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Bambi
BUCKET®
Driven by Innovation

TORRENTULA
(ALL MODELS)
OPERATIONS
AND SERVICE
MANUAL

2013 VERSION B

**TORRENTULA OPERATIONS AND SERVICE MANUAL (All Models)
Version B**

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PLEASE READ BEFORE USING.

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Table of Contents

Section 1: Overview	1
Torrentula Valve and PowerFill Systems	1
Section 2: Preflight Safety Check	2
Torrentula Valve Pre-Flight Checklist	3
PowerFill Pre-Flight Checklist	4
Section 3: Deploying the Bambi Bucket	5
Procedures and Calculations	5
<i>Attaching to the Cargo Hook</i>	5
<i>Interfacing with the Aircraft Power Supply</i>	6
<i>Operator's Control Interface</i>	6
<i>Installation of Non-Standard Breakaway Connectors</i>	7
<i>Pilot-Operated Controls</i>	7
<i>Checking Suspension Cable Length</i>	8
<i>Torrentula Length Chart</i>	8
<i>Instant Deployment System (IDS)</i>	9
Section 4: Flying the Bambi Bucket	10
Flight Procedures	10
<i>Flying Empty</i>	10
<i>Flying Full</i>	10
Section 5: Filling the Bucket	11
Filling Procedures	11
<i>Filling from a Fireflex or Heliwell Tank</i>	11
Section 6: Using Foam	12
Foam Injection Procedures	12
<i>Sacksafoam Foam Injection System</i>	12
<i>Compatible Bambi Bucket/Sacksafoam Models</i>	13
<i>Interface with Torrentula Valve Controller</i>	13
Section 7: Dumping the Bucket	14
Dumping Procedures	14
<i>Dump Pattern</i>	14
<i>Dump Speed</i>	14
<i>Operation of the Dump valve</i>	14
Section 8: Landing	15
Landing Procedures	15

Section 9: PowerFill System	16
System Components	16
<i>Applicable Bucket Models</i>	16
<i>Configuration</i>	17
<i>Factory Installation</i>	17
<i>Retrofit Kit</i>	17
<i>Pumps</i>	17
<i>Electrical Junction Box</i>	17
<i>Interfacing with the Aircraft Power Supply</i>	18
<i>Diagram, Models 4453, 5566, 5870, 6578 and 7590 2-Pump System</i>	19
<i>Diagram, Models HL4000, HL5000, HL7600 and HL9800 4-Pump System</i>	20
<i>Power Requirements</i>	21
<i>Longline Performance</i>	21
<i>Longline Wire and Plug Combinations, BBTV Model B Controls</i>	22
<i>Electrical Controls</i>	22
 Section 10: Operations	 26
Operating the PowerFill Torrentula System	26
<i>Flying with the PowerFill Torrentula System</i>	26
<i>Filling the Bambi Bucket with PowerFill Torrentula</i>	26
<i>Fill Time Chart</i>	27
 Section 11: Packing and Storage	 28
Packing and Storing the Bucket	28
<i>Packing the Bucket</i>	28
<i>Collapsing the IDS on Larger Buckets</i>	32
<i>Storing the Bucket</i>	35
 Section 12: Maintenance and Repairs	 36
Component Descriptions	36
<i>Description of the Torrentula Valve and Actuating Mechanism</i>	36
<i>Description of Torrentula Valve Electrical System</i>	37
Routine Maintenance Procedures	37
<i>Operational Inspections (every 50 hours or 7 days of continuous use)</i>	37
<i>Seasonal Inspections (every six months)</i>	38
<i>Preparation for Storage (in addition to seasonal maintenance)</i>	38
<i>Prevention of Moisture Accumulation in the Control Head</i>	39
Unscheduled Valve Maintenance Procedures	40
<i>Control Head Immersion in Water</i>	40
<i>Actuator Cable Replacement</i>	40
<i>Actuator Cable Drawing</i>	42
<i>Actuator Cable Adjustment</i>	43
<i>Seal Repair and Replacement</i>	44
<i>Top Seal Replacement</i>	44
<i>Bottom Seal Replacement</i>	45
<i>Adjustment of Limit Switches in the Control Head</i>	46
<i>Adjustment of Bottom Valve Bushings</i>	48

PowerFill Maintenance	48
<i>Routine Maintenance Procedures</i>	48
<i>Weekly inspection</i>	49
<i>Pump Output Shaft Lubrication</i>	49
<i>Yearly Maintenance and Preparation for Long Term Storage</i>	50
Unscheduled PowerFill Maintenance Procedures	51
<i>Removal and Disassembly of the PowerFill Torrentula Pump Units</i>	51
<i>Inspection and Replacement of Pump Motors</i>	52
<i>Inspection and Replacement of Pump Impellers</i>	53
<i>Replacement of Secondary Motor Shaft Seal</i>	54
<i>Inspection and Replacement of One-Way Flapper Valves</i>	55
<i>Reassembly of Pumps</i>	56
Bambi Shell and Lines Maintenance	57
<i>Suspension Line Replacement</i>	57
<i>M-Strap Replacement</i>	58
<i>Removing Old M-Straps</i>	59
<i>Installing New M-Straps (Short)</i>	60
<i>Installing New M-Straps (Long)</i>	62
<i>IDS Hub/Spokes Replacement</i>	64
<i>Load Test on the Hook</i>	65
<i>IDS 4453, Detailed Drawing</i>	66
<i>IDS 5566, Detailed Drawing</i>	67
<i>IDS 6578-7590, Detailed Drawing</i>	68
<i>IDS HL4000 - HL9800, Detailed Drawing</i>	69
<i>Shell Repairs</i>	70
<i>Repair Failures</i>	70
<i>Repairing in High Humidity</i>	71
<i>Making Temporary Repairs with Sealing Clamps</i>	72
Temporary Repairs Using Glue	74
<i>Applying the Glue</i>	74
<i>Gluing with Patches</i>	75
<i>Cutting the Patch</i>	76
<i>Applying the Patch</i>	76
Hot Air Gun Patching	78
<i>Hot Air Gun Procedure</i>	79
Repair Kits	80
<i>Repair Kit Parts Table</i>	80
<i>Optional Supplies</i>	80
Section 13: Troubleshooting	81
Troubleshooting Procedures	81
<i>Torrentula Valve Troubleshooting Chart</i>	81
<i>Electrical Controls Troubleshooting</i>	82
<i>Torrentula Valve Electrical Component Function Checks</i>	83
<i>PowerFill Only Electrical Component Function Checks</i>	83
<i>Torrentula Valve Only Electrical Component Function Checks</i>	84
<i>PowerFill Troubleshooting Chart</i>	85

Section 14: Specifications	86
Capacity and Weight Specifications	86
<i>Torrentula Valve Specifications Models 4453-HL9800</i>	86
<i>Torrentula Valve with PowerFill Specifications Models 4453-HL9800</i>	86
<i>Fill Time and Power Requirements</i>	87
Section 15: Torrentula Control Head Parts	88
Control Head Parts Listings	88
<i>Model 4453 Control Head</i>	88
<i>Model 4453 Control Head (continued)</i>	89
<i>Model 4453 Control Head (continued)</i>	90
<i>Control Head Models 4453 Parts Listing</i>	91
<i>Models 5566-HL9800 Control Head</i>	92
<i>Models 5566-HL9800 Control Head (continued)</i>	93
<i>Models 5566-HL9800 Control Head (continued)</i>	94
<i>Control Head Models 5566-HL9800 Parts Listing</i>	95
Section 16: Torrentula Valve Parts	96
Valve Parts Listings	96
<i>Torrentula Valve Parts, Model 4453 Only</i>	96
<i>Torrentula Valve, Model 4453 Parts Listing</i>	97
<i>Torrentula Valve Parts, Models 5566, 5870, 6578, 7590</i>	98
<i>Torrentula Valve, Models 5566, 6578, 7590 Parts Listing</i>	99
<i>Torrentula Valve Parts, Models HL4000, HL5000, HL7600, HL9800</i>	100
<i>Torrentula Valve, Models HL4000, HL5000, HL7600, HL9800 Parts Listing</i>	101
Section 17: Shell Parts	102
Bucket Shell Parts Listings	102
<i>Bucket Shell, Model 4453</i>	102
<i>Bucket Shell, Model 4453 Parts Listing</i>	103
<i>Bucket Shell, Model 5566</i>	104
<i>Bucket Shell, Model 5566 Parts Listing</i>	105
<i>Bucket Shell, Models 6578-HL9800</i>	106
<i>Bucket Shell, Models 6578-HL9800 (continued)</i>	107
<i>Bucket Shell, Models 6578-HL9800 Parts Listing</i>	108
IDS System Parts Listings	109
<i>IDS System, Model 4453</i>	109
<i>IDS System, Model 4453 Parts Listing</i>	110
<i>IDS System, Model 5566</i>	111
<i>IDS System, Model 5566 Parts Listing</i>	112
<i>IDS System, Models 6578-7590</i>	113
<i>IDS System, Models 6578-7590 Parts Listing</i>	114
<i>IDS System, Models HL4000-HL9800</i>	115
<i>IDS System, Models HL4000-HL9800 Parts Listing</i>	116
Rigging Parts Listings	117
<i>Rigging, Model 4453</i>	117
<i>Rigging, Model 4453 Parts Listing</i>	117
<i>Rigging, Model 5566</i>	118

<i>Rigging, Models 5566 Parts Listing</i>	118
<i>Rigging, Models 6578-HL9800</i>	119
<i>Rigging, Models 6578-HL9800 Parts Listing</i>	120
Ballast Parts Listings	121
<i>Ballast, Models 4453-HL9800</i>	121
<i>Ballast, Models 4453-HL9800 Parts Listing</i>	121

Section 18: PowerFill Torrentula Parts 122

PowerFill Torrentula Parts Listings	122
<i>Valve Flapper</i>	122
<i>Valve Flapper Parts Listing</i>	123
<i>PowerFill Torrentula Motor Assembly</i>	124
<i>PowerFill Torrentula Motor Assembly Parts Listing</i>	125
<i>Filter Screens</i>	126
<i>Filter Screens Parts Listing</i>	126
<i>Motor Guards</i>	127
<i>Motor Guards Parts Listing</i>	127
<i>Stand Offs</i>	128
<i>Stand Offs Parts Listing</i>	128
<i>Top Plates and Support Rods</i>	129
<i>Top Plates and Support Rods Parts Listing</i>	129
<i>Wire Harness, Two Pump Model</i>	130
<i>Wire Harness, Two Pump Model Parts Listing</i>	130
<i>Wire Harness, Four Pump Model</i>	131
<i>Wire Harness, Four Pump Model Parts Listing</i>	131

Section 19: Electrical Component Parts 132

Torrentula Control Box	132
<i>Torrentula Control Box Parts Listing</i>	133
Torrentula Control Box Wiring Harness	134
<i>Torrentula Control Box Wiring Harness Parts Listing</i>	135
PowerFill Junction Box	136
<i>PowerFill Junction Box Parts Listing (Models 4453, 5566, 5870, 7590 w/2 pumps)</i>	137
<i>PowerFill Junction Box Parts Listing (Models HL5000, HL7600, HL9800, 7590 w/4 pumps)</i>	138
PowerFill Cable Installation	139
<i>PowerFill Cable Installation Parts Listing</i>	140

Section 20: Repair Kits and Carry Bags Parts 141

Repair Kits	141
<i>Shell Repair Kit #003613, Parts</i>	141
<i>Optional Repair Accessories</i>	141
<i>Carry Bags</i>	141

Section 21: Wiring Diagrams 142

Models 4453 to 7590 (2 pump systems)	142
<i>Models 4453 to 7590 (continued)</i>	143
Models HL4000 to HL9800 (4 pump systems)	144
<i>Models HL4000 to HL9800 (continued)</i>	145

Junction Box and Controller	146
Torrentula Pilot Controls Wiring	147
Torrentula Longline Cable Assemblies Wiring	148
PowerFill Breakaway Plug Wiring	149
Torrentula Controller Box Wiring	150

Section 22: Warranty

151

Section 1: Overview

Torrentula Valve and PowerFill Systems

This manual provides helicopter operators with information on the operation and maintenance of any Bambi bucket equipped with the Torrentula valve or PowerFill system. This manual also includes all parts listings and installation drawings.

For your own protection and for longer bucket life, always read the instructions and warnings. Ignoring these warnings could result in personal injury, bucket damage or aircraft damage. Pay particular attention to the sections on deploying, filling and dumping. If you experience problems, please refer to the sections on *Maintenance and Troubleshooting* which may be especially helpful.

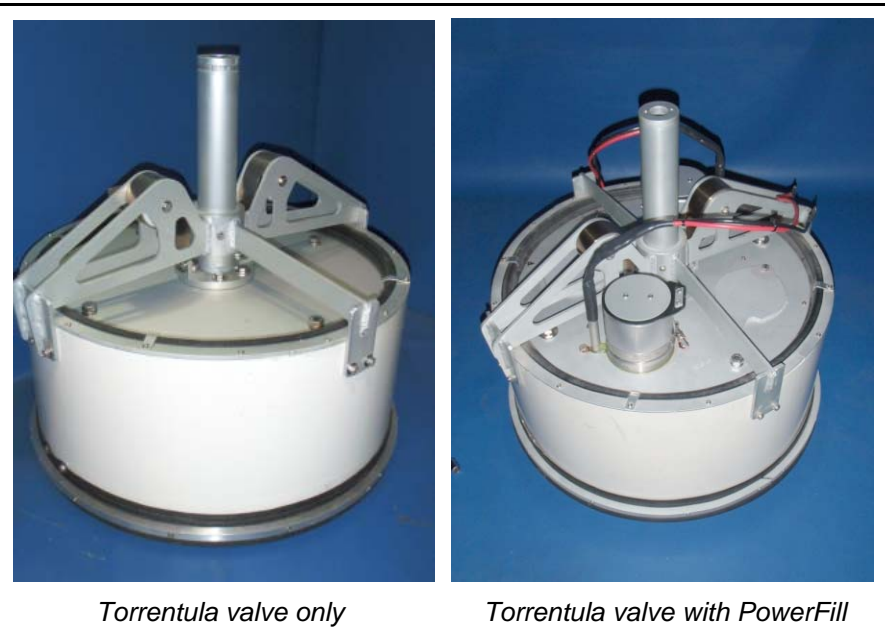
No prior experience is required to quickly master the operation of the Torrentula valve and the bucket requires no assembly. Variable filling of the bucket can be done by off-loading a portion of the water using the valve's open/close feature. The pilot will quickly become familiar with off-loading and the flying characteristics of the bucket.

On all Torrentula valve Bambi buckets, the new PowerFill Torrentula shallow draft pumping system is also available for retrofit or factory installation. The addition of the PowerFill

system gives the operator the ability to perform rapid and complete bottom fills from sources as shallow as 21" (0.53m) deep. The PowerFill system pump motors are designed for intermittent operation and should not be run longer than two minutes at a time. This manual contains a simple suggested wiring diagram to assist operators who wish to use a switch arrangement.

SEI offers complete parts supply and repair facilities for the Bambi bucket. For maintenance and repair purposes, parts diagrams and descriptions are included in this manual. SEI also offers the Bambi bucket repair assessment manual as a guideline 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.



Section 2: Preflight Safety Check

Warning

It is not recommended that the valve be activated unless the bucket head is suspended on a crane or from a helicopter. If it must be operated flat on the ground, follow the steps below. Failure to follow these steps may cause the activation cable to loop inside the head, affecting the micro-switch location that controls the opening and closing of the valve.

1. Fully deploy the IDS.
2. Stretch the suspension lines and activation cable straight out from the bucket.
3. Open the valve.
4. To close the valve, press the close button for a fraction of a second (see note below).
5. Go to the bottom of the bucket and pull the lift bar down.
6. Repeat steps 3 and 4 until the valve is closed.
7. When your test is completed, leave the valve open 1-2" to protect the valve seal.
8. If PowerFill system is installed, run pumps for one cycle.

Important Note

When operating the valve, make sure to lay the control head flat and stretch out the suspension lines and control cable as straight as possible.

Torrentula Valve Pre-Flight Checklist

Just as the pilot preflights his aircraft, the Bambi bucket and valve should also be inspected 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, 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 the valve guard structure for bending or cracks.
6. Check the internal or external cinch strap.
7. Check the suspension cables for frays, kinks or loose swages and all power cables.
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.

PowerFill Pre-Flight Checklist

In addition to performing the pre-flight check on the Torrentula valve, perform the following checks on the PowerFill Torrentula system:

1. Check that the electrical junction box is secure in the aircraft.
2. Inspect the conductor wires for damage, chafing or wear. Confirm that the conductor cables are firmly secured to the Torrentula valve actuator cable and also to the long line cable, if used. Repair any damage before operating the system.

Warning

Do not operate with damaged cables. Damage to an electrical cable, that leaves the conductor exposed, can result in fire if it comes in contact with another conductor or metal object.

3. Inspect the cable connectors for damage and ensure proper connections

Warning

Do not put your fingers or other objects into the pump impeller while the pump is running. Personal injury or damage to the pump could occur.

4. With power “on” check the function of the pumps by pressing the pumps “on” button for four or five seconds. The pumps should turn on, one after the other, until all are running. The pumps will be audible within a few feet of the bucket. Listen for abnormal noises that are not consistent with smooth operation. If you are operating in a noisy environment, you can confirm the pumps are running by holding your hand on each motor and feeling the vibration.
5. Check the filter screen for debris accumulation and clear as necessary
6. Check the pump motor exterior for signs of damage or wear.
7. Check sealing coat on motors to see if it is uniform. Any wear areas could allow water to enter the motor, leading to motor failure.

Section 3: Deploying the Bambi Bucket

Procedures and Calculations

Attaching to the 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.

Interfacing with the Aircraft Power Supply

Connecting to the aircraft power supply should be done in accordance with AC43.13-1B and AC43.13-2A and any applicable aircraft 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, amend 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 supply 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.

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 Torrentula pump system.

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

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

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 Torrentula valve controller, if desired.

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 (three in 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 Controls

As standard equipment with all Torrentula electrical controls are the accommodation for the operation of the optional PowerFill Torrentula pump system. If you are not operating a PowerFill Torrentula system, it is not necessary 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.

Checking Suspension Cable Length**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.

Overall lengths of Bambi buckets with standard rigging are given in the following chart. 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.
- 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.

Torrentula Length Chart

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.

Bambi Model	Standard Torrentula		PowerFill Torrentula	
	Overall Length		Overall Length	
	Feet	Meters	Feet	Meters
4453	23' 8"	7.21	24' 5"	7.44
5566	24' 7"	7.49	25' 4"	7.72
6578	25' 1"	7.63	25' 10"	7.86
7590	30' 6"	9.30	31' 3"	9.53
HL4000	31' 8"	9.65	32' 5"	9.88
HL5000	32' 0"	9.75	32' 9"	9.98
HL7600	33' 1"	10.08	33' 10"	10.31
HL9800	34' 3"	10.44	35' 0"	10.67

Lengths are accurate to within 1%. Overall lengths measured with standard rigging. Specifications subject to change.

Important Note

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.

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.

Caution

Operating the Torrentula valve with the bucket collapsed may cause damage to the valve and/or control head. If the valve must be operated on the ground, please refer to an important note on page 2 of this manual.

When the bucket is full, the IDS Deployment Cable and hub Restraint 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 the parts section of this manual. 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. To collapse the IDS, refer to the packing and storage section of this manual.

Section 4: Flying the Bambi Bucket

Flight Procedures

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 be closed during take-off and landing procedures but always stored in an open position.

Flying Empty

The Bambi bucket has been flown at speeds to 110 m.p.h. (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.

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.

Caution

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

Section 5: Filling the Bucket

Filling Procedures

The Bambi bucket, with the Torrentula valve, can be filled either by tipping the bucket with the valve closed, or a partial fill 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 roll over on lift out. This could cause personal injury and helicopter damage. Check the load and suspension cables with your mirrors before lift out.

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.

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 aluminium panels with an internal vinyl fabric liner. There are three 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 the following chart for recommended tank sizes for different models of the Bambi bucket.

Section 6: Using Foam

Foam Injection Procedures

The Bambi bucket is designed to be effective 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 retardants, cycle through several dumps with water only or hose down with fresh water. This will prolong the bucket life.

Sacksafoam Foam Injection System

The Sacksafoam is SEI Industries' advanced foam dispensing system for use with the Bambi bucket. This system, exclusive to the Bambi, allows foam to be dispensed into the bucket in route from the filling source to the fire site.

There are three models of Sacksafoam to fit this range of Bambi buckets. The operation of the Sacksafoam is controlled by the pilot through a control unit, which is mounted in the cockpit. Sacksafoam I contains the foam reservoir directly installed inside the bucket.



Sacksafoam I

The Sacksafoam II is a self-contained unit that can be stowed onboard the helicopter. This system is completely housed in a foam-resistant case. With the Sacksafoam II, the pilot still controls the foam dispensing through the control unit.

The Sacksafoam III is identical to the Sacksafoam II, except that the controller is mounted in the foam resistant case in the Sacksafoam III.



*Sacksafoam II,
Model 5598*



If additional foam storage is required, the Sacksafoam Plus can be purchased to add an additional 40 gallons of foam on board.

Compatible Bambi Bucket/Sacksafoam Models

Part Number	Bambi Bucket	Reservoir USG	Capacity Liters
Sacksafoam I			
004349	3542-4453	30	114
004340	5566-HL5000	72	272
004341	HL7600-HL9800	132	500
Sacksafoam II			
004343	5566-HL9800	25	95
Sacksafoam III			
004345	5566-HL9800	25	95
Sacksafoam Plus			
004350	ALL	40	151

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.

Section 7: Dumping the Bucket

Dumping Procedures

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.

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.

Important Note

SEI does not recommend dumping at airspeeds above 50 knots.

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.

Controller 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.

Section 8: Landing

Landing Procedures

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.

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.

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 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.

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.

Section 9: PowerFill System

System Components

The PowerFill Torrentula system is comprised of a set of electrically-driven, high-efficiency pumps mounted within the confines of the valve structure on a Torrentula valve-equipped Bambi bucket. The pumps can fill the bucket rapidly and completely in shallow water sources as low as 21" (0.53 m) deep.

The system consists of the following main components:

- Two or four (depending on model) 28 volt DC driven pumps.
- Multi-conductor wiring and breakaway plugs.
- Electrical junction box.

Applicable Bucket Models

Bucket models 4453 through 7590 receive a two pump system, while the larger size buckets, HL4000 through HL9800 receive four pumps. The optimal pumping rate for each pump is 400 to 450 GPM (25 - 28 L/sec).



Configuration

Each system is supplied with a bottom stand-off that supports the bucket and helps to maintain flow into the pump intakes when the bucket is resting on the bottom of the water source. To prevent damage to the pump impellers, each system has large-area filter screens mounted inside the valve structure. Each pump is equipped with a low restriction, one-way valve to prevent back flow through the pumps when they are not running. The PowerFill Torrentula system comes complete with all the required electrical equipment and wire leads for operation of the pumps.

Factory Installation

The PowerFill Torrentula system can be supplied as original equipment on any Torrentula valve-equipped Bambi bucket.

Retrofit Kit

The PowerFill Torrentula system can be supplied as a kit for installation on any existing Torrentula valve-equipped Bambi bucket. Installation instructions can be obtained from SEI Industries.

Pumps

The 28 volt DC-powered pumps are very compact, light weight and efficient. Each pump draws 45 amps of current and can pump between 400 and 450 US gallons per minute (25 to 28 litres per second), depending on bucket size. The power can be supplied by direct 28 volt DC power from the aircraft non-essential or utility bus or from AC to DC transformer/rectifiers with 28 volt DC output.

The pumps are isolated individually by separate circuit breakers. The pumps work by drawing water up through the cavity of the Torrentula valve, through the impeller intakes and directly into the bucket. The pump motors are fully waterproof in operation to a depth of 10 feet (3.0 m) and have a standard hydraulic grease nipple provision to extend the life of the motor output shaft seals.

Electrical Junction Box

All connections and electrical control components are housed in a two-piece anodized aluminium and painted enclosure. The enclosure is impact resistant. Four latches and an interface lead (H5) are supplied with the box to allow it to be coupled to the Torrentula valve controller box. This allows the two boxes to function effectively as a single unit.

The PowerFill Torrentula junction box contains the circuit breakers and power contactors required to run the pumps. Each pump is backed by a dedicated circuit breaker. Current overload to one pump only will not affect the operation of the other pump or pumps.

The pump contactors close sequentially, one after the other, with a delay of 0.4 seconds between each. The purpose of this delay is to limit the initial “inrush” current to the pump motors, thereby putting less strain on the power supply during start-up.



Important Note

The Torrentula valve can operate as a completely independent system if the PowerFill System is not in use.

Interfacing with the Aircraft Power Supply

Please refer to *Wiring Diagrams* for suggested helicopter installation diagrams.

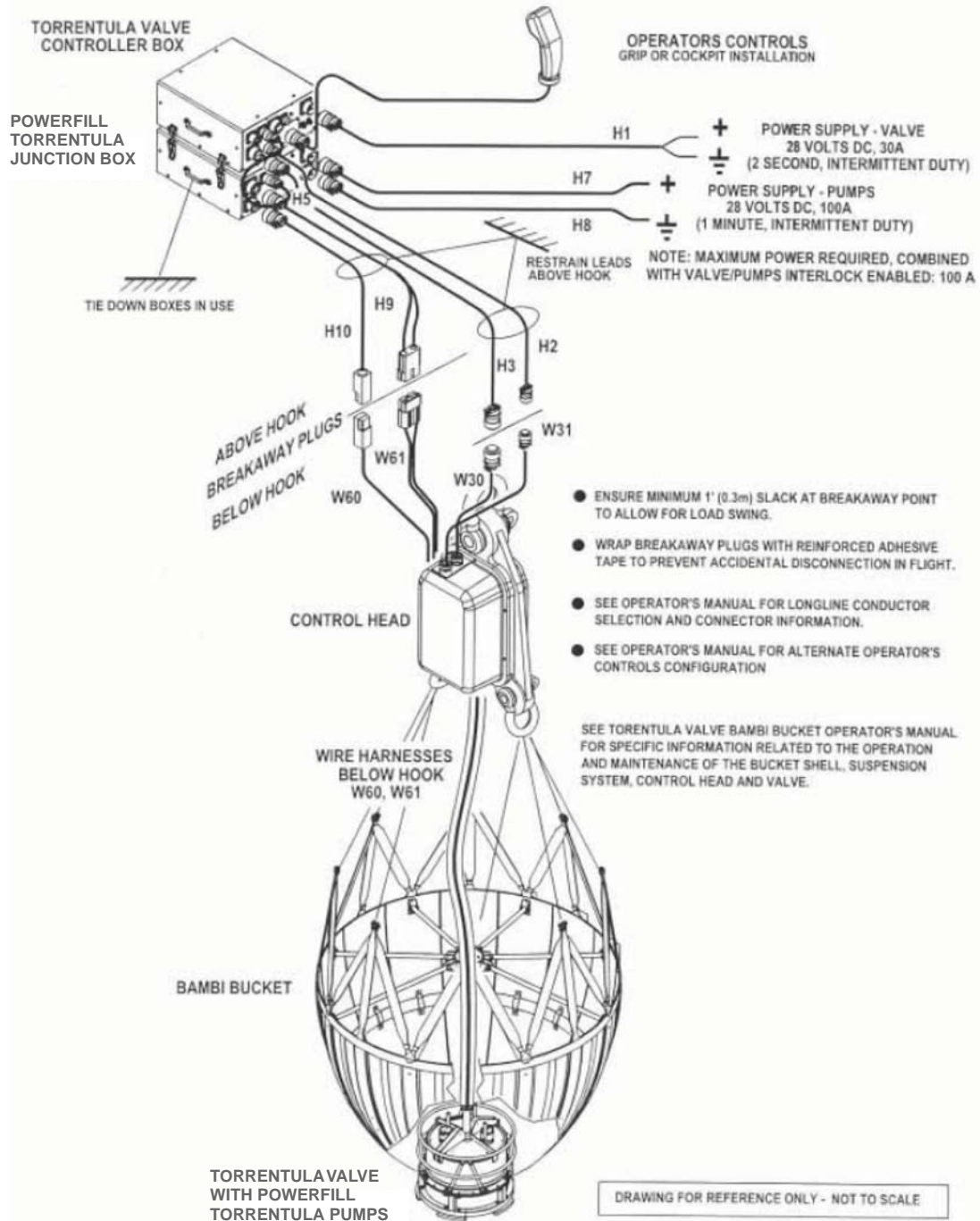
Connection to the aircraft power supply should be done in accordance with FAA Advisory Circulars AC43.13-1B and AC43.13-2A and any applicable aircraft manufacturers' instructions.

Warning

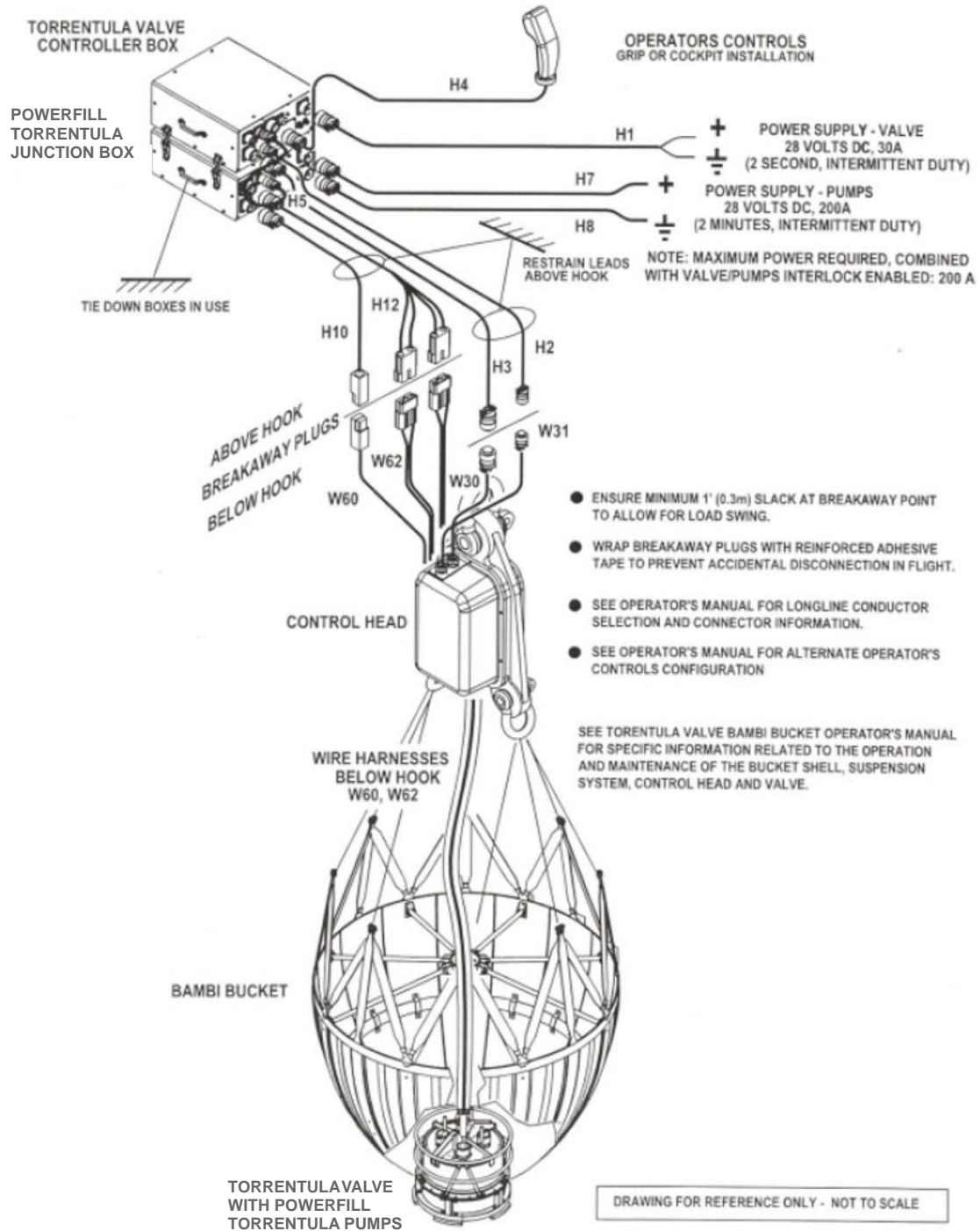
Do not connect the PowerFill Torrentula system to any aircraft bus bar that is used for emergency or essential loads. Before installation, do an electrical load analysis to ensure that the generator capacity is adequate to operate the system and amend the aircraft electrical load to the new requirement.

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.

Diagram, Models 4453, 5566, 5870, 6578 and 7590 2-Pump System



Diagram, Models HL4000, HL5000, HL7600 and HL9800 4-Pump System



Power Requirements

The PowerFill Torrentula system is designed to run on standard 28 volt DC aircraft electrical current. The system requirements by bucket size are shown below. Along with the pump power requirements, the valve requires 30 amps for two seconds.

Models 4453, 5566, 5870, 6578 and 7590: 28 VDC supply, 100 amps continuous output for 60 seconds, intermittent.

Models HL4000, HL5000, HL7600, HL9800: 28 VDC supply, 200 amps continuous output for 120 seconds, intermittent.

Longline Performance

Voltage Drop vs. Fill Performance

If the PowerFill Torrentula system is installed on a bucket deployed on a longline, the conductor cables used to supply power to the pumps must be sized to allow for satisfactory fill performance. The fill performance is proportional to the percentage of full voltage supplied to the pumps, and will vary depending on the “voltage drop” in the long line conductor cables.

The recommended conductor sizes are based on the aircraft power supply giving a minimum of 24.5 volts under full pump load and a minimum pump performance of 90% of optimal.

The optimal fill performance (no longline voltage drop) can be found in *Section 8:Parts and Specifications*. Output voltage can vary between power supply type. Higher pump performance can be expected if the power supply voltage, under load, is higher than 24.5 volts.

Long Line Conductor Configuration

The basic long line conductor cable arrangement consists of one power cable per pump with a common ground return cable for all pumps. Each pair of pumps shares a common 2-contact breakaway connector, while the ground cable has a single breakaway connector to serve all pumps. See the following chart for longline conductor assemblies. SEI Industries can supply complete longline conductor assemblies on request.

Longline Wire and Plug Combinations, BBTV Model B Controls

Combination	Longline Length (ft)	SEI Wires Part Number	SEI Plug Part Number	Wire Codes	Connect or Codes
BB Torrentula Valve	0-100	004877	004878	CE	JKLM
BB Torrentula Valve	101-200	004877	004878	DE	JKLM
BB Torrentula Valve + PowerFill 1, 4453-7590	0-75	006317	006318	CEFFG	GIJKLM
BB Torrentula Valve + PowerFill 1, 4453-7590	76-100	009412	006318	CEFFG	GIJKLM
BB Torrentula Valve + PowerFill 1, 4453-7590	101-150	009413	006318	CEGGH	GIJKLM
BB Torrentula Valve + PowerFill 1, 4453-7590	151-200	009414	006318	DEGGI	GIJKLM
BB Torrentula Valve + PowerFill 1, HL4000-HL9800	0-75	004876	006233	CEFFFFH	GGIJKLM
BB Torrentula Valve + PowerFill 1, HL4000-HL9800	76-100	006234	006233	CEFFFFI	GGIJKLM
BB Torrentula Valve + PowerFill 1, HL4000-HL9800	101-150	008869	006233	CEGGGGI	GGIJKLM
BB Torrentula Valve + PowerFill 1, HL4000-HL9800	151-200	008870	006233	DEGGGGJ	GGIJKLM

Electrical Controls**Control Logic**

The control logic for operation of the pumps is contained within the printed circuit board inside the Torrentula valve controller. The interface to the PowerFill Torrentula junction box consists of wire harness H5, that transfers the signal to operate the pump contactors (power relays) that are located in the PowerFill junction box. When activated, the pumps turn on sequentially with a 0.4 second delay between each. The sequential delay reduces the strain on the power supply upon start-up. The PowerFill junction box does not contain any electrical control logic and cannot operate in isolation from the Torrentula valve controller.

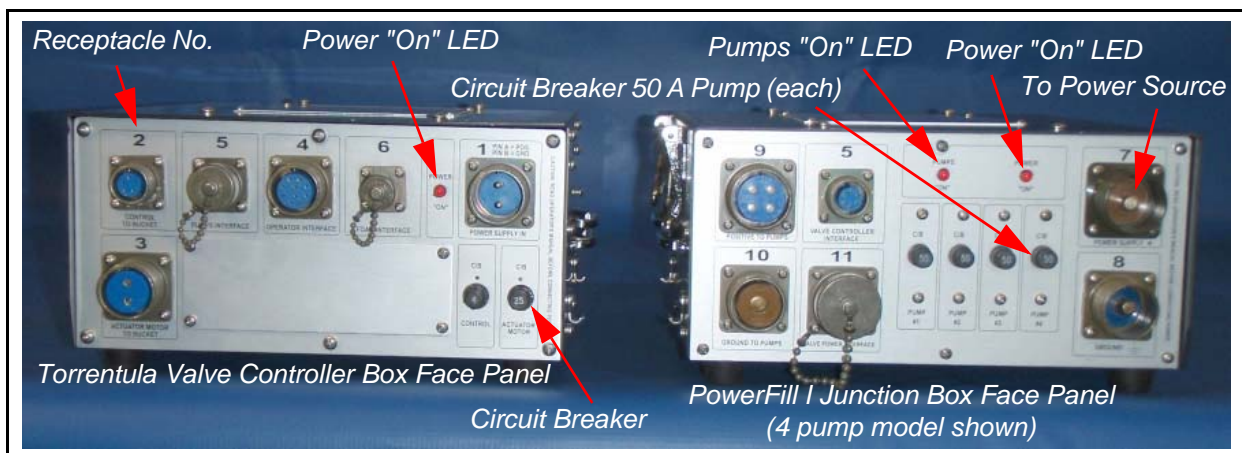
Power Input

The power input for operation of the PowerFill Torrentula pumps consists of receptacles R7 (+) and R8 (Gnd) on the face panel of the junction box. The power input for the operation of the Torrentula valve is receptacle R1 on the Torrentula controller box. The standard configuration for operation of both systems consists of two connections to the power supply. A single connection to the power supply can be accommodated with the installation of wire harness H11. H11 connects R1 to R11 and provides power to operate the valve through PowerFill junction box. See chart on page 13 and wiring diagrams in *Section 9*.

