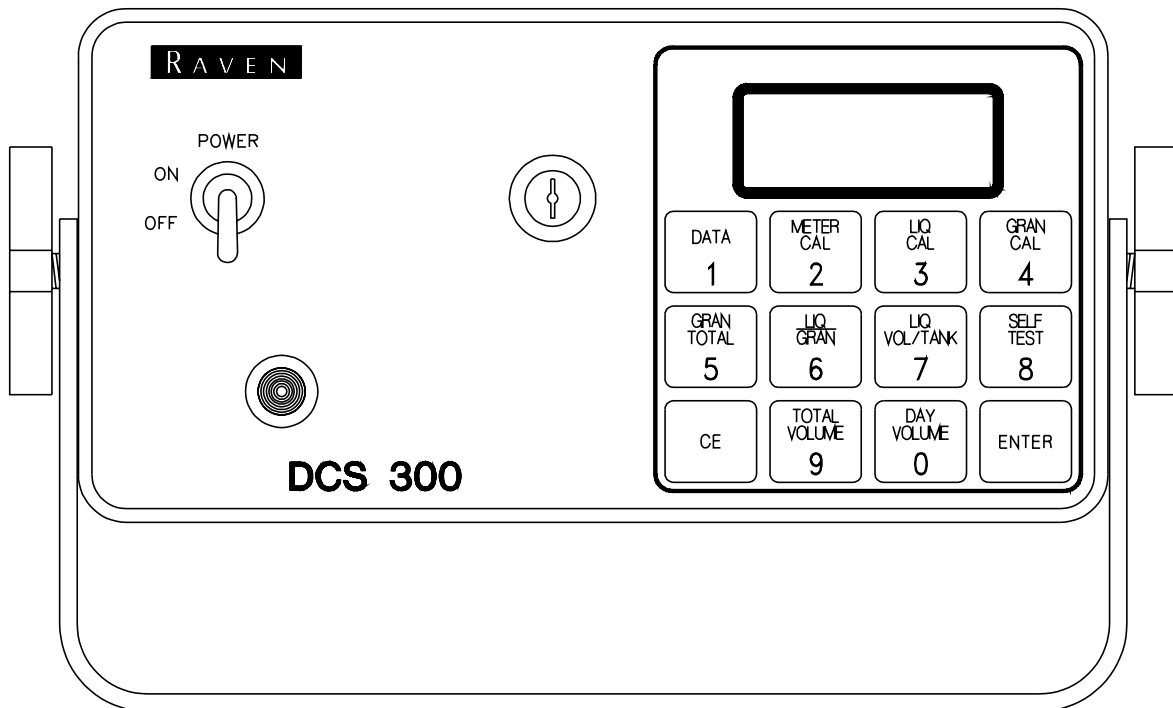


RAVEN

INDUSTRIES

DCS 300



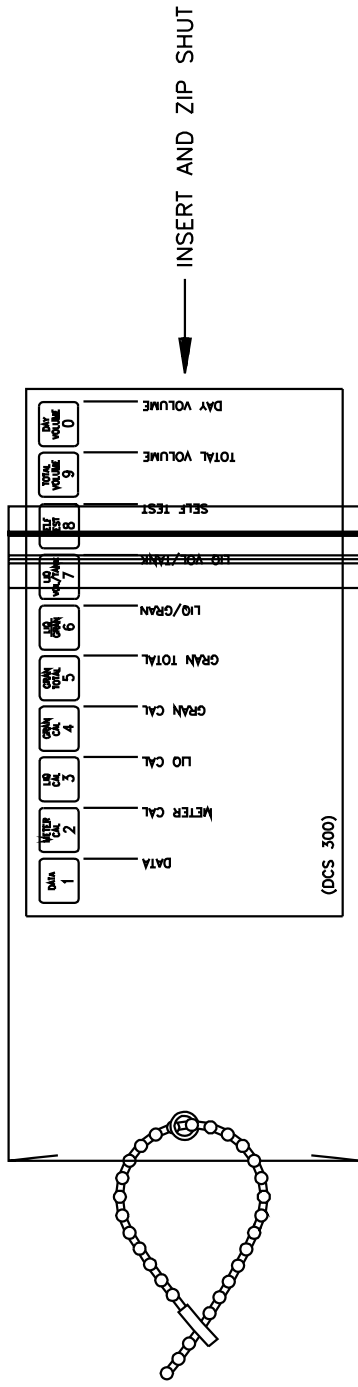
INSTALLATION AND SERVICE MANUAL

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 your Dealer.

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



CUT ON DOTTED LINE

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

DATA ENTRY EXAMPLE: TO ENTER GRAN CAL.

