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CROPHAWK 7/B

Flow Monitoring System

Owner's Manual

Owner's Manual Number 120-045-00
Revision 5
July 17, 2008

ONBOARD™ SYSTEMS INTERNATIONAL

13915 NW 3rd Court Vancouver Washington 98685 USA
Phone: 360-546-3072 Fax: 360-546-3073 Toll Free: 800-275-0883
www.OnboardSystems.com

RECORD OF REVISIONS

Revision	*Date*	*Page(s)*	*Reason for Revision*
2	9/17/02	Title A-10	Factory address change.
3	01/15/07	2-1	Updated figure 2-1 to show proper mounting technique.
4	10/01/07	i, 1-1, 1-2, 1-4, 2-2, 2-11, 3-3, 3-10, 4-1, 5-1 & 5-2	Add explanation of warnings, cautions and notes to general information section. Updated warnings, cautions and notes throughout.
5	07/17/08	TOC, 2-6 to 2-15, A-4, & A-9 to A-11	Added 3" flanged flow section information.

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Section 1
General Information

Introduction

This manual describes the installation and operation of the CROPHAWK 7/B Flow Monitoring System.

Please read the procedures and other information given in this manual before attempting to install or operate this system.

Warnings, Cautions and Notes

The following definitions apply to Warnings, Cautions and Notes used in this manual.

Means that if this information is not observed, serious injury, death or immediate loss of flight safety could occur.

Means that there is a risk of injury or degradation in performance of equipment if this information is not observed.

Draws the reader's attention to information which may not be directly related to safety, but which is important or unusual.

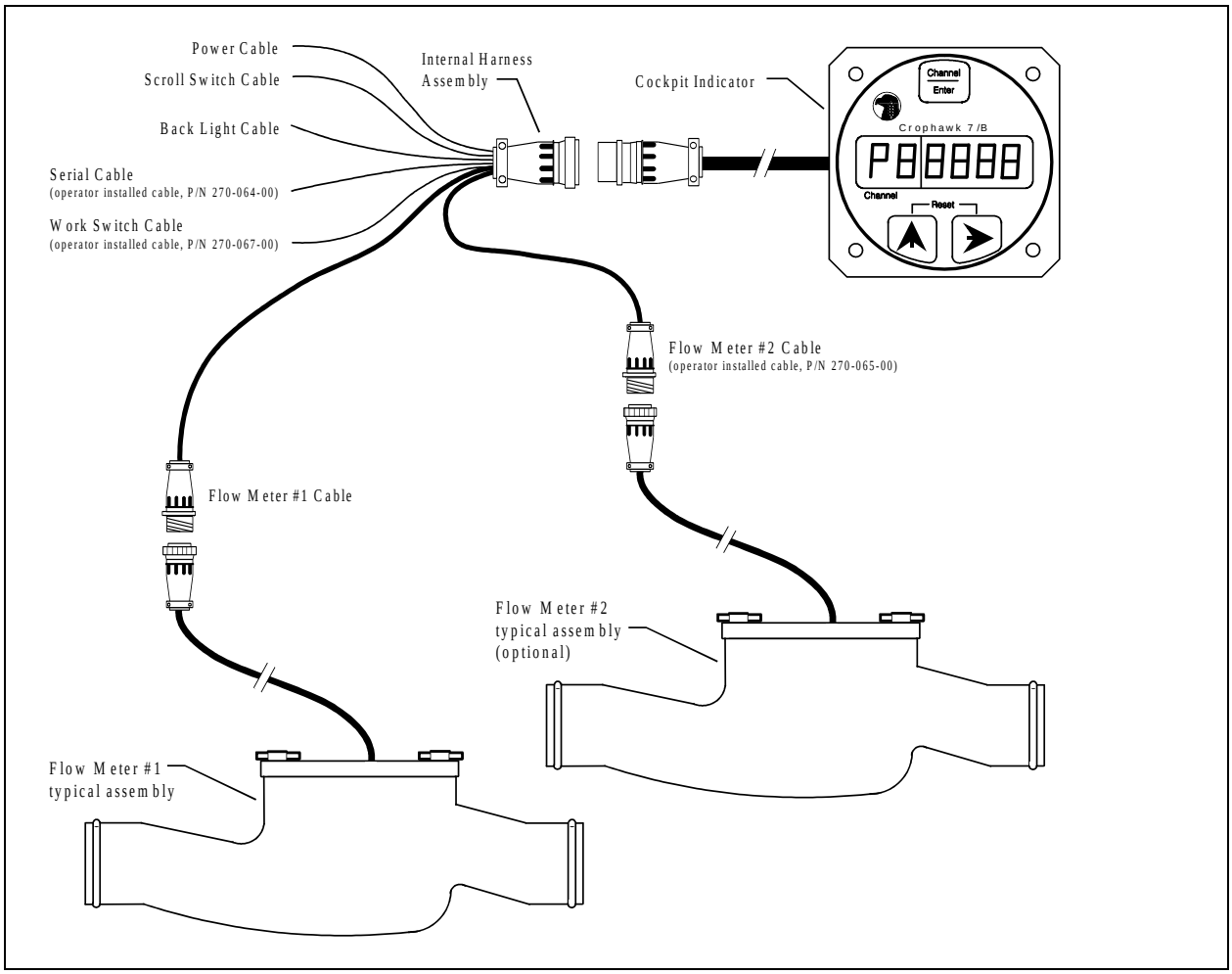
System Overview

The CROPHAWK 7/B is a flow monitoring information system. Flow related data is displayed on a number of pilot selectable channels. Flow information is received from one or two flow meters. The flow meters can be arranged such that both are discharge meters or one can be a discharge meter and the other can be an input meter used to load the aircraft chemical tank. A built-in bi-directional serial port can be used to send flow and acre (hectare) information and receive speed and swath information from GPS receivers. The system can be pilot selected to read in English or Metric units.

The CROPHAWK 7/B Flow Monitoring System consists of a cockpit mounted Indicator, one or two flow meters, an Internal Harness, and optional cables and switches.

Figure 1-1 shows the CROPHAWK 7/B system components.

Figure 1-1 The CROPHAWK 7/B System



Bill of Materials

The following items are included with each standard system, if shortages are found contact the distributor from whom the system was purchased. See the *Appendix* for optional equipment part numbers.

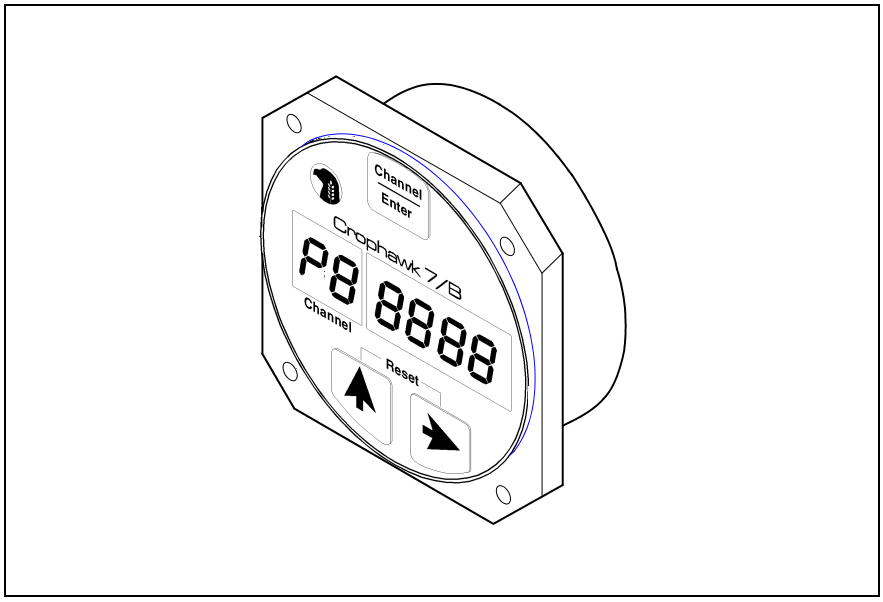
Part Number	Description	Qty
120-045-00	Owner's Manual	1
210-124-00	Cockpit Indicator	1
*210-xxx-00	Flow Meter Assembly	1
270-063-00	Internal Harness	1
232-029-00	Miscellaneous Hardware Kit	1

*Refer to the *Appendix* for flow meter assembly part numbers.

Cockpit Indicator

The Cockpit Indicator is a microprocessor-based instrument that receives data from the operator, one or two flow meters and an optional GPS receiver. Flow and acre (hectare) information is calculated and displayed to the pilot. Flow and acre (hectare) information can also be sent to data collection equipment by way of a bi-directional serial port. Entered and calculated data is retained in the system non-volatile memory when the system is powered down.

Figure 1-2 CROPHAWK 7/B Cockpit Indicator



Flow Meter

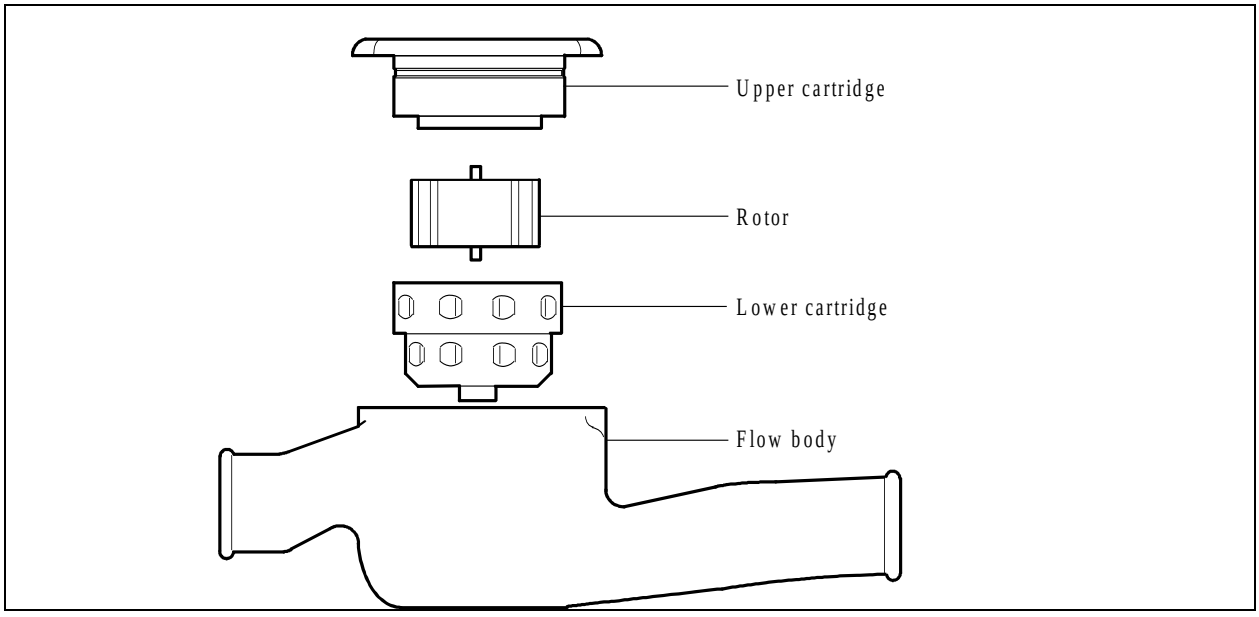
The CROPHAWK 7/B can be connected to one or two flow meters. The two flow meters can be arranged such that both are discharge meters or one can be a discharge meter and the other can be an input meter used to load the aircraft chemical tank. The flow meter monitors the flow of chemical that passes through it. The flow meter is inserted into the chemical line such that all of the chemical to be metered passes through it. As chemical passes through the flow meter the rotor turns and a number of electrical pulses are generated. The pulses are passed to the Cockpit Indicator through the Internal Harness.

Eight flow meters are available: 1¼-inch aluminum, 1¼-inch nickel plated aluminum, 1¼-inch stainless steel, 2-inch aluminum, 2-inch nickel plated aluminum, 2-inch stainless steel, 3-inch aluminum and 3-inch nickel plated aluminum. Each flow meter has a number of cartridges available. The combination of the cartridge and the flow body determines how much chemical will pass through the system and be measured accurately. Any combination of flow meters can be used with the CROPHAWK 7/B.

NOTE

Each cartridge has a range. If flow is passed through the flow meter above or below this range, it will not be accurately measured. Ensure that the system supplied is suitable.

Figure 1-3 Typical flow meter, showing major sections



Flow Meter, continued

- The *upper cartridge* contains a motion detector.
- The *rotor* turns as fluid flows through the flow meter. Magnets in each of seven vanes on the rotor create pulses as they pass a stationary point in the upper cartridge. These pulses are counted to determine the rate of flow.
- The *lower cartridge* manipulates the fluid dynamics to control fluid movement and displacement, and determines the flow range of the flow meter.
- The *flow body* connects to the fluid system and controls the flow.

Specifying a Flow Meter

To determine the correct flow meter for a particular installation consider these variables.

- The *connector size* of the flow body. Select the body that best matches the existing plumbing.
- The *pressure rating* of the flow body. Select the body that meets operating requirements.
- The *material* of the flow body. Select either 356-T6 aluminum, 356-T6 nickel plated aluminum, or 303 stainless steel depending on chemical requirements.
- The *flow range* of the lower cartridge. Select the cartridge with a midrange rating suitable for most applications. Avoid using a cartridge right at its upper or lower rated limit. If actual flow is above or below the specified range, the flow will not be accurately measured. Cartridges can be interchanged easily in the field if one cartridge does not meet all application needs.

