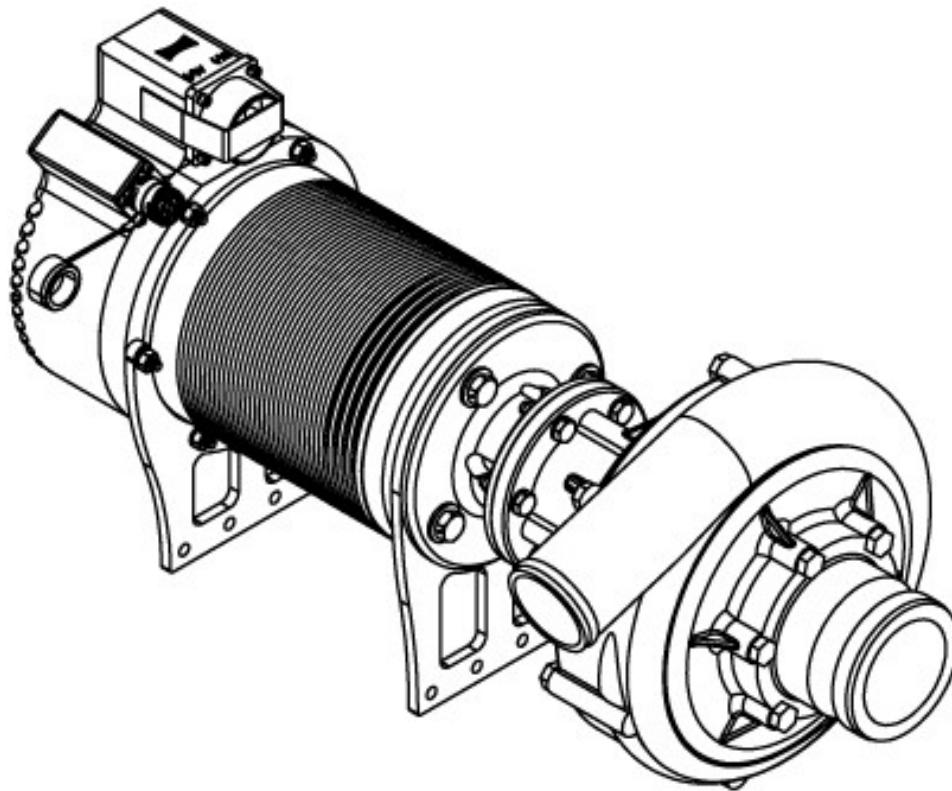


OWNER'S MANUAL

K-FLOW

PN: 42392-0000- (01/02/03)



KAWAK AVIATION
TECHNOLOGIES

PROGRESS THROUGH INNOVATIVE THINKING

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1.0 SAFETY FIRST

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

1.2 Tips and Precautions

-  **CAUTION:** Double check your connector polarity before plugging in. ****If reverse polarity power is applied, this will destroy the controller.***
-  **WARNING:** Keep clothing and loose items clear of the motor shaft. Failure to do so could result in injury.
-  **WARNING:** Take care not to get burned. Motor housing can reach up to 100C when running under load.

2.0 GENERAL INFORMATION

2.1 The Company

Kawak Aviation Technologies, Inc.

20692 Carmen Loop, Suite 102
Bend, Oregon 97702

Website: kawakaviation.com

Email: support@kawakaviation.com

Phone: 541.385.5051

2.2 This Document

The purpose of this manual is to provide instructions on how to safely install, operate, and maintain your Kawak K-FLOW system and accessories. 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 prevent serious damage to your 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 variable speed motor. 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 motor.

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

2.2.1 Definitions

The following terms and abbreviations are used throughout this document. It is important that you understand their intended use:

TERM	DEFINITION
Shall / Must	Used only when application of a procedure is <u>mandatory</u> .
Should	Used only when application of a procedure is <u>recommended</u> .
Will	Used only to indicate <u>futurity</u> , 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 <u>optional</u> .

2.3 The Product

The Kawak K-FLOW system consists of Kawak's 28VDC BRUSHLESS HIGH TORQUE ELECTRIC MOTOR combined with a high performance Agrinautics dispersal pump. The motor is a sealed unit capable of operating submerged or in other environmentally severe conditions. The unit includes a built-in motor controller that interfaces with a software application that can be used to configure various operational parameters. Motor control settings will be factory set based upon customer specification at the time of sale however should a motor control setting need to be changed, a motor interface cable and software are used to adjust user defined settings in the field.

When using the motor in a variable speed application, either a 5VDC potentiometer signal or a digitally controlled voltage source must be installed to provide manual remote speed control. The potentiometer is provided as part of the motor accessory kit, and the motor contains a built-in 5VDC supply. Detailed installation procedures are found in the installation section of this manual.

All measurements are in U.S. standard, unless otherwise specified.

2.3.1 Product Specifications: Motor

MOTOR PERFORMANCE		
Nominal Motor Voltage	28	VDC
No Load Current	6.5	A
Motor Max Speed (No load speed)	3780	RPM
Rated Speed with 10Nm Load	2773 290	RPM RAD/SEC
Maximum Continuous Current*	150	A
Voltage Constant	132.69	RPM/V
Torque Constant	0.075	Nm/A
Peak Torque	11	Nm
Power Usage	4 5.364	KW HP
Range of Operation	50% - 100% of rated speed	
Peak Efficiency	92	%
Number of Poles	8	-
Motor Connector	MS3102R24-9P	
Mating Connector	MS3106R24-9S	
Motor Connector – Variable Speed or K-Link Connection	D38999/20WB98SN	
Recommended Mating Connector	D38999/26WB98PN	
IP Rating	IP66	-
Weight	26.3±0.5 11.9±0.2	lbs kg
Motor Controller Max. Temperature**	105	°C
Default Current Limit	120	A

* Maximum continuous output with nominal airflow of 3.5 m/s. Motor can be driven with larger currents for short periods of time and proper airflow. Motor current limit settable with software.

** The motor has internal protections that will shut off motor if thermal limits are reached, allowing for cool down before restarting.

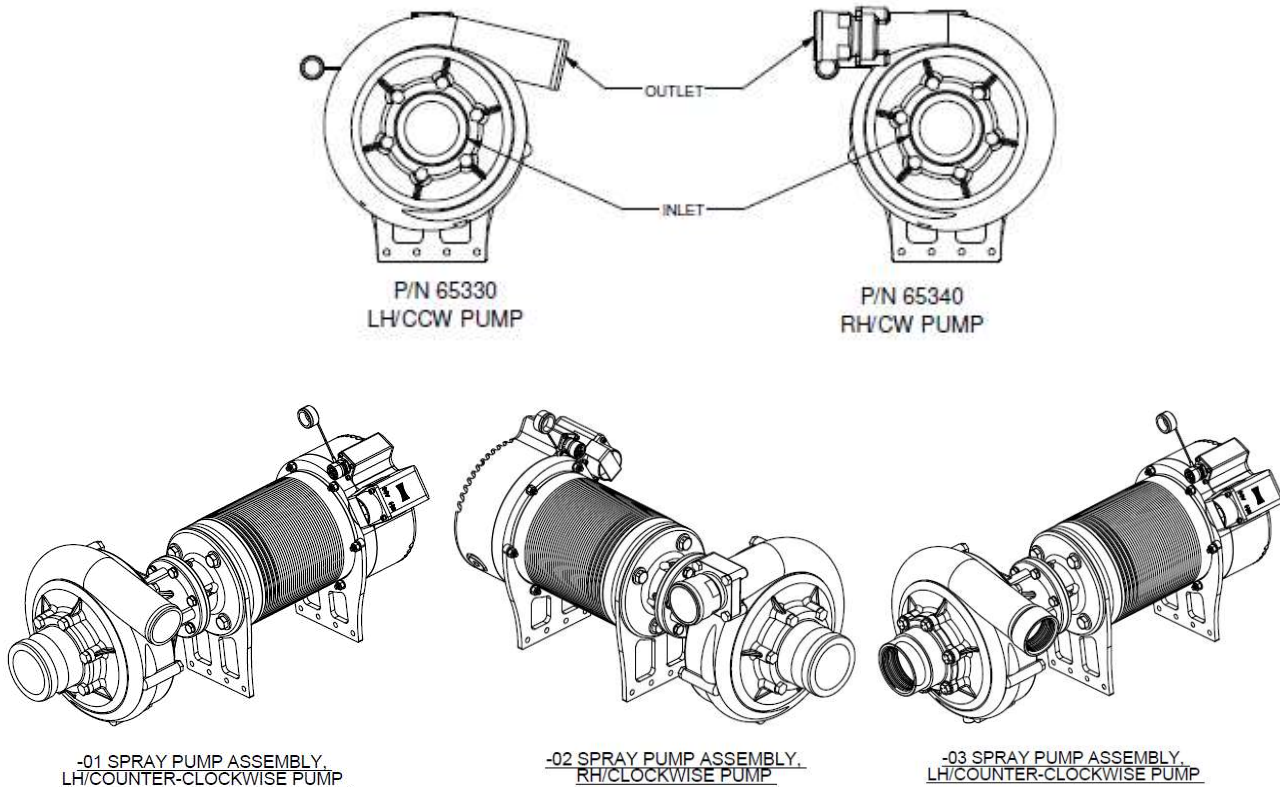
CONTROL VOLTAGE		
Input Voltage***	0 – 5	VDC
Max. Transition Time When Changing Speed	1	sec
Aux. Connector Part Number	JD38999/26WB98PN	
Control Hysteresis	0.2	V
Active Range	0.35 – 4.5	VDC
RPM Output Signal Available On Request		