Mounting the Electrical Enclosures (Boxes)

The Torrentula valve junction box has latches for easy mounting with the PowerFill controller box in a “stacked” configuration. This allows the operator to tie down the systems as a single unit. Alternatively, the operator may wish to locate the two boxes separate from one another, depending on space constraints. Located on each side of the boxes is a tie-down eye strap for the attachment of restraining straps. By design, it is the intent that the electrical boxes and associated wire harnesses can be removed easily from the aircraft when the bucket system is not in use.

Pump Connections



Note: See receptacle number above each plug when using pin-out description on the next page.

Wire Harness Routing and Restraint

The supplied wire harnesses conduct current and electrical signals from the electrical boxes to the bucket systems via breakaway connectors. These connectors will separate cleanly and with minimal strain in the event of an emergency jettison. Where required, the wire harnesses are enclosed with an abrasion resistant covering that prevents damage to the cables during normal use and handling.

The wire harnesses should be routed neatly and in a manner that does not interfere with the operation of flight controls or the load release mechanism. See drawings in the aircraft installation section.

Breakaway Connectors

The breakaway connectors should be located adjacent to the load release hook and there should be some slack in the harnesses to allow for load swing in flight. The wire harnesses should be sufficiently restrained above the load hook to prevent strain on the electrical boxes in the event of a load jettison.

Tape all breakaway connections lightly with reinforced adhesive tape. This will prevent accidental disconnection in flight, while still allowing for positive emergency disconnection should it be required.

Pump Control Options

Control logic for operation of the pumps can be configured in several ways. The configuration chosen will depend on the operating parameters and operator preferences.

Default Configuration

As supplied with original equipment.

Best suited for operators who specify a dedicated crew member, other than a pilot, for operation of the bucket systems. This configuration would include the use of the operator's control grip supplied with the Torrentula valve system.

The pump and valve controls have an interlock feature that prevents simultaneous operation of the pumps and dump valve. The intent of the interlock is to limit the maximum power supply output required to run the pumps. In normal operations, there is no need to have simultaneous control of the pumps and dump valve.

This method of operating the pumps is a push button switch on the control grip (trigger). The button must be depressed for the duration of the fill.

Interlock Disable

Requires installation of interlock disable options plug on Torrentula controller printed circuit card.

Best suited for operators who specify a dedicated crew member, other than a pilot, for operation of the buckets systems and/or where simultaneous operation of the dump valve and pumps is specified, provided the power supply is of sufficient capacity to support it.

Pumps Latch “On”

Requires installation of latch “on” options plug on Torrentula controller printed circuit card and the addition of a pumps “off” push button switch.

Best suited for operators who specify pilot control of the bucket systems.

The “latch on” feature runs the pumps with a single momentary “on” signal from a push button switch. The pumps are turned “off” with a momentary signal from a second switch. The intent of the latch is to reduce operator fatigue while the pumps are filling the bucket.

The latch “on” feature has an automatic timed shut-off in the event the pilot neglects to shut off the pumps after the fill is complete. The shut off can be set at either 60 seconds or 120 seconds, depending on which bucket model is in use. Specify the desired time delay when ordering the options plug.

Options Combinations

The interlock disable option can be combined with the pumps latch “on” option, as long as a single time delay is specified.

Caution

Do not install the latch “on” option where the operator’s control grip is used to operate the bucket systems. The control grip does not have a pumps “off” switch installed as a standard feature.

Section 10: Operations

Operating the PowerFill Torrentula System

Flying with the PowerFill Torrentula System

The addition of the PowerFill Torrentula system will not adversely affect the flight characteristics of the Bambi bucket. Please read the Bambi bucket operations manual for information on flying the Bambi bucket.

Filling the Bambi Bucket with PowerFill Torrentula

There are three different operation modes available with the PowerFill units.

1. Operation Mode: **No Timer**
 - Hold pumps "on" button until full.
 - Use hand control or stick control.

2. Operation Mode: **Timer**
 - Push pumps "on" button to start.
 - Pumps stop when time elapses.
 - Two time settings one minute or two minutes.
 - Use hand control or stick control.

3. Operation Mode: **Timer with override**
 - Push pumps "on" button to start.
 - Automatic stop at elapsed time or when override button is activated.

Once you have determined your operation mode, initiating a fill is simple and can be quickly mastered.

1. **No timer:** Operation of the pumps is accomplished by simply pressing the pumps “on” button for as long as it takes to fill the bucket, then release button.
2. **Timer:** In this mode, the timer must be set to either the one or two minute time setting. When the button is pressed the pumps start and run until the time has elapsed.
3. **Timer with override:** In this mode, the pumps operate in the same way as timer mode, except there is a button that allows you to stop the filling operation at any time.

In any of the three operation modes, there are a few key points to keep in mind:

- To initiate a fill, the pump impellers must be immersed in water that is no less than 18" (0.46m) deep. The fill will be initiated more quickly if the valve is open as the bucket is lowered into the water source. Close the valve when pumps are fully immersed.
- Once a fill has been started, the bucket will need to be supported by maintaining some tension on the suspension lines, particularly when the bucket is nearly full. If the bucket is not supported, the flexible nature of the bucket shell may allow it to collapse to one side as the water load increases.
- Once a fill has been started, the bucket can be raised or lowered relative to the water line without losing the prime, as long as the bottom seal of the dump valve is not lifted completely out of the water.
- The filter screens are designed to filter out objects large enough to damage the pump impellers and to prevent weeds and debris from clogging the pump intakes. If operating the pumps in extremely dirty or swampy water sources, more frequent inspections of the pump impellers and filter screens may be required to maintain optimal function.
- The pumps can be run “dry” without damage. However, maximum life can be obtained from the pump motors if the run time is limited only to filling the bucket. Excessive run time will require more frequent lubrication of the pump output shaft. See *Maintenance and Troubleshooting* for the shaft seal lubrication procedure.

Fill Time Chart

Model	Optimal Fill Time (secs)
4453	40
5566	50
6578	59
7590	68
HL4000	41
HL5000	49
HL7600	75
HL9800	98

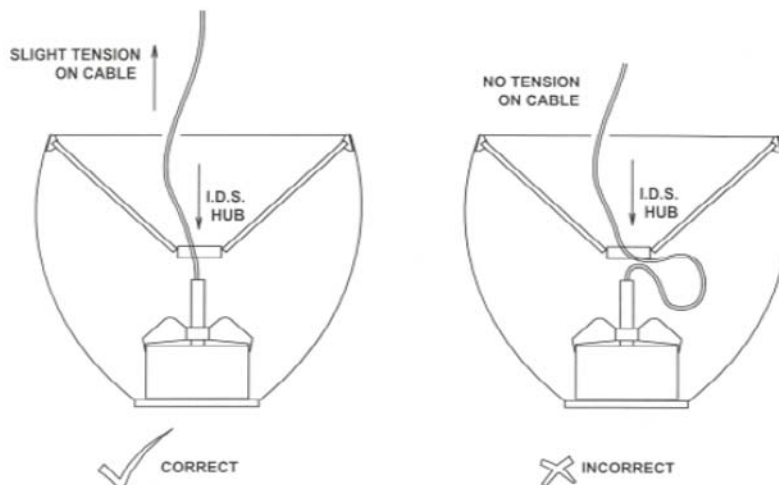
Section 11: Packing and Storage

Packing and Storing the Bucket

Packing the Bucket

Caution

When packing a Torrentula bucket, always prevent the valve control cable from experiencing any sharp bends or kinks. If sharp bends occur during storage, the cable can malfunction and require replacement.



1. Collapse the IDS by pushing the hub into the bucket. For large buckets, please see pages 32-34.



2. Grab the control head and pull the suspension lines taut. Tape the lines together in two bunches.



3. Gather the suspension lines into a coil and stow inside the bucket. Place the control head outside of the bucket to prevent the possibility of the lines tangling.



4. Put head into head bag and insert manual into bag pocket.



5. Place the head on top of the collapsed bucket.



6. Roll the bucket into a bundle and wrap with straps supplied.



7. Rotate shell until head is under the shell.

8. Take the carrying bag and drape it over the bucket.



9. Roll the bucket over.

10. Close with zipper and store with label showing.



The Bambi Bucket carrying bag 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 for rapid deployment when required.

Collapsing the IDS on Larger Buckets

1. Lay the bucket on its side with the ballast on the bottom.



2. Place a 4" x 4" block, centered on the IDS hub, estimating the distance from the shell.



3. Go to the bottom of the bucket and lift. If the bucket is a Torrentula or Torrentula Powerfill, two people may be required to lift the bucket.



4. Check to make sure the block is in the correct position.



5. The bucket should now be in the position shown in the photo.



6. Pull on the sides of the bucket.



7. The IDS is now collapsed. Place the bucket back on its side.



Storing the Bucket

The following guidelines will help to ensure the longevity of your Bambi Bucket:

1. Do not pile heavy objects on the bucket in storage. This may result in creases in the neoprene seal in the dump valve, which may cause leakage.
2. Wash the bucket and allow it to dry prior to storing it.
3. Do not store a wet bucket. This will result in the growth of mildew and the corrosion of aluminium and steel parts.
4. Store the bucket indoors 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 our recommended seasonal maintenance procedures.

Section 12: Maintenance and Repairs

Component Descriptions

Description of the Torrentula Valve and Actuating Mechanism

The maintenance and repair of the Torrentula valve and PowerFill 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. Included in this manual is 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.

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 into several full open drops. If desired, the operator may also extend the length of a water drop by opening the valve partially.

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 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 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 actuator cables pass into the control head via water-tight strain fittings.

Description of Torrentula Valve Electrical System

The Torrentula electrical system is designed to run on 28 volt DC electrical power supplied by the helicopter, requiring a 30 amp circuit. The system consists of: operator's controls, printed circuit card with controller logic, two power relays, three position sensing limit switches, 28 volt DC actuator motor and an operator's control grip that also houses the indicator lights for valve full open and valve full closed positions.

The motor and two 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. 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.

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 50 hours or 7 days of continuous 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.
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 six months)

1. Remove any surface corrosion from aluminium parts with Scotchbrite or similar abrasive pad.
2. Thoroughly clean and 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.

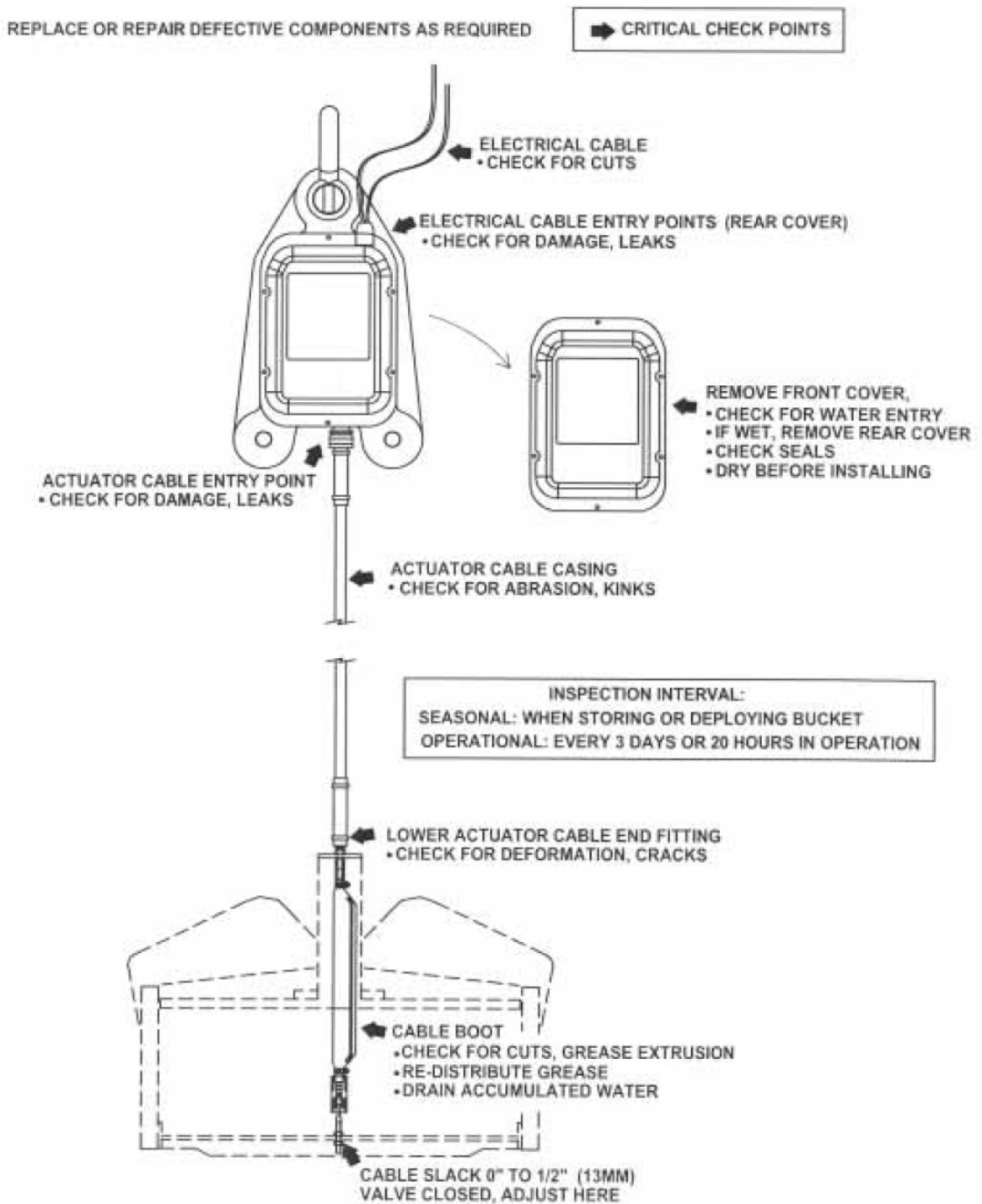
Preparation for Storage (in addition to seasonal maintenance)

Perform all major repairs to the bucket and Torrentula valve system before storage. This will ensure operational readiness when the bucket is needed next.

1. If the bucket is to be stored in a high-humidity environment, all aluminium and steel parts should be given a light coat of corrosion preventative compound such as ACF-50 or WD-40.
2. 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. 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, with the valve open 1-2", away from direct sunlight. This will ensure the bucket components remain dry for the duration of storage.

Prevention of Moisture Accumulation in the Control Head



Unscheduled Valve Maintenance Procedures

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.

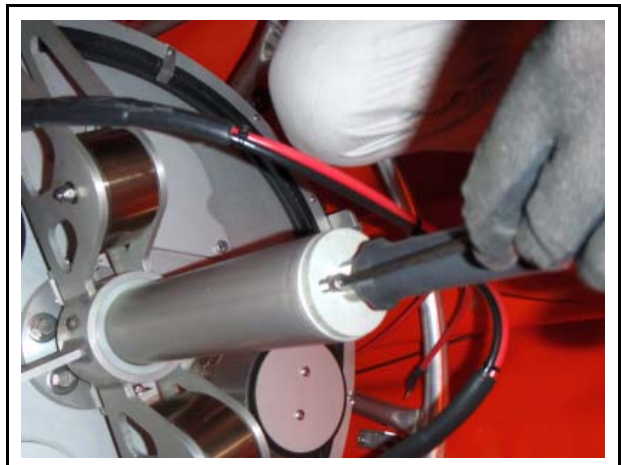
Actuator Cable Replacement

Removal:

1. Loosen and remove the bottom nut securing the bottom cable fitting to the valve lift bar at the base of the valve.



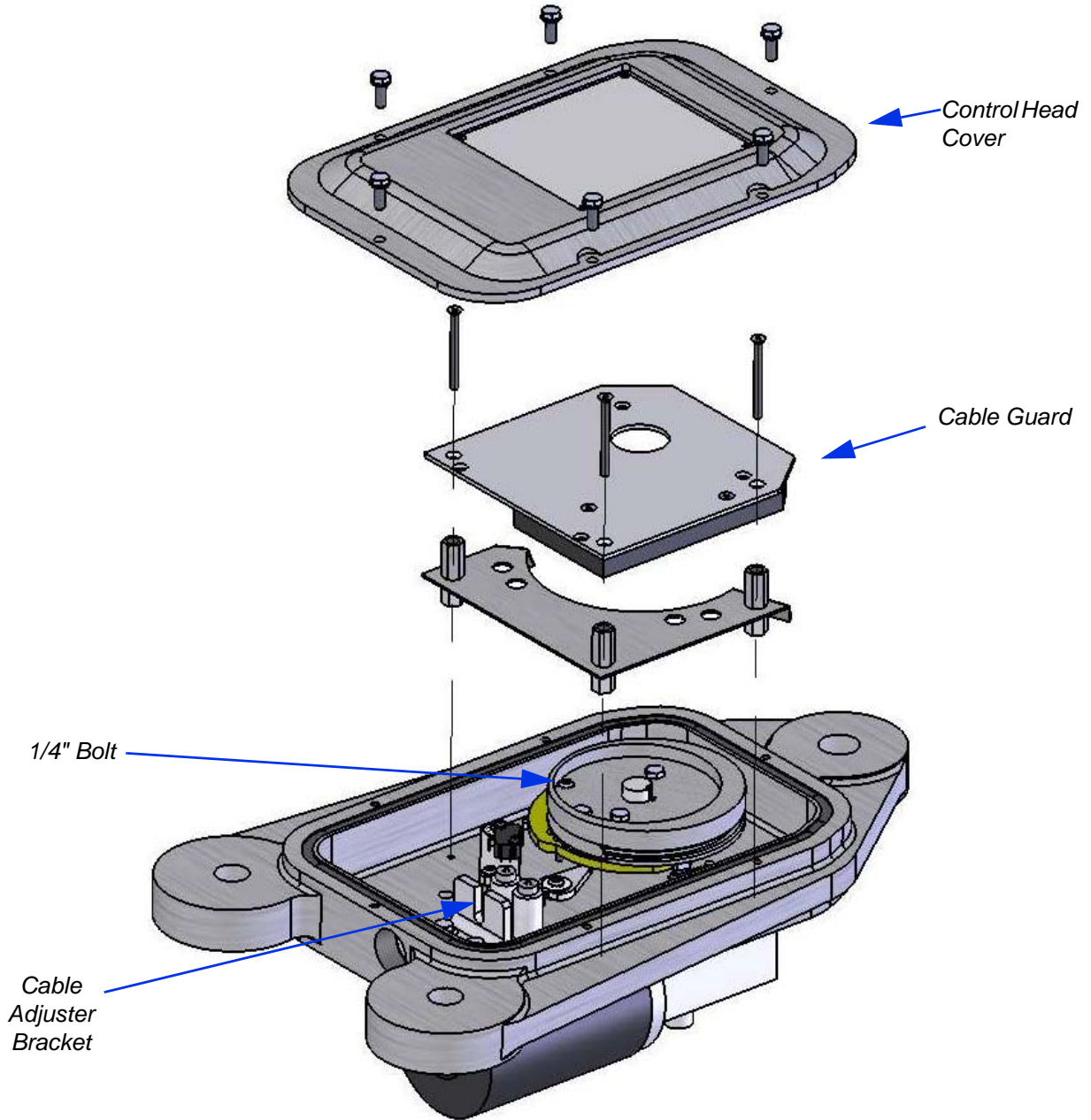
2. Remove the two socket head Allen screws securing the cable plate to the top slider tube.



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, on the actuator cable, at the top cable adjuster bracket.
7. Using water pump pliers, loosen the watertight strain relief at the bottom of the control head housing.
8. Using a 12” crescent wrench, remove the watertight fitting housing from the control head and pull the cable assembly free.



Actuator Cable Drawing



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**Caution**

Always keep the actuator cable from experiencing any sharp bends or kinks. If sharp bends occur, the cable can malfunction and require replacement.

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 in 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.

Warning

Refer to page 2 of this manual for correct closing sequence.

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.

Seal Repair and Replacement

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 cyanoacrylate adhesive (SEI Industries will supply Lock-tite 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.
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.
5. Seal replacement is recommended if repairs fail to restore full seal function.



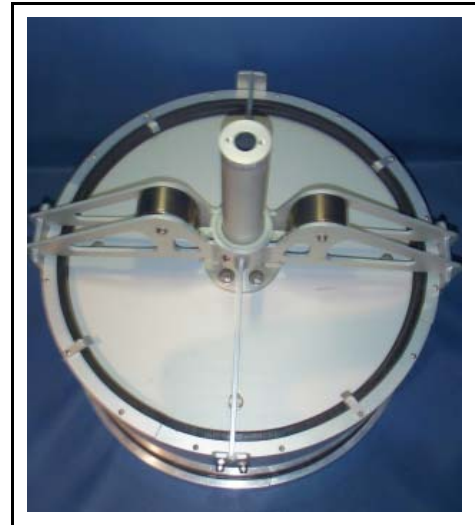
Top Seal Replacement

Important Note

The top seal will come unjoined to allow you to replace it without removing the top spider assembly and spring brackets. Follow steps 1 through 9 below to replace the seal.

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 Loctite 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.



Bottom Seal Replacement

The bottom seal is held in place on the valve sleeve by a 1/2" (13mm) square aluminium 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.

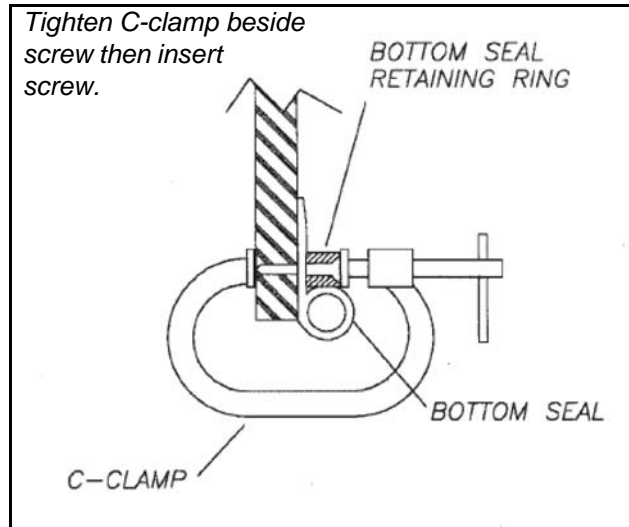
The new valve seal comes pre-joined, the four support pillar retaining bolts must be removed to facilitate installation of the seal. If desired, the valve can be easily removed from the bucket shell by removing two IDS spokes and lifting the top portion of the valve out of the bucket.



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. Remove the old seal.
4. Trial fit the new valve seal to the valve tube. 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. Orientate the retaining ring onto the tube in its correct position. Place the seal on the valve tube, lifting the retaining ring as the seal is moved into its final position.
6. Open the retaining ring and place it around the hard part of the seal so that the bottom surface of the ring is 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. 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. 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.



For the 27" aluminium valve body, all procedures are the same as above except 10-24 bolts and nuts are used with the bolt being inserted from inside the tube and the nut on the outside of the retaining ring.

Adjustment of Limit Switches in the Control Head

Caution

Do not remove the limit switch mounting plate unless absolutely necessary as the exact location of the plate is key to determining the opening/closing of the valve.

Important Note

For Model A valves, please check the SEI website for the appropriate manual.

The limit switch clearance will need adjusting only if the following parts are removed or replaced:

- cable crank
- limit switch cam
- gear reducer unit

Important 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 a cam mounted on it 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. 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.

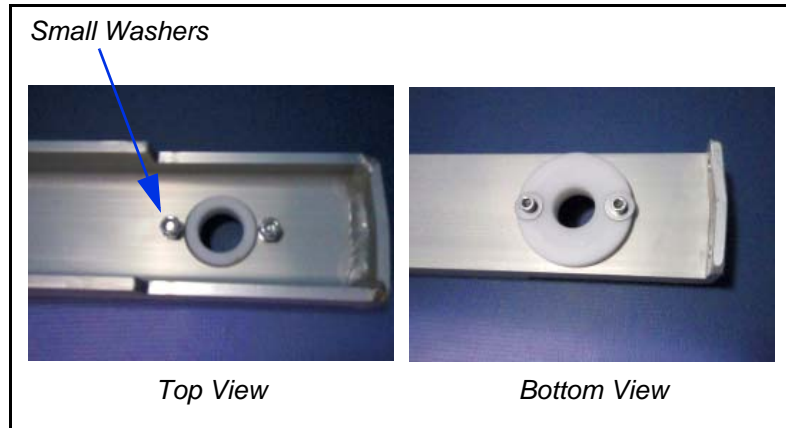
Caution

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.

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.



PowerFill Maintenance

Routine Maintenance Procedures

In addition to the daily pre-flight inspections as outlined in *Section 2: Pre-Flight Safety Check*, follow the weekly inspection procedure in periods when the bucket is in continuous use.

Caution

Lubrication of the pump output shaft seals is critical to the longevity and performance of the pumps. Failure to follow the recommended lubrication intervals may result in premature pump failure.

Weekly inspection

1. Check all parts of the system for visible damage or defects.
2. Clean all debris from the pump motor impellers and debris screen.
3. Inspect the entire length of all electrical cables and plugs for damage.
4. Assess the function of the pumps by running each one in turn. Isolate each pump by turning the other pump circuit breakers “off” during the test.

Warning

Disconnect power to the pump motors before performing visual inspections of the pump impellers.

5. Inspect each pump impeller for signs of damage, particularly on the leading (lower) edge of the impeller blades.
6. Inspect the one-way “flapper” valves on the pump exit ducts (inside the bucket) for cuts or tears.
7. Inspect the motor conductors for cuts or signs of chafing or wear. Immediately repair any damage to conductor cable insulation.
8. Ensure each cable connector is securely attached to its cable and free from cracks or damage.

Pump Output Shaft Lubrication

The pump output shaft must be lubricated periodically to preserve the life of the seals. Good seal condition will prolong the life of the pump motors by preventing moisture and other contaminants from entering the case. Lubrication will require a hand pump grease gun with a 12" (30 cm) flexible extension and standard hydraulic coupler.

Grease Selection

Any multi-purpose wheel bearing grease that has good-to-excellent water-resistant properties is suitable. The following is a list of suitable lubricants from several manufacturers:

- AEROSHELL 5
- BP Energrease LC-2
- Castrol Multi-purpose Wheel Bearing Grease
- Chevron Black Pearl Grease EP
- Exxon Multipurpose Grease EP 2
- Quaker State Multi-purpose Grease & WB #2
- Mobil Mobilgrease XHP 222
- Pennzoil #302 Multi-purpose grease
- Shell Darina XL series

Grease Procedure Intervals

Models 4453, 5566, 5870, 6578, 7590: **Every 400 fill cycles**

Models HL4000, HL5000, HL7600, HL9800: **Every 250 fill cycles**

Important Note

Regular dip fills do not count as fill cycles if the pumps are not operated.

1. Gently apply one or two pumps of grease to the grease nipple extension for each pump motor shaft (just enough to purge grease through the seal). Do not over grease. Excessive grease and or grease pressure may force grease into the motor case.
2. Check for and remove any dirt or gravel accumulation near the pump intake. Clean, if required. Avoid applying high-pressure water spray in the seal area.

**Yearly Maintenance and Preparation for Long Term Storage**

1. Clean and dry the bucket and all components.
2. Perform a functional check of the PowerFill Torrentula System.
3. Perform any necessary repairs to ensure optimal function of the bucket.
4. Lubricate the pump output shaft seals.

Unscheduled PowerFill Maintenance Procedures

When performing repairs or replacements of the PowerFill Torrentula pump components, it is recommended that the Torrentula valve assembly is removed from the Bambi bucket shell. This simple procedure will allow much easier access to the pump components. It is recommended that you use a hoist capable of lifting up to 150 lb., when lifting or lowering the valve and pump assembly.

Removal and Disassembly of the PowerFill Torrentula Pump Units

1. Disconnect the motor power cable from the valve actuator cable and the control head and ground cable from terminal near valve.
2. Remove the debris filter screen.
3. Remove the exit duct/flapper valve assembly from the pump impeller housing.
4. Remove the two 5/16"-18 UNC nuts that secure the motor adapter to the top plate.
5. Gently pull the motor assembly downwards approximately 2" (50mm), tilt the assembly toward the center of the hole and pull the motor/adapter assembly away from the top plate. Coil the conductor cable neatly for easier handling. See this manual for valve installation instructions on how to hook up and protect wires.

Caution

Do not lift the pump assembly by the conductor cables.

6. The impeller housing is a slight press fit into the adapter. Use a large screwdriver to apply a gentle upward prying force between the impeller housing and the adapter to free the impeller housing from the assembly.
7. Place a wooden or plastic block between the impeller and motor adapter and undo the 1/4"-28 UNF bolt that secures the impeller to the motor output shaft.
8. Remove the impeller from the motor output shaft. If the impeller does not come free with gentle upwards prying, use a small 3-Jaw puller, setting the claws between each impeller blade, with the center screw pressing on the (loosened) output shaft bolt.
9. Undo the two 5/16"-18UNC nuts that secure the motor adapter to the motor.
10. Slide the adapter up off the motor shaft and turn the adapter 180 degrees to expose the seal cup.
11. Slide the seal cup off the motor output shaft. Take care not to damage the seal lip.

Important Note

This is the extent of disassembly recommended. Do not attempt to perform maintenance on the conductor wire leads attached to the motor or to disassemble the motor case, without specific instruction from SEI Industries.

Inspection and Replacement of Pump Motors

The pump motors are sealed units and cannot be repaired in the field. Any repairs to the motors must be carried out under supervision of SEI Industries. Inspections of the pump motors are limited to an external assessment of the pump condition and a check for water entry into the motor case.

External Assessment

Check for dents, cracks, punctures or missing coating on the motor case and components. Turn the motor shaft slowly to see if it is bent or turns roughly. Some light resistance to turning is normal, however, rough or intermittent resistance indicates internal damage.

***Motor Shaft Inspection***

Thoroughly inspect the pump motor shaft for nicks or scoring, particularly at the seal line. Address any minor imperfections with a fine emery cloth, 600 grit or finer, being careful to work perpendicular to (around) the shaft.

Check for Water Entry

Check the condition of the grease inside the seal cup. Some discoloration of the grease is normal but obvious trapped water is of concern. If the seal mounted in the seal cup is damaged, water may have entered the seal cup.

If water entry into the motor is suspected, remove one case bolt from the bottom of the motor (the rubberized coating will have to be scraped out of the recess to insert the socket). Turn the motor upright and check for signs of water. Also, inspect the bolt shaft for excessive corrosion.

If the water has been in the motor for only a short period, the interior of the motor may be dried using forced, low-pressure, warm air (not hot) from a heat gun, applied for at least eight hours. When reinstalling the case bolt, be sure to install a new seal washer under the head.

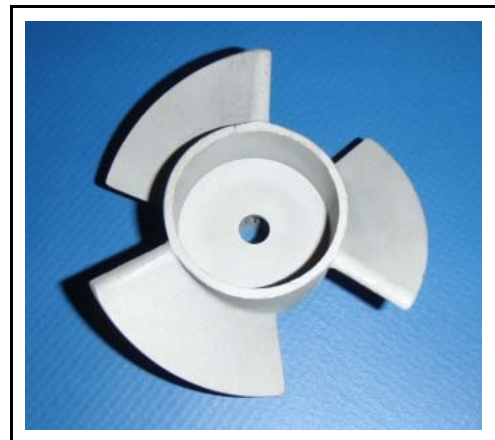
The cause of the water entry must also be rectified before the motor is returned to service. If water is allowed to stay in the motor for too long, there will be permanent damage to the motor shaft bearings and motor replacement or rebuild will be necessary.

Inspection and Replacement of Pump Impellers

The pump impellers rotate at high speeds and are dynamically balanced during manufacture. If, during repairs, too much material is removed from the blades, the impeller may become unbalanced and may cause premature failure of the pump. Minor repairs to the impeller blades are intended to restore lost efficiency, and should not be done if the efficiency of the pumps has not been diminished. Lost efficiency is indicated if fill times are longer, or if current draw is higher than normal.

Inspection of Pump Impellers

Visually inspect the pump impellers, paying particular attention to the leading edge of the blades. The pumps will be more efficient if the leading edge of the blades is relatively sharp, so check for dents and nicks caused by foreign objects.



Repairs to Pump Impellers

- Nicks smaller than 1/32" (0.8mm) across can be filed smooth with a small round file, taking care not to remove more material than is necessary.
- Dents up to 3/16" (4.8mm) can be gently flattened with a small ball peen hammer prior to some minor dressing.
- Larger deformities than those covered above must be assessed individually to see if blade distortion has occurred. Deformities that cannot be straightened and dressed out, without affecting balance, indicate the need for impeller replacement.
- Impellers that show signs of general wear and tear from a long service life should be replaced when efficiency is noticeably diminished.

Re-Installing the Impellers

1. Check if motor shaft has been cleaned up.
2. Apply grease or anti-seize compound to the splines and bolt hole threads. Reinstall the shim washers using the same number that were found upon disassembly.
3. Torque the retaining bolt to 5 ft-lb. (7 Nm).

Replacement of Secondary Motor Shaft Seal

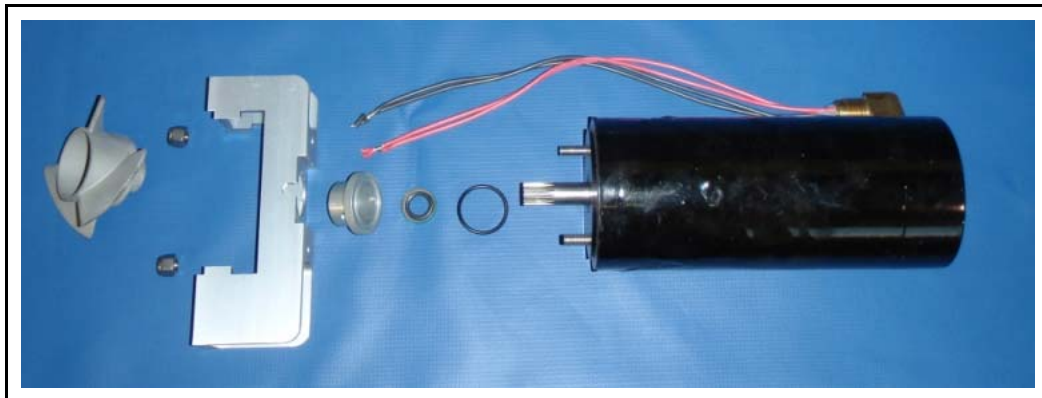
The secondary motor shaft seal is located inside the seal cup that resides at the base of the motor output shaft. The secondary seal serves to provide a grease cavity above the primary shaft seal. The grease lubricates the seals and provides a long service life for the motor.



If disassembly of the pump progresses to the point that the seal cup is removed, it is recommended that the secondary seal and base o-ring be replaced. New seals and o-rings are available from SEI Industries.

Seal Replacement

1. Use a small wrench to remove the grease fitting from the seal cup. The grease line adapter will rotate as the nipple is turned. Do not disconnect the grease line adapter.
2. Tap the old seal out with a pin punch, from the top side. Take care not to damage the seal cup bore or O-ring groove. The seal itself can be discarded.
3. Clean the bore in the seal cup with cleaning solvent.
4. Press in the new seal using a tool socket or spacer of approx. 0.94" to 0.97" (24 to 25 mm) diameter, with a wall thickness of at least 0.20" (5 mm), ensuring that the open side of the seal faces outward from the cup cavity. If available, use a large bench vise and press the seal in slowly. It is critical that the seal body does not become distorted as it is pressed in. Once installed, inspect the lip of the seal from the top side, checking for distortion relative to the seal cup. Any visible misalignment is cause for rejection and a new seal must be installed.
5. Apply Loctite 545 or other waterproof sealant the threads of the grease fitting and reinstall.
6. Fill the cavity of the seal cup with appropriate grease, install a new o-ring in the cup and place the assembly back on the motor output shaft.
7. After final assembly, gently purge the seal cup again with fresh grease before returning the pumps to service.



Inspection and Replacement of One-Way Flapper Valves

The exit duct valves are simple neoprene rubber flappers that seal the opening of the exit ducts under the pressure of water in the bucket.

Inspection of Valves

Check the flapper material for tears, cuts or cracks. Inspect the narrow top edge of the exit duct for dents that may allow water to pass through.

Replacement of Valves

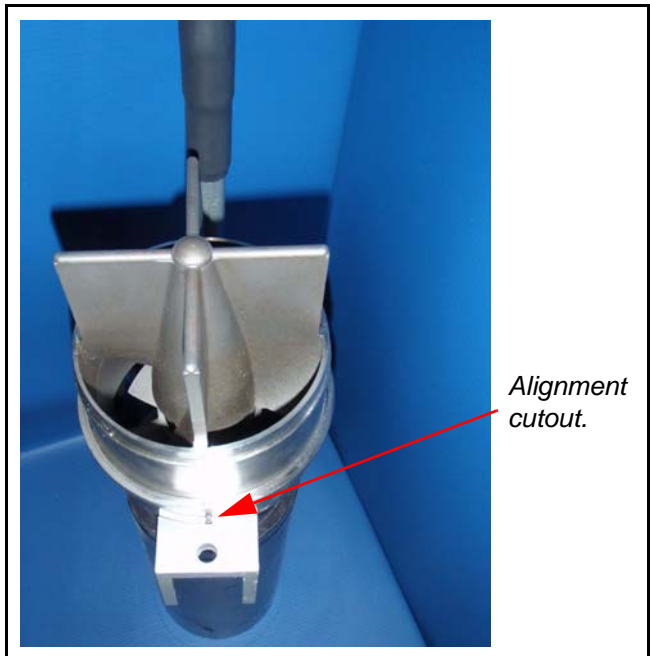
To replace the flapper, simply remove the old flapper from the bracket and install the new one, taking care not to over tighten the screws. Ensure the flapper is centered on the exit duct after pulling it open and releasing it a few times. If the flapper needs re-aligning, loosen the screws and re-position it, until good alignment is achieved.