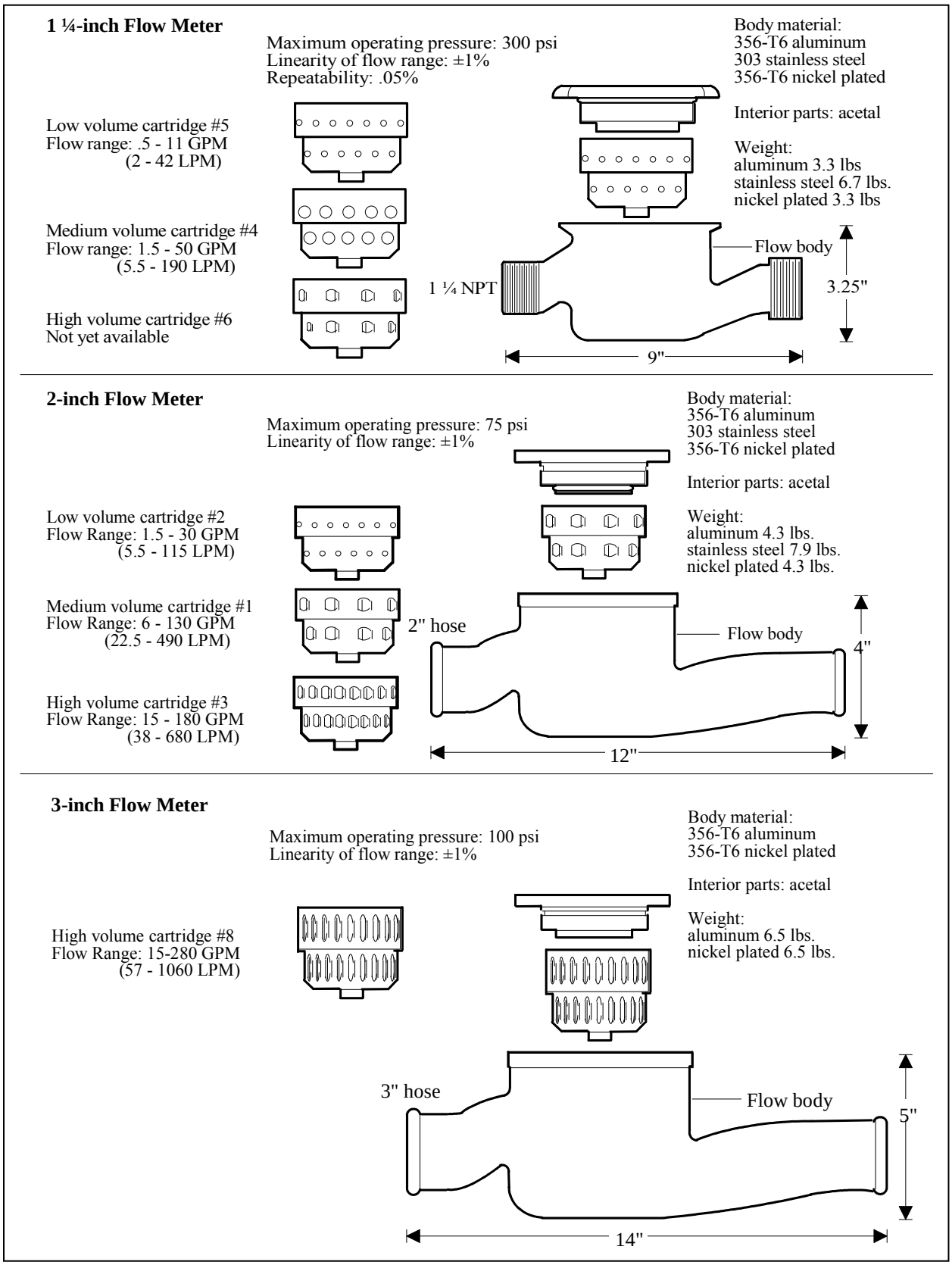
  Use these formulas to calculate the flow rate in gallons per minute (GPM) or liters per minute (LPM).

$$\text{GPM} = \frac{\textit{speed in MPH} \times \textit{swath in feet} \times \textit{gallons per acre}}{495}$$

$$\text{LPM} = \frac{\textit{speed in KPH} \times \textit{swath in meters} \times \textit{liters per hectare}}{600}$$

Figure 1-4 shows the specifications for the three sizes of flow meters and their accompanying cartridges.

Figure 1-4 Flow meter specifications



Internal Harness

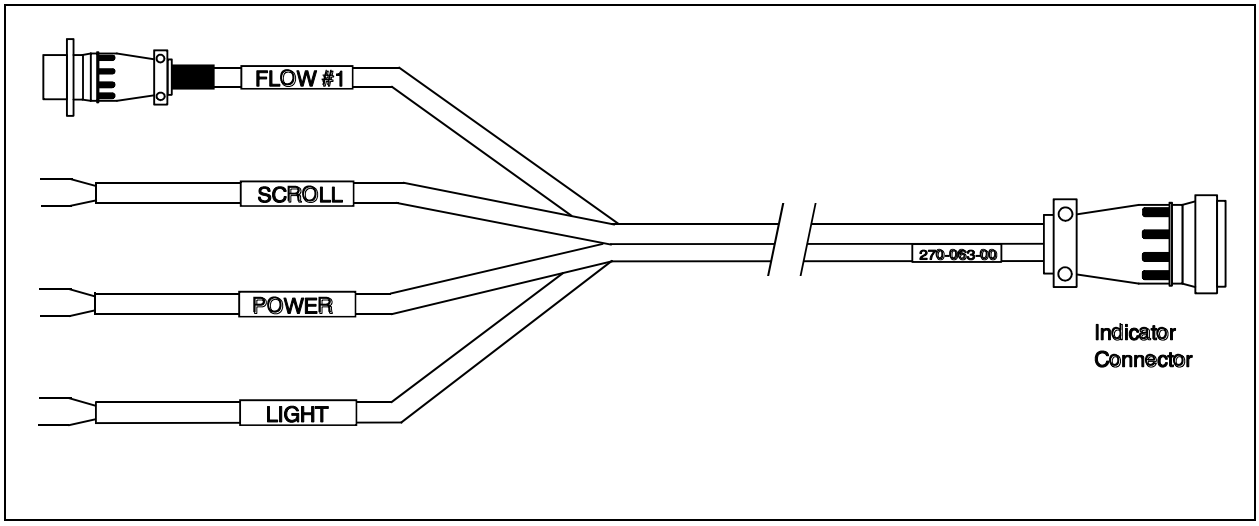
The standard Internal Harness is made up of four cables terminated into one connector. The connector is mated with the Cockpit Indicator connector. One of the Internal Harness cables is marked “FLOW#1” and is to be connected to the primary discharge flow meter. Another cable is marked “POWER” and is connected to aircraft electrical power. The third cable is marked “SCROLL” and can be connected to an external scroll switch. The last cable is marked “LIGHT” and is connected to the aircraft’s instrument panel back light control.

Several optional, field installed cables are available to expand the functions of the system. The optional cables include:

- A flow meter # 2 cable to connect the system to a second flow meter.
- A serial cable to connect the system to a GPS receiver or to a Heads-up display.
- A work switch cable to connect a work switch to the system.

See *Appendix* for optional cable ordering information.

Figure 1-5 Internal Harness

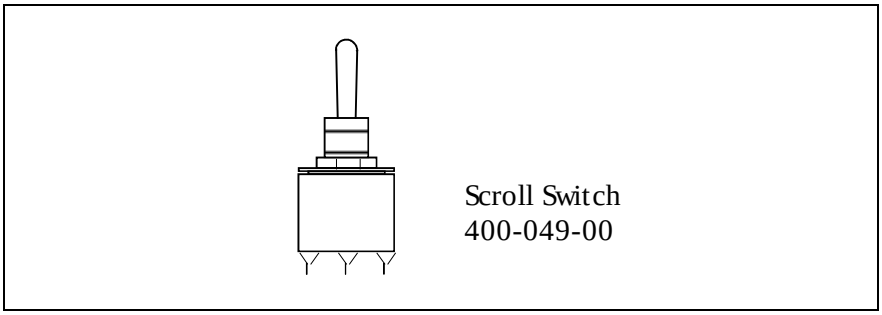


Scroll Switch

The external scroll switch is installed to provide a convenient means for the pilot to scroll the CROPHAWK display channels. It performs a similar function to the “Channel/Enter” button located on the cockpit display with two important additions. If the scroll switch is installed the CROPHAWK can be set up such that only the needed channels are displayed when the scroll switch is used. Also, the scroll switch allows the pilot to scroll up **and** scroll down.

Scroll Switch, continued

Figure 1-6 Scroll Switch



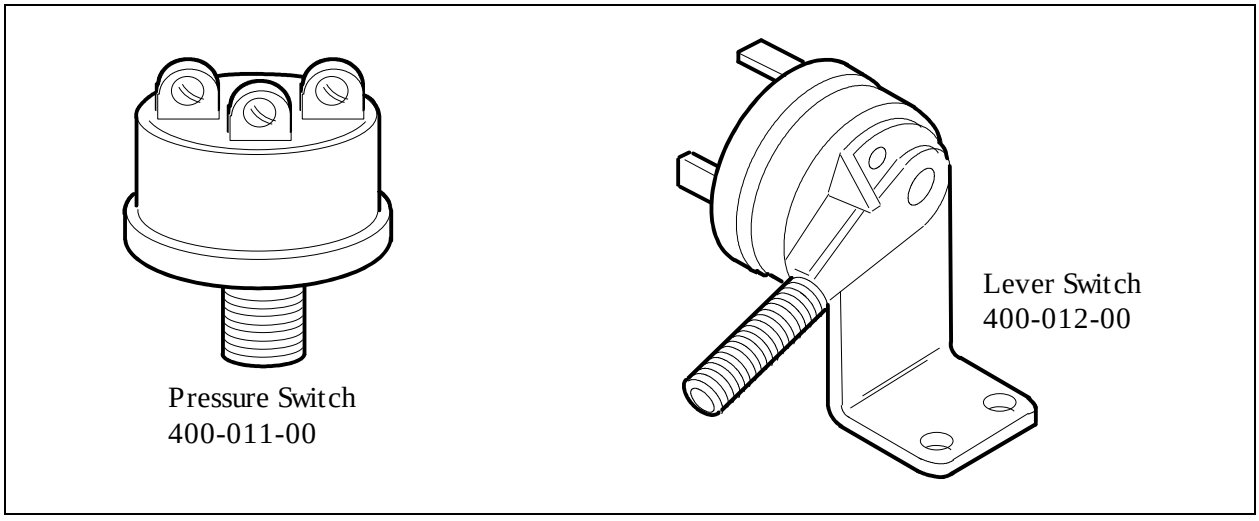
Work Switch

A work switch can be installed to tell the Cockpit Indicator when to count pulses from the discharge flow meter(s).

A work switch is usually not necessary as the Cockpit Indicator watches the flow meter rotor RPM. When the RPM drops below a fixed point it assumes a pass has ended and then ignores low rotor RPM that might be induced by aircraft vibration. A work switch may be necessary if the aircraft vibration is such that it causes the flow meter rotor to turn while ferrying, or if a good suck back valve and leaky nozzles cause the Cockpit Indicator to count in turns.

The work switch can be a pressure switch which is mounted in the booms or a lever switch that is mounted next to the spray valve handle such that when the valve is open the switch is open. Shown below are available switches.

Figure 1-7 Work switches



Section 2
Installation Instructions

Unpacking Inspection

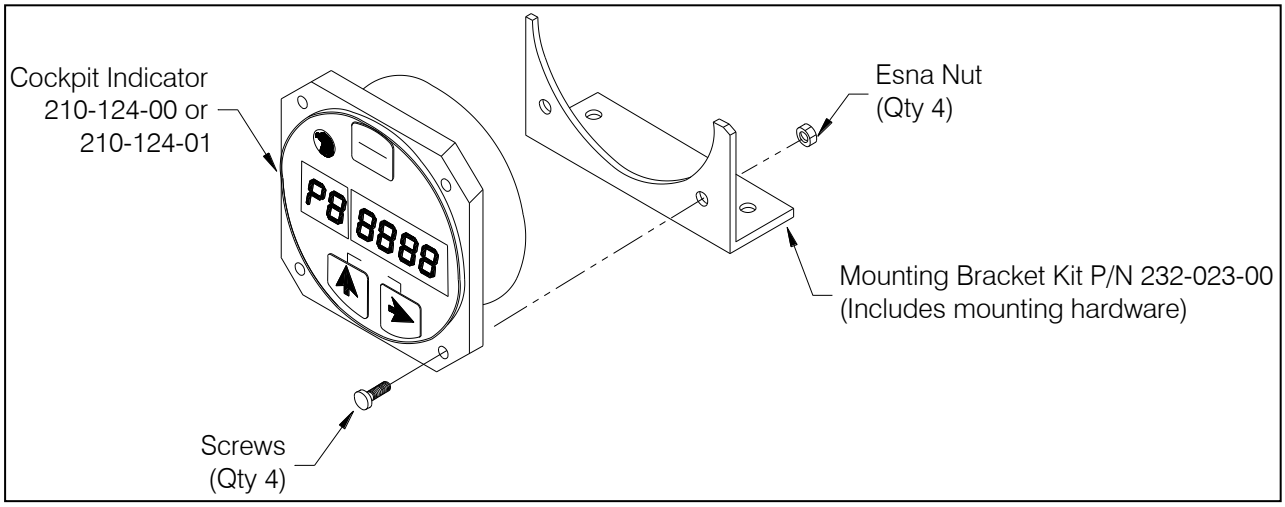
After unpacking the components of the CROPHAWK 7/B System, check each component against the packing list to ensure the correct configuration has been received. If an error is found, notify your distributor.

Inspect the components for evidence of mishandling or damage. All parts packaged at the factory were carefully tested, inspected, and packed. If damage is evident, do not proceed with installation. File a claim with the carrier and notify the distributor from whom the components were purchased.

Cockpit Indicator Installation

The Cockpit Indicator can be mounted in a standard 3-1/8-inch instrument hole or on the instrument panel by using the mounting bracket and hardware provided. Mount the Cockpit Indicator in a location that allows a comfortable viewing angle during operation.

Figure 2-1 Cockpit Indicator with mounting bracket kit



Flow Meter Installation

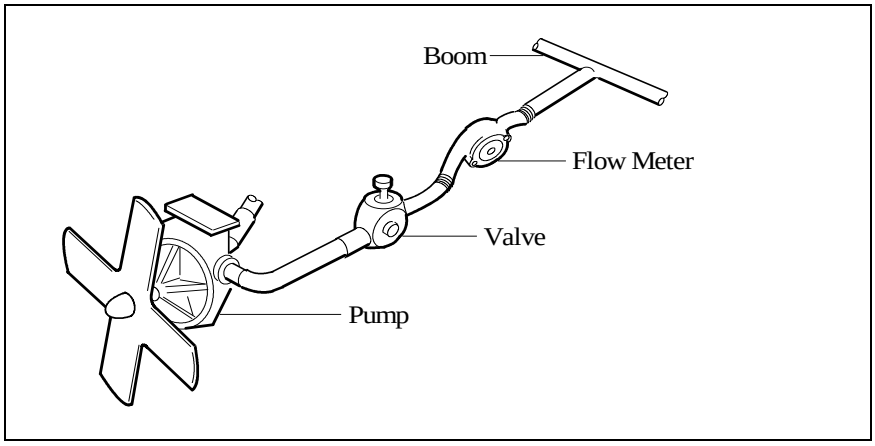
CAUTION

Before installing the flow meter, ensure that its specifications for flow rate, capacity, and material are appropriate given the maximum operating pressure of the dispersal system and the chemical used. Refer to Flow Meter in the General Information section of this manual.

Before installing the flow meter(s), examine the spray system to determine the best location for the flow meter(s). Figure 2-2 shows a typical installation. Follow these general guidelines for all installations.

- Locate the flow meter so that **all** of the chemical to be measured passes through the meter.
- Orient the flow meter so that chemical flows in the direction of the arrow cast on the flow body. If it is more convenient, the flow meter can be mounted on its side.
- Allow sufficient clearance so that the cartridge can be easily changed or removed.
- Locate the flow meter as far as possible from control valves, elbows, and other turbulence-generating obstructions.
- Mount the flow meter securely to reduce excessive vibration.
- Double clamp all hose connections.
- After the initial installation and before operating the system with chemicals, test connections by bringing the system slowly and cautiously up to operating pressure using **water only**. Watch for leaks and other problems.

