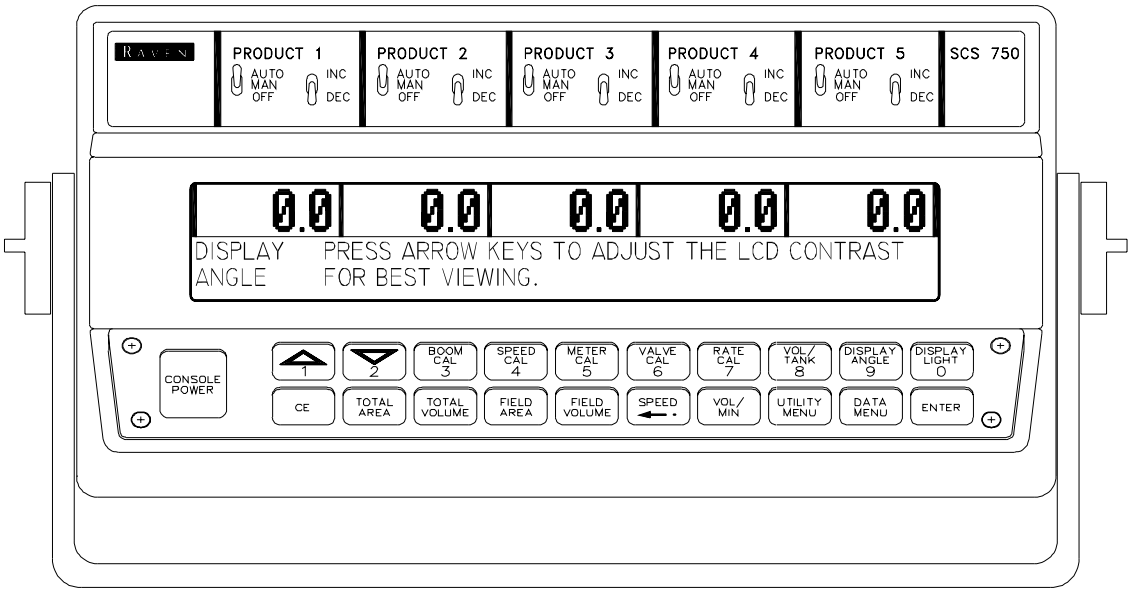
THE Right PRODUCTS PEOPLE CHOICE

RAVEN INDUSTRIES

FLOW CONTROLS DIVISION

SCS 750/760



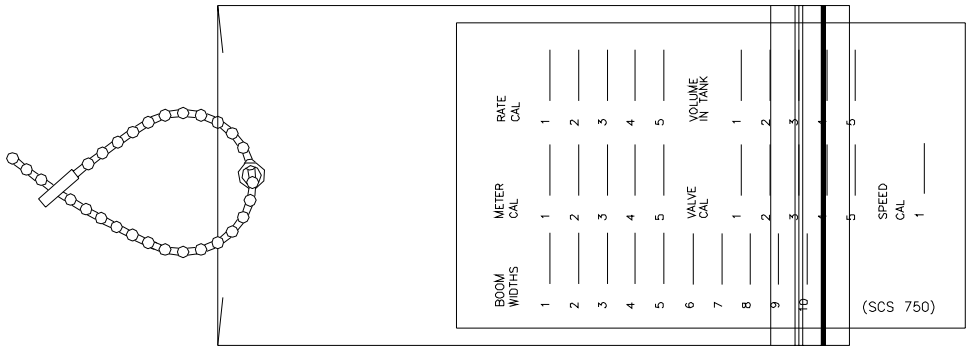
INSTALLATION AND SERVICE MANUAL

N O T I C E

The use of the suspension type fertilizers and lime slurries will significantly reduce the life of the plastic parts in the Flow Meter and motorized Control Valve. Check the rotor and inlet hub assembly in the Flow Meter frequently for worn parts. Excessive wear can affect accuracy.

Do not attempt to modify or lengthen any of the three-wire Speed Sensor or Flow Meter cables. Extension cables are available from Raven Dealers.

THIS CARD IS PROVIDED FOR OPERATOR'S CONVENIENCE. PENCIL IN THE CALIBRATION NUMBERS FOR FUTURE REFERENCE. CUT ON DOTTED LINE, FOLD, AND INSERT INTO PLASTIC ENVELOPE.



INSERT AND ZIP SHUT

FOLD LINE

CUT ON DOTTED LINE

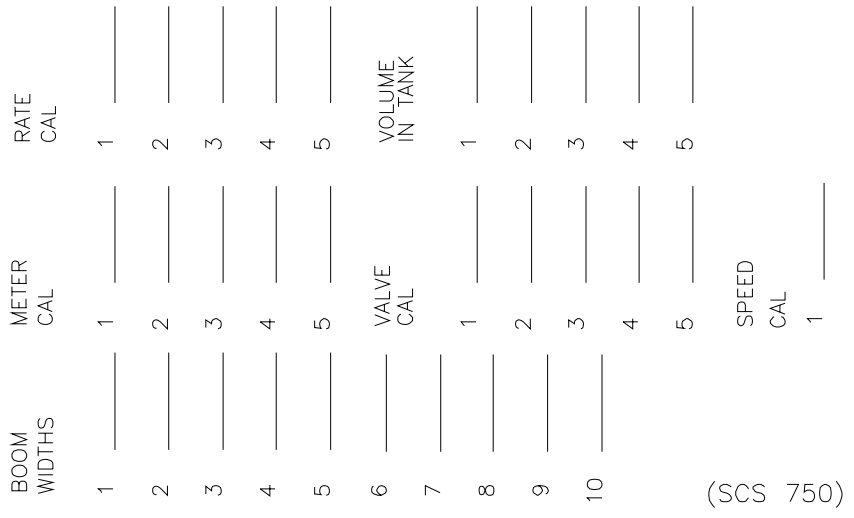
WARNING: DISCONNECT CONSOLE BEFORE JUMP STARTING, CHARGING BATTERY, OR WELDING ON EQUIPMENT.

DATA ENTRY EXAMPLE: TO ENTER VALVE CAL.

1. PRESS VALVE CAL KEY.
2. PRESS ENTER KEY.
3. PRESS KEYS REQUIRED, TO ENTER PROPER NUMBER.

(EXAMPLE: KEYS 2 1 2 BOOM CAL 3 FOR 2123)

4. PRESS ENTER KEY AGAIN.



016-0159-472
09/02

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APPENDIXES

SYMBOL DEFINITION

GPM	- Gallons per minute	cm	- Centimeters
lit/min	- Liters per minute	dm	- Decimeters
dl/min	- Deciliter per minute	m	- Meter
PSI	- Pounds per square inch	MPH	- Miles per hour
kPa	- Kilopascal	km	- Kilometers
GPA	- Gallon per acre	km/h	- Kilometers per hour
lit/ha	- Liter per hectare	US	- Volume per acre
ml/ha	- Milliliter per hectare	SI	- Volume per hectare
GPK	- Gallons per 1,000 sq. ft.	TU	- Volume per 1,000 sq. ft.
mm	- Millimeters	[]	- Metric numbers
		{}	- 1,000 sq. ft. numbers

METER CAL CONVERSIONS
To convert the METER CAL number simply divide the original number (number printed on Flow Meter label) by the desired conversion factor.

FOR EXAMPLE:

Original METER CAL No. = METER CAL No. for displays in Fluid Ounces
128

Original METER CAL No. = METER CAL No. for displays in Liters
3.785

Original METER CAL No. = METER CAL No. for displays in Pounds
Weight of one gallon

LIQUID CONVERSIONS
U.S. Gallons x 128 = Fluid Ounces
U.S. Gallons x 3.785 = Liters
U.S. Gallons x 0.83267 = Imperial Gallons
U.S. Gallons x 8.34 = Pounds (Water)

LENGTH
1 millimeter (mm) = 0.039 inch
1 centimeter (cm) = 0.394 inch
1 meter (m) = 3.281 feet
1 kilometer (km) = 0.621 mile
1 inch = 25.4 millimeters; 2.54 centimeters
1 mile = 1.609 kilometers

PRESSURE
1 psi = 6.89 kPa

AREA
1 square meter = 10.764 square feet
1 hectare (ha) = 2.471 acres; 10,000 square meters
1 acre = 0.405 hectare; 43,560 square feet
1 square mile = 640 acres; 258.9 hectares

INTRODUCTION

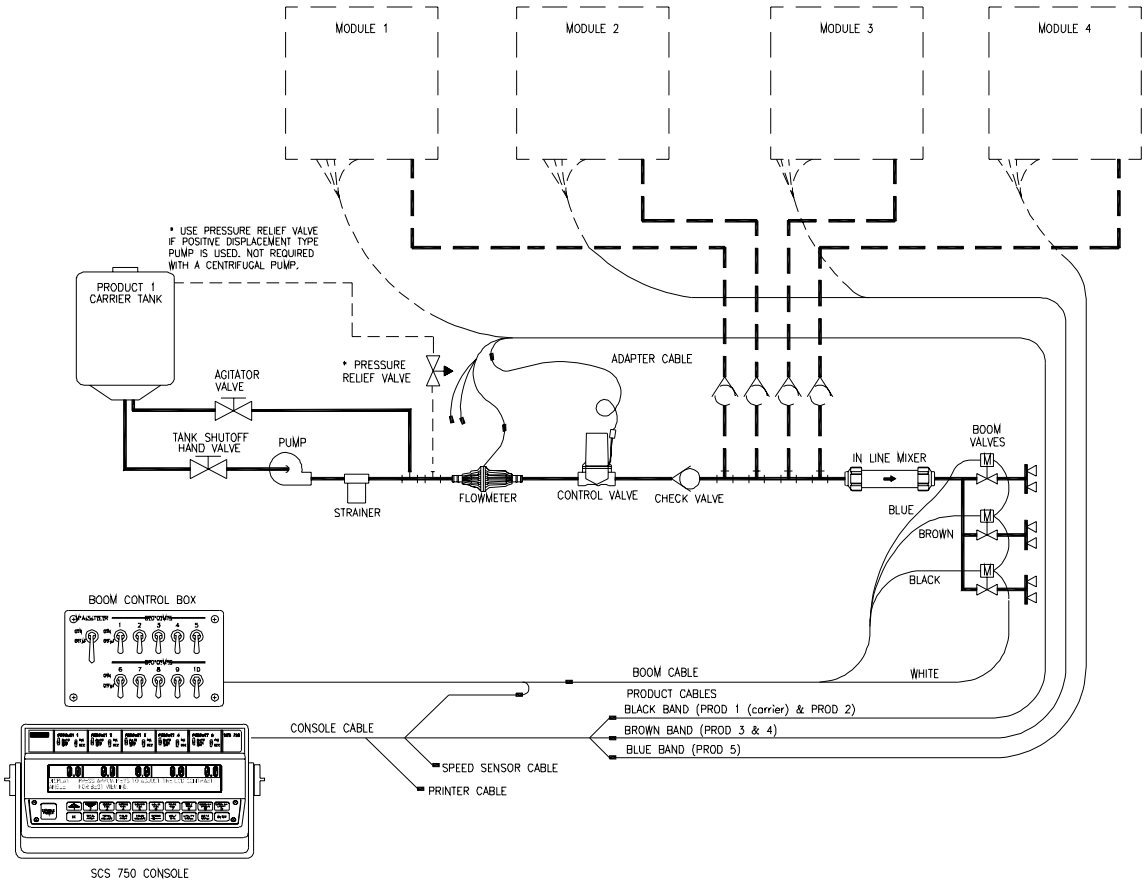
The Raven SCS 750 (CHEMICAL INJECTION SPRAY SYSTEM) is designed to improve the accuracy and uniformity of spray applications. Its performance relies on the installation and preventive maintenance of the complete sprayer. It is important that this Installation and Service Manual be reviewed thoroughly before operating the system. This Manual provides a simple step-by-step procedure for installing and operating.

The SCS 750 system consists of a computer based Control Console, Speed Sensor, Control Valve, Flow Meter, one to five Injection Modules (each includes a Motor Control and Metering Pump with sensors), In-line Mixer, and cables. The Console mounts directly in the cab of the vehicle for easy operator use. The Radar Speed Sensor is mounted to the frame of the vehicle or implement (Wheel Drive Speed Sensor and Speedometer Drive Speed Sensor are also available). The Injection Module mounts to the framework of the sprayer. The In-line Mixer mounts just before the Boom On/Off Valves. Appropriate cabling is furnished for field installation.

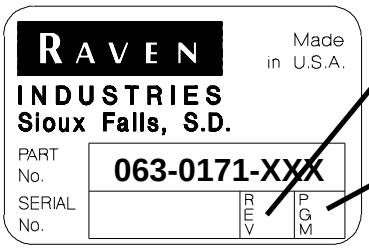
The operator sets the target application rate for each chemical to be sprayed and the SCS 750 automatically maintains the flow regardless of vehicle speed or gear selection. A manual override switch allows the operator to manually control flow for each chemical for spot spraying. Actual volume per area being applied is displayed at all times for all chemicals. The SCS 750 additionally functions as an area monitor, speed monitor, and volume totalizer.

TYPICAL SYSTEM (WITH CARRIER) DIAGRAM:

The diagram shown below is a typical SCS 750 system. It is suggested that the SCS 750 console be installed to use Product 1 as the carrier, and all other remaining Products for injection or auxiliary. Although this is not required, it is the recommended system.



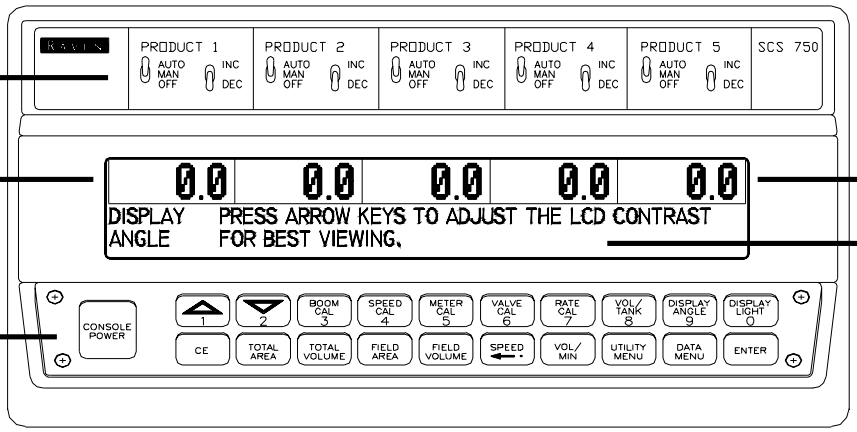
CONSOLE FEATURES



Console Revision can be determined by the letter stamped in REV box on label.

Console Program can be determined by the letter stamped in PGM box on label.

PRODUCT 1 thorough PRODUCT 5 - Selects OFF, manual, or fully automatic control with manual override.



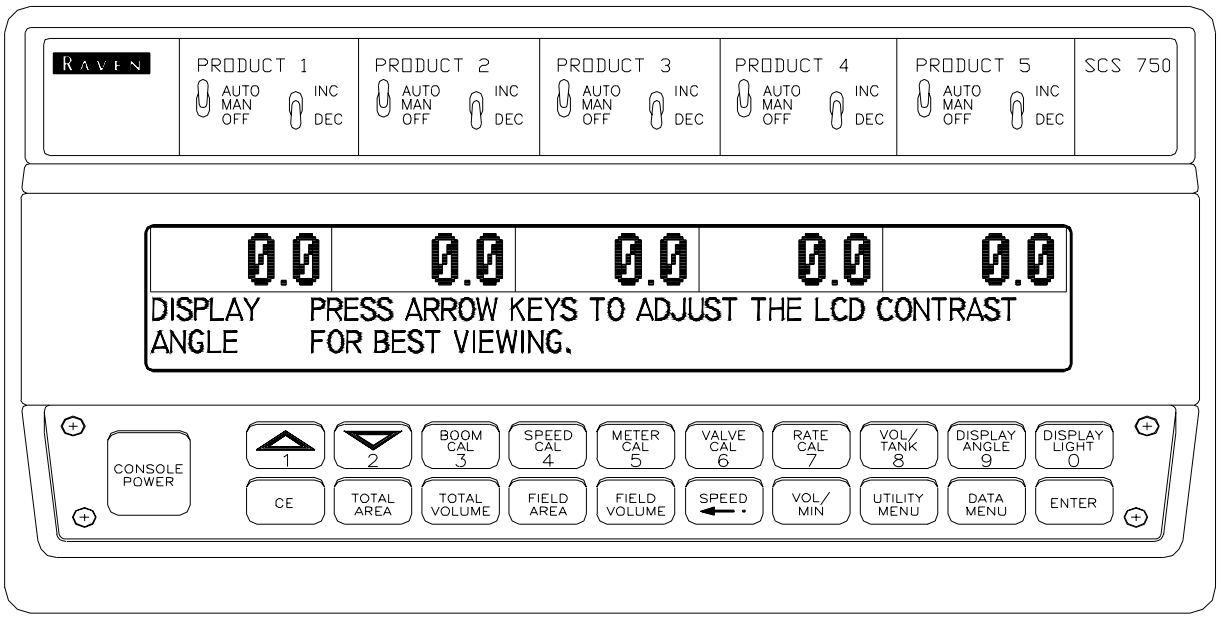
CONSOLE POWER - Power ON/OFF switch.

Displays function and calibration data.

Actual display rate of application.

Cursor moves when arrow key is depressed. Indicates where data will be entered.

DEFINITION OF KEYS



ARROW UP KEY USED TO MOVE CURSOR LOCATION ON DATA DISPLAY

ARROW DOWN KEY USED TO MOVE CURSOR LOCATION ON DATA DISPLAY

BOOM CAL KEY USED WHEN BOOM WIDTHS NEED TO BE ENTERED

SPEED CAL USED TO ENTER THE SPEED SENSOR CALIBRATION NUMBERS

METER CAL USED TO ENTER METER CALIBRATION CONSTANTS

VALVE CAL USED TO CONTROL SYSTEM RESPONSE TIME

RATE CAL USED TO ENTER TARGET APPLICATION RATE

VOL/TANK SHOW REMAINING CHEMICAL IN TANK AND TO ENTER VOLUME IN TANK

DISPLAY ANGLE USED TO ADJUST CONTRAST OF DISPLAY FOR BETTER VIEWING

DISPLAY LIGHT USED TO TURN DISPLAY LIGHT ON FOR NIGHT VIEWING

CE (CLEAR ENTER) USED LIKE CE KEY ON CALCULATOR

TOTAL AREA USED TO DISPLAY TOTAL AREA OF APPLICATION

TOTAL VOLUME USED TO DISPLAY TOTAL AMOUNT OF PRODUCT APPLIED

FIELD AREA USED TO DISPLAY FIELD AREA SPRAYED

FIELD VOLUME USED TO DISPLAY FIELD VOLUME OF PRODUCT APPLIED

SPEED TO DISPLAY VEHICLE SPEED AND DISTANCE. ALSO ALLOWS FOR ENTRY OF SELF TEST SPEED

VOL/MIN DISPLAYS VOLUME PER MINUTE OF EACH PRODUCT

UTILITY MENU
SHOWS TIME, DATE, SELECTED UNITS OF MEASUREMENT, AND SPEED SENSOR TYPE

DATA MENU USED TO DISPLAY DATA NOT ACCESSIBLE FROM KEYBOARD

PRODUCT INSTALLATIONS

1. MOUNTING THE RAVEN RADAR SPEED SENSOR

See Appendix 1 for Wheel Drive Speed Sensor installation instructions.
See Appendix 2 for Speedometer Drive Speed Sensor installation instruction.

For mounting the radar, the following guidelines will assure proper installation: It is suggested that a large heavy mounting bracket, (P/N 107-0159-693) be attached to the vehicle frame for mounting the radar.

1) Park vehicle on level surface.

2) Select mounting site by considering the following:

a) The line of sight from the lens to the ground must not be obstructed by structures or tires. Obstructions must not come closer than 20 inches to the bottom of the radar. See Figures 1 and 2.

b) The radar lens must be parallel to the ground from front to back. Radar can be tilted out 0-15 degrees to provide more clearance and miss obstructions. See Figure 2.

c) The radar should be mounted so that the **length** of the radar is **parallel** with direction of vehicle travel.

3) Use carpenters level to verify that mounting bracket is parallel to the ground.

4) Bolt mounting bracket to implement.

5) Bolt radar to mounting bracket using mounting hardware. See Figure 3.

6) Connect radar with Radar Interface Cable (P/N 115-0159-539) to the Console. The Red wire should be connected to the Orange cable wire. The White wire should be connected to the negative terminal of the battery. See Figure 6.

CAUTION:	The connection of the radar power in reverse polarity could result in damage to the Radar.

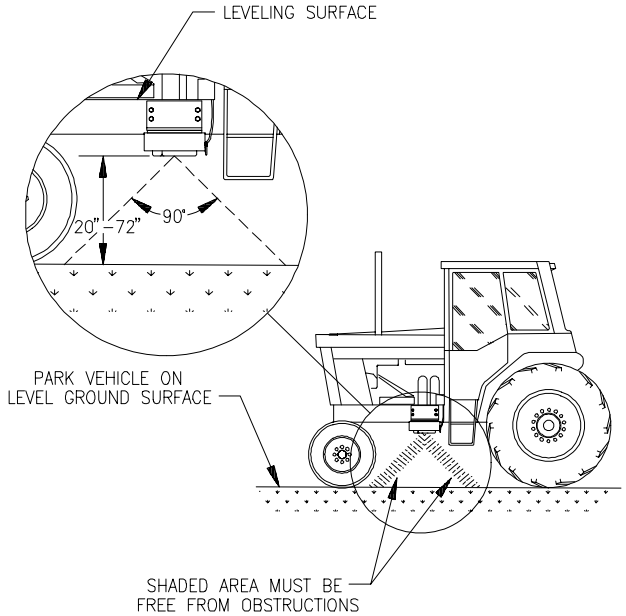


FIGURE 1

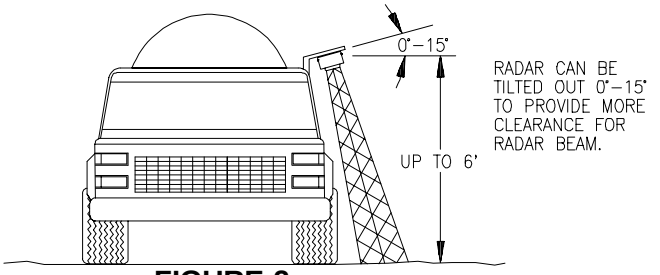


FIGURE 2

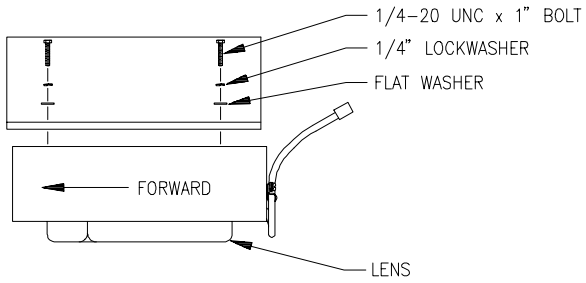


FIGURE 3

2. MOUNTING THE FLOW METER

1) Mount Flow Meter in the area of the boom valves per Figure 4. All flow through Flow Meter must go to booms only, i.e., no return line to tank or pump after Flow Meter.

2) Mount Flow Meter horizontal to the ground. Use the bracket to secure the Flow Meter.

3) For best results, allow a minimum of 7 1/2 inches [20 cm] of straight hose on inlet of Flow Meter. Bend radius of hose on outlet of Flow Meter should be gradual.

4) Flow must be in direction of arrow on Flow Meter.

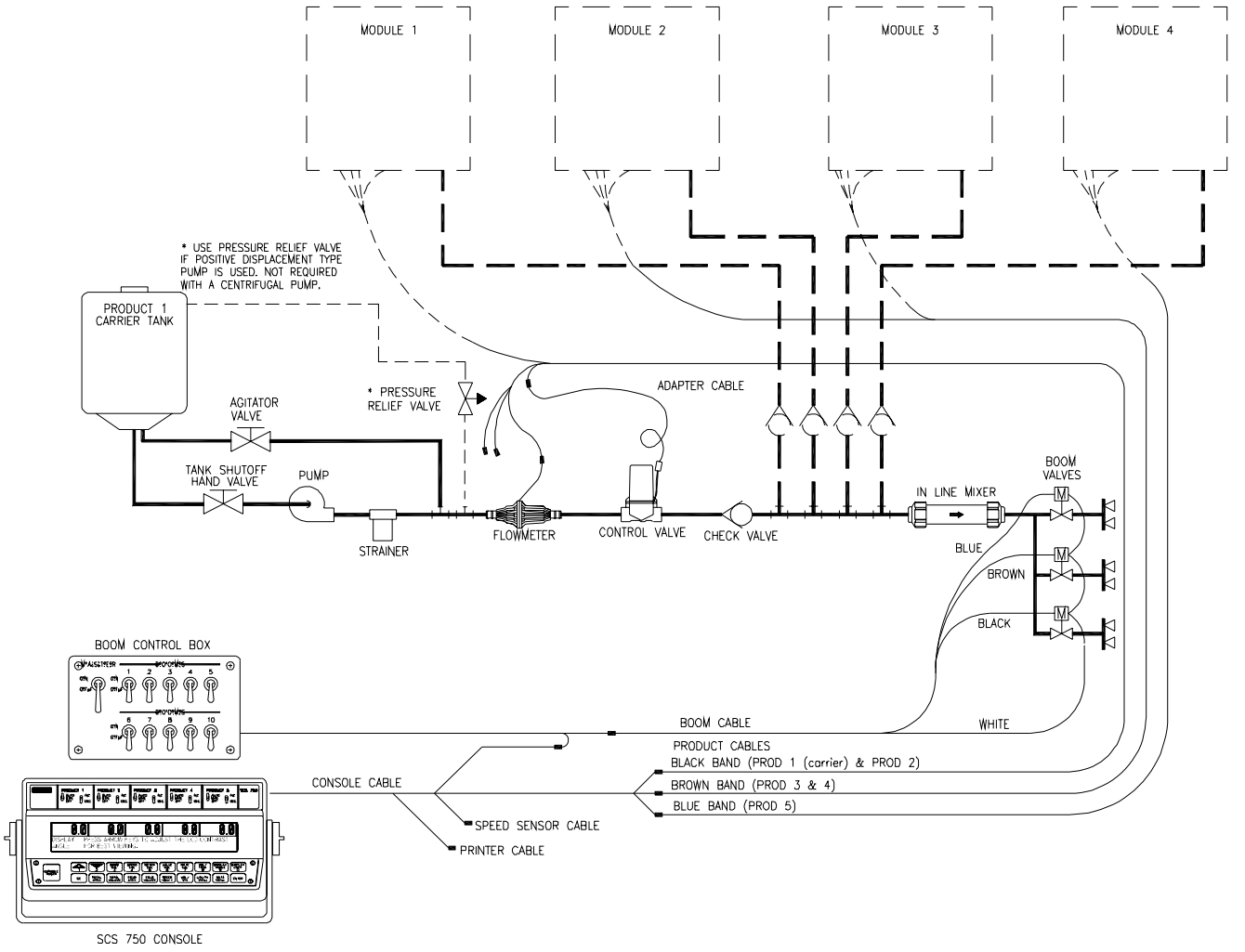


FIGURE 4

NOTE:	It is critical, when using suspensions, that the system be thoroughly rinsed out each day after use.