*** Do not apply negative voltage or exceed 5VDC or else damage to the motor can occur

2.3.2 Product Specifications: Pump

PUMP DATA			
Pump Configuration	42392-0000-01	42392-0000-02	42392-0000-03
Pump Part Number	65330	65340	42392-7100
Rotation	LH/CCW	RH/CW	LH/CCW
Housing Material	356T6 ALUMINUM ALLOY	356T6 ALUMINUM ALLOY	356T6 ALUMINUM ALLOY
Nominal Flow Rate	200 GPM (757 l/m)	200 GPM (757 l/m)	200 GPM (757 l/m)
Weight	12.1 lbs (5.5 kg)	12.1 lbs (5.5 kg)	12.1 lbs (5.5 kg)
Inlet Port	2-1/2" CAM AND GROOVE	2-1/2" CAM AND GROOVE	2" NPT Female
Outlet Port	2" BEADED OUTLET	2" BEADED BOLT ON FLANGE OUTLET	1.5" NPT Female
Pump Shaft Material	303 STAINLESS	303 STAINLESS	303 STAINLESS
Seal Material	CERAMIC AND VITON	CERAMIC AND VITON	CERAMIC AND VITON
Gasket Material	GARLOCK	GARLOCK	GARLOCK
Couples to Motor with Adapter	42392-0003	42392-0003	42392-0003
Adapter Weight	1.6 lbs (0.73 kg)	1.6 lbs (0.73 kg)	1.6 lbs (0.73 kg)

Figure 1: Pump Configurations



2.3.3 Physical Connections

Mounting Features

Figure 2 shows the system's mounting features. There are two mounting brackets included.

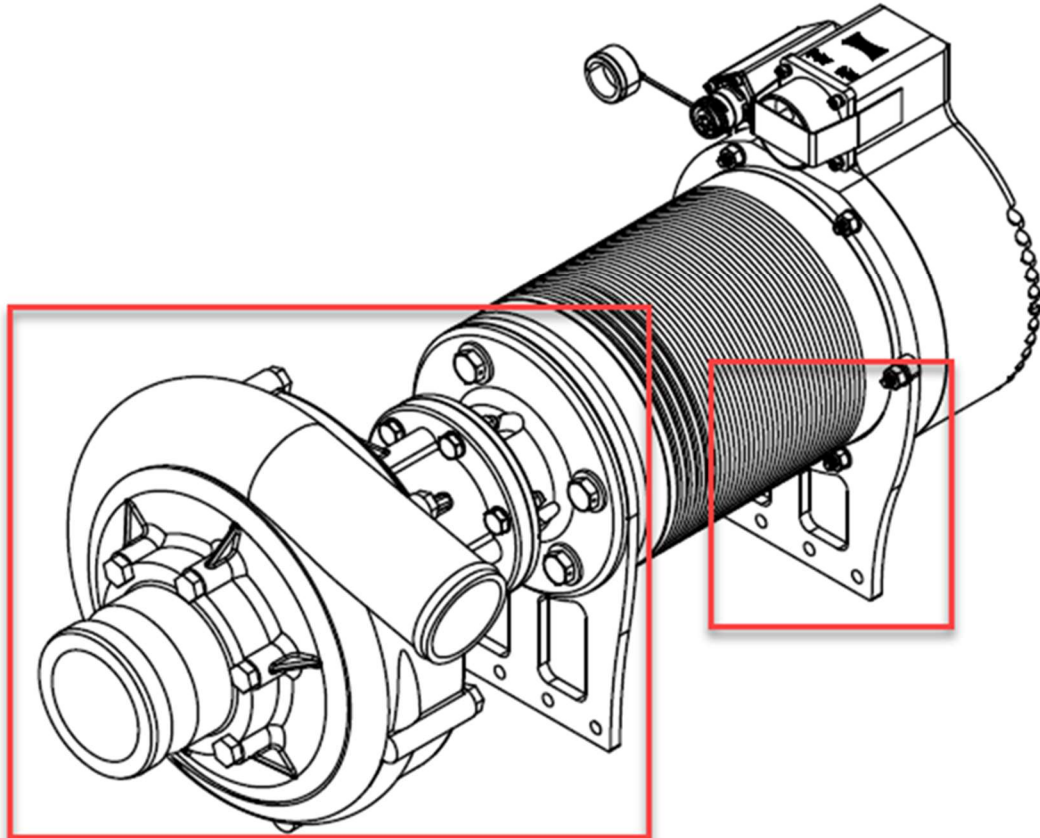


Figure 2: Assembly mounting brackets

3.0 UNBOXING YOUR ORDER

3.1 What's In the Box

The following parts are included in your order:

- One (1) K-FLOW System
- Owner's Manual
- Optional Accessories (see packing list for included accessories)

3.2 Unpacking

Inspect the product for damage prior to installation. Verify that there is no visible damage to the motor body or connectors. Contact Kawak Aviation if any issues are discovered.

3.3 Product Labels and Markings

3.3.1 Warning Labels



3.3.2 Product Markings



3.3.3 Serial Markings



3.4 Tools You Will Need

The following tools are required to complete the installation:

5/16" Hex Key Wrench 1/4" Hex Key Wrench	
Safety Wire Pliers	
Size W Drill Bit (See Section 4.2.2 for application)	

4.0 INSTALLATION

4.1 General Information

The Kawak K-FLOW is designed for use on agricultural aerial application systems and other similar liquid delivery systems, where the unit can be configured for either variable or fixed output. Contact Kawak for information on the available accessories.

The K-Flow unit will be supplied with pre-set current limits, ramp rates, and variable/fixed speed modes based upon application and customer specification.

K-FLOW pump/motor systems come with coupler and mounting brackets pre-assembled

4.2 Installation Instructions

4.2.1 Mounting the System

Two adjustable mounting brackets are included as part of the K-FLOW assembly and can be used to adapt to existing application equipment mounting schemes.

Alternatively, the supplied mounting brackets may be removed, and customer defined mounts can be used. If customer supplied mounts are used, it is recommended that the mounts utilize similar attachment locations to affix the K-FLOW assembly. The included mounts are adjustable. The forward mount is adjustable to any angle, and the rear mount can be adjusted in 60-degree increments. See Figure 3.

To adjust the mounts:

1. To adjust the forward mount, loosen the four bolts attaching the pump to motor adapter to the motor. Rotate the mount to the desired angle and re-tighten the bolts.
2. To adjust the rear mount, remove the mounting fasteners as necessary, and re-position the mount as required. Re-install the fasteners and tighten accordingly.

The motor to spray pump orientation is also adjustable and can be adjusted via the bolts on the motor to pump adapter. When orienting the motor, it is recommended that the electrical connections be positioned laterally or on the top of the assembly. If the spray pump is to be oriented with output port exiting the bottom of the pump, it is recommended that a vent line be connected to the 1/8" NPT port on the top of the volute. This will eliminate the possibility of an air lock in the pump when filling the material tank. A vent line is commonly used on Isolair and Simplex tanks.

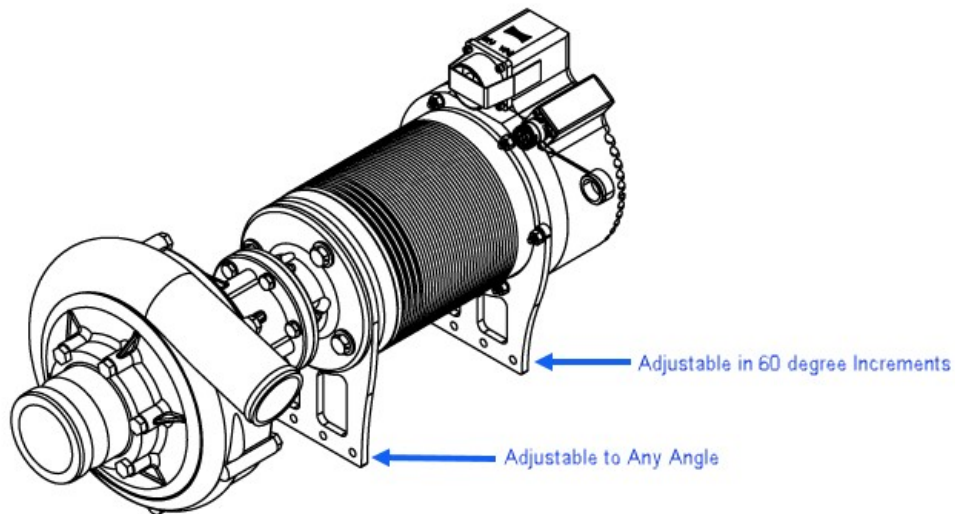


Figure 3: Mounting bracket adjustments

4.2.2 Electrical Installation

The included motor is rated at 28VDC nominal. If other voltages are applied, it will operate with adjusted performance. See performance data (Appendix A) for more details.