Figure 2-2 Typical flow meter installation

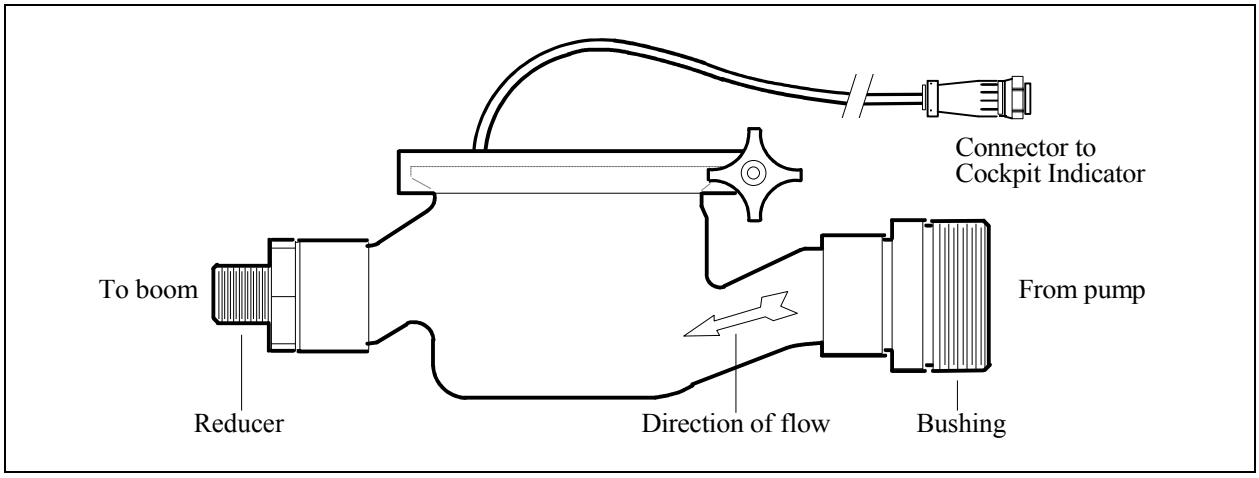


1-1/4-inch Flow Meter Installation

Follow these guidelines for installing a 1-1/4-inch flow meter. Refer to Figure 2-3.

- The maximum system pressure with this flow meter is **300 psi.**
- The standard flow body has 1-1/4-inch male NPT threads. If the threads are not the desired size, use bushings or reducers.
- Use a good grade of thread sealant to prevent leaks.

Figure 2-3 1-1/4-inch flow meter installation

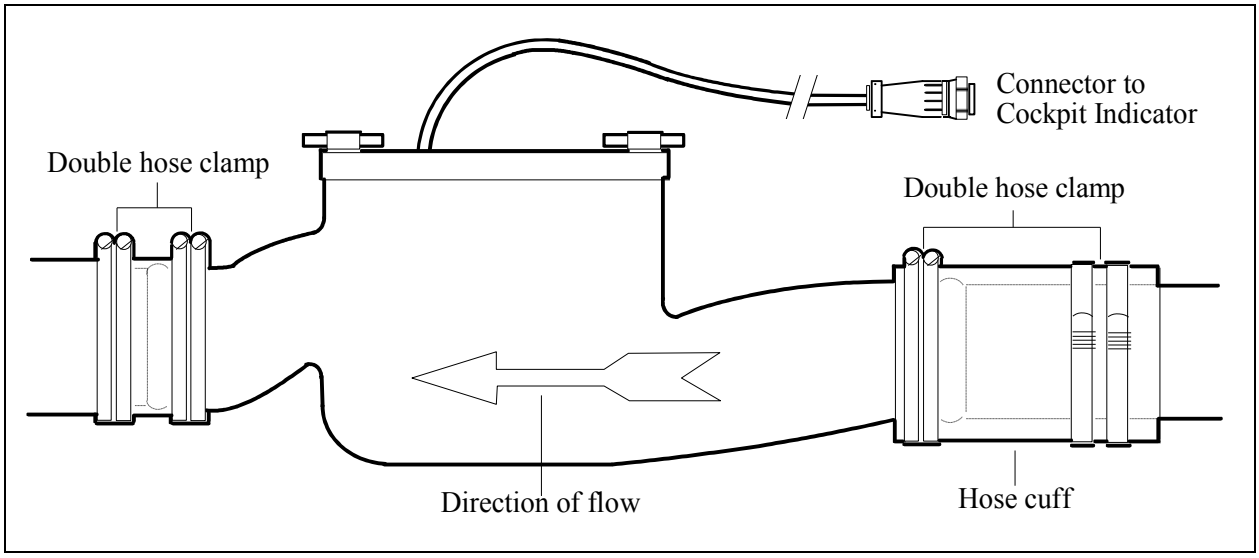


2-inch Flow Meter Installation

Follow these guidelines for installing a 2-inch flow meter. Refer to Figure 2-4.

- The maximum system pressure with this flow meter is **75 psi**.
- The flow meter has 2-inch male hose barbs. Use a short section of suitable hose to connect it to the spray system.
- Use double hose clamps to secure each end, as shown.

Figure 2-4 2-inch flow meter installation

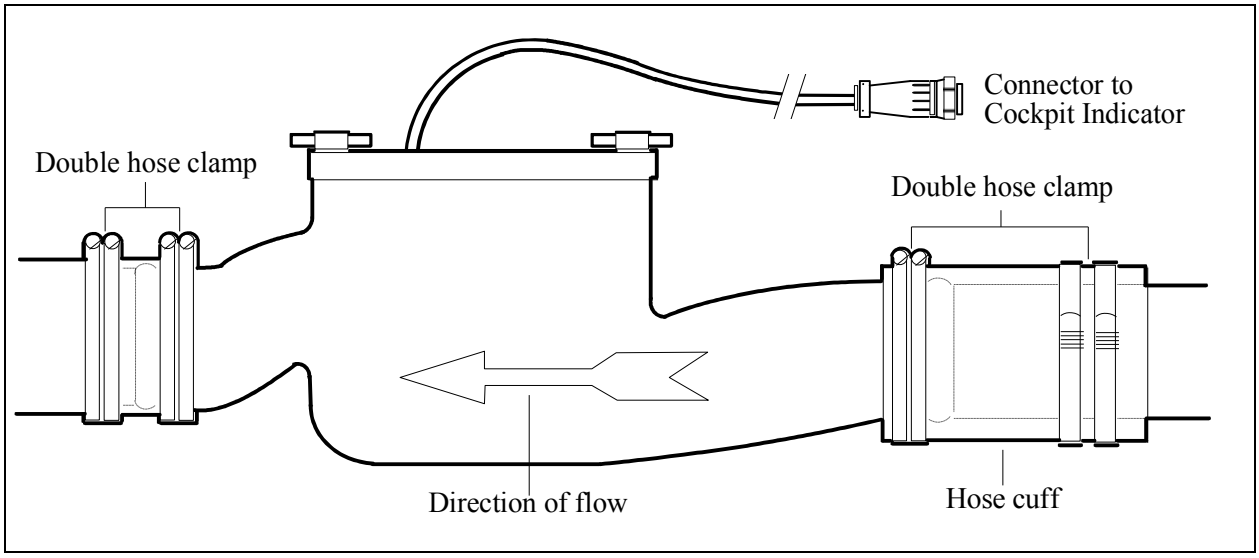


3-inch Hose Barb Flow Meter Installation

Follow these guidelines for installing a 3-inch hose barb flow meter. Refer to Figure 2-5.

- The maximum system pressure with this flow meter is **100 psi**.
- The flow meter has 3-inch male hose barbs. Use a short section of suitable hose to connect it to the spray system.
- Use double hose clamps to secure each end, as shown.

Figure 2-5 3-inch hose barb flow meter installation

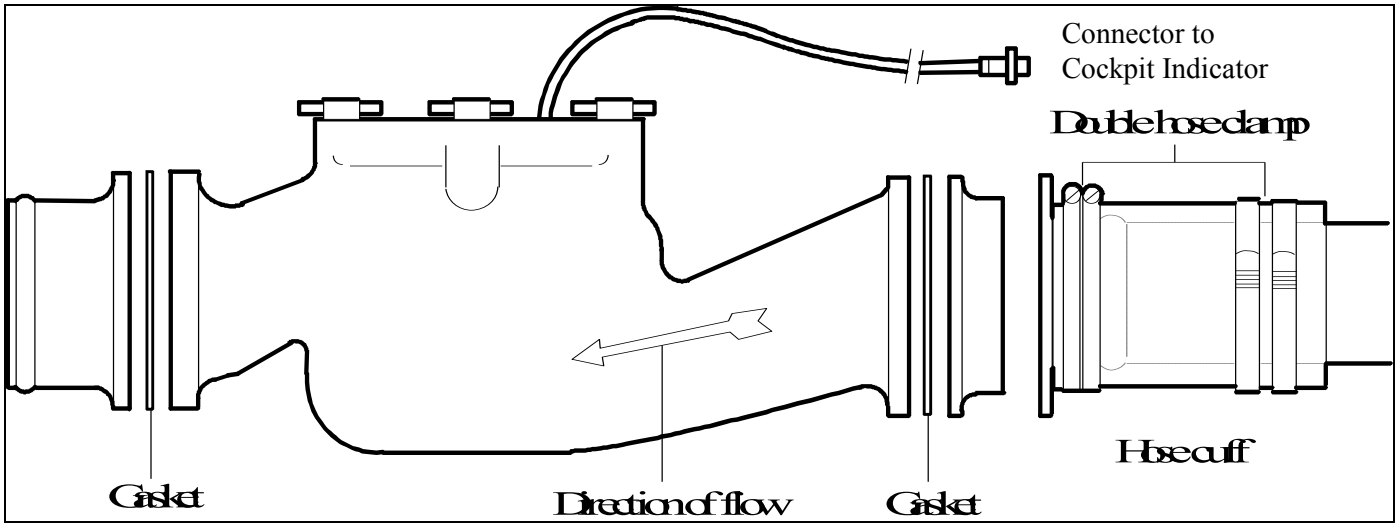


3-inch Flanged Flow Meter Installation

Follow these guidelines for installing a 3-inch flanged flow section. Refer to Figure 2-6.

- The maximum system pressure with this flow section is 100 psi.
- This flow section is available with one of the following connectors.
- 2 1/2-inch female NPT threaded adaptor. If necessary, use bushings to mate with pipe of a different size. Use a good grade of thread sealant to prevent leaks.
- 2-inch or 3-inch male hose adaptor. Use double hose clamps to secure each end.

Figure 2-6 3-inchflanged flow section installation

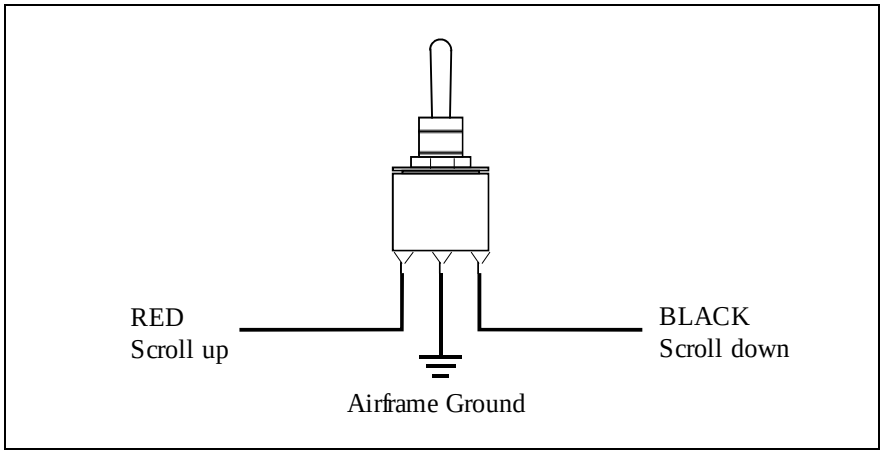


Scroll Switch Installation

Install the scroll switch at the desired position. Locate the Internal Harness cable marked “SCROLL” and connect the wires as illustrated in Figure 2-7.

For best results all connections should be soldered with rosin-core solder.

Figure 2-7 Scroll switch installation



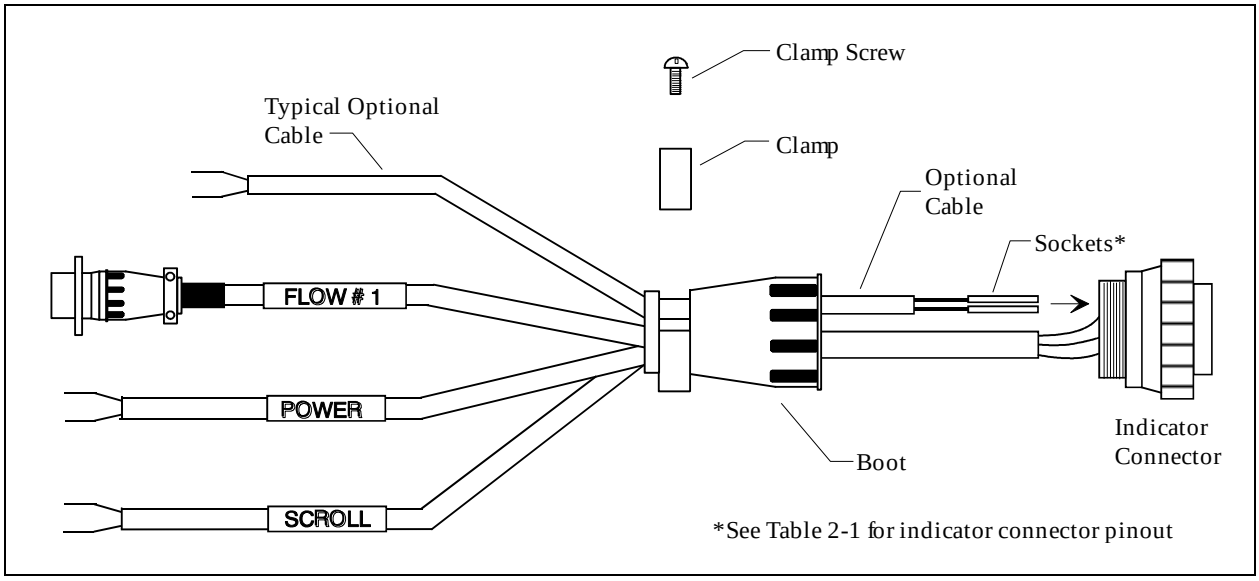
Optional Cables Installation

Several optional cables are available to expand the functions of the CROPHAWK. The optional cables are connected directly to the Internal Harness Indicator connector. Optional cables include a second flow meter cable, serial cable and a work switch cable.

