OPERATIONS MANUAL

CASCADE BUCKET SYSTEM

KCB-0900-0000-32 (900 Gallon, 3407 Liter)

KCB-1057-0000-32 (1057 Gallon, 4000 Liter)

KAWAK AVIATION TECHNOLOGIES

PROGRESS THROUGH INNOVATIVE THINKING

RECORD OF REVISIONS

REV LEVEL	DESCRIPTION OF CHANGES	AUTHOR	CHECKED BY	APPROVED BY	APPROVED DATE
A	Initial Release per IR #503	Z. Harris	C. Edwards	CE	5/14/25

Contents

Section 1: SAFETY FIRST

Terminology

Warnings, cautions, and notes are used throughout this manual to emphasize important and critical instructions, and are used as follows:

TERM	DEFINITION
⚠ **WARNING**	An operating procedure, practice, etc., if not correctly followed, could result in personal injury or loss of life.
⚠ **CAUTION**	An operating procedure, practice, etc., if not strictly observed, could result in damage or destruction of equipment.
****NOTE****	An operating procedure, condition, which is essential to highlight.

Tips and Precautions

⚠ **CAUTION**: Rigging rope assemblies and bucket assemblies are matched, and no attempt should be made to replace assemblies or components unless they are replaced with Kawak genuine components.

⚠ **CAUTION**: Although the bucket system has demonstrated neutral flying qualities, normal in-flight external or sling-load precautions and procedures should be conducted to preclude any unexpected oscillations affecting the safety of the aircraft, its crew or anything on the ground.

⚠ **WARNING: If operating a bucket without a longline, the operator is responsible for confirming appropriate clearance between the bucket and the tail rotor and/or the fuselage during flight.** Failure to do so could result in damage to the tail boom or a rotor strike.

Section 2: GENERAL INFORMATION

The Company

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This Document

This manual provides instructions on how to safely install, operate, and maintain your bucket system. The information contained within this manual is based upon data available at the time of publication and will be kept current by revision changes or service bulletins.

Carefully read and follow all instructions in this manual and any accompanying materials to protect personnel and product. Failure to do so may result in physical harm to you and/or your product and will void the product warranty.

This manual contains information and procedures for the safe and effective installation, operation, and maintenance of the bucket system. It shall not be used as a substitute for sound judgment. Kawak reserves the right to make changes at any time without notice.

This document and any revisions made to it are available for download from the Kawak website. Revisions will carry a new revision letter and will be shown at the bottom of each page of the manual. Revisions supersede any previous revision levels of the manual. Operators and installers should check the Kawak website for the latest revision prior to installing/operating the bucket system.

Although this manual and any revisions are prepared as separate publications, they should be kept and used in conjunction with this maintenance manual.

Definitions

The following terms and abbreviations are used throughout this document. It is important that their intended uses be understood:

TERM	DEFINITION
Shall	Used only when application of a procedure is **mandatory**.
Should	Used only when application of a procedure is **recommended**.
Will	Used only to indicate **futurity**, not used to indicate mandatory procedure.
Product	A complete assembly that is ready for sale.
Component	Parts or subassemblies of a product.
May / Need Not	Used only when application of a procedure is **optional**.

The Product

Introduction

The Cascade Bucket System is a collapsible liquid delivery system for helicopter firefighting activities that require quick deployment, as well as ease of storage and transport.

System Description

The Cascade Bucket System consists of rigging equipped with abrasion-resistant knuckle covers and support components, a pliable containment skin made from a nylon-based fabric coated in thick polyurethane, a lower structure, a linear actuator, and electrical connections and controls.

Product Specifications

BUCKET SYSTEM ELECTRICAL REQUIREMENTS	
Bucket Refill Pump Motor Draw (400Hz AC)	~38 amps of 208VAC 3-phase @ 400Hz
Bucket Refill Pump Motor Draw (28 VDC)	**80 – 150 amps at 28VDC
Linear Actuator Draw	up to 28 amps at 28VDC

Table 1: Bucket System Electrical Requirements

**See Table 4 for detailed current draw, pump performance and suggested wire gauge.

KAWAK CASCADE BUCKET SPECIFICATION MATRIX																		
CASCADE BUCKET	CAPACITY		EMPTY WEIGHT		GROSS WEIGHT		OVERALL LENGTH		STOWED HEIGHT		STOWED WIDTH		MIN. DIP FILL WATER DEPTH		MIN. POWER FILL WATER DEPTH		INLET DIAMETER	
	US Gal	Liters	lb	kg	lb	kg	ft	m	in	m	in	m	ft	m	in	m	ft	m
BUCKET	900	3410	340	154	7846	3558	25'	7.62	44.0	1.12	44.0	1.12	7'-9"	2.36	19.1	0.49	6'-6.5"	2.00
W/PUMP			421	191	7927	3595												
BUCKET	1057	4000	344	156	9159	4154	26'-9"	8.15	44.0	1.12	44.0	1.12	8'-10"	2.69	19.1	0.49	6'-6.5"	2.00
W/PUMP			425	193	9240	4191												

Table 2: Bucket System Weights and Dimensions

Limits

Maximum Airspeed

The maximum recommended airspeed while flying with the Cascade bucket carrying a full load of water is eighty (80) knots or the airspeed limitation specified by the rotorcraft load combination flight manual, whichever is less. When the bucket is empty, the maximum recommended airspeed is one hundred (100) knots.

Reporting Incidents

Kawak strongly encourages prompt reporting of any incidents experienced with the operation of the Cascade bucket. This will allow Kawak to quickly address any incidents on an individual basis and provide the necessary support to keep your buckets operating optimally. We strive to continually improve our products, and operator involvement in this effort is highly valued. Contact information can be found in the beginning of this manual.

Section 3: UNBOXING YOUR ORDER

What's Included

The following parts are included in your order:

- Cascade Bucket System
- Repair Kit

Unpacking

The bucket system will arrive on a 48" x 48" wood pallet platform secured in a cargo net with straps attached to the D-ring anchor points on the pallet. This cargo net and straps are utilized to protect the bucket during transportation and storage. Customers may wish to retain and reuse the wood pallet platform, cargo net, and straps for storage during down time or off season or transporting between sites. Inspect the product for damage prior to installation/use.

Product Labels and Markings

Serial Markings

Serial number information can be found on one of the strap clamp plates on the inside of the bucket skin.

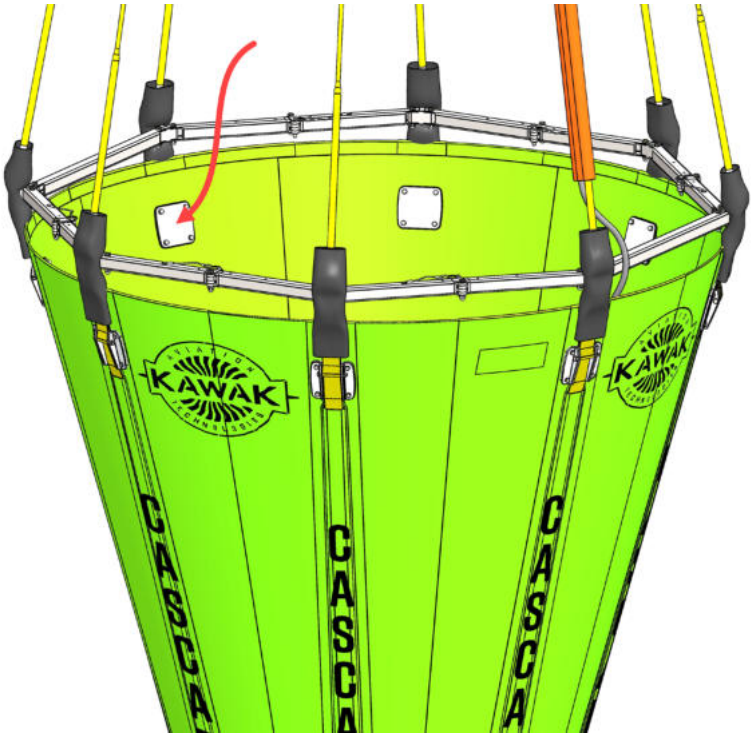


Figure 1: Serial Marking Location

Section 4: SYSTEM OVERVIEW

Equipment Descriptions

The three main sections of the bucket system are the Rigging and Support, the Bucket Skin, and the Lower Structure (see Figure 2). Key features of these sections are outlined below.

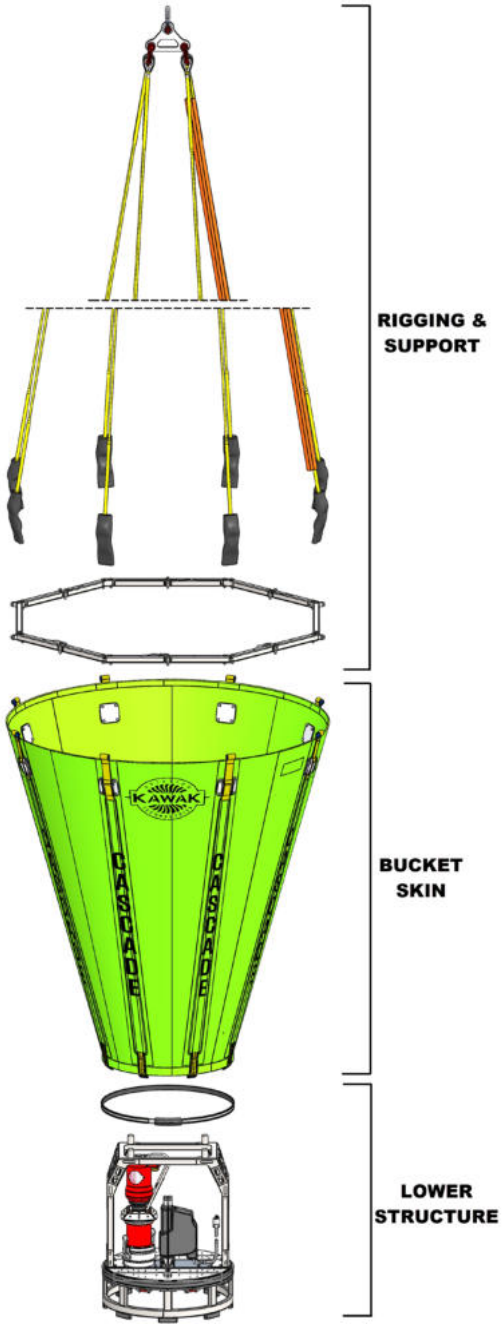


Figure 2: Bucket System Sections

Rigging and Support

The Rigging and Support (Figure 3 and Figure 4) includes the lifting block, screw pin shackle, sling shackles, UHMPE rigging ropes, the collapsible inlet frame, and sling connectors. The lifting block provides a common connection point for the rigging ropes via sling shackles. The screw pin shackle at the top connects to the helicopter's cargo hook (or longline, if so equipped).

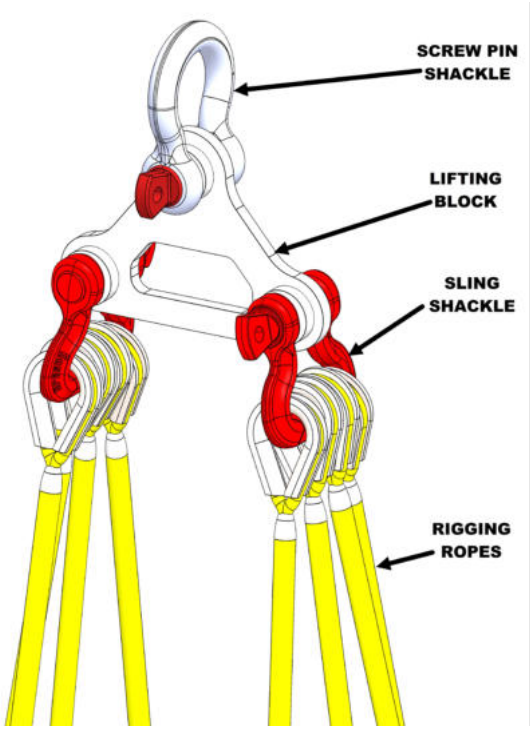


Figure 3: Lifting Block, Shackles, Rigging Ropes

Rigging Ropes

The Rigging Ropes are manufactured from UHMPE rope. The ends have eye splices with stainless steel thimbles that allow connections to be made to the top and bottom shackles directly while preventing wear to the eye splices.

Collapsible Inlet Frame

The Collapsible Inlet Frame (Figure 4) is a segmented ring with the main purpose of keeping the top of the bucket skin open. The main components of the frame are the Frame Arms and the Inlet Joint Fittings. All but two of the frame arms are hinged in the middle to facilitate collapsing the frame for storage or transportation. The frame arms connect to each other via the inlet joint fittings, which also provide connection points for the sling connectors.

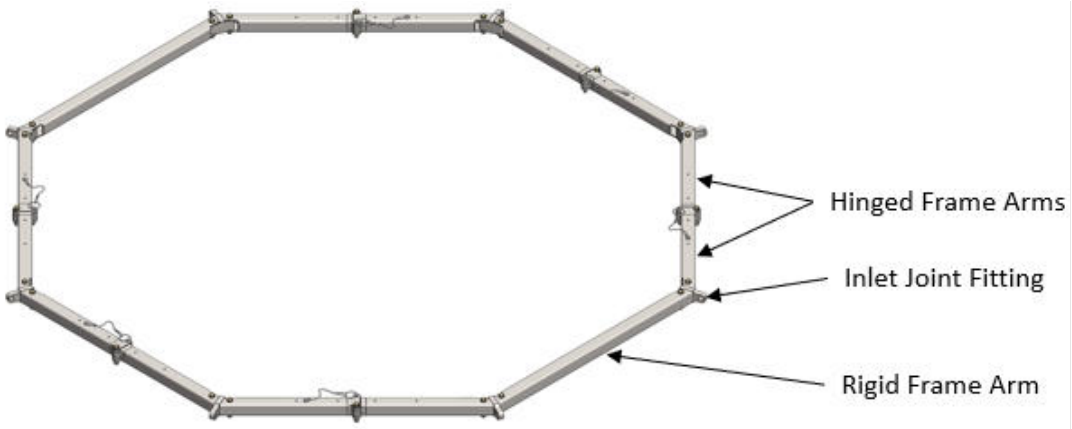


Figure 4: Collapsible Inlet Frame (all other components hidden for clarity)

Sling Connectors

The rigging ropes are connected to the lift straps using high-strength sling connectors (Figure 5). Each sling connector consists of an upper shackle that connects to the rigging rope, a lower shackle that connects to the lifting strap, a pin, and a bushing. The pins and bushings pass through the inlet joint fittings to keep the sling connectors anchored and equally spaced on the inlet frame.

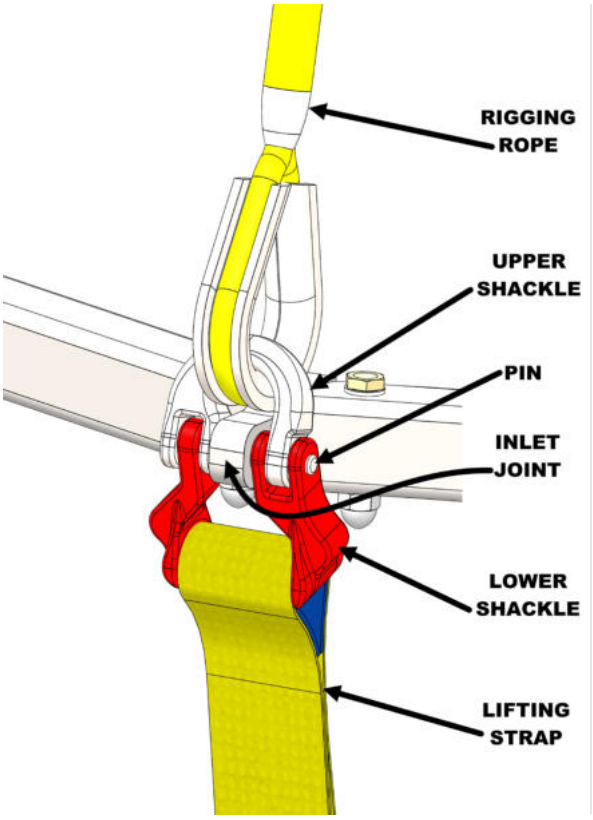


Figure 5: Sling Connector (Bucket Skin and Knuckle Covers hidden for clarity. Bushing not shown.)

Knuckle Covers are provided to reduce wear and tear at the sling connectors and lift straps due to dragging during takeoff, landing, and ground handling. The knuckle covers also provide directional support for the rigging rope thimbles to ensure they do not loop under the sling shackles or inlet.

Bucket Skin

The Bucket Skin contains the water and bears a large portion of the water weight. The main body of the bucket skin is made of a nylon-based fabric covered with a thick polyurethane coating. The strap sleeves are made from the same material as the body.

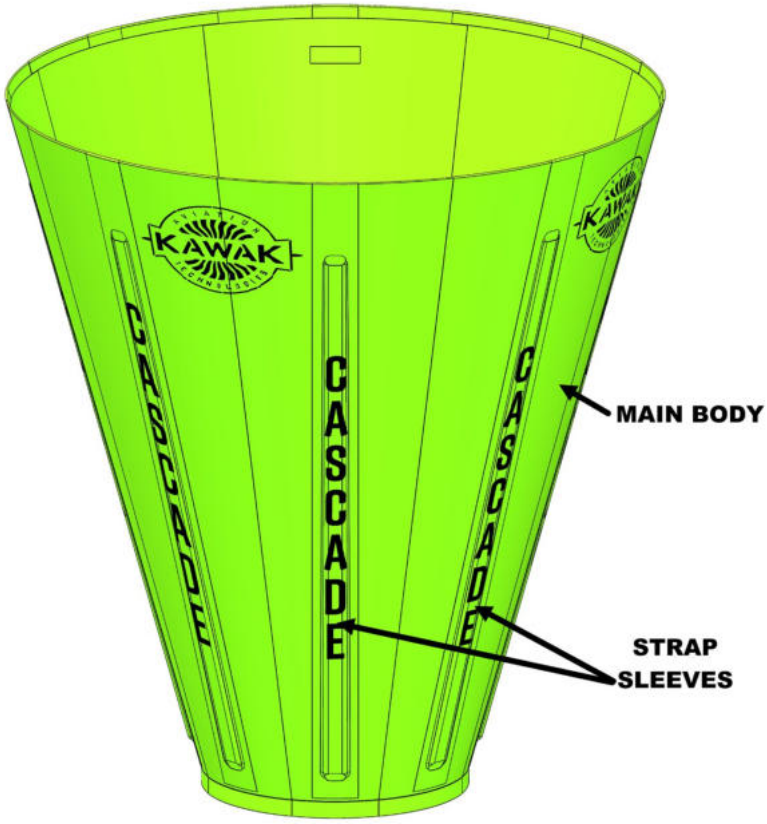


Figure 6: Bucket Skin

Strap Clamp Fittings

The skin is supported by the lift straps via the strap clamp fittings (Figure 7). These clamp fittings are each secured to the skin using four bolts.

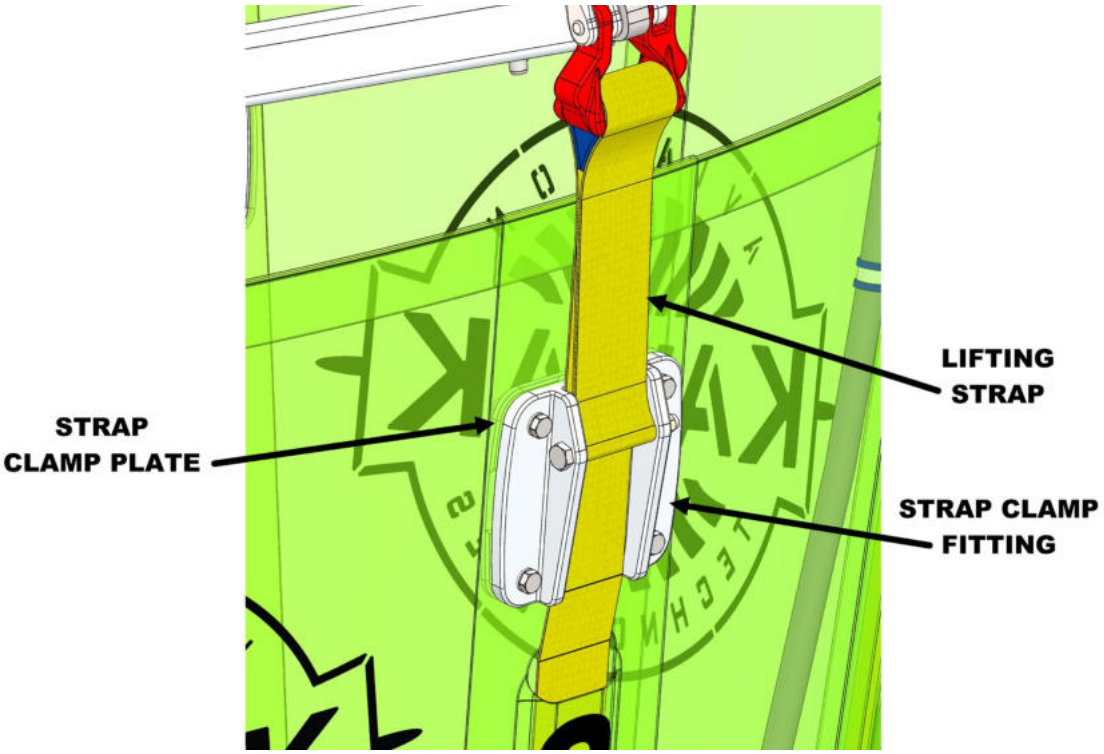


Figure 7: Strap Clamp Fitting

Lift Straps

The Lift Straps that run through the external sleeves of the bucket skin connect to the sling connectors and the valve base. They support the bucket skin and help bear the weight of the water and valve base.

Support Battens

To hold the bucket skin off the ground when the bucket is set down on the ground, and to improve maintenance access, Support Battens have been incorporated into the bottom section of the lift straps. Like the straps, the battens are individually replaceable and fit into pockets on the lift straps. This interface can be seen in Figure 8. When the bucket is set down, these battens hold the bottom 30” of skin up off the ground and form a cup shape. The height of the skin held off the ground is still low enough that the bucket can be easily serviced in this state.