The motor has been tested through the range of 20-30VDC. **Operation outside of this range is not recommended.**

The motor can be used as variable speed with remote speed control, or as fixed RPM. The electrical installation will differ depending on application. Additional electrical components may be required and will differ depending on the type of equipment the K-Flow system is being installed on also whether this is a new installation, or if the motor is replacing an existing spray pump.

For agricultural systems such as an Isolair or Simplex where the system is already configured for an electric spray pump, the K-FLOW motor can simply be connected using the existing power and ground wires for the originally installed motor. The motors typically used in the Isolair and Simplex installations utilize a thermal protection feature where a small two wire cable is connected to the motor to integrate this into the spray system circuitry. The K-FLOW motor also has a thermal protection feature however does not require external electrical connection. As such, if the external thermal protection circuit exists, a jumper wire must be installed, or the two wires be connected for the spray system's motor control relay to operate correctly.

 CAUTION

The main power wires to the motor are polarity sensitive connecting the power and ground wires in reverse polarity will cause the motor controller to immediately and catastrophically fail. The (+) and (-) symbols are engraved into the motor housing adjacent to the motor power connector. Verify the polarity of this connection prior to applying power as a motor failure due to reverse polarity connection is not covered under warranty.

If the K-FLOW pump is to be used in the fixed-output configuration, no additional electrical provisions are necessary as the spray tank controls will activate the K-FLOW motor in identical fashion to that of the original.

If the K-FLOW is to be used in variable speed mode, additional motor control circuitry must be installed to connect the motor to the motor speed control in the cockpit. See the following section on Variable Speed Control Connection.

When installing the K-FLOW system as a retrofit to an existing system, the current limit setting on the motor control must correspond to the component and electrical limitations of the existing system.

For installations that do not have any electrical accommodations such as systems that were designed to use either a gas or hydraulically powered spray pump, additional electrical provisions are necessary. The main power for the motor is typically supplied by a current limiting device, such as: a fuse, circuit breaker, or current limiter; and a contactor/relay. The current rating of the protective device should not exceed available aircraft current capacity.

****NOTE**** When connecting K-FLOW system to aircraft, all power transmission wiring is to be **4 AWG** or larger and supporting wiring shall be **20 AWG**. Control connector contacts can accommodate 20-24 AWG wire.

Figure 4 shows typical electrical wiring configurations for variable and fixed speed installations. If this is a new application, please consult Kawak Customer Support regarding the need for any required ancillary electrical equipment.

4.2.3 Variable Speed Control Installation

The variable speed control connects to the motor via a separate connection adjacent to the main motor power connector. A control harness runs from the motor up to the aircraft shell where a bulkhead electrical connector is located typically below the center console or instrument panel in the aircraft. In the center console (or other customer selected location), a potentiometer for manual speed control adjustment can be installed in conjunction with an Auto/Manual switch if both AUTO and MANUAL modes are to be used.

When configuring the installation for variable speed motor operation, there are a several options for managing the motor on/off control. The first option is to simply use the main power contactor to turn the motor on and off as would be the case in the Simplex and Isolair tanks systems. Alternatively, a switch can be installed in the 0-5v control circuit to tie the control voltage signal to ground. When the control voltage is zero, the motor will turn off. Utilizing the 0-5v control circuit versus opening and closing the main power contactor will significantly increase the life of the contactor.

Existing systems will have some combination of switches affixed to the cyclic for operation of the spray system, one of which is to turn the pump on and off. The simplest configuration is to use the existing pump switch for pump on/off and install a console mounted switch to toggle between auto and manual control. In manual mode, the 0-5 volt signal is provided via the potentiometer for motor speed control. The "Auto" position of the switch is for utilizing an external 0-5-volt source for controlling the motor speed/spray pump output. This would be used when the motor control signal is being supplied by a GPS system or other means of automatically modulating the pump output for constant or variable rate applications. Figure 4 below is a typical schematic for variable speed motor operation.

Pre-assembled electrical harnesses and associated electrical components are available from Kawak when utilizing the variable speed option. Several of the harnesses are supplied with the connector on one end and an ample length of wire to give the installer flexibility for harness routing, switch location, etc. The potentiometer and associated harness connect to the motor 5VDC supply and the Auto/Manual switch. Contact Kawak if longer harness lengths are necessary.

Potentiometer Installation (Variable Speed Applications Only)

A pre-wired potentiometer (motor speed control) with associated harness and controls (P/N 42392-3000) is available from Kawak.

To install the potentiometer assembly:

1. Determine mounting location for potentiometer. Keep in mind that it should be placed where the pilot or equipment operator can easily make adjustments.
2. Using a **Size W Drill Bit**, drill a 0.386" hole in the selected location (e.g. instrument panel, console).
3. Deburr the hole, as necessary.
4. Insert the spindle of the potentiometer into the hole from the back of the panel.
5. Secure the potentiometer into position with the provided nut and lock washer.
6. Note the clocking of the potentiometer once mounted. Loosen nut and re-clock potentiometer, if needed.
7. Install the adjustment knob onto the stem of the potentiometer using the hex wrench with the supplied knob.

Variable Speed Control Circuitry

The below diagram (Figure 4) shows a basic control voltage input that is controlled by a potentiometer that modulates input voltage manually. The Auto/Manual switch selects between the manually adjusted control voltage (potentiometer) or and externally supplied control voltage (GPS, etc.) If using an external control, the external control system input must be 0-5V. The system must be conditioned if the system interfacing with the motor does not have the correctly formatted output. If 0-5V signal is unavailable, contact Kawak for further instruction.

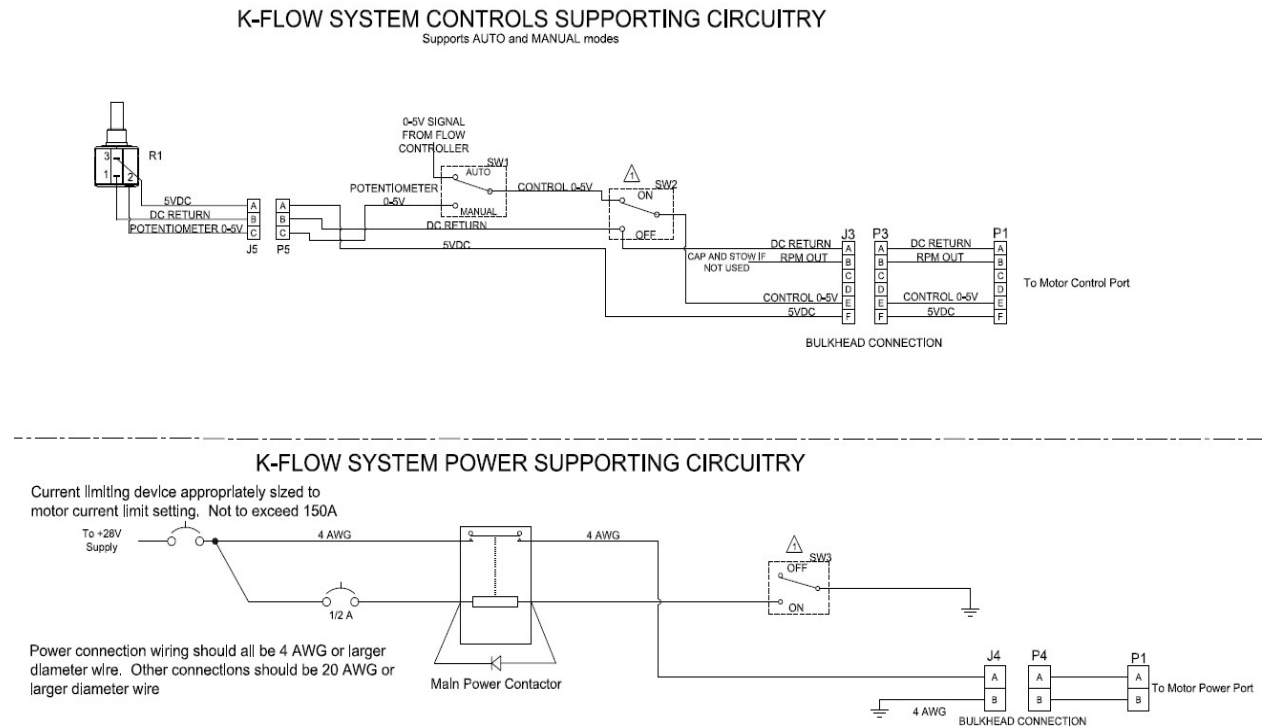


Figure 4: Circuit Diagram, Auto and Manual

The interface circuit for an external control system is detailed above. The output of the interface device is what would connect to the AUTO input of the switch in the diagram above. If the user does not have an external control system and will only be operating in MANUAL mode, the switch can be omitted, and the potentiometer output can go directly to Pin E at the motor.