Reassembly of Pumps

Assembly is the reverse of disassembly.

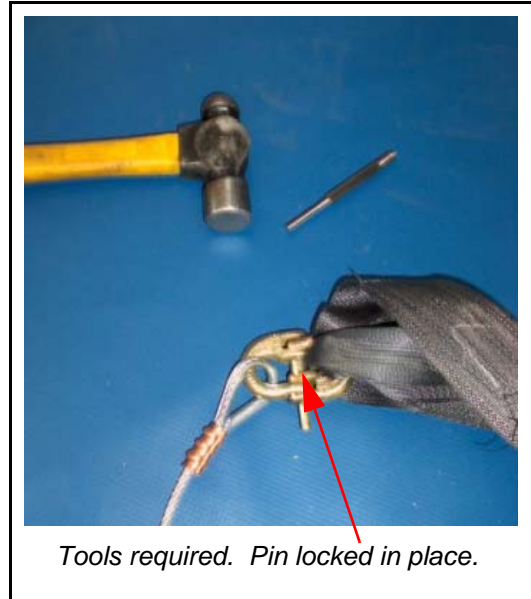
1. The impeller housing has two alignment cut-outs: one to align the housing with a pin on the motor adapter and the other to align with a fastener on the exit duct.
2. Inspect the adapter gasket for damage. The gasket may be re-used if it is intact. If replacement is required, cut the replacement gasket on one side of the largest hole, place it over the electrical conduit, and join the ends of the cut with a drop of Loctite 495 or other cyanoacrylate adhesive.
3. When assembly is complete, cycle the valve up and down to check for interference with the pump components.



Bambi Shell and Lines Maintenance

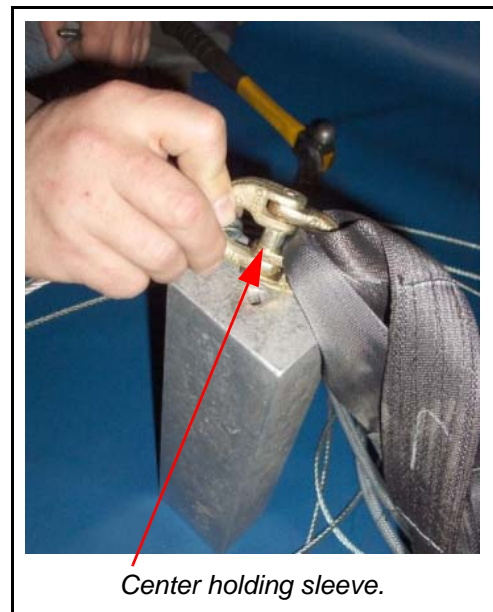
Suspension Line Replacement

A suspension line should be replaced whenever it displays noticeable kinking or fraying. Factory replacement lines come pre-swaged with connection links to make replacing quick and easy.

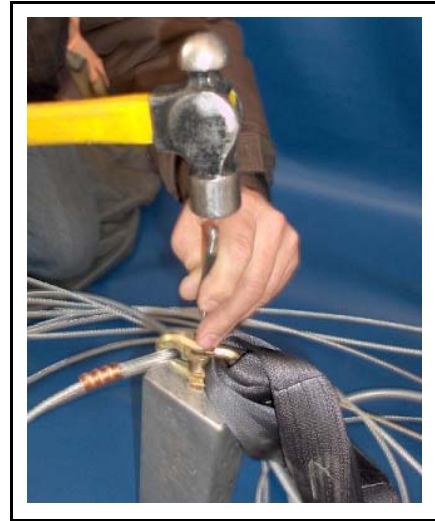


To remove the connecting link (connecting the suspension line to the M-strap) follow the procedures outlined below.

1. Locate a metal bar with a 5/16" hole (or drill a 5/16" hole into any metal bar). If you are unable to locate a metal bar, a wooden block will work, however, make sure to drill the hole into the end grain.



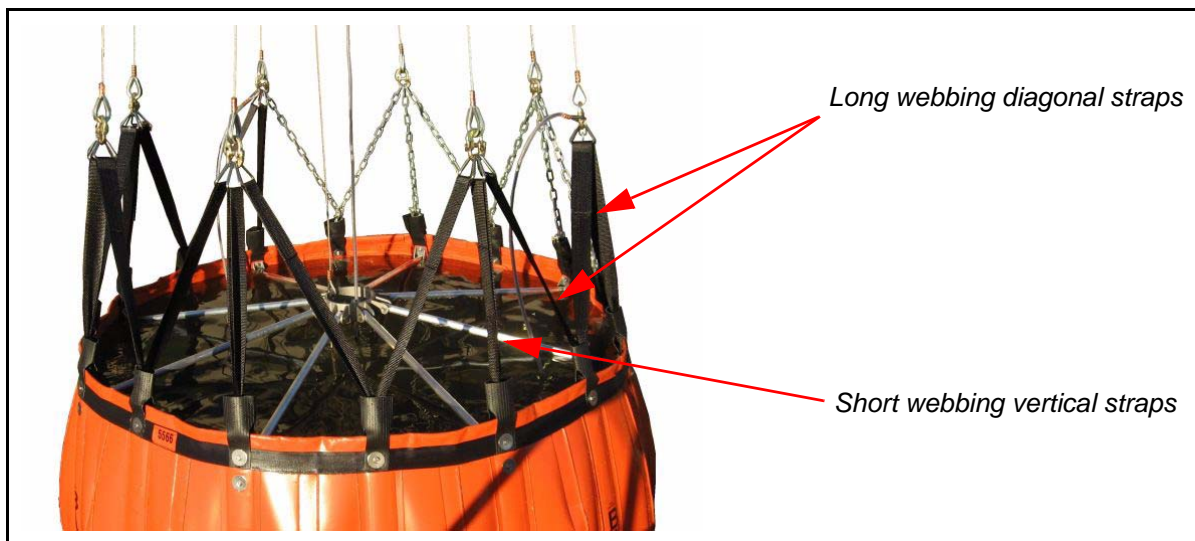
2. Place the connecting link with the pin located over the hole and using a 3/16" punch, drive pin through the center holding sleeve.
3. After the pin is free, remove the old suspension line. Place the new line in the connecting link by inserting the pin into one side of the connecting link. Using a hammer, drive the pin in until it is flush with both sides of the connecting link.



M-Strap Replacement

Replace M-straps if they become noticeably worn. M-straps may be repaired, if frayed, by melting the fray with a lighter to stop the fray from spreading. The length of the M-strap is critical to the proper functioning of the Bambi bucket and we recommend that you replace worn straps with factory-supplied equipment.

There are two types of straps; long webbing and short webbing. Long webbing are used for the diagonal straps while short webbing are used for the vertical straps.



When replacing straps, do one set at a time to avoid confusion. Cut off the old straps from the shackle and un-tie them from the top of the bucket shell. Attach replacement straps as per the originals.

Removing Old M-Straps

1. Using needle nose pliers, insert the tip under the top webbing layer.



2. Fully insert the pliers at the far left hand side of the top layer.



3. Holding the pliers tight, turn your hand clockwise. Repeat the operation until the knot is loose enough to remove the strap.



Installing New M-Straps (Short)

Once the old straps have been removed, the new strap installation can begin.

1. Rotate the strap until the joint is centered.



2. Pass the strap through the loop.



3. Twist the loop eye 180 degrees.



4. Rotate the eye to the opposite side.



5. Pull strap end through the eye.



6. Pull strap tight.



Installing New M-Straps (Long)

Once the old straps have been removed, the new strap installation can begin.

1. Locate the center of the strap.



2. Pass the strap through the loop.



3. Twist the loop eye 180 degrees.



4. Rotate the eye to the opposite side.



5. Pull strap end through the eye.



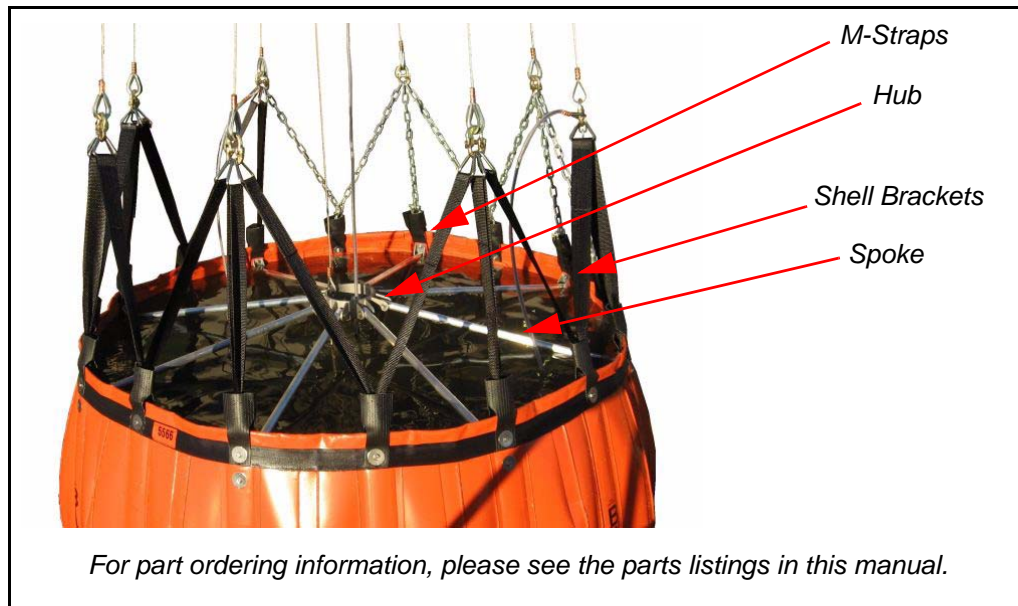
6. Pull the strap tight.



- 7. The M strap set should now look like this. The suspension line attaches to the top of each M-strap set.



IDS Hub/Spokes Replacement



The IDS can be purchased either as a complete kit or as individual pieces, as required. Follow the procedure below 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 control line from the valve since the control line passes through the hub.
2. For re-assembly, first install the new shell brackets. This can be accomplished by installing the bolts through the bucket shell, fitting the fabric wear strips onto the bolts and, then, fitting the brackets to the bolts. Install and tighten the Nylock nuts.
3. With the ballast oriented at the 6 o'clock position, rotate the IDS assembly so that the deployment cable faces upward and it's at the 3 o'clock position.
4. Attach the two spokes at either side of the 12 o'clock position using the stainless steel clevis pins. Complete by fitting the fender washer and cotter pin. Working around the bucket perimeter, attach the rest of the spokes.
5. 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.
6. Remember to re-attach the tripline to the dump valve, passing the line through the hub. Also, attach the IDS deployment cable to the control head small adjustment chain.
7. Attach the two restrainer cables to brackets. One is found below the ballast and the other is directly opposite (6 o'clock position). No wear strips are required for the restrainer cable brackets.

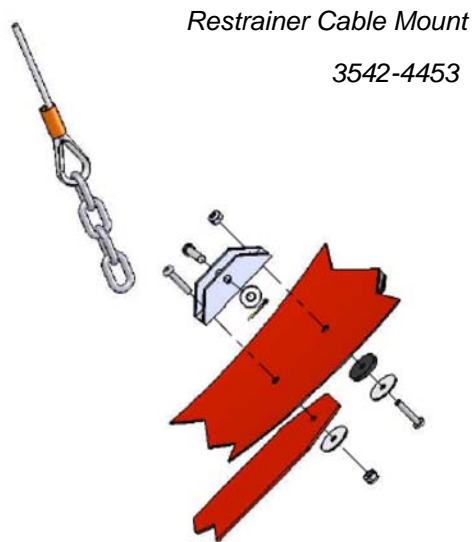
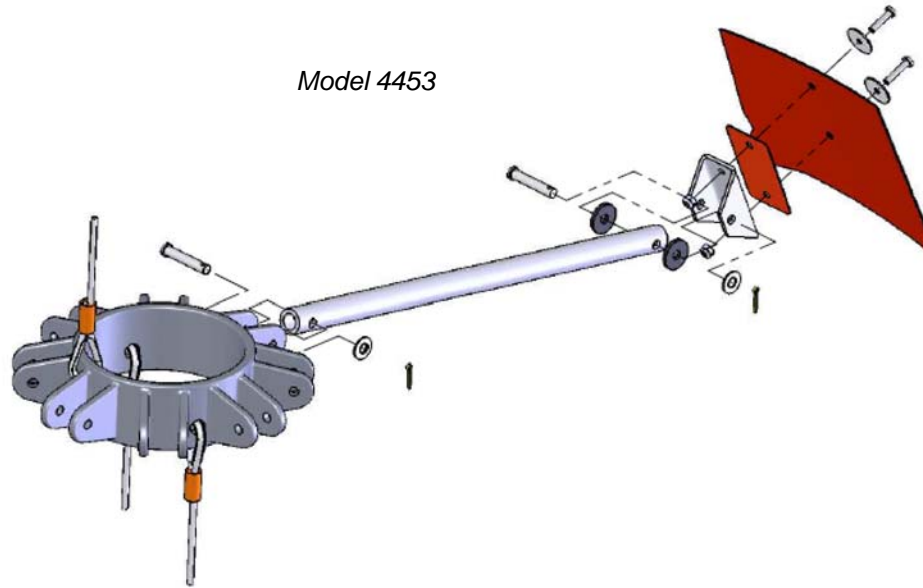
If the IDS is too tight, adjust two of the spokes as follows:

1. Cut off the spoke just above the existing hole on one end only. Then, redrill a new hole centred the same distance from the new end of the spoke as the other spokes. This will likely produce a good fit.
2. If the IDS is still too tight remove another spoke, on the opposite side, and repeat the above steps.
3. These two spokes are across from each other. **Note:** Newer bucket spoke bolt holes are in the same location.

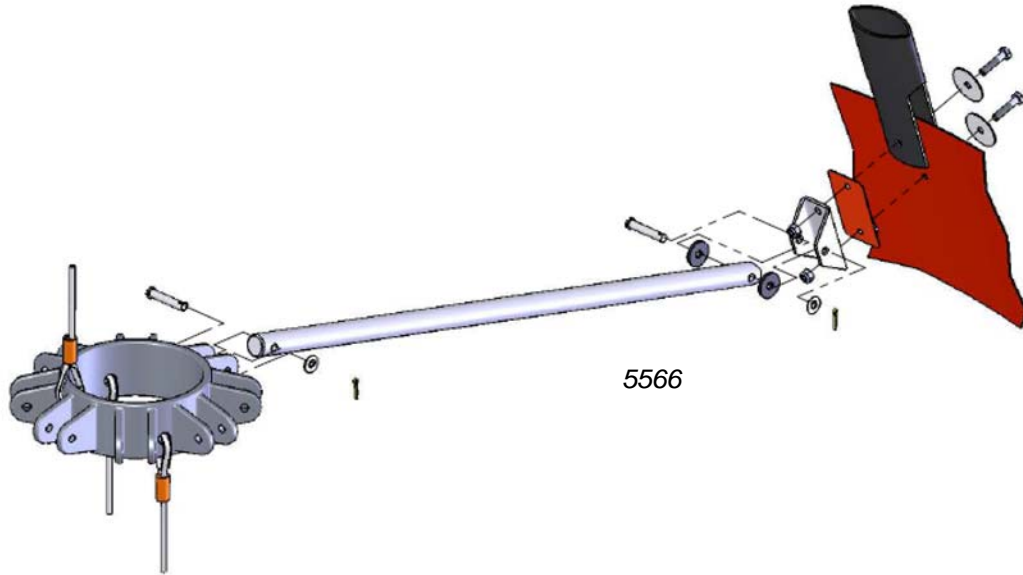
Load Test on the Hook

Deployment cable adjustment can only be properly assessed on the hook of the helicopter or otherwise suspended with a full load of water. For this test, with retrofits, the deployment cable is attached to the middle link of the adjustment chain. Check tension in the deployment cable. Under full load, the deployment cable should feel relaxed but not slack. The hub should be free to move up or down about 1/2" (13 mm).

IDS 4453, Detailed Drawing

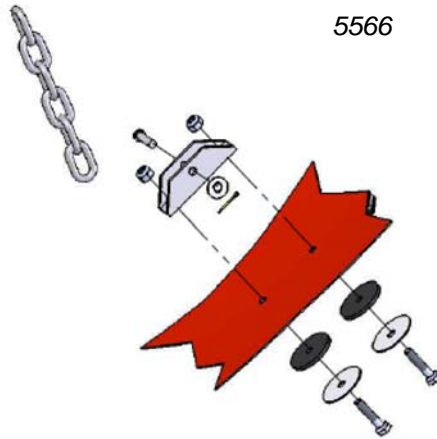


IDS 5566, Detailed Drawing

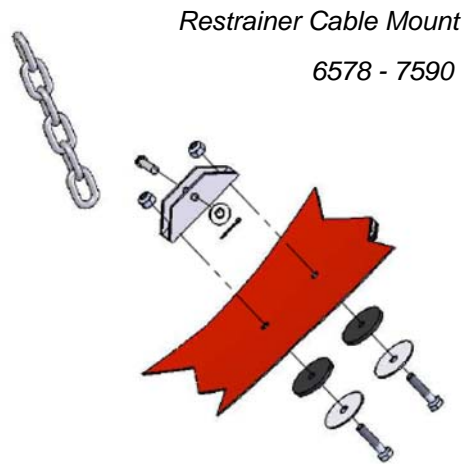
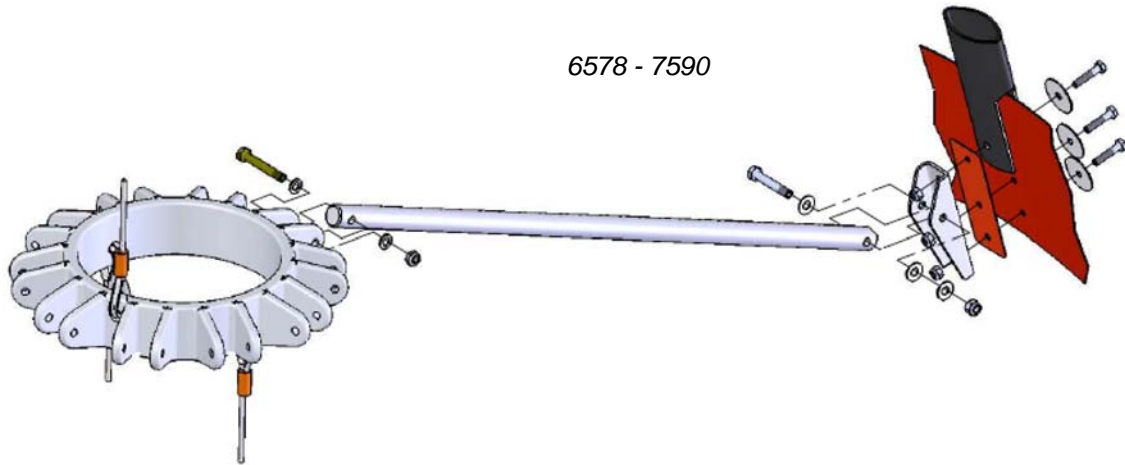


Restrainer Cable Mount

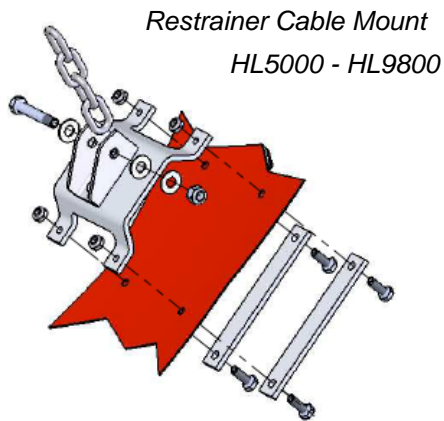
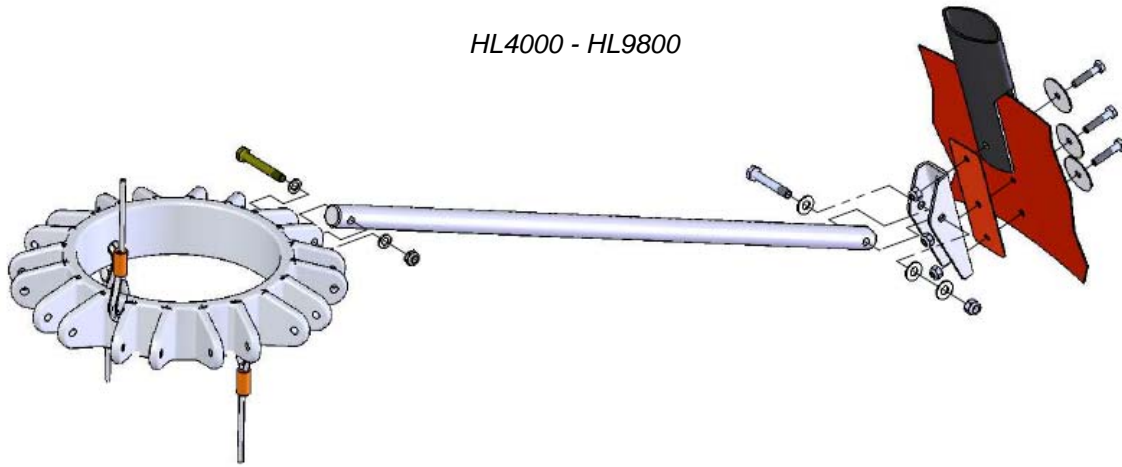
5566



IDS 6578-7590, Detailed Drawing



IDS HL4000 - HL9800, Detailed Drawing



Shell Repairs

Please read these instructions carefully and follow them exactly to obtain a good repair. Failure to follow these instructions or poor repair workmanship can lead to failed repairs and/or more damage to the bucket.

Before commencing repairs using glue, the weather should be warm (above 60 deg. F or 15 deg. C) and dry.

Important Note

Try a test repair before attempting to repair the bucket. This will verify your technique without risking damage to the bucket. It is much harder to fix a repair once a failed attempt has been made as the hardened glue is difficult to remove.

Repair Failures

Repairs will likely fail if:

- The area to be repaired is not perfectly clean and scrubbed to a matte finish before applying the patch.
- Repairs are attempted during wet or cold weather.
- The glue and patch are not properly placed, creating air bubbles between the glue and the patch.
- The patch is not weighed down for 24 hours.
- The bucket is used before the glue has set.

Important Note

Dura-Seal glue has been designed specifically for the SEI family of fabrics. The shelf life of this adhesive is about one year. Fresh adhesive can be obtained directly from SEI Industries Ltd.

Repairing in High Humidity

In conditions of high humidity, a proper technique is essential for securing the bond strength desired. The presence of surface moisture can destroy the effectiveness of the cemented bond.

The evaporation of solvent from the adhesive may reduce surface temperature below the dew point resulting in condensation of water vapour on the surface of the adhesive. This is often visible as fogging or a milky white appearance on the surface.

The use of a solvent to clean the surface prior to cementing can also reduce temperatures below the dew point.

To overcome the high humidity problem, raise the temperature of the patch area. This can be accomplished with a warm air fan.

Warning

- Glue vapours are highly explosive! Explosive vapours may occur causing fire and/or injury. Keep away from all sparks, flame, lighters or cigarettes.
- Solvent and glue are both extremely hazardous. Use solvent and glue under well ventilated conditions only.
- Use an approved respirator mask to avoid breathing fumes.
- When using a warm air fan, either use one which is rated EXPLOSION PROOF or make sure that there is a steady flow of air past the work area to remove fumes as they are generated.

Making Temporary Repairs with Sealing Clamps

Repair clamps are used for an immediate repair to prevent the loss of liquid through large rips or holes. For example, if a vehicle accidentally backed into a bucket and caused a 3" (76 mm) long rip in the bucket, a repair clamp could be inserted to stop the loss of liquid. Repair clamps are only used for temporary repairs. The damage should be permanently repaired with a patch when the bucket can be set aside for 24 hours.

Important Note

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

1. Select the largest clamp that will just slip through the hole in the item. The size of cut or hole will determine the size of the sealing clamp to use.
 - For a cut or hole up to 2" (5 cm), use a 3" (7.6 cm) clamp (supplied).
 - For a cut or hole up to 4" (10 cm), use a 5" (12.7 cm) clamp (supplied).
 - For a cut or hole up to 6" (15 cm), use a 7.5" (19 cm) clamp (special order).

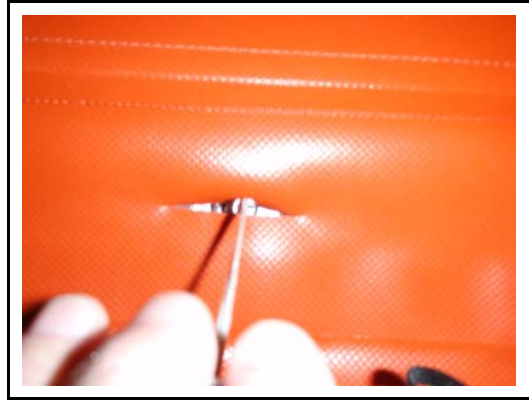
Caution

Use caution if deciding to enlarge the slit to insert a clamp. It is very easy to make the slit too large.

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



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.



Caution

Tightening the nut with tools may break the bolt away from the lower clamp. Overtightening can also deform the clamp and cause leaks.

Temporary Repairs Using Glue

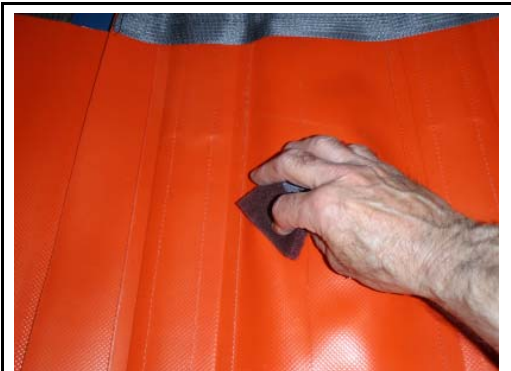
Important Note

Allow repair to harden for 24 hours at room temperature before using the item.

Applying the Glue

Small scrapes, damaged fabric coating or pinholes, which are not leaking, can be repaired with glue only. They do not require a patch. (A small scrape is defined as damage to the outer fabric coating only. A pinhole is defined as a small puncture that is not leaking.) However, damage to the base fabric must be repaired with a patch.

1. Fill the weight bag with water prior to beginning repairs.
2. Clean the area to be repaired with an abrasive pad dampened with solvent. Remove all traces of masking tape, if previously used. If possible, place a piece of masking tape on the back side of the item being repaired.
3. Paint the damaged area with glue. Use a thick coat of glue, overlapping the edges of the repair by 1" (25 mm). Be sure that the edges are well coated. A damaged coating should be given two coats of glue. Apply the second coat within four hours of the first coat.



Clean and apply masking tape on the backside of the tear.



Squeeze glue around the tear and spread with fingers.

Gluing with Patches

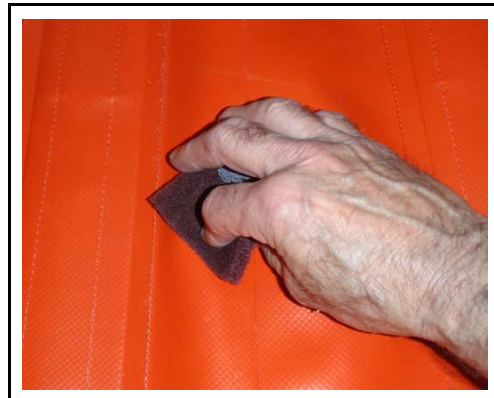
If there is dampness around the area to be patched, then dry the area with a hot air fan or heat gun. Any loose coating should be cut back with scissors.

1. Support the damaged area on a flat, solid platform. This platform should be strong enough to support the fabric (flat) and allow the patch to be rolled once it is in place.



The damaged area should be supported on a flat, solid platform.

2. Scrub the damaged area with an abrasive pad dampened with solvent (isopropyl rubbing alcohol is recommended). Scrub vigorously to remove the cured surface. The area should be clean and dry with a dull matte finish.



Caution

Solvent will damage the fabric if too much is used or if the fabric is left exposed to solvent residue.

3. Wipe with a rag, dampened with solvent, to remove any residue from cleaning. Check to see if the area is totally clean and all coated surfaces and edges are dull. If not, repeat the cleaning. This is critical for a good glue bond.

Cutting the Patch

1. Cut a patch. The patch should be at least 2" (50 mm) larger in every direction from the damaged area. A round patch is recommended but, if a rectangular patch covers the damage better, then round all corners. Clean the patch by scrubbing with a pad dampened with solvent. Rub vigorously to remove the gloss from the fabric. Clean **both sides of the patch**, as it is easy to get the patch turned over during installation. Another reason the patch should be cleaned on both sides is that it will be painted with glue, on the outside, later.



The color of patch will vary, depending on the product repair kit.

Applying the Patch

1. Apply the Dura-Seal glue to the patch and damaged area. Wait 30 minutes (at 75F or 22C) for some of the solvent to evaporate from the glue. The glue should become thicker but still be quite wet. If it has been allowed to dry too long, give both sides another thin coat. If the glue has dried too long, it will be difficult to avoid entrapping air bubbles in the bonded joint.
2. Place the patch and roll it down with the roller. Place the centre of the patch down first, then roll it out towards the edges with the roller. This expels trapped air. Once the patch is rolled down, do not let it lift up. This will prevent air from getting under the patch which causes a weak bond.



3. Weigh down the patch. Place a plastic cover sheet over the patch followed by a weight bag for 12 hours at room temperature. Remove the weight bag and leave to dry for 24 hours.

4. If the patch will be subjected to abrasion after 24 hours, paint over the patch with glue. Painting the patch also provides protection from ultra violet light and weather. Allow the bond to harden for 24 hours at room temperature before using the item.



Hot Air Gun Patching

On most items, hot air gun patching is the preferred method because it provides the most durable, permanent repair possible.

Tools and materials required:

- Patches
- One plastic hand-held roller
- One hot air gun, Steinel HL 1800 E or equivalent: 120 V-1500 W (800 to 1100 deg. F, 450 litres per min.)
- One wide surface nozzle
- Isopropyl alcohol
- Scissors

Warning

It is extremely dangerous to use a hot air gun in the presence of flammable fumes such as gasoline or paint thinner. There is a high risk of explosion and/or burns.

Warning

Injury, especially to hands and fingers, can occur when using a hot air gun. Most welding will occur at temperatures of 800-1000 degrees F. Wear gloves to protect skin from overheating, burning and blistering.

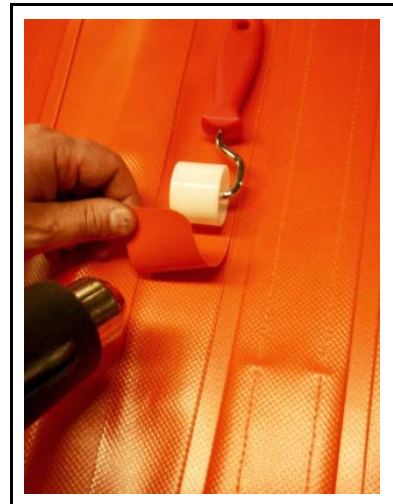
Hot Air Gun Procedure

1. In a well-ventilated location, clean the area to be repaired as well as one side of the patch with an abrasive pad. Wipe down the repair area and patch with isopropyl alcohol.
2. Mount a wide surface air nozzle on the hot air gun so as to direct the heat flow in a large pattern. Turn the power on, adjust the temperature in the low range first and let the hot air gun warm up. Increase the temperature as required during the operation. **DO NOT OVERHEAT OR BLACKEN THE FABRIC.**

**Caution**

Overheating can occur quickly and can damage the product. It's recommended that you test, using the supplied fabric samples, to determine the correct temperature to be used and the duration of heat to be applied.

3. Starting from the centre of the patch (held down by the roller), concentrate the heat flow equally to patch and fabric. Apply a light pressure with the roller when the fabric starts melting. This can be seen as small bubbles. **DO NOT OVERHEAT.**
4. Roll the patch down to fuse it to the fabric, moving roller and gun simultaneously. Repeat on the unfused portion of the patch. Let the repaired area cool down. Attempt to peel off at the edges with your fingers. If there is even a slight peel, repeat the operation locally. Otherwise, the repair is finished.



Repair Kits

Bambi Repair Kit 003613 (no glue)

Used for Bambi MAX's or other product lines where **no glue is required or allowed**.

Important Note

It is the responsibility of the dealer and end user to ensure that the importation of glue is allowed in the country of use.



Repair Kit Parts Table

PART NUMBER	DESCRIPTION	QTY.
02379	BOX, TOOL 16", PLS0.	1
003661	FABRIC REPAIR MANUAL	1
003608	BAG, WEIGHT	1
003064	PAD, ABRASIVE	2
003071	ROLLER, SEAM, 1 ¼	1
003074	SCISSORS	1
004502	CLAMP, REPAIR, SMALL, (2" HOLE)	1
004503	CLAMP, REPAIR, MEDIUM, (4" HOLE)	1
003856	PATCH, FABRIC, 32OZ. BAMBI	3

Optional Supplies

PART NUMBER	DESCRIPTION	QTY.
003090	ADHESIVE, DURA-SEAL ¾ OZ.	1
003091	ADHESIVE, DURA-SEAL 8 OZ.	1
004504	CLAMP, REPAIR, LARGE, (6" HOLE)	1

Section 13: Troubleshooting

Troubleshooting Procedures

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

Electrical Controls Troubleshooting**Important Note**

Refer to the wiring diagrams in *section 21* of this manual.

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:

- Electrical multi-meter for checking voltage, resistance and continuity.
- 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.



Torrentula Valve Electrical Component Function Checks

Circuit Breakers

Location: right hand side of controller 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 misadjustment.

Printed Circuit Card

Location: rear of enclosure.

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

PowerFill Only Electrical Component Function Checks

The function of the junction box components can be checked with a 5 amp power supply, as long as the motor conductor leads are disconnected.

It is possible to check the function of each motor separately by having only one circuit breaker “on” at one time, thereby requiring only a 10 amp power supply to do a full function check of the system, including the motors.

Pump Motors

Apply power to each motor in isolation. The motors should spin smoothly. Investigate any audible discrepancies between the motors. Correct polarity is indicated when the shaft turns counter-clockwise (CCW), looking down.

Torrentula Valve Only Electrical Component Function Checks***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 10-Unscheduled Maintenance, Adjustment of Limit Switches in Control Head*).

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.

PowerFill Troubleshooting Chart

Problem	Possible Cause	Check/Repair
Pump will not run when first connected.	<ol style="list-style-type: none"> 1. Incorrect connection to power supply. 2. Incompatible power supply. 3. Circuit breaker in OFF position. 	<ol style="list-style-type: none"> 1. Re-check connections, check control circuit fuse. 2. Compare power supply output with requirements. 3. Reset breaker to ON position.
Pump fails to operate or suddenly stops in use.	<ol style="list-style-type: none"> 1. Disconnected conductor cable. 2. Overload current on motor. 3. Debris jamming or clogging pump. 	<ol style="list-style-type: none"> 1. Check all cable connections. 2. Check motor. 3. Remove debris.
Average bucket fill times increase over time.	<ol style="list-style-type: none"> 1. Debris filter clogged. 2. Pump impeller worn or damaged. 3. Wear/damage to cable connections or cable. 	<ol style="list-style-type: none"> 1. Clean debris filter. 2. Assess pump function. 3. Inspect and repair/replace pump impeller. 4. Inspect, repair connectors, cable as required
Pump noisy in operation.	<ol style="list-style-type: none"> 1. Damaged pump assembly or impeller. 2. Debris in impeller housing. 	<ol style="list-style-type: none"> 1. Inspect and repair/replace pump components as required. 2. Remove debris.
Fill time longer than expected when used with longline.	<ol style="list-style-type: none"> 1. Excessive voltage drop in longline cables. 	<ol style="list-style-type: none"> 1. Measure cable resistance; compare cable sizes with recommended size in manual.

Section 14: Specifications

Capacity and Weight Specifications

Torrentula Valve Specifications Models 4453-HL9800

Bambi Model	Capacity			Gross Weight		Empty Weight	
	IMP Gal	USG Gal	Liters	lb	kg	lb	kg
4453	440	530	2000	4650	2110	250	120
5566	550	660	2500	5900	2670	400	180
6578	650	780	3000	6930	3140	430	200
7590	750	900	3400	7960	3610	460	210
HL4000	880	1100	4000	9290	4200	480	220
HL5000	1100	1300	5000	11500	5220	500	230
HL7600	1700	2000	7600	17300	7840	580	260
HL9800	2200	2600	9800	22190	10070	640	290

Torrentula Valve with PowerFill Specifications Models 4453-HL9800

Bambi Model	Capacity			Gross Weight		Empty Weight	
	IMP Gal	USG Gal	Liters	lb	kg	lb	kg
4453	440	530	2000	4720	2140	320	140
5566	550	660	2500	6020	2730	520	240
6578	650	780	3000	7100	3220	560	260
7590 2 Pumps	750	900	3400	8080	3670	580	260
HL4000	880	1100	4000	4410	4410	690	310
HL5000	1100	1300	5000	11710	5310	710	320
HL7600	1700	2000	7600	17500	7940	780	350
HL9800	2200	2600	9800	22400	10160	840	380

Note: Capacities and weights are accurate to within 5%. Specifications subject to change. Check original control head nameplate.

Caution

The selection of a Bambi bucket model for a specific aircraft is dependent on many factors including aircraft weight, fuel weight, operation elevation and atmospheric conditions.

The helicopter operator must select a bucket model which is appropriate for their specific situation.

The operator must also ensure that the bucket selected does not pose a tail rotor strike hazard.