When installing the optional cables, remove the two clamp screws and unscrew the boot on the Internal Harness Indicator connector. Each optional cable has sockets attached to one end of the cable. Insert these sockets in their correct location by referring to Figure 2-8 and Table 2-1. The sockets will snap in place. If the sockets are inserted in the wrong location a special extraction tool is available, see Figure 2-8. When finished inserting sockets, screw the boot back in place and tighten the clamp screws.

Optional Cables Installation, continued

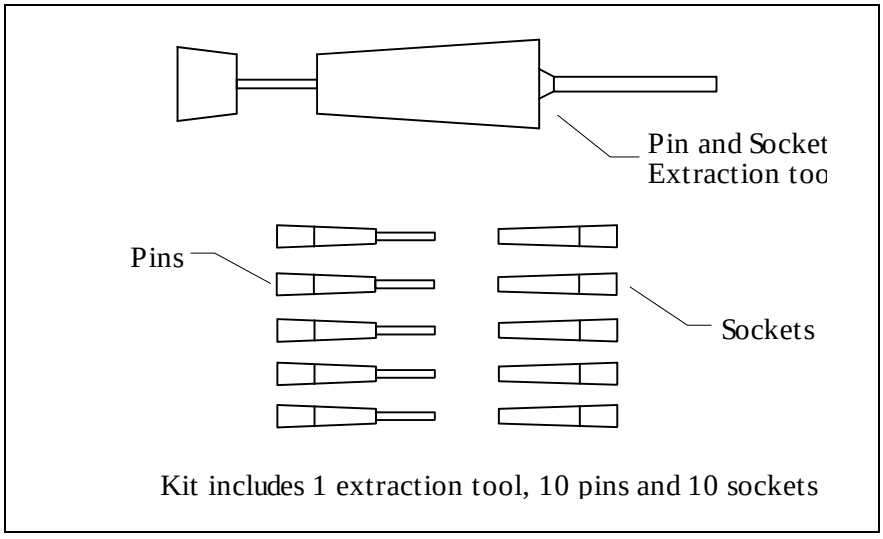
Figure 2-8 Typical optional cable installation



Wiring Modification Kit

To facilitate cable modification a wiring kit is available. The kit includes a pin and socket extraction tool, 10 pins and 10 sockets. The kit part number is 212-007-00.

Figure 2-9 Wiring Modification Kit



Cockpit Indicator Connector Pinout

Table 2-1 Cockpit Indicator Connector Pinout

Pin	Color	Function	Cable
6	Red	+ Power	Power
5	Black	Ground	
4	Bare	Shield for Power, Flow # 1 and Light	
9	Red	Flow # 1 Signal +	Flow #1
10	Black	Flow # 1 Signal -	
1	Red	Flow # 2 Signal +	*Flow #2
2	Black	Flow # 2 Signal -	
3	Bare	Flow # 2 Shield	
7	Red	Back Light, High	Back Light
8	Black	Back Light, Common	
14	Any	External Work Switch	*Work Switch
12	Red	External Scroll Up	Scroll
13	Black	External Scroll Down	
11	Red	Serial Data, Out	*Serial Data
15	Black	Serial Data, Return	
16	Clear	Serial Common	

* Operator installed

Table 2-2 Flow Meter #1 and #2 Connector Pinout

Pin	Color	Function
1	Black	Signal -
3	Red	Signal +
4	Shield	Shield

Work Switch Installation

Install the pressure activated switch in the boom or install the lever switch to the valve handle as described below.

1. Connect the optional work switch cable to the Internal Harness, refer to *Optional Cables Installation*.
2. Pressure switch - The pressure switch has three terminals: NC (normally closed), NO (normally open) and C (common). The work switch wire should be attached to the NC terminal. The C terminal should be tied to aircraft ground.
3. Lever switch - Install the lever switch such that when the valve is open, the switch contacts are open. Connect the work switch wire to one side of the switch and aircraft ground to the other side.

Serial Data Installation

The CROPHAWK 7/B has the circuits to communicate with a GPS receiver or a Heads-up display unit through the bi-directional serial port

1. Connect the optional serial data cable to the Internal Harness, refer to *Optional Cables Installation*.
2. The serial data cable is furnished without a connector. It will be necessary to obtain the appropriate connector from the GPS or Heads-up display equipment supplier. Install the connector using the pinout in Table 2-1.

Flow Meter # 2 Installation

The CROPHAWK 7/B has the circuits to monitor two flow meters. The second flow meter can be used as a discharge meter or as an input meter used to load the aircraft chemical tank.

1. Connect the optional flow meter # 2 cable to the Internal Harness, refer to *Optional Cables Installation*.
2. Plug the flow meter connector into the Internal Harness connector.

Refer to the *Operation Instructions* section of this manual for instructions on entering calibration codes and specifying how the second flow meter is going to be used.

Internal Harness Installation

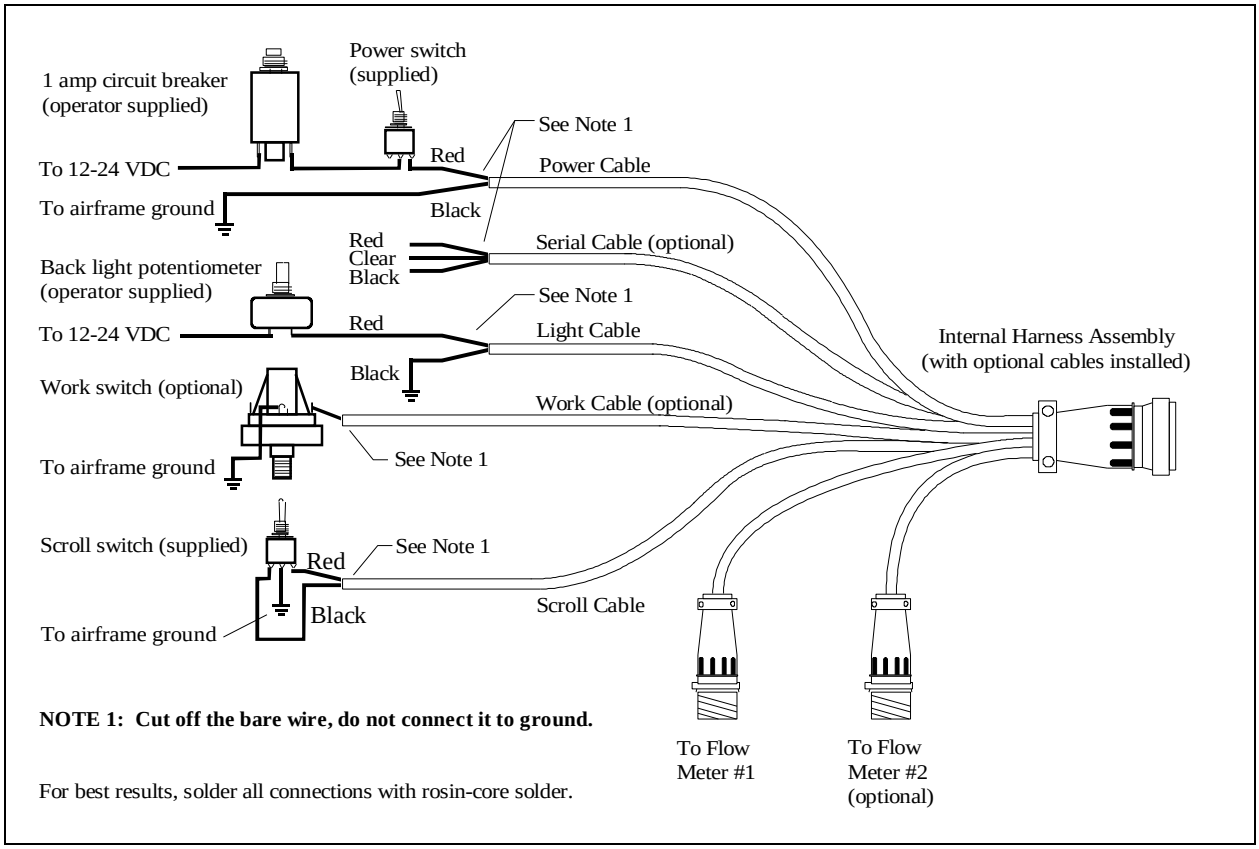
Position the Internal Harness connector next to the Cockpit Indicator connector, but do not connect it. Route the cables to their desired locations. Route the cables so that they are protected from tension, shearing, bending, and vibration. Secure the cables away from other aircraft cables to prevent cable cross talk. Secure the cables away from aircraft controls.

The flow cables are extra long and can be coiled and secured with ty-wraps or shortened using the wiring modification kit P/N 212-007-00. The other cables can be trimmed to length. If joints are needed, solder the wires with rosin-core solder and protect from corrosion.

Back Light Installation

Connect the "LIGHT" red wire to the positive side of the aircraft dimming circuit. Connect the "LIGHT" black wire to airframe ground. Follow the aircraft manufacturer instructions when making any aircraft electrical connections.

Figure 2-10 Wiring Arrangement



Power Connection

Install the supplied power switch (P/N 400-048-00). Connect the "POWER" red wire to one side of the power switch. Connect the power switch to a 1 amp circuit breaker as illustrated in Figure 2-10. Connect the circuit breaker to the 12-24 VDC buss. Use a minimum of 22 gauge wire to make all connections. Secure connections and protect from corrosion.

Connect the Internal Harness connector to the Cockpit Indicator connector.

FAA Paper Work

In the USA fill in FAA form 337 and make the appropriate aircraft log book entry.

FAA Follow-On Approvals

The installation of the CROPHAWK is FAA approved for those aircraft listed on the STC certificate. Follow-on approvals are possible by amendment to the STC or field approval on a FAA form 337. As the CROPHAWK installation is designed basically for external flow systems, generally described in *Flow Meter Installation* in the *Installation Instructions* section of this manual, and does not effect any primary aircraft systems, it readily lends itself to the field approval process. The applicant or installing agency requesting a follow-on approval should contact either Onboard Systems or FAA Engineering, ANM 190S (206) 227-2592 in order to:

1. Obtain verification of the CROPHAWK equipment approval status,
2. Discuss any problem areas or safety issues related to the installation of the CROPHAWK on the follow-on aircraft,
3. Discuss what certification and air worthiness assessments should be made for such an installation.

NOTE

The above statement is based upon the follow-on air worthiness approval philosophy of AC 20-101C, paragraph 10.b., dated 9/12/88 for Omega/VLF installation approvals.

The following letter was prepared by FAA Engineering and distributed to help facilitate follow-on approvals.

U.S. Department
of Transportation
**Federal Aviation
Administration**

**Transport Airplane Directorate
Aircraft Certification Service**

1601 Lind Avenue S.W.
Renton, Washington 98055-4056

MAR 22 1993

In Reply
Refer To: 93-190S-170

Onboard Systems
11212 NW. St. Helens Road
Portland, Oregon 97231

Gentlemen:

In response to your request for our support in facilitating Coordinated Engineering Field Approval of your CROPHAWK spray system in agricultural airplanes, we initiated the issuance of the following message released to all Flight Standards District Office (FSDO) managers in an AFS-300 Memorandum dated March 18, 1993:

> The Renton, Washington, Aircraft Certification Office, ANM-190S, has issued Supplemental Type Certificate (STC) No. SA5783NM, approving the installation of the CROPHAWK spray monitoring system in Schweizer Aircraft (A/C) Model G-164A, Ayres A/C Model S-2R, and PZL-Mielec A/C Model PZL-M18 agricultural airplanes.
>
> In processing this STC, it was determined that the change was insignificant from a safety standpoint for the aircraft models reviewed. This installation does not impose significant safety concerns because it is mounted under the fuselage of these airplanes.
>
> Guidance for field approvals and installation of STC's can be found in FAA Order 8300.10, Airworthiness Inspector's Handbook, volume 2, chapter 1. Field approvals should be considered on similar makes and models to those covered on the STC's.

If we may be of further assistance, please do not hesitate to contact us.

Sincerely,

A. J. Pasion
Manager, Special Certification Branch
Seattle Aircraft Certification Office

STC

United States of America
Department of Transportation — Federal Aviation Administration

Supplemental Type Certificate

Number SA5783NM

This certificate, issued to Onboard Systems

certifies that the change in the type design for the following product with the limitations and conditions therefor as specified hereon meets the airworthiness requirements of Part * *of the* * *Regulations.*

Original Product — Type Certificate Number: * See Attached Approved Model List (AML)
Make: * No. SA5783NM for list of approved aircraft
Model: * models and applicable airworthiness regulations

Description of Type Design Change: Fabrication of Onboard Systems Model 7 CROPHAWK Spray Flow Measuring System in accordance with FAA Approved Onboard Systems Master Drawing List No. 155-018-00, dated August 10, 1992, or later FAA approved revision; and, Installation of this system in accordance with FAA approved Onboard Systems Owners Manual No. 120-012-00, Revision 2, dated August 10, 1992, or later FAA approved revisions. Inspect the flow measuring system in accordance with Section 7 of Onboard Systems Owners Manual No. 120-012-00, dated August 10, 1992, or later FAA approved revision.

Limitations and Conditions: Approval of this change in type design applies to only those agricultural airplane models listed on AML No. SA5783NM, dated October 29, 1992, or later FAA approved revision. This approval should not be extended to aircraft of these models on which other previously approved modifications are incorporated unless it is determined by the installer that the relationship between this change and any of those other previously approved modifications, including changes in type design, will introduce no adverse effect upon the airworthiness of that aircraft. A copy of the Certificate, Continuation Sheet No. SA5783NM and AML No. SA5783NM must be maintained as part of the permanent records of the modified aircraft.

This certificate and the supporting data which is the basis for approval shall remain in effect until surrendered, suspended, revoked, or a termination date is otherwise established by the Administrator of the Federal Aviation Administration.

Date of application: August 23, 1992
Date of issuance: October 29, 1992

Date reissued:
Date amended:
By direction of the Administrator

(Signature)
Manager, Special Certification Branch
Seattle Aircraft Certification Office
(Title)

Any alteration of this certificate is punishable by a fine of not exceeding $1,000, or imprisonment not exceeding 3 years, or both.

This certificate may be transferred in accordance with FAR 21.47.