3. MOUNTING THE CONTROL VALVE

1) Mount the motorized Control Valve in the main hose line between the Flow Meter and the booms, with motor in the upright position. (For flow less than 3 GPM [11 lit/min] the motorized Control Valve is mounted in a bypass line).

2) Connect the Product Cable connector to the Flow Meter. Install Adapter Cable P/N 115-0159-456 on Control Valve and connect to Product Cable.

4. MOUNTING THE CONSOLE AND CABLING

l) Mount the Console to a secure support inside the cab of the vehicle.

2) Install Boom Cable to Boom Valves.

Boom 1	-Black	Boom 6	-Blue/White stripe
Boom 2	-Brown	Boom 7	-White/Black stripe
Boom 3	-Blue	Boom 8	-White/Brown stripe
Boom 4	-Black/White stripe	Boom 9	-White/Blue stripe
Boom 5	-Brown/White stripe	Boom 10	-Pink

3) Install 21 ft. Product Cable to the connectors on the Injection Modules (Product 1 -White; Product 2 -Black). Secure with plastic cable ties. (See Figures 4 & 5).

4) Connect the Console Control Cable to the plug in the back of the Console. (See Figure 5). Route Console Control Cable in vehicle cab and connect with Product Cable and Boom Cable on the sprayer. (Extension cables are available from a Raven Dealer). Secure with plastic cable ties.

5) Route the Red and White battery wires **directly** to a 12-volt battery. Attach the White wire directly to the **NEGATIVE** (-) terminal of the battery and the Red wire directly to the **POSITIVE** (+) terminal of the battery. See Figure 6. **(DO NOT CONNECT WIRES TO THE STARTER).** Secure the battery wires with plastic cable ties. **DO NOT** tie the battery wires close to the existing battery leads or other electrical wiring.

> **NOTE:** Power relay P/N 063-0159-929 must be installed. Reference Battery Connection, Figure 6A.

6) Connect the Speed Sensor Cable to Console Control Cable.

7) Installation of the system is now complete.

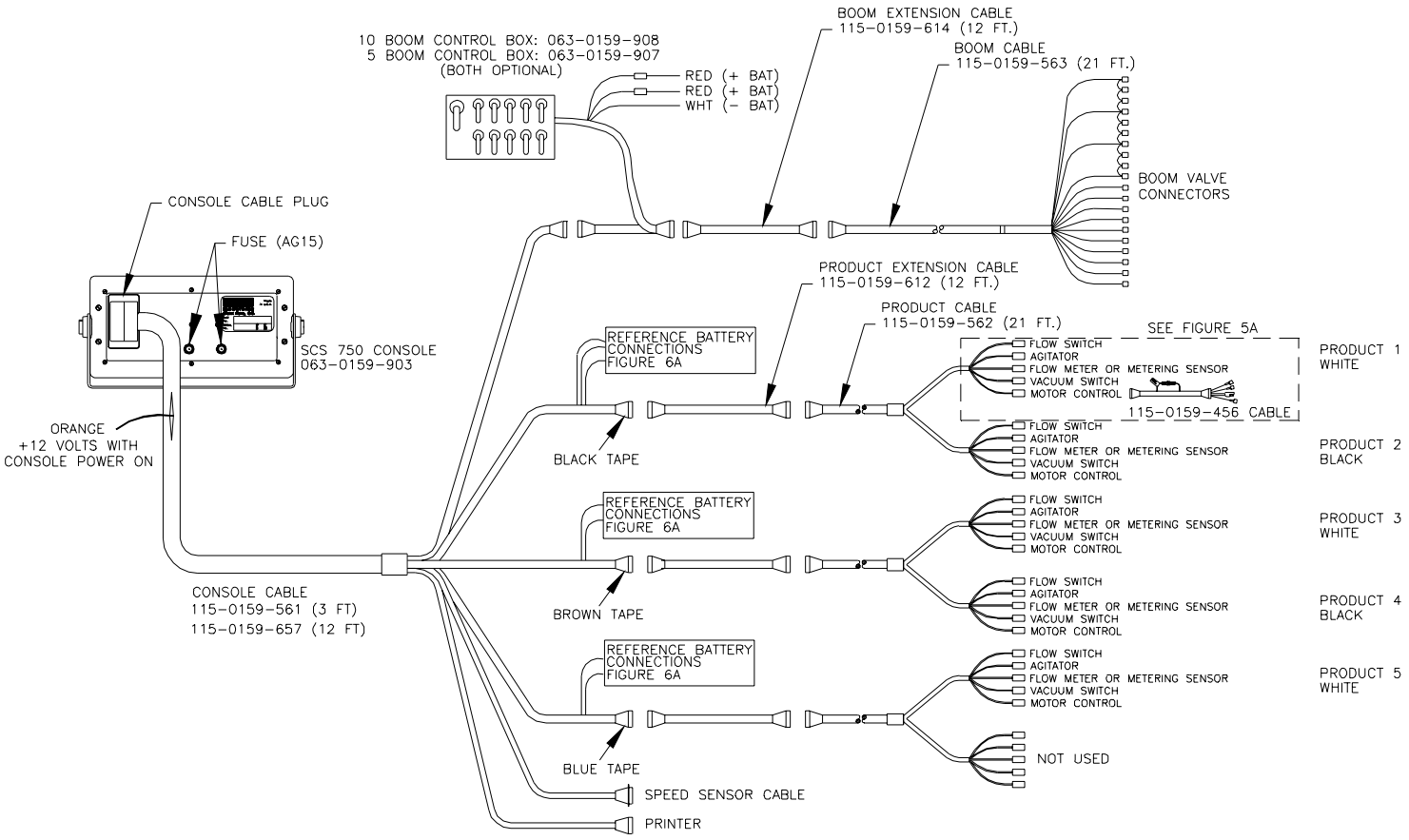


FIGURE 5

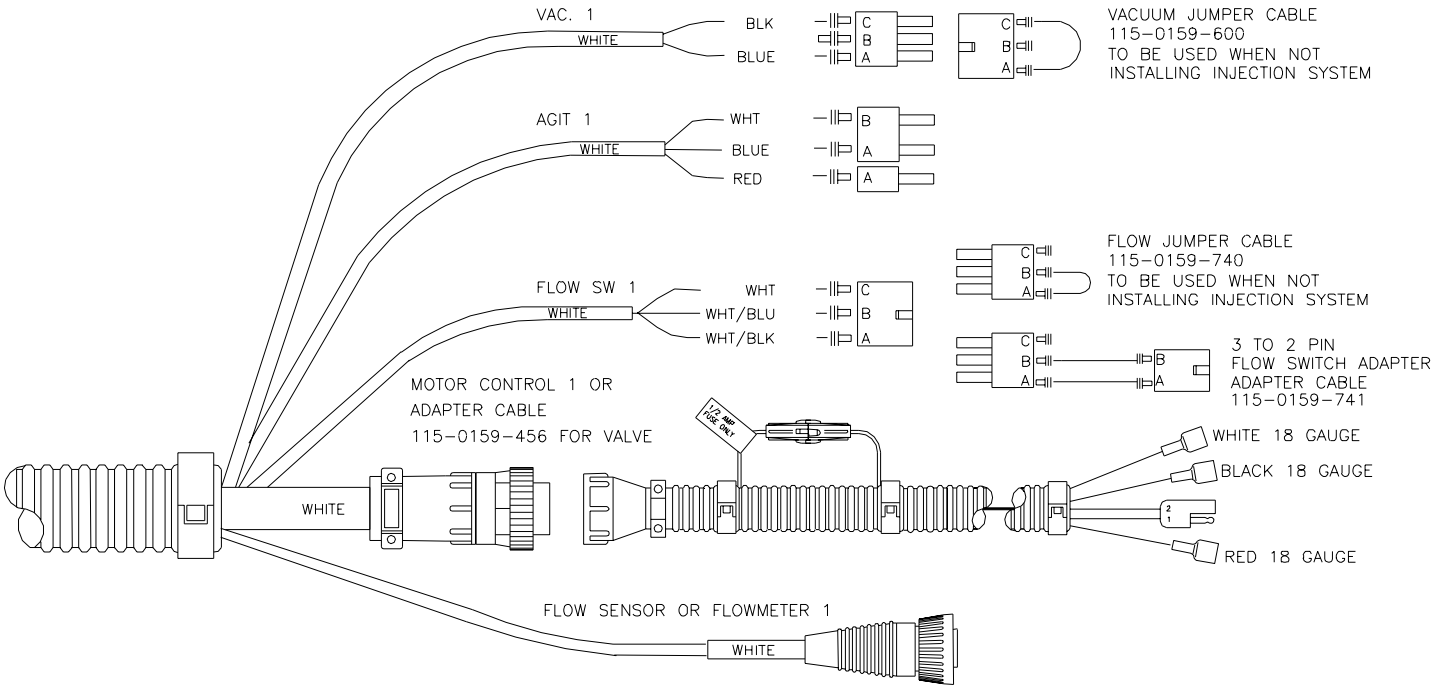


FIGURE 5A

BATTERY CONNECTIONS

BATTERY HOOK-UP FOR CONSOLE HARNESS

1) Connect the 10 gauge white wire to the negative post of the battery. Install fuseholder and 20 amp fuse on 16 gauge red wire. Connect to positive post of battery. See Figure 6A

2) **IMPORTANT:** A relay must be installed between the red 10 gauge wires and the battery. The relay is normally controlled from the accessory side of the ignition switch. See Figure 6A.

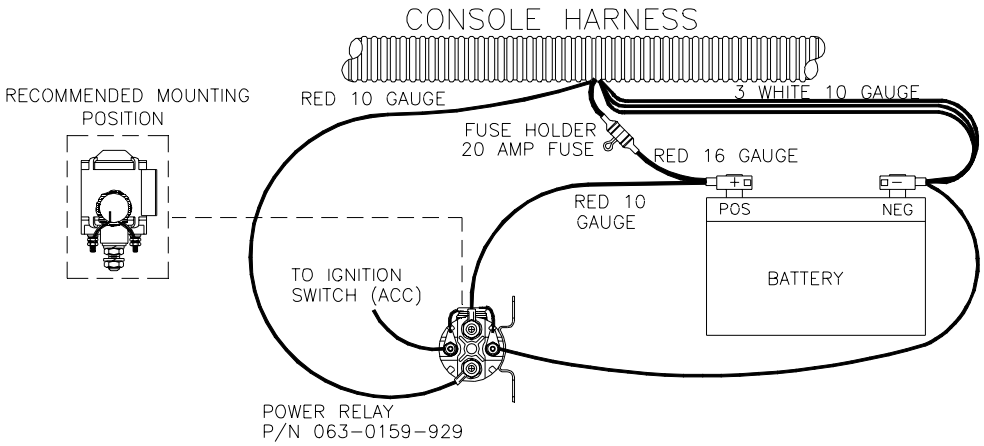
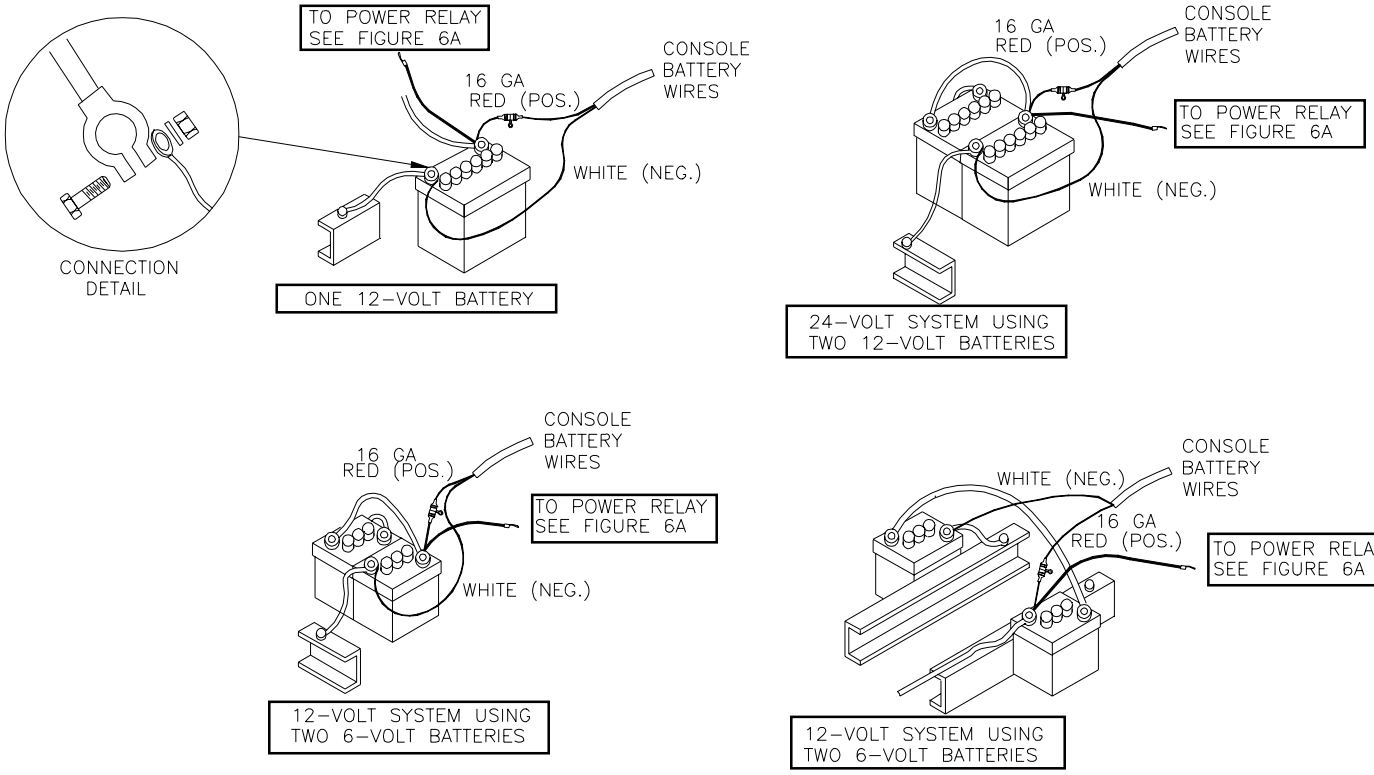


FIGURE 6A



NOTE: Disconnect console battery wires if the system is not used for an extended period, (i.e. two weeks). With the POWER switch to OFF, the system draws 9 milliamps of current to maintain information stored in the Console.

CONSOLE CALIBRATIONS

A calibration procedure must be completed before operating the console. Calibration of the Console can be achieved by performing the following calculations. Once these calculations are complete, the information can be added to the console by following the INITIAL CONSOLE PROGRAMMING procedure.

1. CALCULATING "BOOM CAL"

Calculate the width of each boom in inches [cm] by multiplying the number of nozzles times nozzle spacing. Write these boom widths down for future reference when programming the Console.

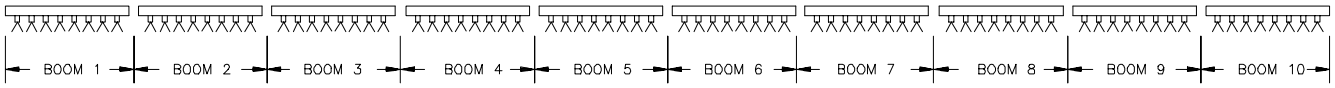


FIGURE 7

2. CALCULATING "SPEED CAL"

See Appendix 1 for Wheel Drive Speed Sensor installation instructions.
See Appendix 2 for Speedometer Drive Speed Sensor installation instructions.

Initial SPEED CAL is 598 [152]. Complete Steps 1 thru 6 to refine this number **after** "INITIAL CONSOLE PROGRAMMING" has been completed.

1) Set POWER switches to ON, all other switches to OFF.

2) Press SPEED . Enter "0" for distance.

3) Drive 1 mile [1 kilometer]. To achieve the most accurate calibration, accelerate and decelerate slowly.

> **CAUTION:** Do not use vehicle odometer to determine distance. Use section lines or highway markers.

4) Read DISTANCE by depressing SPEED . DISTANCE should read a value of approximately 5280 [1000]. If it reads between 5260-5300 [990-1010], the SPEED CAL for the vehicle is 598 [152]. If the DISTANCE display reads any other value, perform the following calculation:

EXAMPLE: Assume DISTANCE reads 5000 [980].

$$\text{Corrected SPEED CAL} = \frac{\text{Old SPEED CAL} \times 5280}{\text{DISTANCE}}$$

ENGLISH UNITS:
$= \frac{598 \times 5280}{5000} = 631.48$

METRIC UNITS:
$= \frac{[152] \times [1000]}{[980]} = [155]$

5) The number to enter for SPEED CAL is 631 [155].

6) Recheck the new SPEED CAL derived in Step 5 by repeating Steps 2 thru 5.

3. CALCULATING "METER CAL"

1) When calculating METER CAL for carrier, refer to the Flow Meter calibration number which is stamped on the label attached to each Flow Meter. This number is to be used for gallon per area applications.

To convert original METER CAL from gallons to desired units of measure (oz, lbs, or liters per area, see "METER CAL CONVERSIONS"). Write down this calibration number for future reference when programming the Console.

NOTE: Reference "CHEMICAL INJECTION INSTALLATION AND SET-UP" For information regarding setting meter cal for injection or auxiliary.

4. CALCULATING "VALVE CAL"

1) The initial calibration number for VALVE CAL is 2123 for all products. After operating the system, this number may be refined. See definitions below:

NOTE: When PROD 1 of the SCS 750 Console is used with a Raven Fast Valve or a D.J. 44419-0004 Hydraulic Control Valve, the initial VALVE CAL should be 0743.

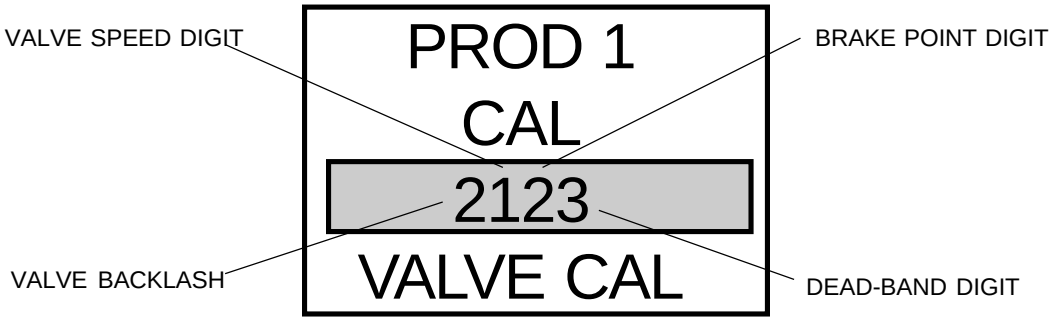


FIGURE 8

Valve Backlash Digit Controls the time of the first correction pulse after a change in correction direction is detected.
(INC to DEC *-or-* DEC to INC).
Range: 1 to 9 1-Short Pulse
9-Long Pulse

Valve Speed Digit Controls response time of Control Valve motor.

CAUTION: Running the Control Valve too fast will cause the system to oscillate.

Product 1 Range *****: 0 to 9 0-Fast
9-Slow

Product 1 valve speed digits are reversed from all other Products to allow the use of a fast valve.

Product 2-5 Ranges: 0 to 9 0-Slow
9-Fast

Brake Point Digit Sets the percent away from target rate at which the Control Valve motor begins turning at a slower rate, so as not to overshoot the desired rate.

Range: 0 to 9 0 = 5%
1 = 10%
9 = 90%

Dead-Band Digit Allowable difference between target and actual application rate, where rate correction is not performed.

Range: 1 to 9 1 = 1%
9 = 9%

5. CALCULATING "RATE CAL"

1) Determine the target application rate at which the chemical should be sprayed for the RATE CAL. Write down this calibration number for future reference when programming the Console.

Selecting Spray Nozzles:

To determine correct spray nozzles, provide the following information:

1) Nominal Application Pressure — PSI [kPa] {PSI}

2) Target Application Rate — GPA [lit/ha] {GPK)

3) Target Speed — MPH [km/h] {MPH}

4) Nozzle Spacing — inches [centimeters] {inches}

From this information calculate the volume per minute per nozzle as follows:

$$GPM = \frac{GPA\ \{GPK\} \times MPH\ \{MPH\} \times inches\ \{inches\}}{5{,}940\ \{137\}}$$

$$lit/min = \frac{lit/ha \times km/h \times cm}{60{,}000}$$

Use GPM [lit/min] and pressure to select appropriate tip from tip chart.

EXAMPLE:
1) Application Pressure — 30 PSI [200 kPa] {30 PSI}
2) Target Application Rate — 20 GPA [200 lit/ha] {.46 GPK}
3) Target Speed — 5.2 MPH [8.4 km/h] {5.2 MPH}
4) Nozzle Spacing — 20 inches [50 cm] {20 inches}

US (ENGLISH UNITS) GPM $= \frac{20\ GPA \times 5.2\ MPH \times 20\ inches}{5{,}940} = 0.35$

SI (METRIC UNITS) [lit/min] = $\frac{200 \text{ lit/ha} \times 8.4 \text{ km/h} \times 50 \text{ cm}}{6{,}000} = 1.40$

TU (TURF UNITS) GPM = $\frac{.46 \text{ GPK} \times 5.2 \text{ MPH} \times 20 \text{ inches}}{137} = 0.35$

Using GPM .35 and pressure 30 select tip number XR8004 from the chart shown as Figure 9, since it comes closest to providing the desired output.

TIP COLOR	TIP NO.		LIQUID PRESSURE IN PSI	CAPACITY 1 NOZZLE IN GPM	CAPACITY 1 NOZZLE IN OZ./MIN.	GALLONS PER ACRE 20" SPACING			
	80 DEG.	110 DEG.				5 MPH	6 MPH	7 MPH	8 MPH
YELLOW	XR8002	XR11002	15	.12	15	7.3	6.1	5.2	4.5
			20	.14	18	8.4	7.0	6.0	5.3
			30	.17	22	10.3	8.6	7.4	6.4
			40	.20	26	11.9	9.9	8.5	7.4
			60	.25	32	14.6	12.1	10.4	9.1
BLUE	XR8003	XR11003	15	.18	23	10.9	9.1	7.8	6.8
			20	.21	27	12.6	10.5	9.0	7.9
			30	.26	33	15.4	12.9	11.0	9.7
			40	.30	38	17.8	14.9	12.7	11.1
			60	.37	47	22.0	18.2	15.6	13.6
RED	XR8004	XR11004	15	.24	31	14.5	12.1	10.4	9.1
			20	.28	36	16.8	14.0	12.0	10.5
			30	.35	45	21.0	17.2	14.7	12.9
			40	.40	51	24.0	19.8	17.0	14.9
			60	.49	63	29.0	24.0	21.0	18.2
BROWN	XR8005	XR11005	15	.31	40	18.2	15.2	13.0	11.4
			20	.35	45	21.0	17.5	15.0	13.1
			30	.43	55	26.0	21.0	18.4	16.1
			40	.50	64	30.0	25.0	21.0	18.6
			60	.61	78	36.0	30.0	26.0	23.0

FIGURE 9

VERIFYING FLOW RATE LIMITS:
The gallons per minute (GPM) (liters per minute [lit/min]) flow rate of the sprayer must be within the range of that specified for the Flow Meter included with the SCS 750.

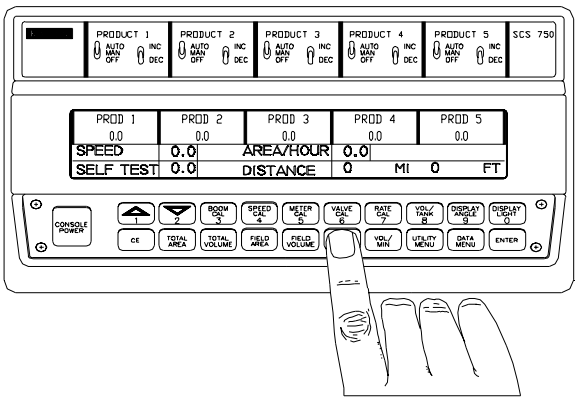
FLOW METER MODEL	FLOW RANGE
RFM 5	0.05-5 GPM [0.2-18.9 lit/min]
RFM 15	0.3-15 GPM [1.1-56.8 lit/min]
RFM 60P/60S	1-60 GPM [3.8-227 lit/min]
RFM 100	3-100 GPM [11.4-379 lit/min]
RFM 200/200 Poly	15-200 GPM [56.8-757 lit/min]
RFM 400	25-400 GPM [94.6-1514 lit/min]

2) Determine the target application rate for remaining products in that you are spraying. (Refer to the instructions on the chemical container). Write these numbers down for future reference when programming the Console.