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

(EXAMPLE: KEYS FOR 200)

4. PRESS ENTER KEY AGAIN.

FOLD LINE

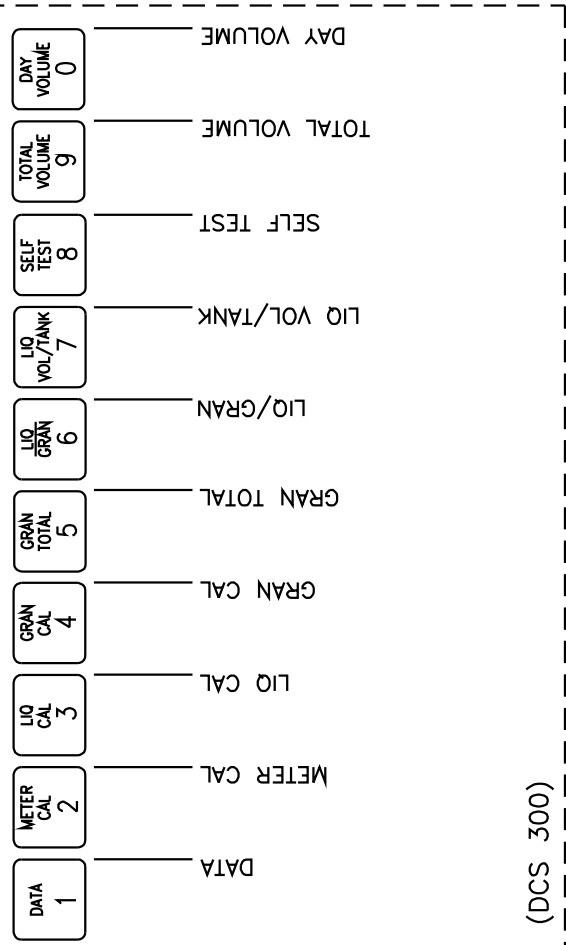


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REPLACEMENT PARTS SHEETS

SYMBOL DEFINITION

gal	- Gallons	lb	- pounds
lit	- Liters	kg	- kilograms
GPT	- Gallons per ton	MPH	- Miles per hour
lit/MT	- Liters per metric ton	km	- Kilometers
PSI	- Pounds per square inch	km/h	- Kilometers per hour
kPa	- Kilopascal	US	- Volume in gallons
lb/mile	- Pounds per mile	SI	- Volume in liters
kg/km	- Kilograms per kilometer	[]	- Metric 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:

$$\frac{\text{Original METER CAL No.}}{128} = \text{METER CAL No. for displays in Fluid Ounces}$$

$$\frac{\text{Original METER CAL No.}}{3.785} = \text{METER CAL No. for displays in Liters}$$

$$\frac{\text{Original METER CAL No.}}{\text{Weight of one gallon}} = \text{METER CAL No. for displays in Pounds}$$

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 meter (m) = 3.281 feet
1 kilometer (km) = 0.621 mile
1 mile = 1.609 kilometers

PRESSURE

1 psi = 6.89 kPa

WEIGHT

1 pound = 0.454 kg
1 kg = 2.205 lbs
1 ton = 2000 lbs
1 metric ton = 1000 kg

INTRODUCTION

The Raven DCS 300 (DE-ICE CONTROL SYSTEM) is designed to improve the uniformity of pre-wetting applications automatically. Its performance relies on the installation and preventive maintenance of the complete system. 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 system.

The DCS 300 consists of a computer based Control Console, a Granular Encoder, a turbine type Flow Meter, and a motorized Control Valve. The Console mounts directly in the cab of the vehicle for easy operator use. The Granular Encoder is mounted on a granular belt shaft. The motorized Control Valve and Flow Meter mount directly to the framework of the spreader truck. Appropriate cabling is furnished for field installation.

The operator sets the target rate (volume per granular ton) to be applied and the DCS 300 automatically maintains the pre-wetting flow according to the actual granular application rate (within range of selected spray nozzles). The DCS 300 additionally functions as a volume totalizer and granular totalizer (up to 10,000 kg or lbs).

INSTALLATION

1. MOUNTING THE ENCODER

- 1) Mount Encoder on output shaft of conveyor or other shaft which rotates at a known ratio to the conveyor.
- 2) Apply grease to Encoder shaft, conveyor shaft, and Encoder coupler (fits 1" diameter conveyor shaft). Secure coupler to Encoder and conveyor shafts with set screws provided.
- 3) Install mounting tabs to Encoder as shown in Figure 1. Connect mounting tab to mounting bracket (not provided) to prevent Encoder from rotating. **DO NOT** rigidly mount Encoder. Encoder is to be supported by coupler ONLY.