FAA Form 8110-2 (10-68)

FAA APPROVED MODEL LIST (AML) NO. SA5783NM

FOR

ONBOARD SYSTEMS

Issue Date: October 29, 1992

ITEM	AIRCRAFT MAKE	AIRCRAFT MODEL	ORIGINAL TYPE CERTIFICATE NUMBER	CERTIFICATION BASIS FOR ALTERATION	FAA SEALED DRAWING/ DRAWING LIST		AFM SUPPLEMENT NO. AND DATE	AML AMENDMENT DATE
					NUMBER	REVISION NO. AND DATE		
1	Schweizer	G-164A	1A16	CAR 8.10(a)(1) effective 10/11/50, and CAM 8 Appendix B, as amended 3/19/57, Restricted Category	Onboard # 120-012-00	Revision 2 August 10, 1992	None	NC
2	Ayres Corp.	S-2R	A4SW	CAR 8 Effective 10/11/50, Restricted Category	"	"	"	"
3	PZL-Mielec	PZL-M18	A47EU	FAR 21.29, FAR 21.25(a)(1) using the airworthiness requirements of FAR Part 23, effective 2/1/65, including amendments 23-1 through 23-16, 11/19/73	"	"	"	"

FAA Approved: _____

Manager, Special Certification Branch
Seattle Aircraft Certification Office

Date: Oct 29, 1992

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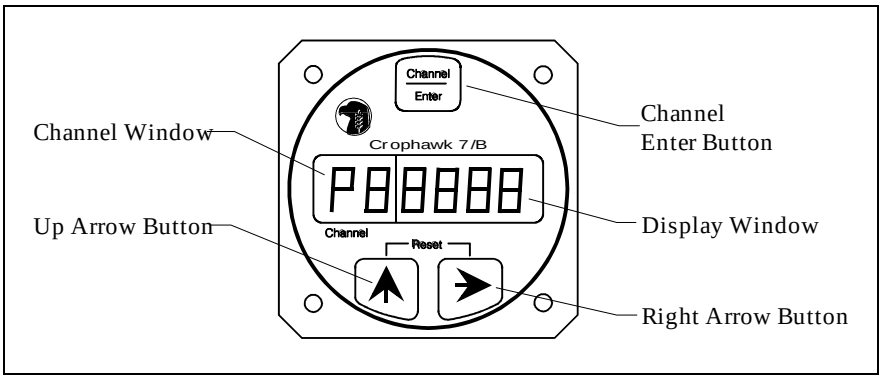
Section 3
Operation Instructions

This section describes the operation of the CROPHAWK 7/B Flow Monitoring System.

The Front Panel

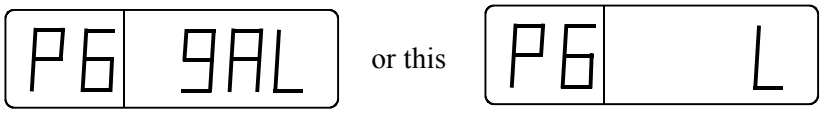
The following figure describes the Cockpit Indicator front panel.

Figure 3-1 The Front Panel



Power Up

After all of the CROPHAWK components have been installed the circuit breaker and power switch can be activated. The system will perform a self diagnostic routine and when completed the display should look like this.



These displays serve as a reminder as to what units the system has been set to read in. To change the units refer to the section below.

Channels

The Cockpit Indicator routines are displayed in a channel format. Each display or routine has a unique channel number, i.e. Channel # 1 displays gallons per minute through flow meter # 1 (liters per minute if Metric).

Channels, continued

There are two types of channels, Program channels and Run channels. Program channels are used to enter data and the Run channels are used to display the calculated data. Program channels are indicated by a "P" prefix. To select a channel use the button labeled "Channel/Enter" or the external scroll switch to scroll to the desired channel number. The channel number is displayed in the channel window. Listed below is a explanation of the channels and a description of their functions.

Table 3-1 The Cockpit Indicator channels

Channel	Description	Display Range
	Program Channels	
P0*	Spray tank load in gallons (liters)	1 to 9999
P1*	Swath in feet (meters)	.1 to 999.9
P2*	Ground speed in miles per hour (kilometers per hour)	.1 to 999.9
P3*	Cal Code, # 1 discharge flow meter	1 to 9999
P4*	Cal Code, # 2 discharge flow meter	1 to 9999
P5	Cal Code, fill flow meter	1 to 9999
P6	Select English or Metric units	N/A
P7	Add or delete Run channels	N/A
P8	Production number & global reset	N/A
	Run Channels	
1	Flow meter # 1 GPM (LPM)	.1 to 999.9
2	Flow meter # 2 GPM (LPM)	.1 to 999.9
3	Flow meter #1 and #2 combined GPM (LPM)	.1 to 999.9
4	Gallons per acre, GPA (LPH)	.01 to 99.99
5*	Gallons remaining in the tank (liters)	.1 to 999.9
6*	Gallons per pass (liters)	.1 to 999.9
7*	Gallons sprayed since reset (liters)	1 to 9999
8*	Total gallons sprayed since reset (liters) times 10	1 to 9999
9*	Time per pass, MM:SS	99:59
10*	Boom on time, HH:MM	99:59
11*	Acres per pass (hectares)	.1 to 999.9
12*	Acres sprayed (hectares)	1 to 9999
13*	Total acres sprayed (hectares) times 10	1 to 9999
14*	Number of passes	1 to 9999
15*	Average gallons per acre (liters per hectare)	.01 to 99.99
16*	Job timer, press Up arrow to start/stop, HH:MM	99:59

* Indicates the display is resetable when the channel is displayed.

How To Reset a Channel

To reset a channel to zero press both the Right arrow button and the Up arrow button simultaneously while the channel is displayed. Refer to Table 3-1 for resetable channels.

To reset all the channels at once see *P8, Production Number & Global Reset* in this section.

Program Channels

Program channels provide the means for the operator to enter data into the CROPHAWK. The Program channels are designated by a "P" prefix. The following sections explain how to view and enter data into the Program channels.

When entering data into the CROPHAWK, the information displayed is only as good as the data entered. It is possible to enter a calibration code that would make the system think that 1 gallon was 2 or 10. It is essential that accurate data be entered for calibration, speed, and swath. If this is done the system can be a valuable aid.

How To Enter Data Into a Program Channel

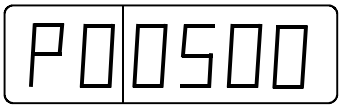
To enter the Program Channel Mode you must first be in Run Channel 16. Press the enter button once and Program Channel P0 will be displayed.

Data is entered into the Program channels by scrolling to the desired channel. The previously entered data is displayed. To change the data press the Right arrow button once. The most significant digit in the display window will blink. The blinking digit is the digit that can be changed. Use the Right arrow button to step through the digits. Use the Up arrow button to change the value of the blinking digit. Use a combination of the Right and Up arrow buttons to enter the desired number. When the desired number is displayed press the Enter button once to store the data in the system memory. The data can be changed as often as necessary and only the last entered data will be stored in the system memory.

Data is entered in Channels P0 through P5 using this procedure. Data is changed in Channels P6 through P8 following the procedures outlined in the description of these individual channels.

Channel P0, Chemical Load

The chemical load is the quantity in gallons (liters) that is to be loaded into the aircraft chemical tank. As chemical is sprayed Channel # 5 will keep track of the quantity remaining in the tank. The quantity is entered in gallons for English systems and liters for Metric systems. To enter the chemical load into the system follow the procedures listed in the section above *How To Enter Data Into a Program Channel*.

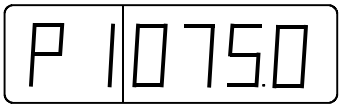


This display indicates that 500 gallons (liters) will be loaded into the chemical tank.

If the second flow meter will be used as a fill flow meter no data need be entered in Channel P0. Any data entered in Channel P0 will be ignored when using the second flow meter as a fill flow meter.

Channel P1, Swath

Swath is a required input if any of the acre (hectare) channels are needed. Swath is entered in feet for English systems and meters for Metric systems. To enter the swath into the system follow the procedures listed in the section above *How To Enter Data Into a Program Channel*.



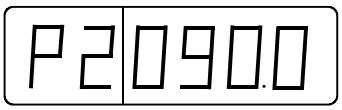
This display indicates that the swath is 75 feet (meters).

The pilot has the option of using either the GPS data or pilot entered data for speed and/or swath. If numbers are programmed into the CROPHAWK for speed or swath, the system will utilize those values in the calculation of acre (hectare) information. If no numbers are entered for speed or swath the system will use the GPS data. If no data is sent from the GPS receiver the CROPHAWK will display an error message (Err 0) in the acre (hectare) readouts. This error message indicates that no GPS data has yet been received or the operator has not yet programmed the speed and swath into the CROPHAWK.

If the GPS data stream stops after it has started, the CROPHAWK will use the last data received. GPS received data is not stored in system memory when the system is powered down.

Channel P2, Ground Speed

Ground speed is a required input if any of the gallons (liters) channels are needed. Speed is entered in miles per hour for English systems and kilometers per hour for Metric systems. To enter the ground speed into the system follow the procedures listed in the section above *How To Enter Data Into a Program Channel*.



This display indicates that the ground speed is 90 miles per hour (kilometers per hour).

The pilot has the option of using either the GPS data or pilot entered data for speed and/or swath. If numbers are programmed into the CROPHAWK for speed or swath, the system will utilize those values in the calculation of acre (hectare) information. If no numbers are entered for speed or swath the system will use the GPS data. If no data is sent from the GPS receiver the CROPHAWK will display an error message (Err 0) in the acre (hectare) readouts. This error message indicates that no GPS data has yet been received or the operator has not yet programmed the speed and swath into the CROPHAWK.

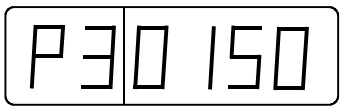
If the GPS data stream stops after it has started, the CROPHAWK will use the last data received. GPS received data is not stored in system memory when the system is powered down.

Channel P3, Calibration Codes, Flow Meter # 1

A wide variety of flow meters can be connected to the Cockpit Indicator. These include those supplied by Onboard Systems as well as many different types of industrial flow meters. The calibration code is the means by which the flow meter is mated to the Cockpit Indicator. Also, adjustments can be made to the calibration code to compensate for the flow variations from one chemical to another. The actual calibration code is the number of electrical pulses generated by the flow meter per gallon. Calibration codes are required if the system is to compute and display any of the flow channels.

The P3 calibration code is the calibration code for flow meter # 1, which is the aircraft's primary discharge flow meter. To enter the P3 calibration code follow the procedures listed in the section above *How To Enter Data Into a Program Channel*. For information on determining the calibration code refer to Section 4, *Calibration Procedures*.

Channel P3, Calibration Codes, Flow Meter # 1, continued



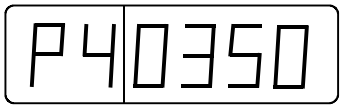
This display indicates that the calibration code for flow meter # 1 is 150. Be careful not to enter a calibration code of 150 as 1500.

Channel P4 & P5, Calibration Codes, Flow Meter # 2

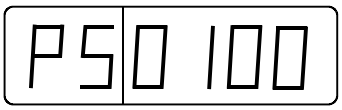
Flow meter # 2 can be used in two different ways. It can be used as a second discharge flow meter. This is often done on large airplanes and helicopters with right and left pumps that supply right and left booms. A second use for flow meter # 2 is an on the aircraft fill flow meter. A second flow meter can be installed in the aircraft plumbing line that is used to fill the chemical tank. As chemical is loaded into the aircraft the Cockpit Indicator Channel # 5 would display the chemical load in gallons (liters).

How the Cockpit Indicator responds to flow meter # 2 is determined by where the calibration code is entered. If the calibration code is entered in Channel P4, the system treats flow meter # 2 as a discharge flow meter. If the calibration code is entered in Channel P5, the system treats flow meter # 2 as a fill flow meter. The system will not allow a calibration code to be entered in both P4 and P5, only the last entered calibration code will be used.

To enter the P4 or P5 calibration code follow the procedures listed in the section above *How To Enter Data Into a Program Channel*. For information on determining the calibration code refer to Section 4, *Calibration Procedures*.



This display indicates that the calibration code for flow meter # 2 is 350 and the flow meter will be used as a discharge flow meter.

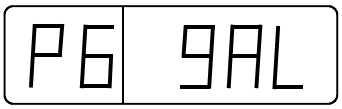


This display indicates that the calibration code for flow meter # 2 is 100 and the flow meter will be used as a fill flow meter.

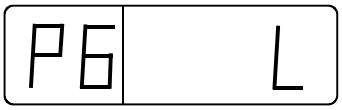
Channel P6, Selecting English or Metric Units

The Cockpit Indicator can be set to read in either English units (gallons, feet, acres, miles) or Metric units (liters, meters, hectares, kilometers). When the units are changed the Cockpit Indicator automatically recalculates the entered values using the specified units, i.e. If tank load, speed and swath are initially entered as English units and later the Indicator is set to read in Metric units, tank load, speed and swath will be converted to Metric units based on the English units.

Press the Channel button to scroll to Channel P6. The current units will be displayed.



This display indicates the channels will read out in English units.



This display indicates the channels will read out in Metric units.

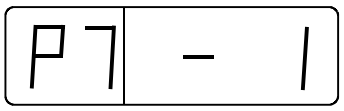
To change the units press the Right arrow button once. The display will blink. Press the Up arrow button to toggle between English and Metric units. When the correct units are displayed, press the Enter button. The display will stop blinking and the changes will be saved to system memory.

Channel P7, Adding or Deleting Run Channels

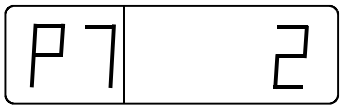
Channel P7 is used by the pilot to select the desired Run channels from the list of available channels. All of the channels can be selected or as few as one can be selected. After the desired channels are selected, they will be the only ones viewed when the external scroll switch is used to scroll through the channels. However, when the Cockpit Indicator Channel button is used to scroll through the channels, all of the Program and Run channels will be displayed.

To select the desired Run channels use the Cockpit Indicator Channel button to scroll to Channel P7.

Channel P7, Adding or Deleting Run Channels, continued



The display will look something like this. Note the presence of the dash in front of the # 1, this indicates that Channel # 1 has been selected. The absence of the dash indicates that the channel has not been selected. The Up arrow button can be used to scroll through all of the Run channels to determine which have been selected and which have not.

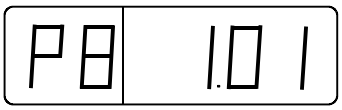


This display indicates that Channel # 2 has not been selected.

To select or unselect a channel, use the Up arrow button (while in P7) to place the desired channel in the display window. To change the status of the displayed channel press the Right arrow button once, the display will blink indicating the system is in the change mode. Press the Right arrow button again to change the status symbol. The status of the other channels can be changed by using the Up arrow button to display the channel in the data window and pressing the Right arrow button to change its status. When all of the selections have been made press the Enter button once to store the data in the system memory. The data can be changed as often as necessary and only the last entered data will be stored in the system memory.

Channel P8, Production Number & Global Reset

Channel P8 displays the Cockpit Indicator's hardware and software revision levels. Version is set at the factory and cannot be changed. Channel P8 is also used as a global reset. Global reset is used when the pilot wants to reset all of the Run channels to zero. Global reset does not reset the "P" channels or the "per pass" channels (gallons or liters per pass, time per pass, acres or hectares per pass).



This display indicates that the Cockpit Indicator's hardware and software revision level is 1.01.

To reset all of the Run channels to zero press both the Right arrow button and the Up arrow button simultaneously while in Channel P8.