****NOTE**** In order to interface with the various control systems available on the market, signal conditioning will likely be necessary to feed a 0-5VDC signal to the motor via the AUTO input. Contact Kawak for the specifics on how to condition the signal from a specific system.

Motor Control Connector

If the variable speed mode is not being used, the motor connector must have the connector cap installed. (Figure 5)



CAUTION: The cap should be tightened securely to prevent moisture intrusion.



Figure 5: Aux. Interface Connector with Cap

5.0 OPERATION – K-FLOW SYSTEM

5.1 Fixed Speed

For a K-FLOW pump connected to an existing spray system control:

ACTION	CONTROL	POSITION
Turn Pump On	Spray Pump Switch	ON
Turn Pump Off	Spray Pump Switch	OFF

***Where the Spray Pump Switch is SW2 in the figure 4 above.

5.2 Variable Speed

For a K-FLOW pump connected to an existing spray system control:

- Spray System Pump Switch – OFF
- K-FLOW Motor Speed Control (Potentiometer) – Rotate full travel counterclockwise.
- Auto/Manual Switch - MANUAL
- Spray System Pump Switch – ON
- K-FLOW Motor Speed Control – To turn motor ON - ROTATE CLOCKWISE
- K-FLOW Motor Speed Control – Adjust speed control to achieve desired motor speed.
- Note – The throttling range of the motor speed control is 50-100%.
- Once the motor speed has been adjusted to the desired setting, the motor can be switched OFF and back ON via the Spray System Pump Switch and the motor will return to the speed setting of the K-FLOW Motor Speed Control.
- Note – The K-FLOW pump can also be turned off by turning the Motor Speed Control all of the way counterclockwise which results in a zero volt output.

NOTE: It is recommended that the throttle control voltage be set to the desired voltage setting and remain there while turning the motor on/off with the optional shutoff switch. Using the optional shutoff switch will turn the motor on/off by grounding the control voltage input to turn off the motor while reducing the number of cycles on the high current power contactor that delivers power to the motor. This practice should extend the lifetime of the high current power contactor used with the motor.

The control voltage input has a 0.2V hysteresis. This prevents the motor from being too sensitive to changes in the control voltage.

If the control voltage increases/decreases, the motor speed will increase/decrease linearly with the input signal after the hysteresis voltage has been exceeded.

For example, to decrease the motor speed after the initial increase, the control voltage must be decreased by 0.2V before observable motor speed decrease will occur. Once this occurs, the decrease will be linear with the control voltage. This behavior is the same for increases in control voltage.

⚠ CAUTION: The analog throttle control input (Pin E) has a narrow window of operation (-2V to +6V). Using voltage outside of this range to Pin E will damage this input and render the motor inoperable. Always verify voltages and their polarity on mating connector before making connections. **Failures of this kind are not covered by the warranty.**

5.3 Electrical Controls – Variable Speed

The auxiliary interface connector pinout has six pins.

PIN	USE
A (DC Return)	Interfacing with computer to modify settings and operational parameters.
B (K-Link Power)	
C (K-Link Signal)	
D (RPM Output)	Indicates the RPM of the motor (Optional)
E (Analog Throttle Control)	Input a 0-5 VDC analog signal to control motor speed.
F (+5VDC Supply)	Powering potentiometer or other low current circuitry. Capable of 500mA output current.

Optional Motor RPM Output Signal

The RPM signal on pin D can be enabled or disabled. It outputs a train of square wave pulses with a frequency proportional to the motor RPM. To determine the RPM of the motor from this signal measure the frequency of the square wave pulses present at the pin, and use the following formula:

$$\text{RPM} = 15 * (\text{frequency measured})$$

6.0 PROGRAMMING

Kawak has included a motor drawing with pre-programmed motor settings. To make changes to these settings or to update the firmware, after receipt, the following items will be needed:

- K-Link Interface Cable (P/N 42399-1000)
- K-Link Programming Kit (P/N 011-0119-00)
- K-Link Software Application (V. 1.0.3)

STOP! If this is your first time using the K-Link application, it is advised that you contact Customer Support prior to programming or refer to instruction document KATI-UI-1299.

6.1 Connection to Motor

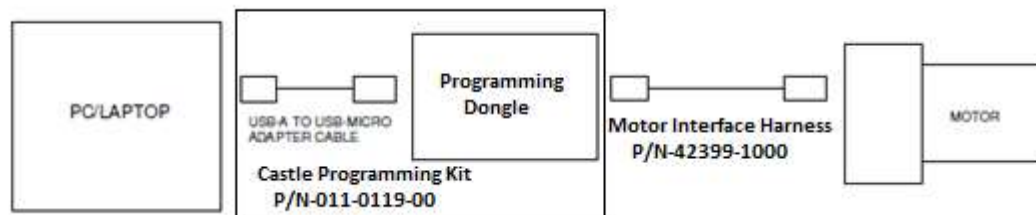


Figure 6: Required Connections for Programming

6.1.1 Computer Interface

The K-Link Interface Cable (P/N-42399-1000) enables the motor to interface with a computer to adjust key operational parameters, such as: operating mode; direction; and current limit. The product is shipped with an initial configuration; however, these settings can be adjusted in the field:

1. Remove the control harness connector or cap from the motor.
2. Connect the P/N 42399-1000 K-Link Interface Cable to the motor connector.
3. Link the standard USB 2.0 A-Male to Micro B cable (Figure 5) between the computer and programming dongle. The USB cable and dongle are included in the Castle programming kit (P/N – 011-0119-00).



Figure 7: USB 2.0 A-Male to Micro B cable

4. The programming dongle connection is not keyed and can be connected incorrectly. If connected incorrectly no damage will occur however the motor will not connect with the computer for configuration adjustment. Plug the

interface module into the 3-wire ribbon cable that is part of the motor interface cable. The brown wire on the ribbon cable goes to the (-) pin on the programming dongle.

- Do not apply power to the main power connector of the motor when programming the motor control.

6.2 Software Interface

The K-Link application is used to manipulate the operational parameters of the 28 VDC Variable Speed Motor.

- Download the K-Link software application available on the Kawak website.
- Run the K-Link application on the computer once connected to manipulate the operational parameters. Contact Kawak Customer Support for additional information on the K-Link Software Application.
- Open the K-Link software using the link in the Start Menu or from the Desktop.

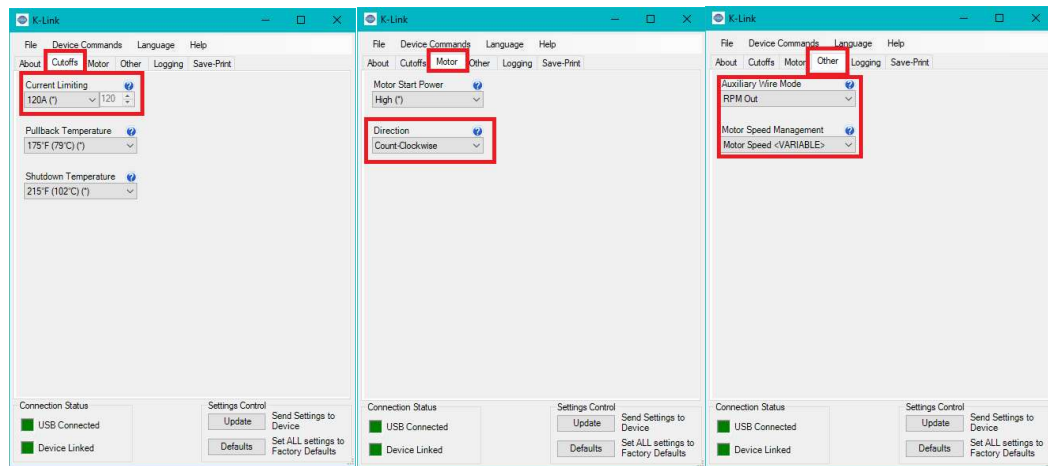


Figure 8: Software Interface Screens

- Figure 8 displays the most commonly modified settings and which tabs they are located on. Contact Kawak Customer Support for information before modifying any of the optional settings.