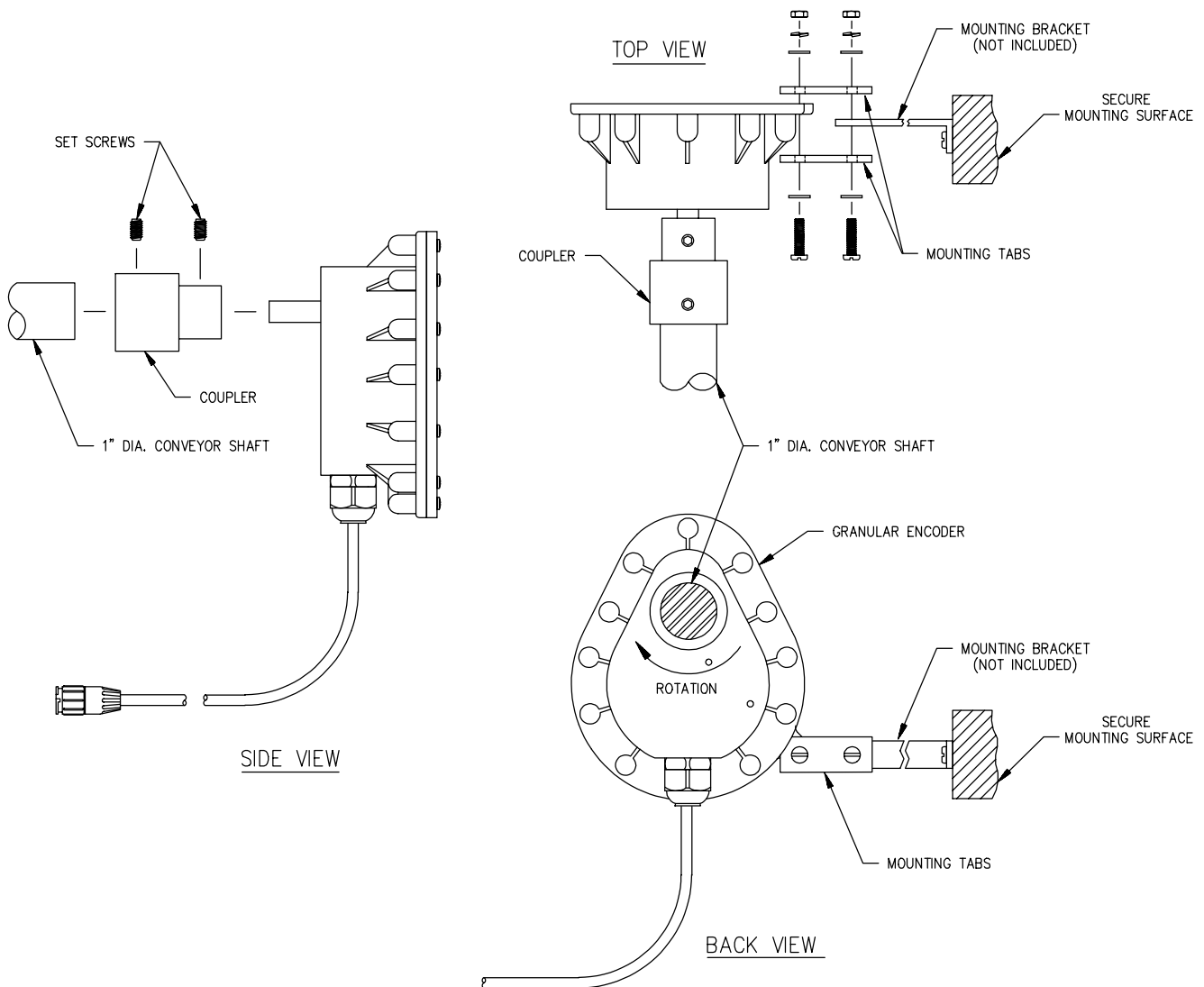


FIGURE 1

2. MOUNTING THE FLOW METER

- 1) Mount the Flow Meter in the area of the boom valve per Figure 2. All flow through the Flow Meter must go to the boom valve 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 [20cm] 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.

NOTE: For flow rates less than 3 GPM [11 lit/min], mount the Flow Meter vertically with arrow pointing upward. (Refer to Appendix 1 for alternate plumbing diagram).

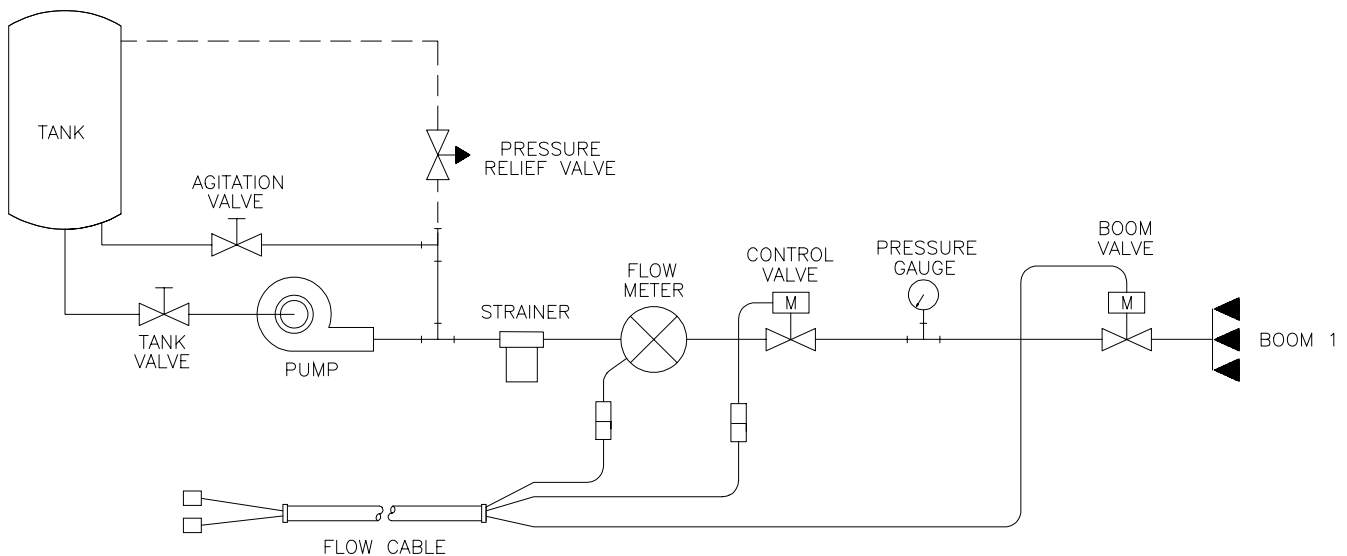


FIGURE 2

NOTE: It is essential, when using suspensions, that the system be thoroughly rinsed out each day after use. Failure to do so may cause system to malfunction.