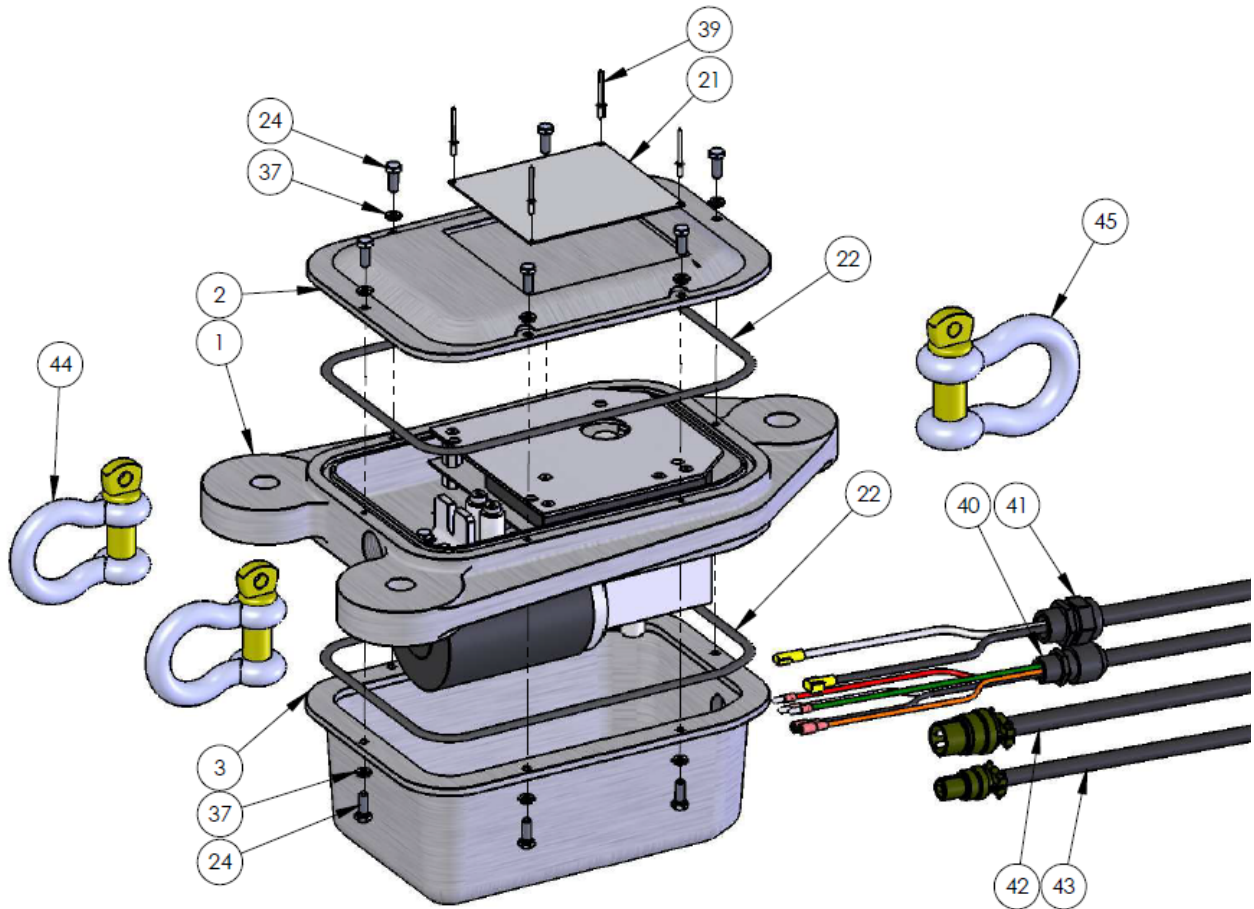
Fill Time and Power Requirements

Model	Number of Pumps	Optimal Fill Time (Sec)	Current (Amps)
4453	2	40	90
5566	2	50	90
6578	2	59	90
7590	2	68	90
HL4000	4	41	180
HL5000	4	49	180
HL7600	4	75	180
HL9800	4	98	180

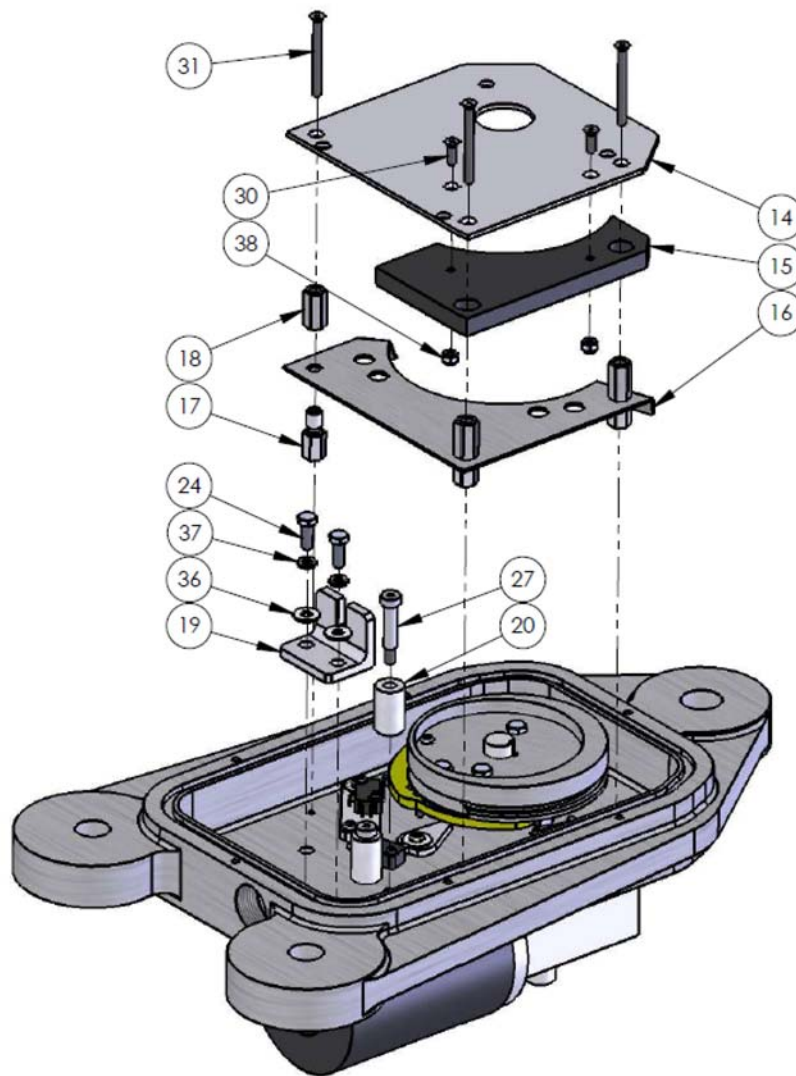
Section 15: Torrentula Control Head Parts

Control Head Parts Listings

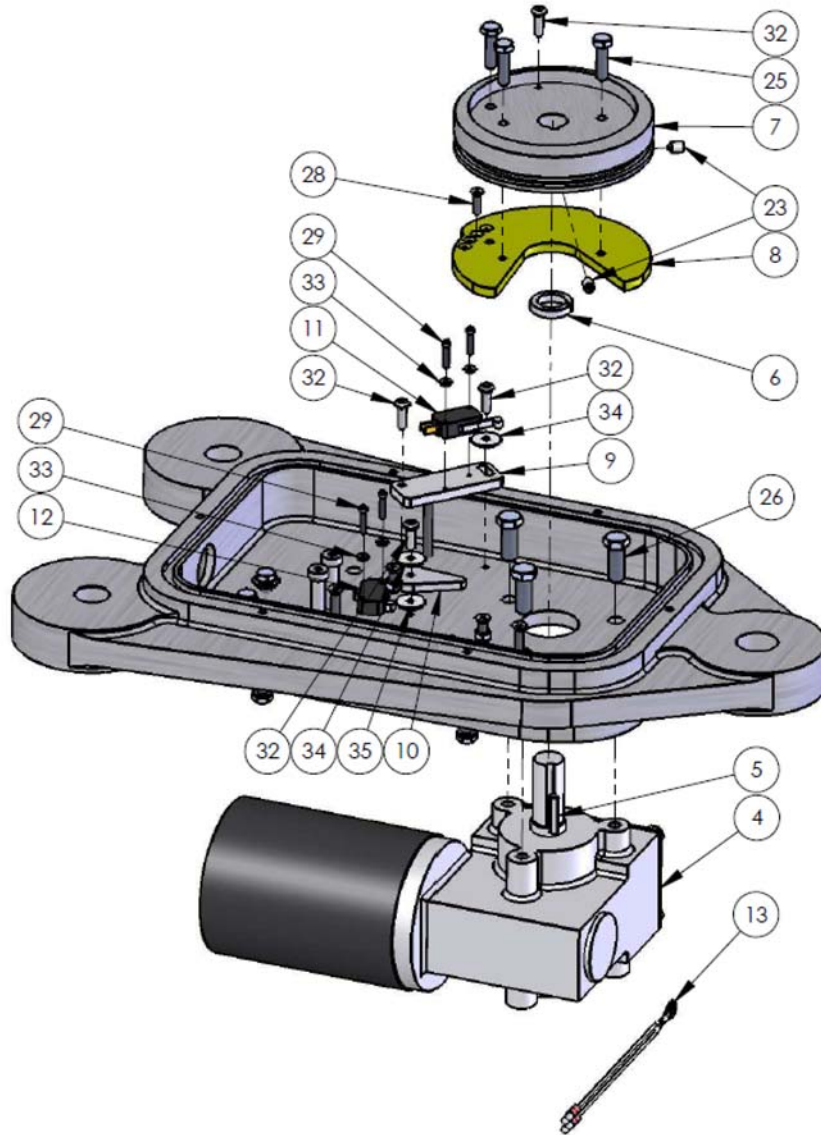
Model 4453 Control Head



Model 4453 Control Head (continued)



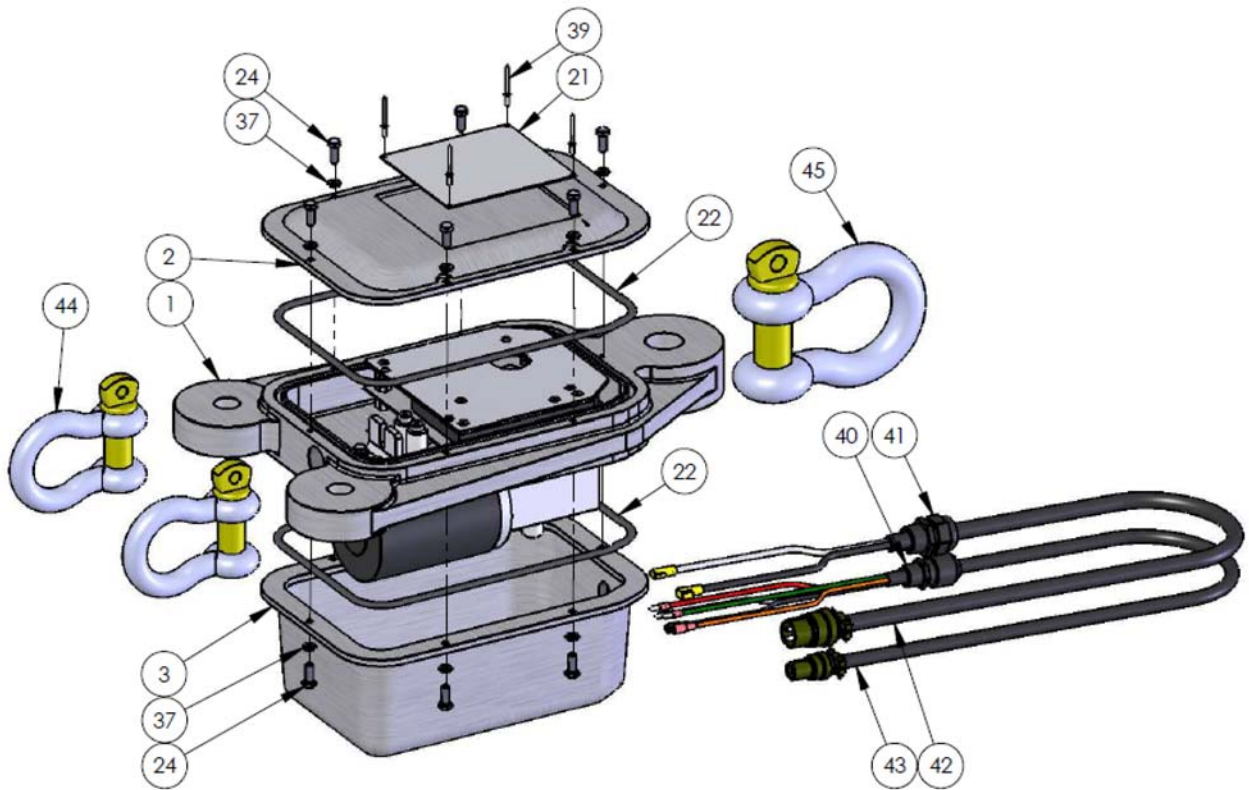
Model 4453 Control Head (continued)



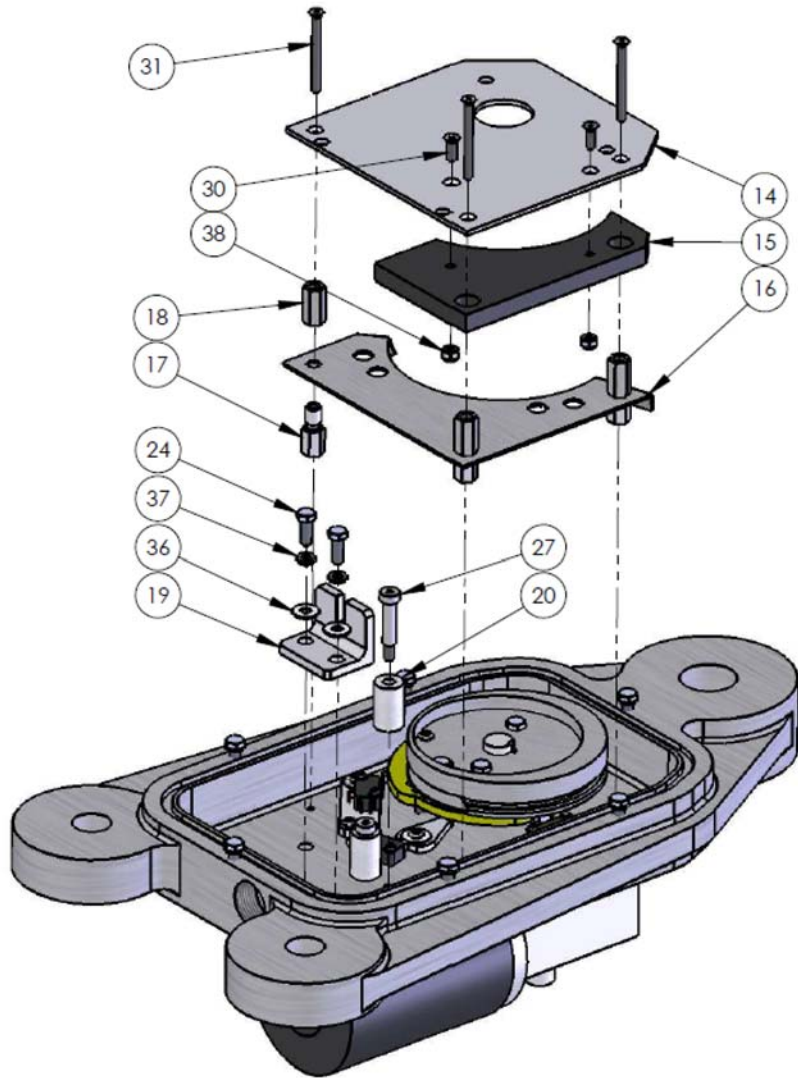
Control Head Models 4453 Parts Listing

ITEM	MODEL	PART NUMBER	DESCRIPTION	QTY
1	Model 4453	005251	HEAD, BASE, MACHINED	1
2		005253	COVER, HEAD, FRONT, MACHINED	1
3		005255	COVER, HEAD, MOTOR, MACHINED	1
4		001164	MOTOR, GEAR, 24VDC, 60:1	1
5		004948	KEY, MACHINED, C1018, SQ., 3/16 X 1"	1
6		001055	SHIM, CRANK, CABLE, 0.21	1
7		005213	CRANK, CABLE	1
8		001022	CAM, MICROSWITCH	1
9		001024	PLATE, MOUNT, MICROSWITCH	2
10		001026	LEVER, TRIP, OVERTRAVEL	1
11		007121	SWITCH, LIMIT, ASSEMBLY	2
12		007122	SWITCH, SAFETY, ASSEMBLY	1
13		000838	HARNESS, WIRE, W26	1
14		001053	PLATE, GUARD, CABLE	1
15		004920	DEFLECTOR, CABLE	1
16		005167	COVER, MICROSWITCH	1
17		004918	STUD, GUARD, CABLE	3
18		004919	NUT, GUARD, CABLE	3
19		001029	BRACKET, CABLE	1
20		004921	ROLLER, CABLE	2
21		004773	LABEL, SPEC PLATE, BLANK	1
22		005169	O-RING, BUNA N, #380	2
23		005151	SETSCREW, 1/4-20 X 3/8, CUP, SS	2
24		000369	BOLT, HX, 1/4-20 X 3/4, SS	14
25		000370	BOLT, HX, 1/4-20 X 1, SS	3
26		000391	BOLT, HX, 3/8-16 X 1, SS	3
27		004936	BOLT, SHOULDER, 5/16 X 1-1/4 X 1/4-20, HX	2
28		006586	SCREW, FSC, 8-32 X 5/8, SS	1
29		000405	SCREW, SC, 4-4- X 5/8, SS	6
30		000450	SCREW, FHPP, 10-24 X 5/8, SS	2
31		000457	SCREW, FHPP, 10-24 X 2-1/4, SS	3
32		000494	SCREW, PNPH, 10-24 X 5/8, SS	6
33		001831	WASHER, FLAT, 0.12 X 0.31 X 0.032, SS	6
34		001855	WASHER, FLAT, 0.20 X 0.75 X 0.036, SS	3
35		001806	WASHER, FLAT, 3/16 X 3/4, NYLON	1
36		001833	WASHER, FLAT, 0.28 X 0.69 X 0.036, SS	2
37		001852	WASHER, LOCK, SPLIT, 1/4, SS	14
38		001660	NUT, HEX, NYLOCK, 10-24, SS	2
39		001742	RIVET, POP, BLIND, 1/8, AL	4
40		001172	STRAIN RELIEF, 3/4 MNPT	1
41		001173	STRAIN RELIEF, 1/2 MNPT	1
42		000839	HARNESS, WIRE, W30	1
43		000840	HARNESS, WIRE, W31	1
44		001790	SHACKLE, ANCHOR, SCREW, 3/4, GLV	2
45		001793	SHACKLE, ANCHOR, SCREW, 7/8, GLV	1

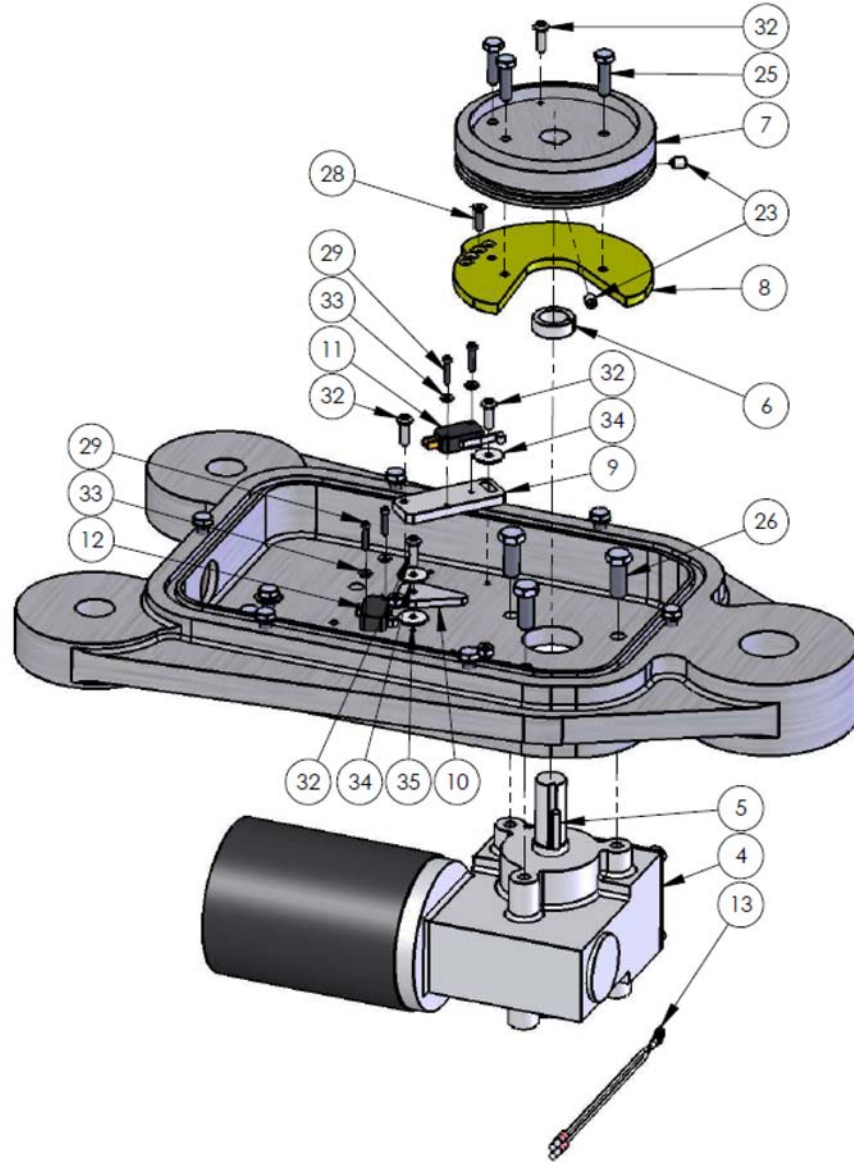
Models 5566-HL9800 Control Head



Models 5566-HL9800 Control Head (continued)



Models 5566-HL9800 Control Head (continued)



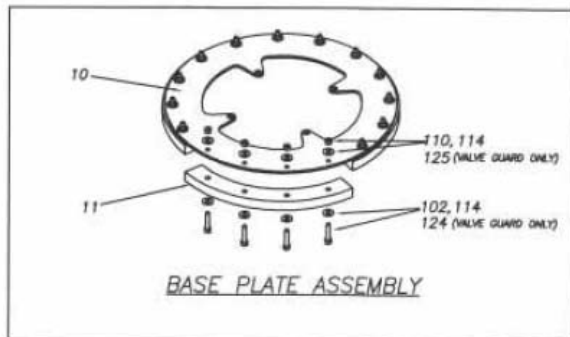
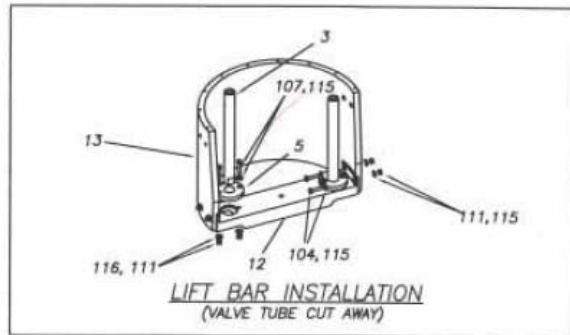
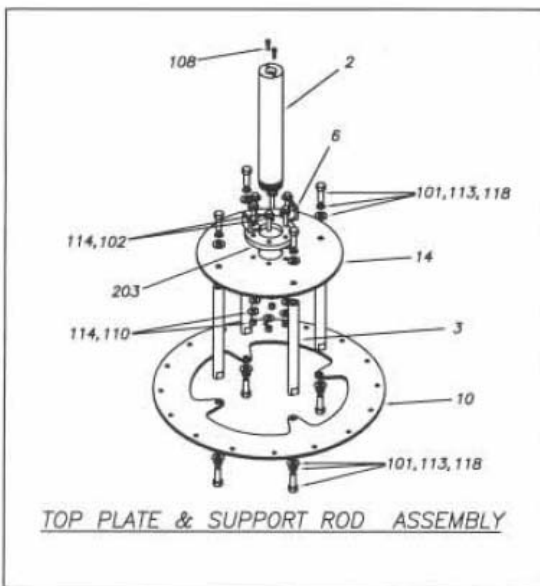
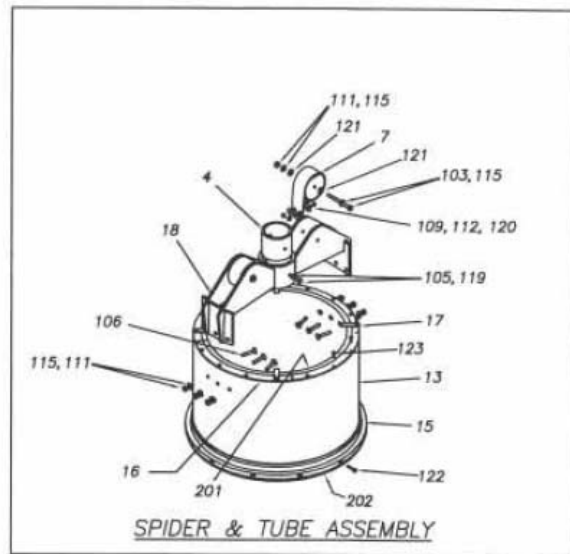
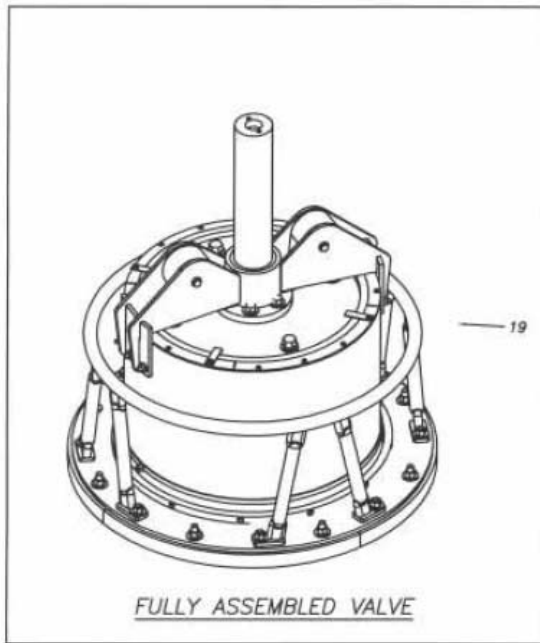
Control Head Models 5566-HL9800 Parts Listing

ITEM	MODEL	PART NUMBER	DESCRIPTION	QTY
1	5566 — HL9800	005245	HEAD, BASE, MACHINED	1
2		005253	COVER, HEAD, FRONT, MACHINED	1
3		005255	COVER, HEAD, MOTOR, MACHINED	1
4		001164	MOTOR, GEAR, 24VDC, 60:1	1
5		004948	KEY, MACHINED, C1018, SQ., 3/16 X 1"	1
6		006948	SHIM, CRANK, CABLE, 0.21	1
7		005213	CRANK, CABLE	1
8		001022	CAM, MICROSWITCH	1
9		001024	PLATE, MOUNT, MICROSWITCH	2
10		001026	LEVER, TRIP, OVERTRAVEL	1
11		007121	SWITCH, LIMIT, ASSEMBLY	2
12		007122	SWITCH, SAFETY, ASSEMBLY	1
13		000838	HARNESS, WIRE, W26	1
14		001053	PLATE, GUARD CABLE	1
15		004920	DEFLECTOR, CABLE	1
16		005167	COVER, MICROSWITCH	1
17		004918	STUD, GUARD, CABLE	3
18		004919	NUT, GUARD, CABLE	3
19		001029	BRACKET, CABLE	1
20		004921	ROLLER, CABLE	2
21		004773	LABEL, SPEC PLATE, BLANK	1
22		005169	O-RING, BUNA N, #380	2
23		005151	SETSCREW, 1/4-20 X 3/8, CUP, SS	2
24		000369	BOLT, HX, 1/4-20 X 3/4, SS	14
25		000370	BOLT, HX, 1/4-20 X 1, SS	3
26		000391	BOLT, HX, 3/8-16 X 1, SS	3
27		004936	BOLT, SHOULDER, 5/16 X 1-1/4 X 1/4-20, HX	2
28		006586	SCREW, FSC, 8-32 X 5/8, SS	1
29		000405	SCREW, SC, 4-4- X 5/8, SS	6
30		000450	SCREW, FHPP, 10-24 X 5/8, SS	2
31		000457	SCREW, FHPP, 10-24 X 2-1/4, SS	3
32		000494	SCREW, PNPH, 10-24 X 5/8, SS	6
33		001831	WASHER, FLAT, 0.12 X 0.31 X 0.032, SS	6
34		001855	WASHER, FLAT, 0.20 X 0.75 X 0.036, SS	3
35		001806	WASHER, FLAT, 3/16 X 3/4, NYLON	1
36		001833	WASHER, FLAT, 0.28 X 0.69 X 0.036, SS	2
37		001852	WASHER, LOCK, SPLIT, 1/4, SS	14
38		001660	NUT, HEX, NYLOCK, 10-24, SS	2
39		001742	RIVET, POP, BLIND, 1/8, AL	4
40		001172	STRAIN RELIEF, 3/4 MNPT	1
41		001173	STRAIN RELIEF, 1/2 MNPT	1
42		000839	HARNESS, WIRE, W30	1
43		000840	HARNESS, WIRE, W31	1
44		001793	SHACKLE, ANCHOR, SCREW, 7/8, GAV	2
45		001792	SHACKLE, ANCHOR, SCREW, 1 1/4, GLV	1

Section 16: Torrentula Valve Parts

Valve Parts Listings

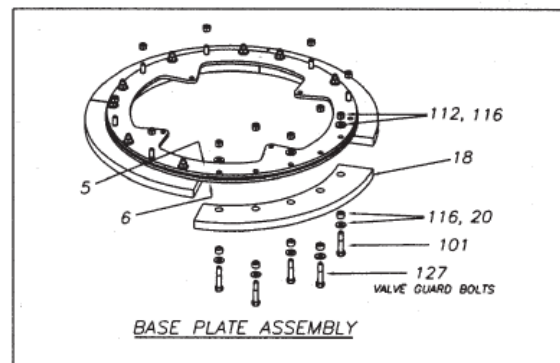
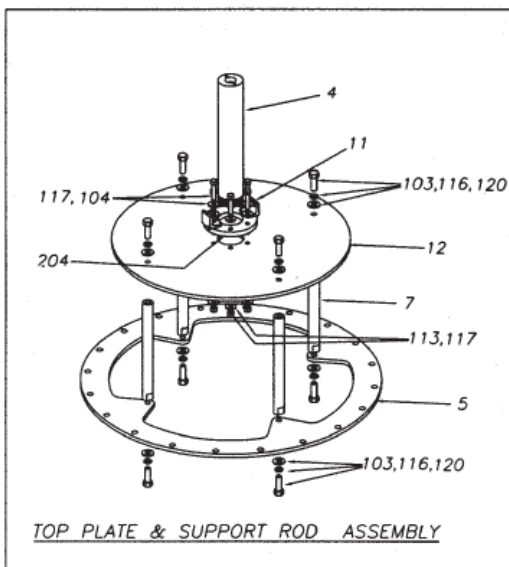
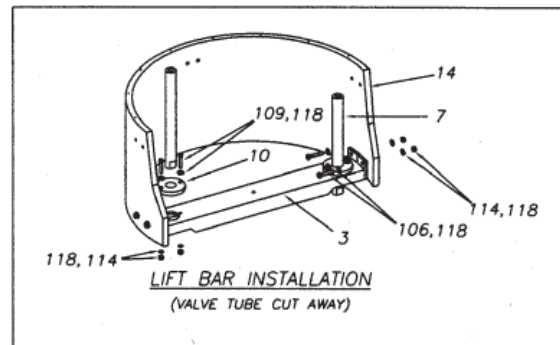
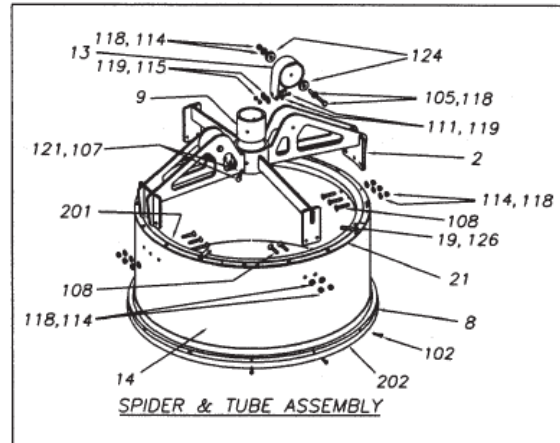
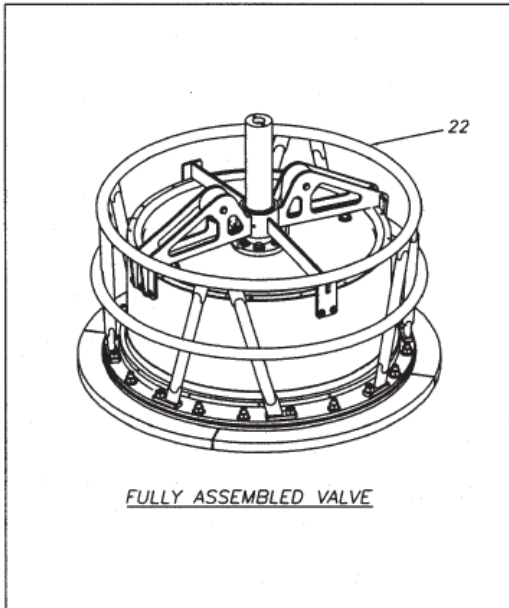
Torrentula Valve Parts, Model 4453 Only



Torrentula Valve, Model 4453 Parts Listing

ITEM	PART NO.	DESCRIPTION	QTY.
207		SEALANT SILICONE	AS REQ.
206	002963	TAPE, BUTYL, 1/8 X 3/8	10'
203	002464	FLANGE, 2" FNPT, AL, GLD, ANO	1
202	005057	SEAL, VALVE, BOTTOM 16"	1
201	005056	SEAL, VALVE, TOP 16"	1
125	001869	WASHER, FLAT, 3/8 X 5/8, AN, SS	8
124	000397	BOLT, HX, 3/8-16 X 3" SS	8
123	001783	SCREW, #8 X 1 1/4, PNP, SS	16
122	001785	SCREW, #8 X 1 1/4, PNP, SS	13
121	001834	WASHER, FLAT, 1/4 X 3/4", SS	4
119	001852	WAHER, LOCK, SPLIT, 1/4", SS	2
118	001854	WASHER, LOCK, SPLIT, 1/2", SS	8
117	001837	WASHER, FLAT, #10 X 7/16", AN, SS	8
116	001838	WASHER, FLAT, 1/4 X 1/2, AN, SS	4
115	001819	WASHER, FLAT, 1/4 X 5/8", SAE, PLT	20
114	001863	WASHER, FLAT, 3/8" SS	44
113	001847	WASHER, FLAT, 1/2 X 1 3/8" USS, SS	8
112	001660	NUT, HX, NYLOCK, 10-24, SS	4
111	001662	NUT, HX, NYLOCK, 1/4-20, SS	16
110	001665	NUT, HX, NYLOCK, 3/8-16, SS	22
109	000495	SCREW, 10-24 X 3/4", PNP, SS	4
108	000428	SCREW, 1/4-20 X 3/4", SC, SS	2
107	000430	SCREW, 1/4-20 X 1-1/4, SC, SS	4
106	000461	SCREW, 1/4-20 X 1-1/4, FHPH, SS	6
105	000365	BOLT, HX, 1/4-20 X 1/2", SS	2
104	000371	BOLT, HX, 1/4-20 X 1-1/4", SS	4
103	000383	BOLT, HX, 1/4-20 X 3", SS	2
102	000393	BOLT, HX, 3/8-16 X 1-3/4", SS	14
101	000398	BOLT, HX, 1/2-13 X 1" SS	8
19	005212	GUARD, VALVE, 16"	1
18	005041	SPIDER, LIFT, ASSY	1
17	001019	CLIP, SEAL, TOP	4
16	001018	RING, SEAL, 16" TOP	4
15	001016	RING, SEAL, 16" BOTTOM	1
14	001014	PLATE, TOP, 16"	1
13	001013	TUBE, VALVE, 16" PVC	1
12	001010	BAR, LIFT, 16"	1
11	001009	BUMPER, BLOCK	4
10	001182	RING, BASE, 16"	1
7	000192	SPRING, CONSTANT, FORCE	2
6	000189	BRACKET, SPRING	2
5	000187	BUSHING, SLIDER, BOTTOM	2
4	000188	BUSHING, SLIDER, TOP	1
3	000182	ROD, SUPPORT, 1 X 10.5, AL, ANO	4
2	000177	SLIDER, PIPE, ASSEMBLY	1
1	005042	VALVE, TORRENTULA, 16" ASSEMBLY	1

