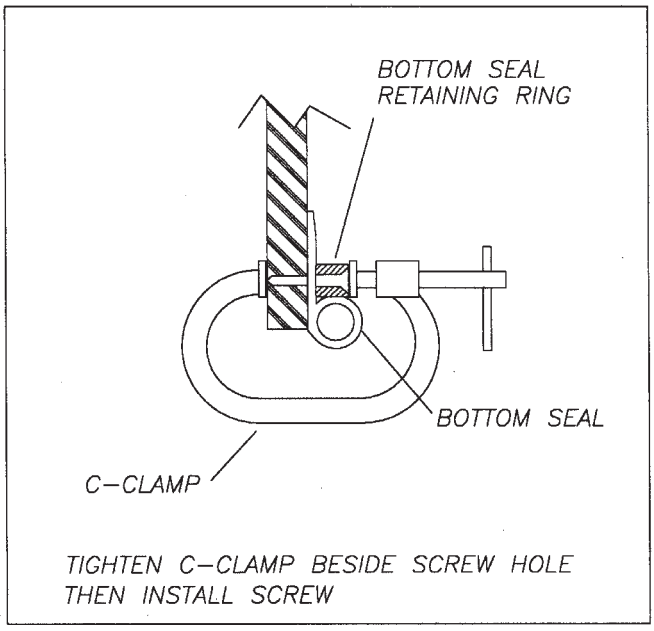


Fig 11.5 Using Clamp To Assist New Seal Installation

Adjustment of limit switches in the control head
The limit switch clearance will need adjusting only if the following parts are removed or replaced: 1) Cable crank, 2) limit switch cam, 3) Gear reducer unit. Note: The adjustment plates on which the limit switches are mounted can remain secured if the only the limit switches need replacement.

The limit switches in the control head provide signals to the power relays to tell them when to stop the actuator motor. The cable crank has mounted on it a cam that trips the limit switches at the full travel in both directions. To access the limit switches the cable must be disconnected from the cable crank and the limit switch cover removed. When adjusted correctly, there should be 0.012" (0.30mm) clearance between the limit switch and the top corner of the limit switch body. See Fig 11.5. The exact clearance ensures that the switch contact is fully depressed while not putting bending stress on the switch lever.

The over-travel trip lever is actuated by a small screw peg that protrudes below the surface of the limit switch cam. If one of the "open" or "closed" limit switches fails, or is not adjusted correctly, the peg will trip the lever and actuate the over travel switch. At this point the motor will stop and the fault must be rectified before continuing use.

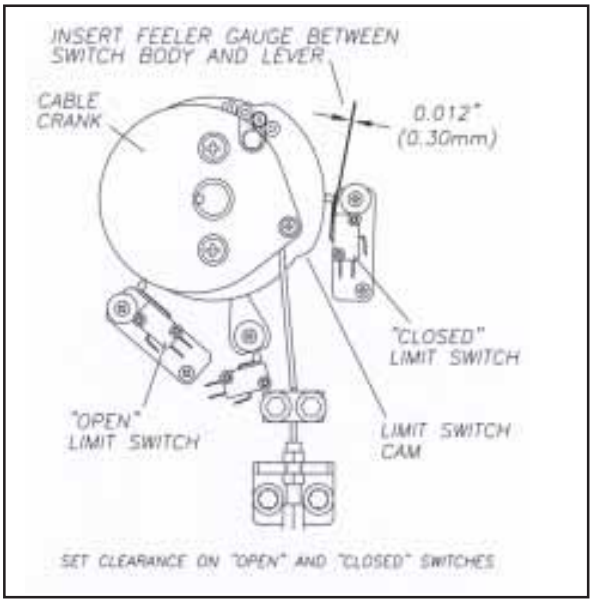


Fig 11.6 Limit Switch Clearance (limit switch cover not shown)

To reset the trip lever, loosen the single securing screw and point the small radius end at the centerline of the gear reducer shaft. Re-tighten the securing screw. Reinstall limit switch cover and reconnect the actuator cable before replacing the front cover. See Fig. 11.6.

CAUTION: Do not operate the Bambi Bucket with the limit switch cover removed. The actuator cable could snag on the limit switches and/or wiring and cause a fault.

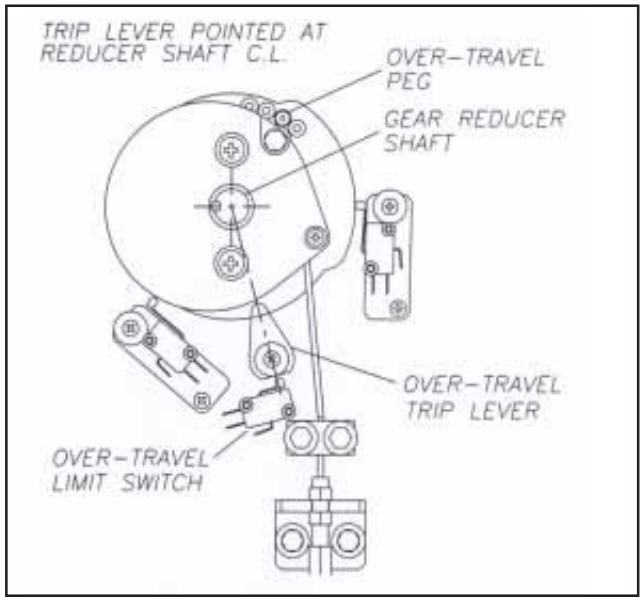


Fig 11.7 Over-Travel Trip Lever Alignment (limit switch cover not shown)

Adjustment of bottom valve bushings
If the valve appears to be "sticking" or not closing fully, even when the closed light on the actuator switch box is "on", check the adjustment of the lower bushings.

1) Loosen the two securing bolts on each bushing to allow the bushings to "float"
2) Pull the valve into the "closed" position and tighten one bolt on each bushing to make them snug.
3) Push the valve to the full "open" position and observe if the valve closes freely without hesitation or binding.
4) Adjust the bushings until a free slide up and down is achieved.
5) Re-tighten the bushing bolts.

11.6 Electrical controls troubleshooting

Troubleshooting faults in the electrical system will require at least a basic knowledge of DC electrical theory and some understanding of the function of switches, relays, and electric motors. Some experience in the art of troubleshooting is essential. For these reasons, we highly recommend that only qualified mechanics and or electrical technicians attempt to repair the electrical system without the assistance of technical support from SEI Industries.

Electrical faults are usually simple and the result of a discontinuity in electrical flow. The most likely place to start is an inspection of all external electrical conduits, checking for breaks in wires or tell-tale damage. Also, check connectors for signs of damage or corrosion. If all external appearances are normal, then an assessment of the function of each component may be required.

For troubleshooting we recommend you have on hand the following tools:

1) Electrical Multi-meter for checking voltage, resistance and continuity
2) Some form of 24-28 volts DC power supply (other than the aircraft power supply) for checking individual component function.

Warning: Observe all reasonable precautions when testing components with live DC power. Failure to do so could result in serious personal injury. Use extreme care when performing any disassembly and re-assembly of the electrical system. All connections as shown on the wiring diagram are non-negotiable - any missed connections will cause failure of the system in some way. Errors in wiring can cause an infinite array of malfunctions, from benign to disastrous – use caution and double check your work.

Keep the wiring diagram handy at all times when working on the electrical system. Before performing any checks, be sure to understand the function of each component within the system.

Electrical component function checks

Circuit breakers

Location: right hand side ofController box. The plunger should be “in” for operation. If the breaker has “tripped” and the plunger is “out”, immediately disconnect power and perform the function checks on each component in isolation. Check for continuity of the circuit breaker with the plunger “in”.

Power relays (aka contactors)

Location: Right hand side of junction box, with lid off, looking down. With power off, there should be good continuity (very low resistance) across the NC terminals. Check the resistance across the coil terminals with plug J4 removed from the circuit board. The Resistance should be approximately 50 ohms. With the relay isolated, apply power across the coil contacts – if it is functioning correctly there will be an audible “click”. With power across the relay coil there should be continuity across the NO terminals.

Caution: It is recommended that the actuator cable be disconnected from the cable crank when performing function checks of the control head components. This will eliminate the possibility of damage the actuator cable and or valve in the event of a malfunction or mis-adjustment.

Printed circuit card

Location: rear of enclosure.
Assessment of the printed circuit board is limited to a visulal inspection. Look for any obvious overheated components or burnt solder connections. If available, swap the suspect board with a known functioning one.

Limit switches (aka micro-switches)

Location: inside front cover of control head
With power off, the limit switch lever extended and the leads disconnected, there should be continuity across the NC and COM terminals. When the lever is depressed, there should be continuity between the NO and COM terminals.

Actuator motor

Location: inside back cover of control head
Remove the motor from the gear reducer unit by undoing the two securing screws and applying gently prying force on either side of the motor. Apply power directly to the motor leads. The motor should run smoothly with no grinding or roughness.

Caution: Applying power directly to the motor leads while it is still attached to the reducer will cause actuation of the over-travel trip lever, and will require re-setting (see maintenance procedures, Section 11.5, Adjustment of limit switches in control head)

12. SHELL AND SUSPENSION LINE MAINTENANCE

Available from SEI Industries is the new **Bambi Bucket Repair Assessment Manual**. This manual is intended to provide the user with information that will allow for the proper repair assessment evaluation of the Bambi Bucket. Contact SEI Industries for a copy, or download one from the SEI website.

12.1 Suspension line replacement

Suspension lines should be replaced whenever they display noticeable kinking or fraying. Factory replacement lines can be ordered with or without the end thimbles swaged on. The incomplete lines can be swaged directly onto the fabric M-straps (as original equipment). Complete lines are attached to the M-straps with shackles. When using shackles, ensure that they are secured with a tie wrap or lock-wire before using bucket.

12.2 M-strap replacement

Replace the M-straps if they become noticeably worn. M-straps can be repaired, if frayed, by melting the fray with a lighter to stop the fray from spreading. The length of the M-straps is critical to proper functioning of the Bambi bucket and we recommend that you replace worn straps with factory equipment. There are three types of straps: fabric long, fabric short and chain. Fabric shorts are used for the vertical straps, fabric longs are used for the diagonal straps and chains are used in the front of the larger Bambi Buckets where abrasion due to dragging can occur.

When replacing straps, do one set at a time to avoid confusion. Cut off the old straps from the shackle and untie them from the top of the bucket shell. Attach replacement straps per the originals. To avoid unnecessary wearing, it is important that the strapping be bound with tie wraps where it attaches to the shackles (observe originals). Secure the shackles with a tie wrap.

12.3 Bucket patching

Temporary patches using materials such as silicone sealant, roofing plastics etc. may spoil the surface for future proper welded or heat-applied permanent repairs. A good quick way to repair the bucket is to apply a stitched on or bolted on patch.

12.4 Bucket patching with a hot air gun

Tools and Materials Required:

- SEI patching kit.
- One plastic hand held roller
- One hot air gun, Steinel HL 1800E, or equivalent (120V-1500W; 200 to 1100° F; 450 Lit. per min.)
- One wide surface nozzle
- T.H.F. solvent or equivalent

Procedure:

1) In a well-ventilated location, clean the area to be repaired with T.H.F. or any other solvent compatible with the fabric. SEI also recommends Isopropyl alcohol for cleaning the damaged area.
2) Mount a wide surface air nozzle on the hot air gun so as to direct the heat flow in a large pattern.
3) Turn the power ON, and set the temperature in the low range first to let the hot air gun warm up. Increase the temperature as required during the operation.

CAUTION: Do not overheat or blacken the fabric.

4) Starting from the centre of the patch held down by the roller as in Fig. 12, concentrate the heat flow equally to patch and fabric. Start applying a light pressure with the roller when the fabric starts melting. DO NOT OVERHEAT.

5) Roll the patch down to fuse it to the tank fabric, moving roller and gun simultaneously.

6) Repeat until the entire patch has been fused to the tank.

7) Let the area cool down.

8) With your fingers, attempt to peel of the patch at the edges. If the patch peels even slightly, repeat the operation locally, otherwise the repair is complete.

CAUTION: Avoid skin contact with hot air gun nozzle or hot air blast. Serious burns may result.

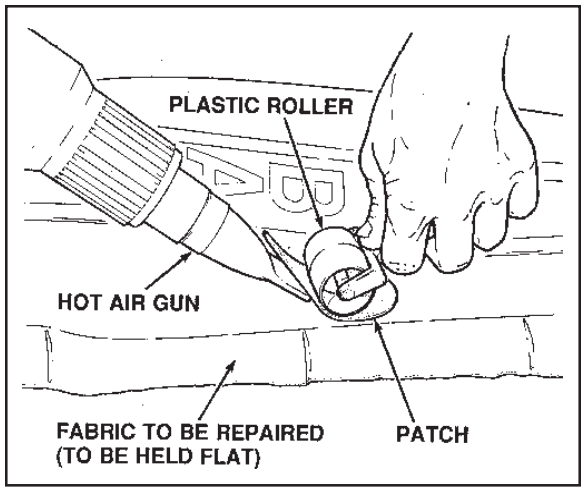


Fig. 12.1: Patching with a hot air gun

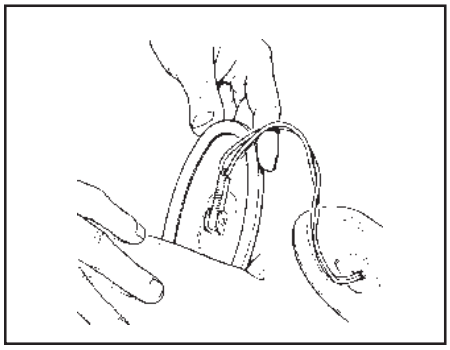
12.5 Bucket patching with repair clamps

Repair clamps are used for an immediate repair to prevent loss of liquid through large rips or holes.

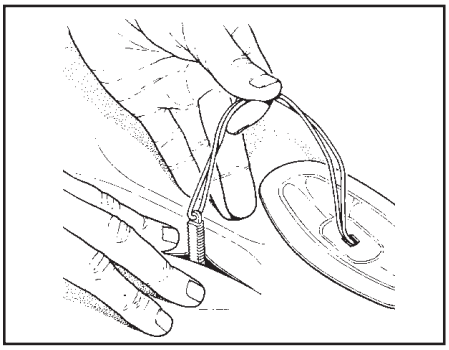
Repair clamps are used only for temporary repairs. The damage should be permanently repaired with a patch when convenient.