3. MOUNTING THE CONTROL VALVE

- 1) Mount the motorized Control Valve in the main hose line between the Flow Meter and the boom valve, with motor in the upright position. (For less than 3 GPM [11 lit/min], the motorized Control Valve is mounted in the by-pass line, refer to Appendix 1 for alternate plumbing diagram).
- 2) Connect the Flow Control Cable connector to the boom valve, Flow Meter, and motorized Control Valve.

4. MOUNTING THE CONSOLE AND CABLING

- 1) Mount the Console to secure support inside the cab of the vehicle.
- 2) Connect the Console Control Cable to the plug in the back of the Console. Route the cable out of the vehicle cab. (Flow Meter extension cables are available from your Dealer).

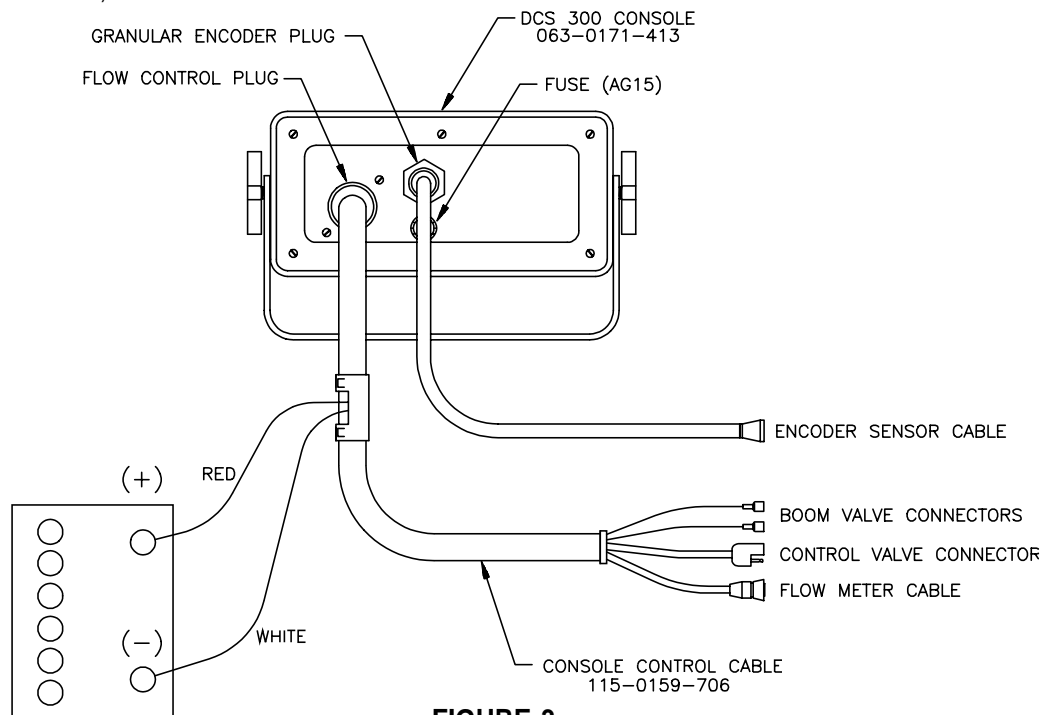


FIGURE 3

- 3) Turn POWER switch OFF and route Red and White battery wires to a 12-Volt battery. Attach White battery wire to the **NEGATIVE** (-) battery terminal, and the Red battery wire directly to the **POSITIVE** (+) battery terminal. See Figure 4 on page 7. (**DO NOT CONNECT RED AND WHITE WIRES TO THE STARTER**). Secure the battery wires with plastic cable ties. **DO NOT** tie battery wires close to existing battery leads or any other electrical wiring.
- 4) Connect the Encoder Sensor Cable to the plug in the back of the Console.
- 5) Secure and tie the Encoder Sensor Cable and Console Control Cable with plastic cable ties.
- 6) Initial installation of the system is now complete.