Run Channels

The following sections describe the Run channels. Table 3-1 summarizes this information. To view a channel press the Enter button or the scroll switch until the channel number is displayed in the channel window.

Channel 1, Gallons per Minute through Flow Meter # 1 (Liters)

This value is the gallons (liters) per minute moving through flow meter #1. It is calculated by dividing the number of flow meter pulses by the Channel P3 calibration code.

Increasing flow readings from zero to 10.9 gallons per minute (liters) are displayed with one decimal point. Flow readings above 10.9 are displayed with no decimal point. Decreasing flow readings above 8.9 gallons per minute (liters) are displayed with no decimal point. Flow readings below 8.9 are displayed with one decimal point.

Channel 2, Gallons per Minute through Flow Meter # 2 (Liters)

This value is the gallons (liters) per minute moving through flow meter #2. It is calculated by dividing the number of flow meter pulses by the Channel P4 calibration code.

Increasing flow readings from zero to 10.9 gallons per minute (liters) are displayed with one decimal point. Flow readings above 10.9 are displayed with no decimal point. Decreasing flow readings above 8.9 gallons per minute (liters) are displayed with no decimal point. Flow readings below 8.9 are displayed with one decimal point.

Channel 3, Combined Gallons per Minute through Flow Meter # 1 & # 2 (Liters)

This value is the sum of the gallons (liters) per minute moving through flow meter # 1 and flow meter # 2. It is calculated by dividing the number of flow meter pulses by their respective calibration codes. If only one flow meter is used the value will be the GPM for that one flow meter.

Increasing flow readings from zero to 10.9 gallons per minute (liters) are displayed with one decimal point. Flow readings above 10.9 are displayed with no decimal point. Decreasing flow readings above 8.9 gallons per minute (liters) are displayed with no decimal point. Flow readings below 8.9 are displayed with one decimal point.

Channel 4, Gallons per Acre (Liters per Hectare)

Gallons per acre (liters per hectare) is a calculated value using the value from Channel # 3 (Combined gallons per minute) and the pilot entered or the GPS provided ground speed and swath. The formula is:

$$GPA = \frac{GPM \times 495}{\text{ground speed in MPH} \times \text{swath in feet}}$$

$$LPH = \frac{LPM \times 600}{\text{ground speed in KPH} \times \text{swath in meters}}$$

Channel 5, Tank Quantity Remaining

This value is the amount of chemical remaining in the tank in gallons (liters). The value decreases as flow is measured moving through the flow meter(s).

To view the tank quantity remaining, press the Channel button to scroll to Channel # 5. Press the Right arrow button and the Up arrow button simultaneously to reset the display to zero.

Press the Up arrow button to add the value entered in Channel P0 (tank quantity) to the current amount of the display. This feature makes it easy to enter a standard or customary load size. The tank quantity value is added each time the Up arrow is pressed.

NOTE

Each time the Up arrow button is pressed the last entered tank quantity will be added to the display. If the button was pushed 3 times in succession, the display would be 3 times the last tank entry.

Channel 6, Gallons per Pass (Liters)

This value is the gallons (liters) of chemical that was dispersed during the last pass or swath. The channel resets itself at the beginning of each new pass.

Channel 7, Gallons Sprayed (Liters)

This value is the accumulation of all gallons (liters) sprayed since the channel was reset.

The channel is reset by pressing the Right arrow button and the Up arrow button simultaneously. This action also resets acres sprayed (hectares) and average gallons per acre (average liters per hectare).

Channel 8, Total Gallons Sprayed (Liters)

This value is the accumulation of all gallons (liters) times 10 sprayed since the channel was reset.

The channel is reset by pressing the Right arrow button and the Up arrow button simultaneously. This action also resets acres sprayed (hectares) and average gallons per acre (average liters per hectare).

Channel 9, Time per Pass

This value is the time duration of the last pass or swath. The channel resets itself at the beginning of each new pass.

Channel 10, Boom on Time

This value is an accumulation of all time per pass since the display was reset.

To reset the display, press the Right arrow button and the Up arrow button simultaneously.

Channel 11, Acres per Pass (Hectares)

This value is the acres (hectares) covered during the last pass or swath. The channel resets itself at the beginning of each new pass. The value is calculated from the time of the pass, the entered ground speed and swath or the GPS transmitted values.

The display can be reset by pressing the Right arrow button and the Up arrow button simultaneously.

Channel 12, Acres Sprayed (Hectares)

This value is an accumulation of all acres (hectares) sprayed since the display was reset.

The value can be reset by pressing the Right arrow button and the Up arrow button simultaneously. This action also resets gallons sprayed (liters) and average gallons per acre (average liters per hectare). This value is also reset when gallons sprayed (liters) is reset, or when total acres sprayed (hectares) is reset.

Channel 13, Total Acres Sprayed (Hectares)

This value is the accumulation of all acres (hectares) times 10 sprayed since the channel was reset.

The channel is reset by pressing the Right arrow button and the Up arrow button simultaneously. This action also resets acres sprayed (hectares) and average gallons per acre (average liters per hectare). This value is an accumulation of all acres per pass (hectares) since the display was reset.

Channel 14, Number of Passes

This value is the number of passes since reset. The value is reset by pressing the Right arrow button and the Up arrow button simultaneously.

Channel 15, Average Gallons per Acre (Average Liters per Hectare)

This value is a calculation of the gallons (liters) sprayed divided by the acres (hectares) sprayed.

To reset the display press the Right arrow button and the Up arrow button simultaneously. This value is also reset when gallons sprayed (liters) is reset or when acres sprayed (hectares) is reset.

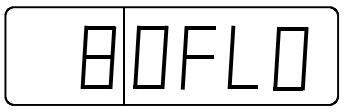
Channel 16, Job Timer

The job timer is a pilot-controlled timer. To start the timer, first press the Channel button to scroll to Channel # 16. Press either arrow button to start the timer. Once started, the value need not be displayed to keep counting. To stop the timer, press either arrow button while Channel #16 is displayed.

To reset the display, press the Right arrow button and the Up arrow button simultaneously.

Overflow Messages

An overflow message is displayed when the maximum value of a channel is exceeded. The overflow message can appear in channels 7, 8, 12 and 13. When the channel is reset the overflow message will disappear.



The overflow message looks like this.

Error Messages

The system displays an “Err 0” to prompt the pilot that data is needed for the system to calculate the display. For example, to complete the calculation for GPA (LPH) values are needed for speed and swath. These can be entered by the pilot or transmitted by the GPS. If the values are not entered or transmitted the error message is displayed in all the channels that require the values. The error message is also displayed if a calibration code is needed for a displayed channel.

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Section 4
Calibration Procedures

Introduction

A calibration code is required for the system to measure flow. The calibration code is the means by which the flow meter(s) are mated to the Indicator. The calibration code is the number of electrical pulses generated by the flow meter per gallon. Calibration codes are always entered as gallons, not liters.

The flow meter rotor has a magnet in each of its 7 vanes. Fluid passing through the flow meter causes the rotor to turn. As the magnets pass by a trigger point in the flow meter, a pulse is generated. The calibration code tells the Cockpit Indicator how many of these pulses equal a gallon.

The CROPHAWK 7/B has been factory calibrated and the suggested calibration code has been attached to the flow meter. This calibration code is for water in a system installed under ideal conditions. This code could vary from what might be needed for a thick chemical passing through a flow meter installed in a less-than-ideal installation. To verify and ensure correct calibration for your installation, you must perform a custom calibration.

The system's calibration must be verified upon installation and:

- After flow meter maintenance
- As a part of regular periodic equipment checks
- When dramatic changes in chemical viscosity occur

NOTE

Before attempting to calibrate the system, you must be familiar with the Cockpit Indicator operations, described in section 3.

Calibration Procedure

Before calibrating the system be familiar with the section below *System Accuracy Difficulties*. Calibration is done by passing a known quantity through the flow meter to be calibrated and adjusting the calibration code until the Cockpit Indicator flow channels display the correct amount. This can be done in several ways depending on the type of spray system and which flow meter is being calibrated. Helicopters and some airplanes allow the spray pump to pump while on the ground, others may require the aircraft to be flying. Regardless of the method the following steps should be covered.

Enter a known quantity. It is critical that an accurate standard be used to check the flow meter against. The accuracy of the CROPHAWK 7/B is only as good as the standard with which it is compared. The aircraft chemical tank quantity marks are usually not accurate enough to be used as a standard. Most mix tank flow meters are converted oil truck meters and should not be considered as a standard. The best standard is a carefully hand-filled aircraft chemical tank using a graduated bucket. The quantity loaded into the aircraft chemical tank will depend somewhat on the method used to spray it out. However, more accurate calibration usually results from larger sample sizes.

Enter the factory calibration code or your best guess into the Cockpit Indicator following the procedures listed in section 3, *How to enter data into a Program Channel*.

If a discharge flow meter is to be calibrated go to Channel # 6, 7 or 8 and reset the display to zero. If the fill flow meter is to be calibrated go to Channel # 5 and reset the display to zero. Pass the known quantity through the flow meter to be calibrated at the approximate rate that it will be used in service. Compare the flow channel reading against the known quantity. If the two values are the same no further calibration is needed.

If the quantity sprayed is not the same as the known quantity, the formula below can be used to compute the correct calibration code.

$$\textit{new cal code} = \frac{\textit{starting cal code} \times \textit{reported qty sprayed}}{\textit{known quantity}}$$

The reported quantity sprayed is the value from whichever Cockpit Indicator channel was used to measure the flow.

Round off the calculated calibration code to the nearest whole number. Enter the new calibration code into the Cockpit Indicator and repeat the calibration test to confirm the results. Record the new calibration code for future reference.

System Accuracy Difficulties

After the system is correctly calibrated there are other factors that contribute to overall system accuracy. These include air in the system, leaking nozzles and suck back valves. The problem is evident when the flow and totals channels are inconsistent or they are not as expected.

Aircraft flow meters typically do not have air eliminators, therefore air that passes through them will be counted as chemical. Air can get into the chemical line by sucking the chemical tank dry and by leaks in the pump suction line. When calibrating the system make sure that the lines have been purged of any air and that the suction leaks have been repaired.

The primary cause of system inconsistencies is a leaky nozzle and a good suck back valve. This combination allows some of the chemical in the boom to be drawn back into the chemical tank during ferrying and turns. This chemical has already been counted by the flow meter on its first trip to the boom. When the boom valve is opened again for the next pass the chemical is measured a second time. The result is the system reports that more chemical was sprayed than actually was. If the system is correctly calibrated the problem may not be significant on fields requiring few turns. The problem will be significant with fields requiring many turns. Corrective action is nozzle maintenance and reducing the boom valve suction adjustment. To eliminate the possibility of introducing this type of error during calibration done while flying, **Do Not Make Multiple Passes During Calibration**. Also, for the same reason, do not attempt to calibrate the system based on the quantity left in the chemical tank.

Converting an Earlier Model CROPHAWK Calibration Code to a CROPHAWK 7/B Calibration Code

The CROPHAWK 7/B uses a new calibration code scheme which is not compatible with earlier CROPHAWK models. To convert an old calibration code to a new calibration code use the formulas below.

Old 2" flow meter medium volume cartridge calibration code, i.e. 1xx:

Crophawk 7/B cal code = old Crophawk cal code - 50

Old 2" flow meter low volume cartridge calibration code, i.e. 2xx:

*Crophawk 7/B cal code = 4 * (old Crophawk cal code - 150)*

Old 2" flow meter high volume cartridge calibration code, i.e. 3xx:

Crophawk 7/B cal code = old Crophawk cal code - 250

Old 3" flow meter cartridge calibration code, i.e. 4xx:

Crophawk 7/B cal code = old Crophawk cal code - 400

Recording Calibration Data

Table 4-1 Calibration data

Date	Calibration code	Flow rate	Chemical used

Section 5
Maintenance Information

Introduction

Minimum periodic maintenance is required to maintain maximum life and accuracy from the CROPHAWK 7/B System. The following procedures should be observed to ensure proper operation.

Cockpit Indicator Maintenance

Keep the Cockpit Indicator dry and clean. Use a mild glass cleaner to clean the display lens. Do not open the unit as this will void the warranty. There are no user replaceable parts inside.

Flow Meter Maintenance

The flow meter consists of two major components, the body and the cartridge assembly containing the rotor. Follow these steps to disassemble the flow meter. Refer to Figures A-1, A-2 and A-3.

1. Remove all fluid from the spray system.
2. Remove the wing bolts or clamp holding the cartridge assembly in place.
3. Remove the cartridge assembly with a twisting and pulling motion.
4. Inspect the cartridge assembly for contamination and obstructions.
5. Ensure that the rotor is free to turn by directing slight air pressure through the bottom set of holes on the assembly. **Do not subject the rotor to high RPM.** The rotor should rattle when the cartridge assembly is shaken.
6. If the rotor does not spin freely, disassemble and clean the cartridge assembly as described in Steps 7 – 12. Refer to Figure A-1.
7. Remove the lower cartridge from the upper cartridge with a twisting and pulling motion.
8. Inspect the rotor to ensure that the magnet on each of the seven rotor vanes is in place and secure. If any are loose or missing, replace the rotor.

Flow Meter Maintenance, continued

9. Inspect the rotor shaft and bushings for wear, and replace, if needed.

10. Clean all the assembly parts thoroughly and ensure that no contaminating substances are between closely fitting parts. Ensure that the mating surfaces between the upper and lower cartridges are free of debris.

11. Reassemble the cartridge assembly by first placing the rotor in the upper cartridge and then placing the lower cartridge over the rotor.

12. Check the rotor end play. An adjustment screw is provided at the base of the cartridge assembly (lower cartridge). The screw must be adjusted whenever a new rotor or cartridge has been installed, and rotor play should be checked periodically and the screw adjusted for rotor wear. If needed, adjust the rotor bearing as described in Steps 13–14.

The mating surfaces between the upper and lower cartridge must be free of debris and securely mated before attempting to adjust rotor end play.

13. Turn the rotor adjustment screw clockwise until there is no more end play in the rotor, then loosen the screw 3/4 of a turn.

14. Check that the rotor rattles just slightly when the cartridge assembly is shaken.

The bearings and rotor shaft can be damaged if the adjustment screw is over tightened.