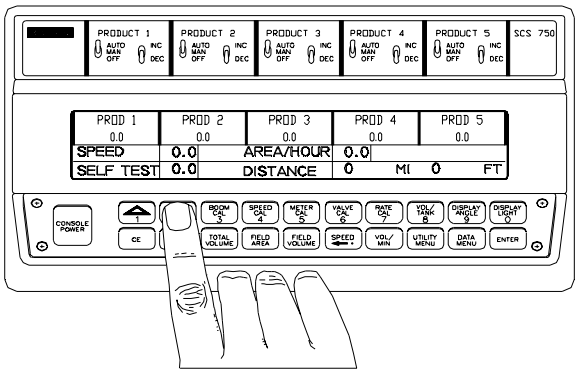
INITIAL CONSOLE PROGRAMMING

STANDARD DATA ENTRY PROCEDURE:

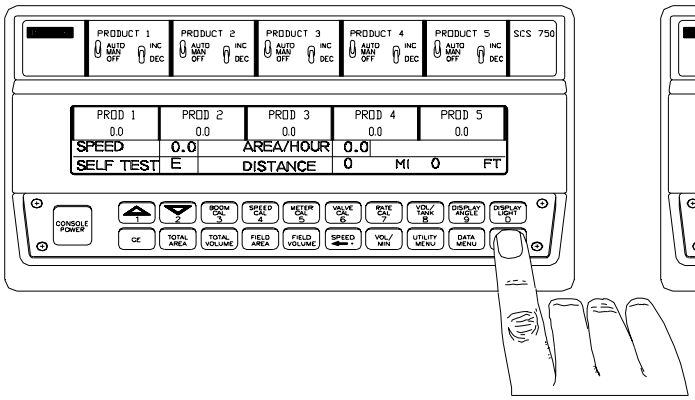
When entering data into any of the keys on the Console, the data entry sequence is always the same.



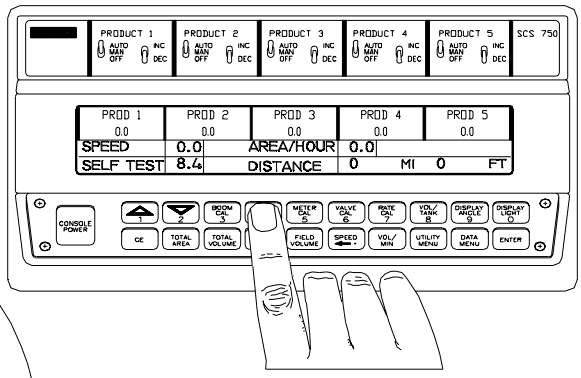
Depress the key in which data is to be entered.



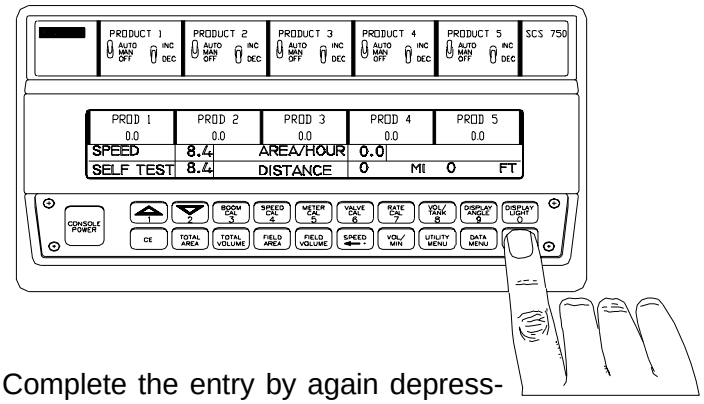
Use arrow keys to position the cursor over function in which data is to be entered.



Depress ENTER key. An "E" will illuminate in the cursor.



Depress keys corresponding to the number to be entered (i.e. "8", "4"). The number will be displayed in the cursor as they are entered.



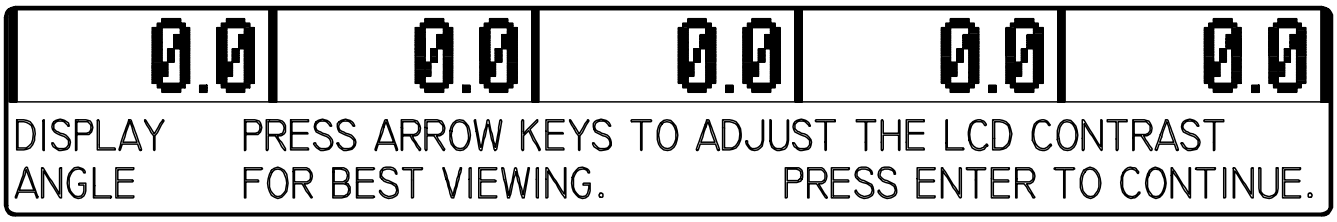
Complete the entry by again depressing the ENTER key.

1. REQUIRED CONSOLE PROGRAMMING

The following calibration features must have data entered into them in order for the Console to operate. This information is required to be entered for each product being used.

TO RESET CONSOLE: If an entry selection error is made during the UNIT OF MEASURE or SPEED SENSOR setting process, press the POWER switch to turn OFF the Console power. While holding [CE], press the POWER switch to turn ON the Console power. All data previously entered will be removed.

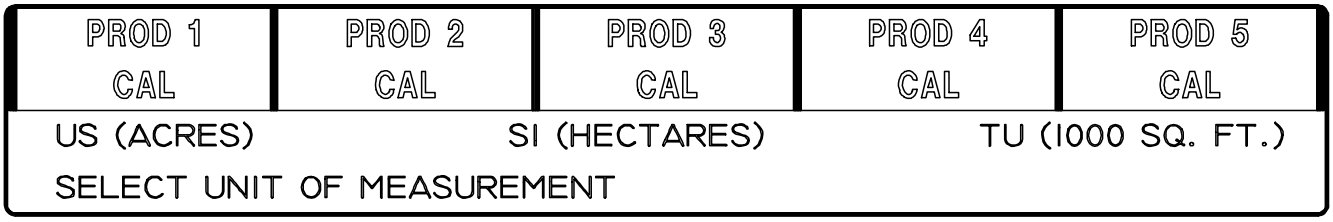
When power is first applied to the Console, it will display the following:



The DISPLAY ANGLE feature allows the operator to change the contrast of the display for better viewing purposes. Depress [1] or [2] to adjust display to a preferred contrast for viewing.

Depress [ENTER] to continue with the next display and resume Console programming.

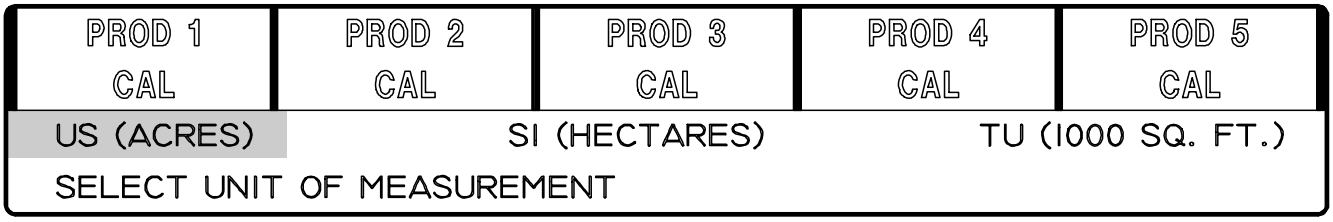
IMPORTANT: This Console requires the selection of area: **US** (acres), **SI**[hectares], or **TU** {1,000 sq. ft.}; and the selection of a speed sensor: **SP1** (wheel drive, etc.), or **SP2** (radar) to operate.



1. SELECTING UNITS OF MEASUREMENTS

Position the cursor over unit of measurement desired using one of the ARROW keys.

When cursor is located over proper selection, depress [ENTER].



2. SELECTING SPEED SENSOR TYPE

Position the cursor over speed sensor type to be used by depressing ARROW keys.

When cursor is located over proper selection, depress [ENTER].

PROD 1 CAL	PROD 2 CAL	PROD 3 CAL	PROD 4 CAL	PROD 5 CAL
SP-1 (MAGNETIC SENSORS, SONAR)			SP-2 (RADAR)	
SELECT SPEED SENSOR TYPE				

***IMPORTANT*:**	SP-1 is used with Wheel Drive, Speedometer, Drive Shaft, and Sonar Speed Sensors. SP-2 is used with Radar Speed Sensors. Selecting improper speed sensor type will cause speed readings to be inaccurate.

3. ENTERING BOOM CALS

Depress [BOOM CAL 3]. Position cursor over boom in which date is to be entered. Depress [ENTER], "E" will illuminate in the cursor. Enter total boom width, in inches [cm], for the boom selected. Depress [ENTER]. Use ARROW keys to shift to the next boom. Continue to enter boom width data into each boom that will be used.

PROD 1 CAL		PROD 2 CAL		PROD 3 CAL		PROD 4 CAL		PROD 5 CAL	
BOOM	1 0	2	0	3	0	4	0	5	0
CAL	6 0	7	0	8	0	9	0	10	0

For information on calculating boom cals see section "CALCULATING BOOM CAL".

4. ENTERING SPEED CAL

Depress [SPEED CAL 4], Depress [ENTER], "E" will illuminate. Enter the speed cal number and depress [ENTER].

PROD 1 CAL	PROD 2 CAL	PROD 3 CAL	PROD 4 CAL	PROD 5 CAL
SPEED CAL 0				

For information on calculating speed cal see section "CALCULATING SPEED CAL".

5. ENTERING METER CAL

Depress [METER CAL 5], Depress [ENTER], "E" will illuminate. Enter meter cal number and depress [ENTER]. Use arrow keys to shift to the next product. Continue to enter data into each product that will be used.

PROD 1 CAL	PROD 2 CAL	PROD 3 CAL	PROD 4 CAL	PROD 5 CAL
0	0	0	0	0
METER CAL				

For information on calculating meter cal see section "CALCULATING METER CAL".

6. ENTERING VALVE CAL

Depress [VALVE CAL 6], Depress [ENTER], "E" will illuminate. Enter valve cal number and depress [ENTER]. Use arrow keys to shift to the next product. Continue to enter data into each product that will be used.

PROD 1 CAL	PROD 2 CAL	PROD 3 CAL	PROD 4 CAL	PROD 5 CAL
0	0	0	0	0
VALVE CAL				

For information on calculating valve cal see section "CALCULATING VALVE CAL".

7. ENTERING RATE CAL

Depress [RATE CAL 7], Depress [ENTER], "E" will illuminate. Enter rate cal number as volume/acre or volume/ha and depress [ENTER]. Use arrow keys to shift to the next product. Continue to enter data into each product that will be used.

PROD 1 CAL	PROD 2 CAL	PROD 3 CAL	PROD 4 CAL	PROD 5 CAL
0.0	0.0	0.0	0.0	0.0
RATE CAL				

For information on calculating rate cal see section "CALCULATING RATE CAL".
When all required data is entered, the "PROD CAL" portion of the display will

be replaced with the actual rate calculations as shown below ("0.0" is shown here as an example rate only):

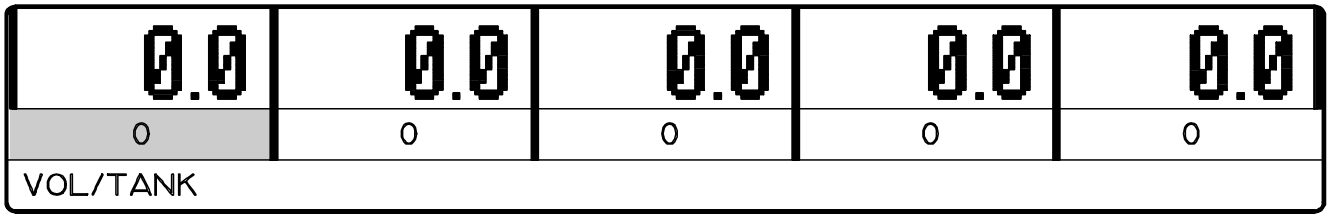
If the "PROD CAL" statement in the display is not replaced with an actual rate calculation, verify that all the calibration numbers have been properly entered into the Console (i.e. BOOM, SPEED, METER, VALVE, AND RATE CAL CALCULATIONS).

2. OTHER DISPLAY FEATURES

1. VOLUME/TANK

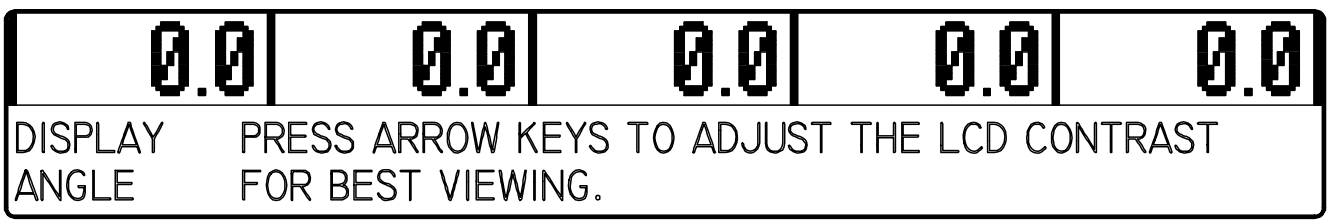
The VOL/TANK button allows the user to enter a volume for the tank at the beginning of application. After a number has been entered, the Console will monitor and display the calculated volume remaining in the tank during the application.

Depress [VOL/ TANK 8], Depress [ENTER], "E" will illuminate. Enter the volume in tank and depress [ENTER]. Use arrow keys to shift to the next product. Continue to enter data into each product that will be used.



2. DISPLAY ANGLE

The DISPLAY ANGLE button allows the operator to change the contrast of the display for better viewing purposes. Depress [DISPLAY ANGLE 9], Depress [▲ 1] or [▼ 2] to adjust display to a preferred contrast for viewing.



3. DISPLAY LIGHT

The DISPLAY LIGHT button allows the operator to enable a display light for evening operation of the Console. Toggle the [DISPLAY LIGHT 0] to turn the light ON or OFF.

4. TOTAL AREA

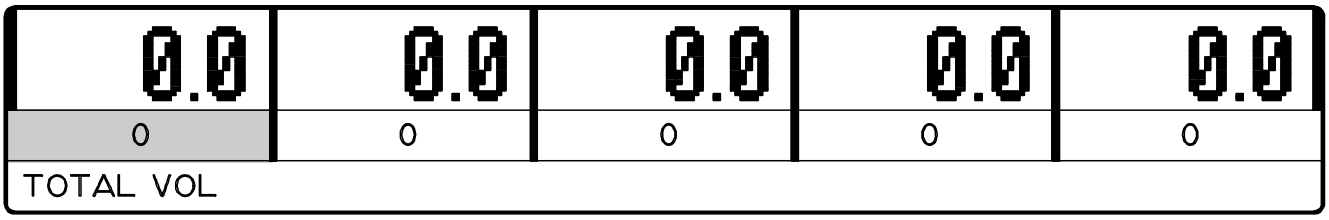
The TOTAL AREA button allows the user to view the total area covered by each product and the vehicle. This number can be cleared or "zeroed out" at any time.

To "zero out" the TOTAL AREA display: depress [TOTAL AREA], depress [ENTER], "E" will illuminate.

Enter a "0" for area and depress [ENTER]. Use arrow keys to shift to the next product. Continue to enter data into each product that will be used.

5. TOTAL VOLUME

The TOTAL VOLUME button allows the user to view the total volume covered by each product. This number can be cleared or "zeroed out" at any time. To "zero out" the TOTAL VOLUME display: depress [TOTAL VOLUME], depress [ENTER], "E" will illuminate. Enter a "0" for volume and depress [ENTER]. Use arrow keys to shift to the next product. Continue to enter data into each product that will be used.

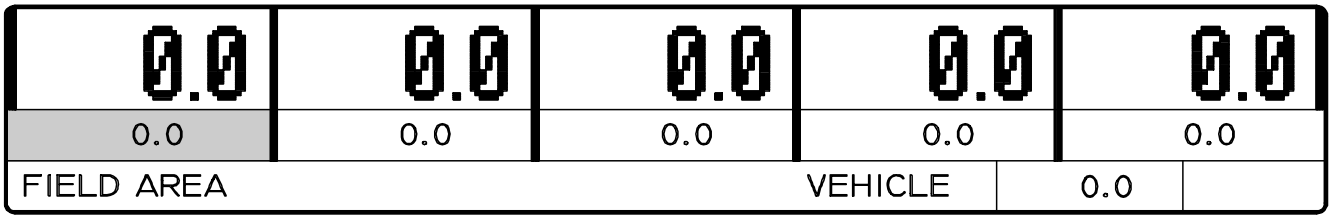


6. FIELD AREA

The FIELD AREA button allows the user to view the total field area covered by each product and the vehicle. This number can be cleared or "zeroed out" at any time.

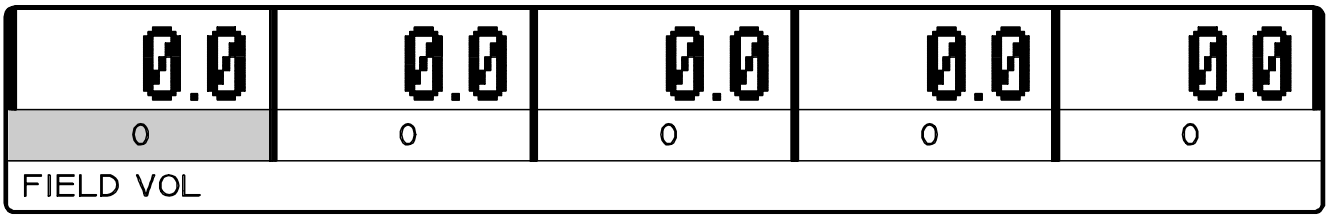
To "zero out" the FIELD AREA display: depress [FIELD AREA], depress [ENTER], "E" will illuminate.

Enter a "0" for area and depress [ENTER]. Use arrow keys to shift to the next product. Continue to enter data into each product that will be used.



7. FIELD VOLUME

The FIELD VOLUME button allows the user to view the field volume covered by each product. This number can be cleared or "zeroed out" at any time. To "zero out" the FIELD VOLUME display: depress [FIELD VOLUME], depress [ENTER], "E" will illuminate. Enter a "0" for volume and depress [ENTER]. Use arrow keys to shift to the next product. Continue to enter data into each product that will be used.

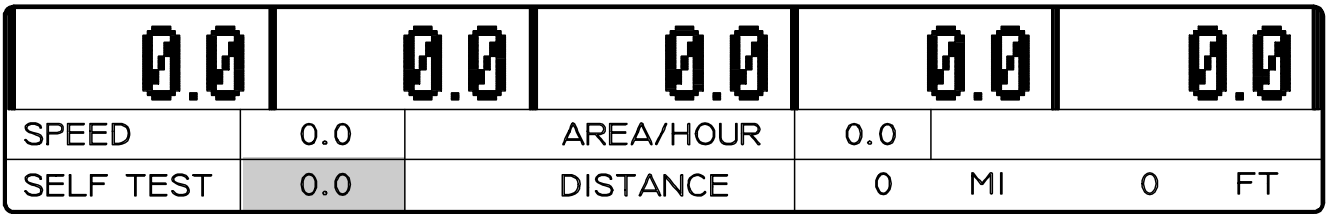


8. SPEED

The SPEED button allows the user to view the vehicle speed, the area covered per hour, and the total distance traveled. A self test mode is also available for simulating normal operating speed. The distance traveled and the self test mode can be cleared or "zeroed out" at any time. To "zero out" the distance traveled or the self test mode: depress [SPEED ←.], depress [ENTER], "E" will illuminate.

Enter a "0" into cursor and depress [ENTER]. Use arrow keys to shift to the next data area.

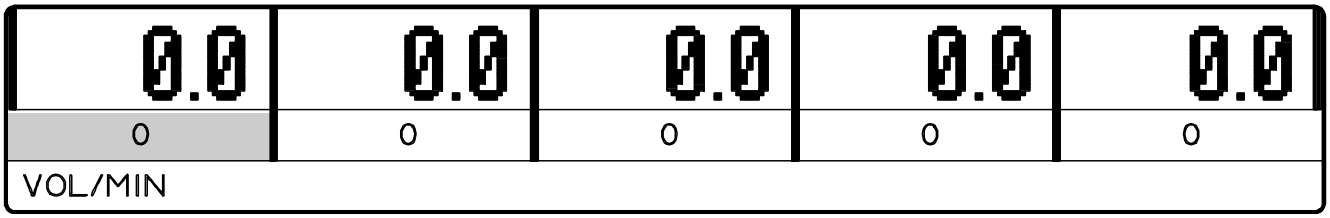
Continue to enter data in each area that will be used. To simulate normal operating speed: depress [SPEED ←.], depress [ENTER], "E" will illuminate. Enter the normal operating speed to be simulated in self test and depress [ENTER].



9. VOLUME/MINUTE

The VOL/MIN button allows the user to view the volume per minute being applied by each product.

To display volume per minute depress [VOL/MIN].



10. UTILITY MENU

The utility menu button displays the selections chosen for the unit of measurement (US, SI, or TU) and the speed sensor option (SP1 or SP2). The time and date settings are also displayed. Refer to "CONSOLE CALIBRATIONS" for information on unit of measurement and speed sensor settings. Refer to "DATA MENU" for information on time and date settings.

3. DATA MENU

The following are brief descriptions of features available under the DATA MENU key:

DISPLAY SCREEN	FEATURE and DESCRIPTION
SERIAL PORT - PART 1	
PRINT FIELD	**CONSOLE DATA PRINTOUT** Sends data through serial port to attached optional printer to print field begin and field end pages.
FIELD REF. #	**FIELD REFERENCE** Allows user to enter up to a four-digit number to represent a field. Field reference is included in field begin and field end pages and the data logger time/date string.
RATE ALARM	**RATE ALARM ON/OFF** Turns rate change alarm ON or OFF. When rate change alarm is selected ON; alarm sounds 4 long beeps when a rate calibration number is changed via the serial port using a valid change request data string.
SERIAL PORT - PART 2	
DATA LOG	**DATA LOGGER ON/OFF** Turns data logger ON or OFF.
BAUD	**BAUD RATE** Used in GPS mode, printer, and data logging mode. Selectable between 1200 or 9600 baud.
TRIGGER	**DATA LOGGER TRIGGER VALUE** Used in data logging mode. The trigger determines how often data (See APPENDIX 12 for data communication string formats) is sent to the serial port. The trigger may be either feet [meters] or seconds.

DISPLAY SCREEN	FEATURE and DESCRIPTION
UNITS	**DATA LOGGER TRIGGER UNITS** Used in data logging mode. The trigger unit is selectable between feet [meters] or seconds.
DATA LOCK	**DATA LOCK CODE SETTING** Used to lock out ability to enter data into console. Code can be entered or reset.
AUDIBLE ALARM	**AUDIBLE ALARM ON/OFF** Turns audible alarm ON or OFF.
VALVE DELAY	**CONTROL VALVE DELAY** Set a time delay between when the booms are turned ON and when the Console begins to control the flow rate. A value ranging from 1-9 means a delay of 1-9 seconds respectively. A value of "0" means no delay. This delay is active if the time between turning OFF and turning ON the booms is less than 30 seconds.
TIME	**TIME** Set the current time of day.
DAY	**DATE** Set the current date.
MONTH	**MONTH** Set the current month.
YEAR	**YEAR** Set the current year.
DISPLAY SMOOTHING	**DISPLAY SMOOTHING ON/OFF** Turns display smoothing ON or OFF. Selecting display smoothing ON means the RATE displays target rate when actual rate is within a percentage of target rate. The third digit of VALVE CAL determines this percentage. Actual rate is displayed if unit does not reach deadband within 10 seconds. Display smoothing OFF means RATE displays actual rate at all times.
BOOM SELECT	**BOOM SELECT** Allows assigning of specific PRODUCT to BOOM configurations.
LOW FLOW LIMIT	**LOW FLOW LIMIT** If actual rate falls below assigned limit, Control Valve stops closing, alarm sounds, and rate display flashes "LO-LIM". This value is automatically proportioned to the percentage of booms that are ON.

DISPLAY SCREEN	FEATURE and DESCRIPTION
RATE +/-	**RATE +/-** Sets the increment at which rate cal is increased or decreased using INC/DEC switch while in AUTO operation.
AGITATOR CONTROL	**AGITATOR ON/OFF** Turns agitators ON or OFF.
LOW TANK LEVEL	**LOW TANK LEVEL** Alarm will intermittently beep every 15 seconds and the RATE display for PRODUCT will flash "TANK LO" when level in tank falls below assigned minimum level.
GPS MENU	
SYSTEM	**GPS SYSTEM INACTIVE/ACTIVE** Used only with Raven Grid Application System. See Grid Application System manual for more details.
FILE	**GPS FILE REFERENCE** Used only with Raven Grid Application System. See Grid Application System manual for more details.

1. DEFINITION OF DATA MENU KEY:

Depressing this key displays selected Data Menu features in menu display screen.

EXAMPLE: Menu display screen will show options by name and a cursor will darken in area displaying default setting.

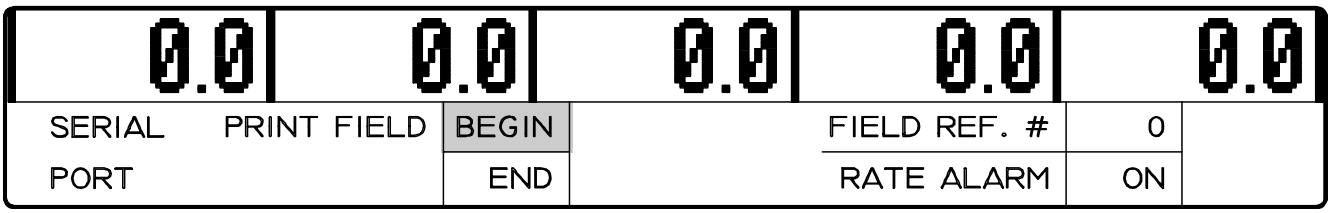
Depressing this key after selecting DATA MENU toggles up through desired features.