BATTERY CONNECTIONS

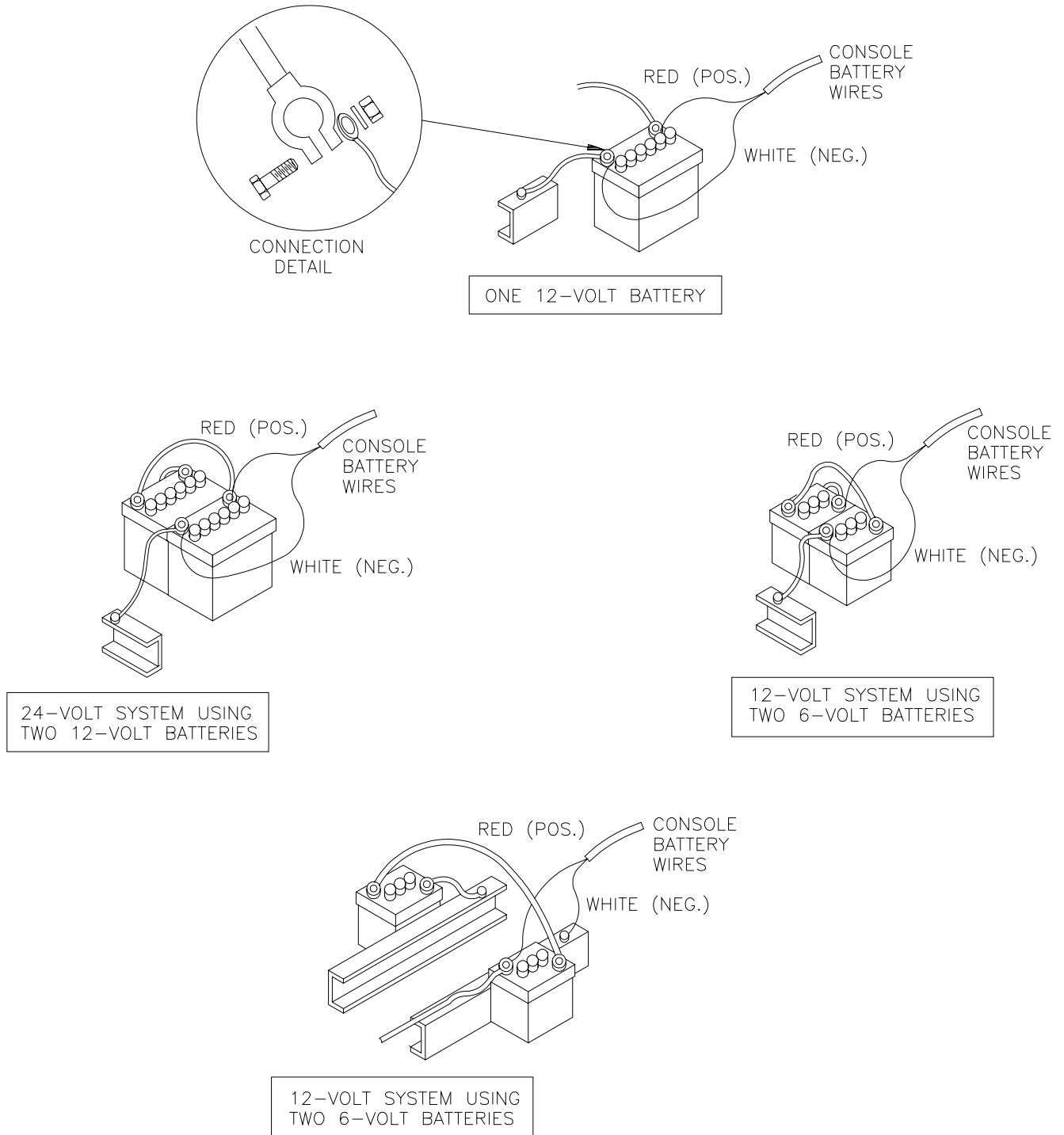


FIGURE 4

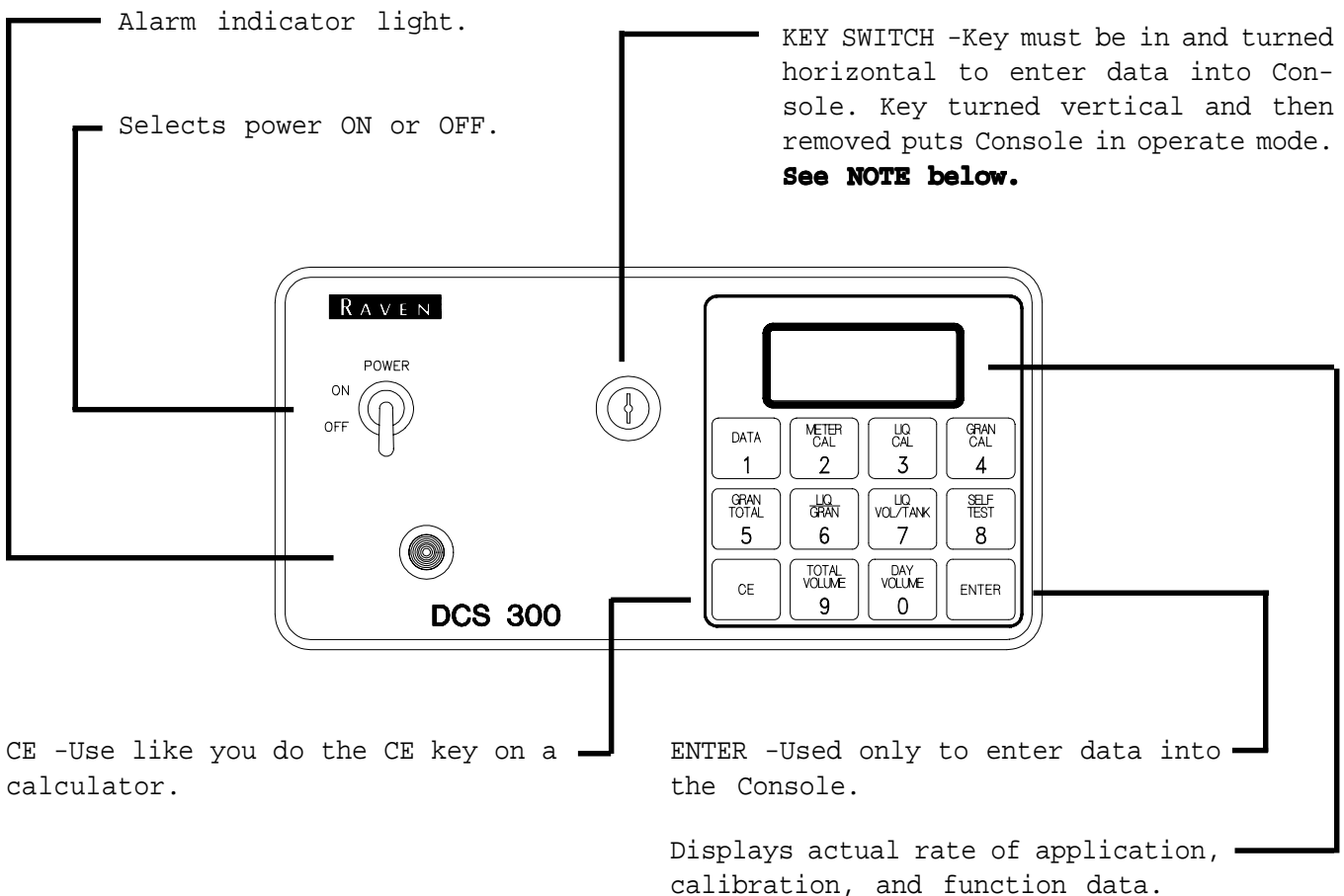
CONSOLE FEATURES

IMPORTANT: This Console requires selection of **US** (gallons) or **SI** [liters]; and **C-Sd** (Standard Valve) or **C-FC** (Fast Close Valve). Hold DAY VOLUME key to view selections.



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

Console Program is determined by letter stamped in PGM box on label.



NOTE: The KEY SWITCH needs to be in the vertical position to allow operation of main ON/OFF Valve or to turn the pump ON. The maximum rating of this switch is 4 AMPS. If the main ON/OFF Valve or pump could draw current in excess of 4 AMPS, an external relay must be added to prevent damage to the KEY SWITCH.

CALIBRATION KEYS -- Used to enter data into the Console to calibrate the system.

METER CAL -- Flow Meter Calibration Number

LIQ CAL -- Target Application Rate

GRAN CAL -- Determined by Encoder and System

FUNCTION KEYS -- Used to Display Data

DATA -- Turn Alarm ON/OFF

GRAN TOTAL -- Total Granular Applied

LIQ/GRAN -- Actual Application Rate

LIQ VOL/TANK -- Volume Remaining in Tank

SELF TEST -- Simulate Granular Output

TOTAL VOLUME -- Total Volume Applied

DAY VOLUME -- Total Volume Applied for Day

CONSOLE CALIBRATION

1. CALCULATING "METER CAL"

The Flow Meter calibration number is stamped on the tag attached to each Flow Meter. This number is to be used for gallons [liters] per application.

To convert original METER CAL from gallons to desired units of measure, see METER CAL CONVERSIONS on page 3. Write down this calibration number for future reference when programming the Console.