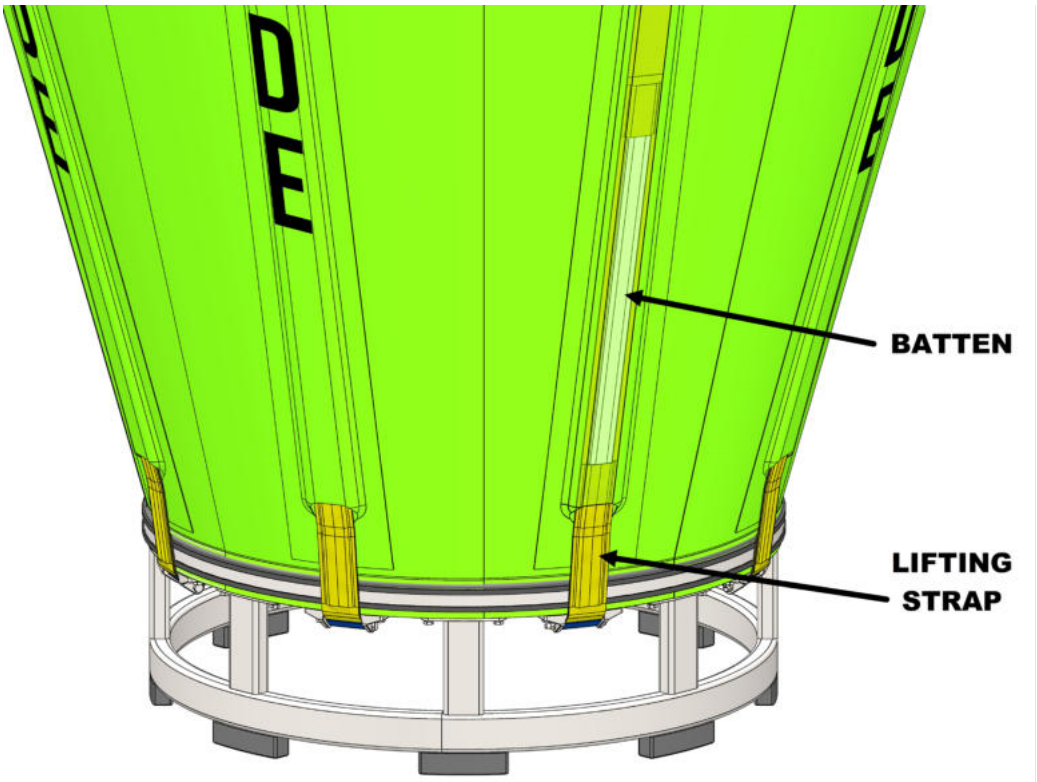


Figure 8: Skin Support Battens

Together with the battens, the Inlet Frame Support Structure makes it easy to fold up the bucket by providing a platform to support the lifting block, rigging, and the inlet frame when it is collapsed. It also provides some protection for the actuation assembly and the bucket refill pump. This welded structure can easily be removed without any tools by removing the pins in each leg and lifting it out of the bucket.

Lower Structure

The group of subsystems at the bottom of the bucket system is the Lower Structure, which is responsible for power filling and emptying the bucket. The lower structure consists of the valve assembly, valve base weldment, standoff, actuation assembly, bucket refill pump, and inlet frame support structure. See Figure 9.

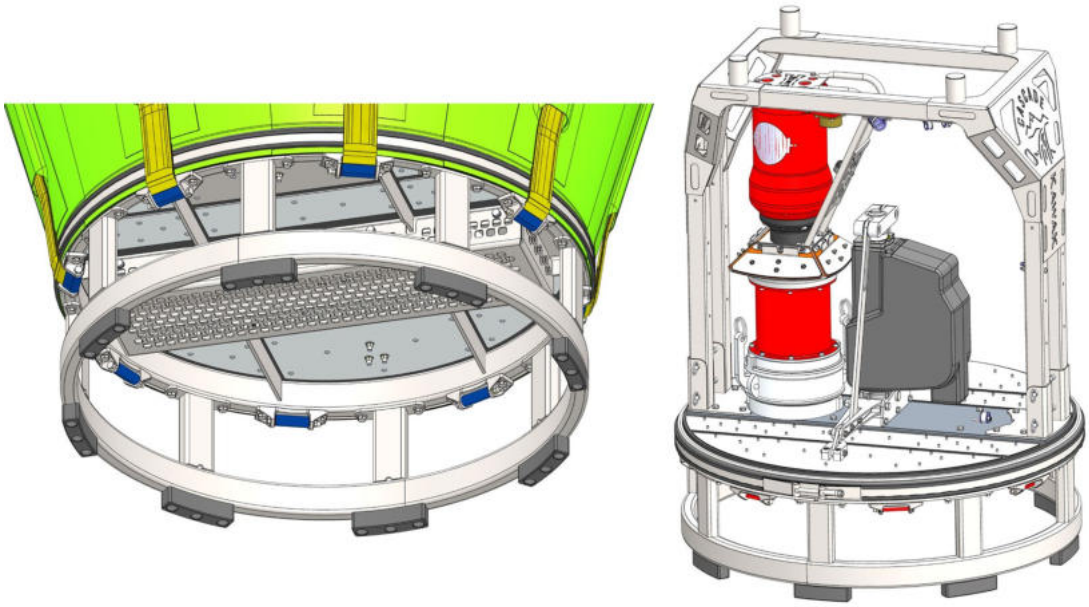


Figure 9: Lower Structure

Valve Base Weldment

Figure 10 shows the stainless-steel Valve Base Weldment, which is the foundation of the lower structure. The valve assembly is attached to the top of the weldment, and seals against the weldment to prevent water leakage. The lower strap brackets at the bottom of the valve base weldment provide connection points for the sewn loops on the lower ends of the lift straps.

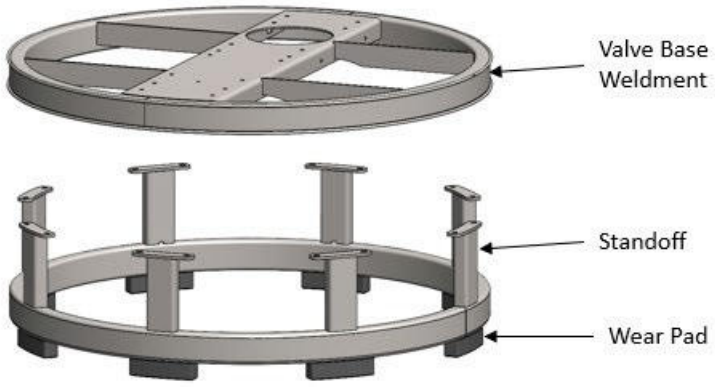


Figure 10: Valve Base Weldment, Standoff, and Wear Pads

Standoff

The Standoff is used to prevent the pump inlet from getting too close to the bottom of the water source and to provide the bucket refill pump with an unrestricted supply of water. The design helps prevent cavitation, promotes consistent bucket refill performance, and keeps unwanted debris out of the pump system.

T-Bolt Clamp Band

A T-Bolt Clamp Band is fitted around the base of the skin to secure the seal between the skin and the perimeter of the valve base. This prevents slippage and provides a robust seal. (Figure 11). The Clamp Guard covers the end of the t-bolt to prevent it from becoming a catch point or wear point during use, storage, or transportation of the bucket.

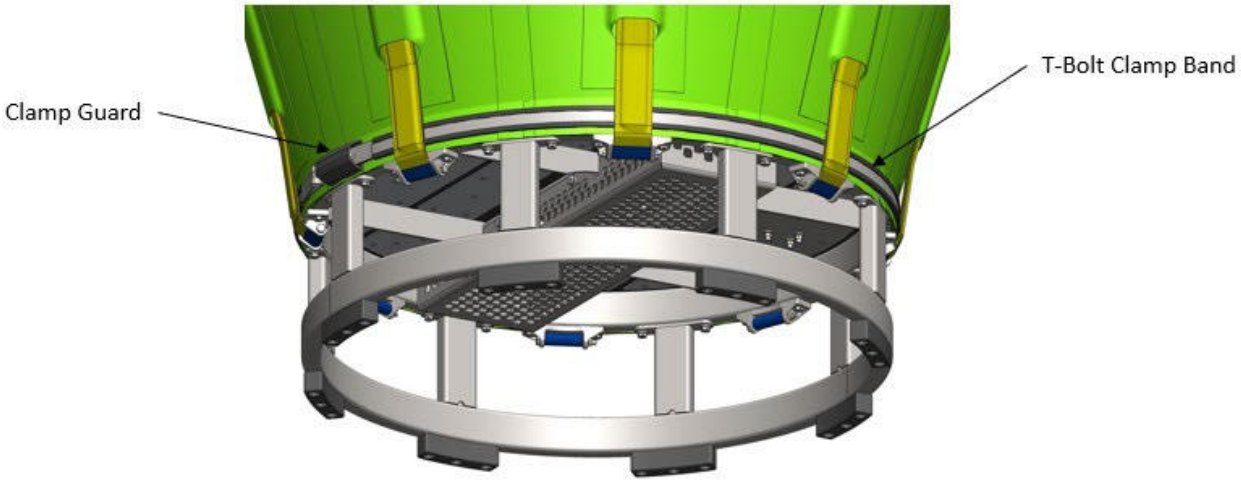


Figure 11: T-Bolt Clamp Band and Clamp Guard

Valve Assembly

The Valve Assembly consists of 2-ply fabric-reinforced EPDM rubber, aluminum hinge plates and backer plates, held together with rivets. These plates stiffen the rubber and have gaps between them, allowing the rubber to behave like a hinge for more controlled opening of the valve.

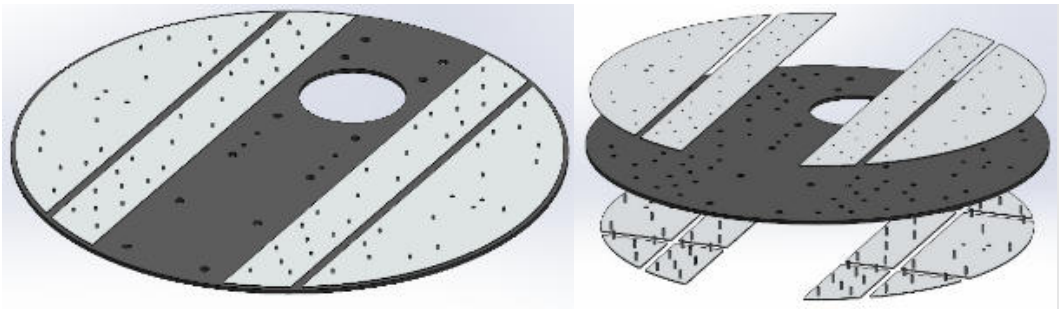


Figure 12: Valve Assembly

Pump Mount Plate

The Pump Mount Plate secures the valve assembly and provides a flat, solid surface to which the actuation assembly and bucket fill pump are mounted.

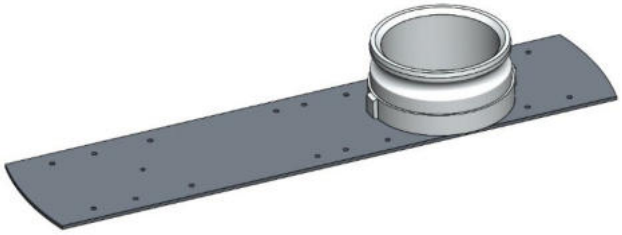


Figure 13: Pump Mount Plate

Bucket Refill Pump Inlet Screen

A screen secured to the bottom of the valve base weldment keeps debris larger than ½" from entering the bucket fill pump, preventing damage to the impeller and other pump components.

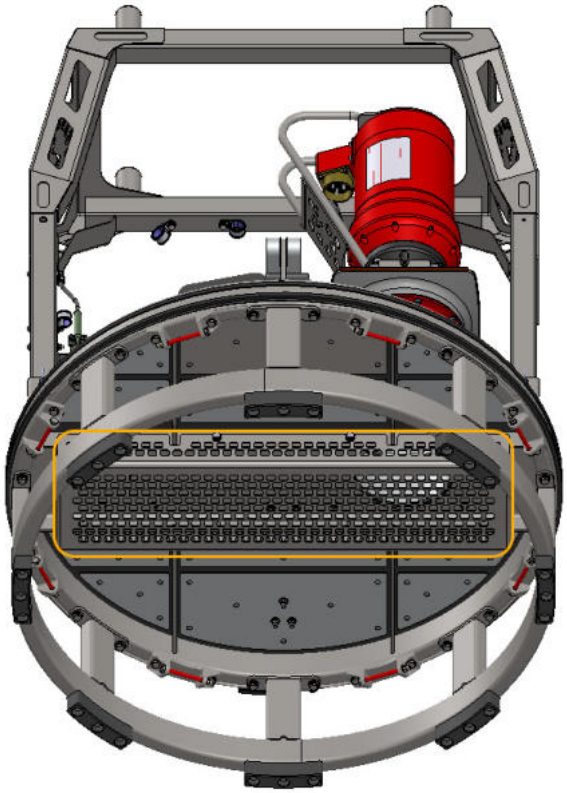


Figure 14: Bucket Refill Pump Inlet Screen

Actuation Assembly

The valve assembly is connected to the actuation assembly, which receives power and control signals from the aircraft. The entire module is designed to be submersible and is positioned at the bottom of the bucket.

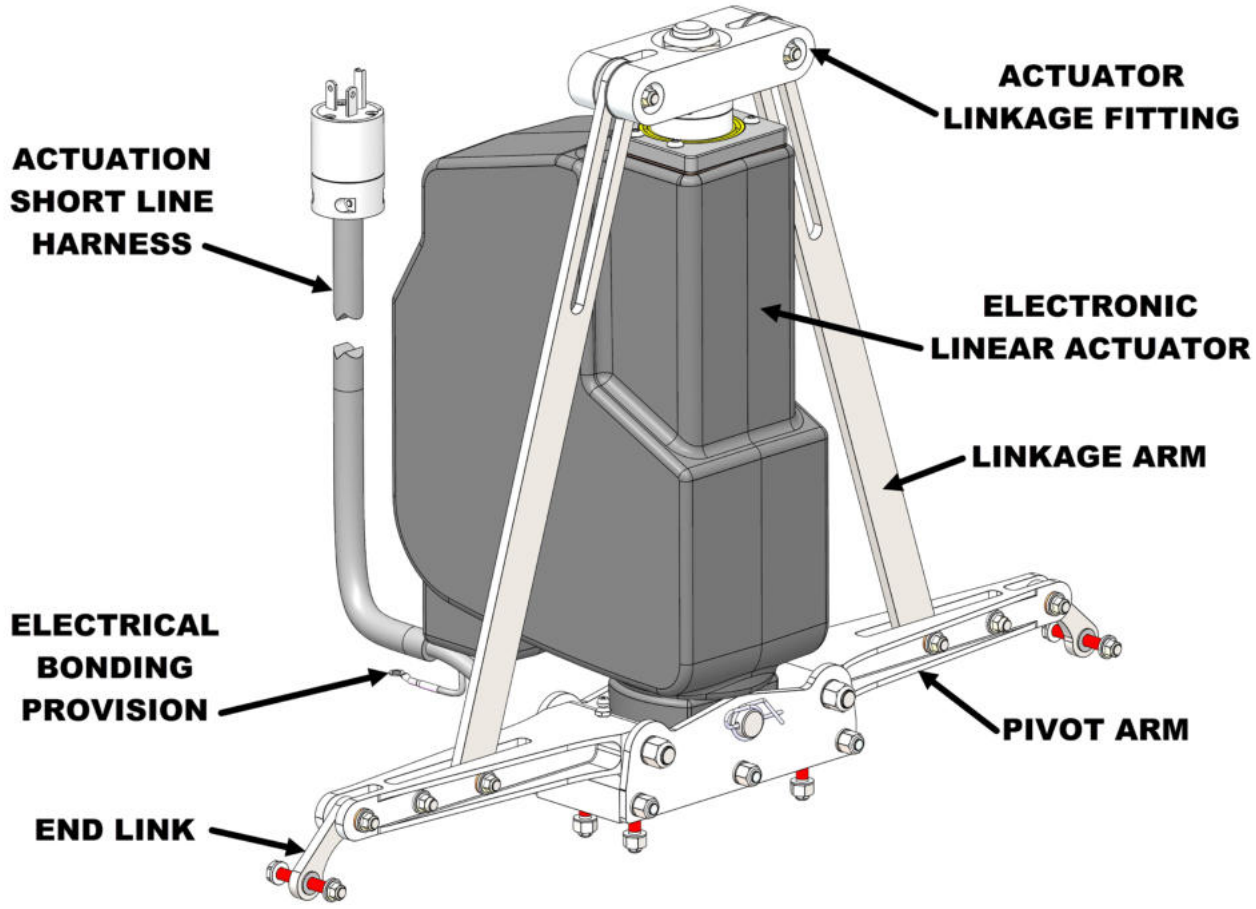


Figure 15: Actuation Assembly

The Actuation Assembly consists of an electronic linear actuator, an actuator linkage fitting, two linkage arms, two pivot arms, and two end links. The slots in the linkage arms allow the valve to open when the actuator is retracted. This allows water to flow into the bucket during dip filling. It also prevents debris from becoming trapped at the valve seal interface.

The actuation assembly is mounted on top of the pump mount plate, centered on the valve platform. The valve assembly connects using shear bolts that attach the end links to the clevis blocks on top of the valve. Electrical signals and power transmitted through the electrical harnesses control the actuator.

When in operation, the actuator draws up to 28A at 28VDC. The actuator has a built in current limiting function. In the event that the load on the actuator draws more than 28A, the actuator will lock out and stop functioning until it is reset. Resetting the actuator can be accomplished by releasing the switch in the cockpit that controls the actuator, and then depressing it again to continue extending the actuator. Alternatively, pressing and releasing the switch will cause the actuator to retract.

Bucket Refill Pump System

When operating with shallow water sources, a powered pump is used to fill the bucket. Instead of dip-filling, operators using the bucket refill pump lower only the bottom of the bucket into as little as 18 inches of water and turn the pump on to fill the bucket to the desired level. The Kawak bucket refill pump system is nominally rated at 1600 gpm flow rate.

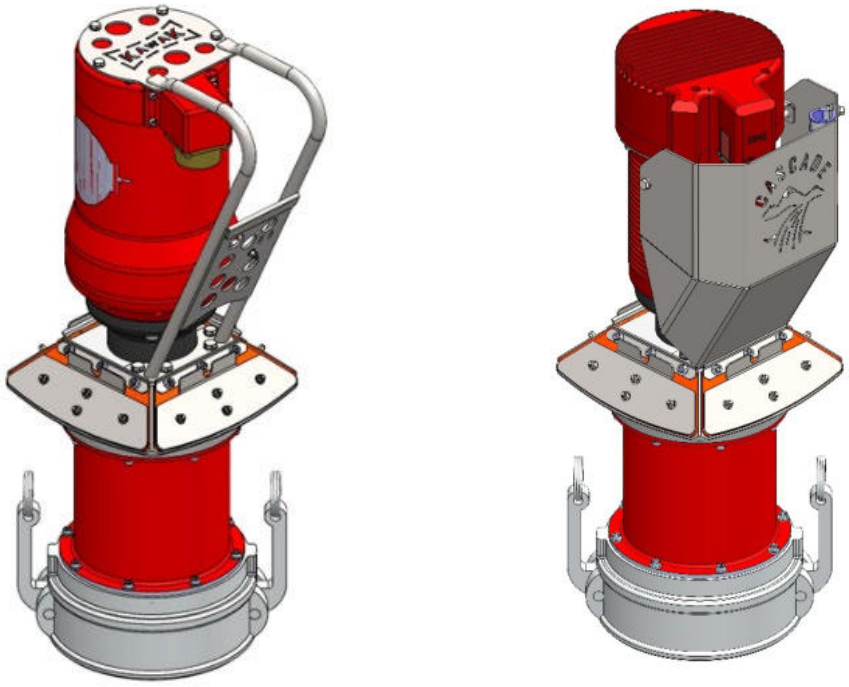


Figure 16: Bucket Refill Pump Assemblies
(Left: 400 Hz AC Refill Pump (recommended) used on 900 & 1057 Gallon Buckets)
(Right: 28VDC Refill Pump used on 900 & 1057 gallon bucket)

Bucket Capacity	Fill Time	Pump Type
900 gallon (3407 liter)	40s	400 Hz AC
900 gallon (3407 liter)	*60s	28VDC
1057 gallon (4000 liter)	48s	400 Hz AC
1057 gallon (4000 liter)	*68s	28VDC

Table 3: Bucket Fill-Time

* Estimated fill times vary depending on motor current limit setting. See Table 4 for more information.

To power the refill system on the 900 & 1057 gallon buckets, the Kawak 400Hz, 7.5hp electric motor is recommended based on its performance advantage over the 28VDC motor.

When water is pumped through the Bell Housing, the Check Valves are forced open. The rubber (fabric reinforced silicone) makes a hinge and the flange on the outer check valve plate limits the range of motion of the valve, so it is held at approximately horizontal.

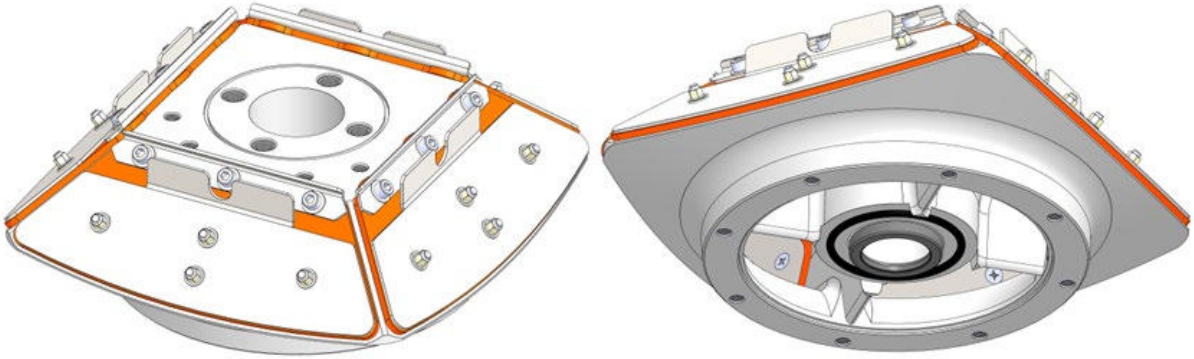


Figure 17: Bell Housing and Check Valves

The Impeller and Stator design is based off Kawak's reliable hover refill pump. The motor spins the impeller which pumps water through the stator fins and out through the four check valves.

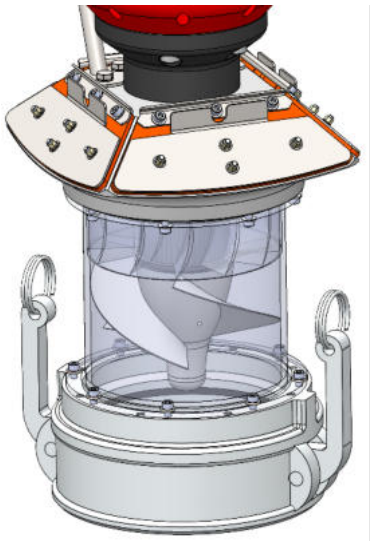


Figure 18: Impeller and Stator

The Cam and Groove mounting method allows for quick removal of the BRP (Bucket Refill Pump) assembly. This quick and robust form of mounting ensures that the BRP remains firmly mounted to the lower structure. For added safety, a hook and loop strap wraps around the cam levers to ensure the levers do not work loose during operation. The pump can be quickly removed and replaced with a cap if the BRP is not needed for a specific application.

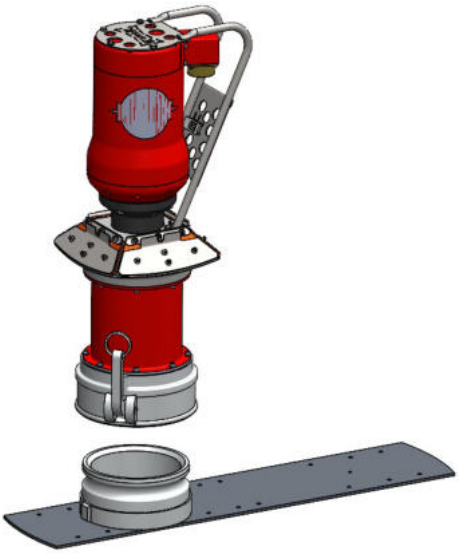


Figure 19: Cam & Groove Interface

Wiring Harness Connection Points

Two wire harnesses come down from near the lifting plate, travel through a zip-up short line sleeve containing both harnesses and a rigging rope, exit the sleeve, and go around the outside of the inlet frame. Both are mounted to a strap clamp plate with two 0.5" wide plastic zip ties and plastic zip tie mounts. From there, they hang freely on the inside of the skin, attach to the inlet frame support structure with Adel clamps, and terminate at the actuator and BRP.