EXAMPLE: "SERIAL PORT SCREEN - PART 1", "SERIAL PORT SCREEN - PART 2", "DATA LOCK", "AUDIBLE ALARM", etc....

Depressing this key after selecting DATA MENU toggles down through desired features.

EXAMPLE: "GPS MENU", "LOW TANK LEVEL", "AGITATOR CONTROL", "RATE +/-",, etc....

2. SERIAL PORT SCREEN - PART 1



CONSOLE DATA PRINTOUT

To print FIELD BEGIN depress 

. The cursor will shift to END.

To print FIELD END depress [ENTER].

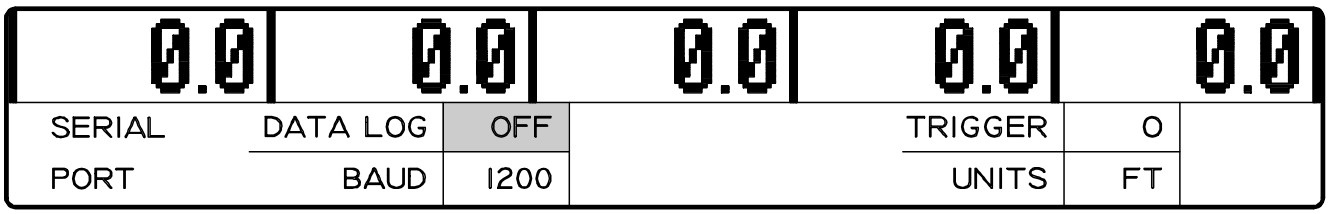
RATE ALARM ON/OFF

Depress [ENTER]. "E" will illuminate in the cursor. Use the ARROW keys to enable or disable the RATE ALARM. Depress [ENTER].

FIELD REFERENCE

To enter a FIELD REFERENCE depress [ENTER]. "E" will illuminate in the cursor. Enter the FIELD REFERENCE number and depress [ENTER].

3. SERIAL PORT SCREEN - PART 2



BAUD RATE

Depress [ENTER]. "E" will illuminate in the cursor. Use the ARROW keys to toggle between "1200" and "9600". Depress [ENTER].

DATA LOGGER ON/OFF

The data logger uses the communication strings (See APPENDIX 12) to pass data through the serial port. The data is sent at a set time interval or a set distance traveled, as determined by the values entered in the DATA LOGGER TRIGGER VALUE and DATA LOGGER TRIGGER UNITS. Upon each trigger, the Actual Rate string, Data strings 1, 2, and 3, and the Time/Date strings are sent respectively. When a console calibration is changed, the console will automatically send out the Cal 1, 2, and 3 strings. When a console switch is changed, the console will send out the Data 1, 2, and 3, Time/Date, and Cal 1, 2, and 3 strings. The Data (with Time/Date string included) and Cal strings can also be requested by the data logger using the request strings (See APPENDIX 12). Depress [ENTER]. "E" will illuminate in the cursor. Use the ARROW keys to toggle data logger ON or OFF. Depress [ENTER].

DATA LOGGER TRIGGER UNITS

Depress [ENTER]. "E" will illuminate in the cursor. Use the ARROW keys to toggle between "SEC" (seconds) and "FEET [MTRS]. Depress [ENTER].

DATA LOGGER TRIGGER VALUE

Depress [ENTER]. "E" will illuminate in the cursor. Enter the DATA LOG TRIGGER VALUE and depress [ENTER].

NOTE:	TRIGGER must have a value other than zero entered for the DATA LOGGER to function.

4. DATA-LOCK SCREEN

This feature allows the Console to be placed into a lock mode, disabling the ability to program the Console.

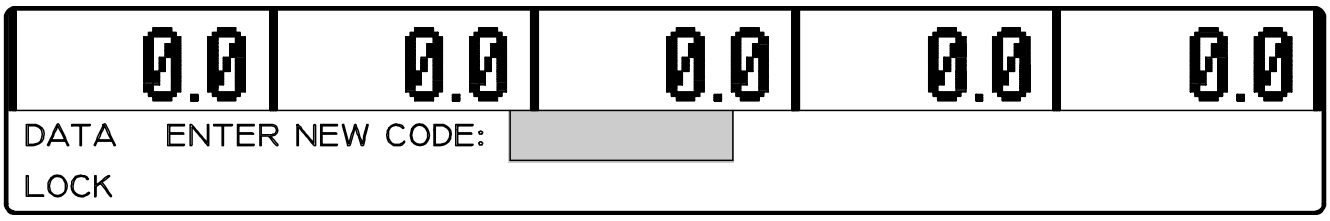
To enter a DATA-LOCK CODE:

a.1) Depress ENTER key.
a.2) Enter up to 4-digit code.
EXAMPLE: (1 3 5 7)
a.3) Depress ENTER key.

To change a DATA-LOCK CODE:

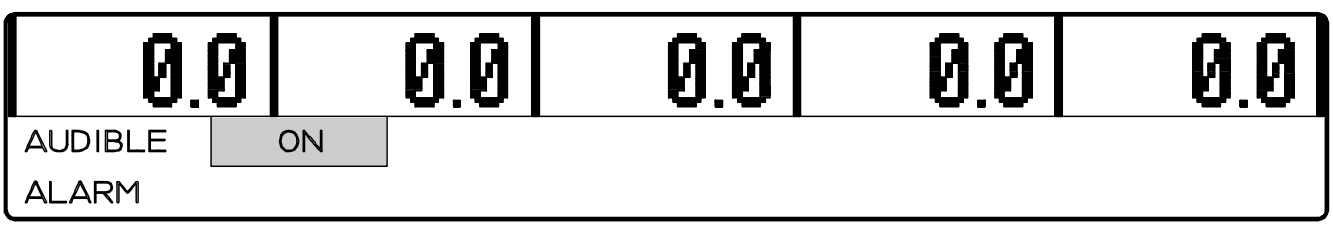
b.1) Depress ENTER key.
b.2) Enter OLD CODE.
b.3) Depress Enter key.
b.4) Enter NEW CODE per instructions a.2 and a.3.

NOTE:	DATA-LOCK CODE may be cleared by changing DATA-LOCK CODE to "0" or by resetting the Console as described under REQUIRED CONSOLE CALIBRATION.



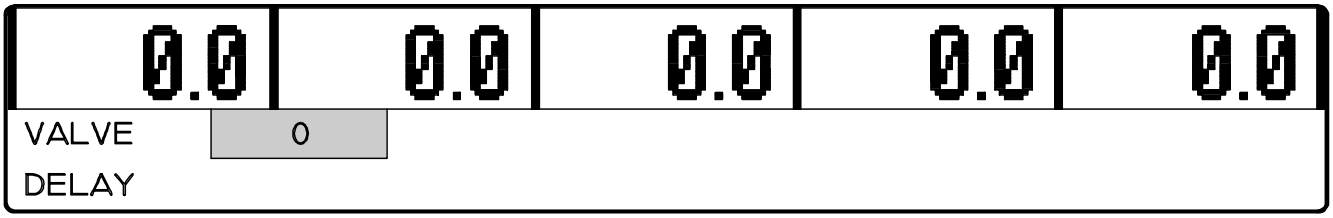
5. AUDIBLE ALARM SCREEN

Depress [ENTER]. "E" will illuminate in the cursor. Use the ARROW keys to toggle between alarm OFF or ON, and depress [ENTER].



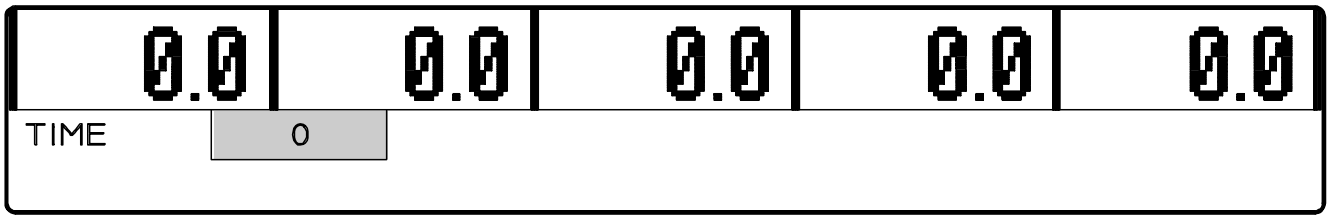
6. CONTROL VALVE DELAY SCREEN

To enter a VALVE DELAY, depress ENTER. "E" will illuminate in the cursor. Enter a value of 0-9, and depress ENTER.



7. TIME, DAY, MONTH, or YEAR SCREENS

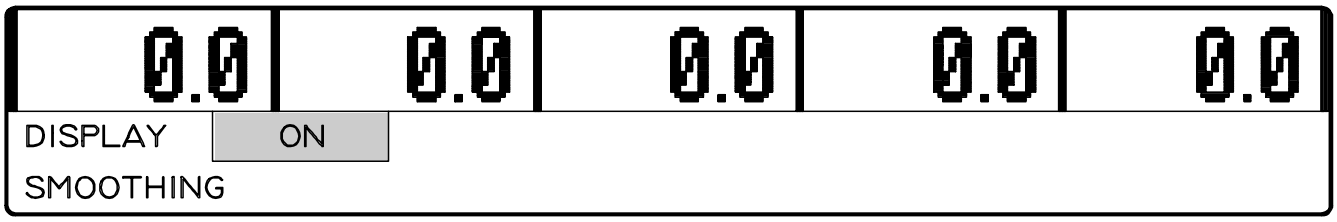
To make an entry of TIME, DAY, MONTH, or YEAR, depress ENTER. "E" will illuminate in the cursor. Enter the correct time of day and depress ENTER.



Enter the current DAY, MONTH, and YEAR in the same manner.

8. DISPLAY SMOOTHING SCREEN

Depress ENTER. "E" will illuminate in the cursor. Use the ARROW keys to toggle between OFF or ON and depress ENTER.



9. BOOM SELECT SCREEN

This feature allows the user to assign specific booms to be used only with certain products. These products will only be enabled when the assigned booms are turned on.

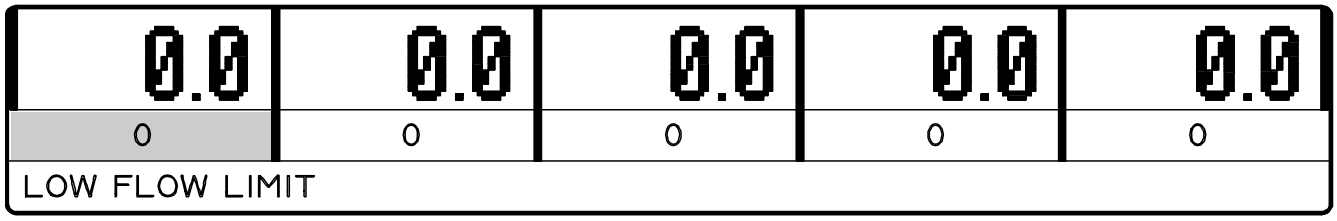
IMPORTANT: System plumbing must accommodate selections made for this feature.

To assign a boom to a specific product; depress ENTER. "E" will illuminate in the cursor. Enter the product number that specific booms will be assigned under and depress ENTER. The cursor will move the selected product. Depress the individual boom numbers to toggle each boom OFF or ON. After making boom selections, depress ENTER. All booms are initially selected ON for each product.

NOTE: A spray symbol ( ) under the boom number for a particular product indicates that the boom is selected ON. A dash mark (-) seen in place of a spray symbol indicates that the boom is selected OFF.

10. LOW FLOW LIMIT SCREEN

Move cursor to product in which to enter LOW FLOW LIMIT number using the ARROW keys. Depress ENTER, "E" will illuminate in the cursor. Enter LOW FLOW LIMIT number (volume per minute), and depress ENTER. The LOW FLOW LIMIT value should be determined with all booms ON. This value is automatically proportioned to the percentage of booms that are ON. (i.e. If the entered limit is 4 gal/min and half of the total boom length is shut OFF, the Console automatically reduces the LOW LIMIT to 2 gal/min).



11. RATE +/- SCREEN

Select RATE +/- for product using the ARROW keys and depress ENTER. E" will illuminate in the cursor. Enter RATE +/- number and depress ENTER.

EXAMPLE: If rate is to be changed by 1 gal/acre; enter a value of "1.0" for the RATE +/- number: When in AUTO mode; each time the INC/DEC switch is positioned to INC, the RATE CAL for that product is increased by "1.0" gal/acre. Positioning the INC/DEC switch to DEC decreases the RATE CAL by "1.0" gal/acre.

PROD 1	PROD 2	PROD 3	PROD 4	PROD 5
0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0
RATE CAL				

12. AGITATOR CONTROL SCREEN

Use ARROW keys to select product. Depress ENTER. Use the ARROW keys to toggle agitator OFF or ON and depress ENTER.

0.0	0.0	0.0	0.0	0.0
OFF	OFF	OFF	OFF	OFF
AGITATOR CONTROL				

13. LOW TANK LEVEL SCREEN

Select LOW TANK LEVEL for specific product using the ARROW keys. Depress ENTER.

E" will illuminate in the cursor. Enter LOW TANK LEVEL value and depress ENTER.

0.0	0.0	0.0	0.0	0.0
0	0	0	0	0
LOW TANK LEVEL				

The alarm will stop when a value equal or greater than the LOW TANK LEVEL is entered into VOL/TANK, or PRODUCT switch is turned off, or the BOOMS are turned off. Entering "0" into LOW TANK LEVEL disables the alarm.

14. GPS MENU SCREEN

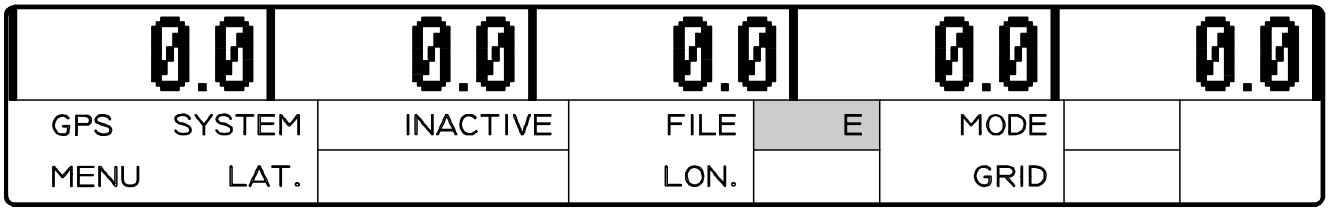
SYSTEM

The GPS feature is inactive when the SYSTEM display shows "INACTIVE". GPS features are explained further in the GRID APPLICATIONS SYSTEM MANUAL.

0.0	0.0	0.0	0.0	0.0
GPS SYSTEM	INACTIVE	FILE	I	MODE		
MENU LAT.		LON.		GRID		

GPS FILE REFERENCE

To enter a GPS FILE REFERENCE depress [ENTER]. "E" will illuminate. Enter the file number and depress [ENTER].

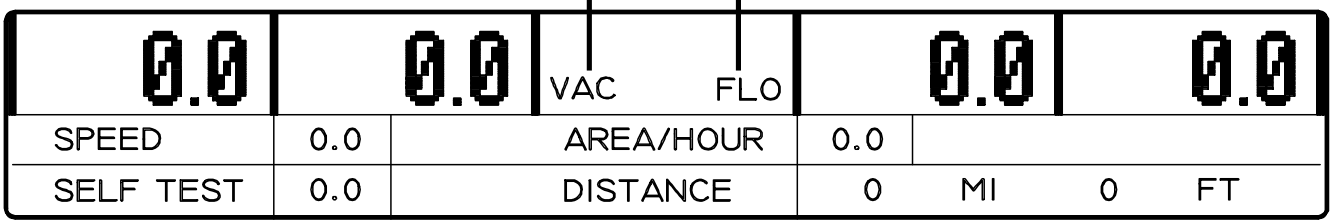


4. AUDIBLE AND VISUAL ALARM

The Console has been equipped with an audible and visual alarm feature. The alarm monitors the vacuum and flow of each product. The alarm will sound and display alternates between actual rate and "VAC" and/or "FLO" error message. The audible portion of the alarm may be turned off through the AUDIBLE ALARM ON/OFF feature under the DATA MENU button.

VAC: Audible and visual alarm if pulling 10 inches of Hg for 5 seconds or more for each product.

FLOW: Audible and visual alarm if no flow for 5 seconds or more for each product.



5. DECIMAL SHIFT

Depress [METER CAL 5]. Select product in which to shift decimal using the ARROW keys. Depress [ENTER], "E" will illuminate. Depress [SPEED ←.] . Depress [ENTER] .

Decimal will shift for corresponding product RATE.

EXAMPLE: RATE display before Decimal Shift = 25.0
RATE display after Decimal Shift = 2.50
RATE must be re-entered as 25.00 (i.e. 2 5 0 0).
If no RATE was previously entered, display will show 0.00.

NOTE: Verify RATE for each product after Decimal Shift is completed. Change as needed.

To unshift decimal point, depress [METER CAL 5], "E" will illuminate. Enter METER

CAL number. Depress ENTER.

PROD 1	PROD 2	PROD 3	PROD 4	PROD 5
0.0	0.0	0.0	0.0	0.0
0	0	0	0	0
METER CAL				

CHEMICAL INJECTION INSTALLATION AND SET-UP

1. PLUMBING THE INJECTION MODULE

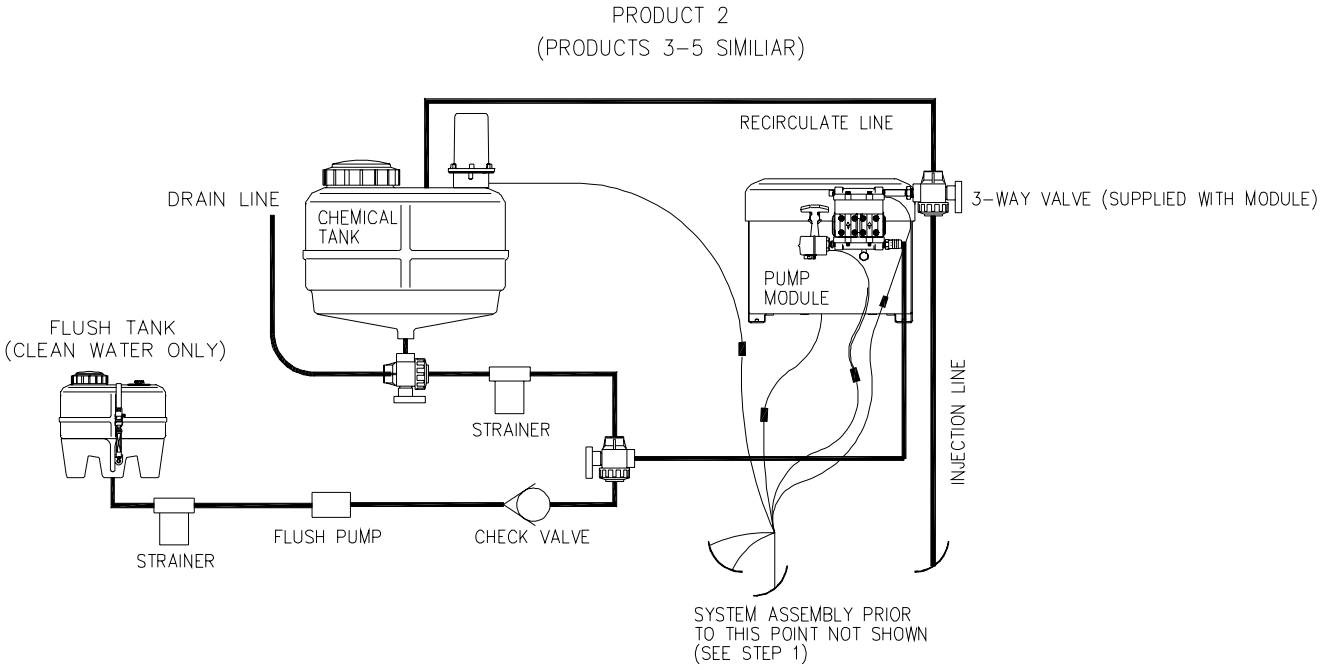


FIGURE 10A

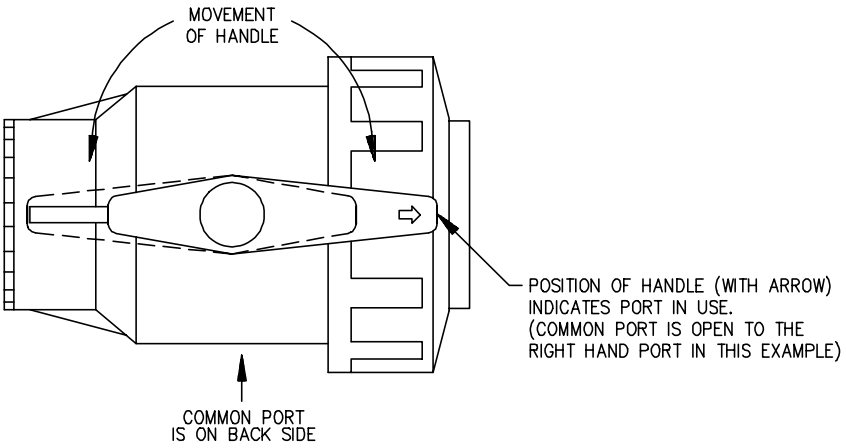
1) Plumb the Pressure Relief Valve (PRV), Flow Meter, Control Valve, Carrier Check Valve, Product Check Valves, and In-line Mixer just ahead of the Boom On/Off Valves as shown in Figure 4.

2) Mount Injection Modules close to the Boom On/Off Valves to minimize amount of product in tubing. See Appendixes 6, 7, and 8 for mounting instructions on various styles of injection modules.

3) Inlet line from chemical tank to Injection Module shall be 3/4" suction hose.

4) Plumb output lines of Injection Modules to Product Check Valves with 3/8 inch [10 mm] tubing on low volume modules; or 1/2 inch [13 mm] tubing on high volume modules (Product Check Valves and tubing not furnished).

5) Figure 10B defines the handle positions for the three way valve.



TYPICAL OPERATION OF THREE WAY VALVE
FIGURE 10B

6) Figure 10C illustrates typical injection module plumbing, showing the three way valve handle positions for injecting chemical.

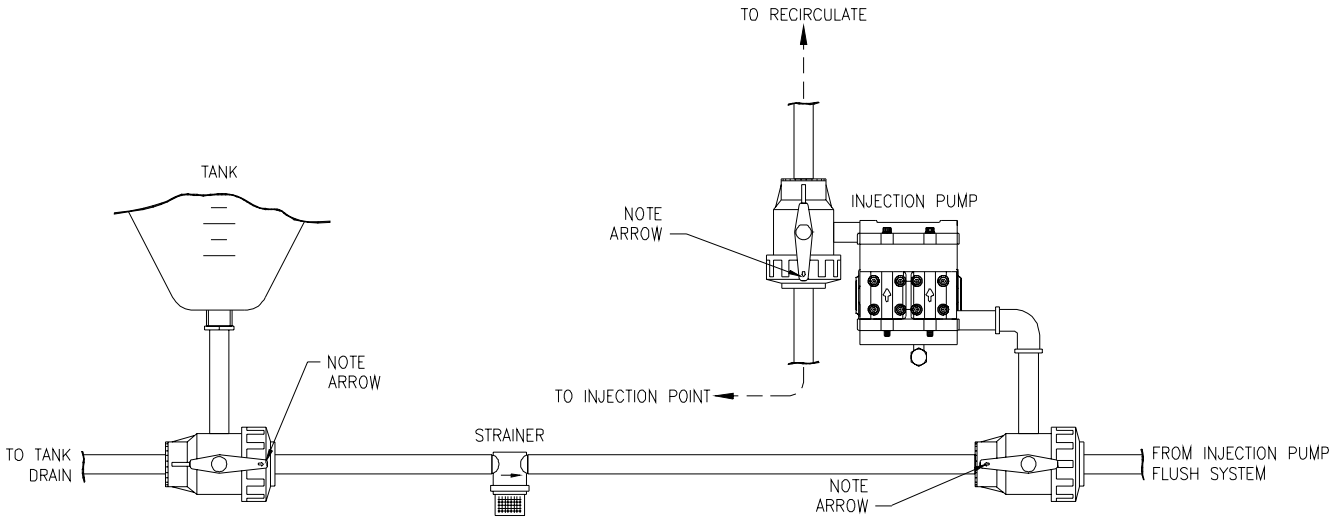


FIGURE 10C

2. RECOMMENDED INJECTION PUMP FLUSH SYSTEM

The recommended system is shown in Figure 11. Strainers are recommended for the product and flush system water. Strainers suitable for concentrated product are typically 20 mesh stainless steel. However, certain products may not flow through strainer without causing excessive vacuum or may clog strainer entirely. It is recommended that a flush system be incorporated with the injection system. This will enhance the performance of the injection pump. The basic components are shown below and are available through a local spraying equipment supplier. This system shall be installed as shown and operated per the following instructions. The required frequency of flushing may vary per the product being injected.

1) Drain or empty Product Injection Tank.

2) Place VALVE 3 in Recirculation position.

3) Place VALVE 2 in position to let clean water circulate thru Injection Pump from flush pump. **VENT CHEMICAL TANK.** Start flush System, pump approximately 1/2 gallon into Injection Tank.

4) Reposition VALVE 2 and VALVE 3 to allow rinse mixture to be injected. Spray rinse mixture at normal recommended rate.

5) Repeat this procedure until Pump and Tank are clean. (i.e. Triple rinse).