2. CALCULATING "LIQ CAL"

Determine the application rate at which your chemical should be applied. Consult with your Dealer to ensure your spray nozzles are capable of applying at this rate.

In determining which spray nozzles to use, you must know:

- 1) Nominal Application Pressure ___PSI [kPa]
- 2) Target Application Rate ___GPT [lit/MT]
- 3) Granular Application Rate ___(lb/mile) [kg/km]
- 4) Target Speed ___MPH [km/h]
- 5) Number Of Nozzles ___

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

$$\text{GPM} = \frac{\text{GPT} \times (\text{lb/mile}) \times \text{MPH}}{120,000 (\text{No. of nozzles})}$$

$$\text{lit/min} = \frac{\text{lit/MT} \times [\text{kg/km}] \times [\text{km/h}]}{60,000 (\text{No. of nozzles})}$$

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

- EXAMPLE:**
- 1) Application Pressure 30 PSI [200 kPa]
 - 2) Target Application Rate 7.0 GPT [30 lit/MT]
 - 3) Granular Application Rate 2900 lb/mile [800 kg/km]
 - 4) Target Speed 6.2 MPH [10.5 km/h]
 - 5) Number of nozzles 3

US UNITS $\text{GPM} = \frac{7.0 \text{ GPT} \times 2900 \text{ lb/mile} \times 6.2 \text{ MPH}}{120,000 (3)} = .35 \text{ GPM}$

SI UNITS [lit/min] = $\frac{30 \text{ lit/MT} \times 800 \text{ kg/km} \times 10.5 \text{ km/h}}{60,000 (3)} = 1.40 \text{ lit/min}$

Using CAPACITY = .35 GPM [1.40 lit/min] and pressure = 30 PSI [200 kPa] you would select tip number XR8004 from the chart on next page, 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

* Chart data from Spraying Systems Company

VERIFYING FLOW RATE LIMITS:

The total gallons per minute (GPM) [lit/min] flow rate of application must be within the range of that specified for the Flow Meter.