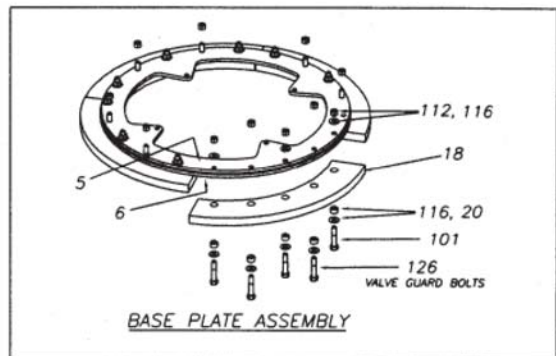
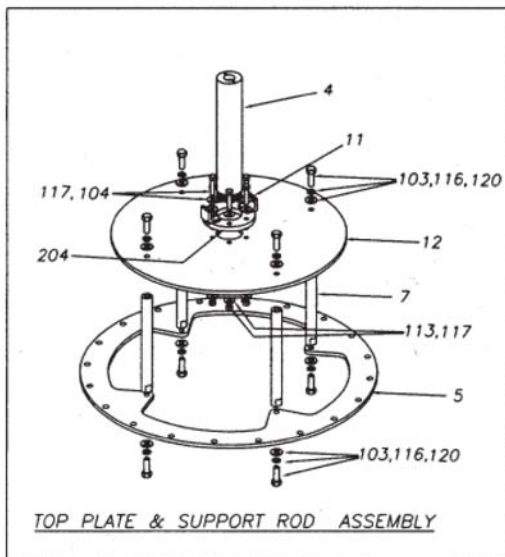
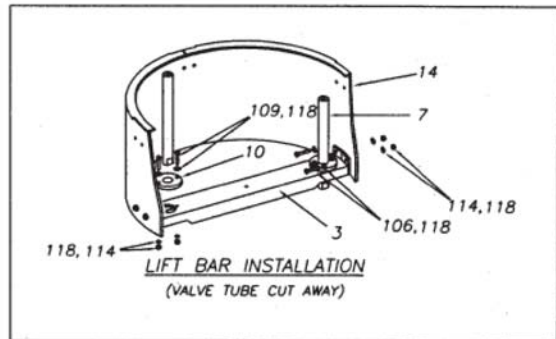
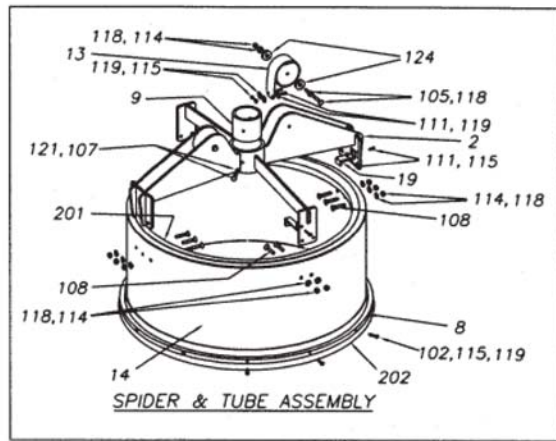
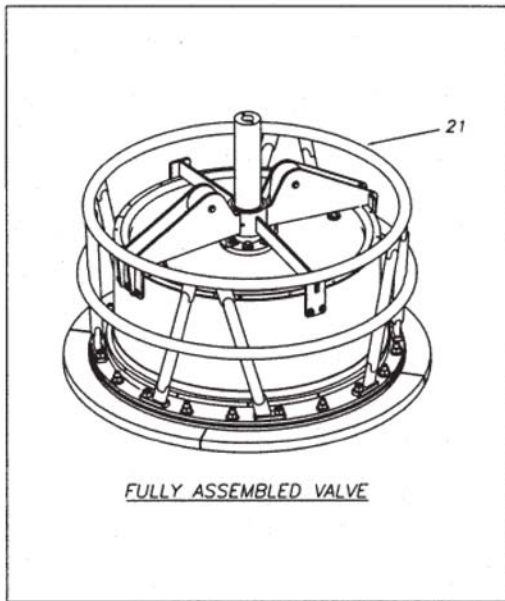
Torrentula Valve Parts, Models 5566, 5870, 6578, 7590



Torrentula Valve, Models 5566, 6578, 7590 Parts Listing

ITEM #	PART #	DESCRIPTION	QTY.
209		SEALANT, SILICONE	AS REQ.
208	002963	TAPE, BUTYL, 1/8 X 3/8	14'
204	002464	FLANGE, 2" FNPT, AL, GLD. ANO	1
202	001140	SEAL, VALVE, BOTTOM, 25"	1
201	001138	SEAL, VALVE, TOP, 25"	1
127	000404	BOLT, HX, 1/2-13 X 3" SS	8
126	001785	SCREW, #8 X 1 1/4", PNP, SS	16
125	001832	WASHER, FLAT, 1/4 X 3/4", SS	4
124	001844	WASHER, FLAT, 1/4 X 1/2", SS	4
123	001855	WASHER, FLAT, #10 X 3/4", FND, SS	4
122	000491	SCREW, 10-24 X 3/8", PNP, SS	4
121	001852	WASHER, LOCK, SPLIT, 1/4", SS	2
120	001854	WASHER, LOCK, SPLIT, 1/2", SS	8
119	001837	WASHER, FLAT, #10 X 7/16", AN, SS	8
118	001838	WASHER, FLAT, 1/4 X 1/2" AN, SS	24
117	001814	WASHER, FLAT, 3/8", PLATED	12
116	001816	WASHER, FLAT, 1/2", PLATED	40
115	001660	NUT, HEX, NYLOCK, 10-24, SS	21
114	001662	NUT, HEX, NYLOCK, 1/4-20, SS	20
113	001645	NUT, HEX, NYLOCK, 3/8-16, SS	6
112	001646	NUT, HEX, NYLOCK, 1/2-13, SS	20
111	000495	SCREW, 10-24, PNP, SS	8
110	000428	SCREW, 1/4 X 20 X 3/4" SC, SS	2
109	000430	SCREW, 1/4 X 20 X 1 1/4" SC, SS	4
108	000460	SCREW, 1/4 X 20 X 1", FHP, SS	10
107	000389	BOLT, HEX, 1/4-20 X 3/4", SS	2
106	000370	BOLT, HEX, 1/4-20 X 1", SS	4
105	000383	BOLT, HEX, 1/4-20 X 3", SS	2
104	000392	BOLT, HEX, 3/8-16 X 1-1/2", SS	6
103	000347	BOLT, HEX, 1/2-13 X 1-1/2", SS	8
102	000454	SCREW, 10-24 X 1 1/4, FHP, SS	13
101	000350	BOLT, HEX, 1/2-13 X 2 1/2", PLT	12
22	005204	GUARD, VALVE, 24"	1
21	001021	RING, SEAL, TOP", 24"	1
19	001019	CLIP, SEAL, TOP	4
18	000999	BUMPER, BLOCK 24"	4
14	001162	TUBE, VALVE, 24", SDR	1
13	000192	SPRING, CONSTANT FORCE	2
12	001163	PLATE, TOP, 24"	1
11	000189	BRACKET, SPRING	2
10	000187	BUSHING, SLIDER, BOTTOM	2
9	000188	BUSHING, SLIDER, TOP	1
8	000185	RING, SEAL, 24" BOTTOM	1
7	000182	ROD, SUPPORT, 1 X 10.5, AL, ANO	4
6	001160	RING, CLAMP, 24"	1
5	001158	RING, BASE, 24"	1
4	000177	SLIDER, PIPE, ASSEMBLY	1
3	000136	BAR, LIFT 24"	1
2	001147	SPIDER, LIFT, ASSY, 24"	1
1	001132	VALVE, TORRENTULA, 24" ASSEMBLY	1

Torrentula Valve Parts, Models HL4000, HL5000, HL7600, HL9800



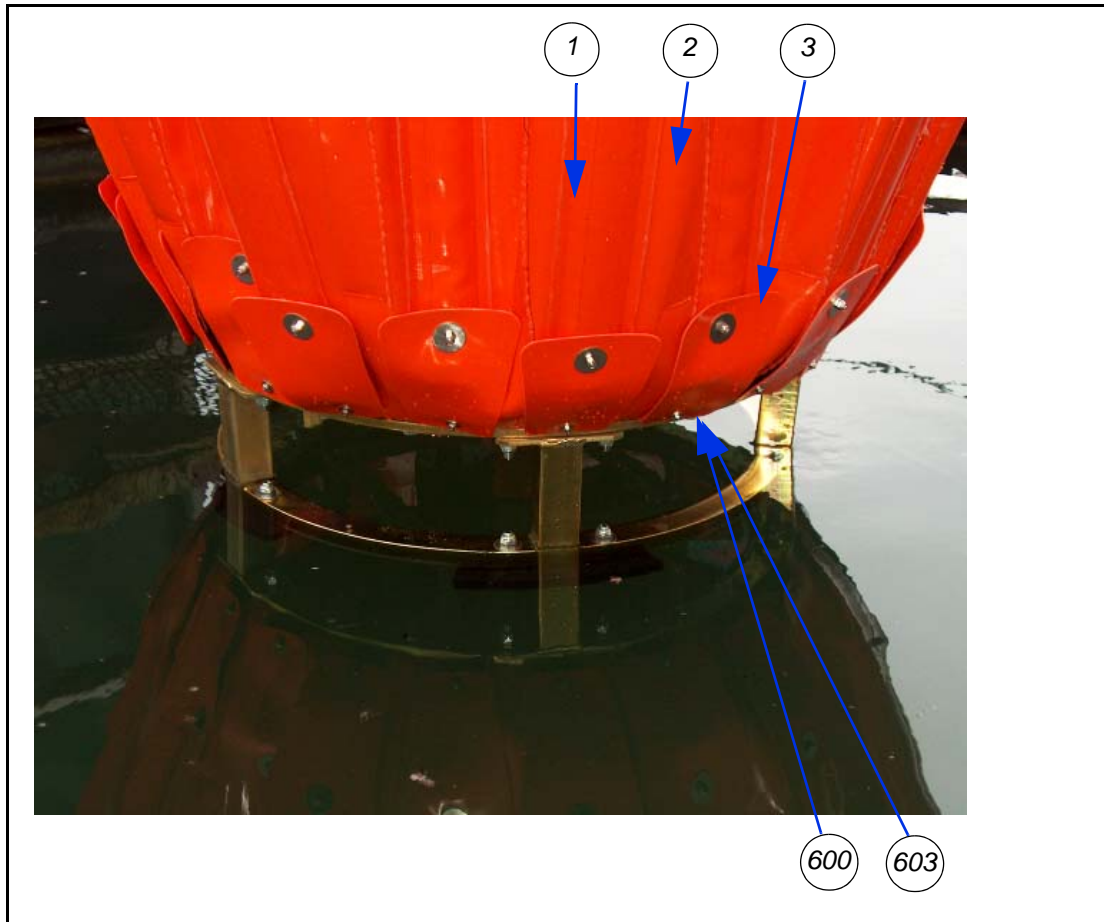
Torrentula Valve, Models HL4000, HL5000, HL7600, HL9800 Parts Listing

ITEM #	PART #	DESCRIPTION	QTY.
209		SEALANT, SILICONE	AS REQ.
208	002963	TAPE, BUTYL, 1/8 X 3/8	14'
204	002464	FLANGE, 2" FNPT, AL, GLD. ANO	1
202	005201	SEAL, VALVE, BTMOM, 27"	1
201	005200	SEAL, VALVE, TOP, 27"	1
126	000404	BOLT, HX, 1/2-13 X 3" SS	8
125	001832	WASHER, FLAT, 1/4 X 3/4", SS	4
124	001844	WASHER, FLAT, 1/4 X 1/2", SS	4
123	001855	WASHER, FLAT, #10 X 3/4", FND, SS	4
122	000491	SCREW, 10-24 X 3/8", PNP,SS	4
121	001852	WASHER, LOCK, SPLIT, 1/4", SS	2
120	001854	WASHER, LOCK, SPLIT, 1/2", SS	8
119	001837	WASHER, FLAT, #10 X 7/16", AN, SS	8
118	001838	WASHER, FLAT, 1/4 X 1/2" AN, SS	24
117	001814	WASHER, FLAT, 3/8", PLATED	12
116	001816	WASHER, FLAT, 1/2", PLATED	40
115	001660	NUT, HEX, NYLOCK, 10-24, SS	21
114	001662	NUT, HEX, NYLOCK, 1/4-20, SS	20
113	001645	NUT, HEX, NYLOCK, 3/8-16, SS	6
112	001646	NUT, HEX, NYLOCK, 1/2-13, SS	20
111	000495	SCREW, 10-24, PNP, SS	8
110	000428	SCREW, 1/4 X 20 X 3/4" SC, SS	2
109	000430	SCREW, 1/4 X 20 X 1 1/4" SC, SS	4
108	000460	SCREW, 1/4 X 20 X 1", FHPH, SS	10
107	000389	BOLT, HEX, 1/4-20 X 3/4", SS	2
106	000370	BOLT, HEX, 1/4-20 X 1", SS	4
105	000383	BOLT, HEX, 1/4-20 X 3", SS	2
104	000392	BOLT, HEX, 3/8-16 X 1-1/2", SS	6
103	000347	BOLT, HEX, 1/2-13 X 1-1/2", SS	8
102	000454	SCREW, 10-24 X 1 1/4, FHPH, SS	13
101	000350	BOLT, HEX, 1/2-13 X 2 1/2", PLT	12
21	006229	GUARD, VALVE, 27"	1
19	001019	CLIP, SEAL, TOP	8
18	001049	BUMPER, BLOCK, 27"	4
14	005203	TUBE, VALVE, 27", AL	1
13	000192	SPRING, CONSTANT FORCE	2
12	001048	PLATE, TOP, 27"	1
11	000189	BRACKET, SPRING	2
10	000187	BUSHING, SLIDER, BOTTOM	2
9	000188	BUSHING, SLIDER, TOP	1
8	001046	RING, SEAL, 27" BOTTOM	1
7	000182	ROD, SUPPORT, 1 X 10.5, AL, ANO	4
6	001045	RING, CLAMP, 27"	1
5	001044	RING, BASE, 27"	1
4	000177	SLIDER, PIPE, ASSEMBLY	1
3	001042	BAR, LIFT, 27"	1
2	005202	SPIDER, LIFT, ASSY, 27"	1
1	005199	VALVE, TORRENTULA, 27" ASSEMBLY	1

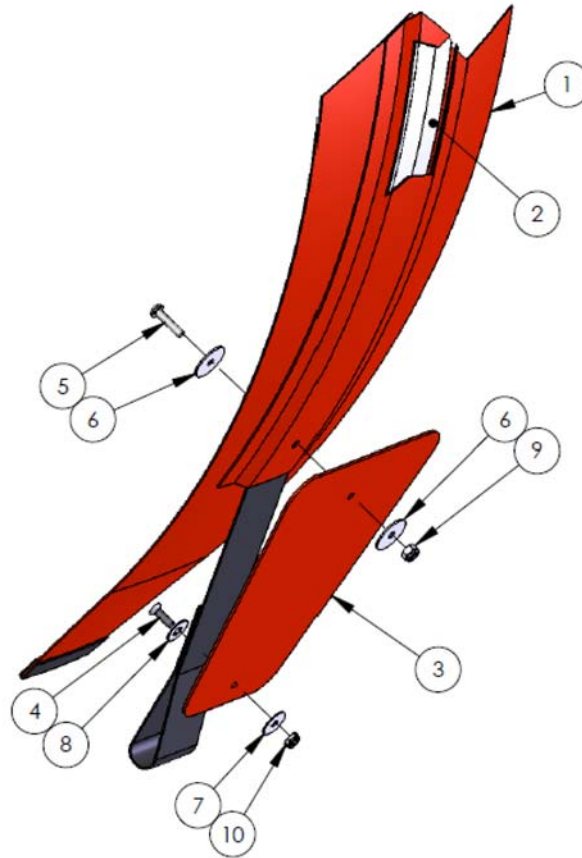
Section 17: Shell Parts

Bucket Shell Parts Listings

Bucket Shell, Model 4453

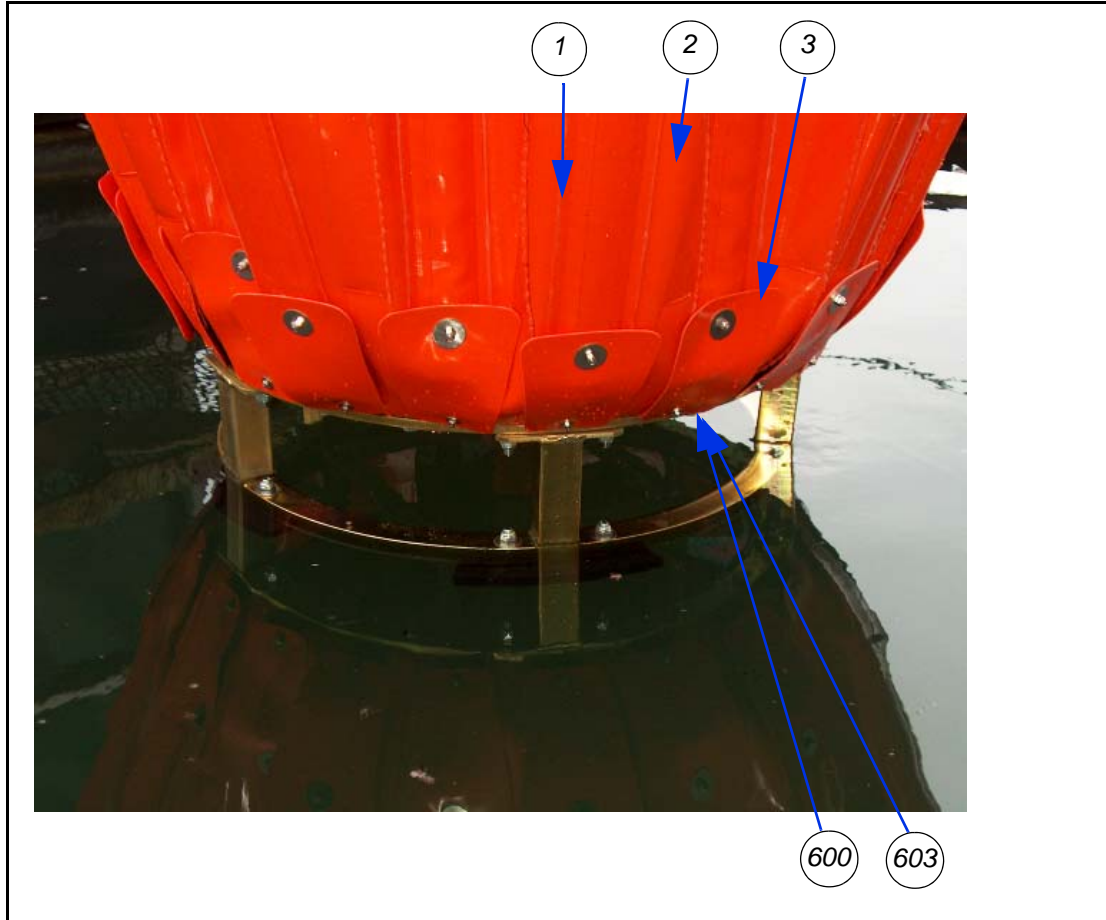


Bucket Shell, Model 4453 Parts Listing

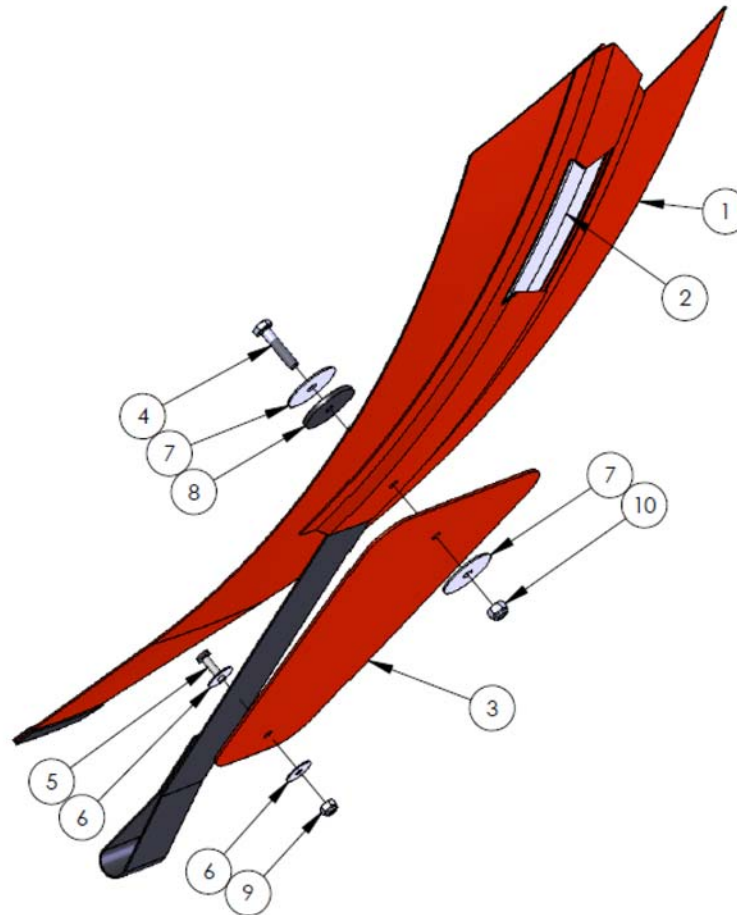


ITEM	MODEL	PART NUMBER	DESCRIPTION	QTY
1	4453	005666	SHELL 4453	1
2		005428	BATTEN 47-1/2"	16
3		005040	STRIP, WEAR, LOWER, 3542-4453	16
4		000450	SCREW, 10-24 X 5/8, FHPH, SS	16
5		000496	SCREW, 10-24 X 7/8, PNPB, SS	14
6		001856	WASHER, FLAT, #10 X 1, FND, SS	32
7		001855	WASHER, FLAT, #10 X 3/4, FND, SS	16
8		001833	WASHER, FLAT, 1 1/4 X 11/16, THIN, SS	16
9		001660	NUT, HX, NYLOCK, 10-24, SS	14
10		001661	NUT, HX, JAM, NYLOCK, 10-24, SS	16
600		001788	SHACKLE, ANCHOR, SCREW, 1/4, GLV	1
603		003844	CHAIN, 3/16" GR30, GLV.	72"

Bucket Shell, Model 5566

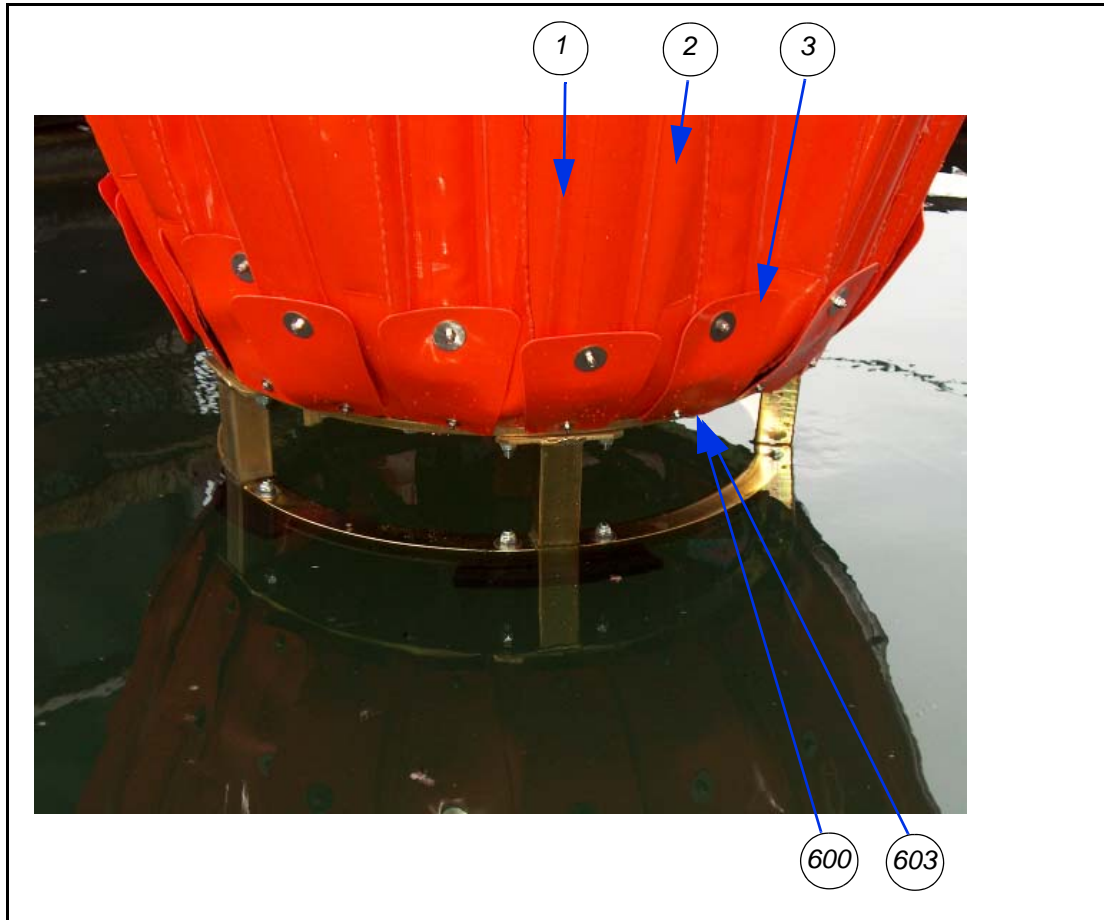


Bucket Shell, Model 5566 Parts Listing

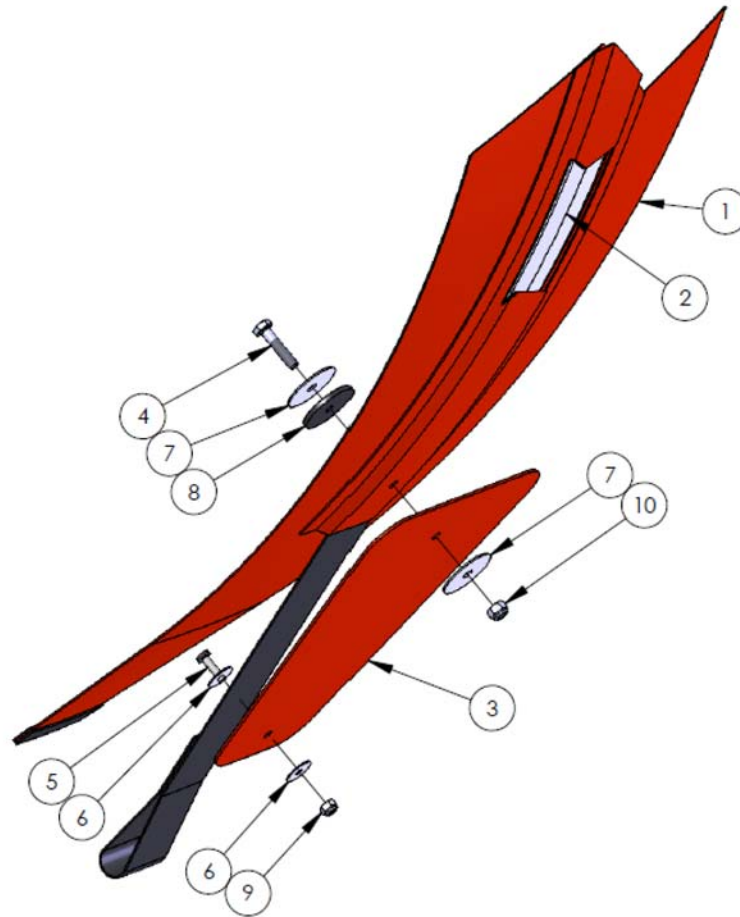


ITEM	MODEL	PART NUMBER	DESCRIPTION	QTY
1	5566	005667	SHELL	1
2		005430	BATTEN, 54"	16
3		005040	STRIP, WEAR, LOWER	16
4		000371	BOLT, HX, 1/4-20 X 1-1/4,SS	16
5		000495	SCREW, 10-24 X 3/4, PNPB, SS	16
6		001855	WASHER, FLAT, #10 X 3/4, FND, SS	32
7		001857	WASHER, FLAT, 1/4 X 1-1/2, FND, SS	32
8		001828	WASHER, 7/32 X 1 1/2 X 1/8, NEO	16
9		001660	NUT, HX, NYLOCK, 10-24, SS	16
10		001662	NUT, HX, NYLOCK, 1/4-20, SS	16
600		001789	SHACKLE, ANCHOR, SCREW 5/16, GLV	1
603		003844	CHAIN, 3/16, GR30, GLV	76"

Bucket Shell, Models 6578-HL9800



Bucket Shell, Models 6578-HL9800 (continued)

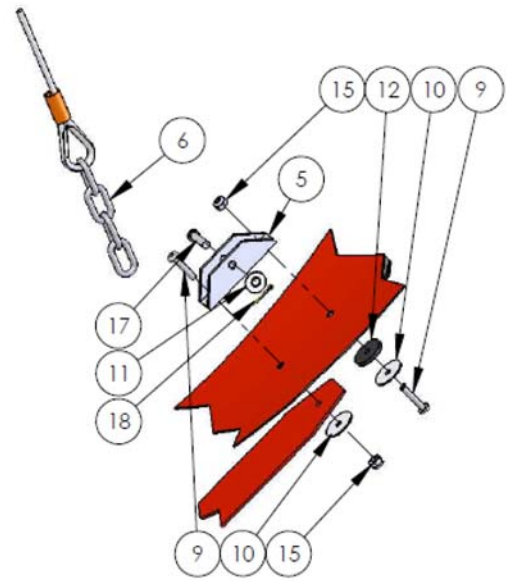
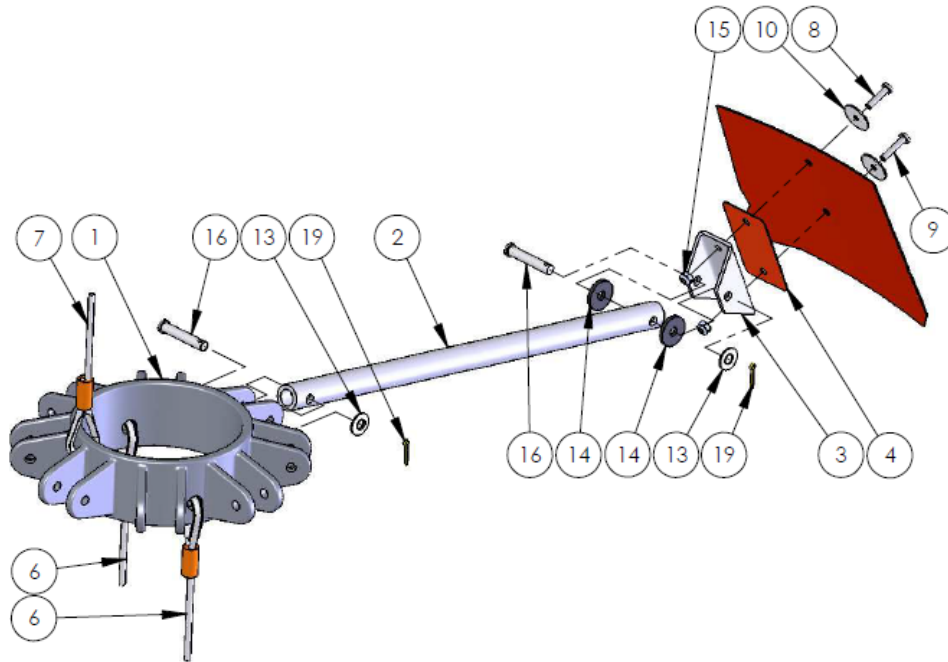


Bucket Shell, Models 6578-HL9800 Parts Listing

ITEM	MODEL	PART NUMBER	DESCRIPTION	QTY	
1	6578	005670	SHELL	1	
	7590	005682			
	HL5000	005675			
	HL7600	005817			
	HL9800	005820			
2	6578	005433	BATTEN, 55"	20	
	7590	005436	BATTEN, 60-1/2"		
	HL5000	005439	BATTEN, 66		
	HL7600	005441	BATTEN, 85-3/4"		
	HL9800	005443	BATTEN, 94"		
3	6578	001020	WEAR STRIP, LOWER	20	
	7590				
	HL5000	005040			
	HL7600				
	HL9800				
4	ALL	000371	BOLT, HX, 1/4-20 X 1-1/4, SS	20	
5		000495	SCREW, 10-24 X 3/4, PNP, SS	20	
6		001855	WASHER, FLAT, #10 X 3/4, FND, SS	40	
7		001857	WASHER, FLAT, 1/4 X 1-1/2, FND, SS	40	
8		001828	WASHER, 7/32 X 1 1/2 X 1/8 NEO	20	
9		001660	NUT, HX, NYLOCK, 10-24, SS	20	
10		001662	NUT, HX, NYLOCK, 1/4-20, SS	20	
600		001789	SHACKLE, ANCHOR, 5/16 SCREW, GR30, GLV	1	
603		6578	003846	CHAIN, GALV, GR30, 5/16	80"
		7590			
	HL5000				
	HL7600				
	HL9800				

IDS System Parts Listings

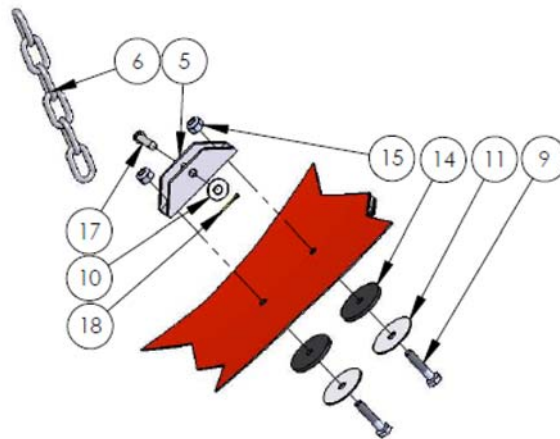
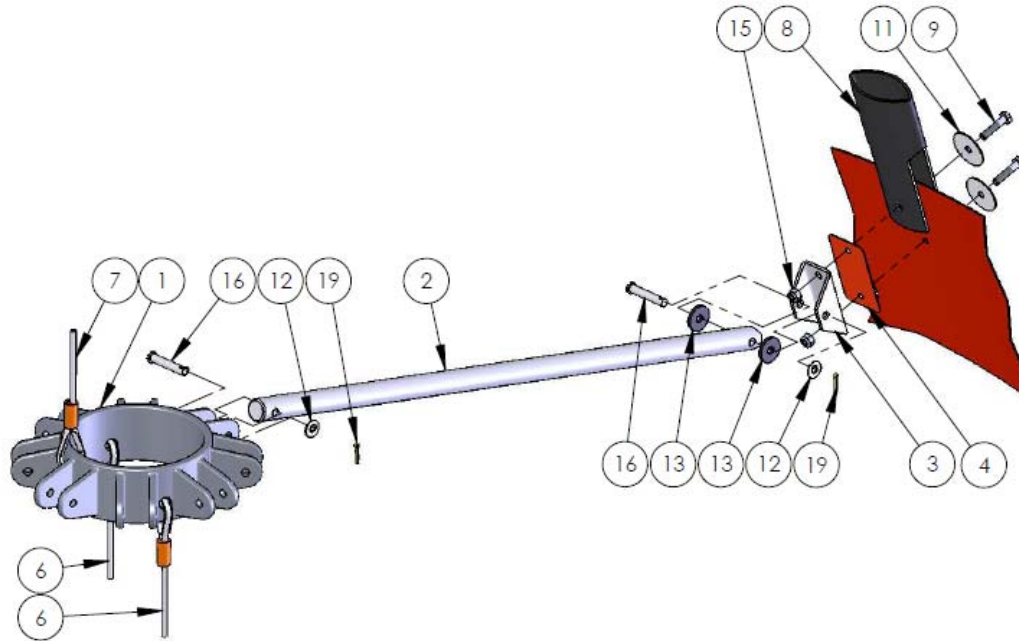
IDS System, Model 4453



IDS System, Model 4453 Parts Listing

ITEM	MODEL	PART NUMBER	DESCRIPTION	QTY
1	BB4453	005372	HUB,8 SPOKE,A356.2 T2 T6, CAST	1
		005456	HUB, ASSEMBLY, C/W CABLES	1
2		007211	SPOKE, SOLID, 24 5/8"	8
3		005386	BRACKET SHELL	8
4		005389	PATCH,WEAR,BRACKET	8
5		005307	BRACKET, RESTRAINER	2
6		005300	CABLE, RESTRAINER,HUB	2
7		005317	CABLE,IDS,DEPLOYMENT	1
8		000496	SCREW,10-24X7/8,PNPH,SS	8
9		000497	SCREW,10-24X1,PNPH,SS	12
10		001856	WASHER,FLAT,10X1,FND,SS	20
11		001833	WASHER,FLAT,1/4X11/16,SS	2
12		001824	WASHER,3/16X1,1/8,NEO	2
13		000068	WASHER,FLAT,5/16X3/4,SS	16
14		001826	WASHER,FLAT,5/16X1,1/8NEO	16
15		001660	NUT,HX, NYLOCK,10-24,SS	20
16		001697	PIN,CLEVIS,5/16 X 1-3/4,SS	16
17		001703	PIN,CLEVIS,1/4 X 1-1/8,SS	2
18		001710	PIN,COTTER,1/16 X 3/4,PLT	2
19	001713	PIN,COTTER,3/32 X3/4,PLT	16	

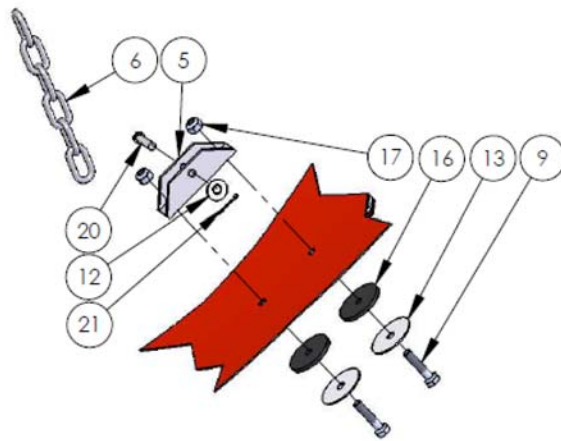
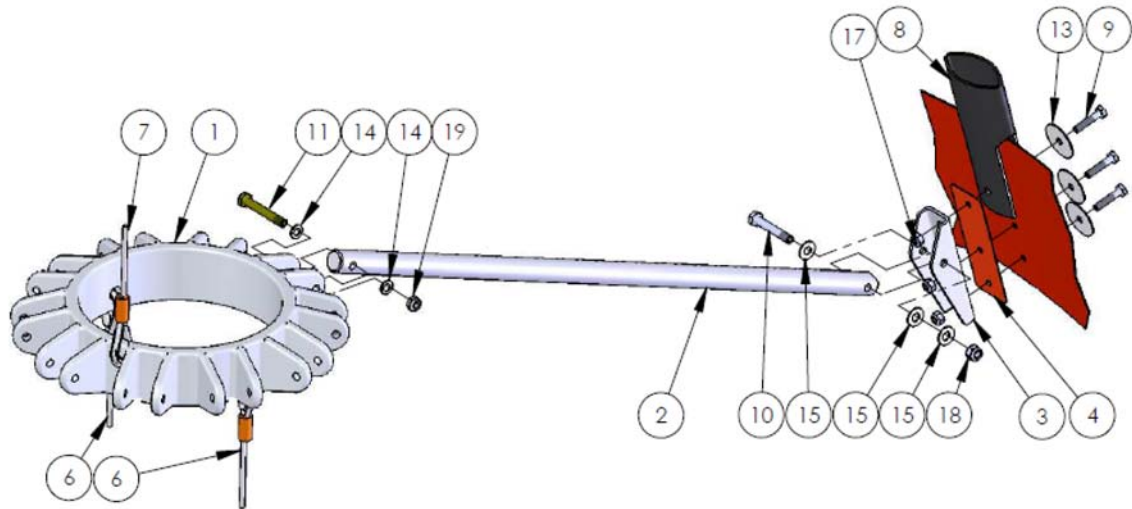
IDS System, Model 5566