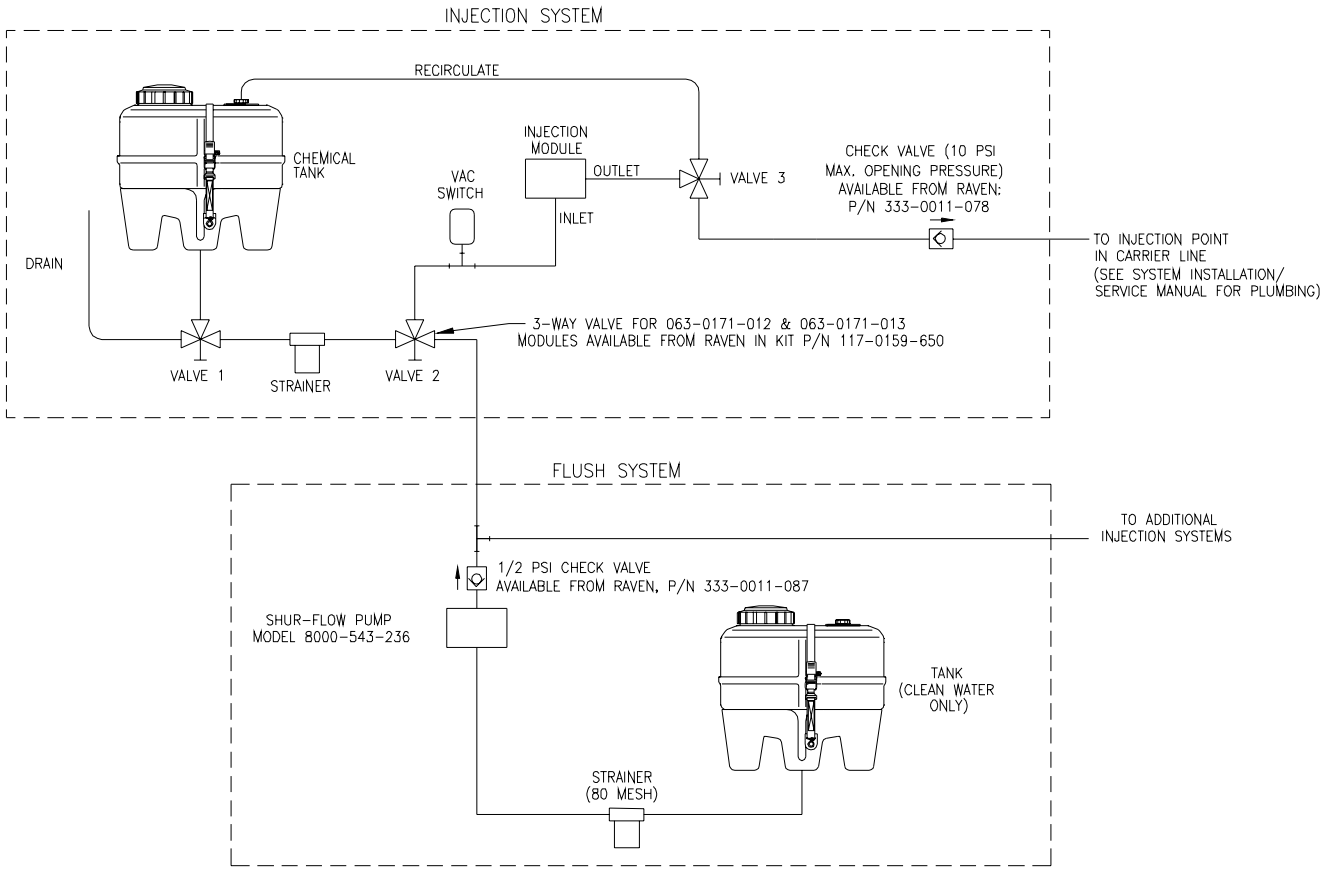
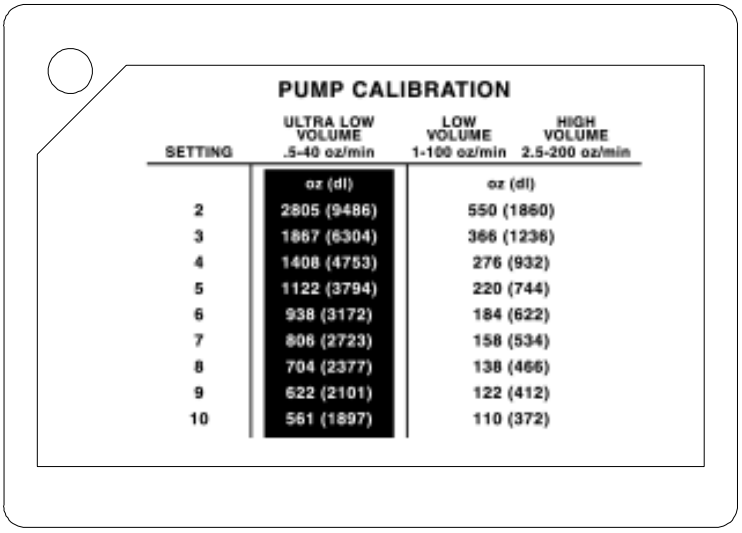


FIGURE 11

3. DETERMINING INJECTION MODULE "METER CAL"

1) Use the calibration tag attached to the Injection Pump (reproduced below) to determine the METER CAL for each product used.

NOTE: Chemical METER CALS are oz (dl) per unit.



PUMP CALIBRATION

SETTING	ULTRA LOW VOLUME .5-40 oz/min	LOW VOLUME 1-100 oz/min	HIGH VOLUME 2.5-200 oz/min
	oz (dl)	oz (dl)	
2	2805 (9486)	550 (1860)	
3	1867 (6304)	366 (1236)	
4	1408 (4753)	276 (932)	
5	1122 (3794)	220 (744)	
6	938 (3172)	184 (622)	
7	806 (2723)	158 (534)	
8	704 (2377)	138 (466)	
9	622 (2101)	122 (412)	
10	561 (1897)	110 (372)	

FIGURE 12

2) Using the Pump Setting Number determined in "CALCULATING PUMP SETTING". Locate the METER CAL number that corresponds to this setting.
EXAMPLE: For Pump Setting 5 the METER CAL number is 220 [744].

3) Write down this METER CAL calibration number for future reference when programming the Console.

4) If two or more Injection Pumps are used, determine the METER CAL for remaining Injection Pumps.

4. CALCULATING PUMP SETTING

The following procedure calculates the correct Pump Setting for Injection Pump. The High Volume Injection Module has an output range of 2.5 to 200 oz/min, use Figure 13A. The Low Volume Injection Module has an output range of 1.0 to 100 oz/min, use Figure 13B. The Ultra-Low Volume Injection Module has an ouput range of .5 to 40 oz/min, use Figure 13C.

1) Calculate **MAXIMUM** and **MINIMUM** volume per minute (oz/min)[dl/min] of chemical required by using the following formulas:

MAXIMUM vol/min = $\frac{\text{Speed x Boom Width x Rate}}{5{,}940\ [60{,}000]\ \{137\}}$

Speed = Maximum Spray Speed in MPH [km/h]
Boom Width = Maximum Number of Spray Nozzles x Nozzle Spacing in inches [cm] (i.e. total boom width)
Rate = Recommended Chemical Application Rate in Ounces per Acre [dl/ha] {oz/1,000 sq. ft.}

MINIMUM vol/min = $\frac{\text{Speed x Boom Width x Rate}}{5{,}940\ [60{,}000]\ \{137\}}$

Speed = Minimum Spray Speed in MPH [km/h]
Boom Width = Minimum Number of Spray Nozzles x Nozzle Spacing in inches [cm] (i.e. one boom width)
Rate = Recommended Chemical Application Rate in Ounces per Acre [dl/ha] {oz/1,000 sq. ft.}

EXAMPLE: Maximum vol/min (High Volume Pump)

US (ENGLISH UNITS)

Speed = 15 MPH
Boom Width = 36 nozzles x 20 inches/nozzle = 720 inches
Rate = 2 pints/acre x 16 oz/pint = 32 oz/acre
Maximum oz/min = $\frac{\text{15 MPH x 720 inches x 32 oz/acre}}{5{,}940} = 58.1$

SI (METRIC UNITS)

Speed = 24.1 km/h
Boom Width = 36 nozzles x 51 cm/nozzles = 1836 cm
Rate = 2.3 lit/ha x 10 dl/liter = 23 dl/ha
Maximum dl/min = $\frac{\text{24.1 km/h x 1836 cm x 23 dl/ha}}{60{,}000} = 17.0$

TU (TURF UNITS)

Speed = 15
Boom Width = 36 nozzles x 20 inches = 720 inches
Rate = .73 oz/1,000 sq. ft.
Maximum oz/min = $\frac{\text{15 MPH x 720 inches x .73 oz/1,000 sq. ft.}}{137} = 58.1$

EXAMPLE: Minimum vol/min (High Volume Pump)

US (ENGLISH UNITS)

Speed	=	8 MPH
Boom Width	=	12 nozzles x 20 inches/nozzle = 240 inches
Rate	=	2 pints/acre x 16 oz/pint = 32 oz/acre
oz/min	=	$\frac{8 \text{ MPH} \times 240 \text{ inches} \times 32 \text{ oz/acre}}{5{,}940} = 10.3$

SI (METRIC UNITS)

Speed	=	12.9 km/h
Boom Width	=	12 nozzles x 51 cm/nozzle = 612 cm
Rate	=	2.3 lit/ha x 10 dl/liter = 23 dl/ha
dl/min	=	$\frac{12.9 \text{ km/h} \times 612 \text{ cm} \times 23 \text{ dl/ha}}{60{,}000} = 3.0$

TU (TURF UNITS)

Speed	=	8
Boom Width	=	12 nozzles x 20 inches/nozzle = 240 inches
Rate	=	.73 oz/1,000 sq. ft.
oz/min	=	$\frac{8 \text{ MPH} \times 240 \text{ inches} \times .73 \text{ oz/1,000 sq. ft.}}{137} = 10.3$

2) Locate the calculated MAXIMUM and MINIMUM oz/min [dl/min] on the horizontal line of Pump Chart. (See Figures 13A, 13B & 13C).

3) Draw a vertical line from these points to the highest pump setting.

4) Use highest pump setting which intersects both vertical lines. **EXAMPLE:** 58.1 oz/min [17.0 dl/min] MAXIMUM, 10.3 oz/min [3.0 dl/min] MINIMUM = pump setting 6. (See Figure 15).

NOTE: Use the "10" setting for all chemical application rates that are within the range of the "10" setting (i.e. 2.5 to 200 oz/min for the high volume module, 1.0 to 100 oz/min for the low volume module and .5 to 40 for the ultra-low volume module.)

NOTE: The pump must be set to the "10" setting for priming.

HIGH VOLUME PUMP OUTPUT CHART
(2.5-200 oz./MIN)

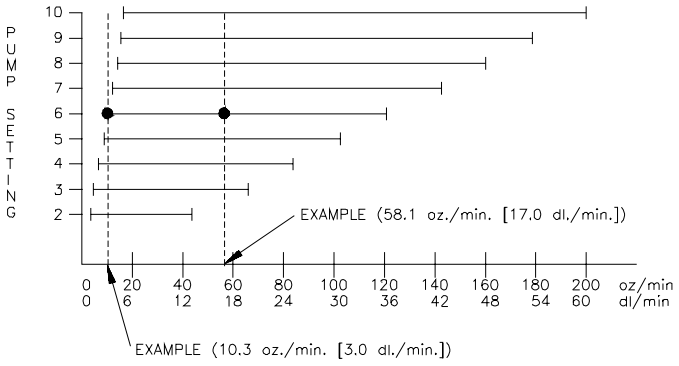


FIGURE 13A

LOW VOLUME PUMP OUTPUT CHART
(1.0-100 oz./MIN)

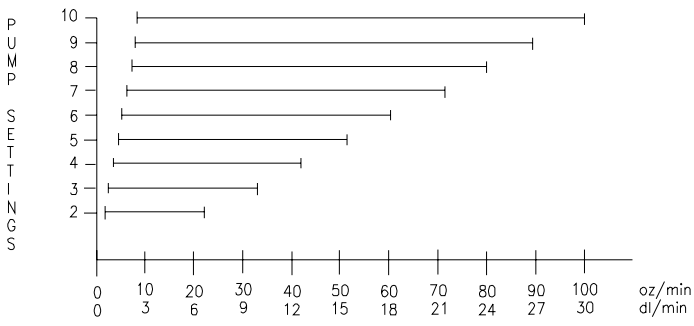


FIGURE 13B

ULTRA-LOW VOLUME PUMP OUTPUT CHART
(.5-40 oz./MIN)

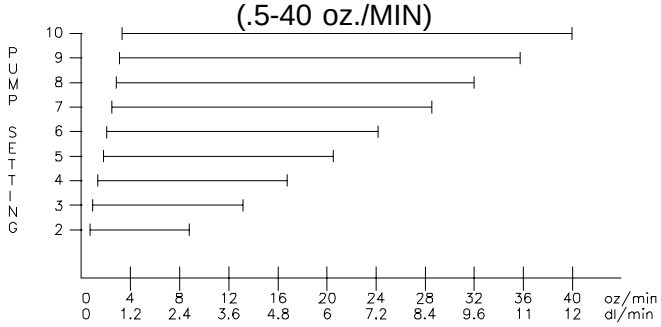


FIGURE 13B

5. ADJUSTING PUMP SETTING

1) Loosen the pump-setting locking nut, pull out on locking pin and rotate the 2-10 setting pointer to the proper number. (See Figure 14).

2) Tighten the pump setting locking nut taking care to keep setting pointer on the number.

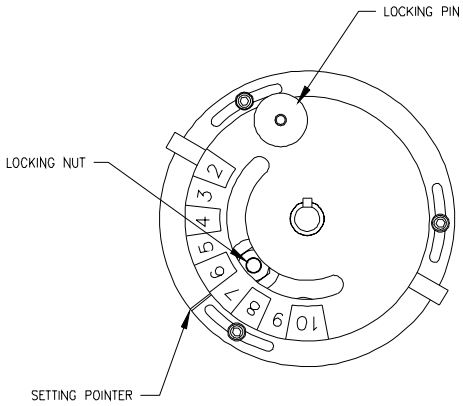


FIGURE 14

CAUTION:	An error in positioning the setting pointer will result in an error in chemical application.

SYSTEM OPERATION

1. INITIAL CARRIER SET-UP

1) Fill tank with water only. (If positive displacement type pump is used, fully open pressure relief valve, PRV).

2) Place MASTER ON/OFF to ON and all BOOM ON/OFF switches to OFF.

3) Place carrier PRODUCT OFF/MAN/AUTO switch to MAN.

4) Place POWER ON/OFF switch to ON.

5) Verify correct Boom Widths, SPEED CALS, METER CALS, VALVE CALS, and RATE CALS have been entered in the Console.

6) Run pump at normal operating RPM.

7) If centrifugal pump is used, proceed to Step 8. If positive displacement type pump is used, set pressure relief valve (PRV) to 65 PSI [448 kPa].

8) Verify that each boom ON/OFF Valve operates and that no nozzles are plugged by operating BOOM ON/OFF switches.

9) Enter a SELF TEST speed equal to that of normal operating speed, verify entry by depressing SPEED (6 MPH [9.6 km/h] is recommended). (See Self Test mode under "SPEED" in "OTHER DISPLAY FEATURES").

10) Place all BOOM ON/OFF switches to ON, the carrier PRODUCT display should display a reading.

11) Hold the carrier PRODUCT INC/DEC switch in INC position for approximately 12 seconds. This assures that the motorized Control Valve is fully open. Verify maximum pressure and carrier PRODUCT rate. (Pressure gauge is not supplied)

NOTE:	A pressure gauge MUST be installed to properly monitor the system.

12) Adjust agitator line hand valve for desired agitation. Verify maximum pressure is still present.

13) Hold the carrier PRODUCT INC/DEC switch in DEC position for approximately 12 seconds. This assures motorized Control Valve is fully closed. Verify minimum pressure and carrier PRODUCT rate can be achieved. If not, consider increasing application rate of carrier or changing type of Control Valve. Consult a Sprayer Dealer.

NOTE:	It is recommended that PRODUCT 1 be used for a Carrier.

2. INITIAL CARRIER FIELD TEST

1) Drive down field or road at target speed with sprayer booms OFF to verify MPH readout on Console.

2) Turn on Sprayer pump and booms, place the carrier PRODUCT OFF/MAN/AUTO switch to AUTO. Increase or decrease speed by one MPH [2 km/h], the system should automatically correct to the target application rate.

3) If, for any reason, the system is unable to correct to the desired GPA [lit/ha], check for an empty tank, a plugged line, a malfunctioning pump, improper vehicle speed, or a defect in the system.

4) If the system does not appear to be correcting properly, review "INITIAL CARRIER SET-UP".

5) At the end of each row, switch the MASTER ON/OFF switch to OFF to shut off flow. This also shuts off the area totalizer.

6) Verify area covered and volume used.

3. INITIAL INJECTION SET-UP

1) Fill Injection Module Tank with **water**.

2) Place the 3-way valve handle on Injection Pump to the "injection" position (See Figure 10C).

3) Place MASTER ON/OFF switch to ON and BOOM ON/OFF switches to OFF.

4) Place all PRODUCT OFF/MAN/AUTO switches to OFF.

5) Place POWER ON/OFF switch to ON.

6) Verify correct Boom Widths, SPEED CALS, METER CALS, VALVE CALS, and RATE CALS have been entered in the Console.

7) Run main carrier pump at normal operating RPM.

8) Verify that each BOOM ON/OFF Valve operates and that no nozzles are plugged by operating Boom ON/OFF switches. (MASTER switch must be ON).

9) Enter a SELF TEST speed equal to that of normal operating speed, verify entry by depressing SPEED (6 MPH [9.6 km/h] is recommended). (See Self Test mode under "SPEED" in "OTHER DISPLAY FEATURES").

10) Place all BOOM ON/OFF switches to ON.

11) Place PRODUCT 2-OFF/MAN/AUTO switch to MAN, the PRODUCT 2 display should display a reading.

12) Verify that by operating the injection PRODUCT 2 INC/DEC switch, that injection PRODUCT 2 can be varied over a wide range above and below the desired application rate in oz/acre [dl/ha]. Then set injection PRODUCT 2 for normal oz/acre [dl/ha] of application.

13) Repeat Steps 11 and 12 for each Product in use.

14) Place OFF/MAN/AUTO switch for each Product in use to AUTO. The system will seek the programmed injection PRODUCT Cal rates.

15) Enter a SELF TEST speed 2 MPH [3.2 km/h] greater than that initially programmed (8.0 MPH) [12.9 km/h]. The system will automatically correct for this speed variation.

16) Turn one BOOM ON/OFF switch to OFF position. The system will automatically correct for this change in boom lengths.

17) Repeat Steps 11 thru 16 for all remaining injection products.

18) Drain water from Injection Module Tank and add chemical.

19) To verify at any time that the Injection Pump is properly calibrated, refer to Appendix 5.

PREVENTIVE MAINTENANCE

Preventive maintenance is most important to assure long life of the system. The following maintenance procedures should be followed on a regular basis:

1) Flush carrier system with water after use of suspension type chemicals. Failure to clean systems can result in crystallization of chemicals which may plug the Flow Meter, lines, and/or tips.

2) Flush and drain system before storing.

IMPORTANT:	Freezing temperatures may damage system if water is not drained.

3) Periodically clean strainer on Injection Module.

4) Check oil level in Injection Pump daily. If addition of oil is required, add Mobil #1 (5W30) ONLY. Drain and refill the pump after every 150 hours of operation. (See Figure 15).

5) Flush Injection system by using flush system (See "RECOMMENDED INJECTION PUMP FLUSH SYSTEM") or by recirculating water through Injection Module until pump is clear of chemical. When storing at the end of season, recirculate antifreeze during the last flush.

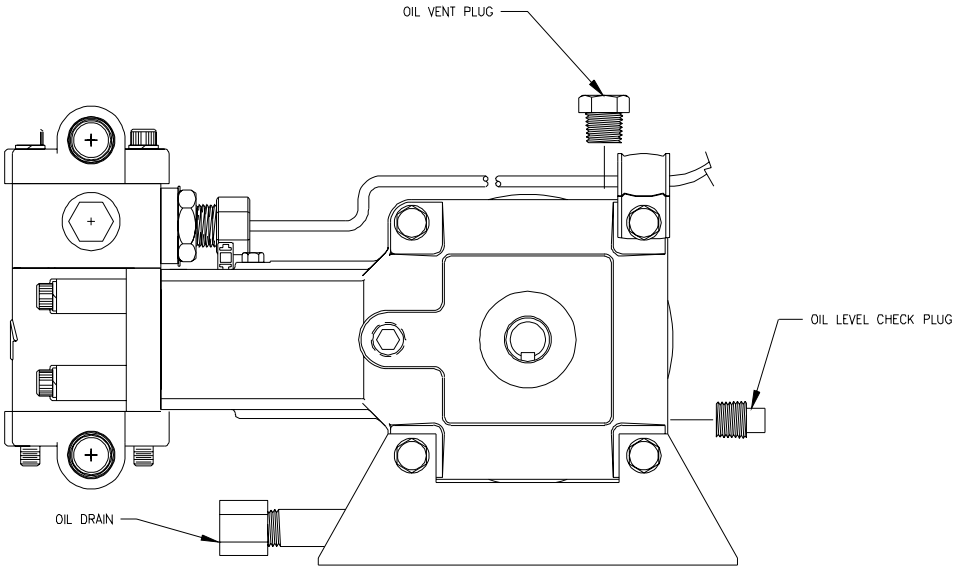


FIGURE 15

APPENDIX 1
WHEEL DRIVE SPEED SENSOR INSTALLATION AND CALIBRATION PROCEDURE

1. MOUNTING WHEEL DRIVE SPEED SENSOR

The Wheel Drive Speed Sensor consists of four magnets, a switch assembly with cable, and mounting hardware.

Sequence of mounting Speed Sensor:

I) Select a non-driven wheel (left front tractor wheel or implement wheel).

2) Check for predrilled holes in rim. If not predrilled, see "RIM DRILLING INSTRUCTIONS FOR WHEEL DRIVE SPEED SENSOR".

3) Mount the four magnets to inside of rim and tighten. (See Figures 16A, 16B, & 16C). Magnets must be mounted in alternating red-black order.

4) Mount switch assembly to stationary column with the hardware provided. (See Figure 16A). The switch assembly need not pivot with the wheel.

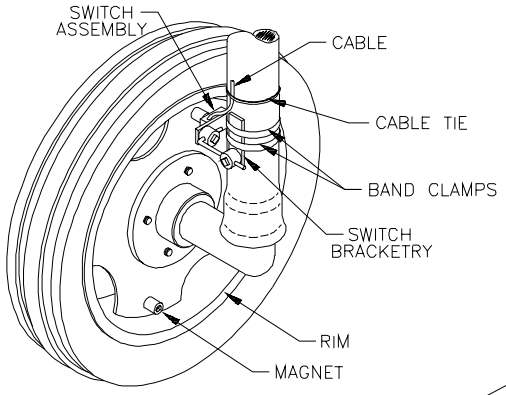


FIGURE 16A

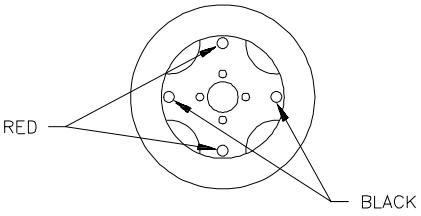


FIGURE 16B

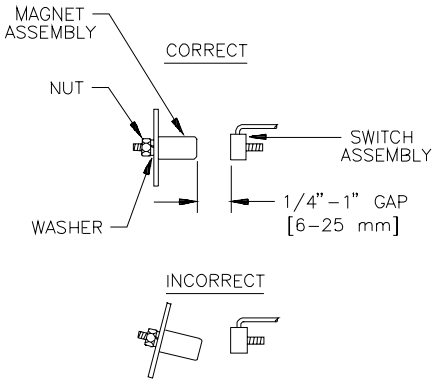


FIGURE 16C

5) Position switch assembly so that as the wheel rotates the magnets pass across the center of the black, molded switch assembly. (See Figures 16A & 16C).

6) Clearance gap between magnets and switch assembly must be between 1/4 inch [6 mm] and 1 inch [25 mm]. With wheels pointed straight ahead, rotate wheel to ensure gap is correct. Make sure vehicle wheels can be turned to their extremes in each direction without the magnets hitting the switch assembly.

7) Tighten switch assembly bracketry.

8) Secure cable to column with plastic cable ties.

2. RIM DRILLING INSTRUCTIONS FOR WHEEL DRIVE SPEED SENSOR MAGNETS

On wheels which do not have pre-punched mounting holes, proceed as follows:

RIMS WITH FOUR OR EIGHT HOLE STUD PATTERN:

Choose stud holes that are opposite each other as shown in Figure 17A. Using the center of opposite holes, scribe two lines on the rim web to divide the circumference into four equal parts. Measure in one inch from the outer edge of the web on each of the lines drawn. Mark this point as the center. Drill four 1/2" holes for mounting the magnets.

NOTE:	Distance (D) between each set of drilled holes must be equal within 1/8" [3 mm] to ensure accuracy of system.

RIMS WITH SIX HOLE STUD PATTERN:

Locate the center of the holes to be drilled by using the rim webbing as a guide. (See Figure 17B). Obtain a small piece of wood and cut to fit exactly over the web as shown in Figure 17B. Measure the length of the piece of wood and mark the center on one edge. Using the center mark on the piece of wood, mark each of the four webs. Measure in one inch from the outer edge of the web on each of the lines drawn. Mark this point as center and drill four 1/2" holes for mounting the magnets.

NOTE:	Distance (D) between each set of drilled holes must be equal within l/8" [3 mm] to ensure accuracy of system.