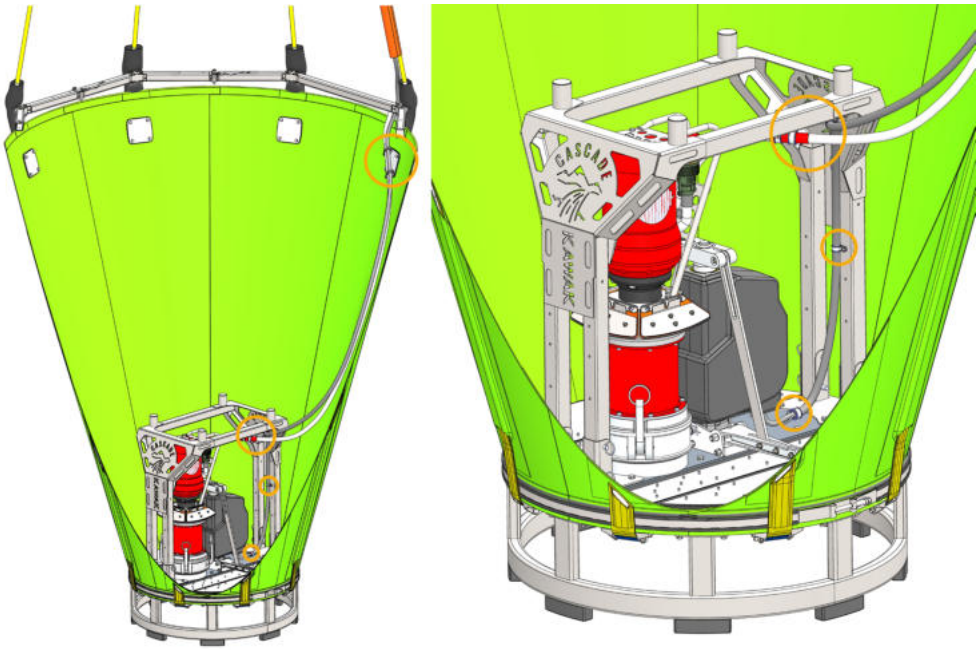


Figure 20: Electrical Harness Connection Points

Section 5: INSTALLATION AND SET-UP

Aircraft Modifications Required

Modifications required for an aircraft to operate the Cascade bucket are limited to electrical wiring. The Cascade bucket does not utilize a dedicated control panel. Instead, switches in the aircraft are dedicated to operating the bucket. It is the responsibility of the operator to build or procure a custom longline to connect the Cascade bucket electrical harnesses to the aircraft, and to configure existing switches in the aircraft for control of the submersible actuation system and optional bucket refill pump. Connection to aircraft power supply shall be made in accordance with FAA regulations, reference advisory circular AC43.13-1B and AC43.12-2A.

⚠WARNING: Do not connect the Cascade bucket to any aircraft bus bar that is used for emergency or essential loads. Amend the aircraft electrical load analysis to ensure that the generator capacity is adequate to operate the system.

Bucket Set-Up

Electrical Installation

The actuator can draw up to 28A at 28VDC depending on the load. A schematic for a typical bucket DC power installation using a momentary (spring-loaded) SPST switch is shown in Figure 23 below. It is the responsibility of the operator to wire the DC harness connector on the belly of the aircraft (J13) as shown. A photo of the Kawak supplied connectors installed on the short line are shown Figure 21 & 22 below. Figure 21 shows a 400 Hz AC refill pump connection, and Figure 22 shows a 28 VDC refill pump connection. Both harnessing configurations contain the same actuation harness connector.

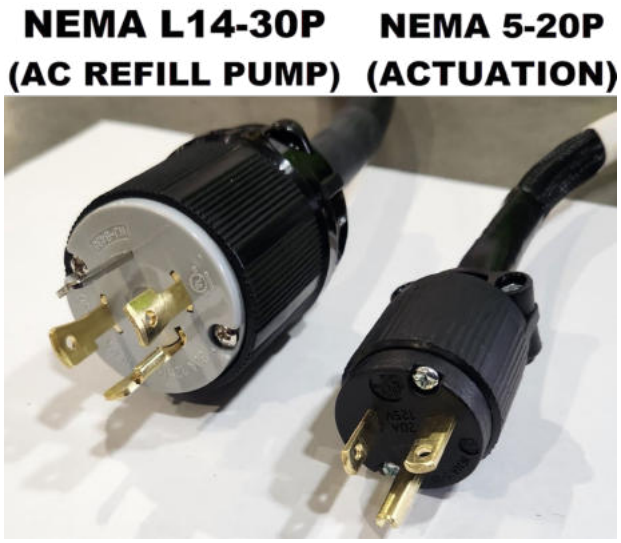


Figure 22 Kawak Supplied Short Line Connectors,
400 Hz AC Refill Pump

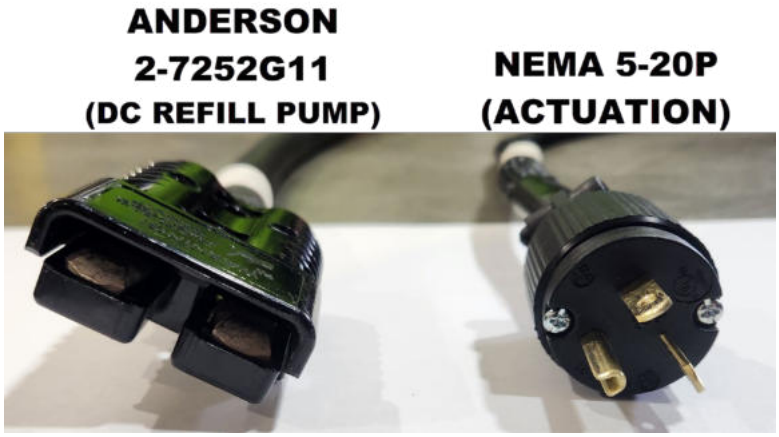


Figure 21 Kawak Supplied Short Line Connectors,
28VDC Refill Pump

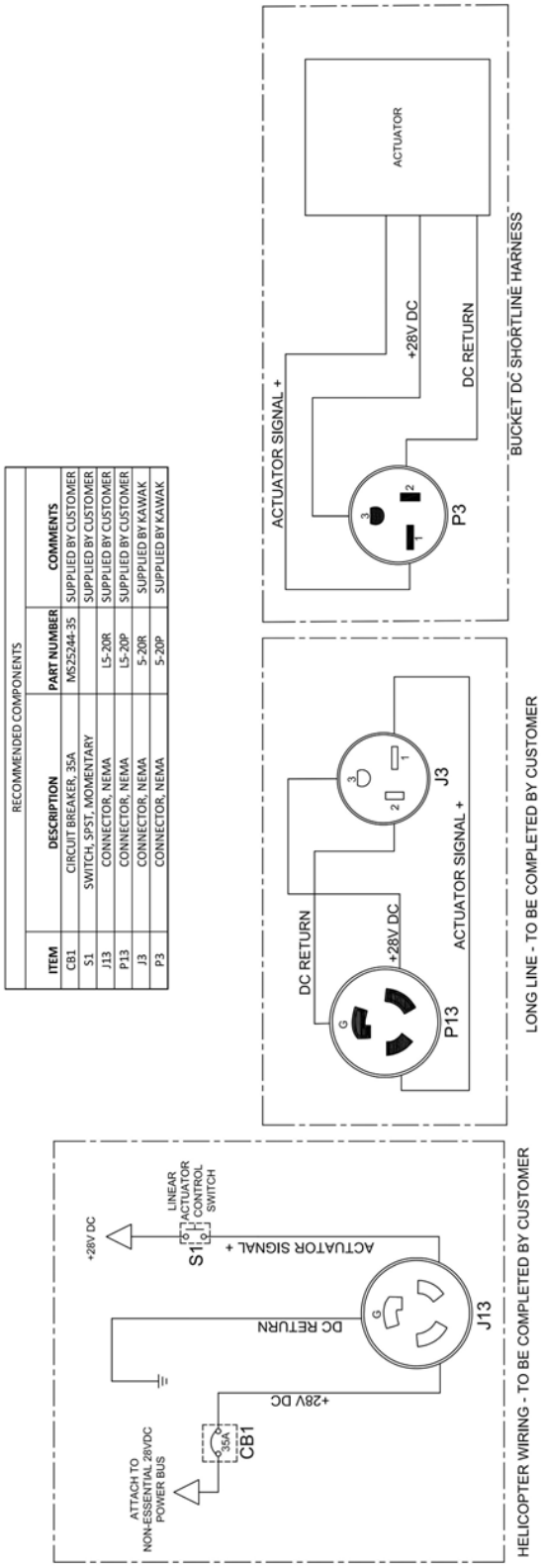


Figure 23: DC Wiring Schematic for the Cascade Bucket Valve Actuation

The 400Hz AC bucket refill pump requires 38A at 208VAC and 400Hz. Refer to Figure 24 below for a schematic of a typical bucket refill pump installation. It is the responsibility of the operator to complete the wiring between the connector on the belly of the aircraft (J13) and a suitable AC power source.

The 28VDC bucket refill pump requires 80A – 150A depending on desired performance and other variables. This DC pump motor's current can be internally limited to 80A, 100A, 120A or 150A. The higher the current limit is set, the greater the fill rate will be. However, the wire gauge will also have to be increased as the current limit and long line length are increased. Table 4 below shows pump performance at different current settings and long line lengths. Refer to Figure 25 below for a schematic of a typical bucket refill pump installation. It is the responsibility of the operator to complete the wiring between the connector on the belly of the aircraft (J7) and a suitable DC power source.

Table 4 DC Pump Performance and Long Line Wire Gauge Table

Long Line Length		Current Setting	Max. Wire Gauge	Flow Rate (GPM)	Est. Line Weight (lb)
	50'	80A	8 AWG	581	13.7
		100A	6 AWG	823	19.4
		120A	6 AWG	940	19.4
		150A	4 AWG	1001	25.75
	100'	**Current Setting**	**Max. Wire Gauge**	**Flow Rate (GPM)**	**Est. Line Weight (lb)**
		80A	4 AWG	598	51.5
		100A	4 AWG	811	51.5
		120A	2 AWG	946	71.2
		150A	2 AWG	987	71.2
	150'	**Current Setting**	**Max. Wire Gauge**	**Flow Rate (GPM)**	**Est. Line Weight (lb)**
		80A	4 AWG	579	77.25
		100A	2 AWG	814	106.8
		120A	0 AWG	948	127.5
		150A	0 AWG	991	127.5
	200'	**Current Setting**	**Max. Wire Gauge**	**Flow Rate (GPM)**	**Est. Line Weight (lb)**
		80A	2 AWG	581	142.4
		100A	0 AWG	824	170
		120A	0 AWG	940	170
		150A	00 AWG	995	192

*All minimum wire gauges maintain a voltage drop
less than or equal to 8 volts (assuming a 28V supply)

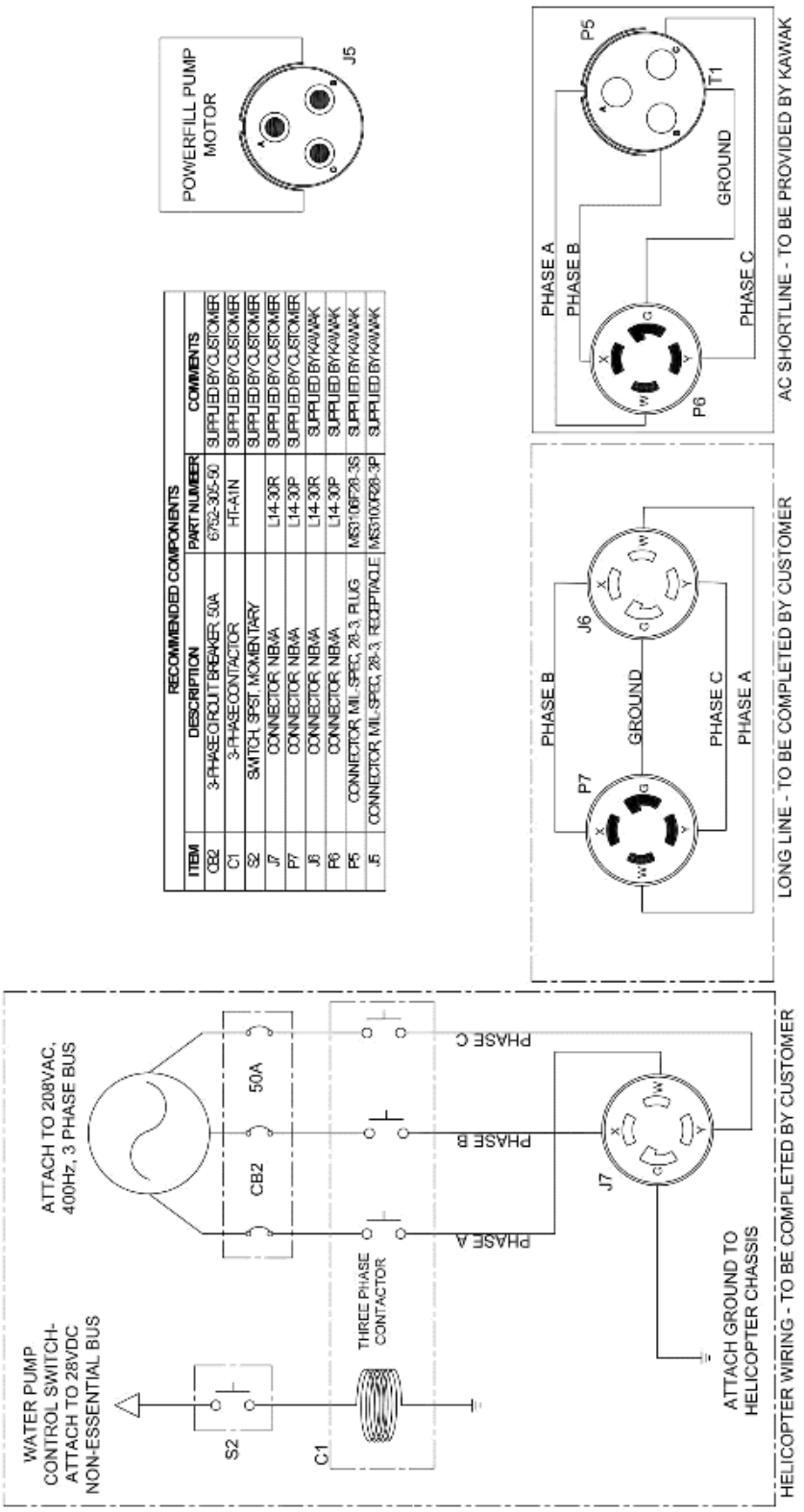
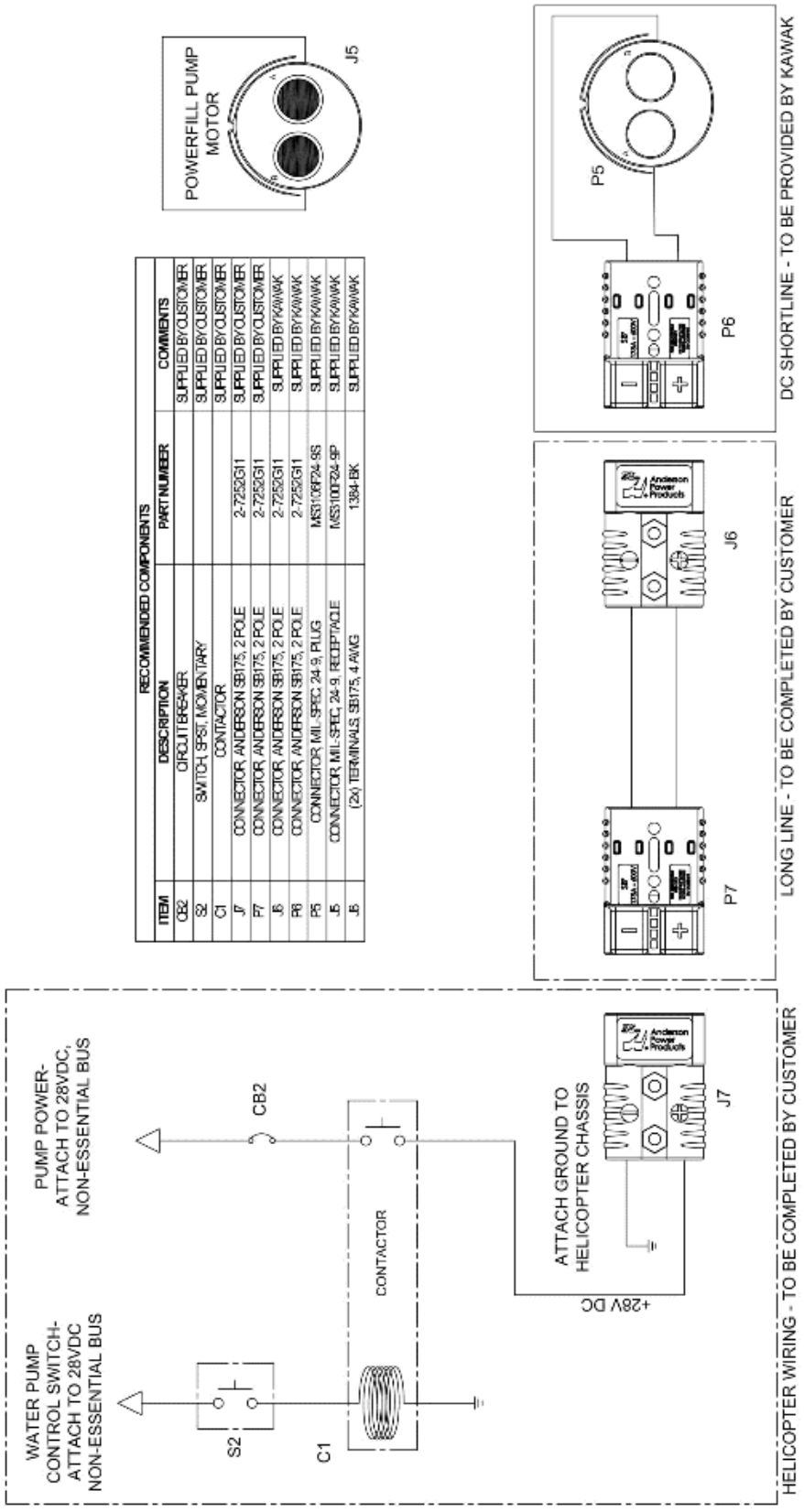


Figure 24: Wiring Schematic for 400Hz AC Bucket Refill Pump



RECOMMENDED COMPONENTS			
ITEM	DESCRIPTION	PART NUMBER	COMMENTS
CB2	CIRCUIT BREAKER		SUPPLIED BY CUSTOMER
S2	SWITCH, SPST, MOMENTARY		SUPPLIED BY CUSTOMER
C1	CONTACTOR		SUPPLIED BY CUSTOMER
J7	CONNECTOR, ANDERSON SB175, 2 POLE	2-7252G11	SUPPLIED BY CUSTOMER
P7	CONNECTOR, ANDERSON SB175, 2 POLE	2-7252G11	SUPPLIED BY CUSTOMER
J6	CONNECTOR, ANDERSON SB175, 2 POLE	2-7252G11	SUPPLIED BY KAWAK
P6	CONNECTOR, ANDERSON SB175, 2 POLE	2-7252G11	SUPPLIED BY KAWAK
P5	CONNECTOR, MIL-SPEC, 24-9, PLUG	MS3106F24-9S	SUPPLIED BY KAWAK
J5	CONNECTOR, MIL-SPEC, 24-9, RECEPTACLE	MS3100F24-9P	SUPPLIED BY KAWAK
J5	(2x) TERMINALS, SB175, 4 AWG	1384-BK	SUPPLIED BY KAWAK

Figure 25: Wiring Schematic for 28VDC Bucket Refill Pump

⚠ CAUTION: Correct polarity must be confirmed prior to powering on 28VDC pump. Reversed polarity will cause irreparable damage to pump circuitry and will not be covered under warranty.

Recommended longline conductor wire gauges for the DC valve actuator and the 400 Hz AC Refill Pump are summarized in Table 5.

**NOTE: Incorrect longline wire size will diminish system performance and can result in electrical shorts.

LONG LINE CONDUCTOR SIZES		
Line Length	**DC Power, Actuation (900, 1057 BUCKETS)**	**AC Power, Bucket Refill Pump**
50’ & under	14 AWG	8 AWG
51’ – 100’	12 AWG	8 AWG
101’ – 150’	12 AWG	8 AWG
151’ – 200’	10 AWG	8 AWG

Table 5: Long Line Conductor Size

When all helicopter-side DC actuator wiring has been completed, the polarity of power supplied to the bucket must be verified to be correct before connecting the DC harness to the actuation assembly.

**NOTE: The actuator will not function if the polarity is incorrect. However, incorrect polarity will not result in damage to the actuator.

To check DC power polarity:

1. Confirm that the DC power source is turned off.
2. Connect the DC harness to the matching 30A connector on the long-line, leaving the bucket-side connector disconnected.
3. Connect the long line to the 30A NEMA connector on the belly of the aircraft or ground power cart.
4. Turn on the 28VDC power source.
5. Check the voltage between terminals 2 and 3 at the DC NEMA receptacle J3 using a DMM (Digital Multimeter) by connecting the positive probe to pin 3, and the negative probe to pin 2. If polarity is correct, the reading will be +24-28VDC at pin 3 with respect to pin 2.
6. If polarity is reversed, turn off DC power, pull the circuit breaker, and swap the wires to terminals 2 and 3 at the DC NEMA receptacle J3 at the end of the long line and re-test.

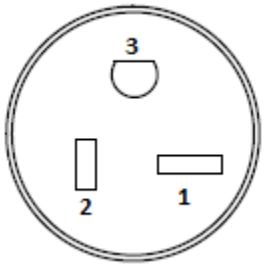


Figure 26: Mating Face of J3

⚠WARNING: INJURY RISK. Failure to turn off DC power and pull the circuit breaker can result in electrical shock.

To check the actuator signal wire connection:

1. If not already completed, follow steps 1-6 in the previous section.
2. Check the voltage between terminals 1 and 2 at the DC NEMA receptacle J3 at the harness connector using a DMM by connecting the positive probe to terminal 1, and the negative probe to terminal 2. If the wiring is correct, the reading will be +24-28VDC at terminal 1 with respect to terminal 2 when the assigned actuator control switch in the cockpit is depressed. There should be no voltage across these pins when the switch is released.

After correct DC power polarity and actuator signal wiring has been confirmed:

- Turn off 28VDC power.
- Connect the DC harness to the actuator harness.

⚠WARNING: INJURY RISK. There are multiple pinch points throughout the next few steps. Be mindful of where your hands and fingers are while initiating power to the linear actuator, as sudden movements may occur. It is recommended to have one person in charge of this operation and giving directions to help prevent injury.

1. Turn on DC power to test the actuator.
2. When the system is ready, test the function of the actuator by closing the switch in the cockpit to open the valve assembly.
3. Releasing the switch will cause the valve assembly to automatically close.
4. Repeat opening and closing the valve a couple times to verify normal function.

<u>Polarity Check for the 400 Hz AC Bucket Refill Pump</u>

When AC wiring is complete, it is necessary to check polarity of the 3-phase power going to the pump motor to make sure that the impeller is being spun in the correct direction. To do this:

1. Connect the bucket refill pump to the aircraft.
2. Turn on the AC power source.

3. While one crew member closes the cockpit switch to turn on the pump, the second person is needed to place a hand at one of the pump outlets.