<u>FLOW METER MODEL</u>	<u>FLOW RANGE</u>
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 55/55A	1-55 GPM [3.8-208 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]

3. CALCULATING "GRAN CAL"

Factors which can affect the product GRAN CAL numbers are the product particle size, density, temperature, and humidity. Always calibrate the material you have purchased. Complete INITIAL CONSOLE PROGRAMMING, on page 15, before proceeding with this procedure. The GRAN CAL value is derived using the following procedure:

- 1) Place chalk mark or tape on granular belt shaft to use as a reference point.
- 2) Mark initial spot on the shaft in a convenient location.
- 3) Turn granular belt on, and allow to turn until a uniform amount of granular is being applied.
- 4) Catch the granular from the belt for a period of 10 revolutions of the granular belt shaft.
- 5) Weigh the amount of granular that was caught (lbs) [kg].
- 6) Divide 18,000 by this number. This is your GRAN CAL number. Write this number down for future reference.

EXAMPLE: Weight of material caught = 90 lbs [40.8 kg]



	ENGLISH UNITS:	METRIC UNITS:
GRAN CAL =	$\frac{18,000}{90} = 200$	$\frac{18,000}{[40.8]} = 441$

GRAN CAL = 200 [441]

NOTE: This measurement is critical to the accuracy of the system. **MEASURE CAREFULLY.** For best results, measure several times and average the results. If for any reason the amount of granular on the belt changes (i.e. the granular gate height is adjusted), the GRAN CAL number will be invalid, and must be measured again.

4. VERIFYING "GRAN CAL"

To verify this GRAN CAL number, perform the following procedure:

- 1) Use a pre-weighed box to capture granules as they are metered out.
- 2) Enter the pre-determined GRAN CAL into key labelled: 
- 3) Enter a "0" in key labelled: 
- 4) Turn granular belt ON to begin collecting granules.
- 5) Turn granular belt OFF when GRAN TOTAL display reads 200.
- 6) Weigh the collected granules. If the actual weight is not 200 lbs, perform the following calculation:

EXAMPLE:

Old GRAN CAL	=	200
GRAN TOTAL reading	=	200
Weight of collected material	=	128

$$\begin{aligned} \text{Corrected GRAN CAL} &= \frac{\text{Old GRAN CAL} \times \text{GRAN TOTAL reading}}{\text{Weight of collected material}} \\ &= \frac{200 \times 200}{128} = 312 \end{aligned}$$

Corrected GRAN CAL = 312

This is the new GRAN CAL value.
Enter this corrected GRAN CAL into key labelled:

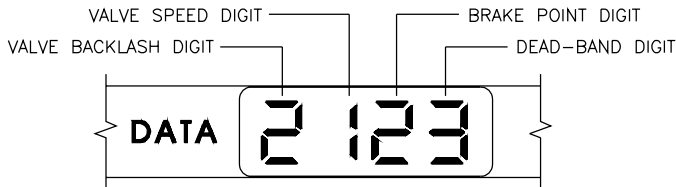


Repeat this procedure (starting with Step 3) until the weight of the metered material equals the value in the GRAN TOTAL display.

4. CALCULATING "VALVE CAL"

The initial Control Valve calibration number for VALVE CAL is 2123 for C-Sd (standard valve), or 743 for C-F (fast valve) and C-FC (fast close valve). The VALVE CAL number is used to control response time of the Motor Control to the change in vehicle speed. After operating the system, you may desire to refine this number. See definitions below:

For **STANDARD VALVE** (C-Sd):



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.