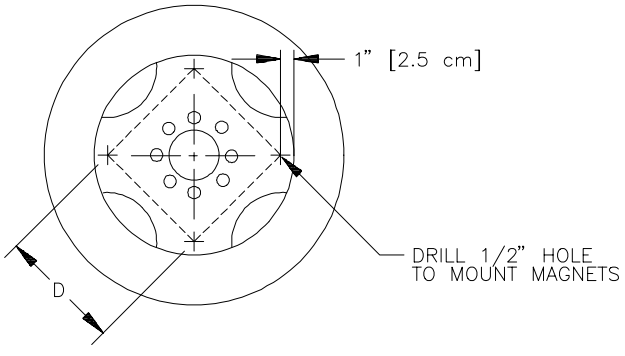


FIGURE 17A
EIGHT HOLE STUD PATTERN

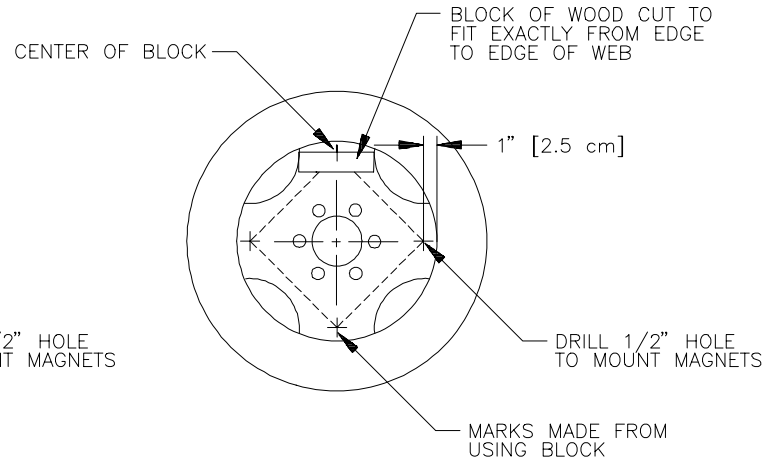


FIGURE 17B
SIX HOLE STUD PATTERN

3. CALCULATING "SPEED CAL"

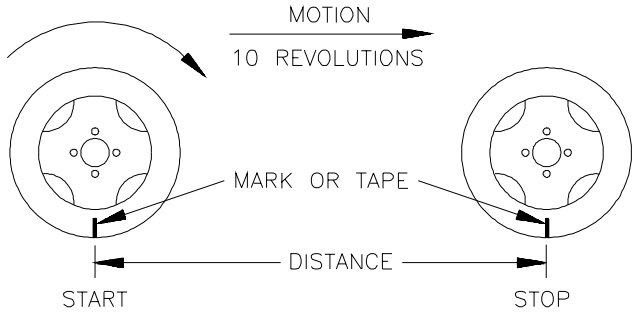
1) Place a chalk mark or tape onto the vehicle tire that the Speed Sensor mounted to it as shown below.

2) Mark the initial spot on the ground.

3) Drive vehicle straight ahead counting 10 full revolutions of the wheel. The mark must stop at the same position it was in when the vehicle started.

4) Measure the distance from the ground starting mark to stopping mark in inches [dm] (Round off fractions).

5) Write down this distance as the SPEED CAL number; keep it for future reference when programming the Console.



NOTE:	This measurement is critical to the performance of the Console. **MEASURE CAREFULLY**. Be sure tire is properly inflated before measuring. Measure tire in type of soil in which you will be spraying. Circumference of tire will vary when measured in soft soil versus hard packed soil. For best results, measure several times and average the results.

Large tires and very low speed applications may require additional magnets to insure accurate speed readings. Any even number of magnets may be used as long as they are of alternating color and equally spaced. After calculating "SPEED CAL", this number must be adjusted according to the number of magnets used.

$$\frac{\text{Normal Number of Magnets}}{\text{Actual Number of Magnets}} \times \text{Speed Cal} = \text{Adjusted Speed Cal}$$

Example: $\frac{4}{6} \times 1200 = 800$

SCS 330, SCS 500 and SCS 550 normally use two magnets. All other consoles normally use four magnets.

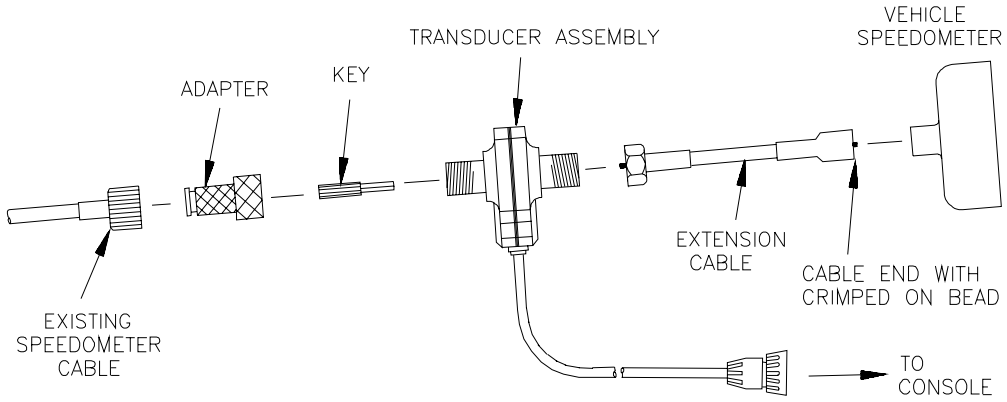
APPENDIX 2
SPEEDOMETER DRIVE SPEED SENSOR INSTALLATION AND CALIBRATION PROCEDURE

1. MOUNTING THE SPEEDOMETER DRIVE SPEED SENSOR

1) Remove the existing speedometer cable from the back of the vehicle speedometer. Pull cable through fire wall into engine compartment.

2) Install adapter and key on speedometer cable and connect to Transducer Assembly. (Some units do not use adapter and key).

3) Connect Extension Cable to Transducer Assembly.



4) Push Extension Cable through fire wall and re-install on speedometer.

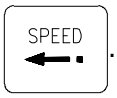
5) Connect the cable on the Transducer Assembly to the Console.

6) Secure all cables with plastic cable ties.

You are now ready to calibrate the Speedometer Drive Speed Sensor.

2. CALCULATING "SPEED CAL"

1) Complete "INITIAL CONSOLE PROGRAMMING" before doing this procedure.

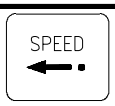
2) Press 

. Enter “0” in key labelled:

3) Enter a SPEED CAL of 612 [155] in key labelled: 

4) Drive 1 mile [1 km].

> **CAUTION:** Do not use vehicle odometer to determine distance. Use section lines or Highway markers.

5) Read DISTANCE by depressing key labelled: 

a) DISTANCE should read a value of approximately 5280 [1000]. If it reads between 5200-5350 [990-1010], the SPEED CAL for your vehicle is 612 [155].

b) If the DISTANCE display reads any other value, perform the following calculation:

Multiply the SPEED CAL by the target distance reading, then divide the sum by the actual value in DISTANCE display. This will give the corrected value to enter for SPEED CAL. ***You must round off to the nearest 3 digit whole number.***

EXAMPLE: SPEED CAL = 612 [155]
Target distance reading = 5280 [1000]
Assume the actual DISTANCE display reads 5000 [980]

	ENGLISH UNITS:	**METRIC UNITS:**
=	$\frac{612 \times 5280}{5000} = 646.3$	$= \frac{[155] \times [1000]}{[980]} = [158.1]$

6) The corrected number to enter for SPEED CAL is 646 [158].

7) Verify the corrected SPEED CAL number calculated above:

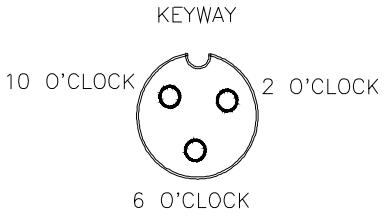
a) Zero out the DISTANCE display as in Step 2.

b) Enter the corrected SPEED CAL number as in Step 3.

c) Repeat Steps 4 and 5a. If DISTANCE value does not read correctly repeat Steps 5b, 6, and 7.

APPENDIX 3
PROCEDURE TO TEST SPEED SENSOR EXTENSION CABLES

Verify that the Console is in the SP1 Speed Sensor mode while testing the cable. Disconnect extension cable from Speed Sensor Assembly cable. Hold extension cable connector so that keyway is pointing in the 12 o'clock position.



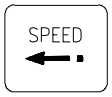
PIN DESIGNATIONS
2 o'clock socket location is power.
10 o'clock socket location is ground.
6 o'clock socket location is signal.

VOLTAGE READINGS
1) 10 o'clock socket to 6 o'clock socket = +5 VDC.
2) 10 o'clock socket to 2 o'clock socket = +5 VDC.

If a +5 VDC voltage reading is not present, disconnect the Flow Sensor cable. If the Speed reading is restored, Test the Flow Sensor cable per Appendix "PROCEDURE TO TEST FLOW METER CABLES".

PROCEDURE TO CHECK CABLE:

I) Enter SPEED CAL number of 1000 in key labelled: 

2) Depress key labelled: 

3) With small jumper wire (or paper clip), short between the 10 o'clock and 6 o'clock sockets with a "short-no short" motion. Each time a contact is made, the DISTANCE total should increase by increments of 1 or more counts.

4) If DISTANCE does not increase, remove the section of cable and repeat test at connector next closest to Console. Replace defective cable as required.

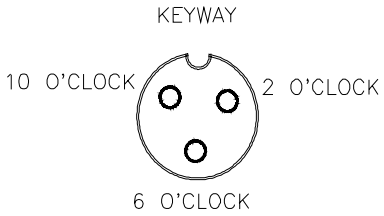
5) Perform above voltage checks.

6) If all cables test good, replace Speed Sensor.

NOTE: After testing is complete, re-enter correct SPEED CAL number before application.

APPENDIX 4
PROCEDURE TO TEST FLOW METER CABLES

Disconnect cable from Flow Sensor. Hold Flow Sensor cable so that the keyway is pointing in the 12 o'clock position:



PIN DESIGNATIONS
2 o'clock socket location is ground.
10 o'clock socket location is power.
6 o'clock socket location is signal.

VOLTAGE READINGS
1) 2 o'clock socket to 6 o'clock socket = +5 VDC.
2) 2 o'clock socket to 10 o'clock socket = +5 VDC.

If a +5 VDC voltage reading is not present, disconnect the Speed Sensor cable. If the Flow reading is restored, Test the Speed Sensor cable per Appendix "PROCEDURE TO TEST SPEED SENSOR EXTENSION CABLES".

PROCEDURE TO CHECK CABLE:

1) Enter a METER CAL number of one (1) in key labelled: METER CAL 5

2) Depress key labelled: TOTAL VOLUME

3) Place BOOM switches to ON.

4) With small jumper wire (or paper clip), short between the 2 o'clock and 6 o'clock sockets with a "short-no short" motion. Each time a contact is made, the TOTAL VOLUME should increase by increments of 1 or more counts.

5) If TOTAL VOLUME does not increase, remove the section of cable and repeat test at connector next closest to Console. Replace defective cable as required.

6) Perform above voltage checks.

7) If all cables test good, replace Flow Sensor.

NOTE: After testing is complete, re-enter correct METER CAL numbers before application.

APPENDIX 5
PROCEDURE TO RE-CALIBRATE PUMP

1) Enter 50 into the METER CAL key on the SCS 750 Console.

2) Place 3-way valve handle on Injection Pump to recirculate position. (See Figure 10C).

3) Place BOOM and MASTER switches ON. Place the OFF/MAN/AUTO switch for product under test to MAN.

4) Run pump until liquid appears from tank return hose. Place OFF/MAN/AUTO switch to OFF.

5) Enter "0" into TOTAL VOLUME key for product under test.

6) Place tank return hose into measuring container.

7) Place OFF/MAN/AUTO switch to MAN until 50 ounces of measured chemical is pumped. The number displayed in TOTAL VOLUME is the new METER CAL.

8) Enter this new METER CAL number in METER CAL key.

9) Enter "0" in TOTAL VOLUME key.

10) Place OFF/MAN/AUTO switch to MAN until 50 ounces of measured product is pumped.

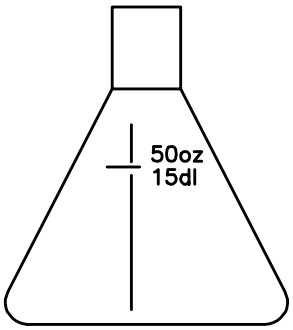
11) The number in TOTAL VOLUME should be 49, 50, or 51. If not, repeat calibration procedures.

12) Empty tank return hose into measuring container.

13) Pour product caught in measuring container back into Injection Module Tank.

14) Repeat procedure to calibrate remaining Injection Pumps.

CALIBRATION FLASK
106–0159–454



APPENDIX 6
IMPREGNATION MODULE INSTALLATION

1. PLUMBING IMPREGNATION MODULE

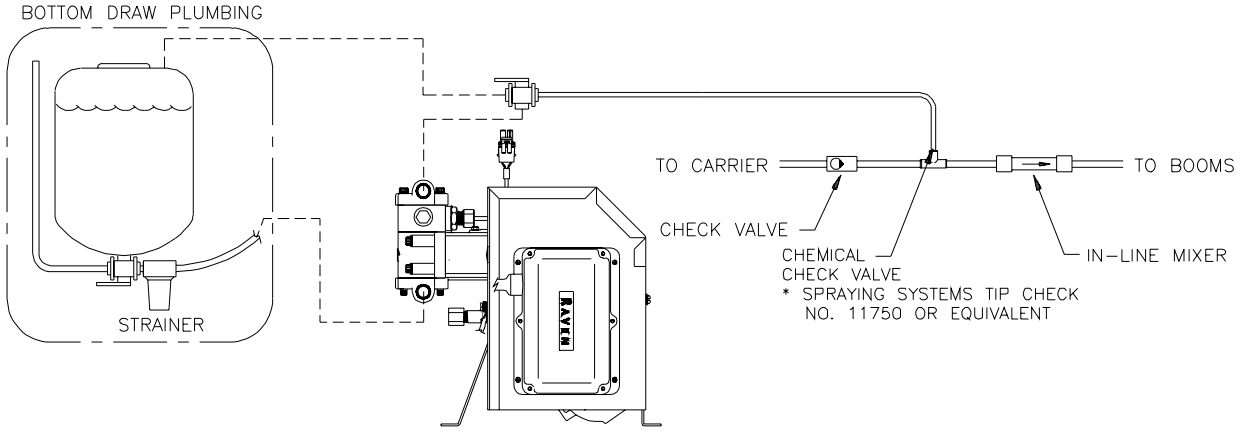


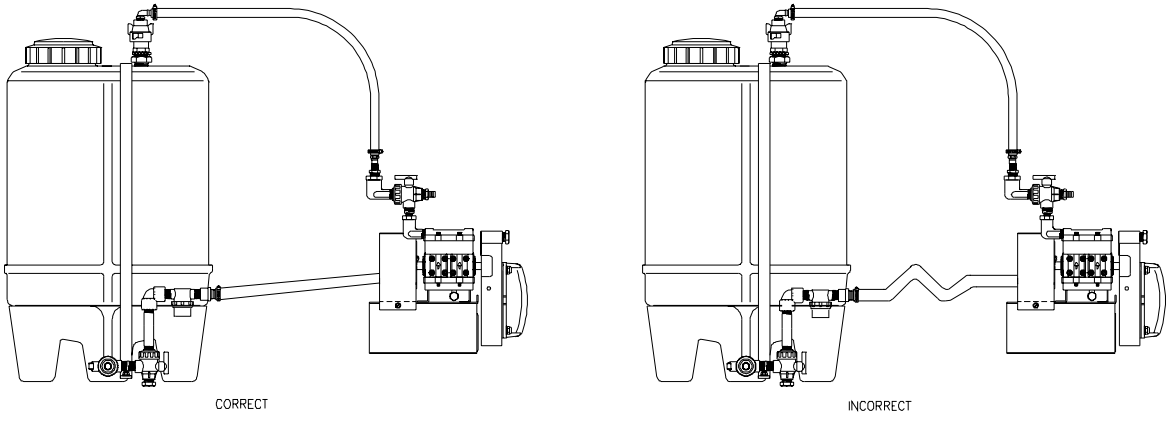
FIGURE 19

1) Plumb the Pressure Relief Valve (PRV), Flow Meter, Control Valve, Carrier Check Valve, Product Check Valve, and In-Line Mixer just ahead of the Boom On/Off Valves as shown in Figure 4.

2) Mount Injection Module close to the Boom On/Off Valves to minimize amount of product in tubing.

3) Plumb three way valve on output line of Injection Module (See Figure 19). Plumb recirculation line from three way valve to Product supply tank using 3/8 inch [10mm] tubing. Plumb injection line from three way valve to product check valve using 3/8 inch [10mm] tubing (For low volume modules) or 1/2 inch [13mm] tubing (for high volume modules). Product Check Valve and tubing not furnished.

4) Plumb inlet hose from product tank as shown in Figure 20.



IMPORTANT: Inlet hose must have gradual upward slope to pump inlet fitting with no dips or sags.

FIGURE 20

5) See "ADJUSTING PUMP SETTING".

6) See "MOUNTING THE CONSOLE AND CABLING" for installation of Control Console.

APPENDIX 7
INJECTION MODULE INSTALLATION

1. PLUMBING THE INJECTION MODULE

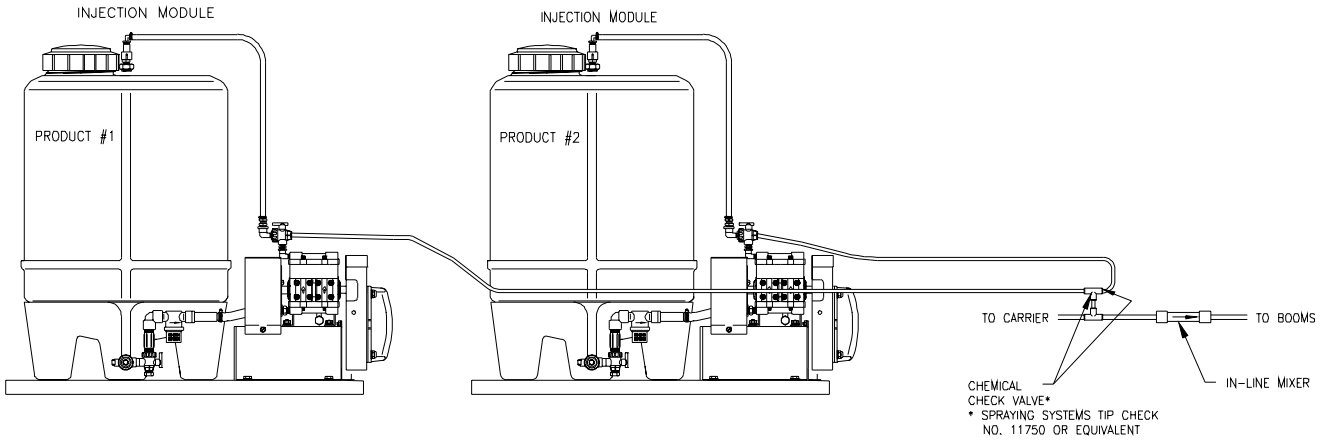


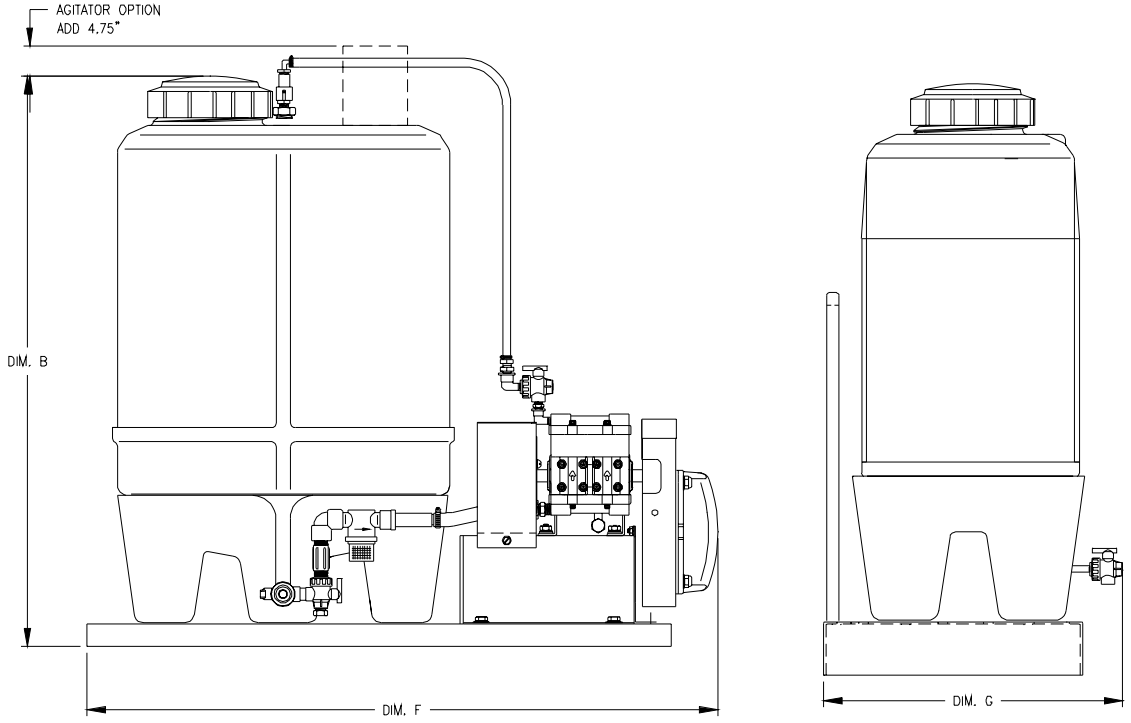
FIGURE 22

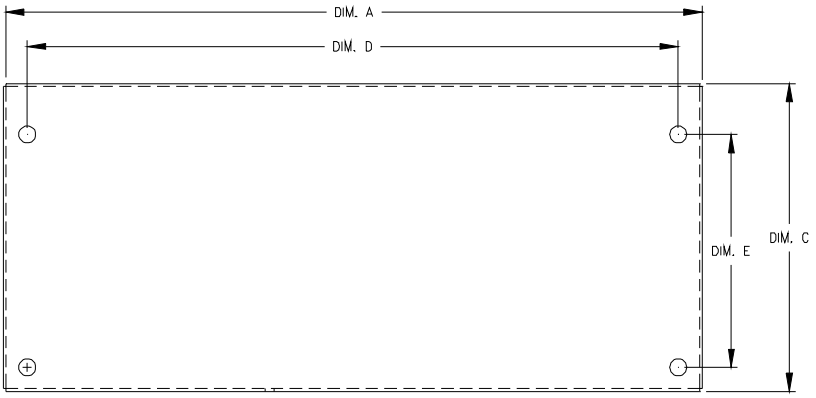
1) Plumb Pressure Relief Valve (PRV), Flow Meter, Control Valve, Carrier Check Valve, Product Check Valves, and In-line Mixer just ahead of the Boom On/Off Valves as shown in Figure 4.

2) Mount Injection Modules close to the Boom On/Off Valves to minimize amount of product in tubing.

3) Plumb output lines of Injection Modules to Product Check Valves (See Figure 22). Use 3/8 inch [10 mm] tubing on low volume modules and 1/2 inch [13 mm] tubing on high volume modules. Product Check Valves and tubing not furnished.

2. MOUNTING INJECTION MODULE





INJ. MODULE	UNITS	DIM A	DIM B	DIM C	DIM D	DIM E	DIM F	DIM G
16 GALLON	IN	29.68	33	12.15	27.78	10.25	32	17
	CM	75.4	83.8	30.8	70.6	26	81.3	43.2
24 GALLON	IN	29.68	41.5	12.15	27.78	10.25	32	17
	CM	75.4	105.4	30.8	70.6	26	81.3	43.2

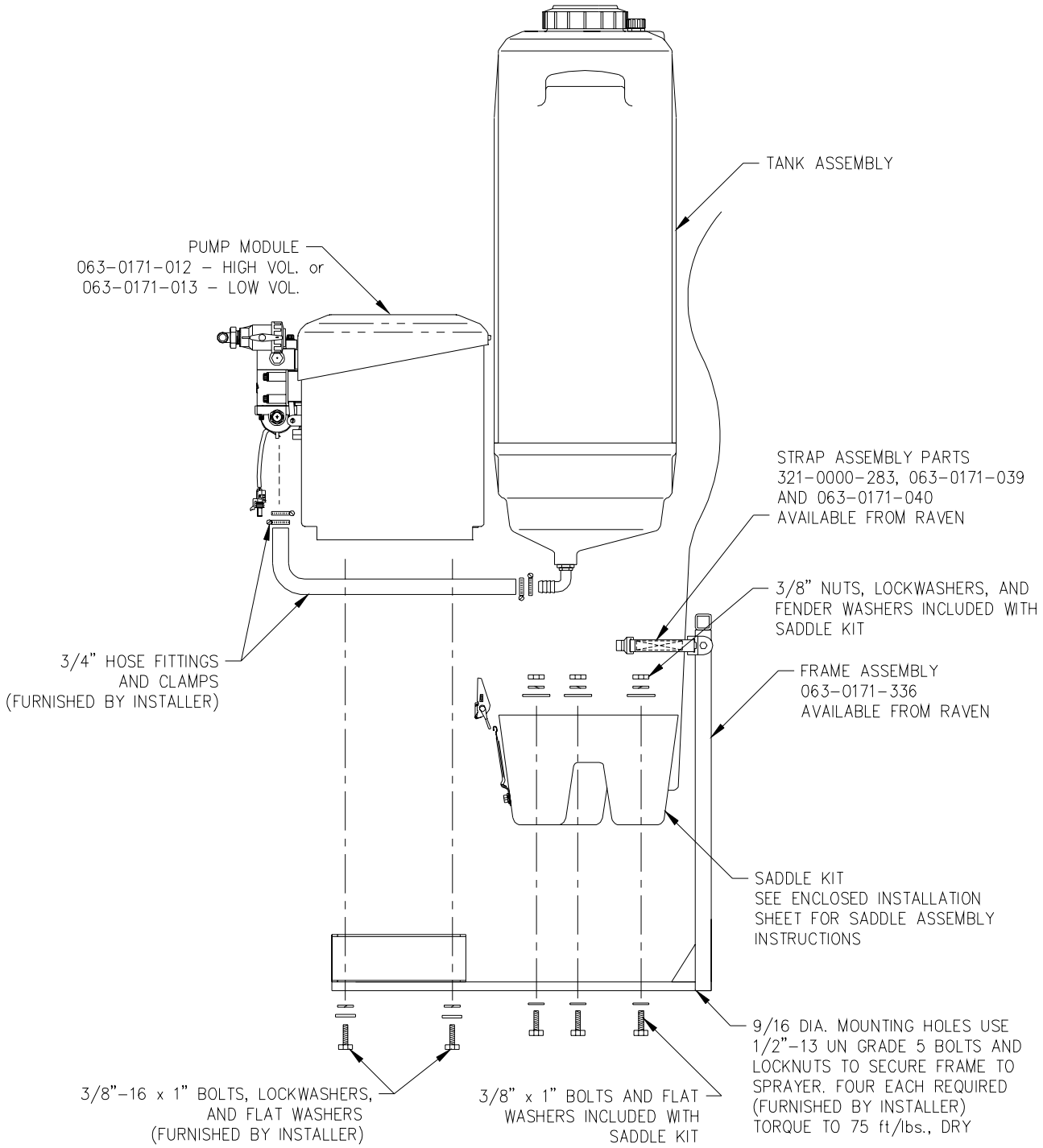
FIGURE 23

1) Mount injection module using bolts in four corners. Reinforce vertical supports with external braces (steel angle iron or tubing) that are secured to structure of mobile sprayer. **OPERATION OF SYSTEM WITHOUT EXTERNAL BRACES MAY CAUSE FAILURE OF TANK SUPPORTS.**

2) See "INITIAL INJECTION SET-UP" before operating system.