⚠ WARNING: INJURY RISK. Do not insert hands, fingers, or objects into the pump outlets while power is connected to the bucket refill pump. Contact with the spinning impeller could result in injury to hands or fingers.

   a. If the second crewmember feels air being forced out of the outlet, the impeller is spinning the correct direction, and no wiring corrections are needed.
   b. If no air is detected flowing out of the outlet, the impeller is spinning backwards, and wiring needs to be corrected.
      i. To correct this, turn off AC power, pull the circuit breaker, swap any two (2) of the phase wires at the 30A belly connector and repeat the test to confirm correct impeller spin direction.

         ⚠ WARNING: INJURY RISK. Failure to turn off AC power and pull the circuit breaker can result in electrical shock.

Polarity Check for the 28 VDC Bucket Refill Pump

When DC Refill Pump wiring is complete, it is necessary to **check the polarity of the supplied DC power BEFORE powering the pump**. To do this:

⚠ CAUTION: Correct polarity must be confirmed prior to powering on 28VDC pump. Reversed polarity will cause irreparable damage to pump circuitry and will not be covered under warranty.

1. Disconnect the Anderson connector for the refill pump short line harness at the lift block so the pump cannot be powered on.
2. While one crew member closes the cockpit switch to power the refill pump circuit, the second person is needed to confirm correct polarity at the disconnected Anderson connector. Consult Figure 25. Polarity should match the (+) & (-) markings on the Anderson Connector.

   a. If the second crewmember measures correct DC polarity, no wiring corrections are needed. Re-connect the Anderson connector at the lifting block. The pump can now be powered on and tested.
   b. If the second crewmember measures reversed DC polarity, wiring corrections are needed.
      i. To correct this, turn off DC power, pull the circuit breaker, and switch the two DC conductors at the connector at the belly of the aircraft.

⚠ WARNING: INJURY RISK. Failure to turn off DC power and pull the circuit breaker can result in electrical shock.

3. If wiring corrections were made, confirm correct polarity before re-connecting the Anderson connector at the lifting block and powering and testing pump.

Initial Receiving and Bucket Setup

Refer to the Cascade Firefighting Bucket Basics video on the Cascade Fire Bucket page on the Kawak website.

1. Loosen the straps and remove them.
2. Remove the cargo net and fold it for future use.
3. Lift the bucket off the pallet using a forklift and set it on the ground. Retain the pallet for future storage and transportation purposes.
4. Remove the straps around the bucket skin and extend the rigging ropes and electrical harnesses.

⚠ CAUTION: Take care not to twist or entangle the rigging ropes or electrical harness. This could cause hazardous lifting conditions and/or damage to the equipment.

NOTE: The straps hold the system in its compact form. The lifting block, rigging ropes and electrical harnesses will be coiled and secured to the top of the collapsible inlet frame sitting on the internal support structure between the locator tubes with a strap.

⚠ WARNING: PINCH POINTS. There are multiple pinch points throughout the next few steps. Be mindful of where your hands and fingers are while manipulating the collapsible inlet frame. It is recommended to have one person in charge of this operation and giving directions to help prevent injury.

5. Remove the quick release pins from the hinge blocks on the frame arms to allow the inlet frame to expand to the open position.
6. Grab one of the two rigid (non-hinged) frame arms, lift it above the locator tubes, and pull it towards you away from the bucket.
7. Lock the hinge blocks in place with the quick release pins as the frame expands.
8. Lift the other rigid (non-hinged) frame arm out and over the locator tubes, allowing the frame to fully expand and be locked in the open and operating position. Be mindful of pinch points for your fingers and the rigging ropes.
   NOTE: With the frame expanded, the bucket will resemble a cup because of the internal battens installed in the strap pockets.
9. Complete a visual inspection of the various components, looking for anything that would cause an operational problem or hazard:
   a. Check for any visible damage, wear, or tear on the bucket's exterior.

b. Ensure there are no cracks, dents, or deformities in the metal parts.
c. Examine the polyurethane-coated fabric for punctures, tears, or abrasions.
d. Inspect shackles, sling connectors, rope thimbles, and attachment hardware for damage.
e. Look for fraying, cuts, or abrasions on rigging ropes and lifting straps.
f. Check for proper operation of the valve assembly and refill pump check valves.

After reconciling any uncovered problems or issues, you are now ready to attach your Cascade Bucket System to the helicopter for deployment.

Section 6: OPERATING THE BUCKET

System Operation

Product User Function and Interface

Actuator Operation

The Cascade bucket currently provides one mode of operation:

- Traditional dead-man operation using a SPST momentary switch

Dead-Man Mode is intended for executing multiple, partial bucket dumps per run.

- Depressing and holding the momentary switch opens the valve.
- Releasing the switch closes the valve.

NOTE: The valve will not stay open unless the switch is held down.
NOTE: In the event the current through the actuator exceeds the rated maximum during actuation, the actuator will lock out. To unlock it, simply release the momentary switch, then press and hold it again to keep the actuator extended. Alternatively, release the switch to retract the actuator.

Bucket Refill Pump Operation

When the bucket refill pump is employed with the bucket, an SPST momentary switch is utilized to control the pump motor. The operation of the bucket refill pump is similar to operation of the valve.

- Depressing and holding the momentary switch powers the motor to fill the bucket and releasing the switch cuts power to the motor.

NOTE: The bucket can be completely or partially filled depending on the length of time for which the switch is depressed. Refer to Figure 24 for the recommended installation of the Bucket refill pump electrical connections.

Deploying the Bucket

To deploy the Cascade Bucket System:

1. Follow the steps outlined in the Initial Receiving and Bucket Setup section to prepare the bucket for use.
2. Connect the harnesses to the longline and secure them in place.
3. Perform the normal pre-flight check procedure (see Pre-Flight Check below).

Collapsing the Bucket

When preparing to collapse the bucket, start with the lower structure sitting upright on the ground surrounded by the inlet frame. To collapse the inlet frame:

1. Pull the quick release pins.

⚠ WARNING: PINCH POINTS. There are multiple pinch points throughout the next few steps. Be mindful of where your hands and fingers are while manipulating the collapsible inlet frame. It is recommended to have one person in charge of this operation and giving directions to help prevent injury.

2. Push the hinge blocks towards the center.
3. Set one of the solid frame arms on top of the inlet frame support structure between the locator tubes.
4. Continue pushing the hinge blocks towards the center until the second solid frame arm can be set on top of the inlet frame support structure between the locator tubes.
5. With the solid arms opposite of each other, the frame will collapse down, as shown in Figure 27.

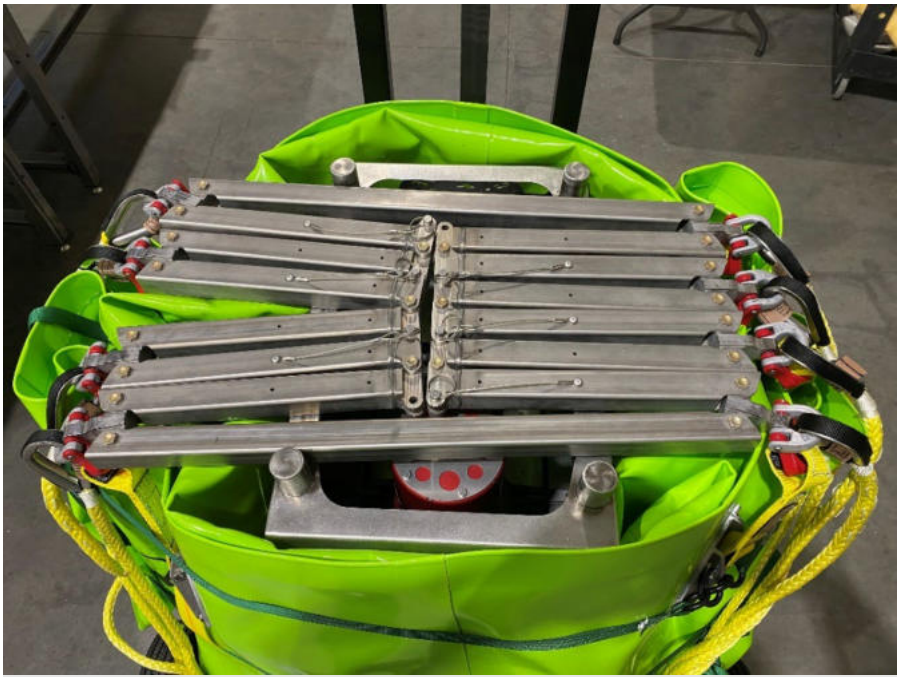


Figure 27: Collapsed Inlet Frame

Pre-Flight Check

Along with the aircraft, the bucket requires daily pre-flight inspection to ensure safe and trouble-free operation.

Beginning at the bottom of the aircraft:

- Inspect the cargo hook and main screw pin shackle for solid attachment and signs of wear.
- Inspect the electrical NEMA connectors for positive and secured connection. Make sure there is enough slack to prevent unwanted tension on the connection.
- Inspect the long line and cables for rips and tears down to the lifting block of the bucket.
- Inspect the shackles connected to the lift block. Check for excessive wear and that the connections are properly secured with tape or safety wire.
- Inspect the NEMA cable connections at the lifting block for a solid positive connection and that a proper service loop is used to prevent tension on the NEMA connectors.
- Inspect the rigging ropes and sling connectors at the inlet frame for signs of excessive wear or fraying of the ropes.
- Inspect the power cables for cuts or heavy scrapes with extra focus on where they interface with the inlet frame.
- Inspect the inlet frame. Look for cracks or breaks. Check that all the quick release pins are in place and operating properly, holding the frame in the open position.
- Inspect the lift straps and strap clamp fittings. Ensure all hardware is present and properly torqued. Check for wear and fraying of the straps in the exposed areas.
- Ensure the area between the lifting strap and strap clamp fitting is clean and free of excessive grit. Keeping this area clean and free of abrasive materials will significantly increase lifting strap service life.
- Inspect the skin for rips, tears, UV degradation, seam separation/fraying/wear, and excessive wear points. Repair, as necessary.
- Inspect the attachment of the skin to the valve base. Ensure the T-bolt clamp is positioned correctly around the sealing surface and is properly torqued to maintain the seal and prevent leakage.
- Inspect the lifting strap attachments to the valve base. Check that all hardware is present and properly torqued.
- Inspect the inlet screen for damage and remove any stuck debris to ensure proper waterflow while power fill operation is occurring.
- Inspect the electrical connections at the bucket refill pump and the actuator. Ensure that proper slack is present, and the connectors are tight, to prevent unwanted leakage.
- Inspect the four (4) check valves on the bucket refill pump. Clear any debris and check that all hardware is present and properly torqued.

- Ensure that the cam and groove attachment point on the bucket refill pump is secure and solid, and that the hook and loop strap is fastened around the cams, to prevent an accidental disconnection from the valve base.
- Inspect the actuation assembly. Check for signs of excess wear on the moving components. Check that all hardware is present and properly torqued.
- Inspect the valve assembly for any cracks or tears or bends in the hinge plates which could cause a poor seal to the base.

After a thorough visual inspection and repair of problems found, test the operating systems of the bucket.

- Have the pilot operate the bucket refill pump. A hum can be heard or felt if it is functioning.
    - Listen or feel for excess vibrations or sounds that would constitute rough operation.
    - Hold a hand near the cast outlet and check valves. If air can be felt coming through the valves, the pump is working properly. If air is not felt, but the pump is spinning, the polarity is reversed and must be corrected.
- WARNING: INJURY RISK. Do not insert hands, fingers, or objects into the pump outlets while power is connected to the bucket refill pump. Contact with the spinning impeller could result in injury to hands or fingers.
- Have the pilot extend and retract the actuator.
    - Watch for smooth and fluid operation.

Lifting the Bucket

The Cascade bucket should be lifted off the ground with the helicopter directly overhead to avoid inducing an unintentional and unwanted swinging or dragging of the load.

In-Flight Operation

The Cascade bucket does not display a tendency to spin while in flight. With most of the weight concentrated down low, its flight characteristics are very stable.

Filling and Dumping

Filling

The unique design of the valve assembly with its attachment to the actuator allows the Cascade bucket to be filled more efficiently than other systems. Because of this design, the Cascade bucket can be filled by simply lowering it into the water source. The valve assembly will automatically open to allow water to fill the bucket from the bottom. If outfitted with the bucket refill pump, turning on the pump (depress and

hold the switch) as the bucket is being lowered into the dip site will cause it to rapidly sink and fill with water. As the bucket is lifted out of the water, the valve assembly will automatically close without any operation from the pilot.

NOTE: The Cascade bucket was designed to be lowered straight down into the water source for filling. Attempting to tip the bucket on its side to get it to sink is discouraged.

Filling using the bucket refill pump is accomplished by pressing and holding the user-configured switch. Releasing the switch will shut off the pump. This is covered in more detail under the Bucket Refill Pump Operation heading at the beginning of this section.

Dumping

Dumping the water load is accomplished by pressing and holding the user-configured switch. Releasing the switch will close the valve. Split drops are controlled manually, with no limit on the number of splits. This is covered in more detail under the Actuator Operation heading at the beginning of this section.

Section 7: MAINTENANCE AND REPAIRS

Maintenance Procedures

General Maintenance

The Cascade bucket has been designed to minimize required maintenance. Daily maintenance activity is limited to completing a post-flight inspection for damage, washing down the bucket at the end of each day of use with fresh water, and allowing it to dry before collapsing for storage or transportation.

Post-Flight Procedures

- At the end of each day of use, rinse the bucket with fresh water. Allow it to dry before collapsing the bucket.
- Inspect the rigging ropes for damage (cuts, abrasion, fraying, discoloration, melting, etc.). Replace, as needed.
- Inspect the lift straps for damage (cuts, abrasion, fraying, discoloration, melting, etc.). Replace, as needed.
- Check for any broken battens. Replace, as needed.
- Inspect the skin for any damage (abrasion, punctures, or tears). Repair as needed.

- Inspect the knuckle covers for wear. Replace as needed.
- Inspect the wire harnesses and connectors for damage. Repair or replace as needed.

Servicing the Actuator Assembly

The actuator assembly is not meant to be disassembled or serviced. Any non-resolvable issues with the actuator assembly necessitate its complete replacement.

If the actuator assembly is removed and replaced, electrical bonding between the actuator and the valve base assembly must be reestablished as the harness and actuator are permanently attached to one another. See Figure 28 below. Using a milliohm meter, measure resistance between the vertical blade of the actuator connector, P3, contactor 2, and the standoff or valve base of the bucket assembly. Resistance should not exceed 20 milliohms. If a milliohm meter is not available, measure the resistance with a multimeter. The resistance must be less than 1 ohm.

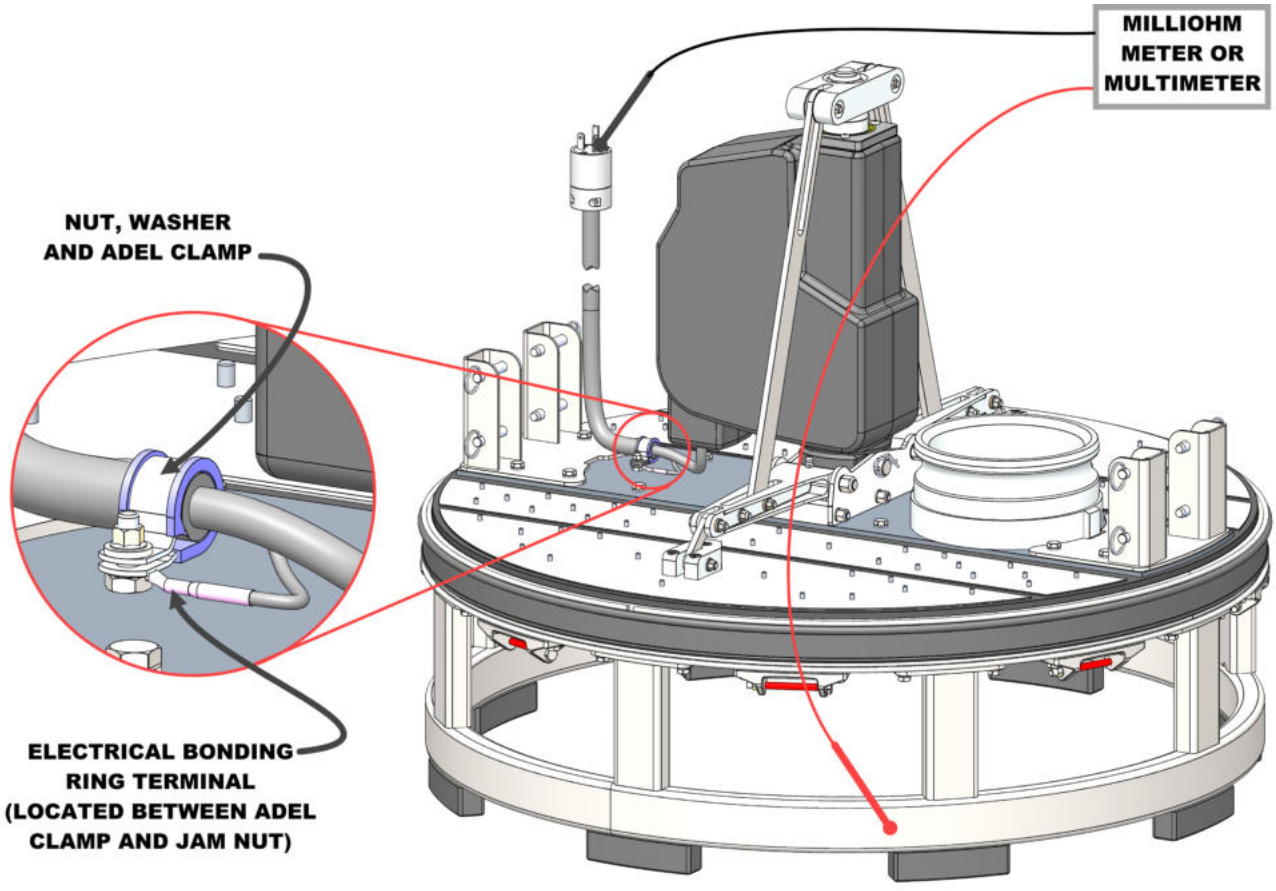


Figure 28 Linear Actuator Electrical Bonding

Servicing the Bucket Refill Pump

NOTE: It is recommended that all bearings, seals, and o-rings be replaced during annual or preventive maintenance, or prior to long term storage for optimum performance of the Bucket Refill Pump.

400 Hz AC & 28VDC Bucket Refill Pump Disassembly

1. Motor Removal (see **Figure 29**)
    a. Disconnect the pump short line harness from the motor.
    b. Remove the hex bolts and washers securing the motor guard assembly (42393-0400, 400 Hz AC motor or KCB-0000-6001-00, 28VDC motor). Set the motor guard and hardware aside for reuse.
    c. Remove the four socket head cap screws and lock washers securing the motor to the motor mount. Set them aside for reuse.

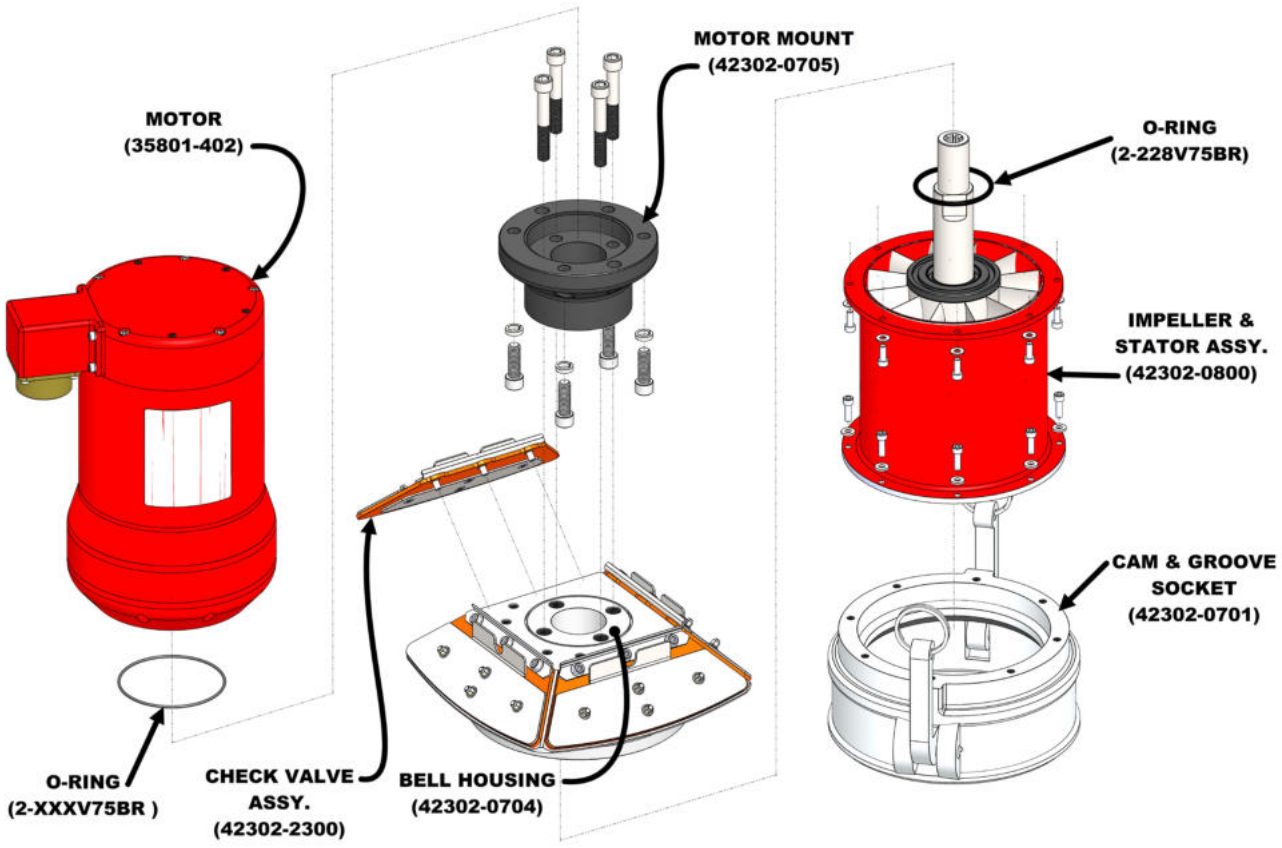


Figure 29: Bucket Refill Pump Disassembly (Motor Guard hidden for clarity)

2. Pump & Stator Disassembly (see Figure 29 and Figure 30)
    a. Remove the bell housing from the impeller & stator assembly.

b. Grasp the impeller shaft (42302-0802) and remove the socket head bolt on the impeller end of the shaft. If necessary to loosen the bolt, clamp the wrench flats of the Impeller Shaft in a vise with non-marring jaws.
c. Remove the lock washer, impeller retaining plug (38420-1), and impeller (38418-1).
d. Remove the spacer (42302-0803), shaft seal sleeve (38415-1) and O-rings from the shaft.
e. From the inlet end of the stator, remove the shaft seal (152062TSS) and the retaining ring (99142A592).
f. From the outlet end of the stator, remove the shaft seal (12162TSS).
g. Slide the impeller shaft out of the stator assembly. The two bearings (SS6205-2RSH) and spacer (38416-1) should remain on the impeller shaft.
h. Remove the two bearings (SS6205-2RSH) and spacer (38416-1) from the impeller shaft.