Procedure to install repair clamps:

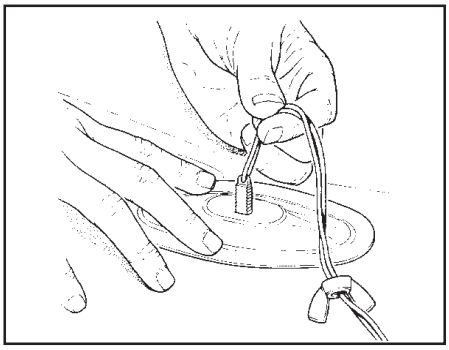
1. Select the largest clamp that will just slip through the hole.



2. Keeping hold of the string, slip one half of the repair clamp through the hole as indicated above.



3. Pull the bolt up through the hole. Turn it until the clamp lines up with the hole.



4. Place the top of the clamp over the bolt

5. Tighten the nut by hand

CAUTION: Tightening the nut with tools may break the bolt away from the lower clamp.

Leaving the string on makes it easier to remove the repair clamp when placing a permanent patch on the bucket.

This procedure is to be used for repairs when hole(s) or small cuts occur. The size of the cut or hole will determine the size of the sealing clamp to use. Clamps may not form a leakproof repair if used on or over a seam. Sealing clamps are available from SEI Industries Ltd.

For a cut or hole up to 2" (5 cm) use a 3" (7.6 cm) clamp.

For a cut or hole up to 4" (10 cm), use a 5"(12.7 cm) clamp.

For a cut or hole up to 6" (15 cm), use a 7.5" (19 cm) clamp.

Slip the inside clamp through the cut in the bucket and rotate it until it is parallel with the cut.

Centre both clamps over the cut, tighten wing nut with fingers and then, if necessary, lightly tighten with pliers. The protruding cord may be cut off if desired. Overtightening can deform the clam and cause leaks.

12.6 IDS hub/spokes replacement

There are three different IDS hub sizes. The small hub fits Bambi Bucket Models 6072 through 1821. The medium hub is found on Models 2024 through 5566 and the large hub is found on Models 6578 and larger.

You can purchase the IDS system either as a complete kit or as individual pieces as required. We will describe here how to replace the entire assembly.

1) Start by removing the old IDS including the shell brackets and the old restrainer cable brackets. You will have to disconnect the trip line from the valve or control head since it passes through the hub.

2) For reassembly, first install the new shell brackets. Install bolts through the bucket shell. Next, fit the fabric wear strips onto the bolts. Then fit the brackets to the bolts, and install and tighten the Nylock nuts.

3) Now install the two restrainer cable brackets. One is found below the ballast and the other is 6 o'clock directly opposite. No wear strips are required for the restrainer cable brackets.

4) With the ballast oriented at the 6 o'clock position, rotate the IDS assembly so that the deployment cable faces upward and is at the 3 o'clock (as it should be on all models 5566HD through HL9800).

5) Now attach the two spokes either side of 12 o'clock using the stainless steel clevis pins. Some models use rubber washers between the spoke and the brackets. Check the old assembly. Complete by fitting the fender washer and cotter pin. Working around the bucket perimeter, attach the rest of the spokes.

6) Attach the two restrainer cables. Refer to section 5.2 for adjusting the length of the restrainer cables.

7) Once the IDS is fully installed, test for fit. You should be able to pull the hub past the midpoint position with a slight effort. If the IDS is either too loose or too tight, it will require adjustment.

8) Note that on all the models (5566HD to HL9800, the adjustment spokes are in either side of 6 o'clock above the ballast. If the IDS is too tight, adjust two of the spokes as follows:

Cut off the spoke just above the existing hole. Then redrill a new hole centered the same distance from the new end of the spoke as the other spokes. You will find this will likely produce a good lift.

If the IDS is still too tight or too loose, there are two extra adjustment spokes provided with your IDS kit which have one end that is undrilled. The spoke is also overlength. We recommend that you utilize a piece of scrap tubing or even some wood doweling or broom handle to experiment with to determine a suitable spoke length. Then cut and drill the proper adjustment spokes to the corrected dimensions.

Load Test on the Hook

Deployment cable adjustment can only be properly assessed on the hook of the helicopter or otherwise suspended with a full load of water. Under full load, the deployment cable should feel relaxed but not slack. The hub should be free to move up or down about ½" (13 mm).

13. WARRANTY

SEI Industries Ltd. (The Company) agrees to grant a Warranty for a period of one year from the date of purchase of Bambi Bucket systems on the following conditions:

a) The Company's sole obligation under this Warranty is limited to repairing or replacing, at the Company's sole discretion, any product proved to be defective.

b) The Company's products are not guaran teed for any specific length of time or measure or service, but are warranted to be free from defects in workmanship and material for a period of one year to the original purchaser.

c) To the extent allowable under applicable law, the Company's liability for consequential and incidental damages is expressly disclaimed. **The Company's** liability in all events is limited to, and shall not exceed, the purchase price paid.

d) This Warranty is granted to the original purchaser of Bambi Bucket systems and does not extend to a subsequent purchaser or assignee.

e) The Company must receive notification in writing of any claims of Warranty from the original purchaser who must give details of the claimed defect in the product.

f) Where the original purchaser is claiming under Warranty, the product must be returned to the Company for inspection with all transportation and duty charges prepaid.

g) The Warranty does not extend to any product that has been accidentally damaged, abraded, altered, punctured, abused, misused, or used for a purpose which has not been approved by the Company.

h) This Warranty does not apply to any acessories used with the product that are not supplied by the Company, and any Warranty on such accessories must be requested from the manufacturer or dealer of the accessories.

i) In the event the original purchaser does not give notice of a Warranty claim within one year of the original purchase of the product, it is understood that the purchaser has waived the claim for Warranty and the purchaser and/or any subsequent purchaser must accept the condition of the product as it may be, without Warranty.

j) Any technical information supplied by the Company regarding the product is not a condition of Warranty but rather is information provided by the Company to the best of its knowledge.

k) There are no implied warranties nor is there any Warranty that can be assumed from any representation of any person, except the Company itself.

Exclusions

l) This Warranty is void if the product is not installed, used and/or maintained in accord ance with the Field Manual supplied by SEI Industries Ltd.

m) All Bambi Buckets are designed and manufactured with substantial safety margins. It is the responsibility of the user to ensure that the bucket is maintained to a safe standard.

14. SPECIFICATIONS

Note: These are guidelines only.
The helicopter operator must make the decision as to which model of Bambi Bucket is appropriate.

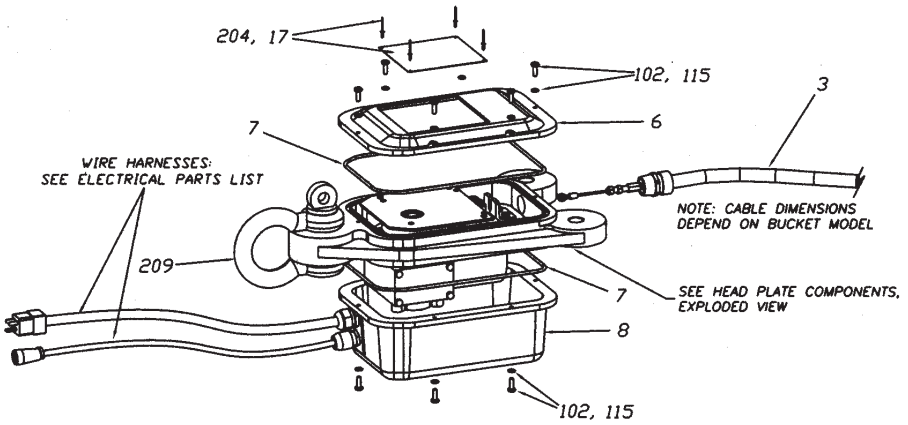
Torrentula Model	Gross Wt (lbs/Kg)	Suggested Helicopters
BBT 2732	2845/1295	Bell 204, Sikorsky S-76A, S-76B, MD Explorer
BBT 3542	3660/1665	Augusta AB 212 & AB 412, Bell 204B, 205, 212 & 412 SP, Huey UH-1H
BBT 4453	4580/2080	Aerospatiale Puma, California/Sikorsky S58T, W3 Sokol
BBT 5566	5777/2600	Aerospatiale Puma, Bell 214B & 214 St., Kawasaki-Boeing KV107, Sikorsky UH 60-A (Black Hawk), MI-8, MI-17
BBT 6578	6818/3068	MI-26
BBT 7590	7747/3486	Agusta AS-61N-1, Aerospatiale Super Puma & Super Frelon, Sikorsky S-61
BBT HL5000	11362/5112	Boeing Vertol CH46, EH101, MI-38, KA-32
BBT HL7600	17087/7690	Sikorsky S-64 Skycrane
BBT HL9800	22152/9968	Boeing Vertol 234/CH47 (Chinook), Sikorsky CH53E

Torrentula Valve Bucket Specifications

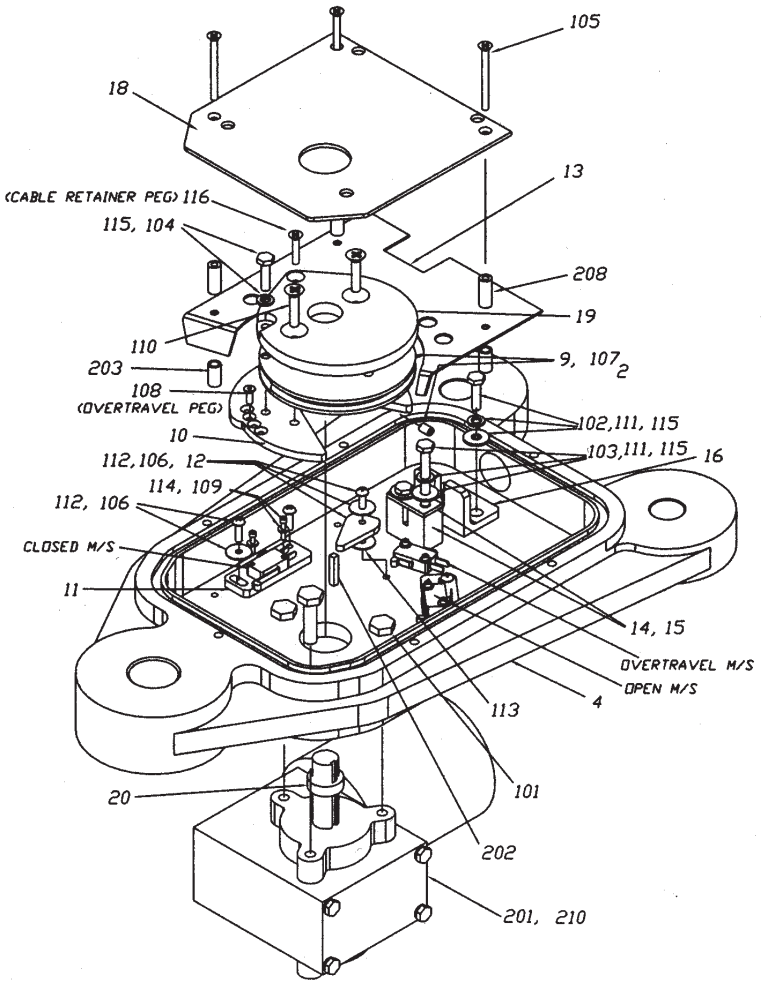
Model	Capacity			Gross Weight		Empty Weight	
	USG	IMP. GAL.	Liters	Lb.	Kg.	Lb.	Kg
BBT 2732	315	265	1190	2845	1295	183	83
BBT 3542	410	345	1555	3660	1665	197	89
BBT 4453	520	435	1960	4580	2080	217	98
BBT 5566 HD	640	535	2400	5777	2600	425	191
BBT 5870 HD	680	566	2574	6124	2778	451	204
BBT 6578 HD	760	635	2850	6818	3068	476	214
BBT 7590 HD	880	735	3300	7747	3486	495	225
BBT HL5000	1300	1080	4900	11362	5112	510	230
BBT HL7600	2000	1665	7570	17087	7690	585	263
BBT HL9800	2600	2165	9840	22152	9968	650	292

15. CONTROL HEAD PARTS ALL MODELS

Figure 15.1 Control Head Parts, ALL Models



COVERS INSTALLATION, EXPLODED



HEAD PLATE COMPONENTS, EXPLODED

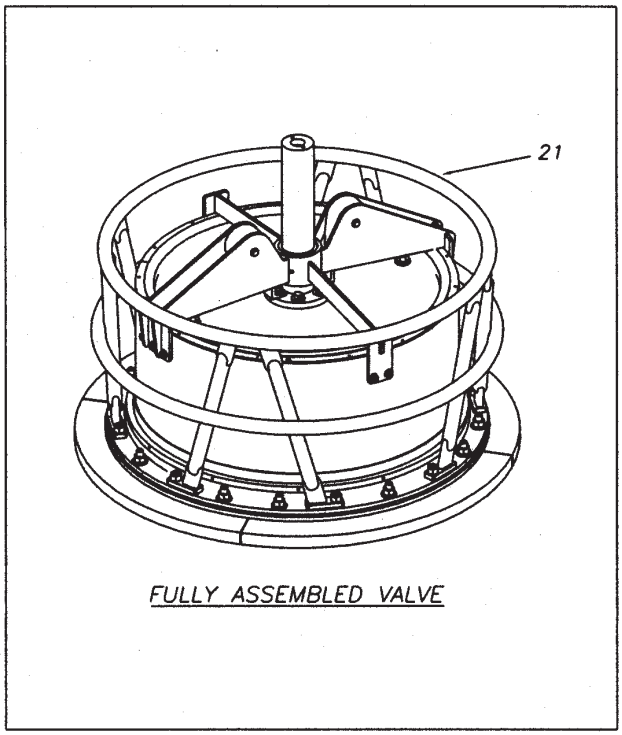
15. CONTROL HEAD PARTS ALL MODELS

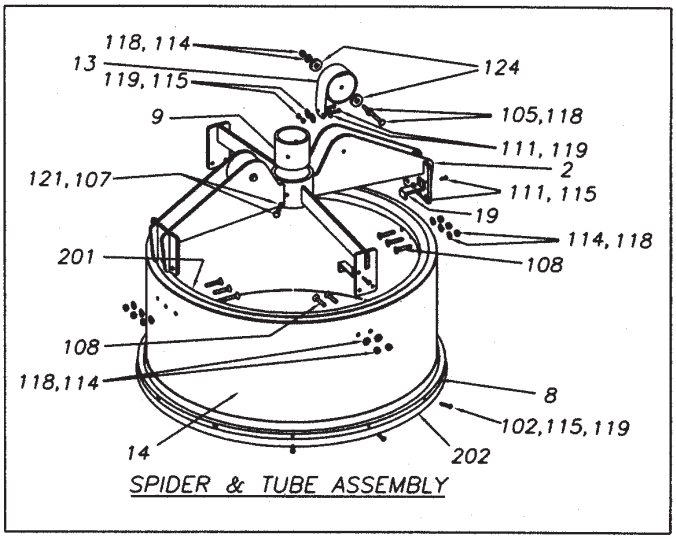
Table 15.1 Control Head Parts List, ALL Models