APPENDIX 8
INJECTION MODULE MOUNTING INSTRUCTIONS

1. TYPICAL MODULE DIAGRAM



2. MODULE ASSEMBLY INSTRUCTIONS

1) Install the straps onto tank saddle per instructions enclosed in saddle kit, and secure saddle to frame (See "TYPICAL MODULE DIAGRAM").

2) Connect hose to elbow on bottom of tank, and secure with two hose clamps. Position clamps opposite to each other for best seal. Place tank in saddle and secure with straps.

3) Install over center buckle on the large strap by inserting webbing thru the metal loop, back thru upper slot. thru the lower slot, and back thru the metal loop as shown in Detail A.

4) Secure with buckle and safety pin on small strap (See Detail B).

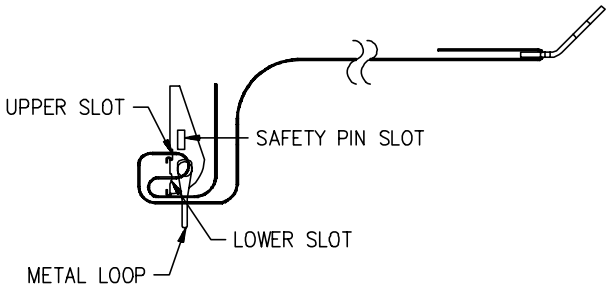
5) Mount pump module to frame using the 3/8" x 1" bolts, lockwashers, and flat washers.

6) Connect hose from tank to hose barb on pump and secure with two hose clamps. Position hose clamps opposite each other for best seal.

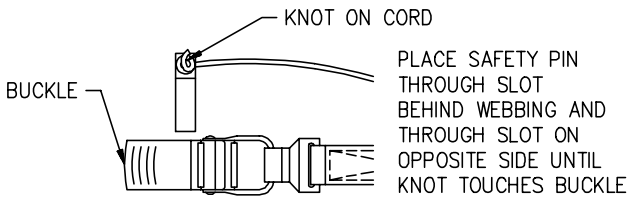
If Strap Assembly parts are desired:

7) Attach the large strap onto right side of the frame using 7/16" x 1 3/4" bolt, lockwasher, and nut.

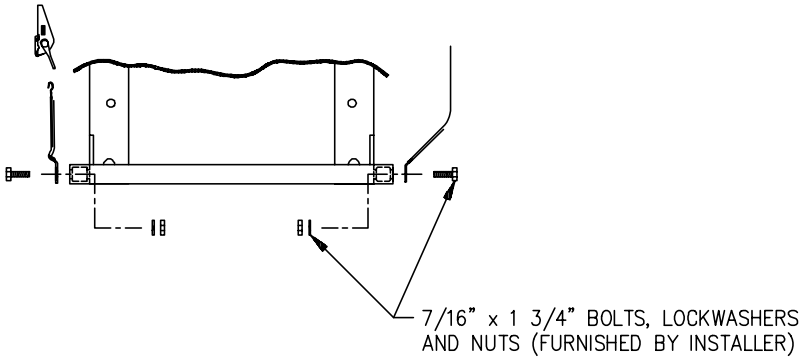
8) Attach the small strap on the left side of the frame using a 7/16" x 1 3/4" bolt, lockwasher, and nut as shown in Detail C.



DETAIL A



DETAIL B



DETAIL C

APPENDIX 9
FLOW METER MAINTENANCE AND ADJUSTMENT PROCEDURE

1) Remove Flow Meter from sprayer and flush with clean water to remove any chemicals.

NH_3 WARNING:	Thoroughly bleed nurse tank hose and all other system lines prior to disassembling the Flow Meter, fittings, and hoses.

2) Remove flange bolts or clamp from the Flow Meter.

3) Remove the turbine hub and turbine from inside Flow Meter.

4) Clean turbine and turbine hub of metal filings or any other foreign material, such as wettable powders. Confirm that the turbine blades are not worn. Hold turbine and turbine hub in your hand and spin turbine. The turbine should spin freely with very little drag inside the turbine hub.

5) If transducer assembly is replaced or if turbine stud is adjusted or replaced, verify the turbine fit before reassembling. Hold turbine hub with turbine on transducer. Spin turbine by blowing on it. Tighten turbine stub until turbine stalls. Loosen turbine stud 1/3 turn. The turbine should spin freely.

6) Re-assemble Flow Meter.

7) Using a low pressure (5 psi) [34.5 kPa] jet of air, verify the turbine spins freely. If there is drag, loosen hex stud on the bottom of turbine hub 1/16 turn until the turbine spins freely.

8) If the turbine spins freely and cables have been checked per Appendix "PROCEDURE TO TEST FLOW CABLES", but Flow Meter still is not totalizing properly, replace Flow Meter transducer.

APPENDIX 10
PROCEDURE TO RE-CALIBRATE FLOW METER

1) Enter a METER CAL number of 10 [38] in the key labelled:

2) Enter a TOTAL VOLUME of 0 in the key labelled:

3) Switch OFF all booms.

4) Remove a boom hose and place in calibrated 5 gallon [19 liter] container.

5) Switch ON appropriate boom switch and MASTER switch. Pump exactly 10 gallons [38 liters].

6) Readout in TOTAL VOLUME is the new METER CAL number. This number should be within +/- 3% of the number stamped on the tag on Flow Meter.

7) Repeat this procedure several times to confirm accuracy. (Always "zero out" the TOTAL VOLUME display before retesting).

NOTE:	For greatest precision, set METER CAL to 100 and pump 100 gallons (378 liters) of water.

8) To verify Flow Meter calibration, fill applicator tank with a predetermined amount of measured liquid (i.e. 250 gallons). **DO NOT RELY ON GRADUATION NUMBERS MOLDED INTO APPLICATOR TANK.** Empty the applicator tank under normal operating conditions. If the number displayed under TOTAL VOLUME is different from the predetermined amount of measured liquid by more than +/ - 3%, complete the following calculation.

EXAMPLE:

METER CAL	= 720 [190]
TOTAL VOLUME	= 260 [984]
Predetermined amount of measured liquid	= 250 [946]

$$\text{Corrected METER CAL} = \frac{\text{METER CAL} \times \text{TOTAL VOLUME}}{\text{Predetermined amount of measured liquid}}$$

ENGLISH UNITS:	METRIC UNITS:
$= \frac{720 \times 260}{250} = 749$	$= \frac{[190] \times [984]}{[946]} = [198]$

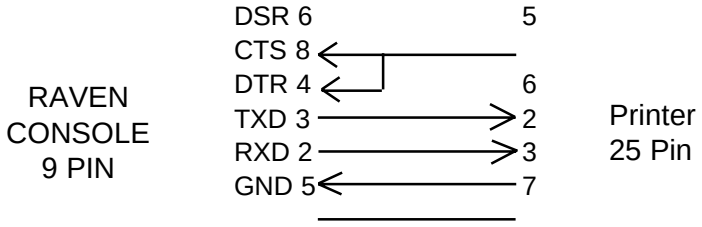
Corrected METER CAL = 749 [198]

9) Enter corrected METER CAL before resuming application.

NOTE:	For RFM 200 series Flow Meter, use old METER CAL number 164 [43] and calibrate as described in Step 8.

APPENDIX 11
SERIAL INTERFACE

1) Cable pinout (P/N 115-0159-624), supplied with Thermal Printer Kit (Part number 117-0159-529).



2) Changing RATE CAL by remote computer.

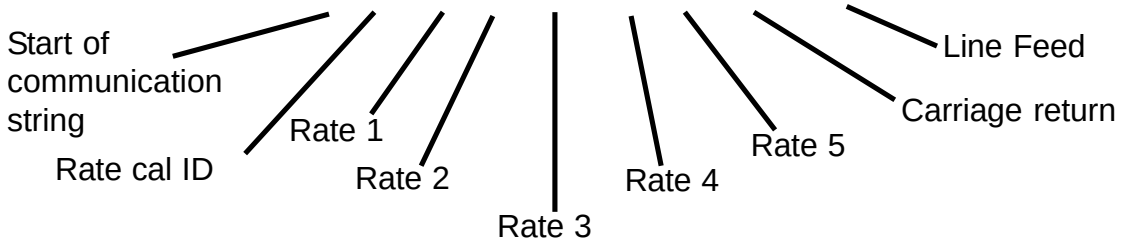
a) Configuration of RS-232c serial port:

1200 or 9600 Baud Rate
NO Parity
8 Data Bits
2 Stop Bits

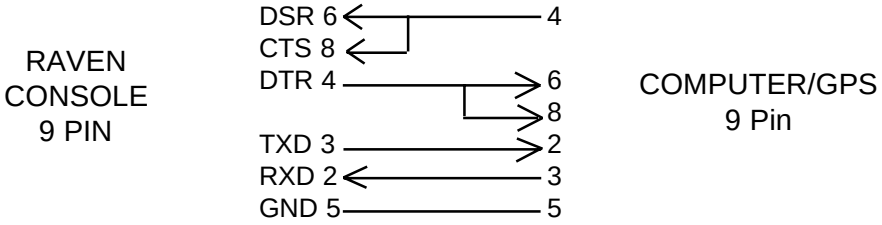
b) Data stream to Raven Console.

EXAMPLE: Change Product 1 rate to 130.0
Change Product 2 rate to 0.0
Change Product 3 rate to 102.7
Change Product 4 rate to 65.5
Change Product 5 rate to 9.5

$R,RC,1300,0,1027,655,95<CR><LF>



3) Optional 9 pin to 9 pin cable pinout (P/N 115-0159-822).



APPENDIX 12
SCS 750 COMMUNICATION STRINGS

REMOTE COMPUTER TO SCS 750 CONSOLE

All request strings begin with $R, to indicate a Raven communication string.

Rate Change Request:

To set Rate Cal values for all five products:

$R,RC,<rate_1_cal>,<rate_2_cal>,<rate_3_cal>,
<rate_4_cal>,<rate_5_cal><CR><LF>

To set Rate Cal values for products 2 and 5 only:

$R,RC,,<rate_2_cal>,,,<rate_5_cal><CR><LF>

Calibration String Values Request:

$R,CR<CR><LF>

Data String Request:

$R,DR<CR><LF>

SCS 750 CONSOLE TO REMOTE COMPUTER

All console output strings begin with $R014D, the $R indicates a Raven communication string, the 014 is the last three digits of the current SCS 750 programmed chip part number and D is the software revision number.

Calibration Strings:

$R014D,C1,<switch_byte_1>,<switch_byte_2>,<switch_byte_3>,
<boom_1_cal>,<boom_2_cal>,<boom_3_cal>,<boom_4_cal>,
<boom_5_cal>,<boom_6_cal>,<boom_7_cal>,<boom_8_cal>,
<boom_9_cal>,<boom_10_cal>,<speed_cal> <CR><LF>

$R014D,C2,<meter_1_cal>,<meter_2_cal>,<meter_3_cal>,
<meter_4_cal>,<meter_5_cal><CR><LF>

$R014D,C3,<valve_1_cal>,<valve_2_cal>,<valve_3_cal>,
<valve_4_cal>,<valve_5_cal>,<rate_1_cal>,<rate_2_cal>,
<rate_3_cal>,<rate_4_cal>,<rate_5_cal><CR><LF>

Bit	Switch Byte 1	Switch Byte 2	Switch Byte 3
0	boom 1	boom 8	prod 3 auto
1	boom 2	boom 9	prod 3 manual
2	boom 3	boom 10	prod 4 auto
3	boom 4	prod 1 auto	prod 4 manual
4	boom 5	prod 1 manual	prod 5 auto
5	boom 6	prod 2 auto	prod 5 manual
6	boom 7	prod 2 manual	0
7	1	1	1

NOTE: If prod auto and manual are both zero, the product is in Off.
For switch Byte Bits; 0 = off and 1 = on.

Data Strings:

$R014D,D1,<total_area_1>,<total_area_2>,<total_area_3>,
<total_area_4>,<total_area_5>,<field_area_1>,<field_area_2>,
<field_area_3>,<field_area_4>,<field_area_5><CR><LF>
$R014D,D2,<total_volume_1>,<total_volume_2>,<total_volume_3>,
<total_volume_4>,<total_volume_5>,<field_volume_1>,
<field_volume_2>,<field_volume_3>,<field_volume_4>,
<field_volume_5><CR><LF>
$R014D,D3,<tank_1_volume>,<tank_2_volume>,<tank_3_volume>,
<tank_4_volume>,<tank_5_volume>,<miles/km>,<feet/meters><CR><LF>

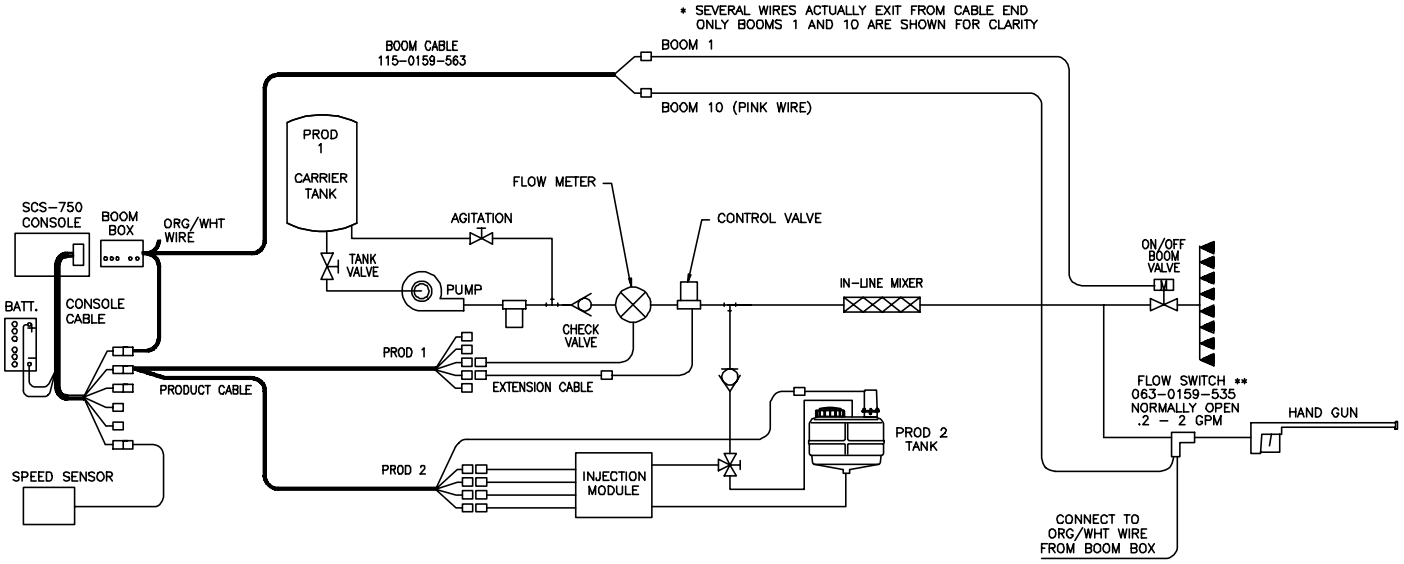
Actual Rate:

$R014D,AR,<actual_rate_1>,<actual_rate_2>,<actual_rate_3>,
<actual_rate_4>,<actual_rate_5><CR><LF>

Time/Date:

$R014D,TD,<hr:min>,<month/day/year>,<field_reference><CR><LF>

APPENDIX 13
HAND GUN OPERATION USING RATIO RATE FEATURE



Ratio Rate feature may be used with chemical injection when hand gun application is desired. The SCS 750 is programmed in the Ratio Rate mode by entering the number "1" into Boom 10. To return to the standard operating mode enter "0" into Boom 10.

When in Ratio Rate, Product 1 is not controlled in the Auto mode. Pressure may be adjusted in the Manual mode.

Products 2 through 5 are controlled in ratio to Product 1. Product 1 rate is shown as vol/min. Enter the desired rate for Products 2 through 5 as volume chemical/volume Product 1.

EXAMPLE: "oz/gal" or "dl/liter"

** For hand gun operation a Flow Switch must be plumbed in line as shown above. Connect one lead of the Flow Switch to the Boom Box "org/wht" wire. Connect the other Flow Switch lead to the Boom 10 "pink" wire.

Hand Gun Operation:

1) Enter "1" as the Boom 10 width.

2) Enter the desired Ratio Rate for Products 2 through 5.

3) Place all Boom Switches to the OFF position.

4) Place the Master Switch to ON.

5) Place AUTO/MAN/OFF switch for Products to be injected to AUTO.

6) When hand gun is operated the injection pump or pumps will run. When the hand gun is OFF, the injection pump or pumps will shut off. The Master Switch overrides injection pump operation. (Continued on next page)

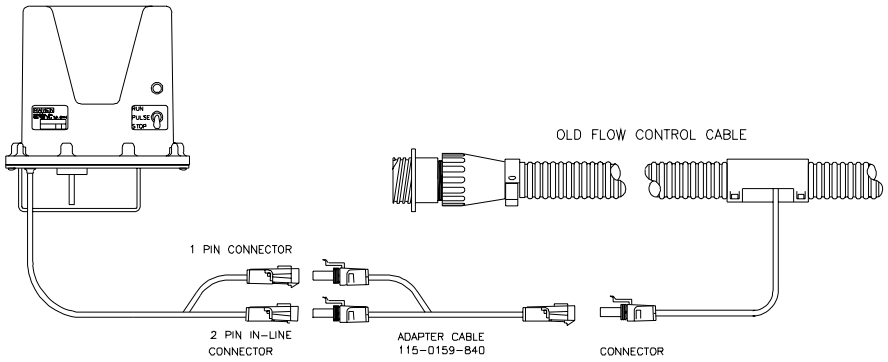
NOTE:	Determine pump setting for hand gun operation. Pump setting may be different than standard operation. **Pump vol/min = Ratio Rate cal X vol/min of product 1** Proceed to pump output chart to determine correct pump setting.

NOTE:	After returning to standard operating mode the Ratio Rate Cal numbers are retained in the Console memory.

IMPORTANT:	Flow switch used must match capacity of hand gun operation. Flow switch must be normally open.

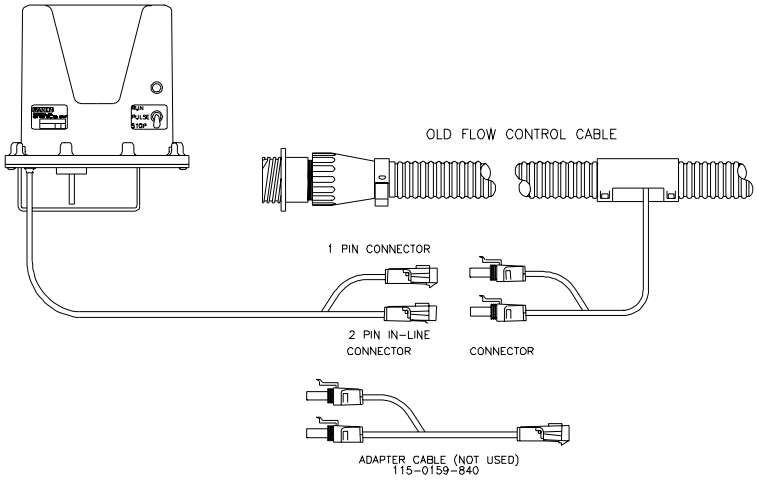
APPENDIX 14
AGITATOR ASSEMBLY HOOK-UP PROCEDURES

I. When using a 1 connector flow control cable with a 2 connector agitator, hook-up cables as shown:



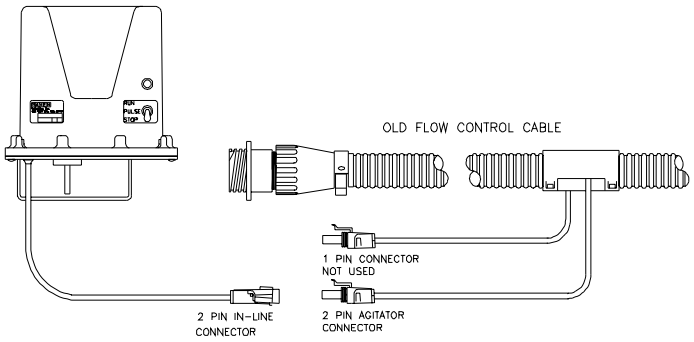
NOTE:	Power and enable lines to the agitator are routed through the Console.

II. When using a 2 connector flow control cable with a 2 connector agitator, hook-up cables as shown:



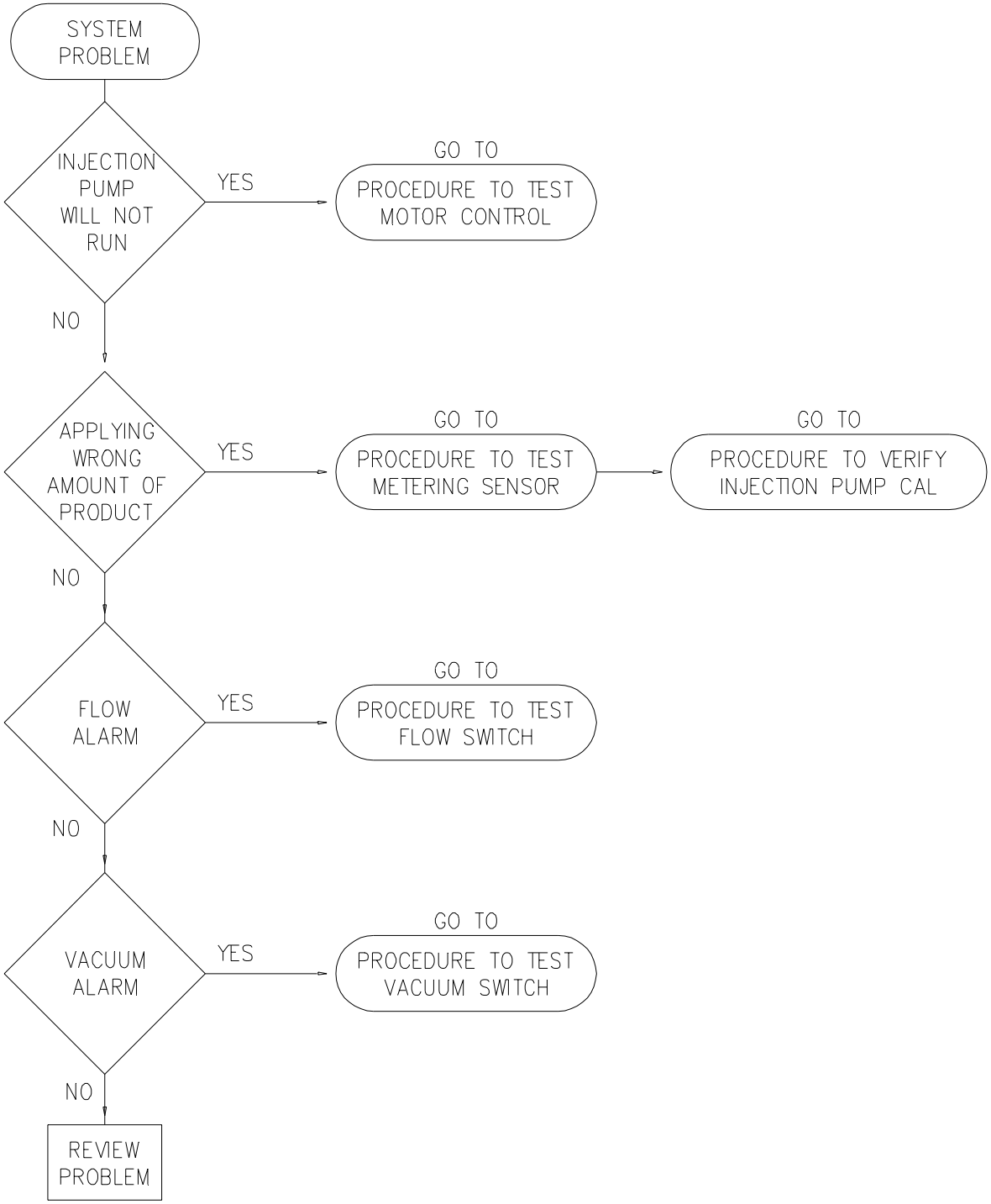
NOTE:	The agitator is enabled through the Console and powered directly from the battery.

III. When using a 2 connector flow control cable with a 1 connector agitator, hook-up cables as shown:



NOTE:	The agitator is powered directly from enable line.

APPENDIX 15
INJECTION SYSTEM TROUBLESHOOTING FLOWCHART



APPENDIX 16
SCS-760
COMBO CONSOLE OPERATION

TABLE OF CONTENTS

The SCS 760 console contains all the features of the SCS 750 plus several additional functions to enhance its operation and flexibility. When initially programming console SYSTEM TYPE and VALVE TYPE must be selected after SPEED SENSOR (SP-1 OR SP-2) has been entered.