IDS System, Model 5566 Parts Listing

ITEM	MODEL	PART #	DESCRIPTION	QTY
1	BB5566	005372	HUB, 8 SPOKE CAST	1
		005378	HUB, C/W, CABLES ASSEMBLIES	1
2		005348	SPOKE, SOLID, 27-1/8"	8
3		005386	BRACKET, SHELL	8
4		005389	PATCH, WEAR, BRACKET	10
5		005307	BRACKET, RESTRAINER	2
6		005301	CABLE, RESTRAINER, HUB	2
7		005317	CABLE, IDS, DEPLOYMENT	1
8		005483	PROTECTOR, M-STRAP	8
9		000371	BOLT, HX, 1/4-20 X 1-1/4, SS	20
10		001833	WASHER, FLAT, 1/4 X 11/16, SS	2
11		001857	WASHER, FLAT, 1/4 X 1-1/2, SS	20
12		000068	WASHER, FLAT, 5/16 X 3/4, SS	16
13		001826	WASHER, FLAT, 5/16 X 1 X 1/8 NEO	16
14		001828	WASHER, FLAT, 1/4 X 1-1/2 X 1/8 NEO	4
15		001662	NUT, HX, NYLOCK, 1/4-20, SS	20
16		001697	PIN, CLEVIS, 5/16 X 1-3/4, SS	16
17		001703	CLEVIS PIN, 1/4 X 1-1/8, SS	2
18		001710	PIN, COTTER, 1/16 X 3/4, PLT	2
19	001713	PIN, COTTER, 3/32 X 3/4, PLT	16	

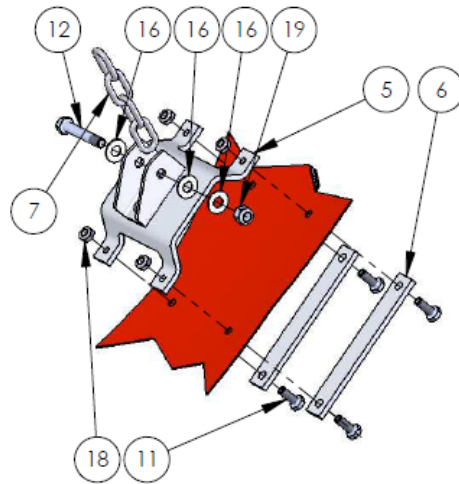
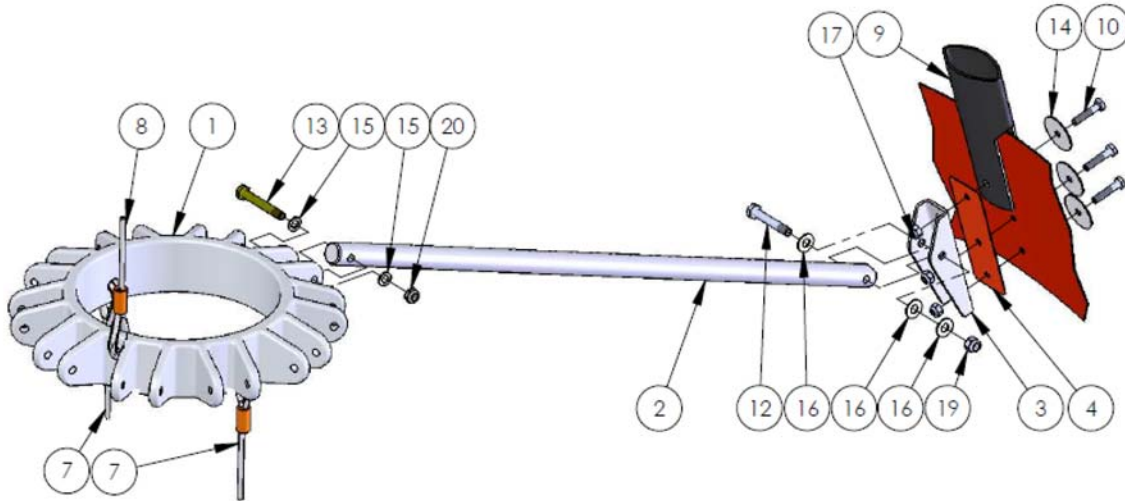
IDS System, Models 6578-7590



IDS System, Models 6578-7590 Parts Listing

ITEM	MODEL	PART #	DESCRIPTION	QTY
1	ALL	005380	HUB, 10 SPOKE	1
	6578	005457	HUB, C/W CABLES ASSEMBLIES	1
	7590	007226		
2	6578	005350	SPOKE, SOLID, 28-1/8"	10
	7590	005351	SPOKE, SOLID, 27-1/2"	
3	ALL	005387	BRACKET, SHELL	10
4		005390	PATCH, WEAR, BRACKET	2
5		005307	BRACKET, RESTRAINER	2
6	6578	005302	RESTRAINER CABLE ASSY	2
	7590			
7	6578	005320	IDS DEPLOYMENT CABLE	1
	7590	005321		
8	ALL	005483	PROTECTOR, M-STRAP	10
9	ALL	000371	BOLT, HEX, 1/4-20 X 1-1/4, SS	34
10	ALL	000390	BOLT, HEX, 5/16-18 X 2, SS	10
11	ALL	000314	BOLT, HEX 5/18-24 X 2-11/32, CAD	10
12	ALL	001833	WASHER, FLAT, 1/4 X 1 1/16, SS	2
13	ALL	001857	WASHER, FLAT, 1/4 X 1-1/2, FND, SS	34
14	ALL	001840	WASHER, FLAT, 5/16 X 9/16, AN, SS	20
15	ALL	000068	WASHER, FLAT, 5/16 X 3/4, SS	30
16	ALL	001828	WASHER, FLAT, 1/4 X 1-1/2 X 1/8, NEO	4
17	ALL	001662	NUT, HEX, NYLOCK, 1/4-20, SS	34
18	ALL	001644	NUT, HEX, NYLOCK, 5/16-18, PLT	10
19	ALL	001637	NUT, HEX, NYLOCK JAM, 5/16-24, SS	10
20	ALL	001703	PIN, CLEVIS, 1/4 X 1-1/8, SS	2
21	ALL	001710	PIN, COTTER, PLATED, 1/16 X 3/4, PLT	2

IDS System, Models HL4000-HL9800

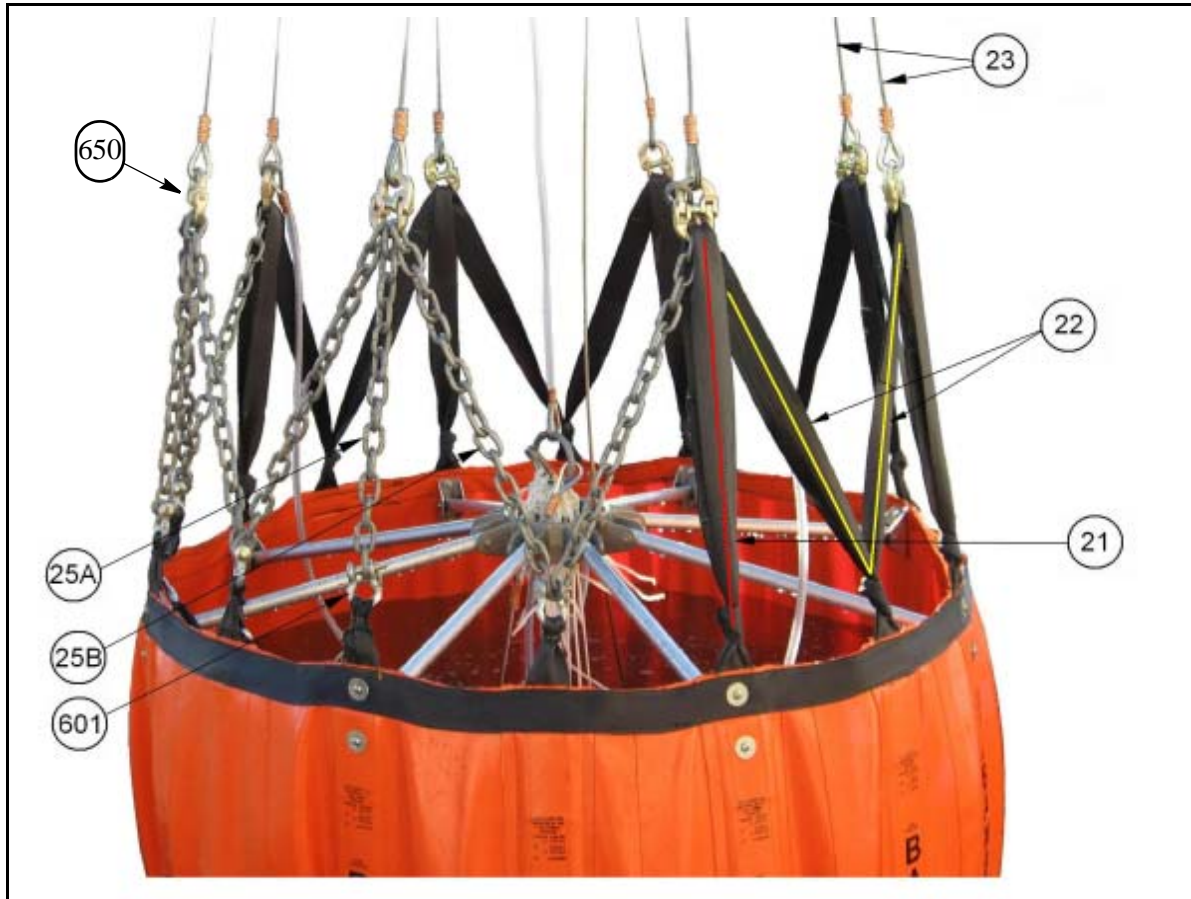


IDS System, Models HL4000-HL9800 Parts Listing

ITEM	MODEL	PART #	DESCRIPTION	QTY
1	ALL	005380	HUB, 10 SPOKE	1
	HL4000	007235	HUB, C/W CABLES, ASSEMBLIES	1
	HL5000	005382		
	HL7600	005383		
	HL9800	005384		
2	HL4000	005352	SPOKE, SOLID, 30-3/4"	10
	HL5000	005353	SPOKE, SOLID, 34-3/8"	
	HL7600	005354	SPOKE, SOLID, 40-7/8"	
	HL9800	005355	SPOKE, SOLID, 43-11/16"	
3	ALL	005387	BRACKET, SHELL	10
4		005390	PATCH, WEAR, BRACKET	2
5		005307	BRACKET, RESTRAINER	2
6		006194	PLATE, BACKING, RESTRAINER	4
7	HL4000	005303	CABLE, IDS, RESTRAINER	2
	HL5000	005304		
	HL7600	005305		
	HL9800	005306		
8	HL4000	005322	CABLE, IDS, DEPLOYMENT	1
	HL5000			
	HL7600	005323		
	HL9800			
9	ALL	005483	PROTECTOR, M-STRAP	10
10		000371	BOLT, HEX, 1/4-20 X 1-1/4, SS	34
11		000390	BOLT, HEX, 5/16-18 X 2, SS	10
12		000314	BOLT, HEX 5/18-24 X 2-11/32, CAD	10
13		001833	WASHER, FLAT, 1/4 X 11/16, SS	2
14		001857	WASHER, FLAT, 1/4 X 1-1/2, FND, SS	34
15		001840	WASHER, FLAT, 5/16 X 9/16, AN, SS	20
16		000068	WASHER, FLAT, 5/16 X 3/4, SS	30
17		001828	WASHER, FLAT, 1/4 X 1-1/2 X 1/8, NEO	4
18		001662	NUT, HEX, NYLOCK, 1/4-20, SS	34
19		001644	NUT, HEX, NYLOCK, 5/16-18, PLT	10
20		001637	NUT, HEX, NYLOCK JAM, 5/16-24, SS	10
21		001703	PIN, CLEVIS, 1/4 X 1-1/8, SS	2
22		001710	PIN, COTTER, PLATED, 1/16 X 3/4, PLT	2

Rigging Parts Listings

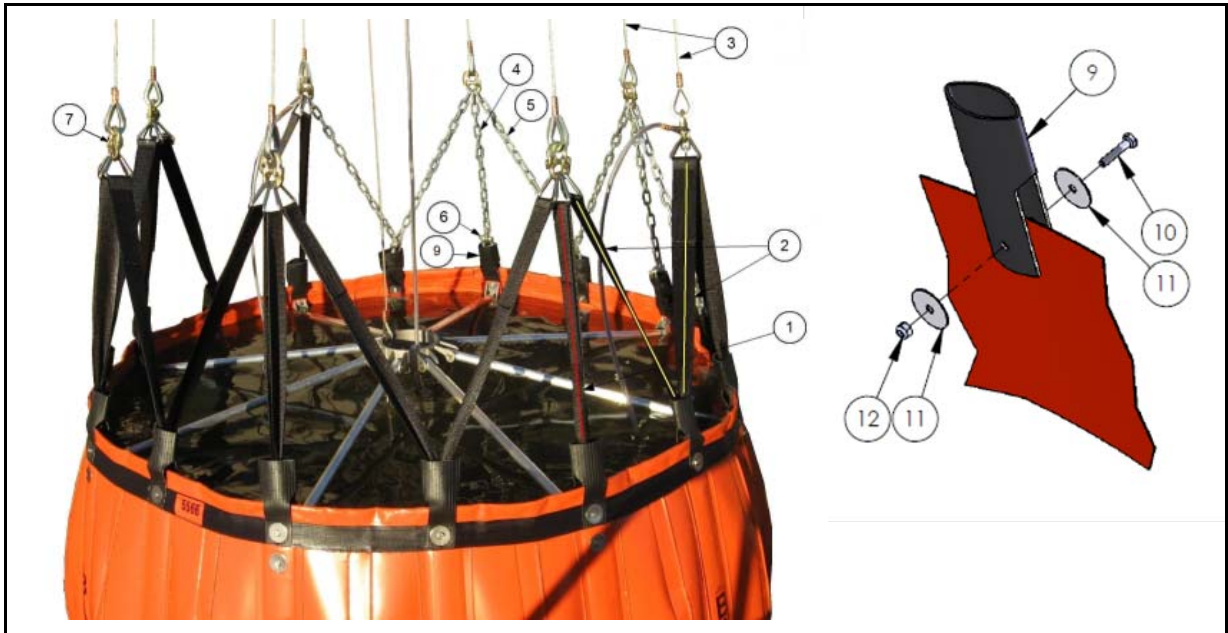
Rigging, Model 4453



Rigging, Models 4453 Parts Listing

ITEM	MODEL	PART NUMBER	DESCRIPTION	QTY
21	4453	005471	STRAP, M, LOOP, 18-3/8"	6
22		005472	STRAP, M, STRAIGHT, 22-1/4	5
23		0005549	CABLE, SUSPENSION, PAIR	4
25A		005526	CHAIN, TOP, 18-1/2"	2
25B		005527	CHAIN, TOP, 20-1/2"	6
601		001789	SHACKLE, ANCHOR, SCREW, 5/16, GLV	5
650		006710	LINK, CONNECTOR, 3/8", PLT	8

Rigging, Models 5566

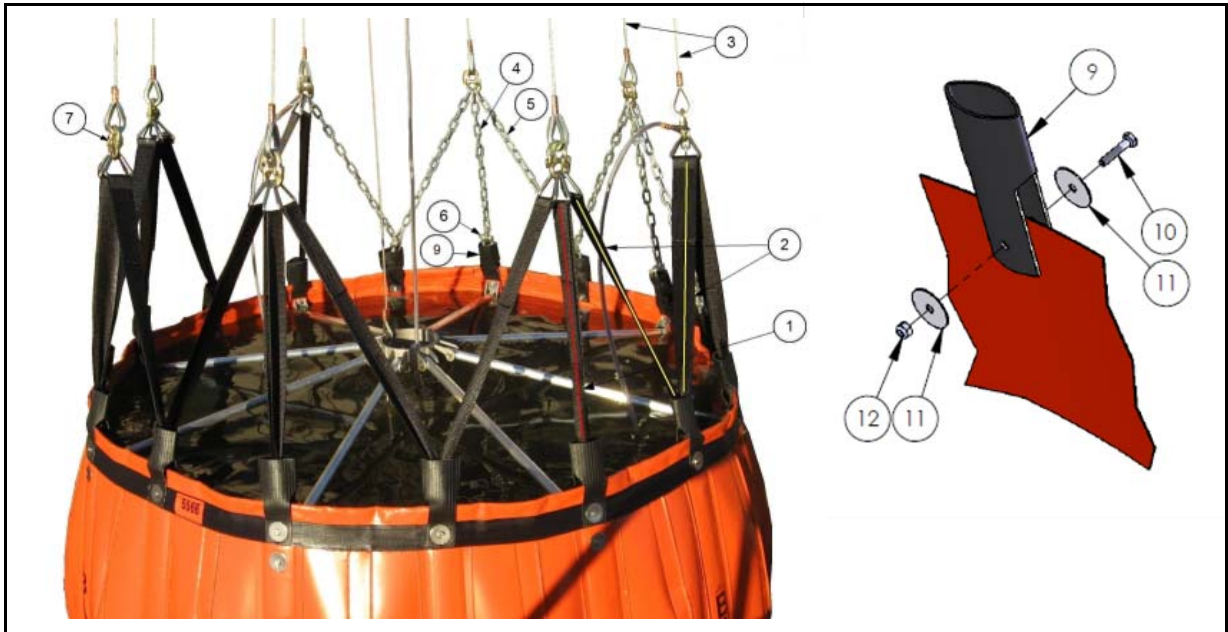


NOTE: #8 is not shown but is the link used to connect suspension lines to the head shackle.

Rigging, Models 5566 Parts Listing

ITEM	MODEL	PART #	DESCRIPTION	QTY
1	BB5566	005473	M-STRAP, LOOP, 22-5/8"	6
2		005474	M-STRAP, STRAIGHT, 50-1/2"	5
3		009857	CABLE, SUSPENSION, PAIR	4
4		005526	CHAIN, TOP, 18-1/2"	2
5		005527	CHAIN, TOP, 21-1/4"	6
6		001789	SHACKLE, ANCHOR, 5/16", SCREW GALV	5
7		004057	LINK, CONNECTING, 9/32", PLT	8
8		006710	LINK, CONNECTING, 3/8" PLT	4
9		005483	PROTECTOR, M-STRAP	8
10		000371	BOLT, HX, 1/4-20 X 1-1/4", SS	8
11		001857	WASHER, FLAT, 1/4 X 1-1/2", SS	16
12		001662	NUT, HX, NYLOCK, 1/4-20, SS	8

Rigging, Models 6578-HL9800



NOTE: #8 is not shown but is the link used to connect suspension lines to the head shackle.

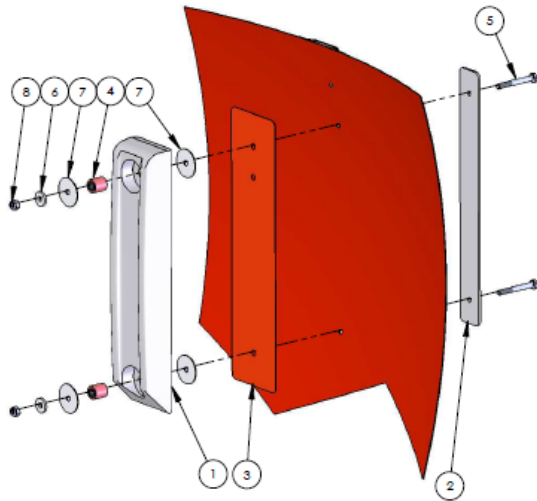
Rigging, Models 6578-HL9800 Parts Listing

ITEM	MODEL	PART #	DESCRIPTION	QTY
1	6578 7590	005475	M-STRAP, LOOP, 23-3/8"	6
	HL4000 HL5000	005477	M-STRAP, LOOP, 20-5/8"	
	HL7600	005479	M-STRAP, LOOP, 30-3/8"	
	HL9800	005481	M-STRAP, LOOP, 34-3/8"	
2	6578 7590	005476	M-STRAP, STRAIGHT, 51"	6
	HL4000 HL5000	BB684	M-STRAP, STRAIGHT, 47-1/4"	
	HL7600	005478	M-STRAP, STRAIGHT, 66-1/8"	
	HL9800	005482	M-STRAP, STRAIGHT, 74-1/4"	
3	6578 7590	009858	CABLE, SUSPENSION LINE, PAIR	4
	HL4000 HL5000	009859		
	HL7600	009860		
	HL9800	009861		
	6578 7590	009862	CABLE, SUSPENSION LINE, SINGLE	2
	HL4000 HL5000	009863		
	HL7600	009864		
	HL9800	009865		
4	6578 7590	005528	CHAIN, TOP, 20"	2
	HL4000 HL5000	005530	CHAIN, TOP, 17-1/2"	
	HL7600	005532	CHAIN, TOP, 26"	
	HL9800	005540	CHAIN, TOP, 30"	
5	6578 7590	005529	CHAIN, TOP, 21-1/4"	6
	HL4000 HL5000	005531	CHAIN, TOP, 20"	
	HL7600	005534	CHAIN, TOP, 28-3/4"	
	HL9800	005536	CHAIN, TOP, 30-1/4"	
5C	HL9800	005538	CHAIN, TOP, 34-3/4"	2
6	ALL	001789	SHACKLE, ANCHOR, 5/16", SCREW, GLV	5
7		004057	LINK, CONNECTING, 9/32", PLT, BOTTOM	6
8		006710	LINK, CONNECTING, 3/8", PLT, TOP	10
9		005483	M-STRAP, PROTECTOR	10
10		000371	BOLT, HEX HEAD, 1/4-20 X 1-1/4, SS	10
11		001857	WASHER, FLAT, 1/4 X 1-1/2, FND, SS	20
12		001662	NUT, HX, NYLOCK, 1/4-20, SS	10

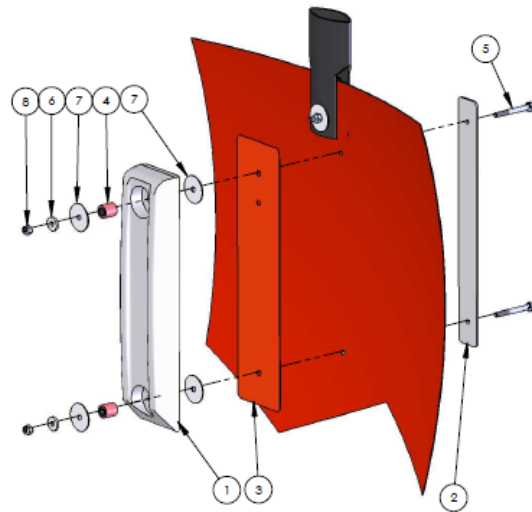
Ballast Parts Listings

Ballast, Models 4453-HL9800

Model 4453



Model 5566-HL9800



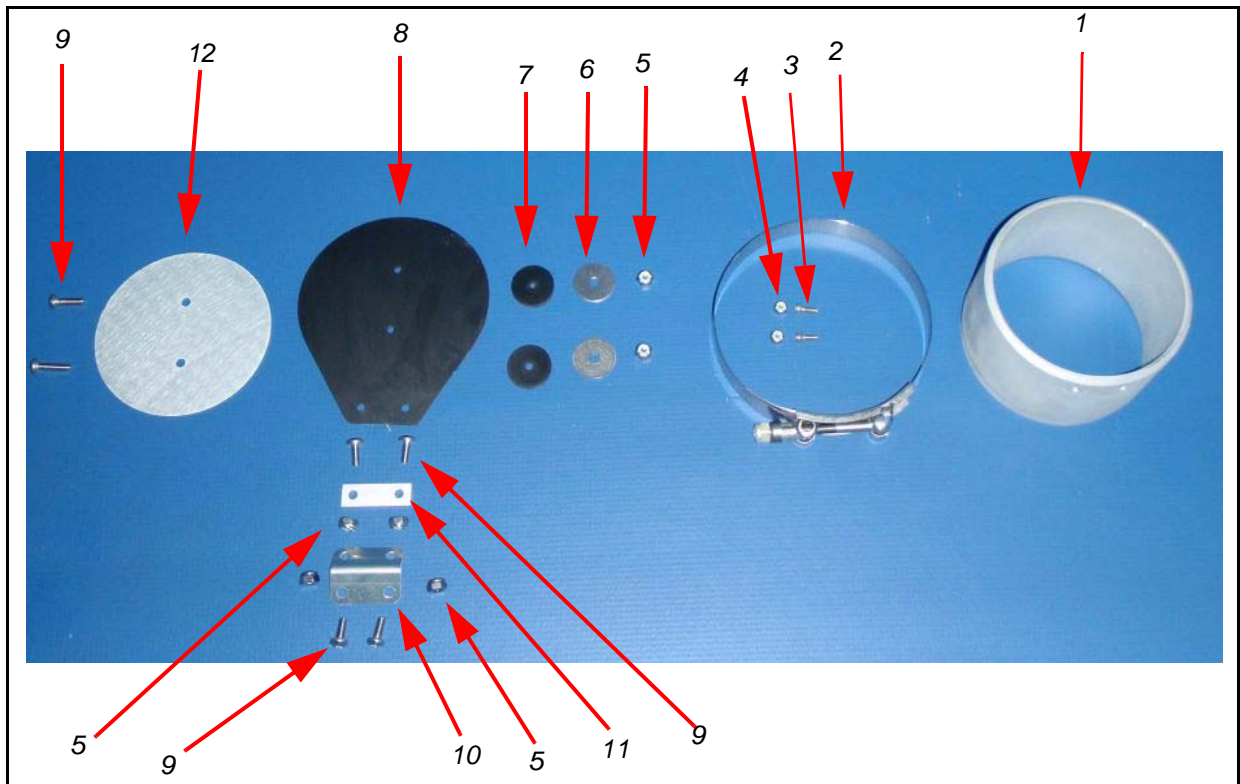
Ballast, Models 4453-HL9800 Parts Listing

ITEM	MODEL	PART NUMBER	DESCRIPTION	QTY
1	ALL	005455	PLATE, BALLAST, 16 LB, GLV	3
2		005459	PLATE, BACKING, BALLAST, BAR, SS	3
3		005464	PATCH, WEAR, BALLAST BAR	3
4		007111	SPACER, BALLAST BAR	6
5		000380	BOLT, HEX HEAD, SS, 1/4-20 X 2-1/4	6
6		001834	WASHER, FLAT, SS, 1/4 X 1-1/2	12
7		001857	WASHER, FLAT, SS, 1/4 X 3/4 X 1/8	6
8		001662	NUT, NYLOCK , SS, 1/4-20	6

Section 18: PowerFill Torrentula Parts

PowerFill Torrentula Parts Listings

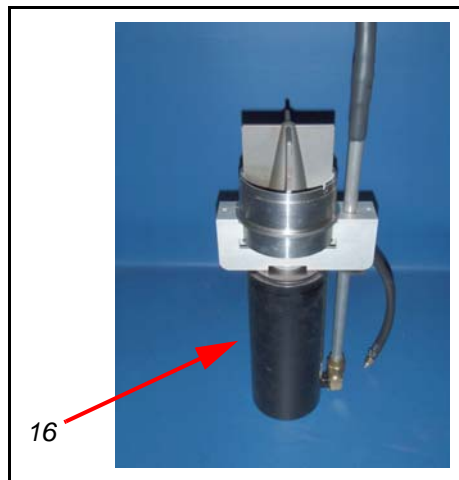
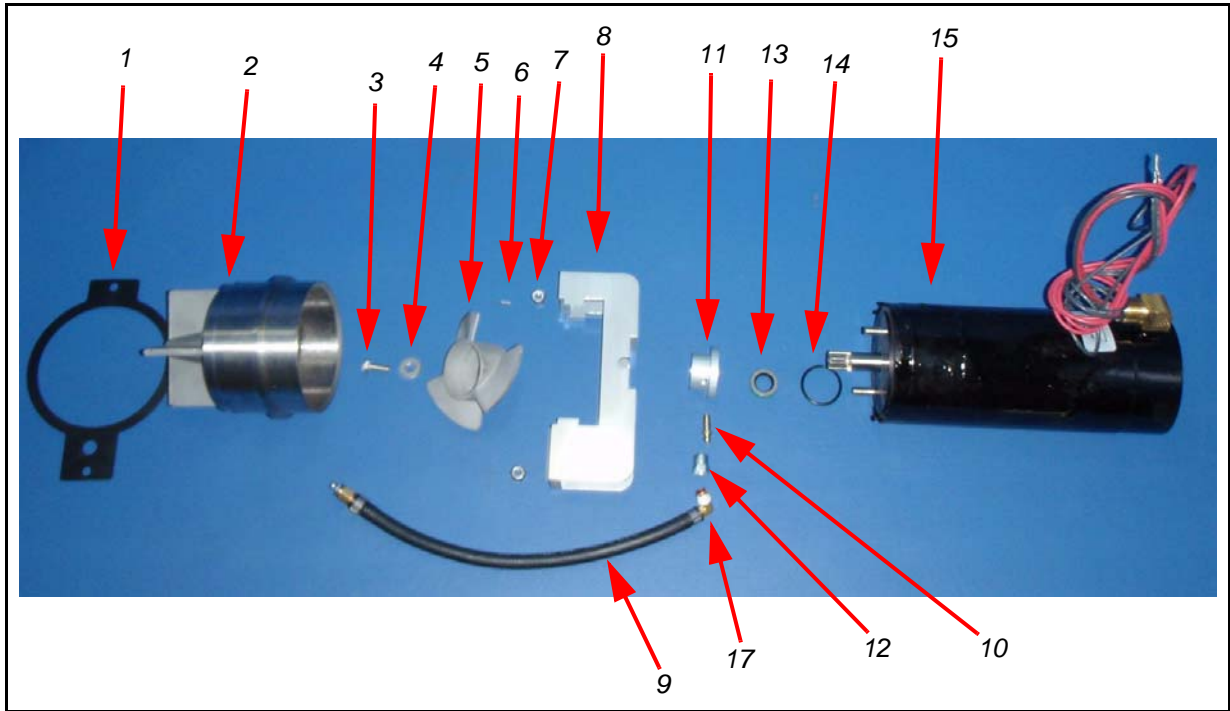
Valve Flapper



Valve Flapper Parts Listing

ITEM	PART NUMBER	DESCRIPTION	QTY
1	001063	DUCT, VALVE, FLAPPER, AL, PF1	1
2	001064	CLAMP, VALVE, FLAPPER, PF1	1
3	000409	SCREW, 6-32 X 1/2", SC, SS	2
4	001658	NUT, HX, NYLOCK, 6-32, SS	2
5	001660	NUT, HX, NYLOCK, 10-24, SS	6
6	001856	WASHER, FLAT, #10 X 1", FND, SS	2
7	001829	GASKET, 1" X 2" X 3/16", NEO.	2
8	001061	VALVE, FLAPPER, PF1, ALL MODELS	1
9	00494	SCREW, 10-24 X 5/8", PNP, SS	6
10	001062	BRACKET, VALVE, FLAPPER, PF1	1
11	001104	BRACKET, PLATE, VALVE, FLAPPER	1
12	001065	BRACE, DISC, 4" DIA, VALVE, FLAPPER	1
13	001036	PLATE, PUMP, PF1	1
14	009047	VALVE, FLAPPER, ASSEMBLY, COMPLETE, PF1	1

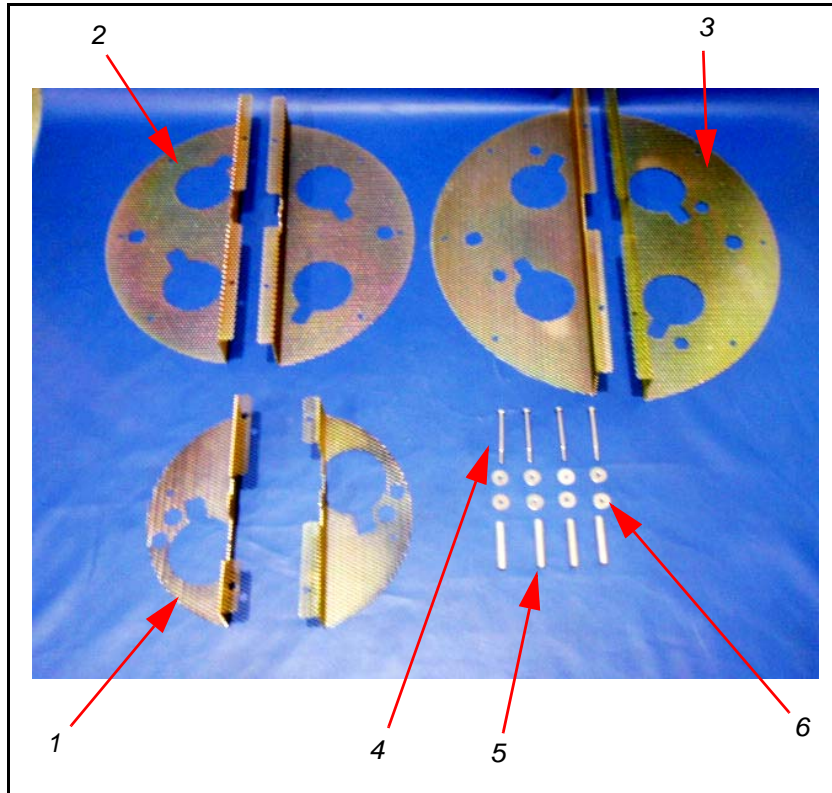
PowerFill Torrentula Motor Assembly



PowerFill Torrentula Motor Assembly Parts Listing

ITEM	PART NUMBER	DESCRIPTION	QTY
1	001067	GASKET, MOTOR, PF1	1
2	005735	RECUPERATOR, CAST, 4" S/S	1
3	000533	BOLT, HX, 1/4-28 X 3/4", SS	1
4	001834	WASHER, FLAT, 1/4" X 3/4" X 1/8", SS	1
5	005734	IMPELLER, CAST, SS, 4", #3	1
6	001734	PIN, SPLIT, 1/8" X 3/8", SS	1
7	001664	NUT, HX, NYLOCK, 5/16-18, SS	2
8	005205	ADAPTER, MOTOR, AL	1
9	001097	EXTENSION, GREASE, ASSEMBLY, PF1	1
10	005175	FITTING, GREASE, 1/4-28 X 15/16", STRAIGHT	1
11	001059	CUP, SEAL, MOTOR, AL	1
12	003132	ADAPTER, GREASE, PLT	1
13	006228	SEAL, 5/8 X 25 X 1/4, R	1
14	001890	O-RING, BUNA, N, #124	1
15	001058	MOTOR, SUBMERSIBLE, 24 VDC	1
16	002615	ELBOW, BARB, 1/4 X 1/8" MNPT BRASS	1
17	003059	CLAMP, OETIKER, 1/2" SS	2
18	005175	FITING, GREASE, 1/4-28 X 15/16 LINCOLN	1
19	006232	MOTOR, ASSEMBLY, PF1 C/W WIRING HARNESS	1

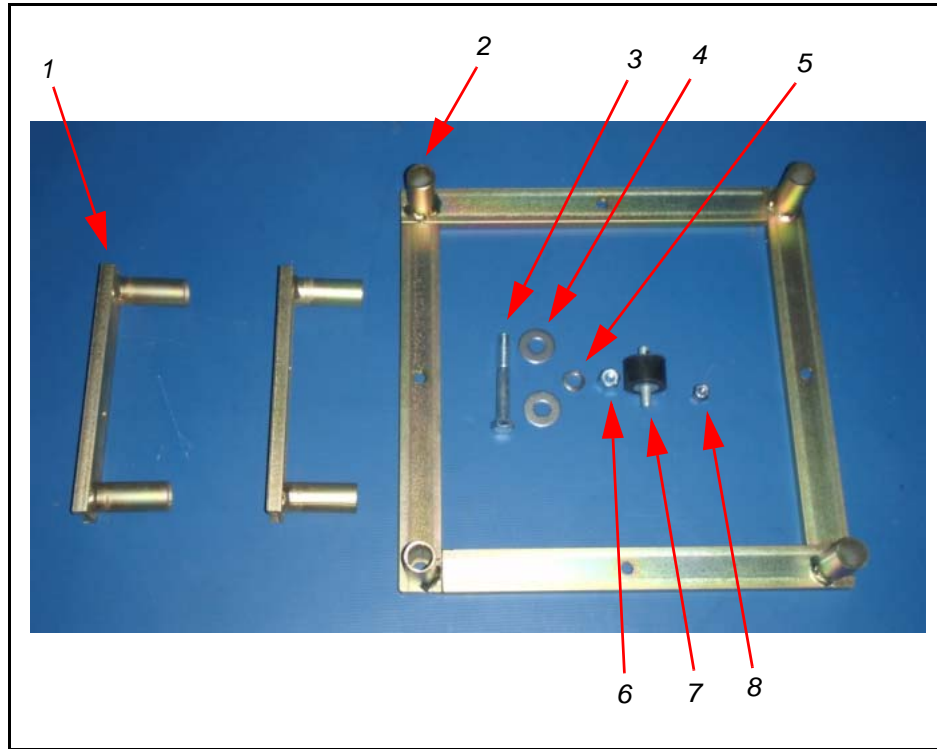
Filter Screens



Filter Screens Parts Listing

ITEM	PART NUMBER	DESCRIPTION	16" Valve	24" Valve	27" Valve
1	005188	SCREEN, FILTER, 16", PF1	2		
2	005189	SCREEN, FILTER, 24", PF1		2	
3	005190	SCREEN, FILTER, 27", PF1			2
4	001032	SPACER, FILTER, SCREEN PF1	2	6	6
5	000384	BOLT, HX, 1/4"-20 X 3 1/2", SS	2	6	6
6	001858	WASHER, FLT, 1/4" X 1", FND, SS	4	12	12