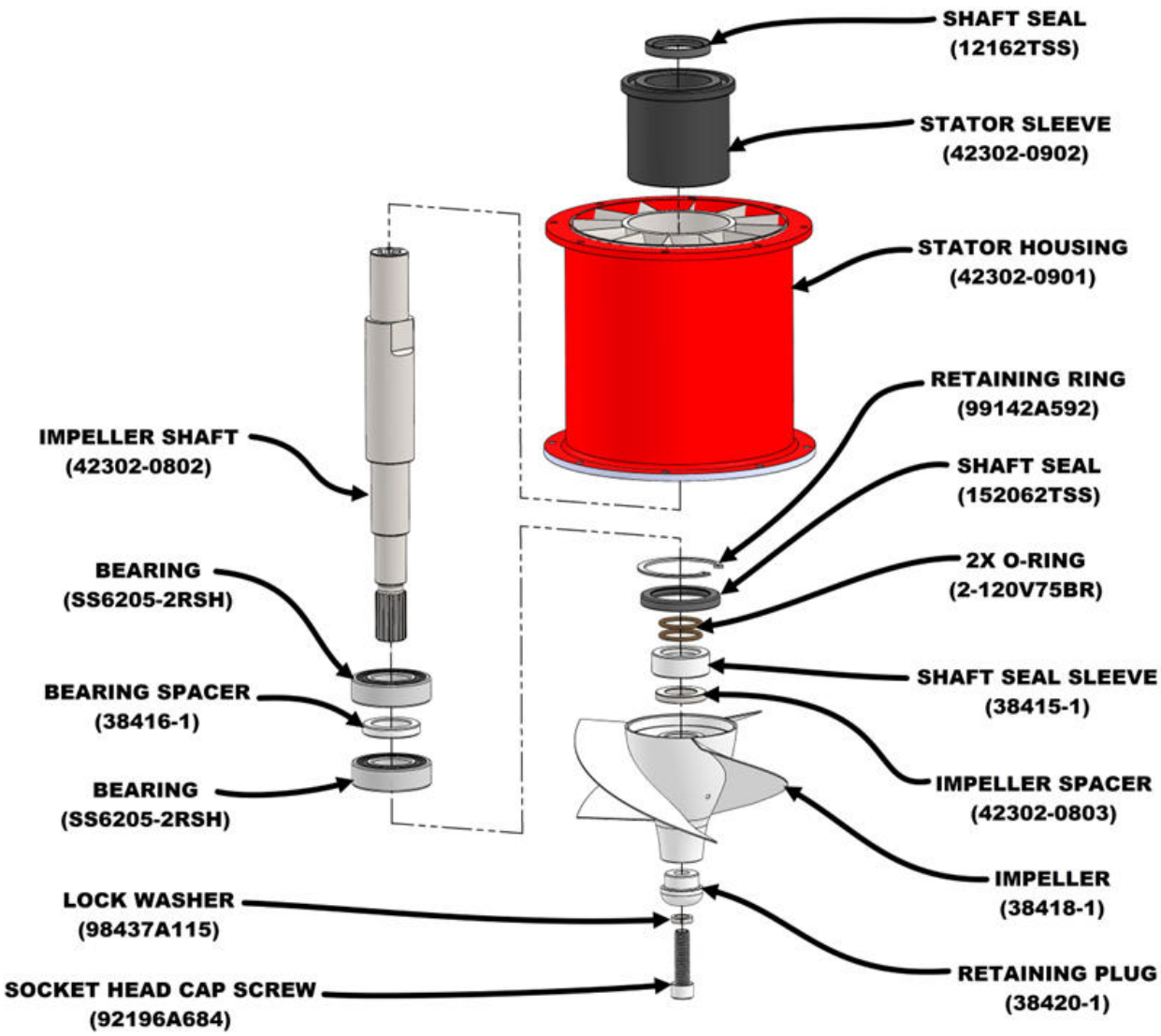


Figure 30: Impeller and Stator Assembly

3. Check Valve(s) Disassembly (see Figure 31)
    a. Remove the three bolts, washers, clamp plate, and aluminum spacers securing each of the four check valve assemblies (42302-2300) to the bell housing (42302-0704).
    b. Remove the four screws, washers, and nuts holding each check valve assembly together.

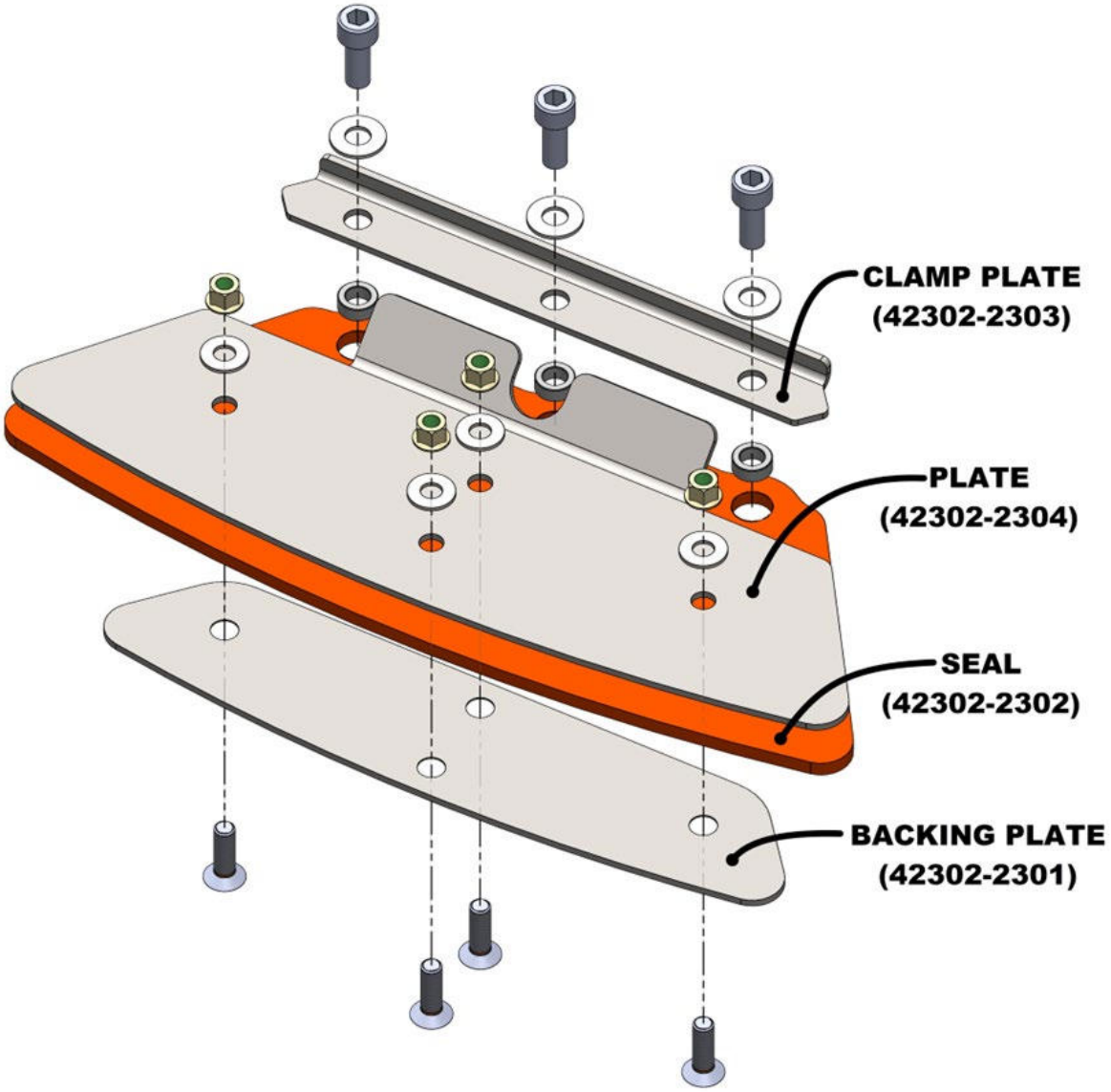


Figure 31: Check Valve Assembly

Pump Assembly Inspection

NOTE: Prior to inspection, it is important to clean all parts that will not be replaced upon reassembly. Pay particular attention to cleaning anaerobic sealant residue from inside the stator sleeve and bell housing/stator sleeve interface.

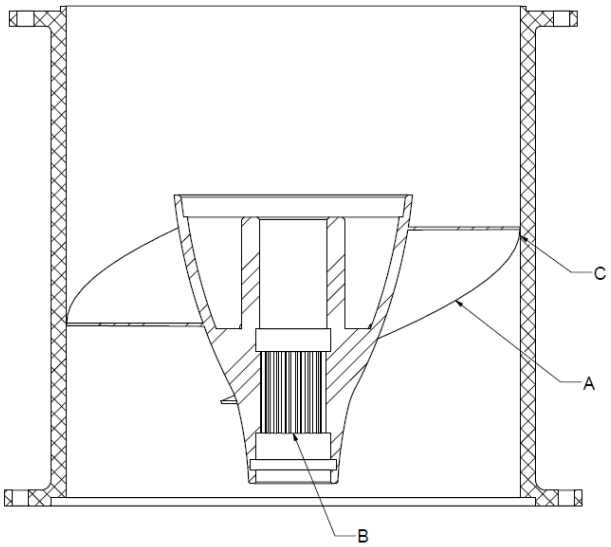


Figure 32: Impeller Inspection Points/Areas

Table 6: Impeller Wear/Damage Limits

Wear/Damage Limits: Impeller, Modified, P/N 38418-1			
AREA	TYPE OF DAMAGE	MAXIMUM DAMAGE/WEAR LIMIT	REPAIR
A	Mechanical, Impeller Blade	Gouges, dings, or damage Significantly degrading pump performance or impeller balance	Replace
B	Mechanical, Spline teeth	0.005” depth on driving face of spline teeth	Replace Superficial corrosion may be removed using fine steel wool.
C	Wear Clearance	If the clearance between the impeller and the stator housing exceeds .015”	Replace

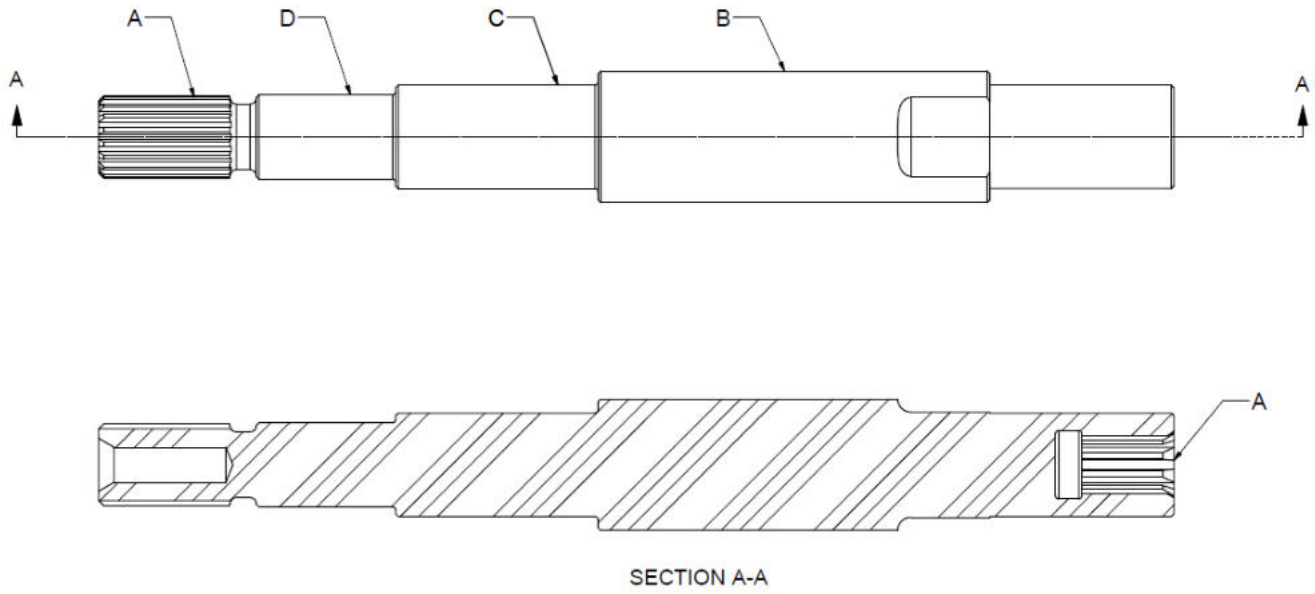


Figure 33: Impeller Drive Shaft Inspection Points/Areas

Table 7: Impeller Shaft Wear/Damage Limits

Wear/Damage Limits: Shaft, Impeller Drive, 38419-1			
AREA	TYPE OF DAMAGE	MAXIMUM DAMAGE/WEAR LIMIT	REPAIR
A	Mechanical, Spline Teeth	.005” depth on driving face of spline teeth	Replace Superficial corrosion may be removed using fine steel wool.
B	Mechanical, Seal Surface	Any scratches, dents, or grooves that would preclude proper sealing	Replace Light Polishing is permissible
C	Mechanical, Bearing Mounting Surface	Less than 0.9838” diameter or any damage that would preclude proper mounting and alignment of the bearings	Replace Light Polishing is permissible
D	Mechanical, Bearing Mounting Surface	Less than 0.795” diameter or any damage that would preclude proper mounting and alignment of the impeller	Replace Light Polishing is permissible

Bell Housing and Check Valve Inspection

Inspect sealing edges of Bell Housing for damage i.e. bent lip, gouges, etc. Minor Damage that will still allow check valves to seal is acceptable and should be addressed to smooth burrs and gouges. Areas of deformation that do not allow check valves to close fully require replacement of Bell Housing.

Inspect the check valve seals for tears, cracking, or abrasion where the valves contact the sealing surfaces on the Bell Housing, and where the seals flex when the valves open and close. Inspect the check valve plates for bends or cracks. Replace any check valve parts with damage that would prevent proper sealing.

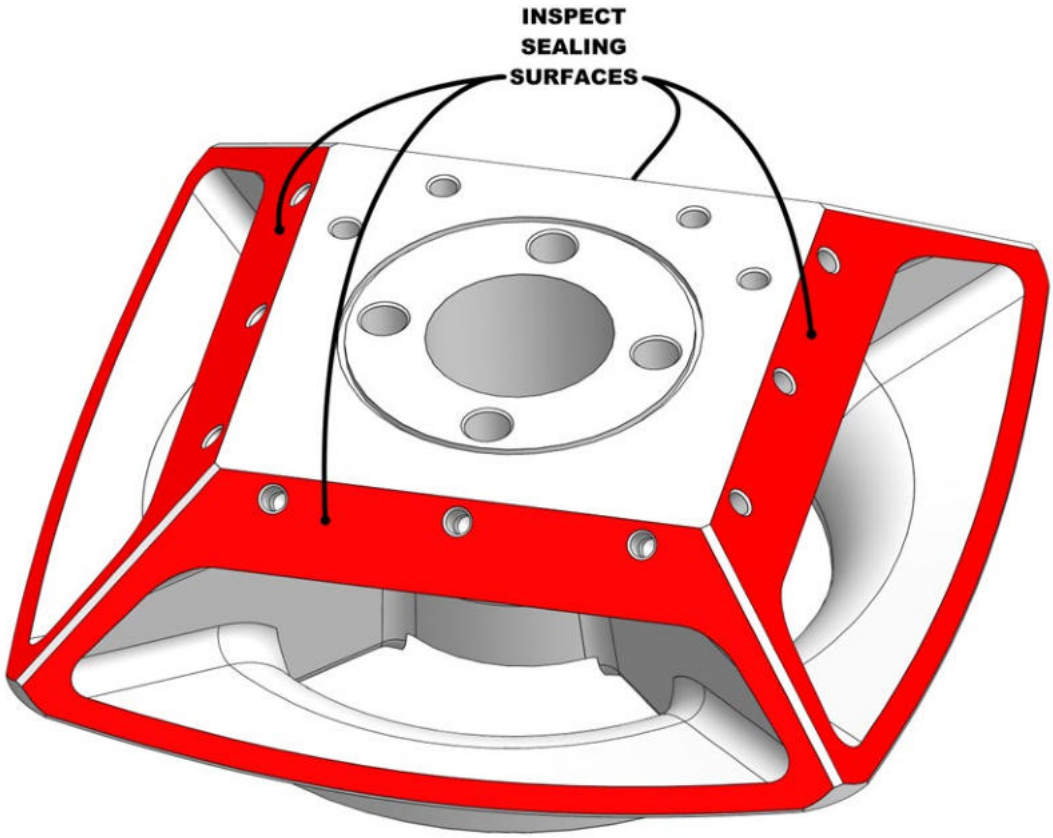


Figure 34: Check Valve Sealing Surface Inspection

Bucket Refill Pump Assembly

1. Pump Impeller and Stator Assembly

NOTE: Ensure the inner diameter of bearing and seal area is clean, and no traces of grease or sealant remain prior to assembly.

NOTE: Clean shaft seal sleeve thoroughly with isopropyl alcohol or other non-residue solvent prior to installation of the O-rings.

   a. Install the bearings (SS6205-2RSH) on the impeller shaft (42302-0802) placing the spacer (38416-1) in between the two bearings.

b. Apply a thin bead of a medium strength anaerobic sealant (e.g. Loctite 518) to OD of shaft seal (12162TSS)
c. Install the shaft seal in the outlet side of the stator sleeve with the open side of the seal facing up (see Figure 32).
d. Apply a thin layer of grease to the indicated (orange) lip area of the seal.

Figure 35: Seal Orientation and Grease Location

NOTE: For the next step, cooling the impeller shaft/bearings assembly and warming the stator housing assembly is recommended to facilitate easier assembly. The interface between the bearings and stator is designed to be a very precise slip fit.

e. Install the impeller shaft/bearing assembly into the stator by inserting the large OD (Outer Diameter) end of the impeller shaft up through the inlet side of the stator.
f. Install the retaining ring (991142A592) to secure the impeller shaft/bearings into the stator.
g. Apply a thin bead of a medium strength anaerobic sealant (e.g. Loctite 518) to OD of Shaft seal (152062TSS) and install it in stator housing with the open side of the seal facing outward. Apply a thin layer of grease to the lip area of the seal.
h. Install the O-rings (2-119V75BR), WITHOUT GREASE, into the groove in the ID (Inner Diameter) of the shaft seal sleeve (38415-1) and install the shaft seal sleeve in the seal installed in step 3. Isopropyl alcohol can be substituted in place of lubricant to assist installation of the shaft seal sleeve onto the Impeller Shaft.
   CAUTION It is important that these O-rings not be lubricated as the shaft seal sleeve (38415-1) MUST rotate inside the Shaft Seal (152062TSS) instead of the shaft (42302-0802) rotating inside the O-rings (2-119V75BR).

Failure to follow this instruction will cause premature wear on the O-rings and cause a leak to develop.

i. Clamp the impeller shaft in a vise with non-marring jaws by the wrench flats on the shaft.
j. Install the spacer (42302-0803) onto the impeller shaft.
k. Apply grease (e.g. MIL-PRF-81322) to the external splines of the impeller shaft and to the internal splines of the Impeller.
l. Install the impeller (38418-1), making sure the splines engage smoothly and the impeller slides in until it presses on the spacer (42302-0803).
m. Install the retaining plug (38420-1), lock washer and socket head cap screw using anti-seize lubricant on the threads.
n. Torque the socket head cap screw to 250 in-lbs.

2. Pump Assembly
    a. Place the stator assembly inlet down, so the shaft end is pointing up.
    b. Install the O-ring (2-228V75BR) using silicone O-ring lube or petroleum jelly to avoid damage to the O-ring during installation.
    c. Install the bell housing assembly (42302-0704) and the motor mount (42302-0705) onto the stator. Use RTV sealant to seal this interface.
    d. Apply grease (MIL-PRF-81322) to the internal splines of the impeller shaft and the external splines of the motor shaft (35801-402).
    e. Install the O-ring (2-042V75BR) on the motor mounting flange pilot using silicone O-ring lube or petroleum jelly to avoid damage to the O-ring during installation.
    f. Install the motor onto the motor mount, making sure the motor splines engage smoothly with the shaft impeller shaft splines.
    g. Fasten the motor in place using the four socket head bolts and lock washers.
    h. Connect the pump short line harness to the pump motor. Use a small amount of RTV sealant on connector threads when installing connector. This serves as a non-permanent thread locking provision.
    i. Install the motor guard (42393-0400, 400 Hz AC motor or KCB-0000-6001-00, 28VDC motor)using the hex head bolts and washers.

Bucket Skin Repair

Minor abrasions to the coating of the bucket skin material, as well as pinholes in the bucket skin, can be fixed using only glue. Repairing larger holes and damage to the underlying fabric requires a patch in addition to glue, or a heat-adhered patch.

⚠ WARNING: Work in a well-ventilated area when performing repairs using glue or a hot air gun.

Tools and Materials Needed:

- PVC Patch Cement for glue repairs
- Isopropyl alcohol, acetone, or similar solvent
- Abrasive pad (e.g., ScotchBrite) or 220-grit sandpaper
- Nitrile shop gloves
- Skin patches
- Scissors
- Hand-held roller
- Hot air gun with slit nozzle for heat-patched repairs

Glue-only repairs

1. Scrub the damaged area with an abrasive pad (e.g., ScotchBrite) or 220-grit sandpaper.
2. Clean with alcohol. Ensure that the damaged area is completely dry, and has a dull, matte appearance before proceeding.
3. Spread a liberal amount of glue over the damaged area with fingers (wear nitrile shop gloves if available/desired) or a brush. **NOTE**: The glue should cover an area that extends one inch beyond the edges of the damaged area in every direction, and two coats should be used.
4. The second coat should be applied within four hours of the first coat.
5. Allow the glue to cure for at least 24 hours at room temperature before using the bucket.
6. Keep the cement container tightly closed when not in use.

Glue Patch Repairs

1. Trim off any loose pieces of coating or fabric around the damage area with scissors.
2. Place the damaged area of the bucket skin on a flat, solid surface (e.g., concrete floor), or place a flat, solid object underneath the damaged area to support the skin.
3. Scrub the damaged area with an abrasive pad (e.g. ScotchBrite) or 220-grit sandpaper.
4. Wipe the area clean with a rag and alcohol.

5. When patching a hole, place a piece of masking tape on the side opposite the side of the skin that is to be patched. **NOTE**: Ensure that the damaged area is completely dry, and has a dull, matte appearance before proceeding.
6. Cut out a patch that will extend at least two inches beyond the damaged area in every direction. **NOTE**: Aim for the patch to be circular, or rectangular with rounded corners.
7. Scrub and clean both sides of the patch using the same method as in steps 3 and 4.
8. Apply glue to one side of the patch as well as the damaged area on the bucket skin. If the application instructions for the glue dictate, wait the prescribed amount of time before applying the patch to the damaged area.
9. Place the center of the patch onto the damaged area.
10. Lay the rest of the patch down, working outwards from the center.
11. If the work surface or supporting object underneath the skin is significantly sloped, tape the patch down using masking tape to ensure the patch does not slide away from the damaged area.
12. Using a roller, apply pressure to the center of the patch.
13. Roll outwards toward the edges in every direction to force any air bubbles out. **NOTE**: Ensure that the patch does not lift once it has been placed. Maintaining full contact of the patch with the damaged area creates the strongest possible bond between the patch and the skin.
14. Place a plastic sheet over the patched area.
15. Weigh down the patch with a flat, heavy object for 12 hours at room temperature. **NOTE**: After 12 hours have elapsed, the skin can be moved, but the bucket should not be used until the glue has cured for at least 24 hours.
16. Keep the cement container tightly closed when not in use.