The below table describes the commonly modified parameters from Figure 8:

SETTING	DESCRIPTION
Current Limiting	Sets the current limit for the motor.
Motor Start Power	Dictates whether the motor ramps up quick or slow. Can be set to low , medium , or high .
Direction	Determines the rotational direction of the motor shaft. Can be set to forward (clockwise rotation) or reverse (counterclockwise rotation). Shaft direction is viewed from the shaft as it comes out of the motor face.
Auxiliary Wire Mode	Enables the RPM signal coming out of Pin D on the auxiliary connector.
Motor Speed Management	Determines whether the motor will run in fixed mode, at full throttle, consistently, or, whether it will respond to changes in the control voltage.

7.0 CARE AND MAINTENANCE

The operating environment and duty cycle of the motor will affect its maintenance requirements. Intermittent duty applications will require less frequent inspections and lubrication. Shaft sideload conditions and continuous duty operation will equate to more frequent inspections and bearing replacement. When estimating bearing life, it is recommended to use conservative replacement intervals since if the bearings fail and the rotor makes contact with the motor stator, the motor is rendered unusable.

Bearing replacement is not considered something that is field serviceable, and the motor must be sent to Kawak for maintenance. The magnets on the rotor are extremely strong and require special tooling for the removal or installation of the rotor into the stator. Do not attempt to remove or install a stator without the correct equipment as injury and motor damage will likely occur.

If the motor is configured with a spline shaft and the coupling to the driven accessory is a direct spline to spline connection, it is recommended that the splines be inspected and relubricated at a minimum of every 100 hrs. of operation with a high-pressure wide temperature range grease such as MIL-PRF-81322G grease. If the motor and driven device utilizes an elastomeric shaft coupling, spline lubrication is not required.

Should the internal motor control board or the electrical connectors on the end cap get damaged, the end cap of the motor can be replaced in the field. To do so, remove the electrical harness(s) from the connectors on the end cap. Remove the six socket head cap screws attaching the end cap to the motor body. Carefully rotate the end cap back and forth to work the end cap out of the motor body. Once the end cap is free of the motor, remove the shrink tubing on the three conductors between the end cap and the motor. Make sure to mark what wires on the motor correspond the colors on the end cap (red, black, white). Pull apart the connectors.

Prior to the installation of a new end cap, if the end cap is not pre-programmed relative to the application, program the end cap per the instructions in this manual.

To install a new end cap, slide new pieces of appropriately sized shrink tube over the three wires and push together the connections. Ensure that the wire connections are exactly the same as the previous end cap or the end cap will be destroyed when applying power. Slide the shrink tube over the connections and shrink with a heat gun.

****NOTE**:** Connecting the wires incorrectly will reverse the direction the motor spins, making forward become reverse and reverse becomes forward.

Prior to installing new the end cap, apply a small amount of o-ring lubricant to the o-ring seals on the end cap as well as the corresponding register in the motor housing. Orient the end cap with the motor housing and insert the pilot of the end cap into the motor housing. As the o-rings make contact with the motor housing work the end cap back and forth while applying pressure to the end cap. Be extremely careful as the o-rings enter the motor housing to ensure that the

the o-rings are not damaged. If a piece shears off the top of either o-ring, the o-ring must be replaced. Once the end cap has been successfully seated, orient the mounting holes to the motor housing and install the socket head cap screws with washers and new lock nuts. Use either a lubricated nut or stainless lubricant to prevent galling of the threads. Torque fasteners appropriately.

For any questions regarding motor maintenance, please contact Kawak Customer Support.

8.0 TROUBLESHOOTING

System not working at variable speed: If motor is not working in variable speed mode, verify voltage and polarity are correct at throttle control input and verify 28V is present at the power connector. You may need to remove connector back-shells to do this.

If all of this appears to be in good order, use the K-link software to change the motor configuration to FIXED operation. This will ignore the throttle input voltage and run (if it can) when power is applied. If it runs in FIXED mode and not in VARIABLE mode then there is likely an issue with the throttle control input and the endcap will likely need to be replaced.

System randomly shuts off: If the system is randomly shutting off during operation, this could be due to control signal or power interruptions or overheating. If this occurs, verify power and control connections are solid with no intermittencies. If the motor is too hot to touch when it turns off, the motor may have entered thermal shutdown. It will turn itself off to protect itself from getting to temperatures that will start to damage internal components. Once the motor cools off enough, it will resume normal operation. If this happens repeatedly, then you are likely not getting enough airflow over the motor body to cool the motor off sufficiently. The larger the load, the faster the motor will heat up.

System not running and smells: If the motor will not run and smells burnt, open the endcap and inspect the inside. If there are obvious signs of burning/overheating, contact Kawak customer support as one or more of the components are likely damaged and will need to be replaced.

Can I run a data log?: There is a data logging function implemented in the motor. If the motor was not completely fried at the time of failure, records can be extracted from the motor for analysis. However, if the endcap has catastrophically failed, the logged data will not be recoverable.

9.0 SPRAY SYSTEM OPTIMIZATION

The K-FLOW pump assembly is designed to reduce the maintenance and reliability issues associated with the spray pumps that have been historically installed on agricultural spray systems. Most importantly, the K-FLOW pump with its high efficiency brushless motor and Agrinautics pump, will provide higher performance in terms of flow and pressure. This increased performance can translate into a substantial increase in the productivity of the aircraft and return on your investment. Getting the most out of your spray system may not

necessarily involve simply putting on a larger spray pump. Centrifugal pumps used in these applications are not considered positive displacement pumps and therefore their performance can be affected by the other elements of the spray system hardware and plumbing. The following are suggestions and considerations on how to optimize the performance of your spray system when using the K-FLOW pump.

- Ensure that the other components in your spray system are sized relative to the pump output. Undersized 3-way valves, flow controls, flow transducers, and strainers can result in limiting the output of the spray pump. Spray system manufacturers are notorious for undersizing components because they get so fixated on weight. While weight is important, a light spray system with undersized components and plumbing is not good if it cannot operate in the necessary performance envelope.
- Pay attention to your spray plumbing sizing. Plastic fittings are light and cheap however they typically have heavier wall thicknesses that can restrict flow as opposed to their aluminum or stainless-steel counterparts.
- On pump suction lines, use an appropriate hose type rated for vacuum service. Most suction hoses will have a spiral wire within the hose material to keep the hose from collapsing when under vacuum. This is particularly important if the hose tends to soften up due to chemical exposure of the material being sprayed.
- Minimize the number of bends in your spray plumbing and where you must, use long radius elbows to promote a smooth flow and less pressure drop.

10.0 ACCESSORIES

10.1 Harness Kits

The K-Flow system has several harness kits available that are relative to the spray pump/motor application. The ancillary electrical components necessary to connect the motor can be customer supplied or purchased from Kawak. Some connector/harness assemblies have the wires installed in the connector with flying leads that are to be cut to length and terminated by the installer. For variable speed operation, pre-wired potentiometers and power supplies facilitate fewer connections during installation. The connector/harness assemblies and their interconnections are shown in the following graphic.

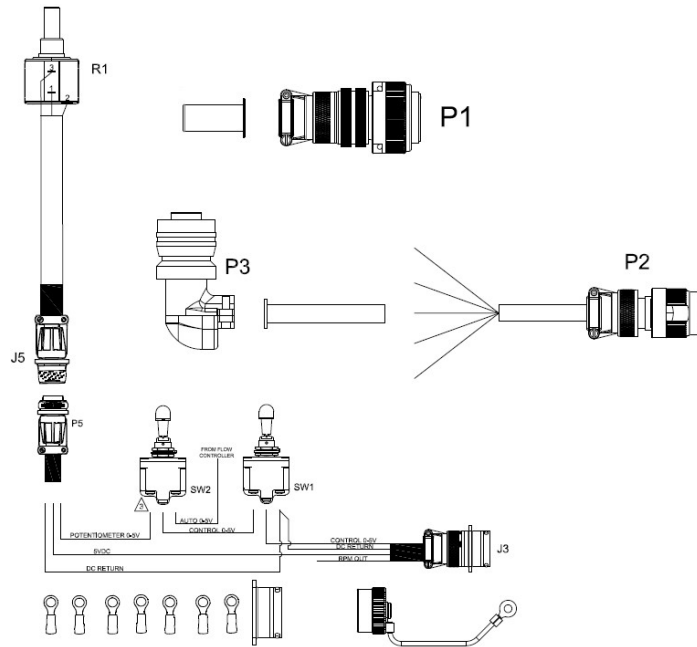


Figure 9: Connector/Harness Assemblies (P/N 42392-1100)

The following table provides part number information for the available harnesses that go with the standard K-FLOW assembly.