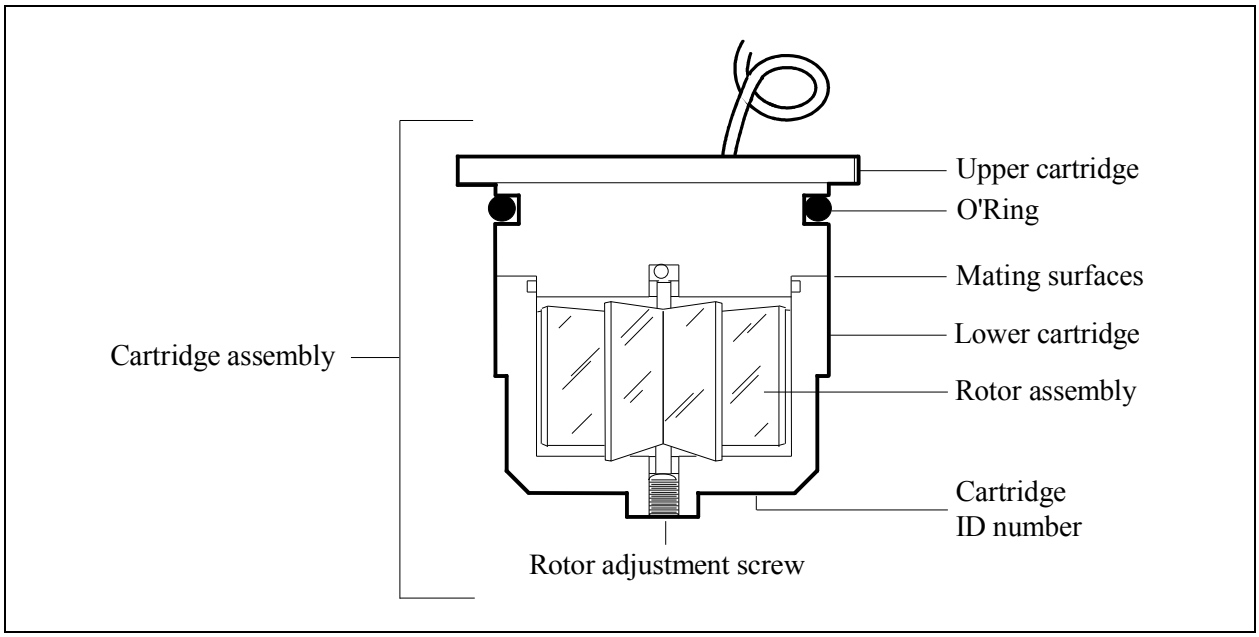
15. Before reassembling the flow meter, inspect the O'Ring on the upper cartridge and replace it if it is damaged.

16. Lubricate the O'Ring on the upper cartridge.

17. Clean the flow meter, paying particular attention to the O'Ring seal area and the cartridge seat area. Contamination here can cause the system to leak.

18. Reassemble the cartridge assembly and the flow meter.

Figure 5-1 Cartridge assembly



Cable and Connector Maintenance

Follow these guidelines for cable and connector maintenance.

- Check cables and connectors periodically for signs of wear. Replace cables that have worn through the foil shield.
- Attempt to identify and correct the causes of cable wear including bending, shearing, and sawing.
- Cover and protect the connectors when not in use to prevent corrosion and mechanical damage to the pins.

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Section 6
Trouble Shooting

Trouble Shooting

PROBABLE CAUSE	DIFFICULTY	CORRECTIVE ACTION
A blown fuse, faulty circuit breaker, corroded or faulty connections.	The display is blank, the unit appears dead.	Replace the fuse or circuit breaker, check connections for corrosion. Attach the unit to a charged 12 or 24V battery, if no response refer to *Returning a System to the Factory* in the *Appendix*.
A momentary burst or absence of electrical power, loose or corroded wires.	The display shows numbers, but they do not change with flow or key closure.	Shut off the Cockpit Indicator power switch for 10 seconds. The long term solution is to ensure that the wires are tight and free of corrosion and install an electrical filter if the problem persists.
The work switch is defective or not wired correctly. The work switch wire is grounded. The cable connecting the Cockpit Indicator to the flow meter is damaged. The flow meter connector is corroded or damaged. The flow meter rotor adjusting screw is too tight.	The display does not count when flow is passing through the flow meter.	If a work switch is installed disconnect its wire and isolate it from airframe ground and retest. Check all cables for signs of damage and replace as necessary. Check all connections for corrosion and replace if necessary. If this action does not correct the problem, it is necessary to isolate the cause to the flow meter or the Cockpit Indicator. This can be done by replacing either unit with a known operational unit. If this is not possible, refer to *Returning a System to the Factory* in the *Appendix*.

Trouble Shooting, continued

PROBABLE CAUSE	DIFFICULTY	CORRECTIVE ACTION
The system is not properly calibrated. The wrong type of cartridge is being used, wires are not separated from other electrical wires, system picks up power from the same point that other electrical devices do, system is not grounded correctly.	The flow displays are significantly higher or lower than they should be.	Refer to the *Calibration Procedures* section to adjust the calibration code. Ensure that the correct cartridge is being used. Physically separate all CROPHAWK wires as far as possible from other aircraft electrical wires. Ensure that the CROPHAWK does not pick up its power from the same point that other electronic devices do. Ensure that the system is grounded only at the battery.
The system is not properly calibrated. The quantity in the tank is entered into the Cockpit Indicator incorrectly. The aircraft is equipped with a good suck back valve and leaky nozzles. This will allow some of the already counted chemical to be drawn from the boom back into the chemical tank. When the boom valve is again opened for the next pass some of this same chemical will be counted a second time. If the system is correctly calibrated the problem may not be significant on fields requiring few turns. The problem will be significant with fields requiring many turns.	The quantity remaining in the tank display runs out before the chemical tank.	Make sure the proper calibration code is entered and the correct quantity was in the tank. Reduce the suction on the suck back valve. Fix leaky nozzles.

Trouble Shooting, continued

PROBABLE CAUSE	DIFFICULTY	CORRECTIVE ACTION
The system is not properly calibrated, quantity in the tank is entered into the Cockpit Indicator incorrectly, a sticking work switch. With a sticking work switch the system would begin to spray before the switch would allow the Cockpit Indicator to begin counting. Thus the chemical would run out before the Cockpit Indicator.	The chemical tank runs out before the quantity remaining in the tank display.	Make sure the proper calibration code is entered and the correct quantity was in the tank. Check the work switch and make sure it is not sticking, replace if necessary.

Electrical Noise - An Explanation

Electrical noise is the enemy of micro-electronics. It can cause faulty readings, information to drop from memory, and shorten the life of the unit.

Electrical noise is generated by many aircraft components such as: relays, solenoids, motors, defective alternators, worn starters, and some of the biggest culprits: loose wires and corrosion. Any device that produces a spark will generate electrical noise. The electrical noise is radiated through the wires and through the air. It is picked up by the frame and the electrical wires and they act as an antenna and conduct the noise into micro-electronic devices. Electronic components and micro-electronics have elaborate filters to remove much of the noise before it reaches the circuits. However, no filter can remove noise generated by worn or defective systems.

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Appendix

This appendix contains the following information for the CROPHAWK 7/B Flow Monitoring System.

- Specifications
- Ordering information
- Limited warranty
- Return instructions

Specifications

The tables in this section give the specifications for the CROPHAWK 7/B System and components.

Physical Specifications

Table A-1 shows the physical specifications for CROPHAWK 7/B system components.

Table A-1 Physical specifications

Component	Height	Width	Depth	Weight
CROPHAWK 7/B Cockpit Indicator	3.25 in 8.26 cm	3.25 in 8.26 cm	1.28 in 3.25 cm	12 ounces 340 g
Flow Meters	See Figure 1-4, flow meter specifications, and Table A-3, CROPHAWK flow meter and system ordering information.			

Electrical Specifications

Table A-2 shows the electrical specifications for the CROPHAWK 7/B Cockpit Indicator.

Table A-2 Cockpit Indicator electrical specifications

Characteristic	Specification
Operating voltage	12 – 31 VDC
Current consumption	40 mA
Storage temperature	-40° to 158°F (-40° to 70°C)
Operating temperature	-5° to 158°F (-20° to 70°C)

Serial Input/Output Specifications

If the Crophawk is to compute GPA (LPH) and acres (hectares) using the GPS supplied speed and swath data follow the specifications listed below.

Data Input

Data Item	ASCII identification character	Data
Ground Speed in MPH x 10	S	4 digits followed by a <CR>
Swath in feet x 10	W	4 digits followed by a <CR>

Speed and swath need to be updated at least once after power-up. The last values received are used until new values are received. Ideally they should be updated at least once per pass. They can both be updated up to a combined total of 8 times per second (4 speed and 4 swath, 5 speed and 3 swath, etc.).

Data Output

Data Item	ASCII identification character	Data
Gallons sprayed this pass x 10	G	4 digits followed by a <CR>
Acres covered this pass x 10	A	4 digits followed by a <CR>

The data is sent once at the end of each pass

Data Query

Data Query	Data Return
The ASCII character Q followed by a <CR>	The ASCII charcter G followed by 4 digits and a <CR>. (Gallons sprayed this pass x 10)

The data returned from the query is the gallons applied so far in the current pass. The data is not the job total. Subsequent queries will return the new total for the pass not the quantity since the last query. If the query feature will be used to accumulate gallons the capture routine will need to discern the end of a pass as the gallons sprayed in a pass resets to zero when a new pass is started. To eliminate the possibility of losing data the query should be at 1 - 2 second intervals.

Data I/O: 9600 baud, no parity & 1 stop bit

The serial port sends and receives data in English units only.

<CR> is a carriage return without a line feed.

Ordering Information

Order CROPHAWK 7/B Systems using the "System part number" shown in Table A-3. Each system includes one Cockpit Indicator, the flow meter indicated, the owner's manual and the Internal Harness. For dual flow meter installations, also use the "Flow meter part number" to order a second flow meter, and order the flow meter adaptor cable listed in Table A-4. Order other components, accessories, and supplies by quantity and the part number shown in Table A-4. All items can be ordered separately.

Table A-3 System and flow meter ordering information

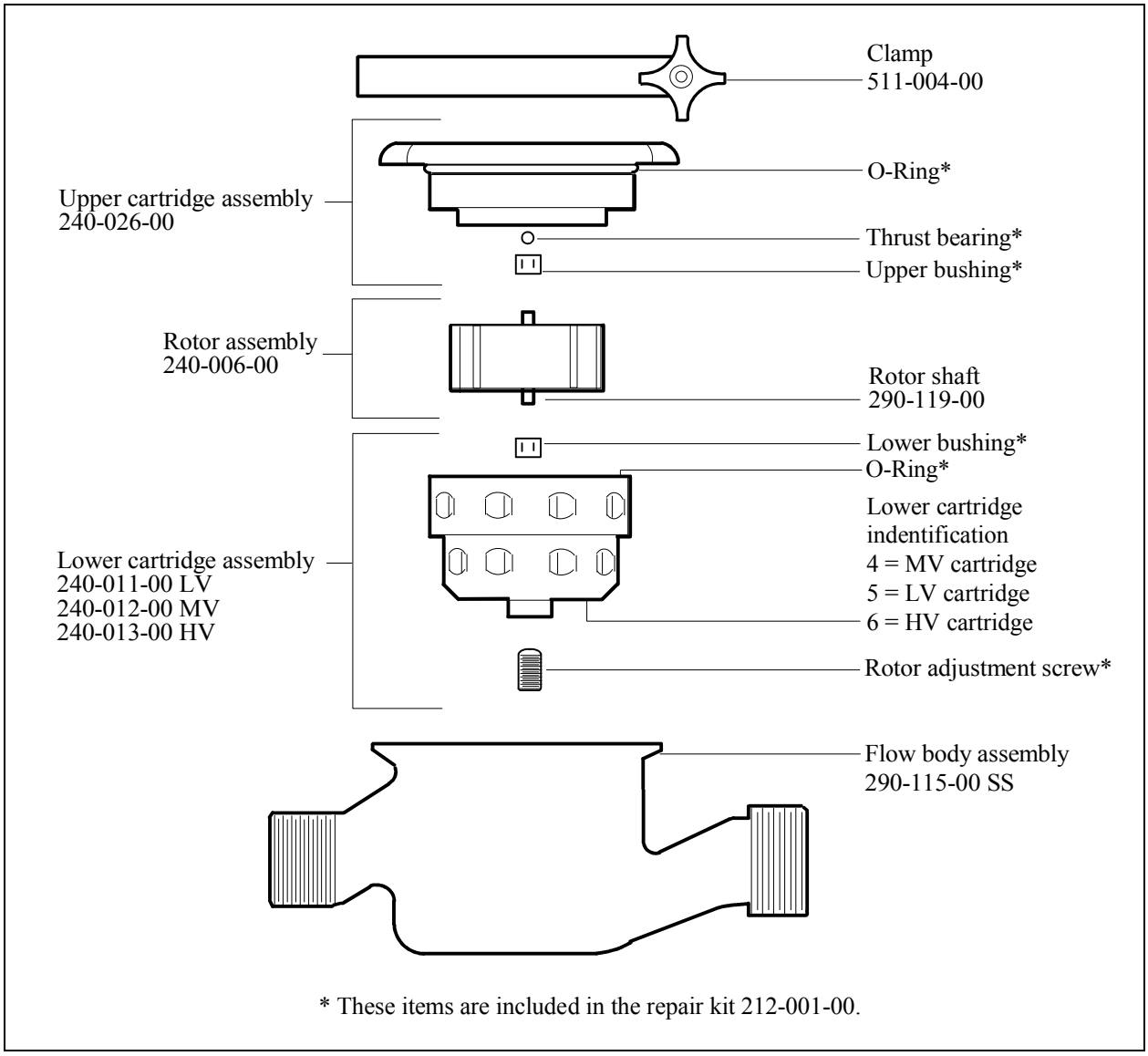
Flow Meter Specifications						Flow meter part number	System part number
			Cartridge Volume				
Size	Material	Connection	Range	English (GPM)	Metric (LPM)		
1-1/4"	Aluminum 356 alloy black anodized	1-1/4" male NPT thread	Low	0.5-11	2-42	210-146-00	200-180-00
			Med	1.5-50	5.5-190	210-147-00	200-181-00
1-1/4"	Aluminum 356 alloy nickel plated	1-1/4" male NPT thread	Low	0.5-11	2-42	210-149-00	200-182-00
			Med	1.5-50	5.5-190	210-150-00	200-183-00
1-1/4"	Stainless Steel 303 alloy	1-1/4" male NPT thread	Low	0.5-11	2-42	210-125-00	200-160-00
			Med	1.5-50	5.5-190	210-126-00	200-161-00
2"	Aluminum 356 alloy black anodized	2" hose barb	Low	1.5-30	5.5-115	210-128-00	200-162-00
			Med	6-130	22.5-490	210-129-00	200-163-00
			High	15-180	38-680	210-130-00	200-164-00
2"	Aluminum 356 alloy nickel plated	2" hose barb	Low	1.5-30	5.5-115	210-131-00	200-165-00
			Med	6-130	22.5-490	210-132-00	200-166-00
			High	15-180	38-680	210-133-00	200-167-00
2"	Stainless Steel 303 alloy	2" hose barb	Low	1.5-30	5.5-115	210-134-00	200-168-00
			Med	6-130	22.5-490	210-135-00	200-169-00
			High	15-180	38-680	210-136-00	200-170-00
3"	Aluminum 356 alloy black anodized	3” hose barb	High	15-280	57-1060	210-160-00	200-185-00
3"	Aluminum 356 alloy nickel plated	3” hose barb	High	15-280	57-1060	210-161-00	200-186-00
3"	Aluminum 356 alloy black anodized	3” flanged	High	15-280	57-1060	210-165-00	200-194-00
3"	Aluminum 356 alloy nickel plated	3” flanged	High	15-280	57-1060	210-166-00	200-197-00