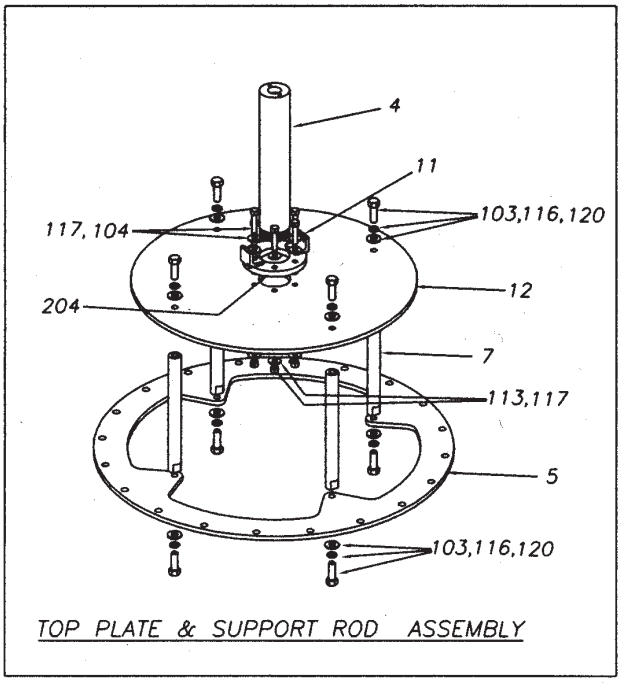
Item #	Part #	Description	Qty.
209	FTAG-005	SHACKLE, 5566 TO 9800	1
208		CABLE GUARD STAND-OFF, 15/16" LG.	3
205		SILICONE SEALANT	AS REQ.
204	FRA 002	RIVET, SELF SEALING, 1/8"	4
203	FSN 250	M/S COVER STAND-OFF, 13/16" LG.	3
202		MOTOR SHAFT KEY, 3/16" SQ. X 1" LG.	1
201	BAD1652	GEAR MOTOR	1
116	FBSC 010406	HEX HD CAP SCREW	2
115	FWS 0504	SPLIT LOCK WASHER, 1/4" ID	19
114	FWS 0100	PLAIN WASHER, #4 ID	6
113	FWN 0303	PLAIN WASHER, NYLON, 3/16" ID	1
112	FWS 060306	PLAIN WASHER, 3/16" ID, 3/4" OD	3
111	FWS 0204	PLAIN WASHER, 1/4" ID, 5/8" OD	7
110		CSK PHIL SCREW, 1/4-20 X 1-1/4" LG	7
109	FBSC 020005	SOC HD CAP SCREW, 4-40 X 5/8"	6
108	FPPC 030204	HEX DRIVE CSK SCREW, 8-32 X 1/2"	1
107	BADZ 46107	HEXDRIVE SET SCREW, 1/4-20 X 3/8"	2
106	FBSC 040305	PAN PHIL SCREW, 10-24 X 5/8"	15
105	FBSC 040314	CSK PHIL SCREW, 10-24 X 2-1/4"	3
104	FBSC 010410	HEX HD CAP SCREW, 1/4-20 X 1-1/4"	3
103	FBSC 010416	HEX HD CAP SCREW, 1/4-20 X 1-3/4"	2
102	FBSC 010406	HEX HD CAP SCREW, 1/4-20 X 3/4"	14
101	FBPC 010610	HEX HD BOLT, 3/8-16 X 1"	3
20	SPECIFY MODEL, S/N	CABLE CRANK SHIM	1
19	BAB 334	CRANK SPACER	1
18	BAB 333	CABLE GUARD PLATE	1
17	LB 001E	S/N PLATE	1
16	BAB 262	CABLE BRACKET	1
15	BAB 261	CABLE GUIDE PLATE	1
14	BAB 260	CABLE GUIDE	1
13	SPECIFY MODEL, S/N	MICROSWITCH COVER	1
12	BAB 257	OVERTRAVEL TRIP LEVER	1
11	BAB 256	MICROSWITCH MOUNT PLATE	2
10	BAB 255	MICROSWITCH CAM	1
9	BAB 254	CABLE CRANK	1
8	BB0571M	CAST MOTOR COVER	1
7	BAD2827	COVER 0-RING SEAL	2
6	BB0570M	CAST FRONT COVER	1
5	SPECIFY MODEL, S/N	FRONT COVER STAND OFF	1
4	SPECIFY MODEL, S/N	HEAD PLATE	1
3	SPECIFY MODEL, S/N	CONTROL CABLE ASSEMBLY	1
2	BB 597	HEAD ASSY. MODELS 2732 - 4453	
1	BB 596	HEAD ASSY. MODELS 5566 - HL9800	

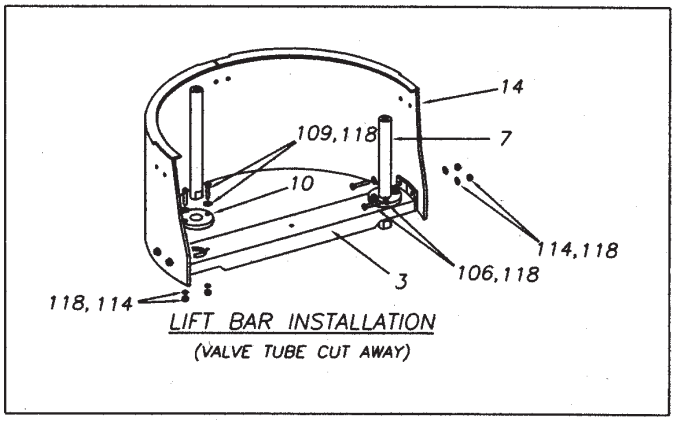
16. TORRENTULA VALVE PARTS MODELS HL5000, HL7600, HL9800

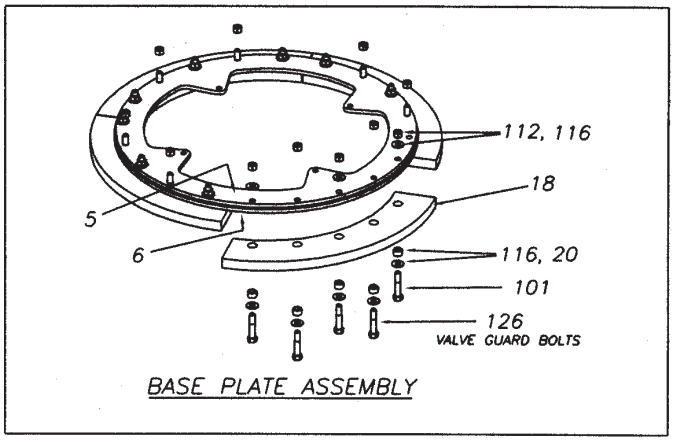
Fig 16.1 Torrentula Valve Parts, Models HL5000, HL7600, HL9800











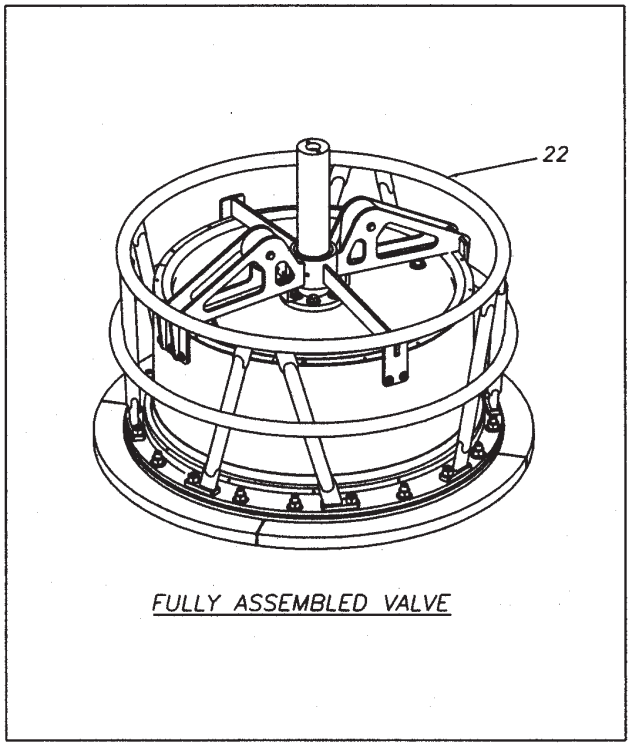
16. TORRENTULA VALVE PARTS MODELS HL5000, HL7600, HL9800

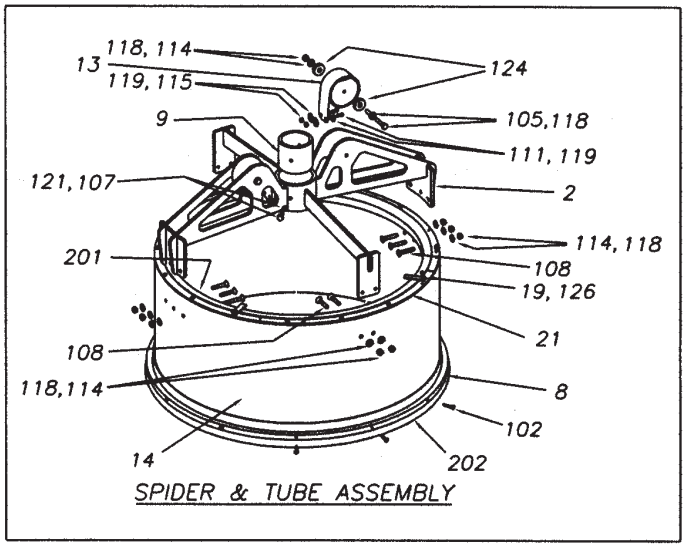
Table 16.1 Torrentula Valve Parts List, Models HL5000, HL7600, HL9800

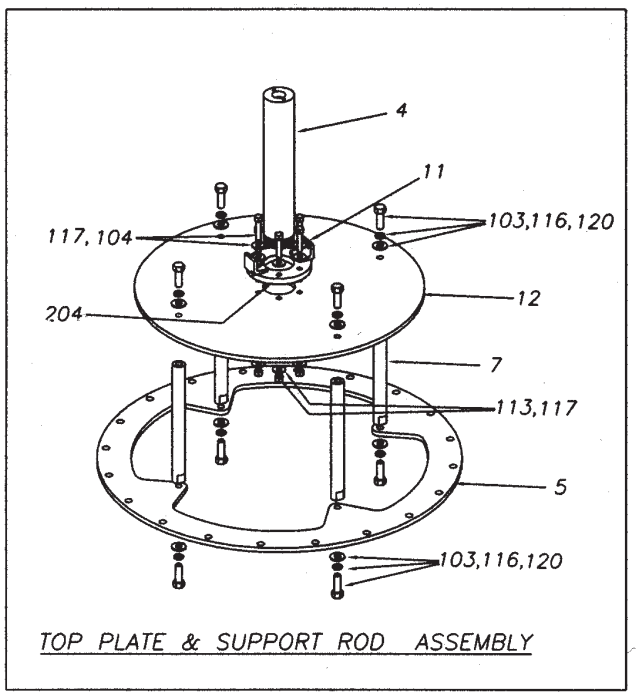
Item #	Part #	Description	Qty.
209		SILICONE SEALANT	AS REQ.
208	PP 020	SEALANT TAPE	14 FT.
205	BAD 316205	ROD - BENT TO 27"	1
204	PLA 001A	2" NPT FLANGE	1
202	BAD 316202	BOTTOM SEAL, CUT 84.75" LG.	1
201	BAD 316201	TOP SEAL, CUT 79.75" LG.	1
126		HEX HD BOLT, 1/2UNC X 3”	8
125	FWS 0104	FENDER WASHER, 1/4 ID X 3/4 OD	4
124	FWS 0304	THICK WASHER, 1/4 ID X 1/8” THK.	4
123	FWS 060306	FENDER WASHER,	4
122		PANPHIL SCREW, 10-24 X 3/8”	4
121	FWS 0504	SPLIT LOCK WASHER, 1/4 ID	2
120	FWP 0508	SPLIT LOCK WASHER, 1/2 ID	8
119	FWS 0203	PLAIN WASHER, 3/16 ID	8
118	FWS 0204	PLAIN WASHER, 1/4 ID	24
117	FWP 0106	PLAIN WASHER, 3/8 ID	12
116	QTXNOW40	PLAIN WASHER, 1/2 ID	40
115	FNSC 0203	NYLOC NUT, 10-24	21
114	FNSC 0204	NYLOC NUT, 1/4UNC	20
113	FNPC 0206	NYLOC NUT, 3/8UNC	6
112	FNPC 0208	NYLOC NUT, 1/2UNC	20
111	FBSC 040306	PAN PHIL SCREW, 10-24 X 3/4”	8
110	FBSC 020406	SOC HD. CAP SCREW, 1/4UNC X 3/4”	2
109	FBSC 020412	SOC HD. CAP SCREW, 1/4UNC X 1-1/4”	4
108	FBSC 030410	CSK SOC HD. CAP SCREW, 1/4UNC X 1”	10
107	FBSC 010406	HEX HD. BOLT, 1/4UNC X 1/2”	2
106	FBSC 0101410	HEX HD. BOLT, 1/4UNC X 1”	4
105	FBSC 010430	HEX HD. BOLT, 1/4UNC X 3”	2
104	FBPC 010616	HEX HD. BOLT, 3/8UNC X 1-1/2”	6
103	FBPC 010814	HEX HD. BOLT, 1/2UNC X 1-1/2”	8
102	FBSC 030312	CSK PHIL SCREW, 10-24 X 1-1/4”	13
101	FBPC010824	HEX HD. BOLT, 1/2UNC X 2-1/2”	12
21	BAD 357	VALVE GUARD ASSEMBLY	1
20	RMA 6020	SPACER	20
19	BAB 207	TOP SEAL CLIP	8
18	BAB 328	BUMPER BLOCK	4
17	BAB 162	LIFT BAR SHIM	AS REQ.
16	BAB 161	LARGE SPIDER SHIM	AS REQ.
15	BAB 161	SMALL SPIDER SHIM	AS REQ.
14	BAD 324	VALVE TUBE	1
13	BAB 158	SPRING ASSEMBLY	2
12	BAB 327	TOP PLATE	1
11	BAB 156	SPRING BRACKET	2
10	BAB 155	BOTTOM BUSHING	2
9	BAB 154	TOP SLIDER BUSHING	1
8	BAB 325	BOTTOM SEAL HOOP	1
7	BAB 150	SUPPORT ROD	4
6	BAB 323	CLAMP RING	1
5	BAB 322	BASE RING	1
4	BAB 144	SLIDER PIPE ASSEMBLY	1
3	BAB 321	LIFT BAR ASSEMBLY	1
2	BAD 317	LIFT SPIDER ASSEMBLY	1
1	BAD 316	VALVE ASSEMBLY	