Part Number	Description	Purpose
42392-3000	Potentiometer Variable Speed Control Harness	Potentiometer for manual speed control
42392-4000	External Control Interface Harness	Control signal connections from aircraft bulkhead connector to motor
42392-6000	Variable Speed Motor Control Harness	Controls bulkhead connection for potentiometer and switches to toggle AUTO/MANUAL control and to turn motor ON/OFF
42399-1000	Programming Interface Harness	Allows interfacing motor with computer to configure settings. Used with 011-0119-00.
011-0119-00	Castle Programming Kit	Includes USB cable and programming dongle. Used with 42399-1000.

11.0 THE WARRANTY

Kawak Aviation Technologies, Inc. (KATI) warrants products manufactured by KATI to be free of defects in materials and workmanship for a period of six hundred (600) hours of operation or 12 months, whichever comes first, when operated under normal use and service. This warranty shall not apply to any product that has been misused, mishandled, disassembled, repaired, or modified subsequent to its manufacture. The product or article must be and has been maintained and operated in accordance with the manufacturers or KATI's approved operating and maintenance instructions and manuals.

All parts, components or assemblies eligible for warranty must be returned to KATI's facility with transportation charges prepaid and are subject to the conditions of KATI's RMA policy. Warranty claims can be completed and submitted via Kawak's website, <http://kawakaviation.com>

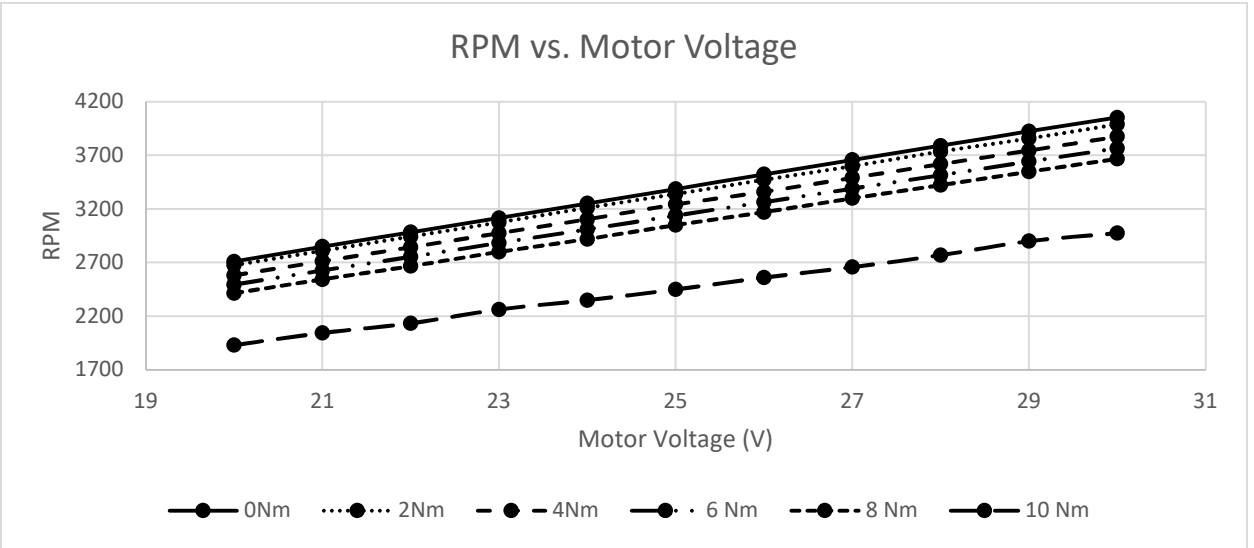
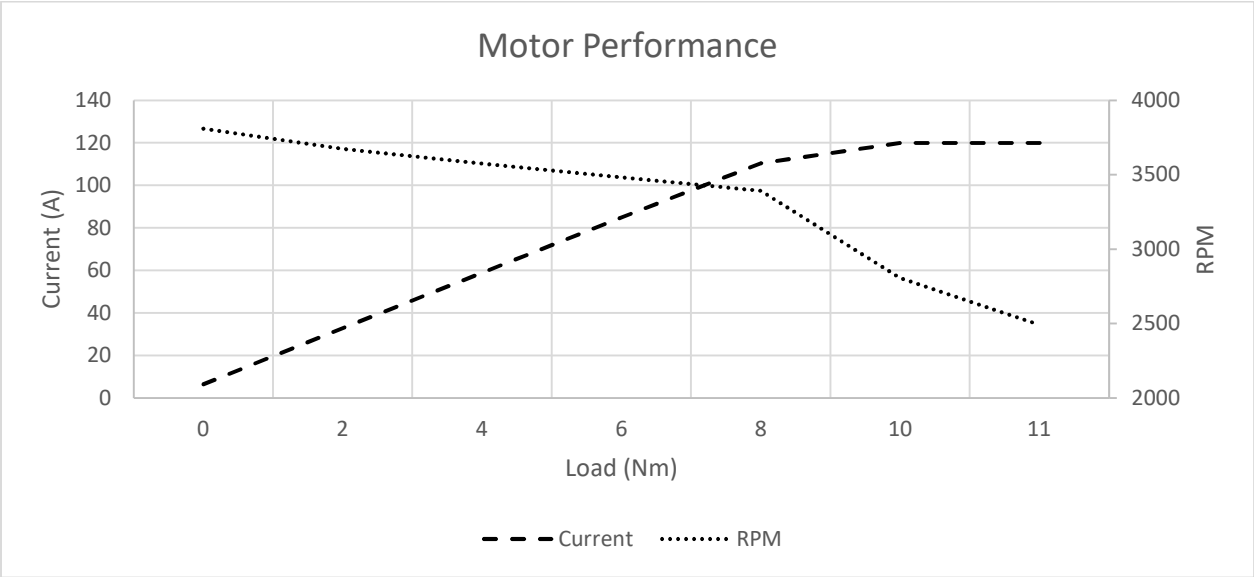
This is the exclusive warranty made by KATI expressed or implied. The exclusive and sole remedies of the Purchaser and the obligations and liability of KATI is limited to the repair or replacement of any component, part or assembly that, after inspection and/or test by KATI, is proven to be defective. This warranty does not extend beyond the repair or replacement of the defective part nor does it extend to any costs as a result of the part being defective. KATI shall not be liable, whether in contract, tort, or otherwise for special, consequential, incidental, or indirect arising out of workmanship or materials supplied by KATI. KATI reserves the sole right to determine the validity of the warranty claim, and the sole right to determine which of the above alternatives shall be exercised to satisfy a valid claim.

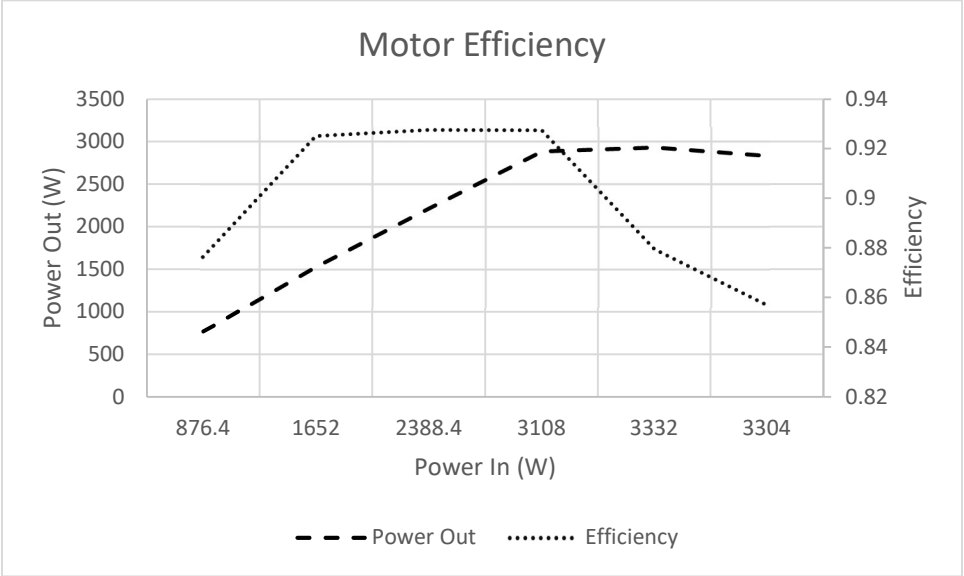
KATI makes no warranty with regard to engines, propellers, and trade accessories that are warranted separately by their respective manufacturers. KATI however will support and process any warranty terms offered by the manufacturers of the supportive components that KATI supplies as part of its systems and products when they have been used within the design limitations as set by KATI or the manufacturer. KATI will abide by the manufacturers' decision as to the acceptability of the warranty claim against their product.

This warranty is given by KATI and the purchaser, by acceptance of delivery and use of the product, has accepted this warranty in place of, and hereby waves all other express and implied warranties, including merchantability and fitness for particular purpose and obligation, liability, right, claim, or remedy in contract or in tort including product liability based upon strict liability or negligence actual or imputed.