<u>Hot Air Patch Repairs</u>

1. Follow steps 1-7 of the preceding Glue Patch Repair procedure.
2. Turn the hot air gun on, and let it warm up. Adjust the temperature as needed while adhering the patch. If a hot air gun with a temperature display/setter is used, set the temperature between 750-1000°F (400-550°C).
3. Place the patch on the damaged area while holding half of the patch partly folded up.
4. Heat the patch and the bucket skin between the two surfaces, starting at the center and working towards the edges. Keep the nozzle between 0.25” and 0.5” (0.6cm and 1.2cm) away from the surface.
5. Apply light pressure with the roller as the coating starts to melt (small bubbles will start to appear within seconds as the coating melts).
6. Continue to heat the patch and bucket skin and roll it simultaneously until the entire patch has adhered to the bucket skin.
7. Allow the patched area to cool down completely.

8. Attempt to peel back the edges and corners of the patch to ensure the patch has adhered completely.
9. If necessary, repeat heating and rolling the patch in any areas that can be peeled back.

⚠ CAUTION: Do not overheat the patch or the bucket skin, as this can result in permanent damage to one or both.

Skin Replacement

If the bucket skin gets damaged beyond repair, as defined in the above section, a replacement skin will need to be obtained from Kawak Aviation. A replacement skin will come as a lone item with the placement holes for the strap clamp fittings predrilled. The existing hardware, strap clamp fittings and plates, lift straps, and battens will need to be removed from the original skin and reused if no damage is found upon inspection. If any damage has occurred to these parts, replacements will also need to be ordered along with the replacement skin.

Tools you will need:

- Set of combination wrenches
- Deep socket set and ratchet
- Hammer and punch
- Pliers
- Blunt round rods/Phillips screwdriver
- Air compressor with hose and blow nozzle
- Alcohol
- Fish tape
- Safety wire
- Side cutters
- Clamps
- Electrical connector pliers
- Dielectric grease

NOTE: Utilizing an overhead hoist system to suspend the bucket makes removal and installation of the new skin much easier. If that is not an available option, the task can still be completed with additional steps and help.

<u>Disassembling the Skin</u>

1. With the inlet frame expanded and locked in the open position, remove the knuckle covers and set them aside.
2. Using electrical connector pliers, disconnect the electrical harnesses from the bucket refill pump (if equipped).
3. Disconnect the zip ties and Adel clamps that secure the harnesse(s) to the bucket skin.

4. Once free, pull the refill pump harness (if equipped) out and away from the work area to prevent damage while manipulating the bucket.
   NOTE: If not utilizing a hoist, removing the bucket refill pump, if equipped, and setting it aside at this point will aid in maneuvering the valve base by making it lighter.
5. Remove the orange sleeve containing the actuation harness and BRP harness (if equipped) as well as the choker.
6. Coil the actuation harness around the actuator. Secure in place with cable ties as needed.
7. With the pump set aside and the actuator harness coiled on the valve base, pull the valve base onto its side.
8. Pull the inlet frame away to stretch the skin tight and gain access to the lower strap brackets that attach the lift straps to the valve base assembly.
9. Use wrenches to remove the attachment bolts and free the lift straps from the valve base assembly.
10. Use a deep socket and ratchet to loosen and remove the T-bolt clamp.
11. Pull the valve base assembly free from the bucket skin.
12. Mark the joint on the inlet frame where the rigging rope with the electrical harness(es) and zip up sleeve is attached to facilitate reassembly in the proper orientation.
13. With the hammer and punch, pound out the retaining pin of the sling connectors to disconnect the straps from the inlet frame.
14. Remove the frame from the damaged skin.
15. Take the skin to a flat workspace.
16. Lay it out in order to remove the lift straps and strap clamp fittings and plates.
17. Use wrenches to remove the strap attachment bolt from the clamp fitting.
18. Using compressed air, blow into the bottom of the strap pocket of the skin while simultaneously pulling the strap out of the top of the skin pocket. **NOTE**: If compressed air is not available, alcohol can be used to lubricate the pocket and strap to aid in the removal.
19. Use wrenches to remove the four (4) bolts holding the clamp fittings and plates to the skin. Repeat steps 17 and 18 for all remaining straps and clamp fittings and plates. Note the location of zip tie mounts during disassembly.

Reassembling the Skin

1. Use the four (4) bolts to attach the strap clamp fittings through the predrilled holes in the skin.
2. Torque the fasteners to 40in-lb.
3. Using compressed air or alcohol, push the end of the fish tape up through one strap pocket from the bottom of the skin.
4. Use the safety wire to create a suitable loop to attach the fish tape to the bottom loop of one lift strap.
5. Using compressed air or alcohol, pull the strap through the pocket until the bottom loop is protruding past the bottom of the skin. Ensure the loop at the top is in line with the attachment bolt at the strap clamp fitting.
6. Install the bolt and tighten until it is just snug enough not to rotate by hand.

⚠ **CAUTION**: Over-torquing this bolt could cause the tabs on the strap clamp fitting to break off.

7. Repeat steps 1 - 6 for all the remaining straps. Remember to attach the zip tie mounts to one instance of the strap clamp fittings.
8. Bring the skin to the inlet frame.
9. Orient the skin so the strap clamp fitting with the zip tie mounts, the rigging rope with the zip up sleeve and electrical harnesses, and the joint of the inlet frame that was marked during disassembly are all lined up.
10. Using the hammer and punch, install the sling connector to the inlet frame with the lower red shackle connected to the lift strap and the upper gray shackle connected to the rigging rope.
11. Pull the rigging rope straight and follow the weave of the line from top to bottom to prevent twisting or tangling.
12. Repeat steps 10-11 for each of the rigging ropes, ensuring that none of the ropes are tangled.
13. Orient the inlet frame and attached skin such that the rigging rope with the electrical harnesses is bottommost.
14. Bring the valve base to the bottom of the skin and tip it onto its side. Clock the skin so the zip tie mounts are positioned as shown in Figure 36.

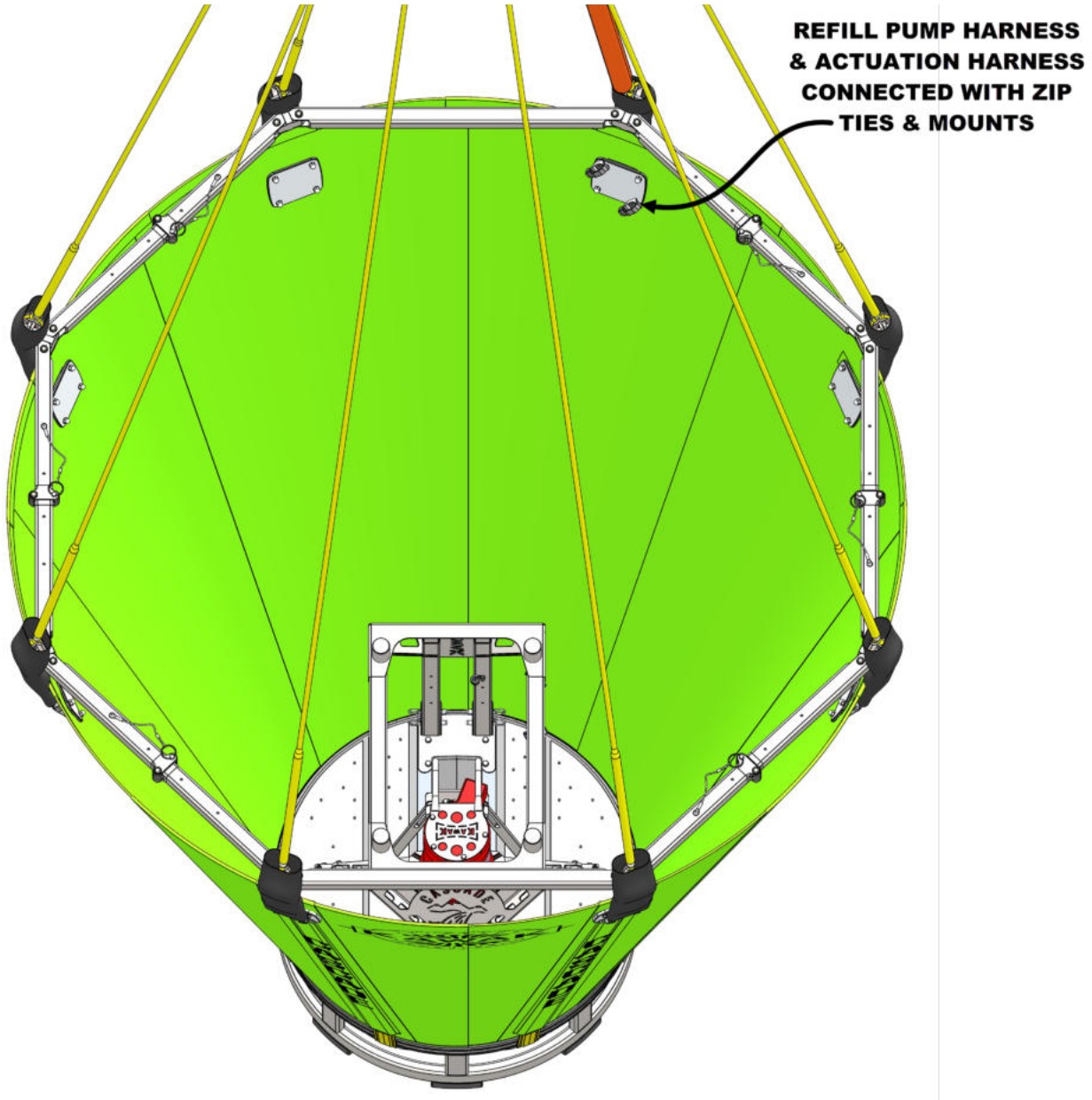


Figure 36 Skin Assembly Clocking

15. Using alcohol, round rods, clamps, and pliers, work your way around the base pulling the skin over the gasket until the bottom of the skin is flush with the bottom of the valve base weldment. **NOTE**: Make sure that the lift straps line up with the lower strap brackets on the underside of the valve base and the skin is oriented per step 14. The skin will not easily rotate about the valve base once installed.
16. With the skin in positioned and flush with the bottom of the valve base, install the T-bolt clamp. **NOTE**: Wet the inside surface of the clamp's rubber cushion with alcohol prior to installation. This serves to lubricate the interface between the strap

and skin allowing the strap slide on the skin while tightening, lending to an even clamping load.

17. Position the clamp approximately ½" up from the bottom of the skin.
18. Using a deep socket and ratchet, tighten the clamp to secure the skin to the base. Ensure the bolt guard is properly positioned to cover the protruding end of the T-bolt.
19. Use wrenches to reattach the lift strap & lower strap brackets on the underside of the valve base weldment.
20. Torque the fasteners.
21. Repeat steps 19-20 for all remaining straps.
22. With the straps installed, pull the valve base back to the upright position and rearrange the skin and inlet frame back around the valve base to regain the cup-like formation.
23. Reroute the electrical harnesses. Reference Figure 20 as necessary.
24. Apply dielectric grease to the face of the refill pump connector (if equipped).
25. Use electrical connector pliers to tighten the connectors securely. Apply a small amount of RTV to electrical connector threads. This acts as a non-permanent thread locking mechanism.
26. Replace the zip ties retaining the refill pump harness (if equipped) and actuation harness and cinch them down tight to prevent slippage. Trim off the excess from the zip ties.
27. Ensure there is adequate slack in the harnesses, so they are not tensioned when the bucket is deployed.
28. Reinstall the orange sleeve and choker on the actuation harness. Wrap the choker around only the harness; do not choker the rigging rope.
29. Ensure there is adequate slack in the harness, so it is not tensioned by the rigging rope when the bucket is deployed.
30. Replace the knuckle covers over the sling fittings at the inlet frame.
31. The bucket system is now ready to be returned to service.

Section 8: STOWAGE & GROUND HANDLING

Pre-Stowage Maintenance

At the end of the fire season the bucket should get a thorough inspection and cleaning. Any issues found during an inspection should be resolved at this time, so that the bucket is repaired, fully functional, and ready for the next season. Once any issues are addressed, the bucket system should be washed to remove any residue accumulated during use, especially if fire retardants were used during deployment. These can be caustic and can accelerate corrosion of the materials used in the bucket system. After sufficient cleaning, the bucket must be allowed to dry completely before being folded up for storage, to prevent mold growth and corrosion.

Stowage

⚠ WARNING: There are multiple pinch points throughout the next steps. Be mindful of where your hands and fingers are while manipulating the collapsible inlet frame. It is recommended to have one person in charge of this process to give directions to prevent injury.

1. Once dry, pull all the quick release pins in the inlet frame to allow the joints to collapse.
2. Lift one of the solid segments of the inlet frame up and set it between the locator tubes of the inlet frame support structure.
3. Simultaneously, collapse the segments into themselves to the center while folding the bucket skin in neatly.
4. Moving to the other solid segment, lift it up and over the locator tubes of the support frame.
5. When the frame is properly collapsed inside the area between the locator tubes, the joints will align, and the quick release pins can be reinserted to help secure the inlet frame in the collapsed position. See Figure 27.
6. Extend the rigging ropes and electrical harnesses.
7. Secure the ropes in a few places along their length to hold them in a bundle that can be easily controlled and manipulated.
8. Coil the bundle on top of the inlet frame and secure it with the included strap.
9. With the bundle secured in position, wrap the two straps around the skin and tighten them down to make the bucket more compact and easier to handle and store.
10. Wrap and secure the Gladiator Cargo Net around the bucket with the four (4) L-straps.
11. The bucket can now be stored as-is, or it can be put back on the shipping pallet for easy maneuvering with a forklift or pallet jack.

Optional Ground Cart

The ground cart is a cart specifically designed to make it easy to move the Cascade Bucket System around on the tarmac or on uneven ground, which can be the case with remote Heli-bases. The cart has the capability to lift the bucket system in and out of the cargo area of a Blackhawk helicopter so the bucket can be easily deployed by a single operator. The cart can also be stowed in the cargo area to be used for unloading the bucket at the destination.

Figure 37: Ground cart

It is designed to operate much like a pallet jack/manual lift. There are two (2) stationary wheels mounted on the front outriggers and two (2) locking swivel casters with brakes at the back. The lift mechanism is operated by a strap style winch that can be driven by either the included handle, or a hand drill with a 5/8” socket. The winch automatically holds the position of the forks as soon as lifting or lowering is stopped, allowing starts and stops at any point while lifting and lowering, safely and easily.

To operate the cart:

1. Release the wheel brake by pressing down with your foot to move the lever to the neutral center position.
2. Pull and rotate the swivel lock out so that the wheels can swivel freely.
3. Roll the ground cart up to the collapsed bucket perpendicular to either side of the collapsed inlet frame and insert the forks into the opening between the standoff ring and the valve base.
4. Center the standoff post between the forks. If positioned correctly, the forks should land on the lower strap fittings on the underside of the valve base weldment. **NOTE**: There is a rubber strip fastened to the top of the forks to protect the fittings while being operated.
5. With either the supplied handle or with a drill, operate the winch clockwise to lift and counterclockwise to lower.

With the bucket raised 4-5" off the ground, the cart can be easily maneuvered, even if the terrain is less than ideal.

⚠ CAUTION: As with all lift trucks, it is not recommended to move the cart more than necessary with a raised load. Always keep the load at the lowest possible height while maneuvering the cart.

To load the bucket onto a helicopter:

1. Open the cargo bay door and steer the bucket and cart up to the opening.
2. Raise the bucket until the base clears the floor of the cargo area.
3. Push the cart forward until the bucket is safely over the floor.
4. Lower the winch back down until the forks are clear of the bucket and it is sitting safely on the floor of the helicopter.
5. Pull the cart back out and lower the forks back down.
   NOTE: The cart is also equipped with skid pads on the underside to help prevent damage to the leading edge of the doorframe while the cart is loaded into and unloaded from the helicopter.
6. Push the bucket further into the helicopter to allow enough floorspace for the cart to sit inside the door.
7. Push the cart forward enough to swivel the rear wheels back towards you to decrease angle of approach when the cart is tipped back.
8. Engage the swivel lock to hold the wheels in place.
9. Set a foot against the base frame of the cart and pull the top towards you to lift the front tires up and onto the cargo deck.
10. In this position, reach down and grab the supplied handle on the top of the winch.
11. Brace the cart with your shoulder, while lifting the back, rolling it forward, and stabbing the forks back through the standoff of the bucket base.
12. Push forward until the rear tires can also be set on the floor of the helicopter.
13. Once loaded, the cart and bucket can be situated in the cargo area to be properly strapped in place prior to take-off.
14. Unloading the cart and bucket is the reverse of the loading process.

Section 9: TROUBLESHOOTING

General

This section contains information for troubleshooting the main functionality of the bucket system. The failure modes described in these sections are the most likely to be encountered during operation. Schematics of the electrical systems can be found in Section 5. If the information in this troubleshooting section does not resolve the failure mode, contact Kawak Aviation Technologies for further assistance.

Actuation System

MALFUNCTION	PROBABLE FAULT	TROUBLESHOOTING / CORRECTIVE ACTION
ACTUATOR		
ACTUATOR INOPERABLE	A. Circuit breaker tripped.	1. Check the 35A circuit breaker. If breaker trips again, clear fault & retry.
	B. Electrical power supply issue	1. Confirm the system is connected to a circuit capable of supplying >15A at 28VDC. 2. Confirm the system is configured as outlined in Section 5 and Figure 23. 3. Check all electrical connections and confirm polarity and voltage at connector J3 are correct following the steps in the Bucket Set-Up section in Section 5. 4. Check for wire-to-wire short circuits and verify end to end continuity of the signal paths through the long line and short line using a multimeter. Repair/replace as required.

	C. Faulty actuator assembly	1. For reference, see figure 21 in section 5. In a quiet place, apply 28V between pin 3 (+) and pin 2 (-) on connector P3. Then apply 28V to pin 1. If listening near the actuator, an audible click should be heard once 28V is applied to pin 1 and the actuator should begin to extend and another audible click should be heard when 28V is removed from pin 1 and the actuator will retract. If these clicks are not heard and the actuator does not move, the actuator assembly will likely need to be replaced. 2. Apply 28V to pin 3 (+) and pin 2 (-) on the short line connector for the actuator (P3) and measure the current drawn. A small current (<100ma) should be observed. Large current or zero current indicates a faulty actuator. Replace as required. 3. With 28V still applied across pins 3 and 2, apply 28V to pin 1 (+) to extend the actuator <u>while monitoring the current drawn</u>. Zero current or more than 5 amps while unloaded indicates reverse polarity or a faulty actuator, respectively. Removing the 28V from pin 1 should cause the actuator to retract.

400 Hz AC Bucket Refill Pump

MALFUNCTION	PROBABLE FAULT	TROUBLESHOOTING / CORRECTIVE ACTION
BUCKET REFILL PUMP		
REFILL PUMP INOPERABLE	A. Circuit breaker tripped	1. Check the 50A circuit breaker. If breaker is tripped, reset.
	B. Electrical power supply issue	1. Confirm the system is connected to a circuit capable of supplying >40A at 208VAC 400Hz. 2. Confirm the system is configured as outlined in Section 5 and Figure 24. 3. Check all electrical connections, and confirm polarity is correct following the steps in the Polarity Check for the 400 Hz AC Bucket Refill Pump in Section 5. 4. Check for short circuits and broken connections in the long line and short line using a multimeter. Repair/replace as required.

	C. Faulty pump motor	1. Remove connector P5 from the refill pump motor. Check resistance between pins on motor connector. If resistance reading is greater than 2 ohms and very similar between pins, the motor windings are faulty. Replace motor. 2. With connector P5 removed check continuity between pins on motor connector and bolts on the motor housing. If continuity exists, the motor windings are faulty. Replace motor. 3. If problems still persist, check the aircraft power supply and contactor. Refer to the aircraft manuals as needed.
REFILL PUMP TURNS ON, BUT DOES NOT PUMP WATER AND INSTEAD SPINS BACKWARDS	A. Clogged inlet screen	1. Remove any accumulated debris on the inlet screen.
	B. Incorrect phase connections	1. Turn off AC power, pull the 50A circuit breaker, and swap any two of the phase wires at the belly connector (J7 in Figure 24).

28VDC Bucket Refill Pump

MALFUNCTION	PROBABLE FAULT	TROUBLESHOOTING / CORRECTIVE ACTION
BUCKET REFILL PUMP		
REFILL PUMP INOPERABLE	A. Circuit breaker tripped	1. Check the associated circuit breaker. If breaker is tripped, reset.
	B. Electrical power supply issue	1. Confirm the system is connected to a DC circuit capable of supplying 100A (or whatever current limit the motor is set to) at 28VDC. 2. Confirm the system is configured as outlined in Figure 25, located in section 5. 3. Polarity Check for the 28 VDC Bucket Refill Pump in Section 5. If polarity was reversed, the pump circuitry was likely damaged, and the motor will likely need to be replaced. 4. Check for short circuits and broken connections in the long line and short line using a multimeter. Repair/replace as required.
	C. Faulty motor	5. If all electrical connections are in good operating condition and the voltage, polarity and amperage requirements from the above

		steps are met, the motor should run. If the motor still fails to run, the motor is faulty and will need to be replaced to restore pump function.

Section 10: KITS AND ACCESSORIES

Contact Kawak Customer Services for available kits and accessories.

Section 11: THE WARRANTY

The most up-to-date version of the warranty can be accessed on the Kawak website.