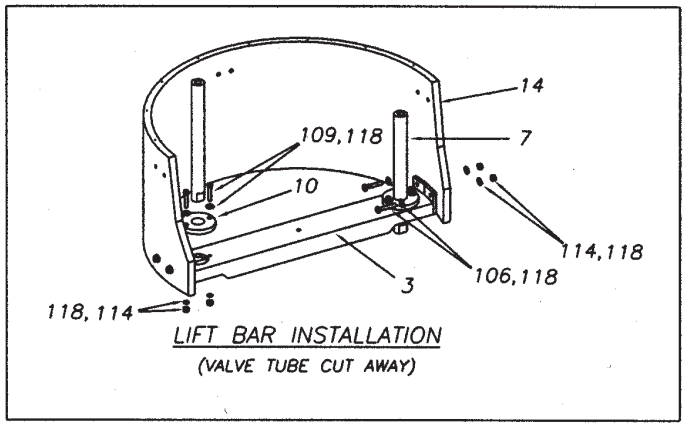
17. TORRENTULA VALVE PARTS MODELS 5566, 5870, 6578, 7590

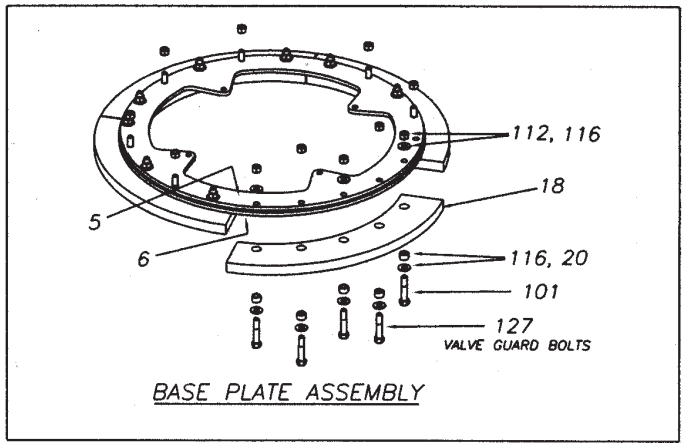
Figure 17.1 Torrentula Valve Parts, Models 5566, 5870, 6578, 7590











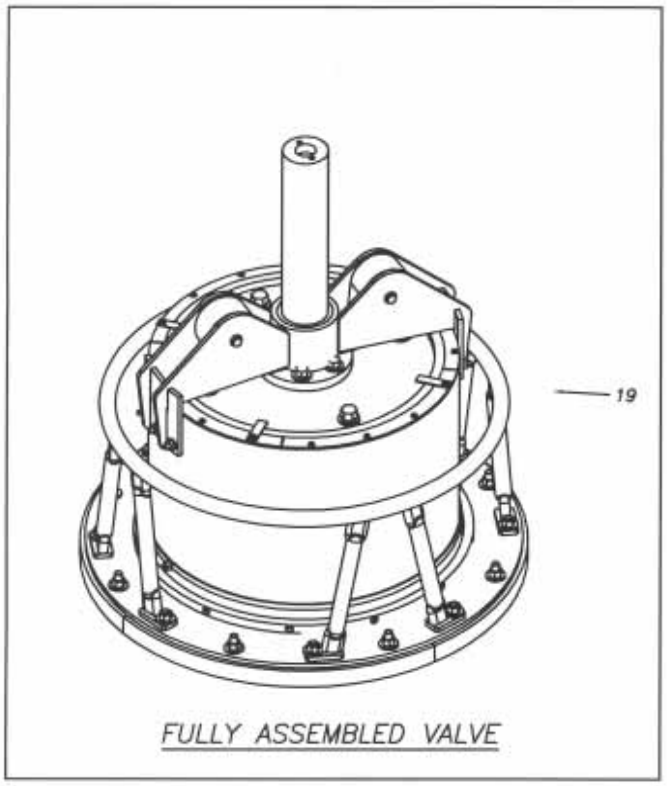
17. TORRENTULA VALVE PARTS MODELS 5566, 5870, 6578, 7590

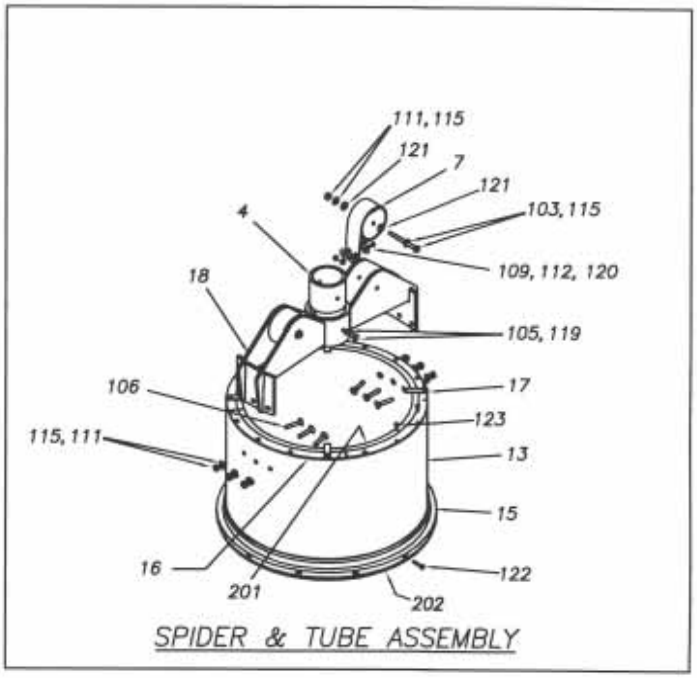
Table17.1 Torrentula Valve Parts List, models 5566, 5870, 6578, 7590

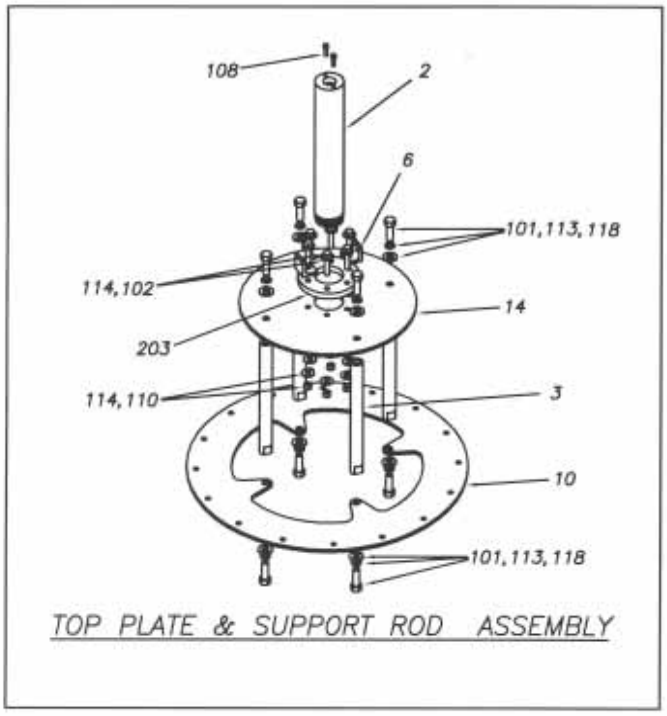
Item #	Part #	Description	Qty.
209	CLEAR SILICONE	SILICONE SEALANT	
208	PP 020	SEALANT	14'
205	BAD 316205	ROD - BENT TO 27"	1
204	PLA 001A	2" NPT FLANGE	1
202	BAD 134202	BOTTOM SEAL, CUT 76" LG.	1
201	BAD 134201	TOP SEAL, CUT 69" LG.	1
127		HEX HD. BOLT, 1/2UNC X 3”	8
126	FSS 060212	PAN PHIL TAPPING SCREW, #8 X 5/8”	16
125	FWS 0104	FENDER WASHER, 1/4 ID, 3/4 OD	4
124	FWS 0304	THICK WASHER, 1/4 ID X 1/8” THK.	4
123	FWS 060306	FENDER WASHER, 3/16 ID, 3/4 OD	4
121	FWS 0504	SPLIT LOCK WASHER, 1/4 ID	2
120	FWP 0508	SPLIT LOCK WASHER, 1/2 ID	8
119	FWS 0203	PLAIN WASHER, 3/16 ID	4
118	FWS 0204	PLAIN WASHER, 1/4 ID	24
117	FWP 0106	PLAIN WASHER, 3/8 ID	12
116	FWP 0108	PLAIN WASHER, 1/2 ID	40
115	FNSC 0203	NYLOC NUT, 10-24	4
114	FNSC 0204	NYLOC NUT, 1/4UNC	20
113	FNPC 0206	NYLOC NUT, 3/8UNC	6
112	FNPC 0208	NYLOC NUT, 1/2UNC	20
111	FBSC 040306	PAN PHIL SCREW, 10-24UNC X 3/4”	4
110	FBSC 020406	SOC HD. CAP SCREW, 1/4UNC X 3/4”	2
109	FBSC 020412	SOC HD. CAP SCREW, 1/4UNC X 1-1/4”	4
108	FBSC 030410	CSK SOC HD. CAP SCREW, 1/4UNC X 1-1/2”	10
107	FBSC 010406	HEX HD. BOLT, 1/4UNC X 1/2”	2
106	FBSC 0101410	HEX HD. BOLT, 1/4UNC X 1-1/4”	4
105	FBSC 010430	HEX HD. BOLT, 1/4UNC X 3”	2
104	FBPC 010616	HEX HD. BOLT, 3/8UNC X 1-3/4”	6
103	FBPC 010814	HEX HD. BOLT, 1/2UNC X 1-1/2”	8
102	FBSC 030312	CSK PHIL TAPPING SCREW, #8 X 1-1/4”	16
101	FBPC 010824	HEX HD. BOLT, 1/2UNC X 2-1/2”	12
22	BAD 356	VALVE GUARD ASSEMBLY	1
21	BAB 233	TOP SEAL RING	4
20	RMA 6020	SPACER	20
19	BAB 179	TOP SEAL CLIP	4
18	BAB 328	BUMPER BLOCK	4
17	BAB 162	LIFT BAR SHIM, AS REQ.	
16	BAB 161	LARGE SPIDER SHIM, AS REQ.	
15	BAB 161	SMALL SPIDER SHIM, AS REQ.	
14	BAD 324	VALVE TUBE	1
13	BAB 158	SPRING ASSEMBLY	2
12	BAB 327	TOP PLATE	1
11	BAB 156	SPRING BRACKET	2
10	BAB 155	BOTTOM BUSHING	2
9	BAB 154	TOP SLIDER BUSHING	1
8	BAB 325	BOTTOM SEAL HOOP	1
7	BAB 150	SUPPORT ROD	4
6	BAB 323	CLAMP RING	1
5	BAB 322	BASE RING	1
4	BAB 144	SLIDER PIPE ASSEMBLY	1
3	BAB 321	LIFT BAR ASSEMBLY	1
2	BAD 317	LIFT SPIDER ASSEMBLY	1
1	BAD 134	GENERAL ASSEMBLY	

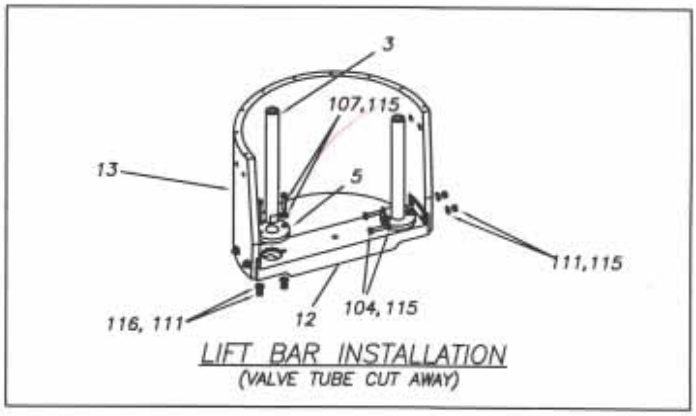
18. TORRENTULA VALVE PARTS MODELS 2732, 3542, 4453