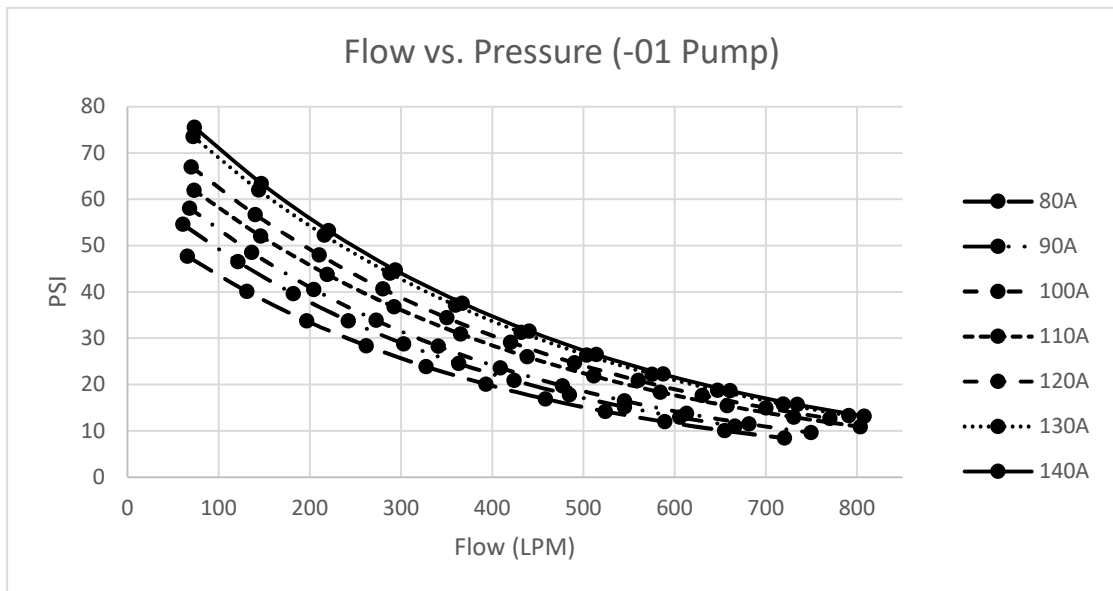
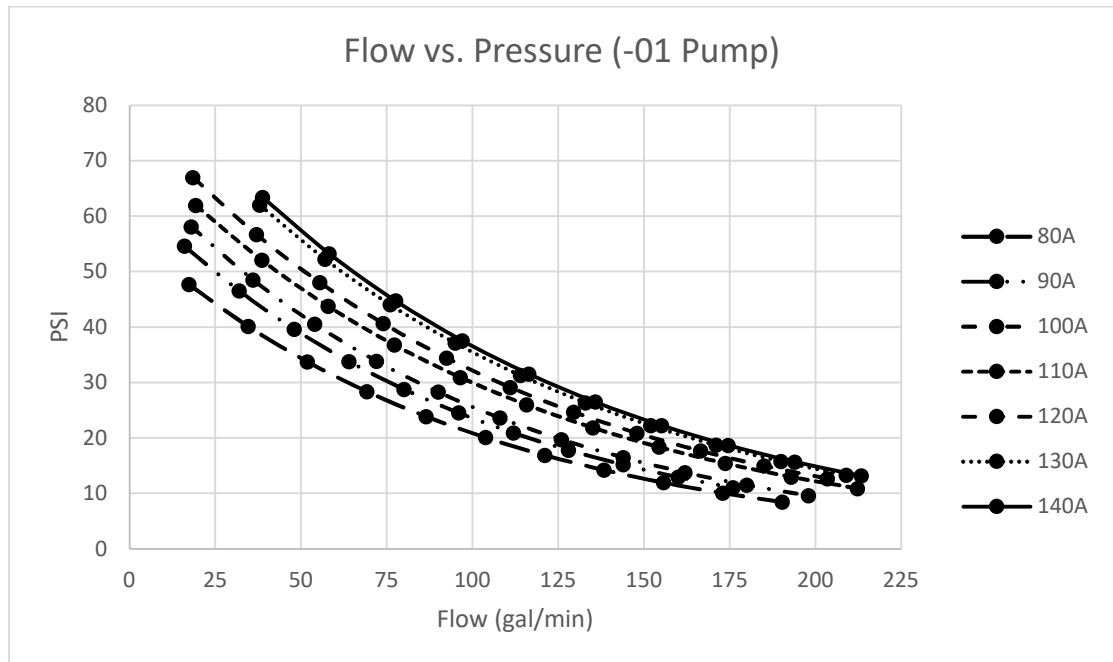
12.0 APPENDIX / ADDENDUM

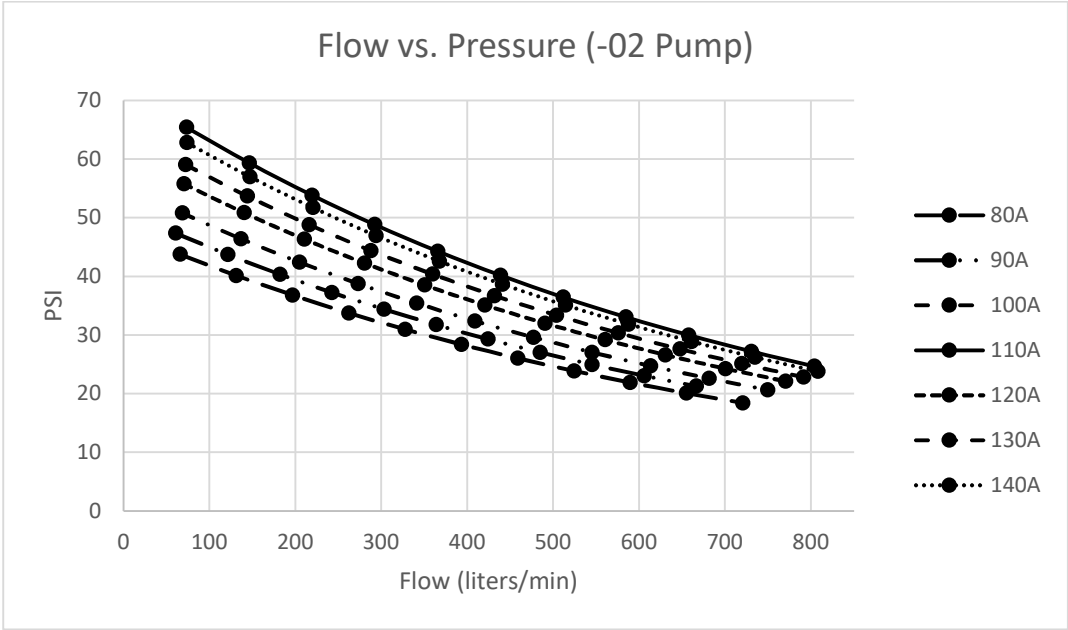
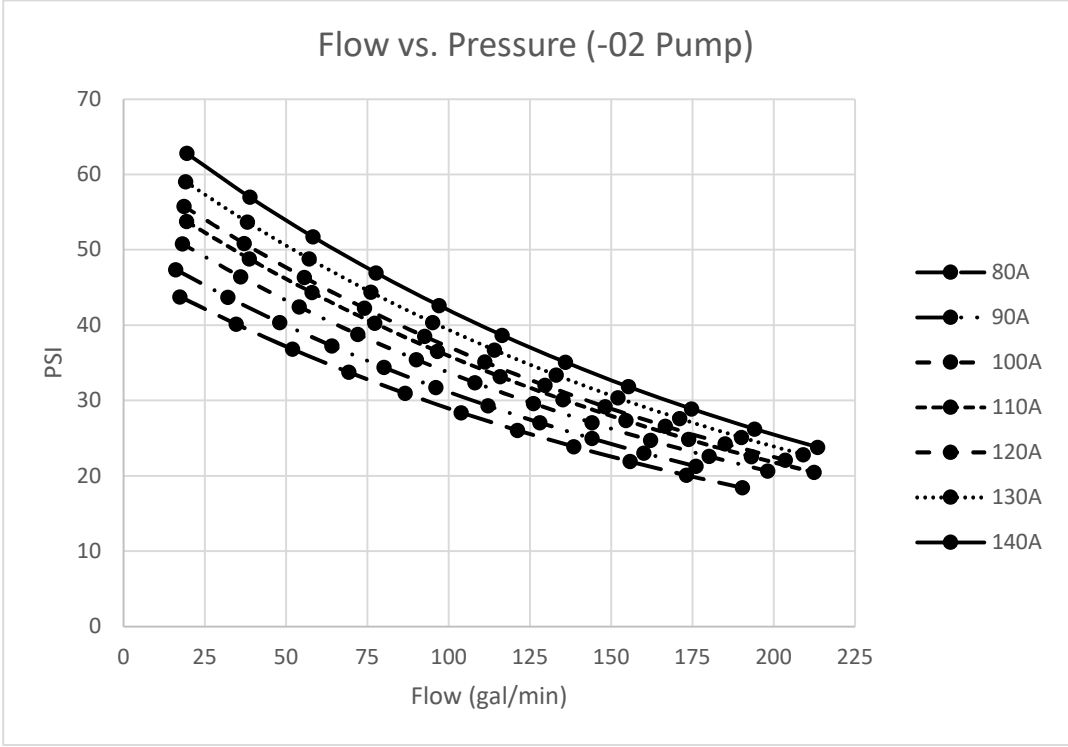
A. PERFORMANCE DATA - Motor