Motor Guards



Motor Guards Parts Listing

ITEM	PART NUMBER	DESCRIPTION	16" Valve	24" Valve	27" Valve
1	001033	GUARD, MOTOR, 16" PF1	2		
2	005192	GUARD, MOTOR, 24" PF1		1	
2	005191	GUARD, MOTOR, 27" PF1			1
3	000354	BOLT, HX, 1/2"-13 X 3 1/2" , PLT	4	4	4
4	001847	WASHER, FLT 1/2" X 1 380, USS, S/S	4	4	4
5	001854	WASHER, LOCK, SPLIT 1/2" S/S	4	4	4
6	001846	WASHER, FLT, 3/8" X 1 X .125, S/S	2	4	4
7	002187	MOUNT, VIBRATION, NEO, 1" X 3/8"	2	4	4
8	001665	NUT, HX, NYLOCK, 3/8-16 S/S	2	4	4

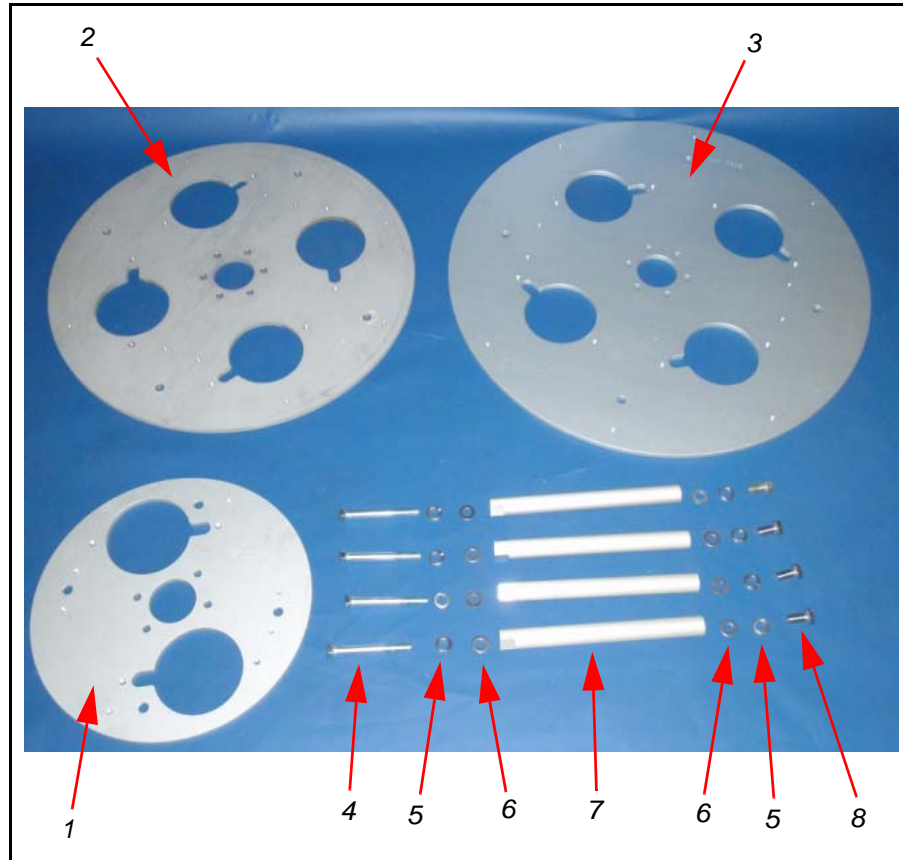
Stand Offs



Stand Offs Parts Listing

ITEM	PART NUMBER	DESCRIPTION	16" Valve	24" Valve	27" Valve
1	001039	STANDOFF, BASE, 16", PF1	4		
	005194	STANDOFF, BASE, 24", PF1		1	
	005193	STANDOFF, BASE, 27", PF1			1
4	001034	BLOCK, BUMPER, 16", PF1	4		
	001107	BLOCK, MUDPAD, 16", PF1	4		
	001068	BLOCK, BUMPER, 24", PF1		4	
	007500	BLOCK, MUDPAD, 24", PF1		4	
	001069	BLOCK, BUMPER, 27", PF1			5
	001095	BLOCK, MUDPAD, 27", PF1			5
3	000341	BOLT, HEX, 3/8"-16 X 1 3/4", PLATED	8		
4	000343	BOLT, HEX, 3/8"-16 X 2 1/2", PLATED	8		
5	000354	BOLT, HEX, 1/2"- 13 X 3 1/2", PLATED		8	
6	000350	BOLT, HEX, 1/2"-, 13 X 2 1/2", PLATED		8	
7	001863	WASHER, FLAT, 3/8", SS	32		
8	001847	WASHER, FLAT, 1/2" X 1 3/8", USS, SS		30	40
9	001645	NUT, HX, NYLOCK, 3/8"-16, PLATED	16		
10	001646	NUT, HX, NYLOCK, 1/2"-13, PLATED		16	20

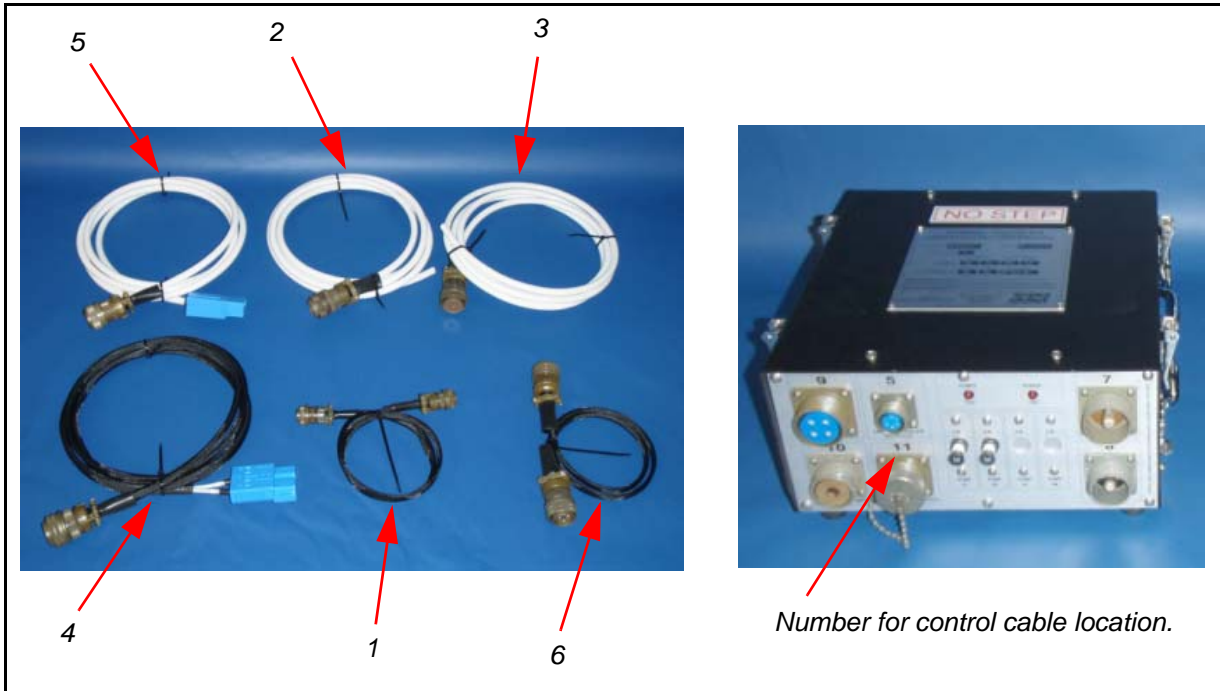
Top Plates and Support Rods



Top Plates and Support Rods Parts Listing

ITEM	PART NUMBER	DESCRIPTION	QTY.
1	005185	TOP, PLATE, 16" PF1	1
2	005186	TOP, PLATE, 24" PF1	1
3	005187	TOP, PLATE, 27" PF1	1
4	000354	BOLT, 1/2-13 x 3-1/2 , PLATED	4
5	001854	WASHER, LOCK, SPLIT, 1/2", SS	8
6	001842	WASHER, FLAT, 1/2" X 7/8", AN, SS	8
7	000182	ROD, SUPPORT, 1" X 10.5", AL, ANO	4
8	000398	BOLT, HX, 1/2" -13 X 1", SS	4

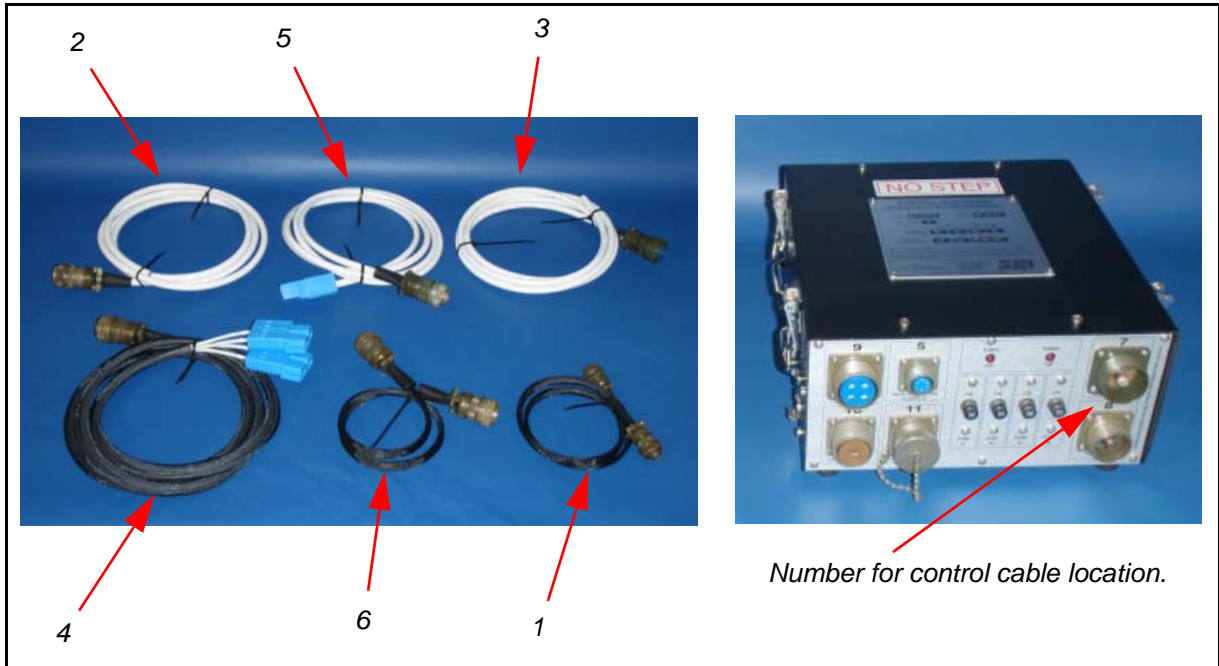
Wire Harness, Two Pump Model



Wire Harness, Two Pump Model Parts Listing

ITEM	PART NUMBER	DESCRIPTION	QTY
1	000804	HARNESS, WIRE, H5, PF1	1
2	000805	HARNESS, WIRE, H7, PF1	1
3	000806	HARNESS, WIRE, H8, PF1	1
4	000807	HARNESS, WIRE, H9, PF1	1
5	000808	HARNESS, WIRE, H10, PF1	1
6	000809	HARNESS, WIRE, H11, PF1	1

Wire Harness, Four Pump Model

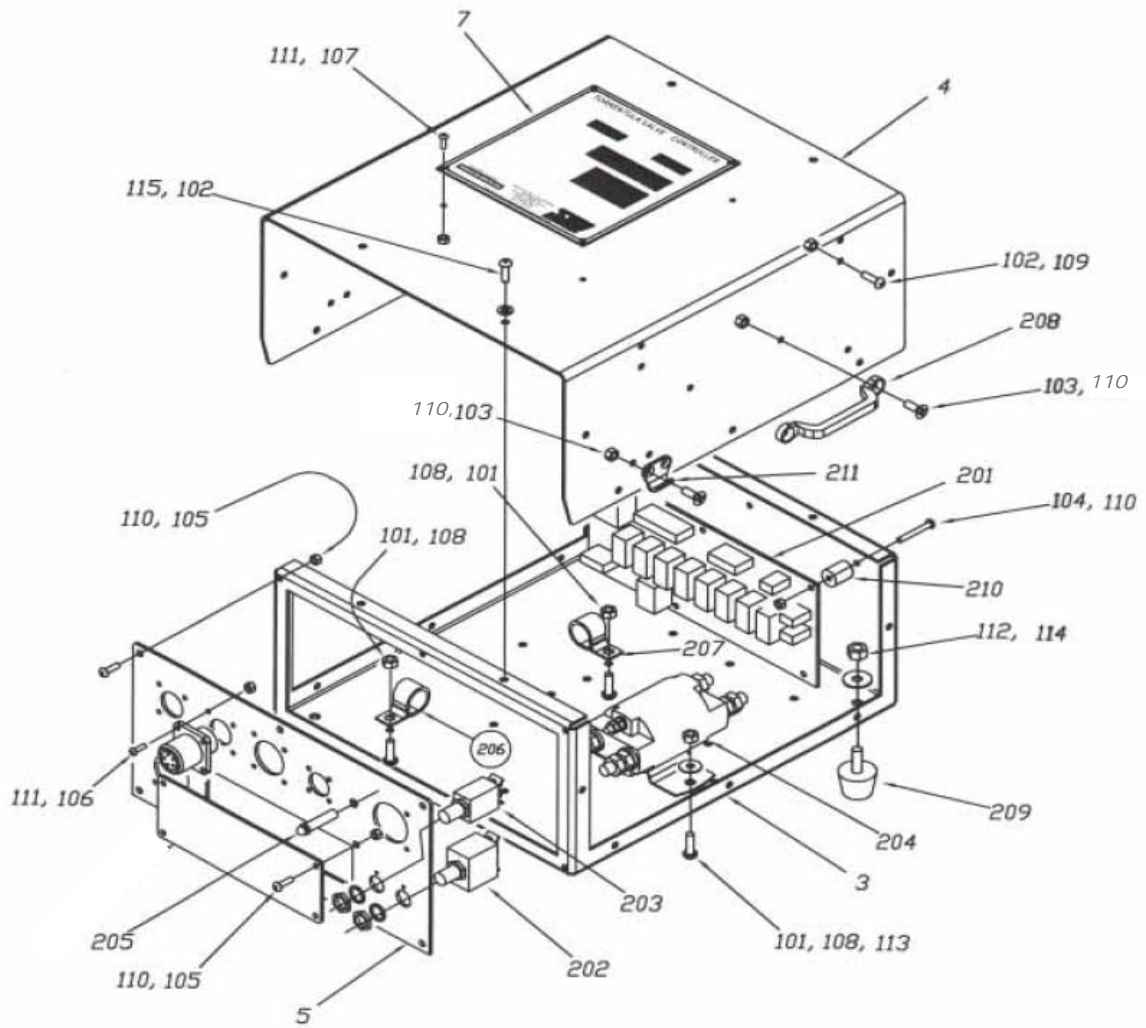


Wire Harness, Four Pump Model Parts Listing

ITEM	PART NUMBER	DESCRIPTION	QTY
1	000804	HARNESS, WIRE, H5, PF1	1
2	000805	HARNESS, WIRE, H7, PF1	1
3	000806	HARNESS, WIRE, H8, PF1	1
4	000808	HARNESS, WIRE, H10, PF1	1
5	000809	HARNESS, WIRE, H11, PF1	1
6	000810	HARNESS, WIRE, H12, PF1	1

Section 19: Electrical Component Parts

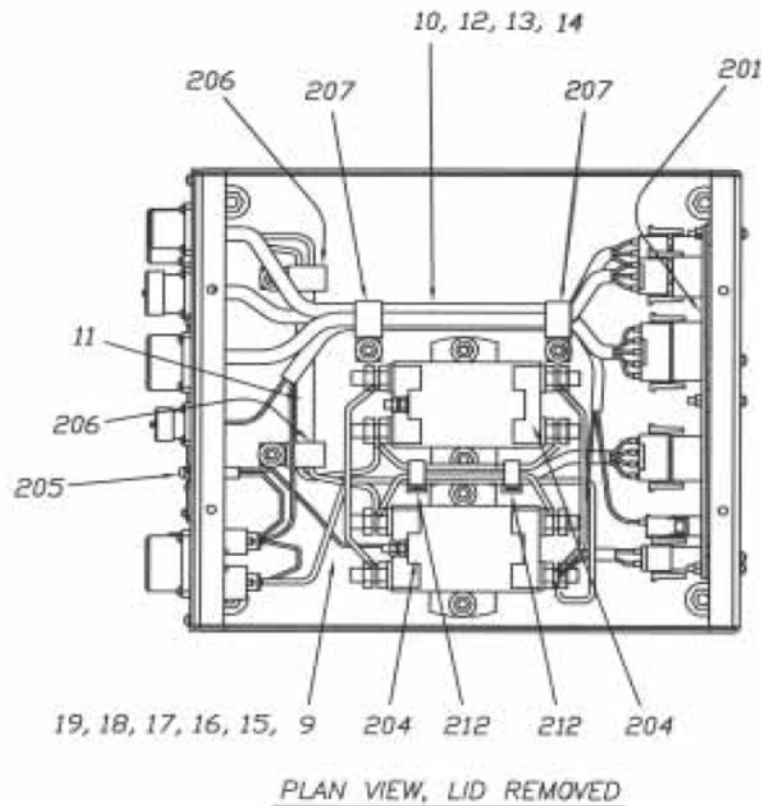
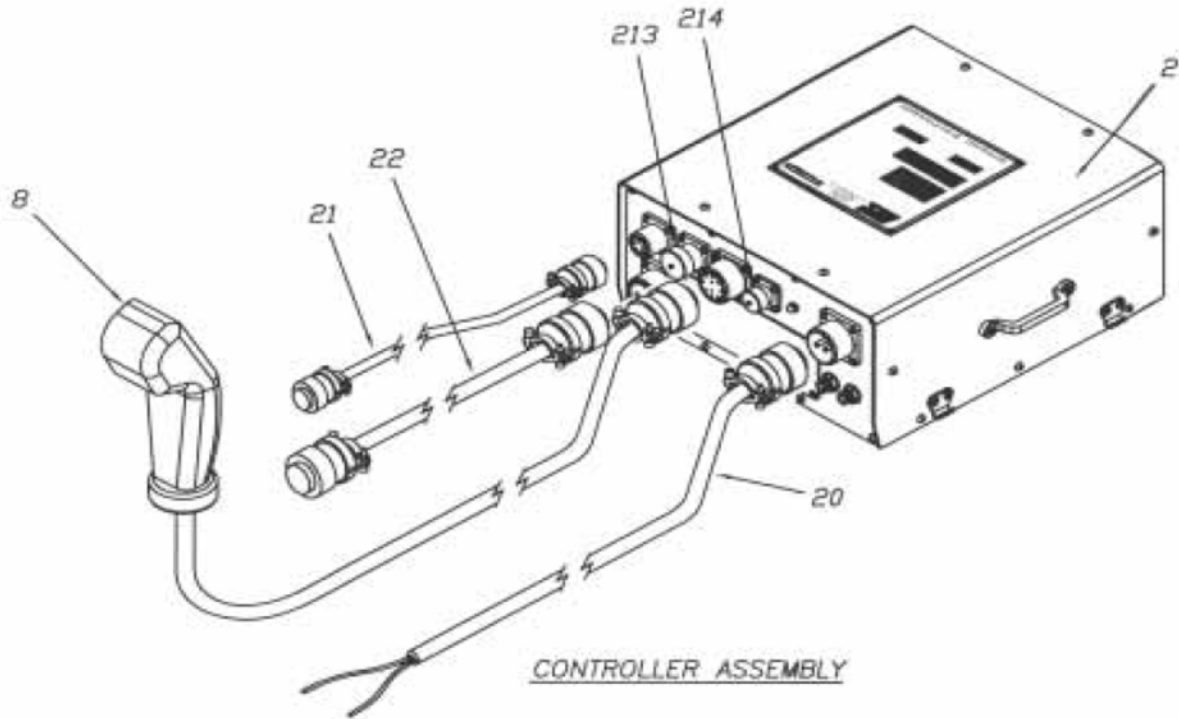
Torrentula Control Box



Torrentula Control Box Parts Listing

ITEM #	PART #	DESCRIPTION	QTY.
216	001658	NUT, HX, NYLOCK, 6-32, SS	6
210	001751	SPACER, ROUND, #6 X 5/8", NYLON	6
209	003127	MOUNT, VIBRATION, 1/4"-20	4
204	001323	RELAY, DPST, 24VDC, 100A	2
203	000897	BREAKER, CIRCUIT, 4A	1
202	000902	BREAKER, CIRCUIT, 30A	1
201	000826	BOARD, CIRCUIT, ASSEMBLY	1
117	000485	SCREW, 6-32 X 1-1/4", PNP, SS	6
116	000494	SCREW, 10-24 X 5/8", PNP, SS	8
114	001833	WASHER, FLAT, 1/4 X 11/16", THIN, SS	4
113	001855	WASHER, FLAT, #10 X 3/4", FND, SS	4
112	001644	NUT, HX, NYLOCK, 1/4-20, SS	4
111	001657	NUT, HX, NYLOCK, 4-40, SS	28
110	001659	NUT, HX, NYLOCK, 8-32, SS	32
108	001660	NUT, HX, NYLOCK, 10-24, SS	18
107	000475	SCREW, 4-40 X 3/8", PNP, SS	4
106	000405	SCREW, 4-40 X 5/8", PNP, SS	24
105	000488	SCREW, 8-32 X 1/2", PNP, SS	16
103	000443	SCREW, 8-32 X 1/2" FHP, SS	8
102	000487	SCREW, 8-32 X 3/8", PNP, SS	16
101	000494	SCREW, 10-24 X 5/8", PNP, SS	8
25	001305	LED, 24VDC, 20MCD, GR	1
7	000873	PLATE, FACR, CONTROL	1
4	000871	ENCLOSURE, LID, CONTROL	1
3	000870	ENCLOSURE, BASE, CONTROL	1

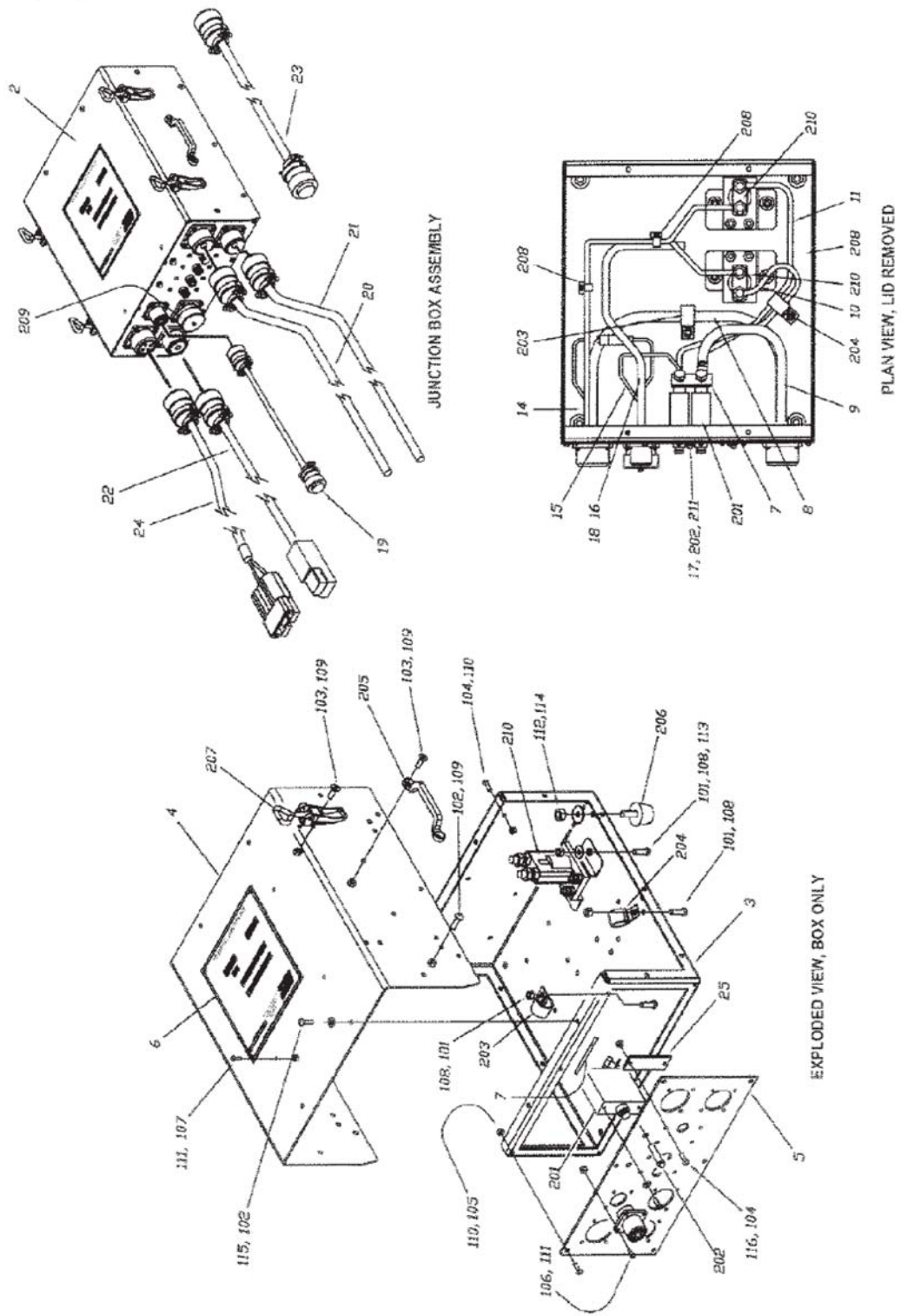
Torrentula Control Box Wiring Harness



Torrentula Control Box Wiring Harness Parts Listing

ITEM #	PART #	DESCRIPTION	QTY.
214	001255	CAP, RECEPTACLE, SIZE 10	1
213	001256	CAP, RESEPTACLE, SIZE 14	1
212	002946	TIEWRAP, 3/16" X 7.5"	2
207	002957	CLAMP, CABLE, 5/8"	2
206	002956	CLAMP, CABLE, 3/8"	2
205	001305	LED, 24VDC, 20MCD, GR	1
204	001323	RELAY, DPST, 24VDC, 100A	2
201	000826	BOARD, CIRCUIT, ASSY	1
22	000843	HARNESS, WIRE, H3	1
21	000842	HARNESS, WIRE, H2	1
20	000841	HARNESS, WIRE, H1	1
19	000835	HARNESS, WIRE, W23	1
18	000852	HARNESS, WIRE, W22	1
17	007737	HARNESS, WIRE, W21	2
16	000834	HARNESS, WIRE, W20	2
15	000833	HARNESS, WIRE, W7	1
14	000832	HARNESS, WIRE, W6	1
13	000831	HARNESS, WIRE, H5	1
12	000830	HARNESS, WIRE, W4	1
11	000829	HARNESS, WIRE, W3	1
10	000828	HARNESS, WIRE, W2	1
9	000827	HARNESS, WIRE, W1	1
8	000825	GRIP, OPERATOR, CONTROL	1
2	006766	CONTROL, TORRENTULA	1

PowerFill Junction Box



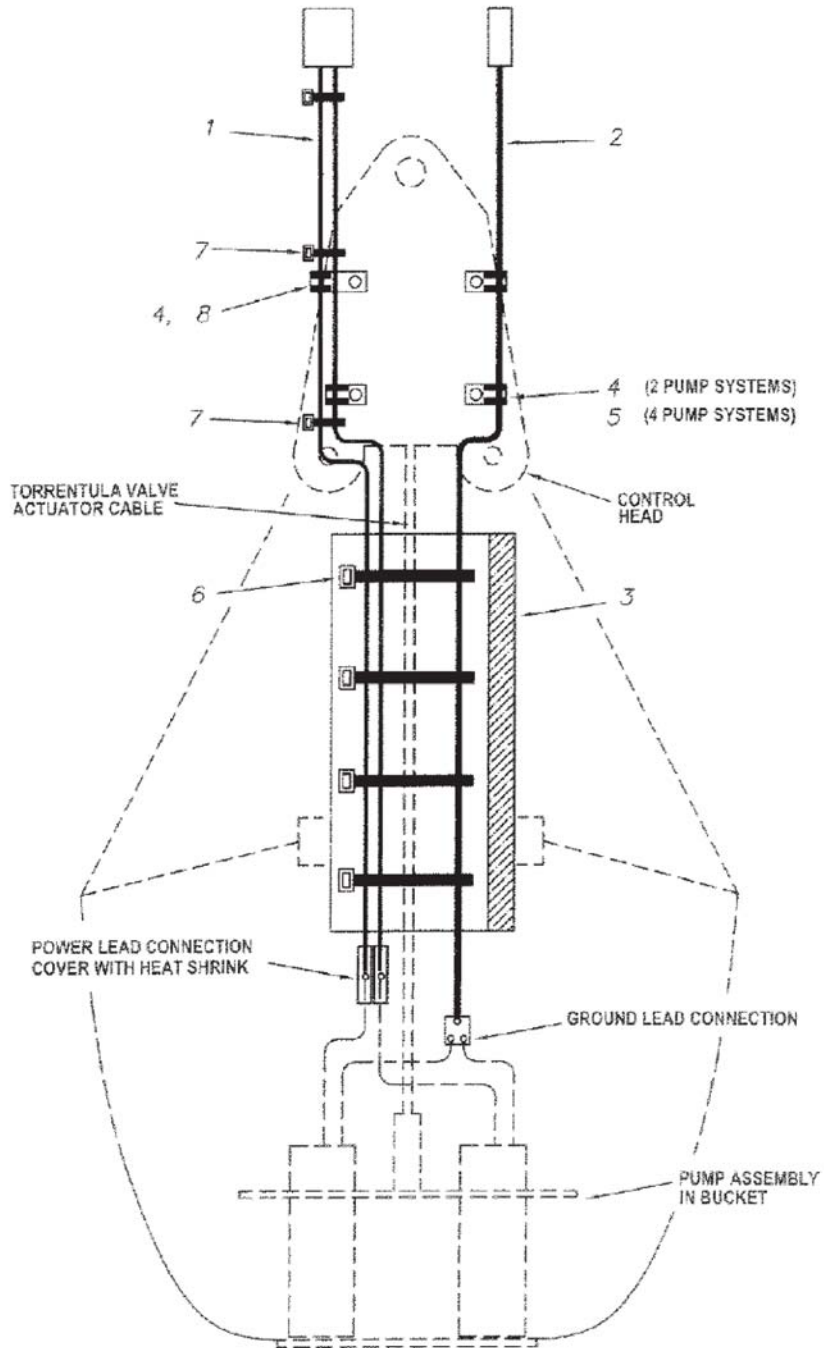
PowerFill Junction Box Parts Listing (Models 4453, 5566, 5870, 7590 w/2 pumps)

ITEM	PART NUMBER	DESCRIPTION	QTY.
1	000812	CONTROL, BOX, ASSEMBLY, POWERFILL, 4453-7590	1
2	000780	CONTROL, POWERFILL, 2 PUMP	1
3	000870	ENCLOSURE, BASE, CONTROLLER	1
4	000871	ENCLOSURE, LID, CONTROLLER	1
5	000816	ENCLOSURE, FACE, PLATE	1
6	000818	TAG, MACHINE, PF1	1
7	000819	BUS, BAR	1
8	000782	HARNESS, WIRE, W40	1
9	000783	HARNESS, WIRE, W41	1
10	000784	HARNESS, WIRE, W42	1
11	000785	HARNESS, WIRE, W43	1
14	000788	HARNESS, WIRE, W47	1
15	000789	HARNESS, WIRE, W48	1
16	000790	HARNESS, WIRE, W49	1
17	000791	HARNESS, WIRE, W50	1
18	000792	HARNESS, WIRE, W51	1
19	000804	HARNESS, WIRE, H5	1
20	000805	HARNESS, WIRE, H7, NON UH60 COPTERS	1
	000811	HARNESS, WIRE, H78, FOR UH60	1
21	000806	HARNESS, WIRE, H8	1
22	000808	HARNESS, WIRE, H10	1
23	000809	HARNESS, WIRE, H11	1
24	000807	HARNESS, WIRE, H9	1
25	000817	PLATE, BLANK, CIRCUIT, BREAKER	2
101	000494	SCREW, 10-24 X 5/8" PNPH, SS	18
102	000487	SCREW, 8-32 X 3/8" PHPH, SS	20
103	000488	SCREW, 8-32 X 1/2", FHPH, SS	12
104	000482	SCREW, 6-32 X 3/8" PNPH, SS	14
105	000483	SCREW, 6-32 X 1/2" PHPH, SS	6
106	000478	SCREW, 4-40 X 5/8" PNPH, SS	24
107	000475	SCREW, 4-40 X 3/8" PHPH, SS	4
108	001660	NUT, NYLOCK 10-24, HX, SS	18
109	001659	NUT, NYLOCK, 8-32, HX, SS	28
110	001658	NUT, NYLOCK, 6-32, HX, SS	12
111	001657	NUT, NYLOCK, 4-40, HX, SS	28
112	001662	NUT, NYLOCK 1/4-20, HX, SS	4
113	001855	WASHER, FLT, #10 X 3/4" SS	8
114	001832	WASHER, FLT, 1/4 X 3/4, SS	4
115	001850	WASHER, LOCK, SPLIT #8, SS	14
116	001849	WASHER, LOCK, SPLIT #6, SS	8
201	000904	CIRCUIT BREAKER, 50A MS25361-50	2
202	001305	LED, INDICATOR GREEN	2
203	002956	CLAMP CABLE 3/8" ID	1
204	002957	CLAMP CABLE 1/2" ID	1
205	006700	EYE, STRAP, TIEDOWN 2"	2
206	003127	MOUNT, VIBRATION 1/4-20	3
207	003018	PLATE, CATCH, SS	4
208	002945	TIEWRAP, 1/8 X 5.5"	4
210	001324	RELAY, SPST-NO 24 VDC, 100A	2
211	001498	TERMINAL, RING 1/4", 22-16 AWG	1

PowerFill Junction Box Parts Listing (Models HL5000, HL7600, HL9800, 7590 w/4 pumps)

ITEM	PART #	DESCRIPTION	QTY.
1	000812	CONTROL, BOX, ASSEMBLY, POWERFILL, HL4000-HL9800	1
2	000781	CONTROL, POWERFILL, 4 PUMP	1
3	000870	ENCLOSURE, BASE, CONTROLLER	1
4	000871	ENCLOSURE, LID, CONTROLLER	1
5	000816	ENCLOSURE, FACE, PLATE	1
6	000818	TAG, MACHINE, PF1	1
7	000819	BUS, BAR	1
8	000782	HARNESS, WIRE, W40	1
9	000783	HARNESS, WIRE, W41	1
10	000784	HARNESS, WIRE, W42	1
11	000785	HARNESS, WIRE, W43	1
12	000786	HARNESS, WIRE, W44	1
13	000787	HARNESS, WIRE, W45	1
14	000788	HARNESS, WIRE, W47	1
15	000789	HARNESS, WIRE, W48	1
16	000790	HARNESS, WIRE, W49	1
17	000791	HARNESS, WIRE, W50	1
18	009427	HARNESS, WIRE, W52	1
19	000804	HARNESS, WIRE, H5	1
20	000805	HARNESS, WIRE, H7, NON UH60 COPTERS	1
	000811	HARNESS, WIRE, H78, FOR UH60	1
21	000806	HARNESS, WIRE, H8	1
22	000808	HARNESS, WIRE, H10	1
23	000809	HARNESS, WIRE, H11	1
24	000807	HARNESS, WIRE, H9	1
25	000817	PLATE, BLANK, CIRCUIT, BREAKER	2
101	000494	SCREW, 10-24 X 5/8" PNP, SS	18
102	000487	SCREW, 8-32 X 3/8" PPH, SS	20
103	000488	SCREW, 8-32 X 1/2", FHPH, SS	12
104	000482	SCREW, 6-32 X 3/8" PNP, SS	14
105	000483	SCREW, 6-32 X 1/2" PPH, SS	6
106	000478	SCREW, 4-40 X 5/8" PNP, SS	24
107	000475	SCREW, 4-40 X 3/8" PPH, SS	4
108	001660	NUT, NYLOCK 10-24, HX, SS	18
109	001659	NUT, NYLOCK, 8-32, HX, SS	28
110	001658	NUT, NYLOCK, 6-32, HX, SS	12
111	001657	NUT, NYLOCK, 4-40, HX, SS	28
112	001662	NUT, NYLOCK 1/4-20, HX, SS	4
113	001855	WASHER, FLT, #10 X 3/4" SS	8
114	001832	WASHER, FLT, 1/4 X 3/4, SS	4
115	001850	WASHER, LOCK, SPLIT #8, SS	14
116	001849	WASHER, LOCK, SPLIT #6, SS	8
201	000904	CIRCUIT BREAKER, 50A MS25361-50	4
202	001305	LED, INDICATOR GREEN	4
203	002956	CLAMP CABLE 3/8" ID	1
204	002957	CLAMP CABLE 1/2" ID	1
205	006700	EYE, STRAP, TIEDOWN 2"	2
206	003127	MOUNT, VIBRATION 1/4-20	3
207	003018	PLATE, CATCH, SS	4
208	002945	TIEWRAP, 1/8 X 5.5"	4
210	001324	RELAY, SPST-NO 24 VDC, 100A	2
211	001498	TERMINAL, RING 1/4", 22-16 AWG	1

PowerFill Cable Installation



PowerFill Cable Installation Parts Listing

ITEM	PART NUMBER	DESCRIPTION	QTY.
1	000798	HARNESS, WIRE, W61, 4453	1
	000799	HARNESS, WIRE, W61, 5566 - 7590 (7590 2 PUMP)	1
	000800	HARNESS, WIRE, W62, 7590, 4 PUMP	1
	000801	HARNESS, WIRE, W62, HL4000 – HL5000	1
	000803	HARNESS, WIRE, W62, HL7600 – HL9800	1
2	000793	HARNESS, WIRE, W60, 2732 – 4453	1
	000794	HARNESS, WIRE, W60, 5566 – 7590 (7590 2 PUMP)	1
	000795	HARNESS, WIRE, W60, 7590 4 PUMP	1
	000796	HARNESS, WIRE, W60, HL4000 – HL5000	1
	000797	HARNESS, WIRE, W60, HL7600 – HL9800	1
3	005196	SLEEVE, ACTUATOR, CABLE, 2732 – 7590 (7590 2 PUMP)	1
	005197	SLEEVE, ACTUATOR, CABLE, 7590 4 PUMP – HL4000	1
	005198	SLEEVE, ACTUATOR, CABLE, HL7600 – HL9800	1
4	002956	CLAMP CABLE 3/8" ID	4
5	002957	CLAMP CABLE 1/2" ID	2
6	002945	TIEWRAP, 3/16 X 7 1/2"	15
7	002945	TIEWRAP, 1/8 X 5 1/2"	15
8	000331	BOLT, 1/4-20 X 1, HX, SS	2

Section 20: Repair Kits and Carry Bags Parts

Repair Kits

Note: Always specify model and serial number when ordering parts and accessories

Shell Repair Kit #003613, Parts

PART NUMBER	DESCRIPTION	QTY.
002383	BAG, ZILOCK, 9 X 12"	2
003064	PAD, ABRASIVE	2
003071	ROLLER, SEAM, 1.25, PLS	1
003074	SCISSORS, SS	1
003608	BAG, WEIGHT, REPAIR	1
003661	MANUAL, PRODUCT, REPAIR	1
002379	BOX, TOOL, 16" PLS	1
004502	CLAMP, REPAIR, SMALL	1
008905	PATCH, FABRIC, 8 X 10" 32 oz, ORANGE	2

Optional Repair Accessories

PART NUMBER	DESCRIPTION
004502	CLAMP, REPAIR, SMALL
004503	CLAMP, REPAIR, MEDIUM
004504	CLAMP, REPAIR, LARGE
003071	ROLLER, SEAM, 1.25", PLS
003072	ROLLER, SEAM, 2" STEEL
003090	ADHESIVE, AQUASEAL, 3/4oz.