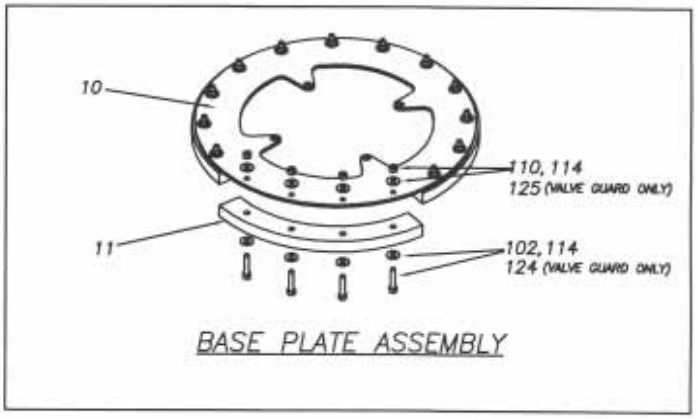
Figure 18.1 Torrentula Valve Parts, Models 2732, 3542, 4453











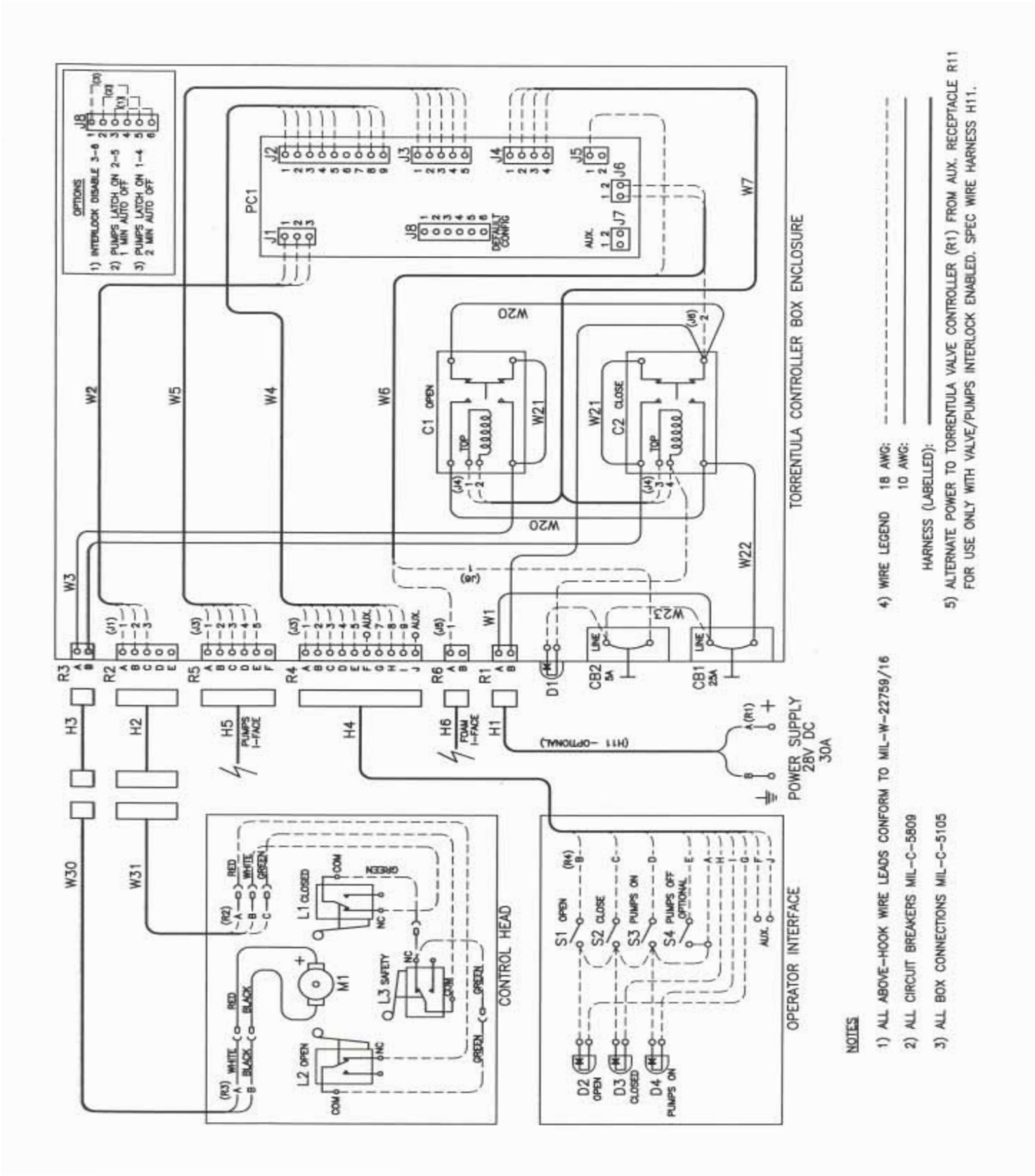
18. TORRENTULA VALVE PARTS MODELS 2732, 3542, 4453

Table 18.1 Torrentula Valve Parts Models 2732, 3542, 4453

Item #	Part #	Description	Qty.
207		SILICONE SEALANT	AS REQ.
206	PP 020	SEALANT	10'
205	FTAG 001	SHACKLE	1
204	RMCG 001	UTILITY CHAIN	1
203	PLA 001A	2" NPT TT FLANGE	1
202	BAD 134201	BOTTOM SEAL, CUT 51" LG.	1
201	BAD 134201	TOP SEAL, CUT 43-3/4" LG.	1
125		PLAIN WASHER, 3/8 ID X 5/8 OD	8
124		HEX HD. BOLT, 3/8UNC X 2"	8
123	FSS 060205	PAN PHIL TAPPING SCREW, #8 X 5/8"	16
122	FSS 030212	CSK PHIL TAPPING SCREW, #8 X 1-1/4"	13
121	FWS 0104H	THICK WASHER, 1/4 ID, 3/4 OD X 1/8" THK	4
119	FWS 0504	SPLIT LOCK WASHER, 1/4 ID	2
118	FWS 0508	SPLIT LOCK WASHER, 1/2 ID	8
117	FWS 0203	PLAIN WASHER, 3/16 ID X 3/4 OD	8
116	FWS 01040	PLAIN WASHER, 1/4 ID X 7/16 OD	4
115	FWS 01040	PLAIN WASHER, 1/4 ID X 5/8 OD	20
114	FWS 0306	PLAIN WASHER, 3/8 ID	44
113	FWS 0308	PLAIN WASHER, 1/2 ID	8
112	FNSC 0203	NYLOC NUT, 10-24 UNC	4
111	FNSC 0204	NYLOC NUT, 1/4-20UNC	16
110	FNPC 0206	NYLOC NUT, 3/8-16UNC	22
109	FBSC 040306	PAN PHIL SCREW, 10-24UNC X 3/4"	4
108	FBSC 020406	SOC HD. CAP SCREW, 1/4-20UNC X 3/4"	2
107	FBSC 020412	SOC HD. CAP SCREW, 1/4-20UNC X 1-1/4"	4
106	FBSC 0304144	CSK SOC HD. CAP SCREW, 1/4-20UNC X 1-1/4"	6
105	FBSC 010140	HEX HD. BOLT, 1/4-20UNC X 1/2"	2
104	FBSC 010142	HEX HD. BOLT, 1/4-20UNC X 1-1/4"	4
103	FBSC 010430	HEX HD. BOLT, 1/4-20UNC X 3"	2
102	FBSC 010616	HEX HD. BOLT, 3/8-16UNC X 1-3/4"	14
101	FBSC 010810	HEX HD. BOLT, 1/2-13UNC X 1"	8
19	BAD 453	VALVE GUARD	1
18	BAD 209	LIFT SPIDER ASSEMBLY	1
17	BAD 207	TOP SEAL CLIP	4
16	BAB 204	TOP SEAL RING	4
15	BAB 203	BOTTOM SEAL HOOP	1
14	BAB 201	TOP PLATE	1
13	BAB 199	VALVE TUBE	1
12	BAB 197	LIFT BAR ASSEMBLY	1
11	BAB 196	BUMPER BLOCK	4
10	BAD 195	BASE RING	1
9	BAB 162	LIFT BAR SHIM, AS REQ.	
8	BAB 161	LARGE SPIDER SHIM, AS REQ.	
7	BAB 158	SPRING ASSEMBLY	2
6	BAB 156	SPRING BRACKET	2
5	BAB 155	BOTTOM BUSHING	2
4	BAB 154	TOP SLIDER BUSHING	1
3	BAB 150	SUPPORT ROD	4
2	BAB 144	SLIDER PIPE ASSEMBLY	1
1		GENERAL ASSEMBLY	

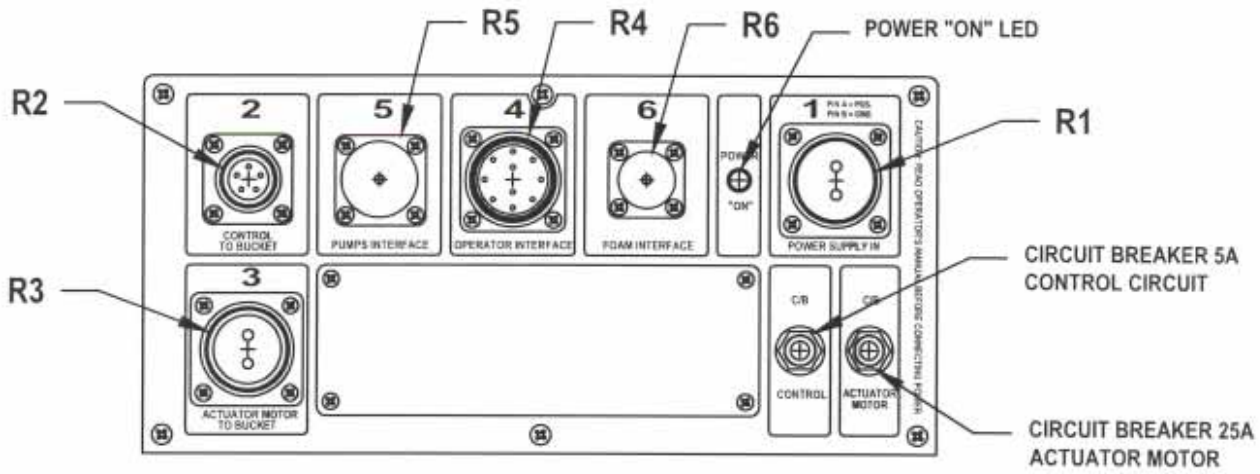
19. WIRING DIAGRAMS

Figure 19.1 Wiring diagram



19. WIRING DIAGRAMS

Figure 19.2 Controller Box receptacle pin-outs



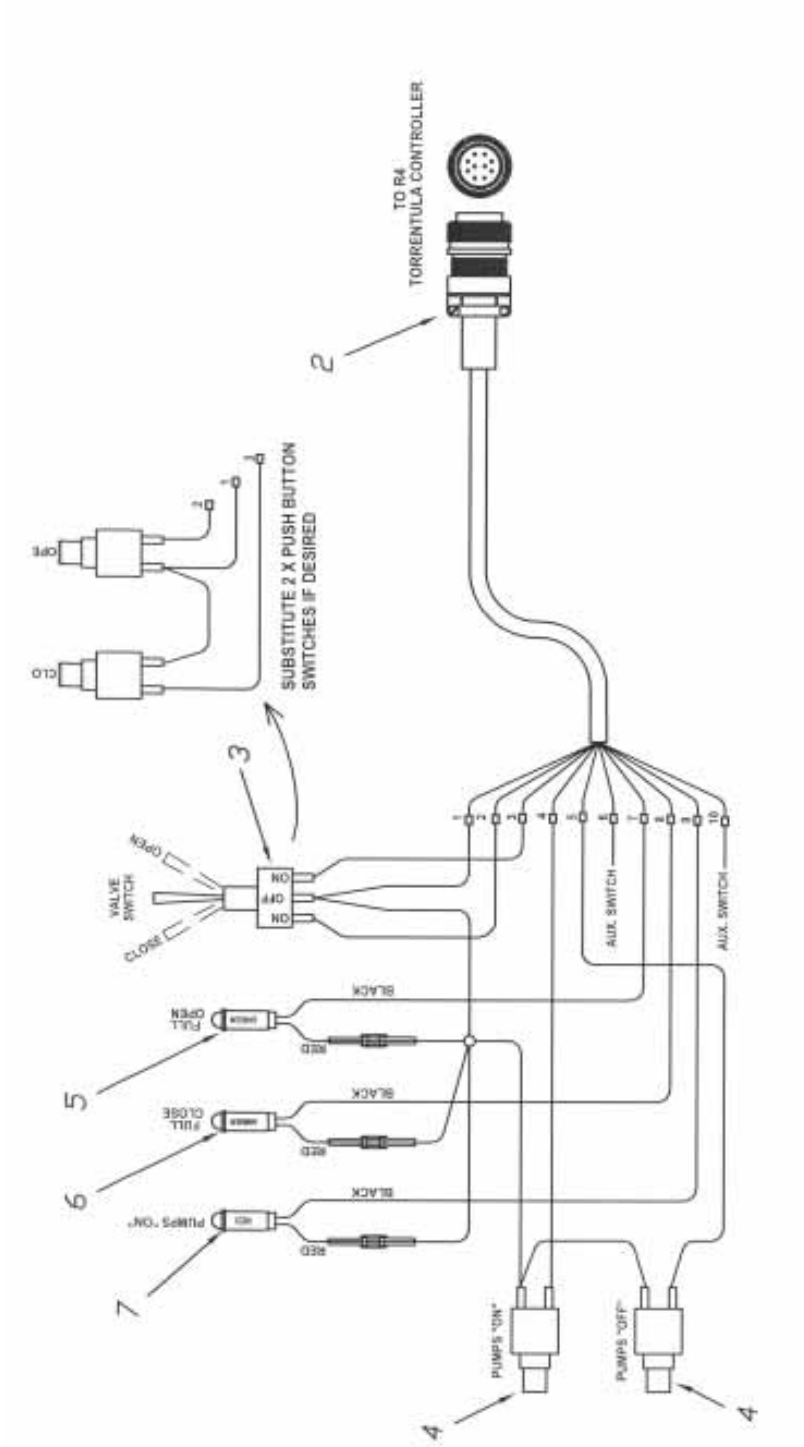
TORRENTULA VALVE CONTROLLER BOX FACE PANEL

RECEPTACLE PIN-OUTS:

R1	POWER SUPPLY INPUT	R5	PUMPS INTERFACE
A	POWER INPUT, +28 VOLTS DC	A	PUMP #1 CONTACTOR +28 VOLTS DC
B	GROUND	B	PUMP #2 CONTACTOR +28 VOLTS DC
		C	PUMP #3 CONTACTOR +28 VOLTS DC
R2	CONTROL - TO BUCKET	D	PUMP #4 CONTACTOR +28 VOLTS DC
A	OPEN LIMIT	E	GROUND, COMMON
B	CLOSE LIMIT		
C	LIMIT COMMON	R6	CLASS "A" FOAM SYSTEM INTERFACE
		A	DISPENSE CYCLE CANCEL, +28 VOLTS DC
R3	ACTUATOR MOTOR - TO BUCKET		
A	ACTUATOR MOTOR +28 VOLTS DC "OPEN" (B GROUND)		
B	ACTUATOR MOTOR +28 VOLTS DC "CLOSE" (A GROUND)		
R4	OPERATOR INTERFACE		
A	OPERATOR SWITCH, LED COMMOM, +28 VOLTS DC		
B	VALVE "OPEN"		
C	VALVE "CLOSE"		
D	PUMPS "ON"		
E	PUMPS "OFF" (LATCH ENABLED)		
F	AUXILIARY		
G	VALVE "OPEN" LED INDICATOR		
H	VALVE "CLOSED" LED INDICATOR		
I	PUMPS "ON" LED INDICATOR		
J	AUXILIARY		

Figure 19.3 Pilot controls wiring diagram Reference Only

Note: Pilot Controls wire harness assemblies available from SEI Industries. Configuration as shown may differ depending on options, see section 3.5



Parts list

Item	Description	Qty.
1.	Assembly PN BTSK00450	1
2.	Wire harness 9 x #18 AWG Mil-W-22759/16	1
3.	Toggle switch SPDT (on)-off-(on)	1
4.	Push button switch	2 (4)
5.	“open” LED, green	1
6.	“closed” LED, amber	1
7.	“pumps on” LED, red	1

Figure 19.4 Longline conductor cable assemblies

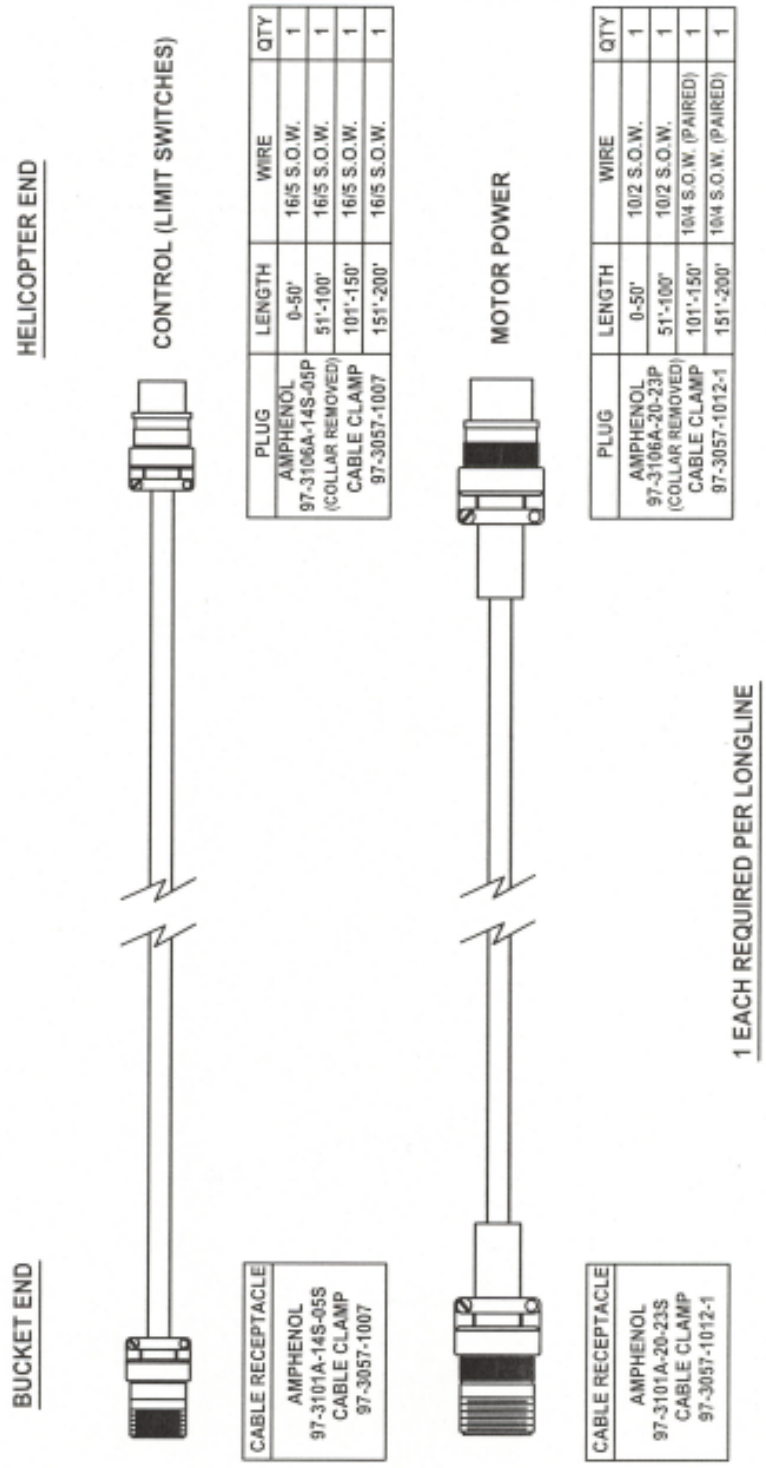
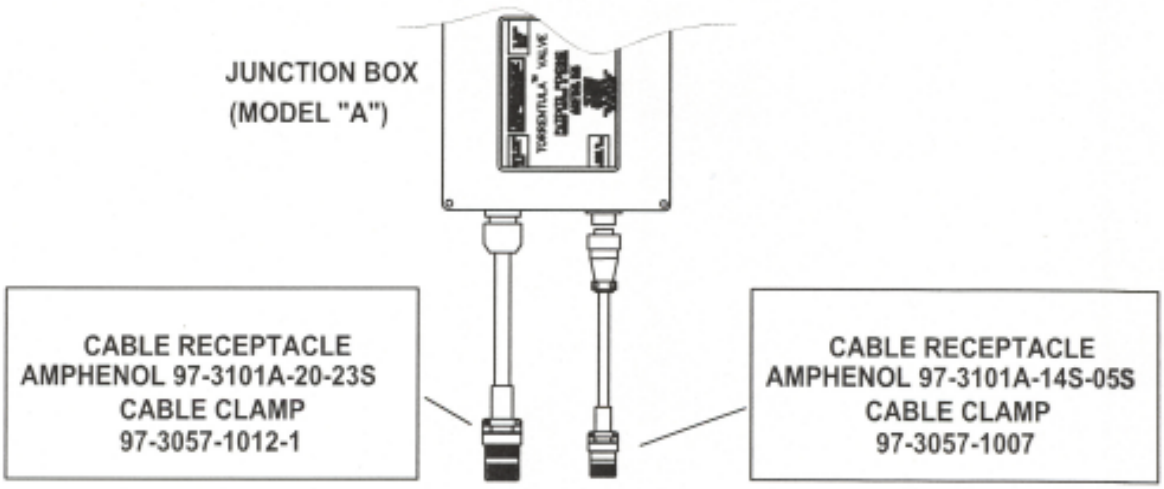


Figure 19.5 Breakaway plugs conversion to Model “B” pin plugs and pin protocol

1) MODEL "A" JUNCTION BOXES (LEADS) MODIFIED IN ACCORDANCE WITH THIS DRAWING CAN BE USED TO OPERATE BUCKETS ORIGINALLY SUPPLIED WITH MODEL "B" ELECTRICAL CONTROLS

2) BUCKET CONTROL HEADS, ORIGINALLY SUPPLED WITH MODEL "A" ELECTRICAL CONTROLS, MODIFIED IN ACCORDANCE WITH THIS DRAWING, CAN BE OPERATED WITH MODEL "B" ELECTRICAL CONTROLS

3) MODEL "B" BREAKAWAY PLUG SET: PART NO. BTSK00452



MOTOR POWER HARNESSES

PIN	WIRE COLOR
A	WHITE
B	BLACK

CONTROL HARNESSES

PIN	WIRE COLOR
A	RED
B	WHITE
C	GREEN
D	BLACK
E	ORANGE

DRAWING NOT TO SCALE

20. ELECTRICAL CONTROLS PARTS ALL MODELS

Figure 20.1 Controller Box Parts

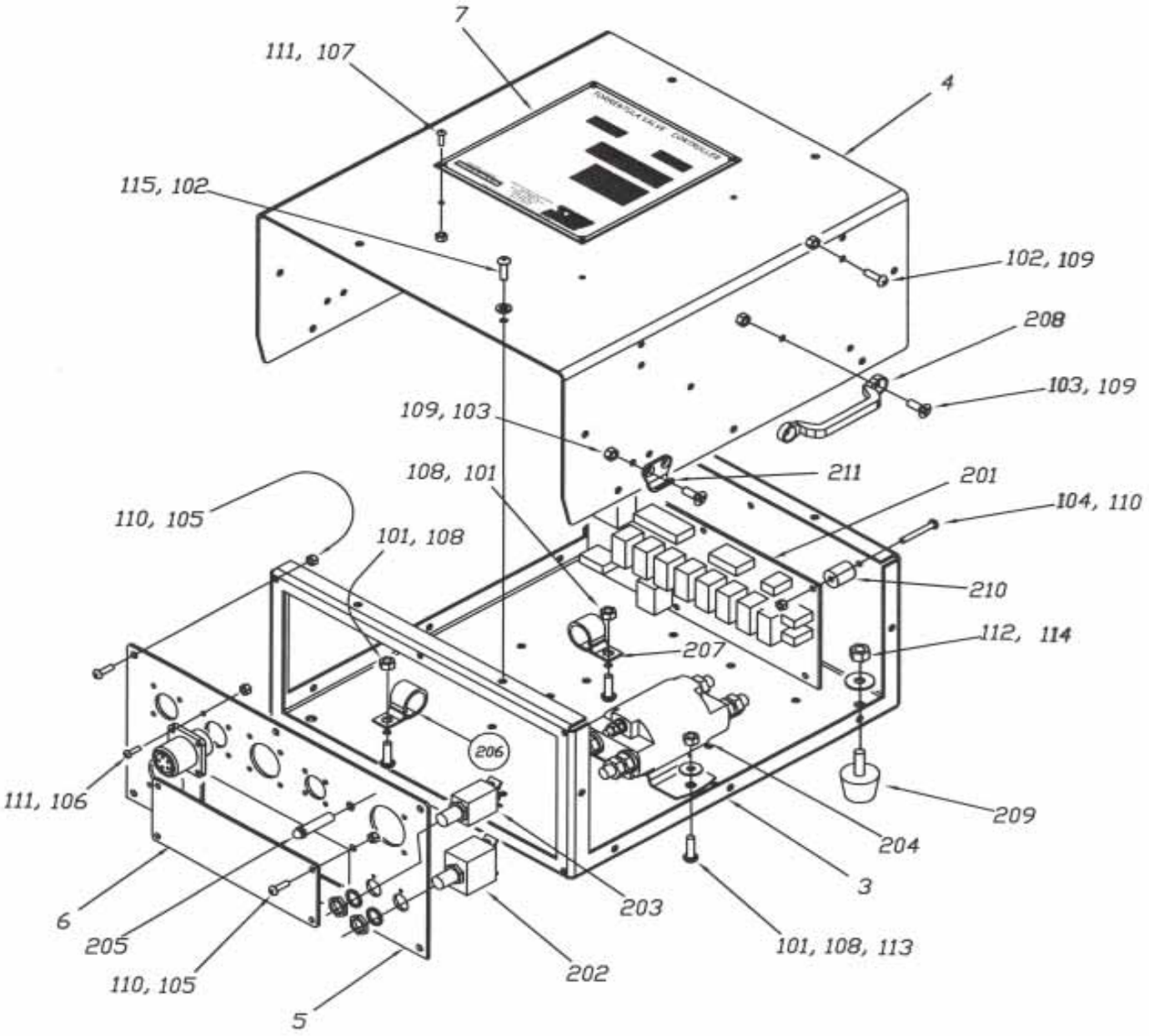
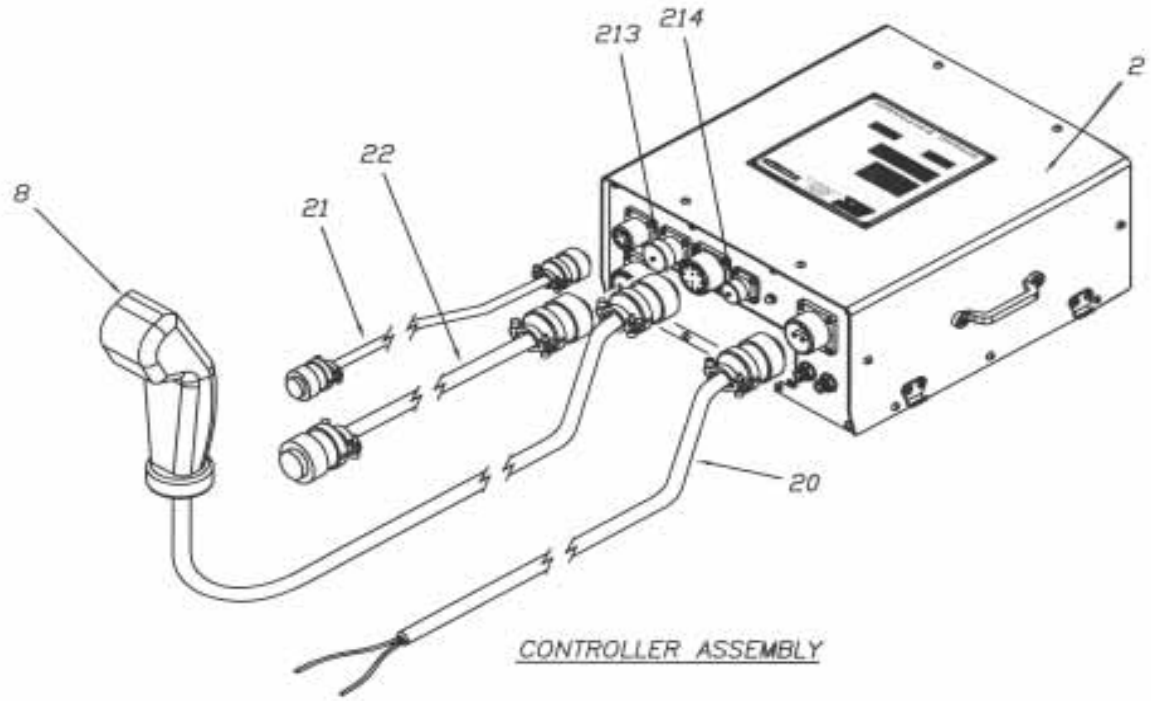
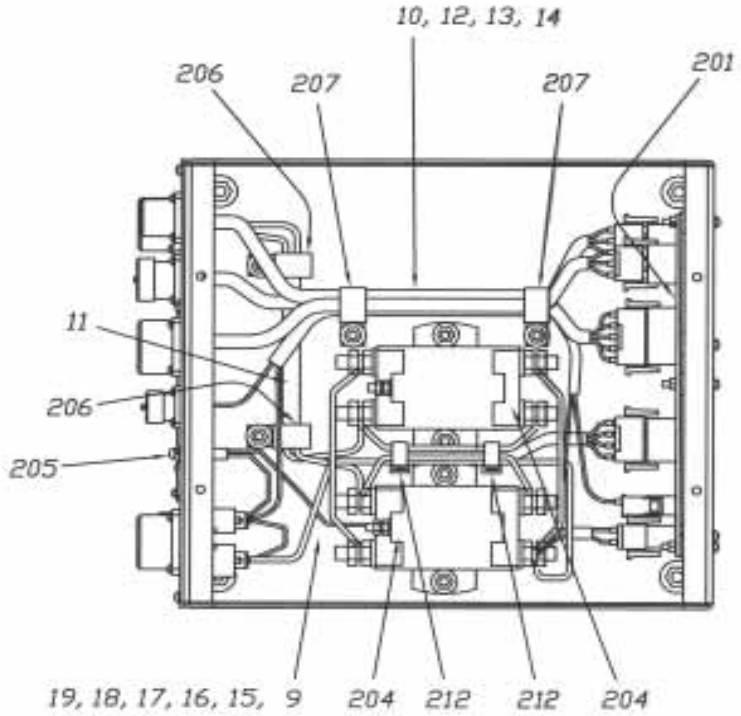