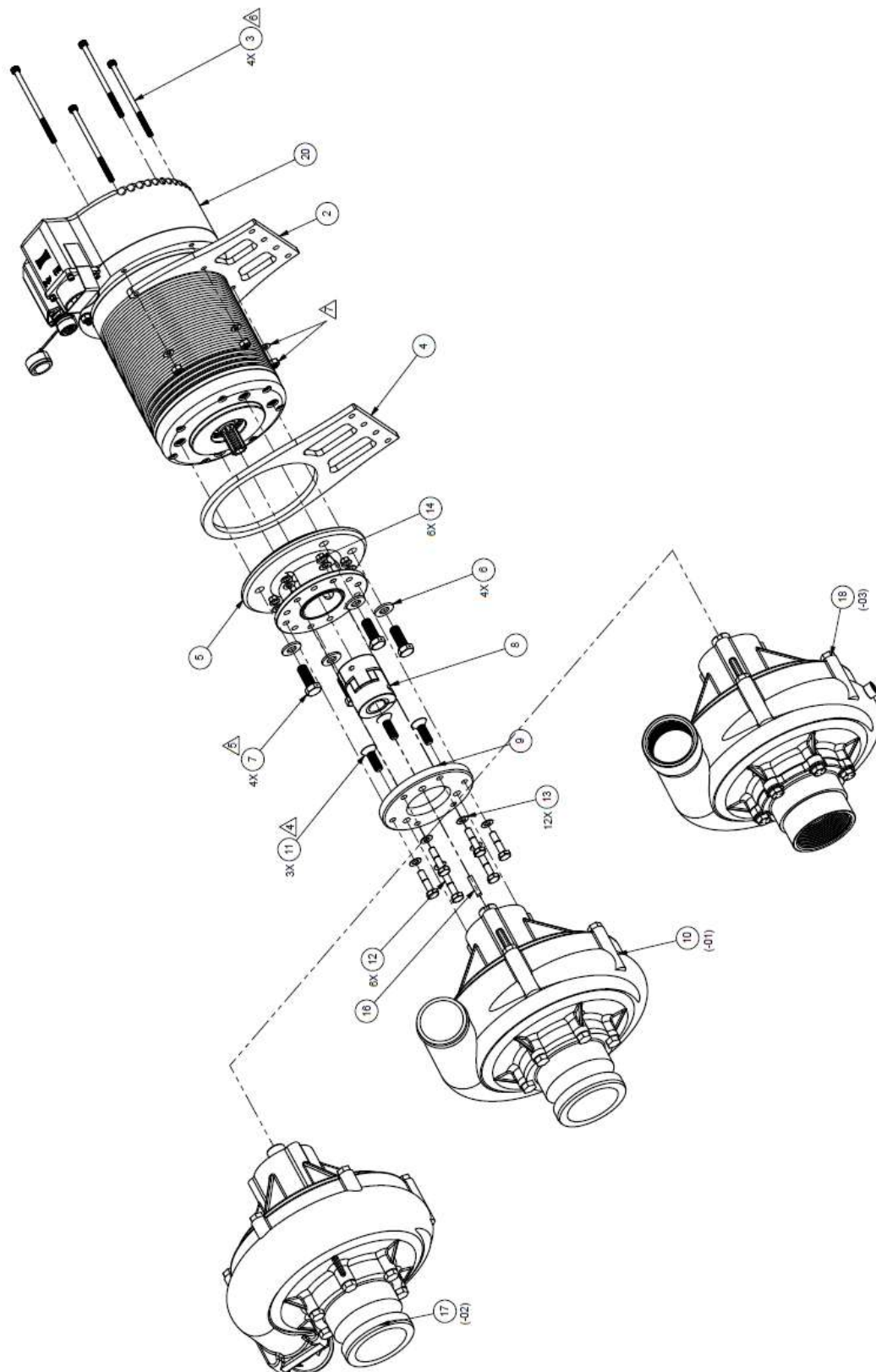


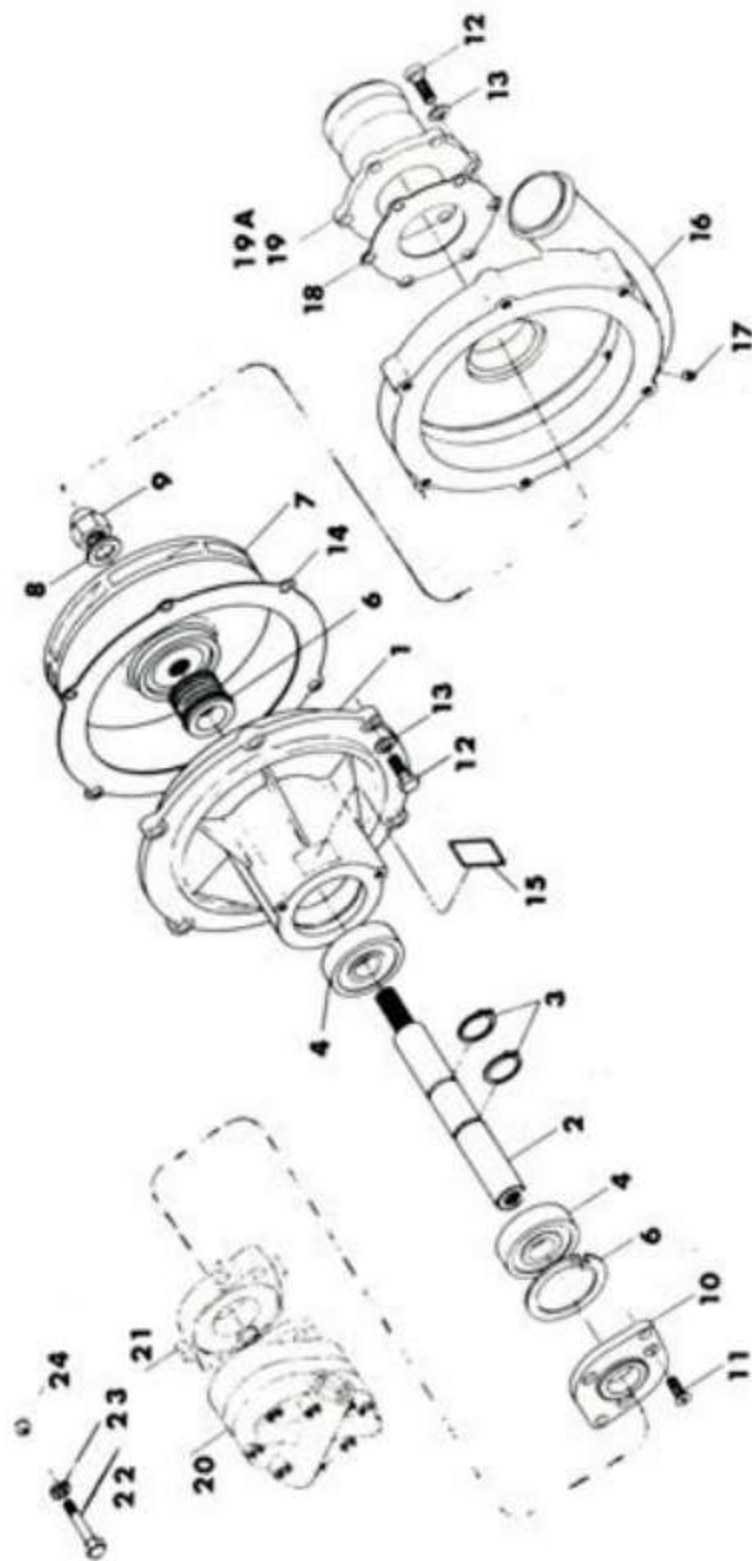
B. PERFORMANCE DATA – Pump





C. PUMP/MOTOR ASSEMBLY DIAGRAMS





Hydraulic Motor Driven Pump

END OF DOCUMENT

RECORD OF REVISIONS

REV LEVEL	DESCRIPTION OF CHANGES	AUTHOR	CHECKED BY	APPROVED BY	APPROVED DATE
A	Initial Release	S. Boyd	Z. Harris	S. Siemsen	7/30/24
B	Updated per ECO #988	S. Boyd	S. SIEMSEN	A. TIRMIZI	11/5/24