Section 12: ILLUSTRATED PARTS CATALOG

RIGGING

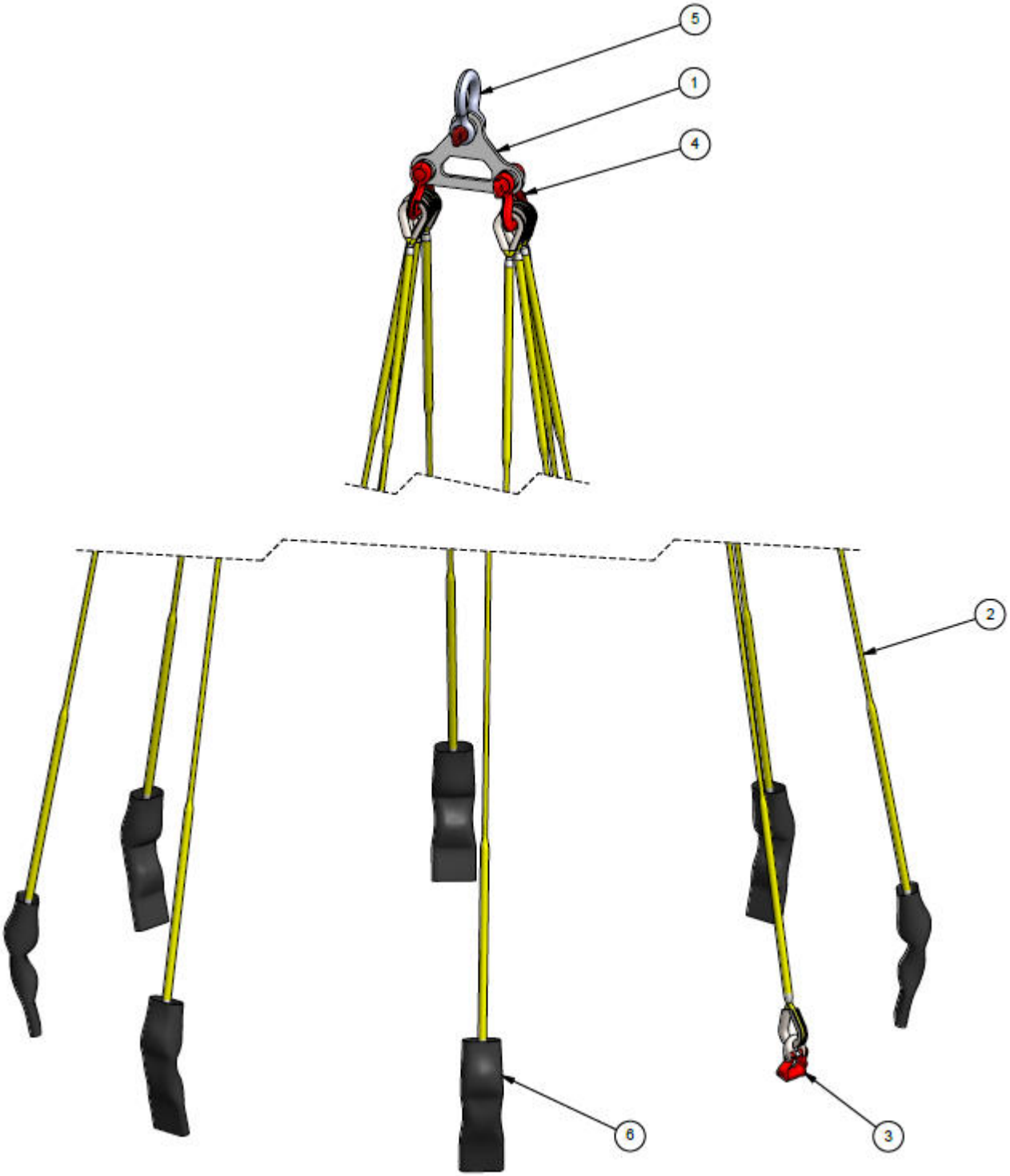


Table 8: Rigging part numbers

ITEM NO.	QTY.	PART NUMBER	DESCRIPTION
1	1	KCB-0000-0010-01	LIFTING BLOCK WELDMENT
2	8	KCB-0000-0002-01	RIGGING ROPE ASSEMBLY, MED/LARGE BUCKET
3	8	1020695	SLING CONNECTOR, 2"
4	2	1021075	CROSBY WEB SLING SHACKLE, SCREW PIN, 8.5 TON
5	1	1017582	SCREW PIN SHACKLE, GALVANIZED, 12.5 TON, 1.13" PIN DIA.
6	8	KCB-0000-0003-00	KNUCKLE COVER, BUCKET

INLET FRAME

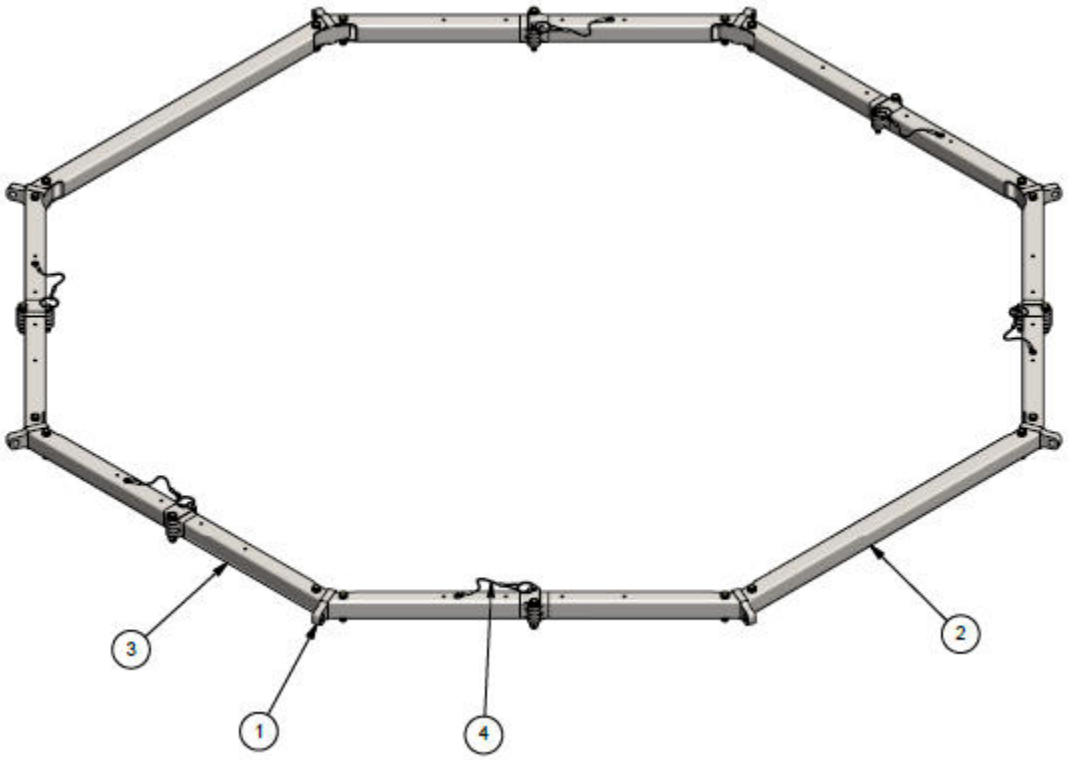


Table 9: Inlet Frame part numbers

ITEM NO.	BUCKET SIZE (GAL)		PART NUMBER	DESCRIPTION
	900	1057		
	QTY.	QTY.		
1	8	8	KCB-0000-4001-01	INLET JOINT FITTING, BUCKET V1
2	2	2	KCB-0000-4002-32	INLET FRAME ARM, RIGID, BUCKET V1
3	12	12	KCB-0000-4010-32	INLET FRAME ARM, BUCKET V1
4	6	6	94975A235	PIN, QUICK RELEASE, 3/8 X 1.5, SS, W/LANYARD

SKIN ASSEMBLY

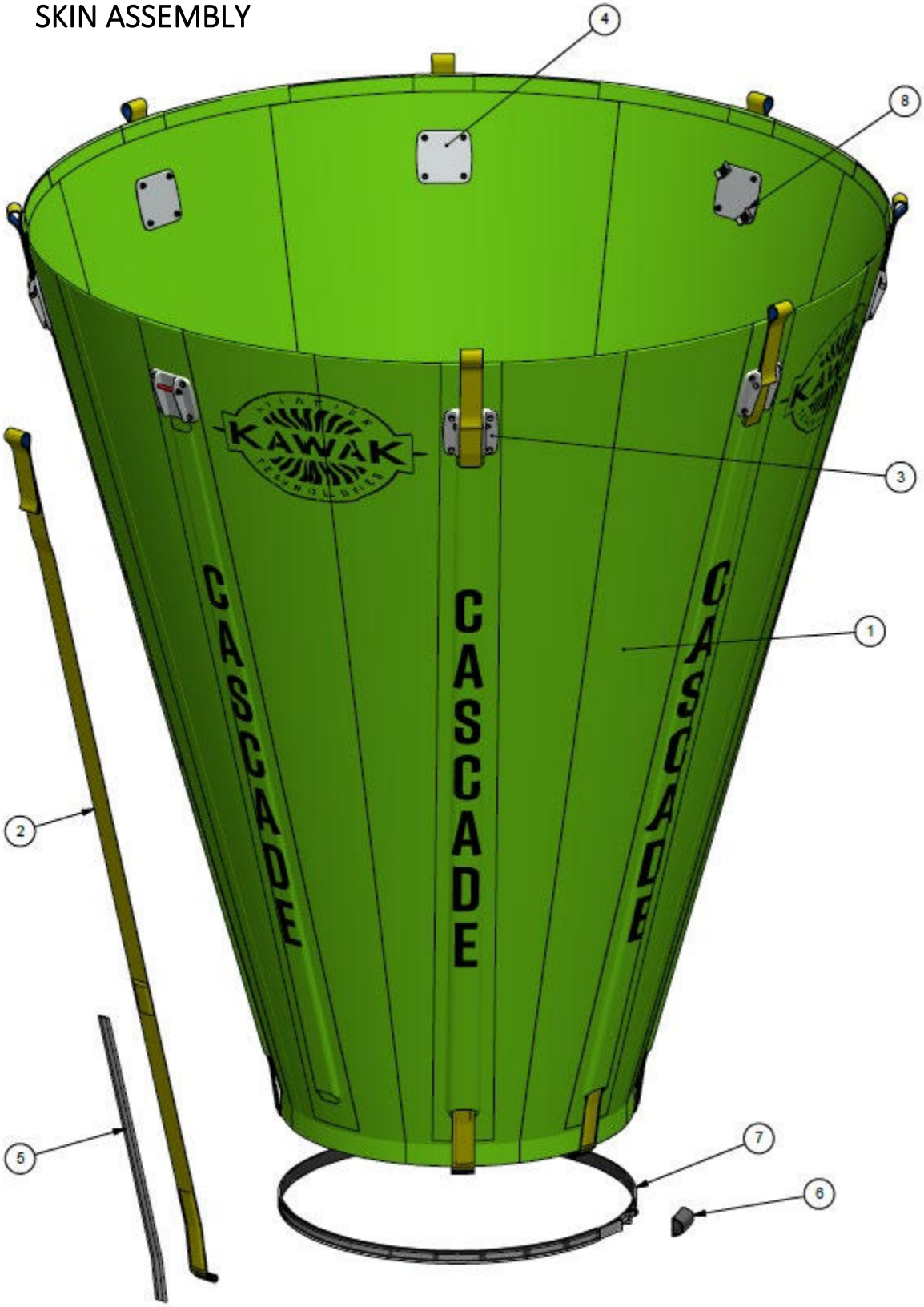


Table 10: Skin Assembly part numbers

ITEM NO.	BUCKET SIZE (GAL)		PART NUMBER	DESCRIPTION
	900	1057		
	QTY.	QTY.		
1	1		KCB-0900-1001-32	SKIN, 900 GAL, BUCKET
		1	KCB-1057-1001-32	SKIN, 1057 GAL, BUCKET
2	8		KCB-0900-1002-32	STRAP, VERTICAL, 900 GALLON BUCKET SKIN
		8	KCB-1057-1002-32	STRAP, VERTICAL, 1057 GALLON BUCKET SKIN
3	8	8	KCB-0000-1005-00	STRAP CLAMP FITTING, MACHINED, BUCKET V1
4	8	8	KCB-0000-1007-00	STRAP CLAMP PLATE, BUCKET V1
5	8	8	KCB-0000-1003-01	SUPPORT BATTEN 32" & 44" BASES
6	1	1	KCB-0000-0005-01	CLAMP GUARD, BUCKET
7	1	1	975JR-0002	CLAMP, T-BOLT, 32" BASE, BUCKET
8	2	2	7582K83	MOUNT, ZIP TIE, 1/4" MOUNTING BOLT, 1/2" WIDE TIE

ELECTRICAL

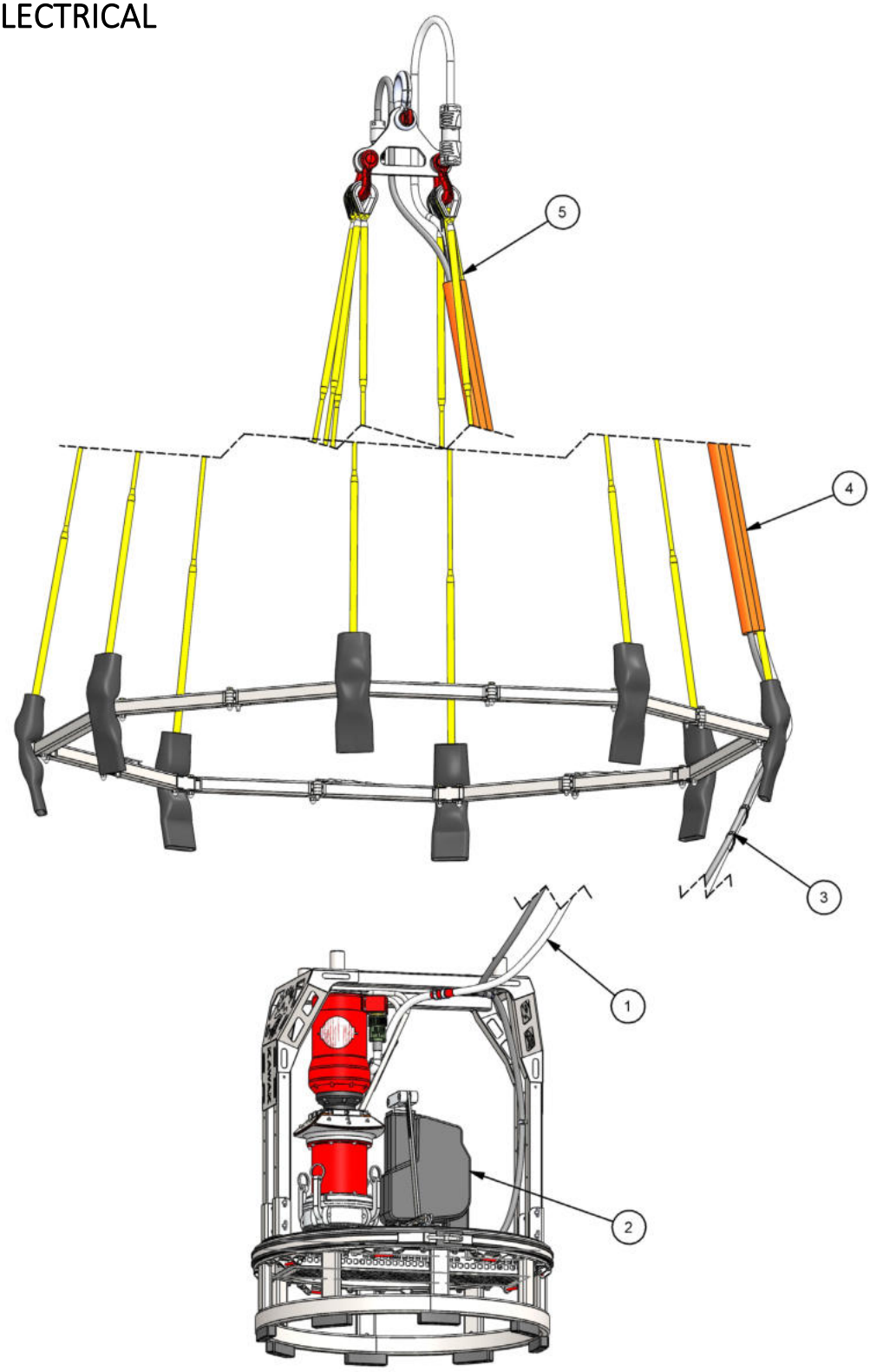


Table 11: Electrical part numbers

ITEM NO.	QTY.	PART NUMBER	DESCRIPTION
1	1	KCB-0000-0001-00	HARNESS, SHORT LINE, PUMP, BUCKET
1**	1	KCB-0000-0012-00	HARNESS, SHORT LINE, 28VDC PUMP, BUCKET
2	1	KCB-0000-3500-32	ACTUATOR ASSEMBLY, 100mm STROKE
3	2	69455K12	ZIP TIE, ½" WIDE, 0.09" THICK, 9" LONG
4	1	PC-CHD-.4375-PL-SOX2-180IN-ZP-O-SP	SHORT LINE SLEEVE, ZIP UP, 180" LONG
5	1	WCS-SO-1	WEB CHOKING STRAP, POWER CORDS

**This harness is required if bucket is equipped with a 28vdc refill pump.

LOWER STRUCTURE

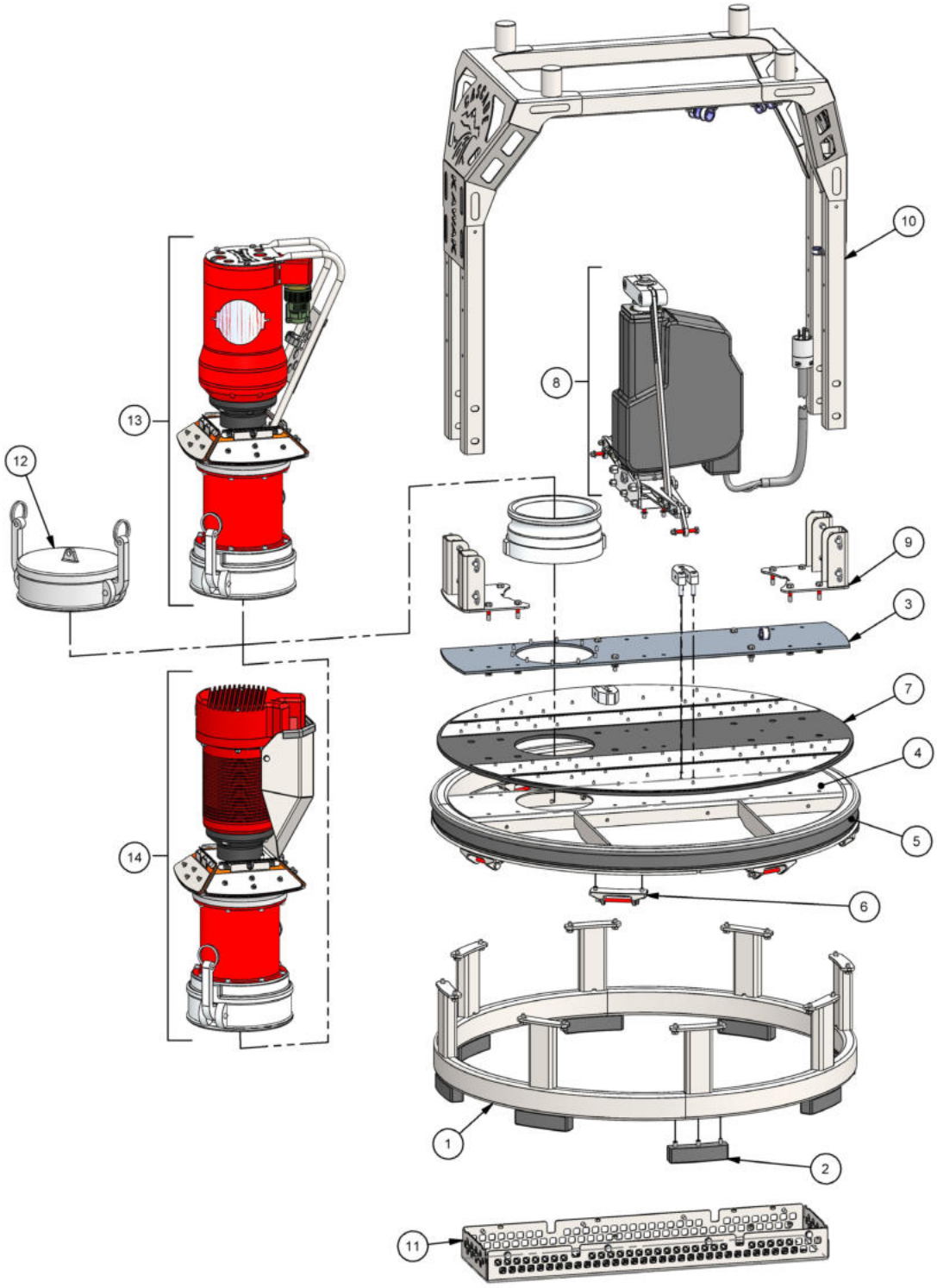


Table 12: Lower Structure part numbers

QTY.	ITEM NO.	PART NUMBER	DESCRIPTION
1	14	KCB-0000-6000-00	PUMP, BUCKET FILL, 28VDC, ASSEMBLY
1	13	42302-0700	PUMP, BUCKET FILL, ASSEMBLY
1	12	51415K89	C&G, CAP, PUMP, BUCKET
1	11	KCB-0000-0008-32	SCREEN, VALVE BASE
1	10	KCB-0000-0030-32	WELDMENT, INLET FRAME SUPPORT STRUCTURE, 32" BASE
2	9	KCB-0000-2030-32	CAGE MOUNT BRACKET, VALVE BASE, 32" BASE
1	8	KCB-0000-2800-32	ACTUATION ASSEMBLY, BUCKET, 32"
1	7	KCB-0000-2100-32	VALVE ASSEMBLY, BUCKET V1
8	6	KCB-0000-2006-00	LOWER STRAP BRACKET, BUCKET V1
1	5	KCB-0000-2004-32	VALVE BASE SEAL, BUCKET V1
1	4	KCB-0000-2010-32	VALVE BASE, BUCKET, WELDMENT
1	3	KCB-0000-2001-32	PUMP MOUNT PLATE, 32" BASE
8	2	KCB-0000-2007-32	WEAR PAD, VALVE BASE, BUCKET, 32"
1	1	KCB-0000-2020-32	STANDOFF, 32" BASE, BUCKET

ACTUATION ASSEMBLY

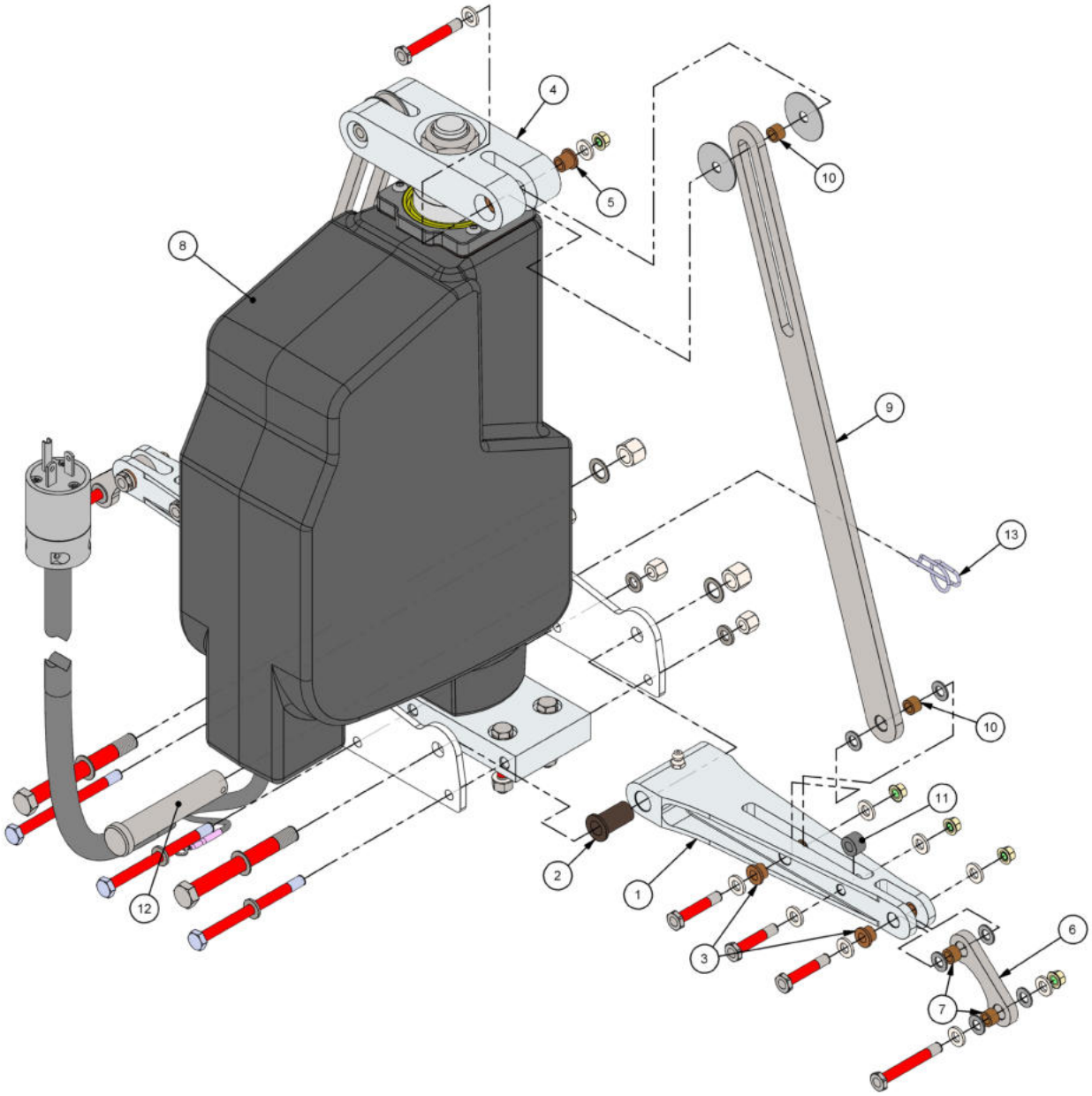


Table 13: Actuation Assembly part numbers

QTY.	ITEM NO.	PART NUMBER	DESCRIPTION
1	13	92391A770	HAIRPIN COTTER PIN, SS, 0.625" DIAMETER CLEVIS PIN
1	12	92056A234	PIN, CLEVIS, .625 OD X 3.0 USEABLE LENGTH
2	11	92825A710	SPACER, 1/4 ID X 1/2 OD X 5/16 LG, LDPE
4	10	2867T43	BEARING, 3/8 OD X 1/4 ID X 1/4 LG, 954 ALUMINUM BRONZE
2	9	KCB-0000-2601-32	LINKAGE ARM, 32" BASE
1	8	KCB-0000-3500-32	ACTUATOR ASSEMBLY, 100mm STROKE
4	7	6381K412	SLEEVE BEARING, .250 X .375 X .250, SAE 660
2	6	KCB-0000-2701-32	END LINK, VALVE BASE, ACTUATOR
4	5	NAS77A4-032P	BUSHING, FLANGED, .250 X .3761 X .320
1	4	KCB-0000-2841-32	ACTUATOR LINKAGE FITTING
8	3	NAS77A4-022P	BUSHING, FLANGED, .250 X .3761 X .220
4	2	1677K326	FLANGED BEARING, 3/8" X 1/2" X 1", SAE 841 BRONZE
2	1	KCB-0000-2401-32	ARM, VALVE BASE, ACTUATOR