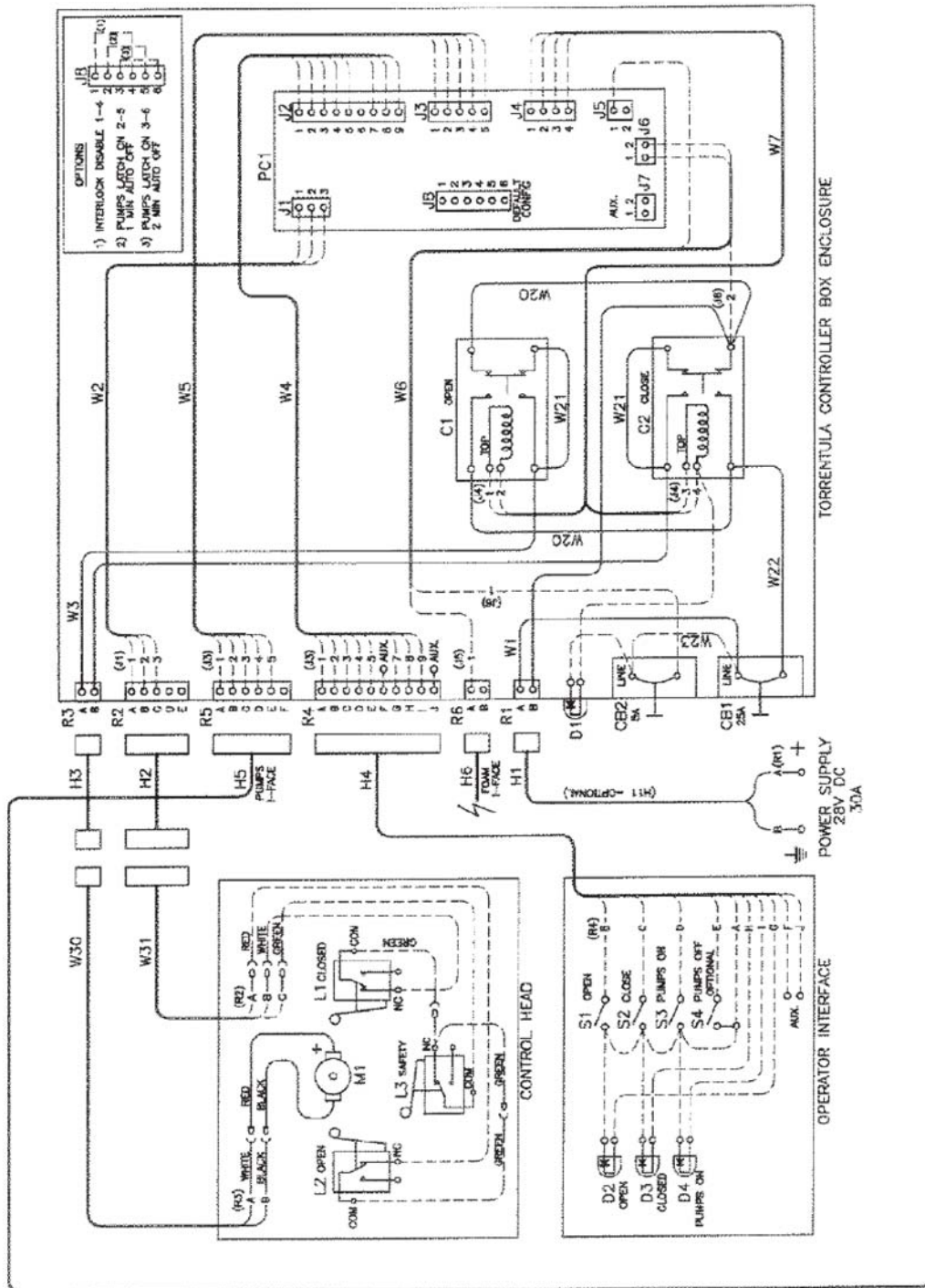
Carry Bags

PART NUMBER	DESCRIPTION
005602	BAG, CARRY, 3542-4453
005604	BAG CARRY, 5566-6578
005605	BAG, CARRY, 7590
005606	BAG, CARRY, HL4000-HL5000
005608	BAG, CARRY, HL7600
005610	BAG, CARRY, HL9800

Section 21: Wiring Diagrams

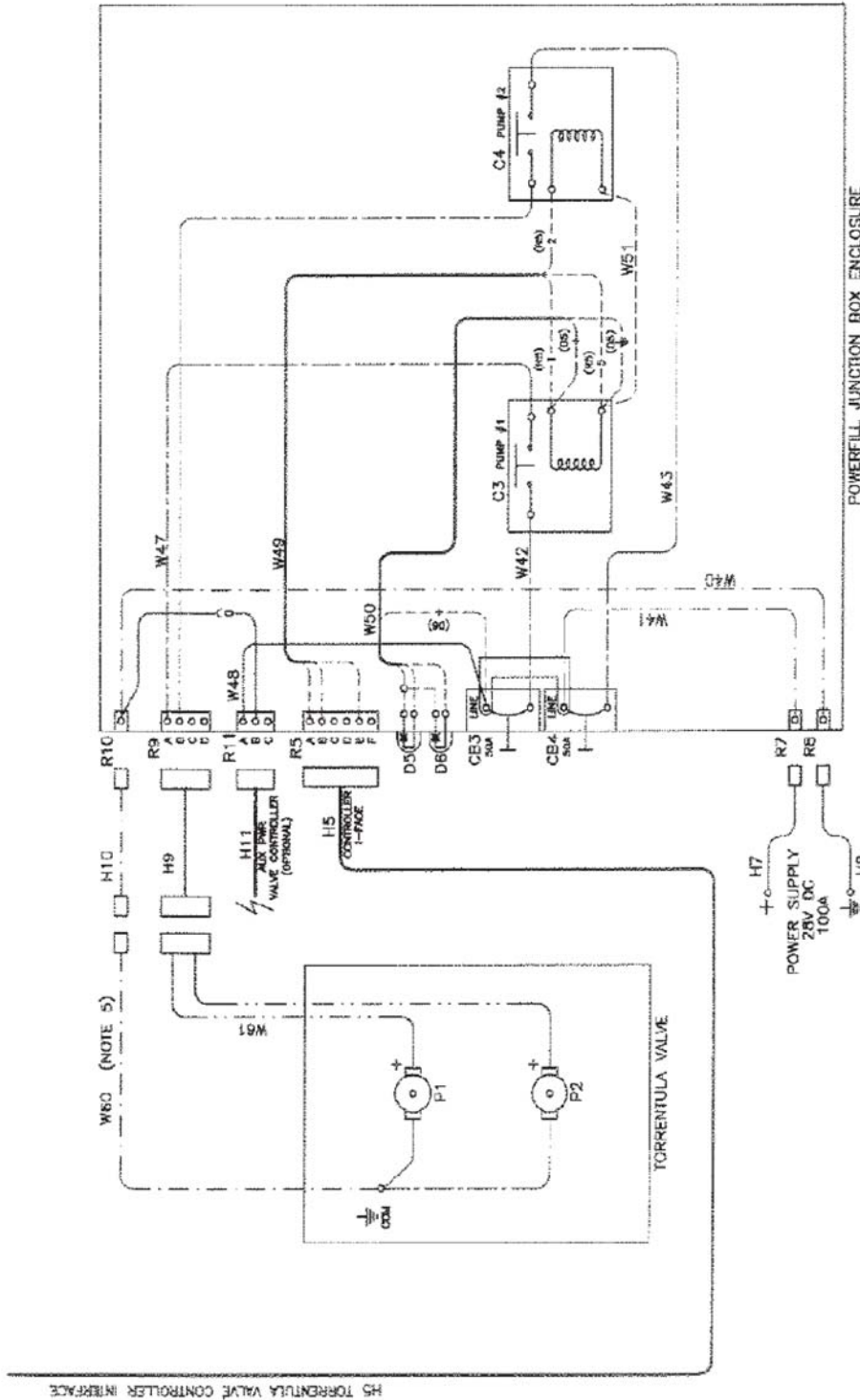
Models 4453 to 7590 (2 pump systems)

1 of 2



Models 4453 to 7590 (continued)

2 of 2



- NOTES**
- 1) ALL ABOVE-HOOK WIRE LEADS CONFORM TO MIL-W-22750/16
 - 2) ALL CIRCUIT BREAKERS MIL-C-5809
 - 3) ALL BOX CONNECTIONS MIL-C-5015
 - 4) WIRE LEGEND

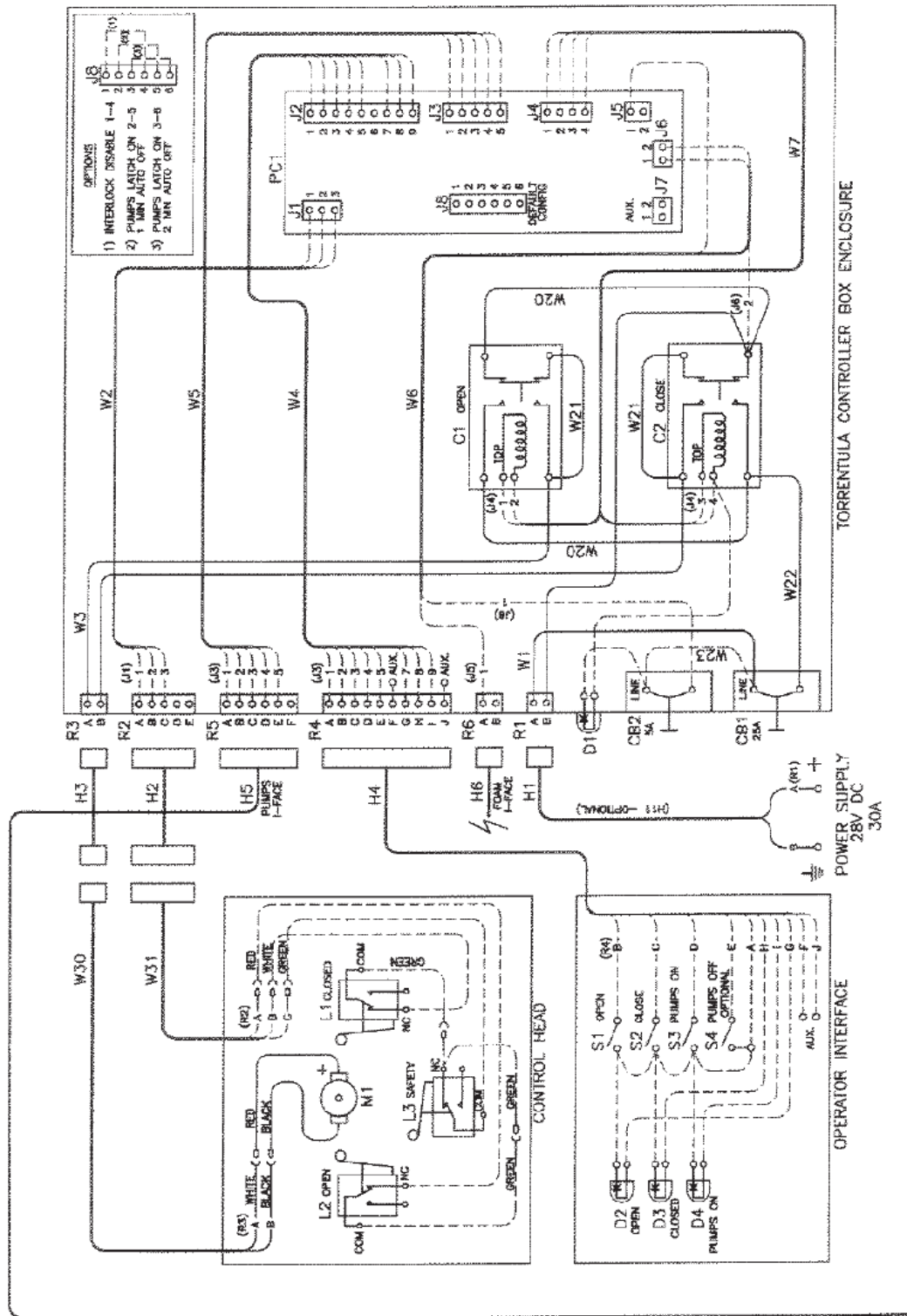
18 AWG:	---
10 AWG:	----
8 AWG:	-----
6 AWG:	-----
5 AWG:	-----
1 AWG:	-----

 HARNESS (LABELLED):
- POWERFILL JUNCTION BOX ENCLOSURE**
- 5) W60: #4 AWG ON MODELS 2732, 3542, 4453
 - 6) ALTERNATE POWER TO TORRENTULA VALVE CONTROLLER (R1) FROM AUX. RECEPTACLE R11 FOR USE ONLY WITH VALVE/PUMPS INTERLOCK ENABLED. SPEC WIRE HARNESS H11.



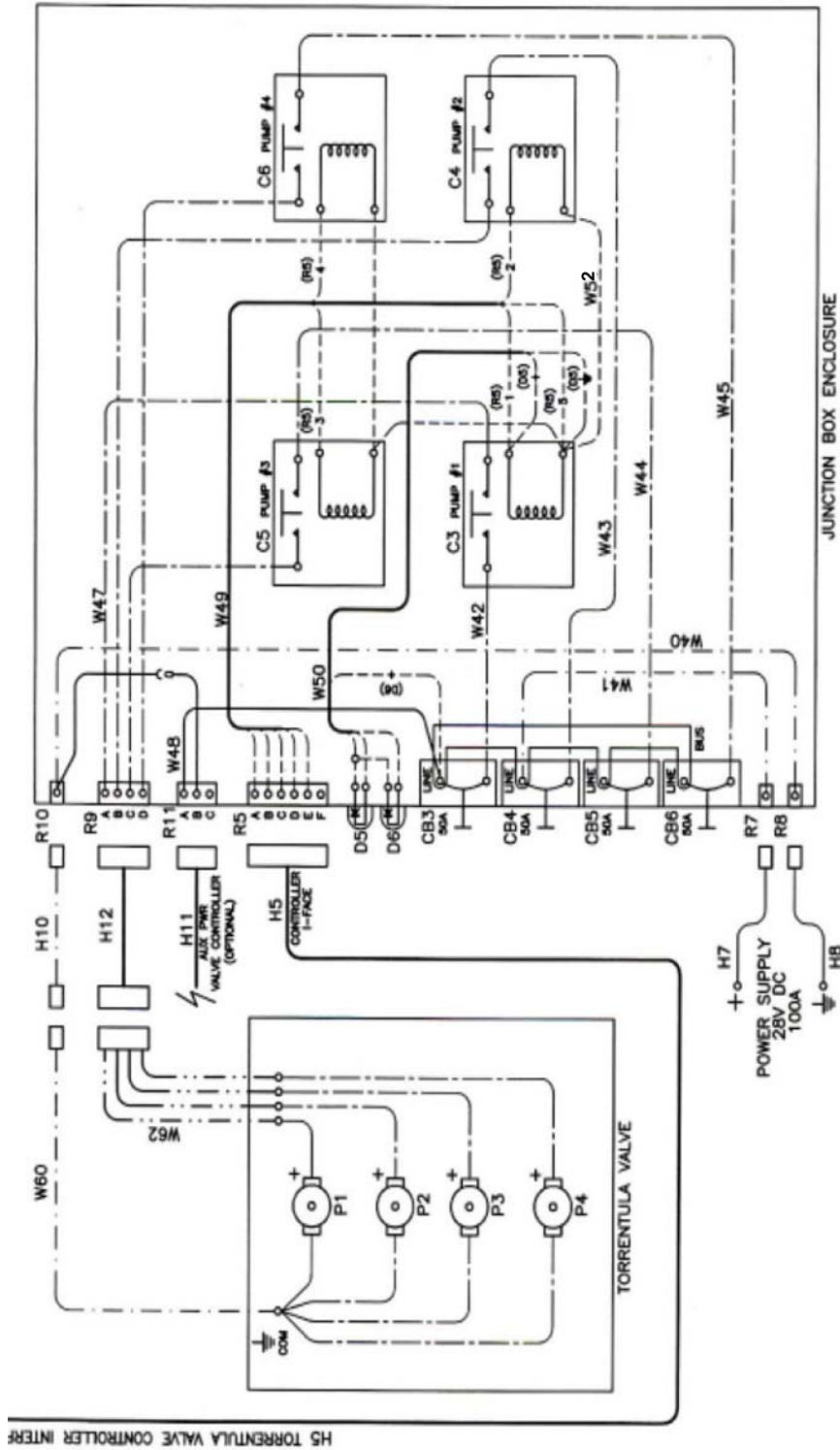
Models HL4000 to HL9800 (4 pump systems)

1 of 2



Models HL4000 to HL9800 (continued)

2 of 2



- NOTES**
- 1) ALL ABOVE-HOOK WIRE LEADS CONFORM TO MIL-W-22759/16
 - 2) ALL CIRCUIT BREAKERS MIL-C-5809
 - 3) ALL BOX CONNECTIONS MIL-C-5015
 - 4) WIRE LEGEND

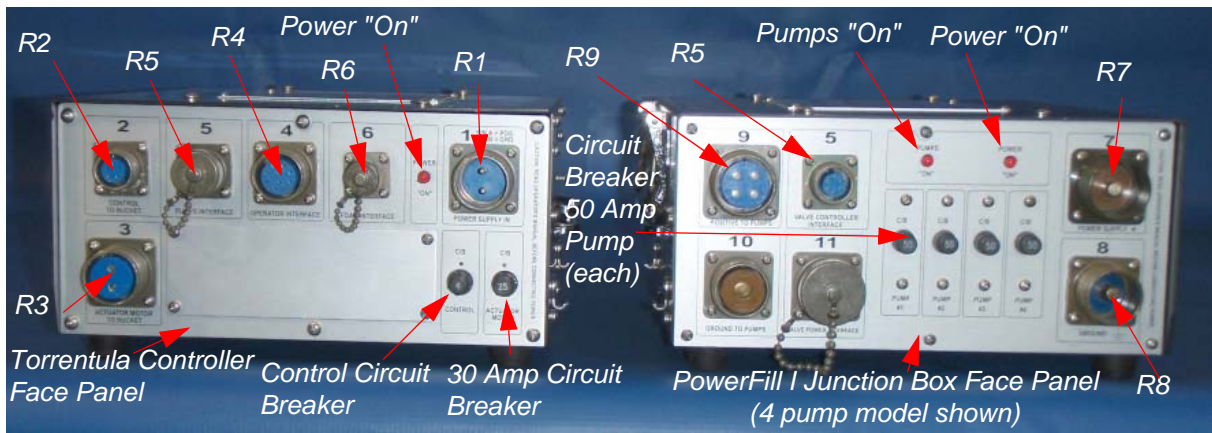
18 AWG:	-----
10 AWG:	-----
8 AWG:	-----
6 AWG:	-----
1 AWG:	-----

 HARNESS (LABELLED):

 - 5) ALTERNATE POWER TO TORRENTULA VALVE CONTROLLER (R11) FROM AUX. RECEPTACLE R11 FOR USE ONLY WITH VALVE/PUMPS INTERLOCK ENABLED. SPEC WIRE HARNESS H11.



Junction Box and Controller

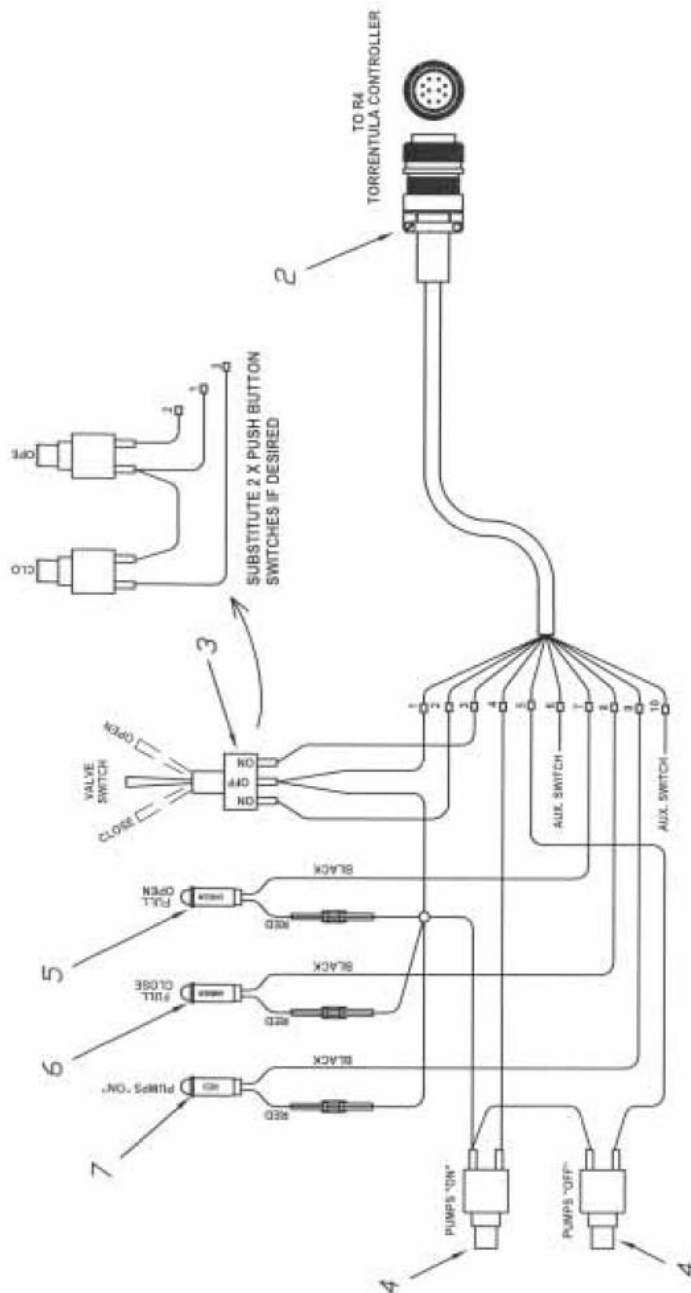


ITEM	Torrentula Controller Box
1	POWER SUPPLY INPUT
A	POWER INPUT, +28 VOLTS DC
B	GROUND
2	CONTROL TO BUCKET
A	OPEN LIMIT
B	CLOSE LIMIT
C	LIMIT COMMON
3	ACTUATOR MOTOR TO BUCKET
A	ACTUATOR MOTOR +28 VDC "OPEN" (B GRD.)
B	ACTUATOR MOTOR +28 VDC "CLOSE" (A GRD.)
4	OPERATOR INTERFACE
A	OPERATORS SWITCH, LED COMMON +28 VDC
B	VALVE "OPEN"
C	VALVE "CLOSED"
D	POMPS "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
5	PUMPS INTERFACE
A	PUMPS #1 CONTACTOR +28 VDC
B	PUMPS #2 CONTACTOR +28 VDC
C	PUMPS #3 CONTACTOR +28 VDC
D	PUMPS #4 CONTACTOR +28 VDC
E	GROUND COMMON
6	CLASS "A" FOAM SYSTEM INTERFACE
A	DISPENSE CYCLE CANCEL, +28 VDC

ITEM	PowerFill Junction Box
5	VALVE CONTROL INTERFACE
A	PUMPS #1 CONTACTOR
B	PUMPS #2 CONTACTOR
C	PUMPS #3 CONTACTOR
D	PUMPS #4 CONTACTOR
E	CONTACTOR COMMON GROUND
7	POWER SUPPLY, 28 VDC
8	POWER SUPPLY GROUND
9	POSITIVE TO PUMPS
A	PUMP # 1 +28 VDC
B	PUMP # 2 +28 VDC
C	PUMP # 3 +28 VDC
D	PUMP # 4 +28 VDC
10	GROUND TO PUMPS
11	VALVE POWER INTERFACE (AUXILIARY)
A	+28 VDC
B	GROUND

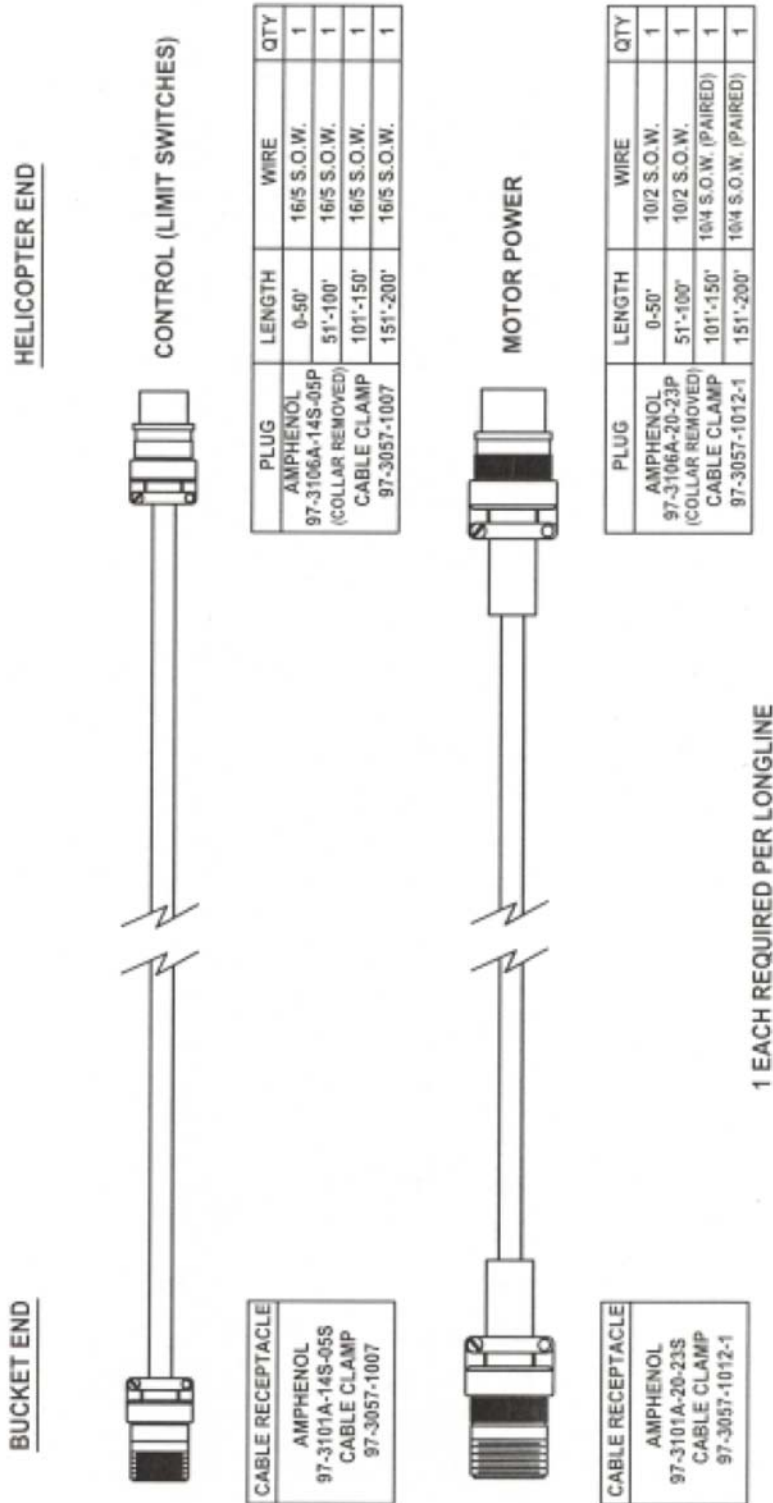
Torrentula Pilot Controls Wiring

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

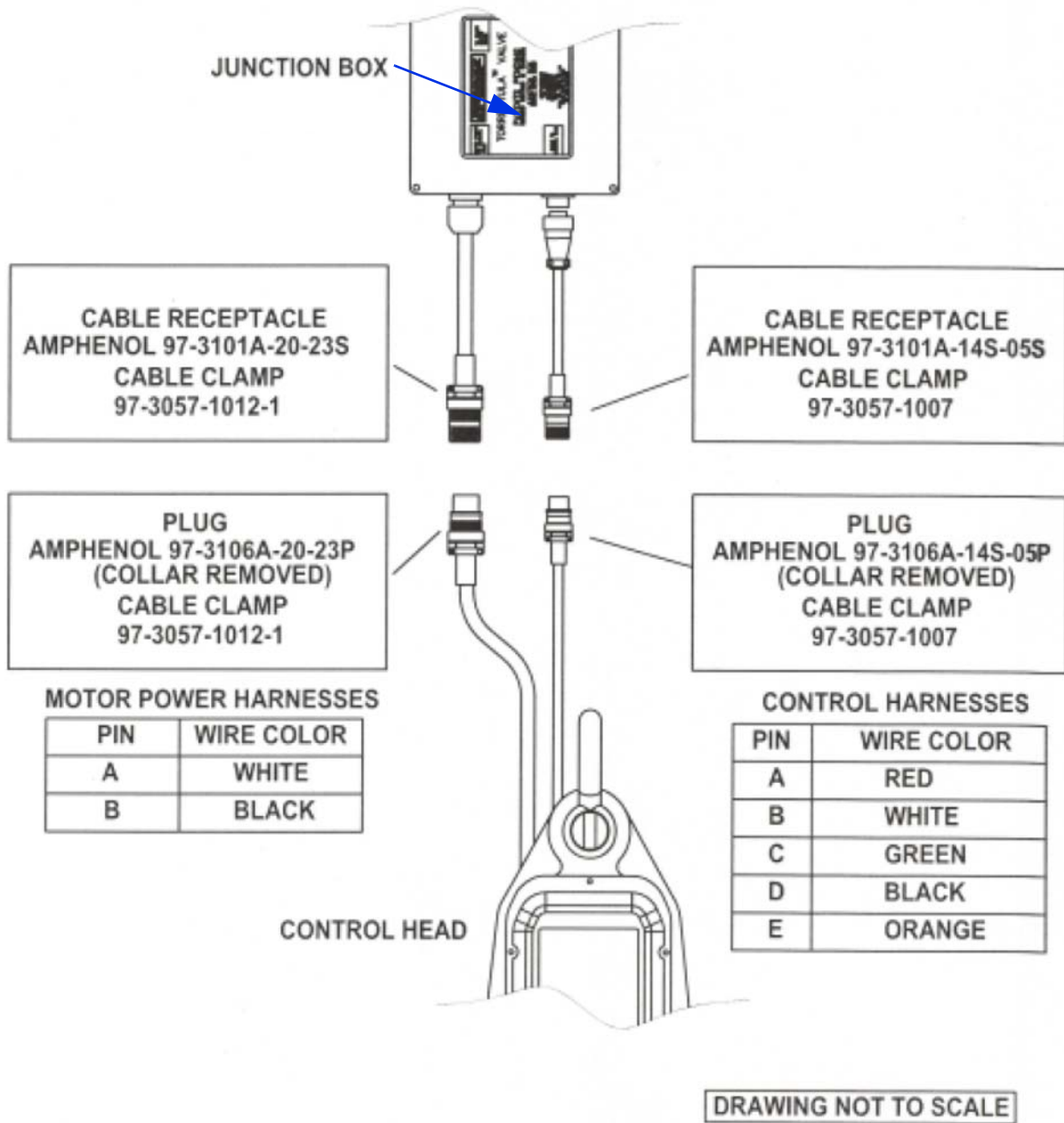


Parts list item	Description	Qty.
1.	Assembly PN BTSK00450	1
2.	Wire harness 9 x #18 AWG Mil-W-22759/16	1
3.	Toggle switch SPDT (on)-off-(on)	1
4.	Push button switch	2 (4)
5.	"open" LED, green	1
6.	"closed" LED, amber	1
7.	"pumps on" LED, red	1

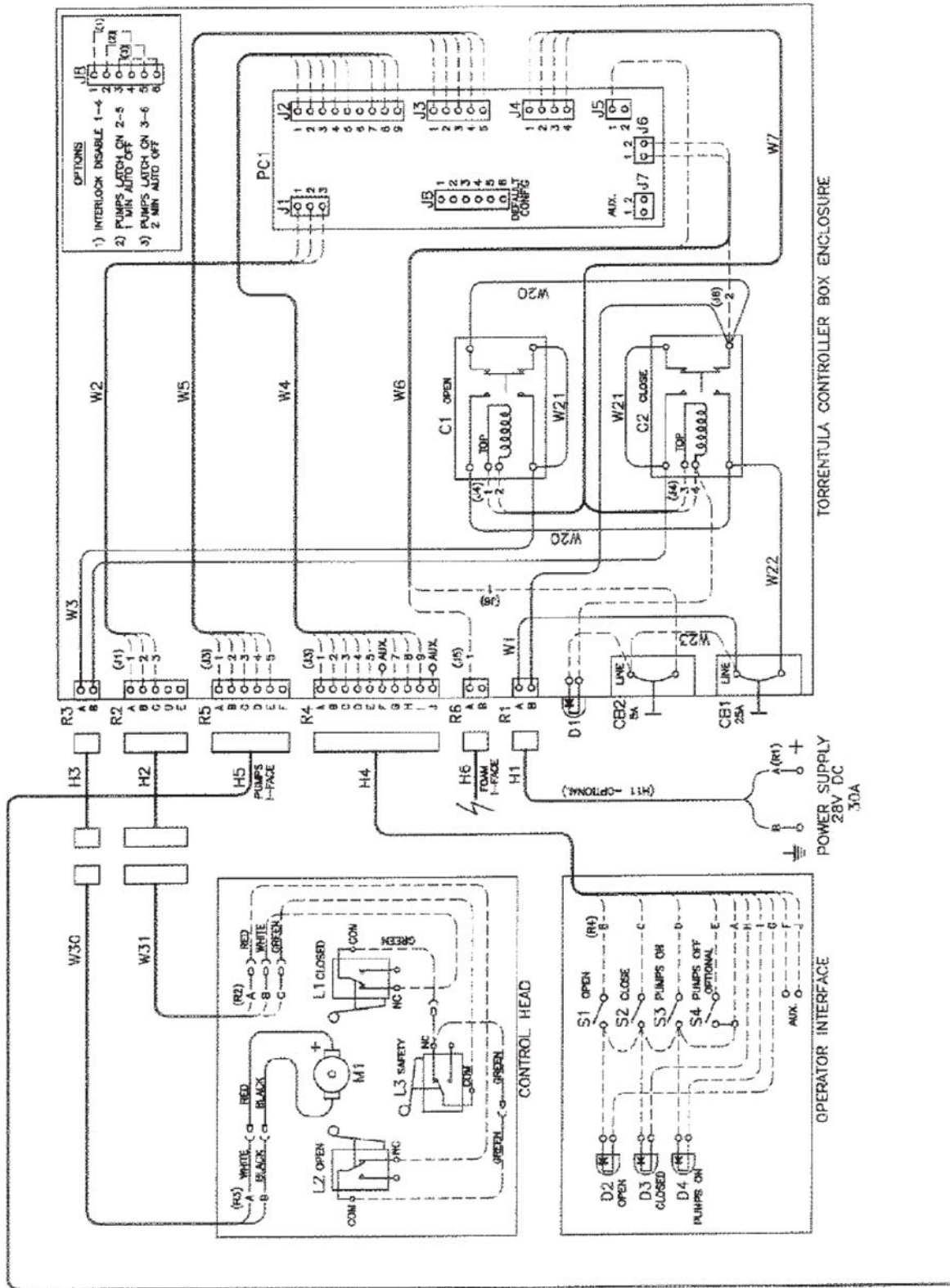
Torrentula Longline Cable Assemblies Wiring



PowerFill Breakaway Plug Wiring



Torrentula Controller Box Wiring



Section 22: 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 shown to be defective.
- b) The company's products are not guaranteed for any specific length of time or measure of service, but are warranted only 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 which 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 accessories 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, 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 accordance with the operations manual supplied by SEI.
- 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.