Table A-4 Component ordering information

Description		Part number
Hardware components	CROPHAWK 7/B Cockpit Indicator	210-124-00
Accessories	CROPHAWK 7/B system owner's manual	120-045-00
	Work switch, pressure	400-011-00
	Work switch, lever	400-012-00
	Scroll switch	400-049-00
	Power switch	400-048-00
	Cockpit Indicator mounting bracket kit	232-023-00
	Wiring Modification Kit	212-007-00
	Placard, Metric	215-078-00
	Placard, English	215-079-00
Cables	CROPHAWK 7/B Internal Harness	270-063-00
	CROPHAWK 7/B serial cable	270-064-00
	CROPHAWK 7/B flow meter # 2 cable	270-065-00
	CROPHAWK 7/B work switch cable	270-067-00

1-1/4-inch Flow Meter Assembly

Figure A-1 1-1/4-inch flow meter assembly

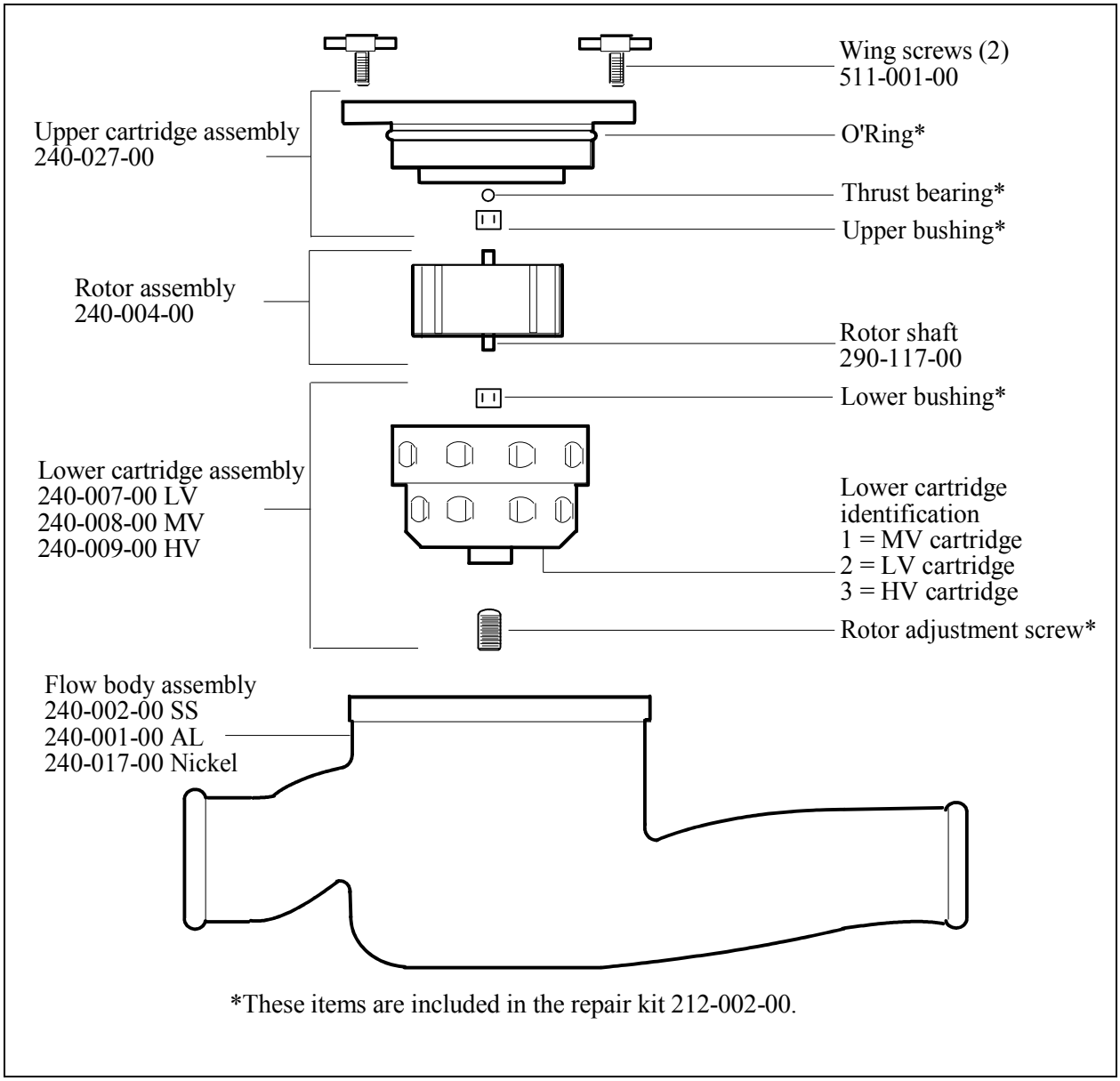


* These items are included in the repair kit 212-001-00.

See Table A-3 for flow meter assembly part numbers.

2-inch Flow Meter Assembly

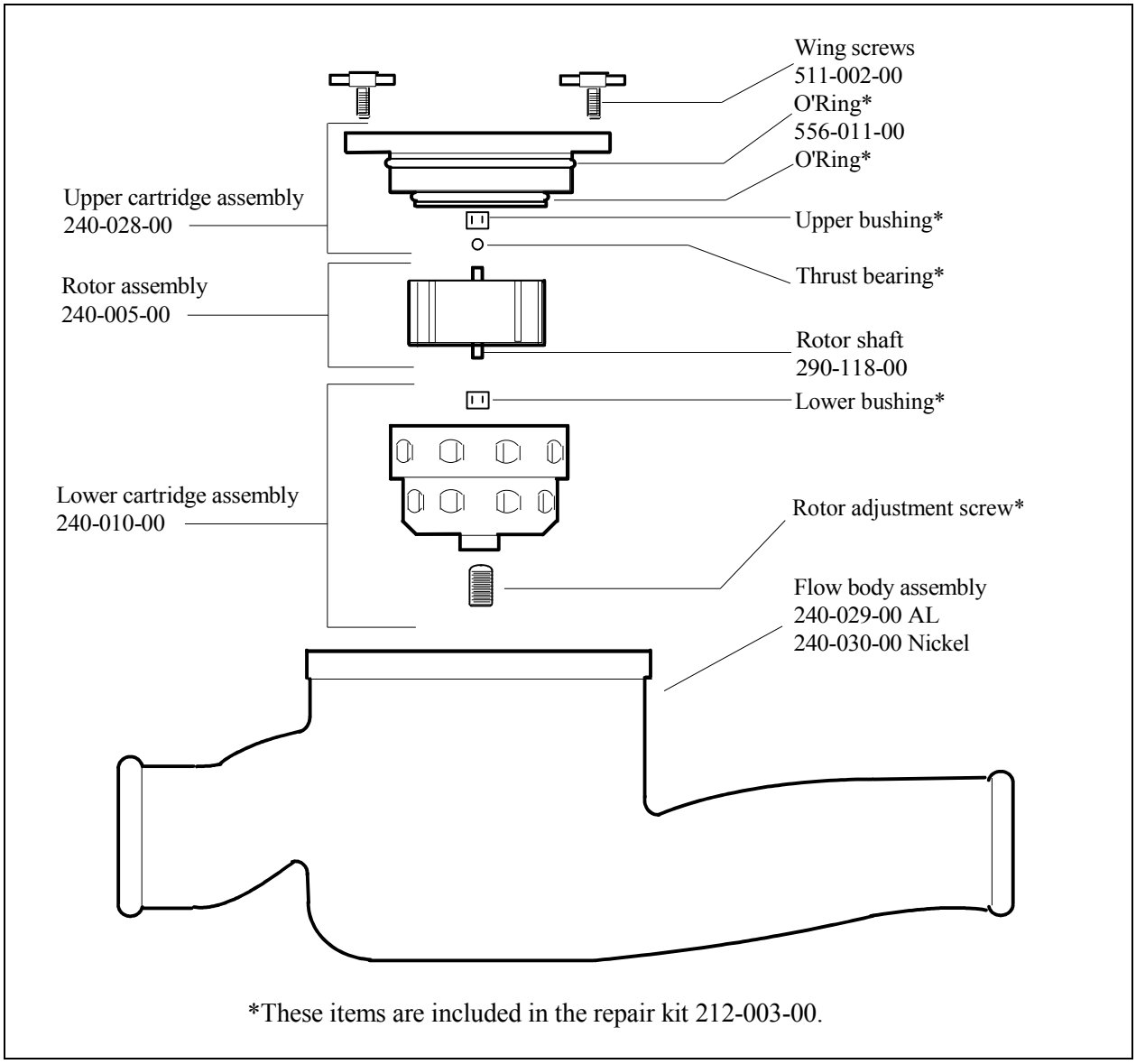
Figure A-2 2-inch flow meter assembly



See Table A-3 for flow meter assembly part numbers.

3-inch Flow Meter Assembly

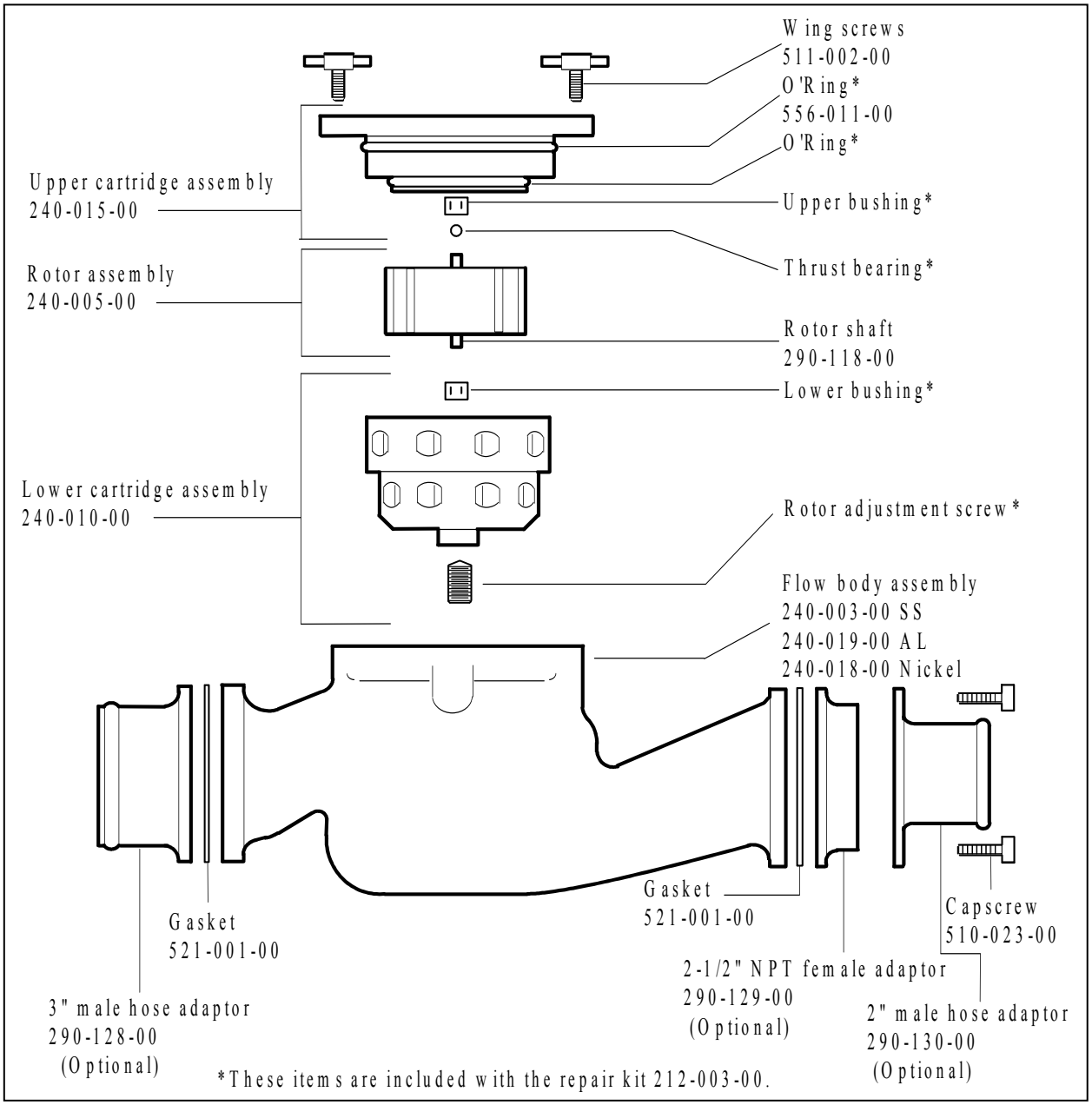
Figure A-3 3-inch flow meter assembly



See Table A-3 for flow meter assembly part numbers.

3-inch Flanged Flow Meter Assembly

Figure A-4 3-inch flanged flow meter assembly



Limited Warranty

Onboard Systems CROPHAWK 7/B components are warranted to be free from defects in workmanship and materials for a period of one year from the date of purchase. The components are warranted to function as intended when properly installed and used for their intended purpose. Parts which prove to be defective are repaired or replaced free of charge FOB factory at the manufacturer's option if the following conditions have been met.

- No repairs have been attempted by anyone other than Onboard Systems personnel.
- The system or component is returned properly packaged, insured, with transportation charges prepaid.
- After examination, Onboard Systems personnel are satisfied that the defects were not caused by abuse, and that the components were not subjected to conditions that violate system specifications.

This warranty covers only the original purchaser. In no event shall Onboard Systems be liable for indirect, special, incidental or consequential damage resulting from the use of this product, even if Onboard Systems has been advised of the possibility of such damage. Each user must satisfy himself that the system is suited to his needs and is performing according to his requirements.

Instructions for Returning Equipment to the Factory

If an Onboard Systems product must be returned to the factory for any reason (including returns, service, repairs, overhaul, etc) obtain an RMA number before shipping your return.

An RMA number is required for all equipment returns.

- To obtain an RMA, please use one of the listed methods.
    - Contact Technical Support by phone or e-mail (Techhelp@OnboardSystems.com).
    - Generate an RMA number at our website: http://www.onboardsystems.com/rma.php
- After you have obtained the RMA number, please be sure to:
    - Package the component carefully to ensure safe transit.
    - Write the RMA number on the outside of the box or on the mailing label.
    - Include the RMA number and reason for the return on your purchase or work order.
    - Include your name, address, phone and fax number and email (as applicable).
    - Return the components freight, cartage, insurance and customs prepaid to:

      Onboard Systems
      13915 NW 3rd Court
      Vancouver, Washington 98685
      USA
      Phone: 360-546-3072