BUCKET REFILL PUMPS

Motor Guard, 400 Hz AC Motor

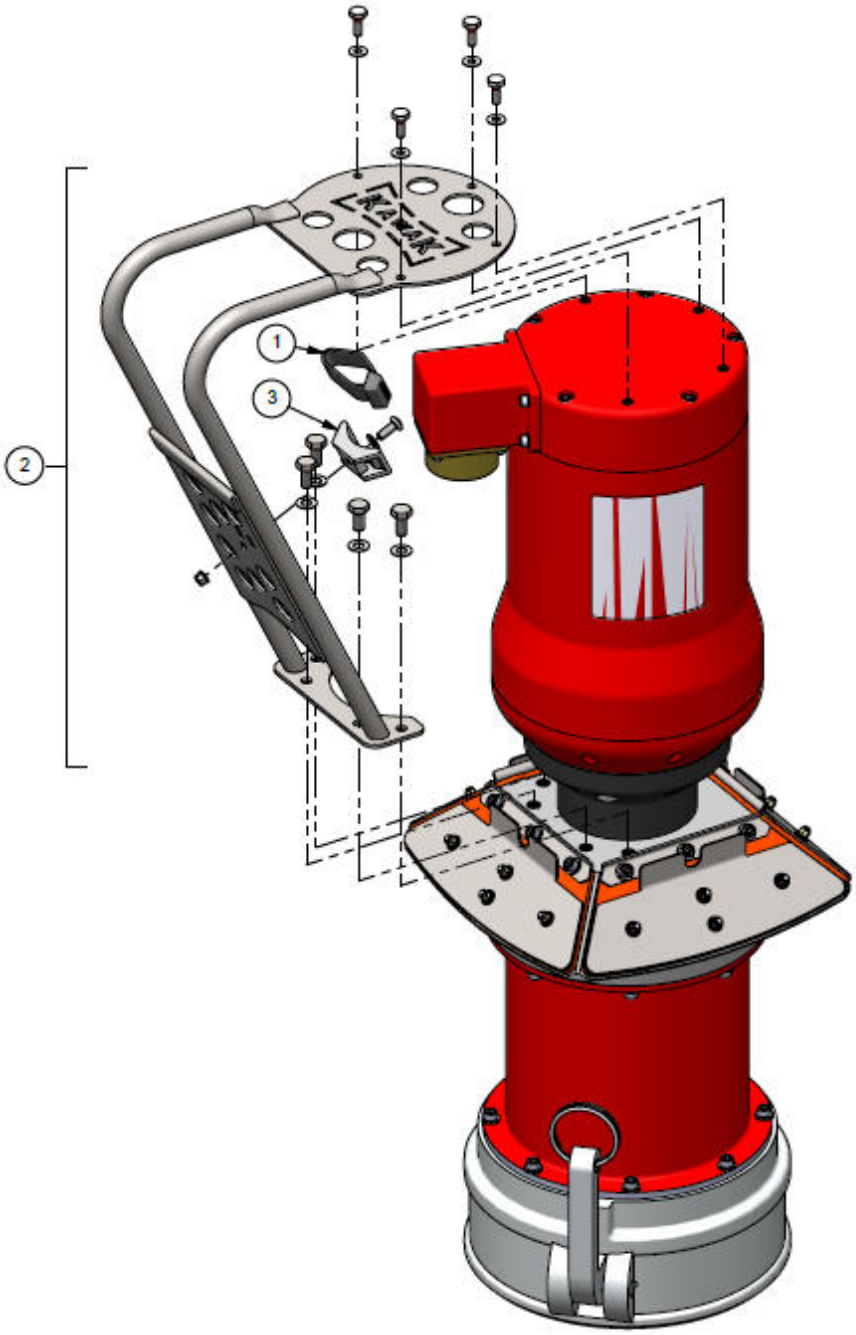


Table 14: Bucket Refill Pump Motor Guard, 400Hz AC part numbers

QTY.	ITEM NO.	PART NUMBER	DESCRIPTION
1	3	7582K82	MOUNT, ZIP TIE, #10 MOUNTING BOLT, 1/2" WIDE TIE
1	2	42393-0400	WELDMENT, BFP MOTOR GUARD
1	1	69455K12	ZIP TIE, 1/2" WIDE, 0.09" THICK, 9" LONG

Motor Guard, 28 VDC Motor

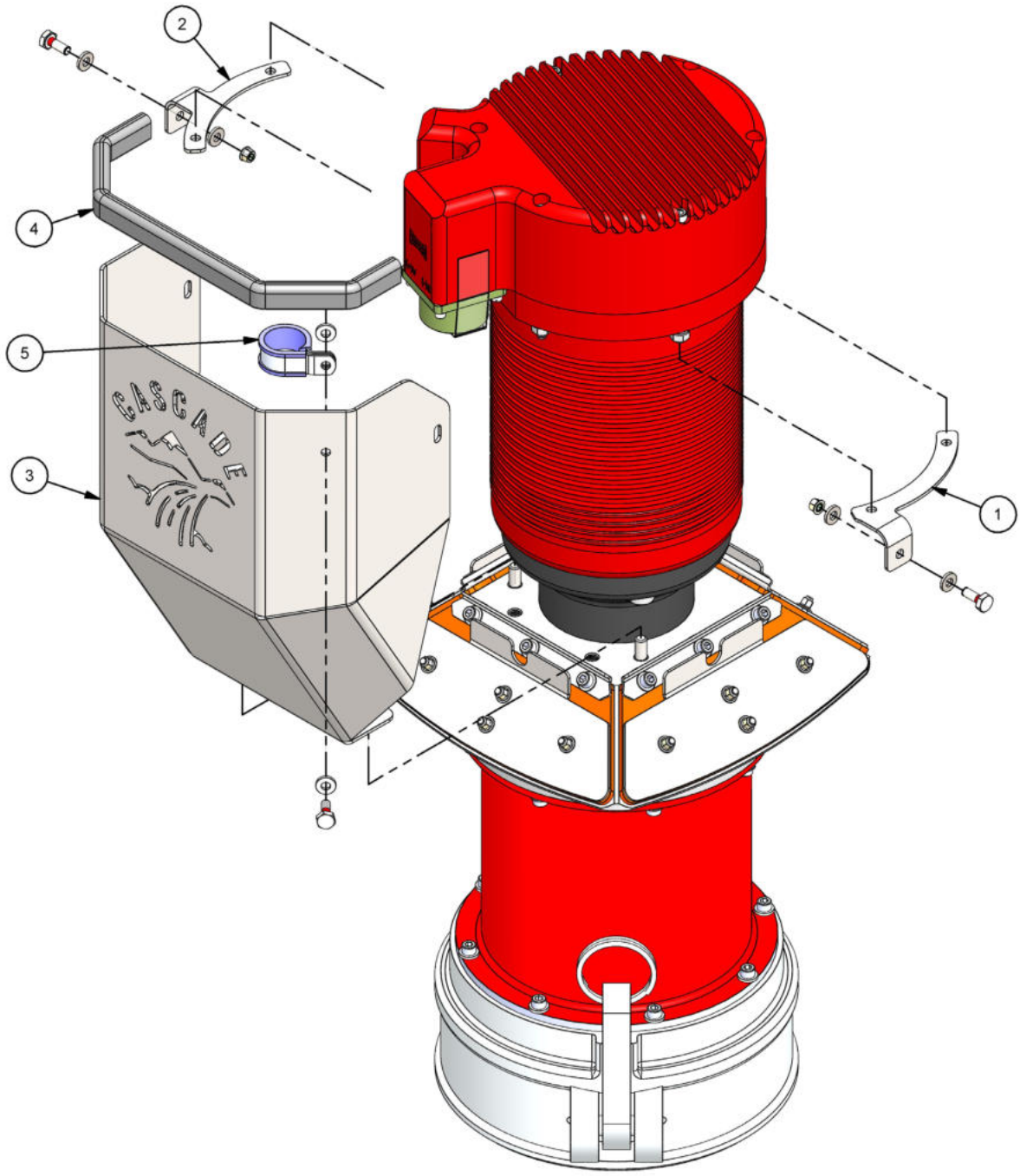


Table 15: Bucket Refill Pump Motor Guard, 28 VDC part numbers

QTY.	ITEM NO.	PART NUMBER	DESCRIPTION
1	5	MS21919WDG-14	CLAMP, CUSH., .875
1	4	KCB-0000-6008-24	SNAG SHIELD EDGE TRIM, BUCKET
1	3	KCB-0000-6001-00	SNAG SHIELD, 28VDC MOTOR, BUCKET
1	2	KCB-0000-6002-00	UPPER SNAG SHIELD MOUNT, PLUG SIDE
1	1	KCB-0000-6003-00	UPPER SNAG SHIELD MOUNT

Pump Assembly

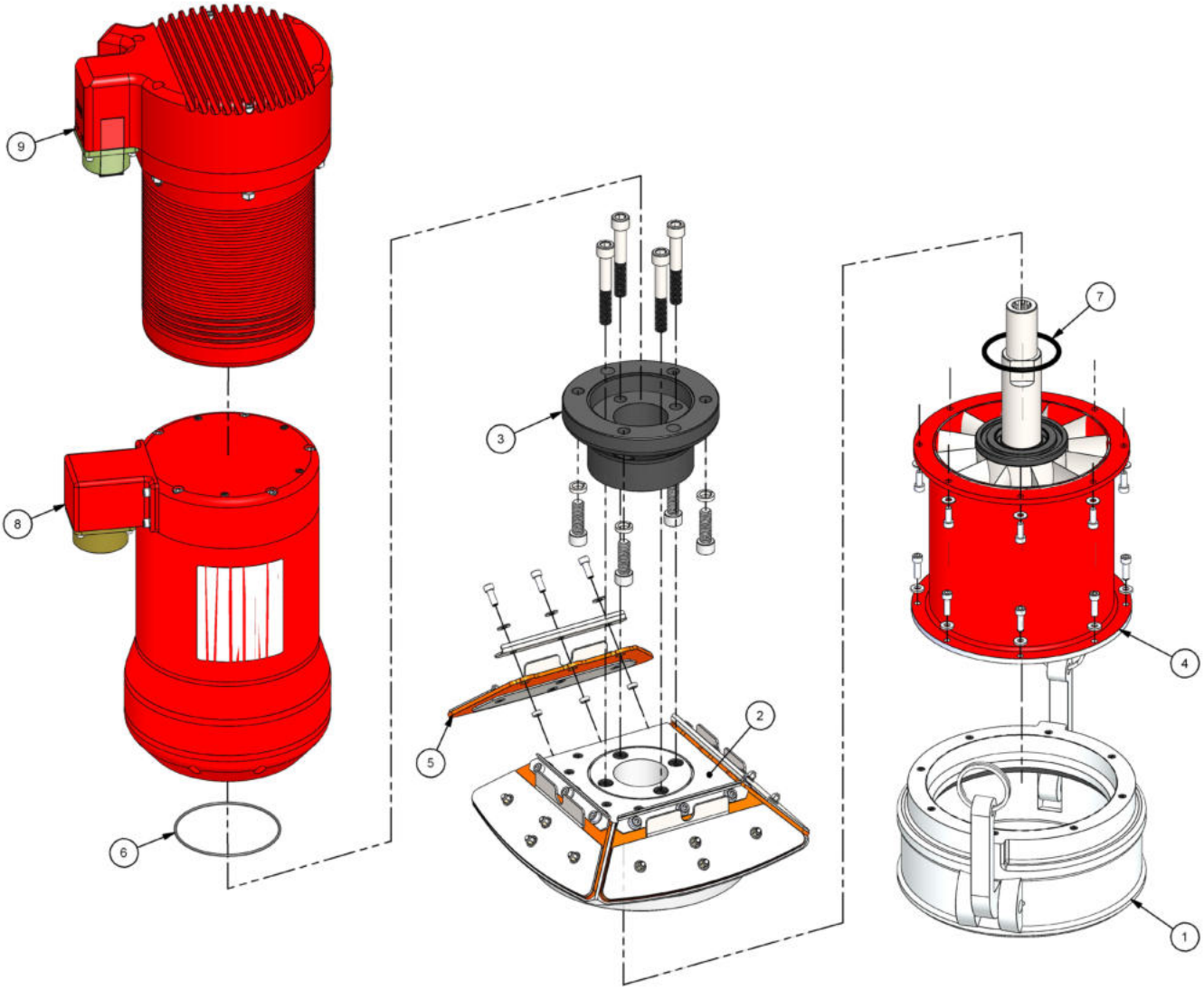


Table 16: Pump Assembly part numbers

QTY.	ITEM NO.	PART NUMBER	DESCRIPTION
1	9	42394-0000	MOTOR ASSY, VARIABLE SPEED, 28V BLDC
1	8	35801-402	MOTOR, 400 HZ 7.5 HP
1	7	2-228V75BR	O-RING, 2-1/4 X 2-1/2, VITON
1	6	2-042V75BR	O-RING, 3-1/4 X 3-3/8, VITON
4	5	42302-2300	CHECK VALVE, COAXIAL DISCHARGE, BUCKET
1	4	42302-0800	PUMP, IMPELLER & STATOR, ASSEMBLY
1	3	42302-0705	MOTOR MOUNT, BFP, BUCKET
1	2	42302-0704	BELL HOUSING, BFP, BUCKET
1	1	42302-0701	C&G, SOCKET, PUMP, BUCKET

Impeller and Stator Assembly

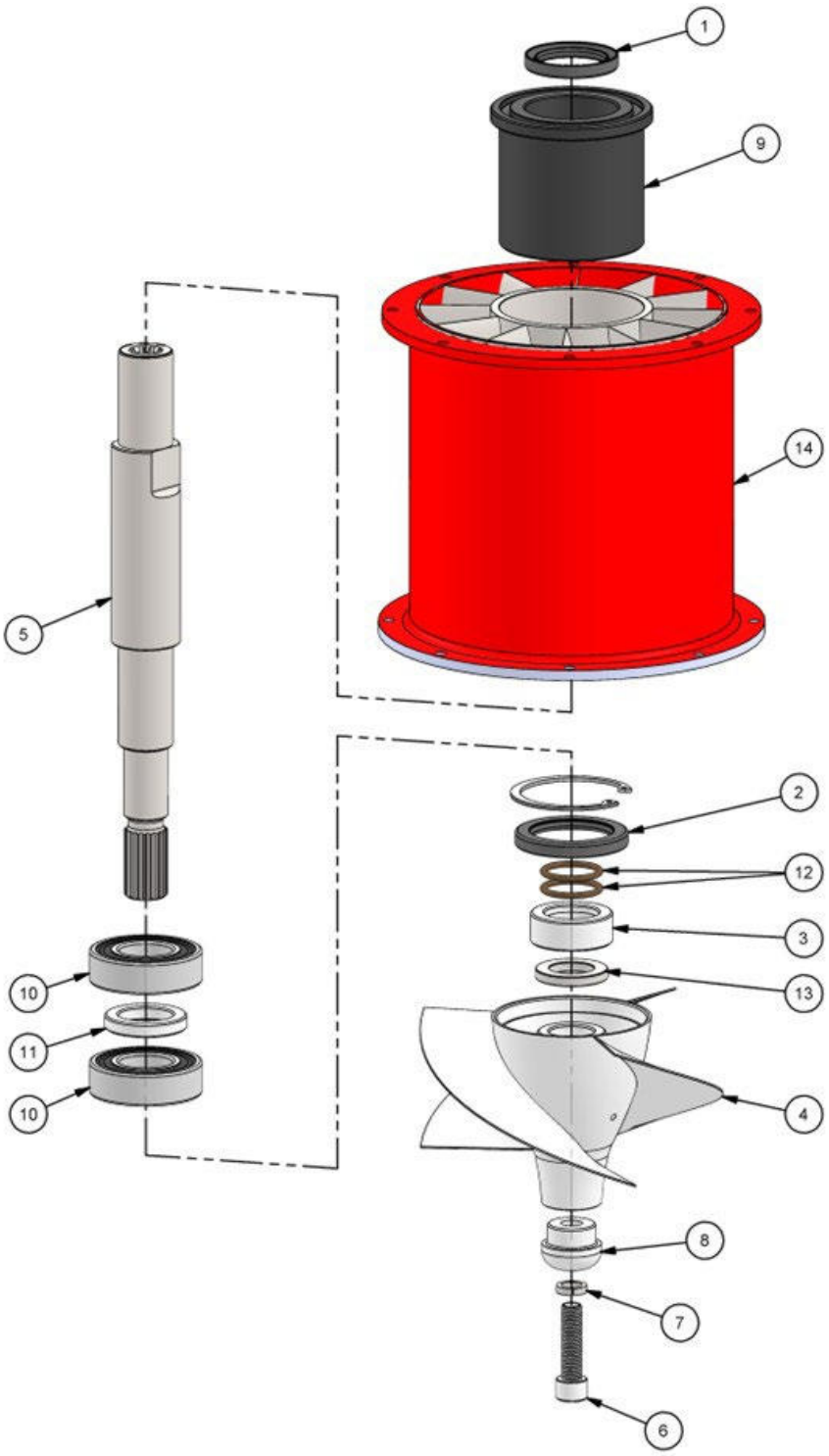


Table 17: Impeller and Stator Assembly part numbers

QTY.	ITEM NO.	PART NUMBER	DESCRIPTION
1	14	42302-0901	STATOR, MACHINED HOUSING, BUCKET
1	13	42302-0803	SPACER, IMPELLER, BUCKET V1
2	12	2-119V75BR	O-RING, 1 X 1.1875, VITON
1	11	38416-1	SPACER, STATOR BEARINGS INNER RACE
2	10	SS6205-2RSH	BEARING, SS, .984x2.047x.591
1	9	42302-0902	SLEEVE, STATOR, BUCKET
1	8	38420-1	RETAINING PLUG, IMPELLER
1	7	98437A115	LOCKWASHER, HC, 3/8, SS
1	6	92196A684	SHCS, 3/8-24 UNF X 1.375, SS
1	5	42302-0802	SHAFT, IMPELLER, BUCKET
1	4	38418-1	IMPELLER, ELECTRIC HOVER PUMP
1	3	38415-1	SLEEVE, SHAFT SEAL, BFP
1	2	152062TSS	SEAL, 1.500x2.062x.250 BUNA
1	1	12162TSS	SEAL, 1.250x1.687x.250, BUNA

Check Valve Assembly

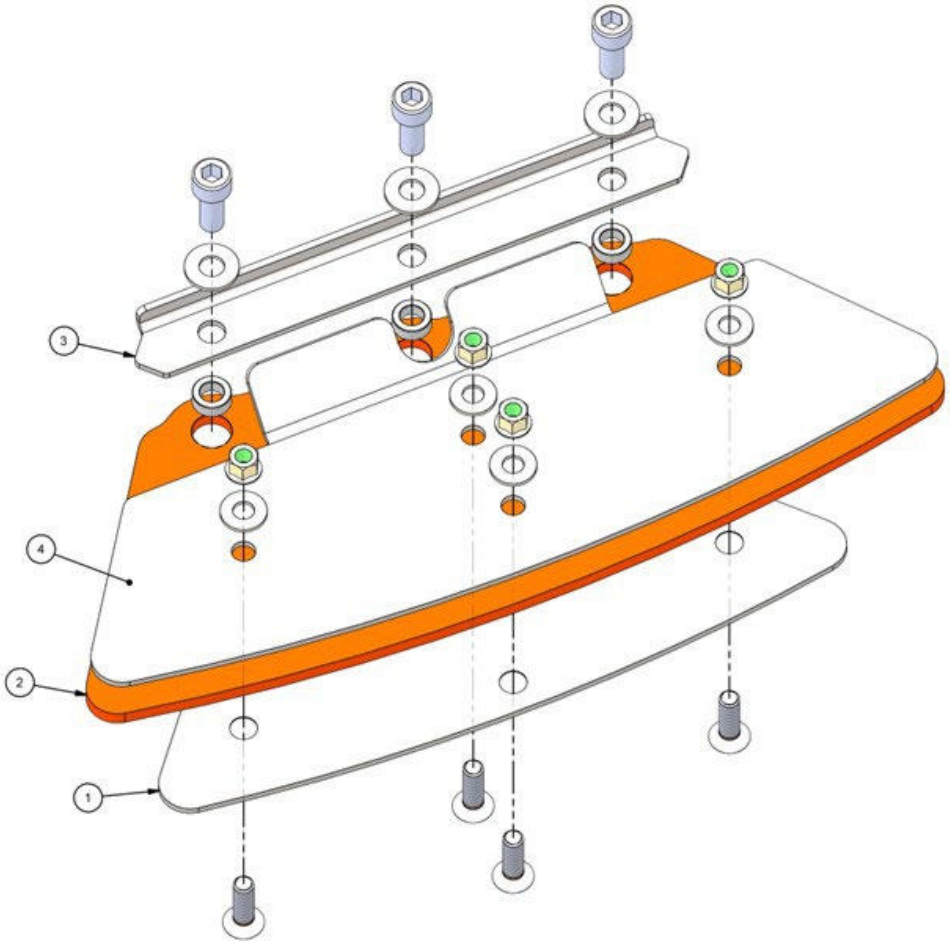


Table 18: Check Valve Assembly part numbers

QTY.	ITEM NO.	PART NUMBER	DESCRIPTION
1	4	42302-2304	PLATE, CHECK VALVE, BUCKET
1	3	42302-2303	CLAMP PLATE, CHECK VALVE, BUCKET
1	2	42302-2302	SEAL, CHECK VALVE, BUCKET
1	1	42302-2301	BACKING PLATE, CHECK VALVE, BUCKET

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