Figure 20.2 Controller Box wire harnesses, top view lid removed





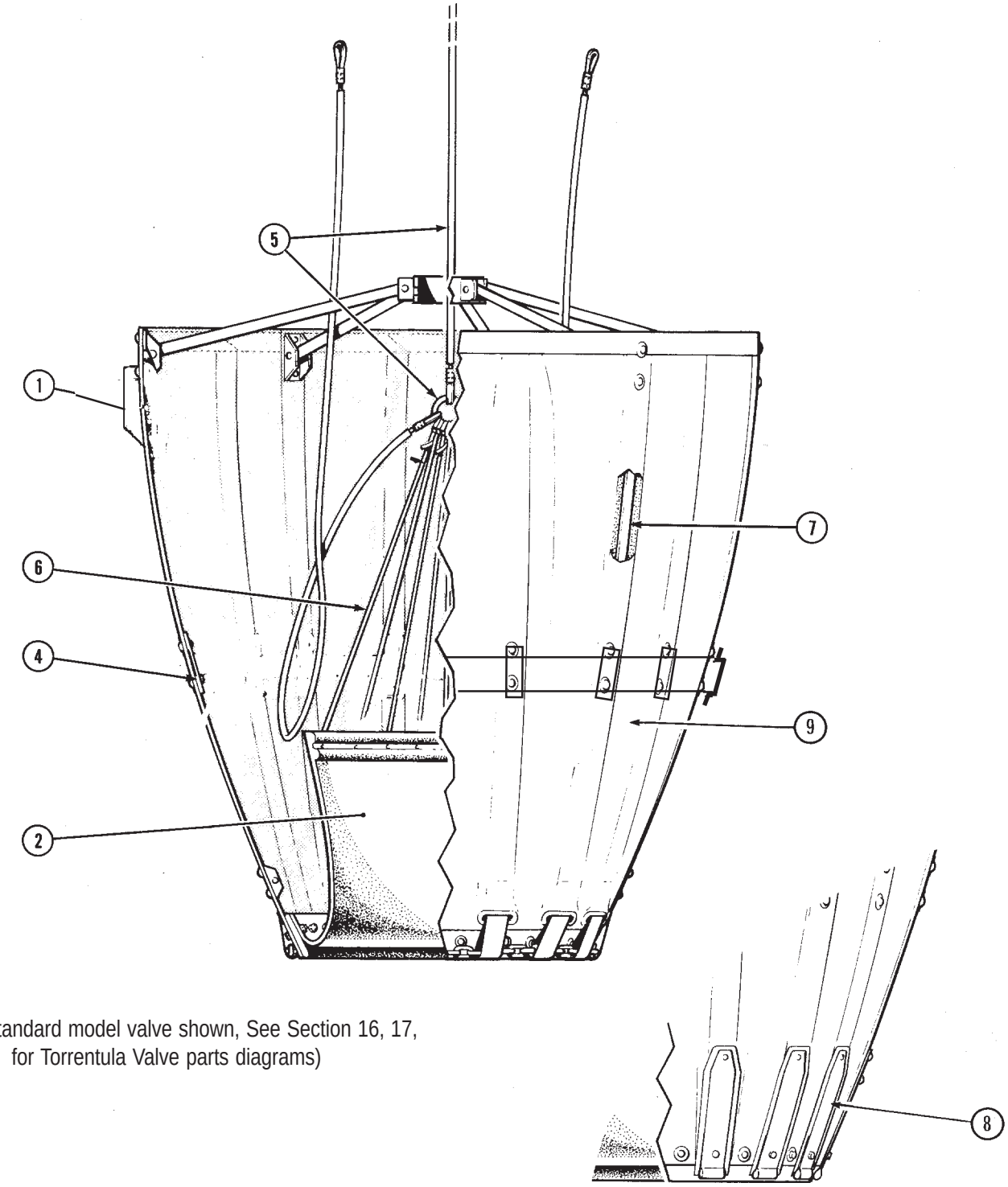
20. ELECTRICAL CONTROLS PARTS ALL MODELS

Table 20.1 Electrical Controls Parts List, ALL Models

Item #	Part #	Description	Qty.
1	BTSK00405	Electrical Controls Assembly	
2	BTSA00406	Torrentula Controller Box	1
3	BTSP00420	Base, Enclosure	1
4	BTSP00421	Lid, Enclosure	1
5	BTSP00423	Plate, enclosure face, with graphics	1
6	BTSP00424	Plate, options blank	1
7	BTSP00426	Tag, machine	1
8	BTSA00407	Control Grip assembly	1
9	BTSA00501	Wire Harness W1	1
10	BTSA00502	Wire Harness W2	1
11	BTSA00503	Wire Harness W3	1
12	BTSA00504	Wire Harness W4	1
13	BTSA00505	Wire Harness W5	1
14	BTSA00506	Wire Harness W6	1
15	BTSA00507	Wire Harness W7	1
16	BTSA00520	Wire Harness W20	2
17	BTSA00521	Wire Harness W21	2
18	BTSA00522	Wire Harness W22	1
19	BTSA00523	Wire Harness W23	1
20	BTSA00551	Wire Harness H1	1
21	BTSA00552	Wire Harness H2	1
22	BTSA00553	Wire Harness H3	1
23	BTSA00530	Wire Harness W30 (not shown)	1
24	BTSA00531	Wire Harness W31 (not shown)	1
25	BTSK00440	Limit Switch Kit (not shown)	1
101	FBSC040305	Screw, panphil 10-24UNC x 5/8	8
102	FBSC040203	Screw, panphil, 8-32UNC x 3/8	16
103	FBSC030204	Screw, CSKphil, 8-32UNC x 1/2	4
104	FBSC040112	Screw, panphil, 6-32UNC x 1-1/4	6
105	FBSC040104	Screw, panphil, 6-32UNC x 1/2	10
106	FBSF04005	Screw, panphil, 4-40UNC x 5/8	24
107	FBSF04003	Screw, panphil, 4-40UNC x 3/8	4
108	FNSC0203	Nylock nut, 10-24UNC	10
109	FNSC0202	Nylock nut, 8-32UNC	20
110	FNSC0201	Nylock nut, 6-32UNC	16
111	FNSF0200	Nylock nut, 4-40UNC	28
112	FNSC0204	Nylock nut, 1/4-20UNC	4
113	FWS060306	Washer, plain #10 ID, 3/4 OD	4
115	FWS0502	Washer, split lock #8	14
201	BTSA00430	PC board Torrentula controls, model B	1
202	EBRE0205	Circuit breaker, 25 amp	1
203	EBRE025	Circuit breaker, 5 amp	1
204	EREL011	Contactor, DPST	2
205		LED indicator light, red, 24V	1
206	PP013	Clamp, 3/8" ID	2
207	PP014	Clamp, 5/8" ID	2
208	PP265	Tie down eye strap, 2"	2
209	PP722	Rubber pad	4
210	FSN243	Spacer, #6 hole x 5/8" lg.	6
211	PP261	Striker plate	4
212	PP001	Cable Tie, nylon	2
213		Receptacle cap #14 shell	1
214		Receptacle cap #10 shell	1

21. BAMBI BUCKET SHELL PARTS ALL MODELS

Figure 21.1 Bambi Bucket Shell Parts, ALL Models



(Standard model valve shown, See Section 16, 17, 18 for Torrentula Valve parts diagrams)

21. BAMBI BUCKET SHELL PARTS ALL MODELS

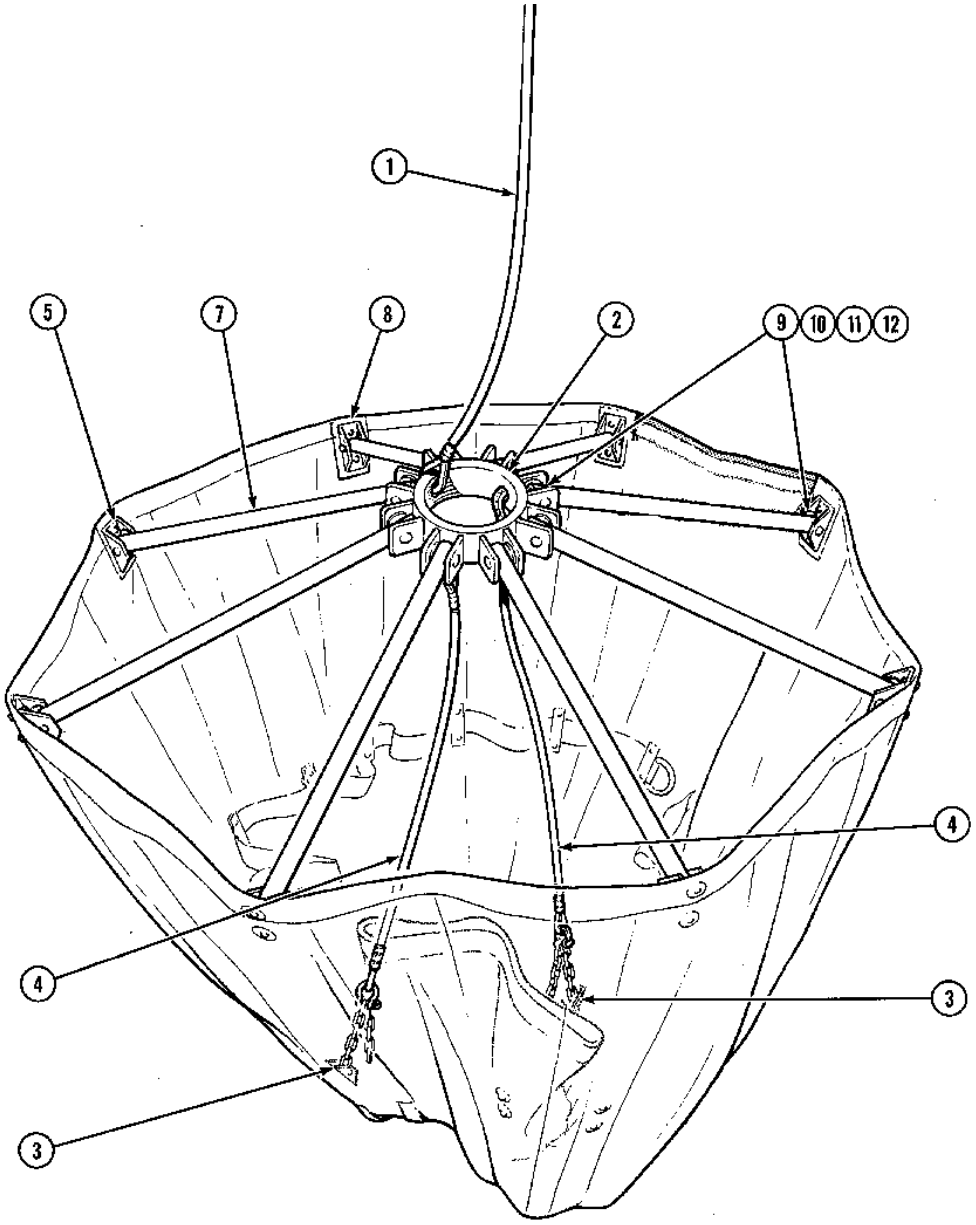
Table 21.1 Bambi Bucket Shell Parts List, ALL Models