1. SELECTING SYSTEM TYPE

Select system type for product highlighted by cursor by depressing ARROW key until desired type is displayed. Depress [ENTER], to enter selection and advance cursor to next PROD. LIQUID (liquid spraying), GRAN 1 (single bed belt), or GRAN 2 (split bed belt).

PROD 1 CAL	PROD 2 CAL	PROD 3 CAL	PROD 4 CAL	PROD 5 CAL
LIQUID	LIQUID	LIQUID	LIQUID	LIQUID
SELECT CONTROL				

2. SELECTING VALVE TYPE

Select valve type for PROD highlighted by cursor by depressing ARROW key until desired type is displayed. Depress [ENTER] to enter selection and advance cursor to next PROD. STANDARD (standard valve), FAST (fast valve), FAST CLOSE (fast close valve), OR PWM (pulse width modulated valve).

PROD 1 CAL	PROD 2 CAL	PROD 3 CAL	PROD 4 CAL	PROD 5 CAL
STANDARD	STANDARD	STANDARD	STANDARD	STANDARD
SELECT VALVE				

Depress [UTILITY MENU] to view selected data. If an entry error was made, reset the console to re-enter data. Continue programming WIDTH (BOOM) CAL, SPEED CAL, METER CAL, VALVE CAL, RATE CAL and OTHER DISPLAY FEATURES as described in the SCS 750 manual. The SPEED screen will include a FAN RPM display. The FAN CAL will be found in the DATA MENU.

Use [▲ 1] to proceed through DATA MENU and make entries as needed according to SCS 750 manual until SPREADER CONSTANT is displayed.

0.0	0.0	0.0	0.0	0.0
0	0	0	0	0
SPREADER CONSTANT				

Entering a SPREADER CONSTANT for each granular product allows the use of product density as the METER CAL.

3. CALCULATING "SPREADER CONSTANT"

1) Find the cubic feet [Cubic cm] of discharge per 1 revolution of the Sensor.
L = Length in inches [cm], of belt travel per 1 revolution of sensor
GH = Gate Height in inches [cm]
GW = Gate Width in inches [cm]

Cubic Feet [cubic cm] of Discharge per 1 revolution of sensor:

$$\text{cu ft/rev. of sensor} = \frac{L \times GH \times GW}{1728}$$

cu cm/rev. of sensor **=** L x GH x GW

EXAMPLE: 1) L = 13 inches [33 cm]
2) GH = 7 inches [18 cm]
3) GW = 15 inches [38 cm]

$$\text{cu ft/rev. of sensor} = \frac{13" \times 7" \times 15"}{1728} = .789$$

cu cm/rev. of sensor **=** 33 x 18 x 38 = 22,572

2) For RATE displayed in 1 lb increments:

$$\text{Spreader Constant (1 lb)} = \frac{\text{counts per rev of sensor}}{\text{cu ft/rev. of sensor}}$$

EXAMPLE: 180 counts per rev $= \frac{180}{.789} = 228$

3) For RATE displayed in 1 Kg increments

$$\text{Spreader Constant (1 Kg)} = \frac{\text{counts per 1 rev of sensor x 100,000}}{\text{cu cm / rev of sensor}}$$

EXAMPLE: 180 counts per rev $= \frac{18,000,000}{22,572} = 797$

Counts per 1 rev of sensor may be determined by entering a METER CAL number of 10, enter 0 in TOTAL VOL and turning sensor exactly 1 revolution. The number in TOTAL VOL will be the counts per 1 rev of sensor.

For systems where calculating voulume of discharge is difficult (metering wheels, augers, etc.) Spreader Constant can be determined by perfoming a catch test.

Confirm that Spreader Constant is zero (no decimal point in Meter Cal) and enter a Meter Cal of 200. Enter zero in Total Volume. Run machine and collect a sample large enough to weigh accurately and perform following calculation.

$$\frac{\text{Meter Cal} \times \text{Total Volume}}{\text{Actual volume}} \times \frac{\text{Product Density}}{10} = \text{Spreader Constant}$$

EXAMPLE:

Meter Cal	= 200
Total Volume	= 200
Weight of collected material	= 128
Product Density	= 50.0lbs/cu.ft.

$$= \frac{200 \times 200}{128} = \frac{312 \times 50}{10} = 1560$$

Spreader Constant = 1560

Enter this number as Spreader Constant and enter Product Density as Meter Cal which will have a decimal point now.

NOTE: Verify Spreader Constant by performing following procedure.

1) Enter a "0" into the TOTAL VOLUME.

2) With the product switch in the MAN position, unload a portion of the load by positioning the boom switch to ON.

3) Determine the actual weight unloaded by re-weighing the truck.

4) Compare to the TOTAL VOLUME displayed by the Console.

5) Perform the following calculation to correct the Spreader Constant if desired:

$$\text{Corrected Spreader Constant} = \frac{\text{old Spreader Constant} \times \text{TOTAL VOLUME}}{\text{actual weight unloaded}}$$

EXAMPLE:

old Spreader Constant	=	228 [797]
TOTAL VOLUME amount	=	2000 lbs [4400 kg]
actual weight unloaded	=	1950 lbs [4290 kg]

English (US):

$$\text{Corrected Spreader Constant (1 lb)} = \frac{228 \times 2000}{1950} = 234$$

Metric (SI):

$$\text{Corrected Spreader Constant (1 kg)} = \frac{[797] \times [4400]}{[4290]} = [817]$$

This is the new Spreader Constant. Repeat this procedure until the weight of the metered material equals the TOTAL VOLUME value.

4. CALCULATING "METER CAL"

Product Density in lbs/cu.ft. [grams/liter] is entered as METER CAL.

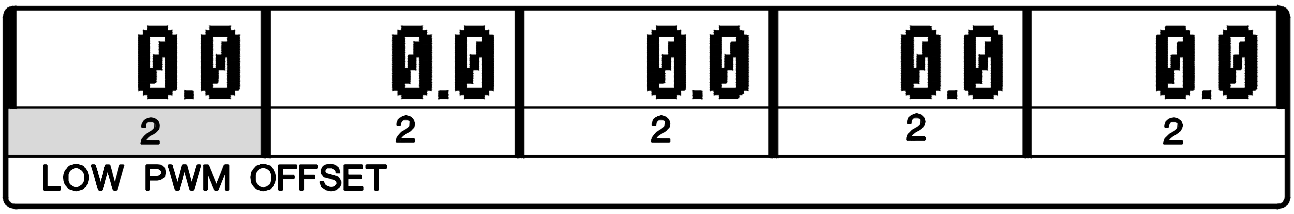
NOTE:	To increase the system accuracy when applying at low rates, use the decimal shift feature as explained in CONSOLE PROGRAMMING.

5. LOW PWM OFFSET

a) Place PRODUCT switch to MAN and BOOM or MASTER switch ON. The display will show 2.

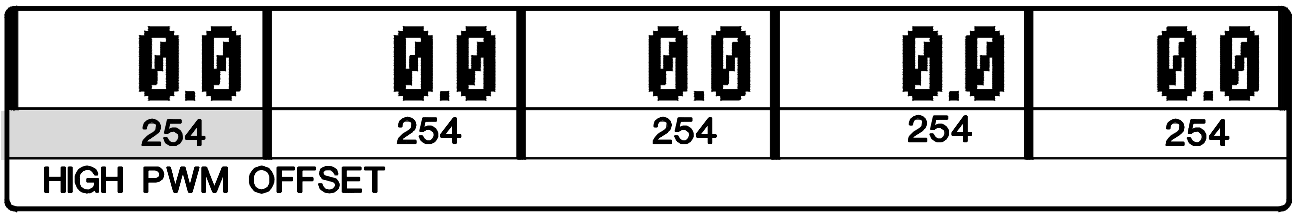
b) Increase this number until motor runs, then enter a number of 10 less.

c) Hold INC/DEC switch to DEC. If Motor does not stop, lower offset number by 10 and push DEC switch again.



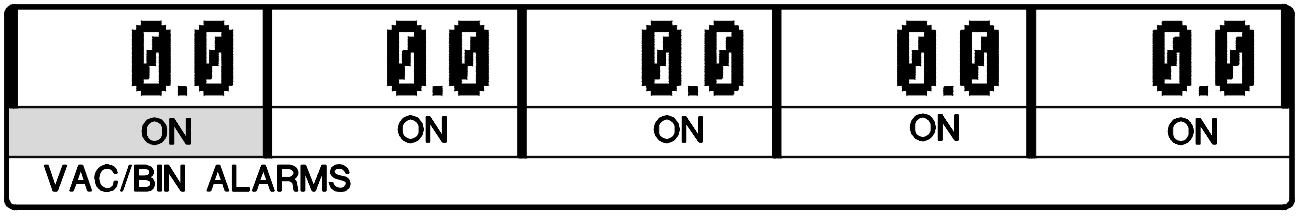
6. HIGH PWM OFFSET

Place PRODUCT switch to MAN and BOOM or MASTER switch to ON. The display will show 254. Decrease this number until motor runs at desired maximum RPM then enter a number of 10 more. Hold INC/DEC switch to INC, if motor exceeds desired RPM decrease number by 10 and push INC again.



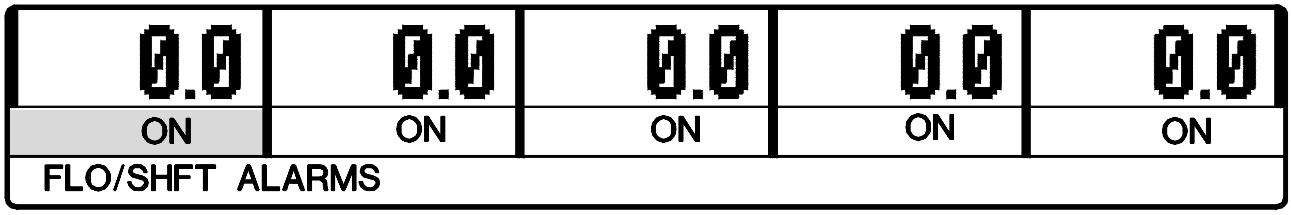
7. VAC/BIN ALARMS

The alarms may be disabled by entering OFF under selected product. Depress ENTER. "E" will illuminate in the cursor. Use the ARROW keys to toggle between OFF and ON and depress ENTER.



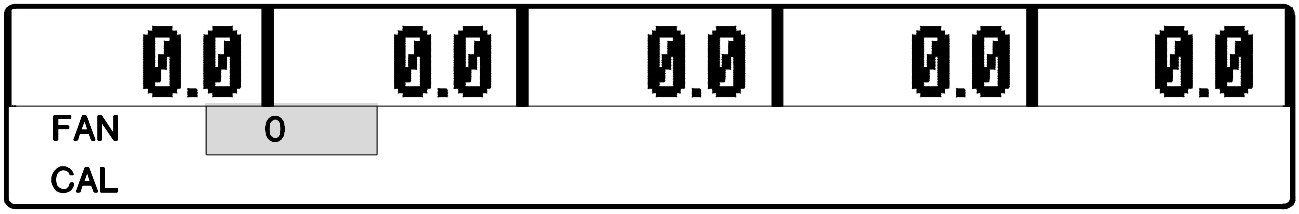
8. FLO/SHFT ALARMS

The alarms may be disabled by entering OFF under selected product. Depress ENTER. "E" will illuminate in the cursor. Use the ARROW keys to toggle between OFF and ON and depress ENTER.



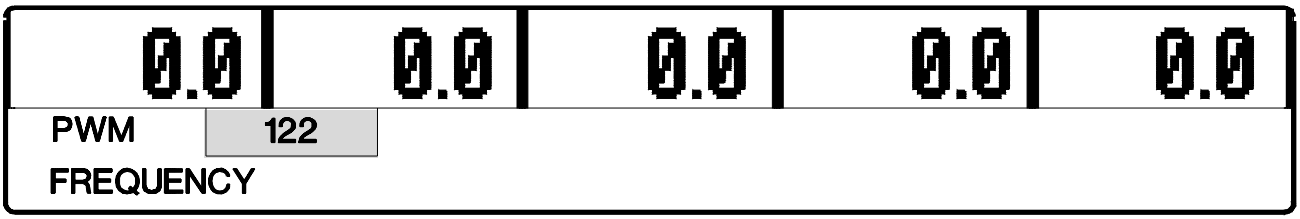
9. FAN CAL

The FAN CAL value is the number of "points" that pass by the fan sensor. Depress ENTER. Enter the correct number and depress ENTER again.



10. PWM FREQUENCY

Depress ENTER. Enter the coil frequency of the PWM type valve being used (i.e. 180 Hz) Press 1-8-0, depress ENTER again.



ZERO SPEED SHUT OFF

1) An additional feature of the SCS 760 console is a “Zero speed shut off”. When the console senses a speed of .7 MPH or less it will shut down all products. This function can not be disabled. The only way the console can operate at .7 MPH or less is in the manual mode. The valve type selection (standard, fast, fast close or PWM) will determine how the product shut off is accomplished.

2) If STANDARD or FAST has been selected the “enable” line will go to 0 volts. This will turn off an injection module or close a valve that is switched by the black wire in a 115-0159-456 adaptor cable.

3) If FAST CLOSE has been selected the valve will receive a decrease signal and run closed when speed drops to .7 MPH or less. The enable line will also go to 0 volts.

4) In the PWM mode, the INC/DEC frequency will go to 0 and the enable line will also go to 0 volts.

When a zero speed shut-off has occurred the MASTER SWITCH must be turned OFF and then ON to restart the system. If a constant speed greater than .7 MPH is not attained within 10 seconds the zero speed shut off will be enacted again.

PROCEDURE TO TEST MOTOR CONTROL

063-0159-788
063-0171-022

To verify Motor Control location see ULTRA LOW VOLUME INJECTION MODULE ASSEMBLY REPLACEMENT PARTS sheet for low volume units or HIGH VOLUME INJECTION MODULE ASSEMBLY REPLACEMENT PARTS sheet for high volume units.

Symptoms of a defective Motor Control may include the following:

1. Injection Pump will not turn ON with MASTER Switch.
2. Injection Pump will not turn OFF with MASTER Switch.
3. Injection Pump speed cannot be changed.

NOTE:	This symptom may be caused by a defective Feedback Generator or defective cables.

Proper diagnosis of a Motor Control failure requires the technician to isolate the correct symptom. A mechanical failure (i.e. pump piston siezed up) must be eliminated before proceeding with this electrical troubleshooting procedure.

CAUTION:	Pump must not be operated without a Boom Valve “ON”. During this test water is injected into the carrier line, through the open Boom Valve and out the boom nozzles. Position Console Switches as follows: OFF\MAN\AUTO to MAN, Boom 1 Switch “ON”, Master Switch "ON”.

1) Flush Injection System with water. Ensure that system is free of all chemical and that there is water in chemical tank.

2) Injection Module should now be running. If not, verify the following:
a) 12 VDC on enable wire (pin 4 of 9 pin connector on Product Cable)
b) 0 VDC on ground wire (pin 8 and 9 of 9 pin connector on Product Cable)
If 12 VDC is present on pin 4, proceed to step 4 of this procedure.

3) If 12 VDC is NOT present on pin 4, go to the section of cable next closest to Console and repeat test. Product 1 enable signal is on pin 10 of the 22 pin connector. Product 2 enable is on pin 7 of the 22 pin connector. Replace defective cable as required.

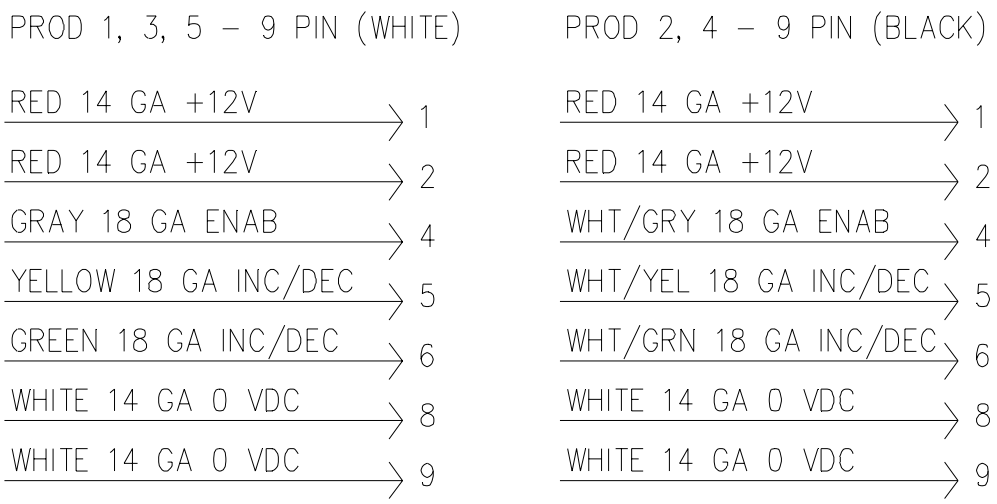
4) Perform voltage checks with ground lead of multimeter in pin 8 or 9 of 9 pin connector.

NOTE:	Operator must toggle Console increase/decrease switch to get a reading on pins 5 and 6.

5) Supply 12 VDC directly to the Injection Pump connector (2 pin shroud connector) to verify pump will run.

6) Verify Injection Pump speed changes with Inc\Dec Switch. If speed can not be changed, test the Feedback Generator using "Procedure to Test Feedback Generator".

7) Place the Master Switch to off. The Injection Module should stop running. If not, replace the Motor Control.



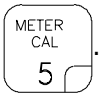
PROCEDURE TO TEST METERING SENSOR

063-0159-620

To verify Metering Sensor location see DRIVE MOTOR REPLACEMENT PARTS sheet for low volume units or HIGH VOLUME PUMP/MOTOR ASSEMBLY REPLACEMENT PARTS sheet for high volume units.

NOTE:	A cable test should be performed on the main harness prior to testing the Metering Sensor. A cable test is identical to the "Procedure to Test Product Flow Cables" or "Procedure to Test Encoder Cables".

Disconnect the 9 pin connector of Motor Control from the Product Cable. This is done as a safety measure to guard against the chance of starting the Injection Module during the test.

1) Enter a METER CAL number of "10" in key labelled 

.

2) Turn the Master Switch and Boom 1 Switch to "ON".

3) Rotate printed magnet wheel by hand.

4) Depress 

and display should count up 1 increment per revolution for a high volume module, and 10 increments per revolution for a low volume module. If not, replace the Metering Sensor.

NOTE:	If Injection Module is over-applying or under-applying product, it may be necessary to clean the intake and discharge valves. Verify programming calibration numbers and pump setting when either over-applying or under-applying.

PROCEDURE TO VERIFY INJECTION PUMP CALIBRATION

1) Enter 50 into the METER CAL key on the SCS 750 Console for product under test.

2) Place 3-way valve handle on Injection Pump to recirculate position (See below).

3) Place BOOM and MASTER switches ON. Place the OFF/MAN/AUTO switch for product under test to MAN.

4) Run pump until liquid appears from tank return hose. Place OFF/MAN/AUTO switch to OFF.

5) Enter "0" into TOTAL VOLUME key for product under test.

6) Place tank return hose into calibration flask. Figure 1.

7) Place OFF/MAN/AUTO switch to MAN until 50 ounces of measured chemical is pumped. The number displayed in TOTAL VOLUME is the new METER CAL.

8) Enter this new METER CAL number in METER CAL key for product under test.

9) Enter "0" in TOTAL VOLUME key.

10) Place OFF/MAN/AUTO switch to MAN until 50 ounces of measured product is pumped.

11) The number in TOTAL VOLUME should be 49, 50, or 51. If not, repeat calibration procedures.

12) Empty tank return hose into measuring container.

13) Pour product caught in measuring container back into Injection Module Tank.

14) Repeat procedure to calibrate remaining Injection Pumps.

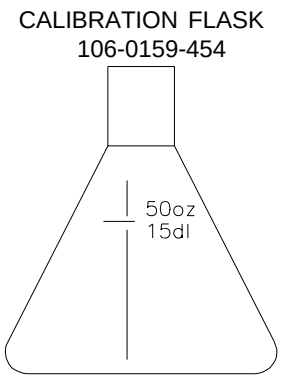


FIGURE 1

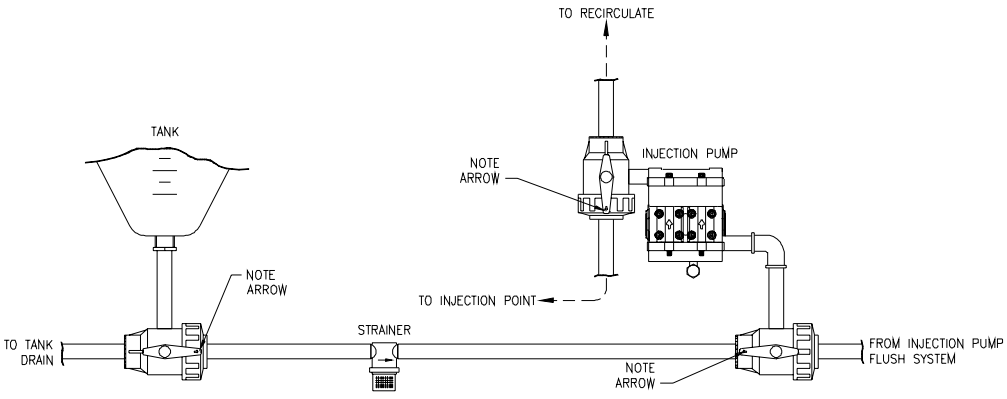


FIGURE 2

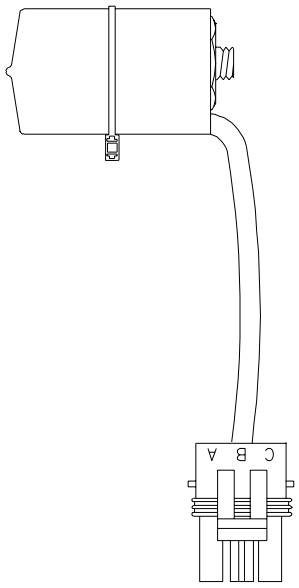
PROCEDURE TO TEST VACUUM SWITCH

063-0171-035

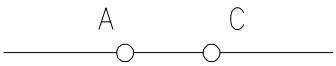
To verify Vacuum Sensor location see ULTRA LOW VOLUME INJECTION MODULE ASSEMBLY REPLACEMENT PARTS sheet for low volume units or HIGH VOLUME INJECTION MODULE ASSEMBLY REPLACEMENT PARTS sheet for high volume units.

1) Disconnect the Vacuum Switch from product cable.

2) Test for continuity between pins A and C of the Vacuum Switch. If the OHM meter reads a short, the switch is good, if it reads an open, the Vacuum Switch is bad.



NOTE: The Vacuum Switch is a normally closed circuit.

Schematic Symbol: 

(Pin B not used)

PROCEDURE TO TEST FEEDBACK GENERATOR

063-0159-833 (ULTRA-LOW VOLUME, REVERSE FEEDBACK GENERATOR)
063-0159-784 (HIGH VOLUME FEEDBACK GENERATOR)
(LOW VOLUME FEEDBACK GENERATOR)

To verify Feedback Generator location see DRIVE MOTOR REPLACEMENT PARTS sheet for the 063-0159-833 generator or HIGH VOLUME PUMP/MOTOR ASSEMBLY REPLACEMENT PARTS sheet for the 063-0159-784 generator.

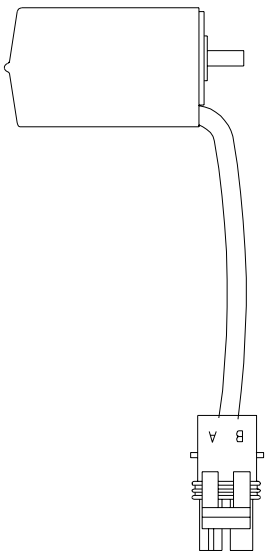
1) Flush injection system with water. Ensure that system is free of all chemical and that there is water in chemical tank.

CAUTION:	Pump must not be operated without a boom valve “ON”. During this test water is injected into the carrier line, through the open boom valve and out the boom nozzles. Position console switches as follows: OFF\MAN\AUTO to MAN, Boom 1 switch “ON”, Master switch “ON”.

2) Injection module should now be running. If you can change pump speed by using the Inc\Dec switch, the Feedback Generator is good. If you can not, proceed to step 3.

3) Position the Master switch to "OFF". Disconnect the cable coming from the Feedback Generator. Connect a DC volt meter to the Feedback Generator leads, positive to pin A, negative to pin B. Position the Master switch to “ON”. The volt meter should read at least 9 volts. If not, replace the Feedback Generator.

NOTE:	If the Feedback Generator is good and the injection module was not running at full speed before the Feedback Generator was disconnected, it is normal for the injection module to run at full speed with the Feedback Generator disconnected.



NOTE:	The Low and High Volume Feedback Generator typically has a black vinyl boot. The Ultra Low Volume Feedback Generator typically has a grey vinyl boot. The High Volume, Low Volume Feedback generators are pinned opposite of the Ultra Low Feedback generator.

RAVEN INDUSTRIES

LIMITED WARRANTY

WHAT IS COVERED?

This warranty covers all defects in workmanship or materials in your Raven Flow Control Product under normal use, maintenance, and service.

HOW LONG IS THE COVERAGE PERIOD?

This warranty coverage runs for 12 months from the purchase date of your Raven Flow Control Product. This warranty coverage applies only to the original owner and is not transferrable.

HOW CAN YOU GET SERVICE?

Bring the defective part, and proof of date of purchase, to your local dealer. If your dealer agrees with the warranty claim, he will send the part, and proof of purchase to his distributor or to Raven for final approval.

WHAT WILL RAVEN INDUSTRIES DO?

When our inspection proves the warranty claim, we will, at our option, repair or replace the defective part and pay for return freight.

WHAT DOES THIS WARRANTY NOT COVER?

Raven Industries will not assume any expense or liability for repairs made outside our plant without written consent. We are not responsible for damage to any associated equipment or product and will not be liable for loss of profit or other special damages. The obligation of this warranty is in lieu of all other warranties, expressed or implied, and no person is authorized to assume for us any liability. Damages caused by normal wear and tear, mis-use, abuse, neglect, accident, or improper installation and maintenance are not covered by this warranty.