Item #	Part #	Description	Qty
1	BB-655TG	Ballast, Large (5566-HL9800, as required) 16 lbs. (7.2 kg)	as required
	BB-656TG	Ballast, Small (2732-5566, as required) 8 lbs. (3.6 kg)	as required
	BB-657	Bolt Kit, Ballast, Small (one plate)	1
	BB-659	Wear Strip for Ballast, All	1
	BB-658	Bolt Kit, Ballast, Large (one plate)	1
3	BB-711	FCAS Cinch Strap, 2732	1
	BB-712	FCAS Cinch Strap, 3542	1
	BB-713	FCAS Cinch Strap, 4453	1
	BB-714E	FCAS Cinch Strap 5566 External	1
	BB-715E	FCAS Cinch Strap 6578 External	1
	BB-720E	FCAS Cinch Strap 7590 External	1
	BB-722E	FCAS Cinch Strap HL5000 External	1
	BB-723E	FCAS Cinch Strap HL7600 External	1
	BB-724E	FCAS Cinch Strap HL9800 External	1
4	BB-746A	Stand-off Spacer, plastic, round (5566)	32
	BB-746-B	Stand-off Spacer, plastic, round (6578-HL5000)	40
	BB-748	Cinch Strap Bar, alum., round ends (5566-HL5000)	20
	BB-749	Cinch Strap Bar, alum., formed (2732-4453) (no spacer req'd)	16
	BB-7498	Cinch Strap Bracket, formed (HL7600, HL9800)	20
	BB-7498BP	Cinch Strap Bracket Backing Plate (HL7600, HL9800)	20
5	BB-281	Risers 2732	1
	BB-282	Risers 3542, 4453	1
	BB-283	Risers, 5566	1
	BB-290	Risers, 6578, 7590	1
	BB-291	Risers, HL500, HL7600	1
	BB-292	Risers, HL7600	1
	BB-293	Risers, HL9800	1
7	BB-611	Batten, 2732	16
	BB-612	Batten, 3542	16
	BB-613	Batten, 4453	16
	BB-614	Batten, 5566	16
	BB-615	Batten, 6578	20
	BB-620	Batten, 7590	20
	BB-622	Batten, HL5000	20
	BB-623	Batten, HL7600	20
	BB-624	Batten, HL9800	20
8	BB-081T	Wear Strip, Fabric, 7590 - HL9800	20
	BB-082T	Wear Strip, Fabric, 2732-5566	16
9	*BB-961T	Shell, 2732	1
	*BB-962T	Shell, 3542	1
	*BB-963T	Shell, 4453	1
	*BB-964HT	Shell, 5566	1
	*BB-965HT	Shell, 6578	1
	*BB-970T	Shell, 7590	1
	*BB-972T	Shell, HL5000	1
	*BB-973T	Shell, HL7600	1
	*BB-974T	Shell, HL9800	1

*Add "S" suffix to part number when a complete shell with all attached hardware is required

22. IDS SYSTEMS ALL MODELS

Figure 22.1 IDS systems parts



IDS System Parts Diagram

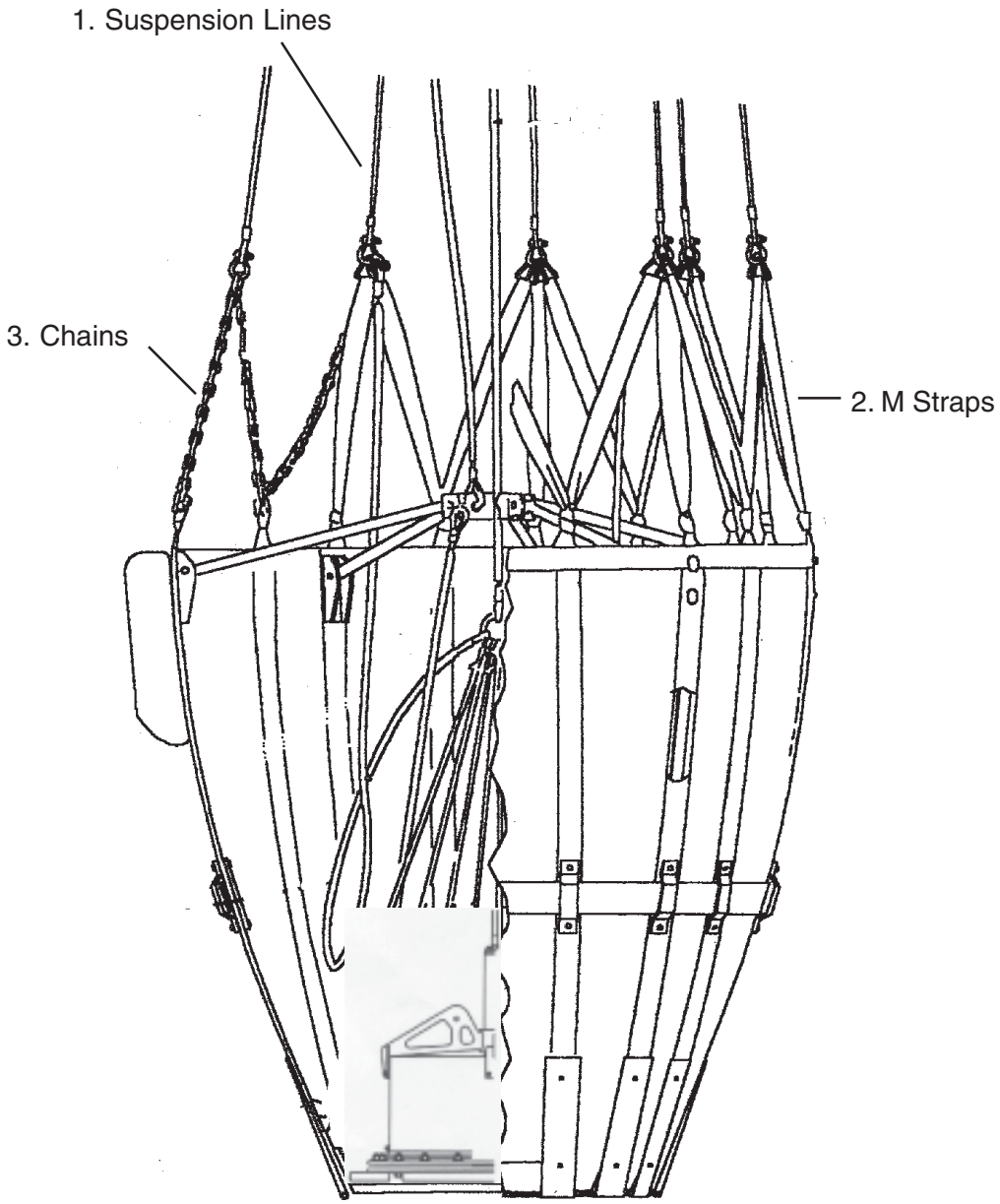
22. IDS SYSTEM ALL MODELS

Table 22.1 IDS Systems Parts List, ALL Models

Item #	Part #	Description	Qty.
1	BB-361	Deployment Cable Assy, 2732-4453	1
	BB-364	Deployment Cable Assy, 5566, 6578	1
	BB-370	Deployment Cable Assy, 7590	1
	BB-372	Deployment Cable Assy, HL5000	1
	BB-373	Deployment Cable Assy, HL7600	1
	BB-374	Deployment Cable Assy, HL9800	1
2	BB-456	Hub, Casting, Machined, 2732-5566	1
	BB-461	Hub, Casting, Machined, 6578-HL9800	1
3	BB-330	Restrainer Brackets, 2732-HL5000	2
	BB-	Restrainer Brackets, HL7600, HL9800	2
4	BB-311	Cable, Hub Restrainer, 2732	2
	BB-312	Cable, Hub Restrainer, 3542	2
	BB-313	Cable, Hub Restrainer, 4453	2
	BB-314	Cable, Hub Restrainer, 5566, 6578	2
	BB-320	Cable, Hub Restrainer, 7590	2
	BB-322	Cable, Hub Restrainer, HL5000	2
	BB-323	Cable, Hub Restrainer, HL7600	2
	BB-324	Cable, Hub Restrainer, HL9800	2
5	BB-465	Shell Brackets, 2732-5566	8
	BB-466	Shell Brackets, 6578-HL9800	8
7	BB-411	Spoke Tube, IDS, 2732	8
	BB-412	Spoke Tube, IDS, 3542	8
	BB-413	Spoke Tube, IDS, 4453	8
	BB-414	Spoke Tube, IDS, 5566	8
	BB-415	Spoke Solid, 6578	10
	BB-420	Spoke Solid, IDS, 7590	10
	BB-422	Spoke Solid, IDS, HL5000	10
	BB-423	Spoke Solid, IDS, HL7600	10
	BB-424	Spoke Solid, IDS, HL9800	10
8	BB-469	IDS Bracket Wear Strip, spec model	as req.
9	FPCC-020	Clevis Pin, 2732-5566 (both ends)	16
	FPCC-023	Clevis Pin, 6578-HL9800 (IDS hub)	10
	FBSC010520C	Clevis Bolt, 6578-HL9800 (Shell Brackets)	10
10	FPDC-002	Cotter Pin, 2732-5566	16
	FPDC-002	Cotter Pin, 6578-HL9800	10
11	FWS-0605-06	Flat Washer, 2732-5566	16
	FWS-0605-06	Flat Washer, 6578-HL9800	20
12	FWR-0105	Spacer, Rubber, 2732-5566	32
	FWR-0105	Spacer, Rubber, 6578-HL9800	40

23. RIGGING ALL MODELS

Figure 23.1 Rigging, ALL Models



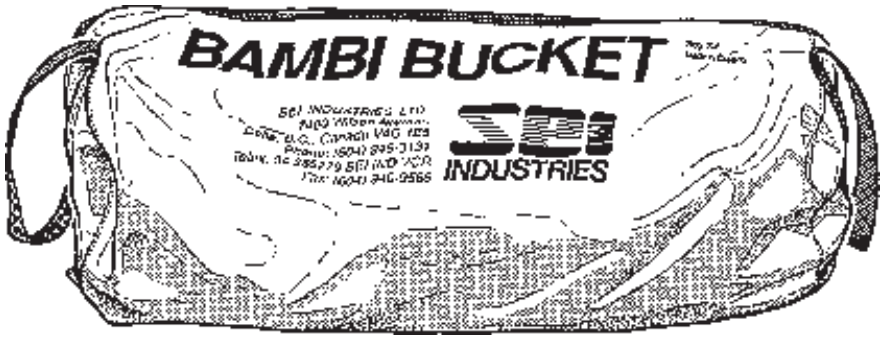
23. RIGGING ALL MODELS

Table 23.2 Rigging Parts List, ALL Models

Item #	Part #	Description	Qty.
1	BB-836	Suspension Line Set, 2732-4453	4 pairs/set
	BB-837	Suspension Line Set, 5566	4 pairs/set
	BB-838	Suspension Line Set, 6578-HL5000	4 pairs + 2 singles/set
	BB-842	Suspension Line Set, HL7600	4 pairs + 2 singles/set
	BB-844	Suspension Line Set, HL9800	4 pairs + 2 singles/set
2	BB-677	M-Strap, 2732-4453, Loop	8
	BB-678	M-Strap, 2732-4453, Straight	8
	BB-679	M-Strap, 5566, Loop	8
	BB-680	M-Strap, 5566, Straight	8
	BB-681	M-Strap, 6578, 7590, Loop	10
	BB-682	M-Strap, 6578, 7590, Straight	10
	BB-683	M-Strap, HL 5000, Loop	10
	BB-684	M-Strap, HL 5000, Straight	10
	BB-685	M-Strap, HL 7600, Loop	10
	BB-686	M-Strap, HL 7600, Straight	10
	BB-687	M-Strap, HL 9800, Loop	10
	BB-688	M-Strap, HL 9800, Straight	10
3	BB-782	Chain Top, 18-1/2”, 2732-5566	2
	BB-783	Chain Top, 20-1/2”, 2732-5566	2
	BB-783S	Chain Top, Set 2732-5566(2XBB-782, 6XBB783)	1
	BB-784	Chain Top, 19 ½”, 6578-7590	2
	BB-785	Chain Top, 20 ¾, 6578-7590	2
	BB-786	Chain Top, 17 ½, HL 5000	2
	BB-787	Chain Top, 21 ½, HL 5000	2
	BB-788	Chain Top, 26", HL 7600	2
	BB-789	Chain Top, 28", HL 7600	2
	BB-789S	Chain Top, Set, HL7600(2XBB-788, 3XBB-789)	1
	BB-790	Chain Top, 32", HL 9800	2
	BB-791	Chain Top, 34", HL 9800	2

24. PACKAGING

Figure 24.1 Packaging **Carry Bag**



Part No.	Description
BB-865T	Bag, carrying, 2732 - 4453
BB-871T	Bag, carrying, 5566, 6578
BB-872T	Bag, carrying, 7590, HL5000
BB-875T	Bag, carrying, HL7600
BB-877T	Bag, carrying, HL9800

Shell Repair Kit BB-991 2732 - 4453
Shell Repair Kit BB-992 5566 - HL9800

Description	Qty	Description	Qty.
Repair manual	1	Tape for holding patches in place	1
Solvent (isopropyl alcohol)	250ml	Brushes for applying glue	3
Abrasive pads	2	Patch material	6
Rag for cleaning tank	1	Roller for rolling down patches	1
Glue (Loctite 495)	1	Weight bag and plastic sheet for holding down patches	1
Scissors for cutting patches	1		

Optional Repair Accessories

TT-105	Small clamp
TT-106	Medium clamp
TT-107	Large clamp
PP-510	Roller
Special order	Hot air gun
Special order	Glue-specify model/fabric type

Torrentula Valve Spare Parts Kit, Model B Controls **BBTVK002**

Note: Always Specify Model and Serial Number when ordering parts and accessories.