C-Sd Valve Control

Range: 1 to 9 1-Slow
 9-Fast

C-F or C-FC Valve Control

Range: 0 to 9 0-Fast
 9-Slow

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

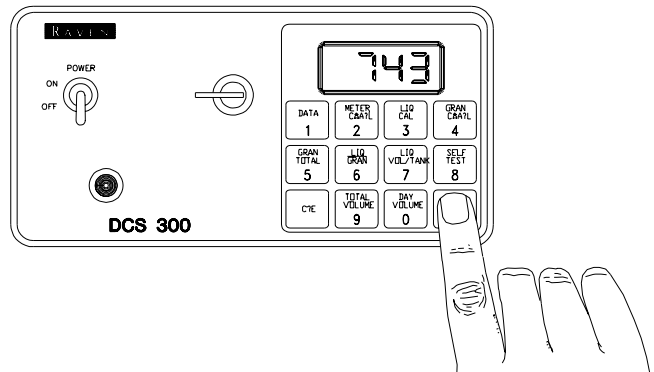
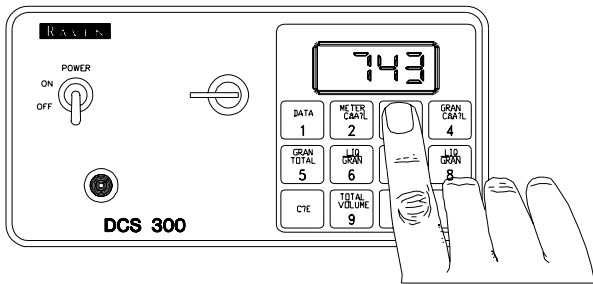
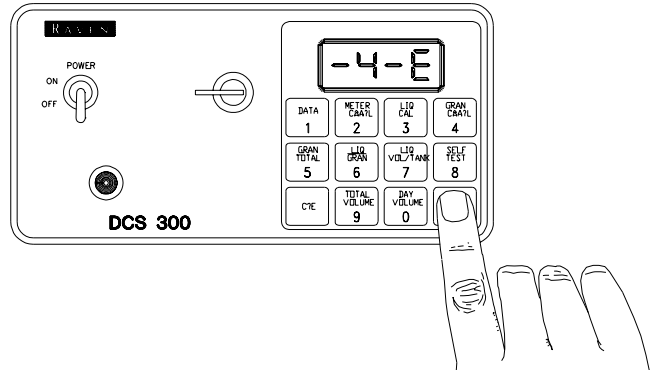
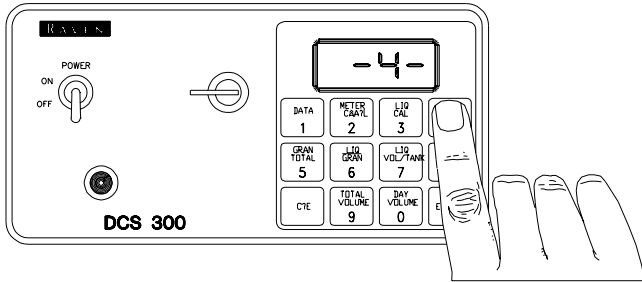
Allowable difference between target and actual application rate, where rate correction is not performed.

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

CONSOLE PROGRAMMING

When entering data into the Console, the entry sequence is always the same.

NOTE: Data must be entered into keys 2, 3, & 4 with the key switch turned to the horizontal position.



Depress the keys corresponding to the number you wish to enter (i.e. "7", "4", "3"). The numbers will be displayed as they are entered.

Complete the entry by again depressing the ENTER key.

1. INITIAL CONSOLE PROGRAMMING

When you first turn on Console power, after all installation procedures have been completed, the Console will display "US" in the display window. This means you must "calibrate" or program the Console before it can be operated. This is a one-time operation which does not have to be repeated. Turning OFF the POWER ON/OFF switch does not affect the Console memory. All data is retained in non-volatile memory.

IMPORTANT: If an entry selection error is made during Steps 1-4, place the power switch to the OFF position. Depress and hold while placing the power switch to ON. This will "reset" the Console. The display will now show "US". The following steps must be followed:

1) Display US (gallons) or SI (liters).

- a) Depressing momentarily steps the display from US to SI.
- b) Depressing momentarily steps the display from SI to US.

2) Selecting US or SI.

- a) To select US or SI, step with until the desired code is displayed.
- b) Momentarily depress . The display will now show C-Sd.

3) Display C-Sd (Standard Valve) or C-FC (Fast Close Valve).

- a) Depressing momentarily steps the display from C-Sd to C-FC.
- b) Depressing momentarily steps the display from C-FC to C-Sd.

4) Selecting C-Sd or C-FC.

- a) To select C-Sd or C-FC step until desired code is displayed.
- b) Momentarily depress . The display will now show CAL.

5) Enter METER CAL in key labelled:

METER
CAL
2

6) Enter target LIQUID CAL application rate (GPT) [lit/MT] in key labelled:

LIQ
CAL
3


NOTE: A decimal point is displayed automatically. Therefore, twenty gallons per ton is entered as 20.0, not 2.0.


7) Enter initial GRAN CAL calibration number of 200 in key labelled:


GRAN
CAL
4

YOU HAVE NOW COMPLETED PROGRAMMING THE CONSOLE

The flashing "CAL" will now extinguish. If not, repeat procedure starting at

Step 5. You may also wish to enter data in the key labelled:  although it is not required for the operation of the system.

8) Enter the estimated TOTAL VOLUME in TANK before you start applying product in key labelled:  Each time the tank is refilled, this number must be re-entered.


9) To change VALVE CAL calibration number depress key labelled:  for 5 seconds. Display will flash. Enter VALVE CAL number. (See page 13 for default VALVE CAL settings).

NOTE: To display operating mode (US, SI), and valve control (C-Sd, C-FC), depress


key labelled:  for 5 seconds and continue holding.

2. OTHER DISPLAYS


1) To display your actual application rate, LIQ per TON, momentarily depress key

labelled: 

2) To display TOTAL GRANULAR applied (lb) [kg], momentarily depress the key

labelled:  To "zero out" this total at any time, enter a "0" in this key.

3) To display LIQUID VOLUME remaining in TANK (gal) [lit], momentarily depress

key labelled: 

4) To display liquid TOTAL VOLUME applied, momentarily depress key labelled:




To "zero out" this total at any time, enter a "0" in this key.

5) To display liquid DAY VOLUME applied, momentarily depress key labelled: To "zero out" this total at any time, enter a "0" in this key.



3. SELF TEST FEATURE

SELF TEST allows granular application simulation for testing the system while the vehicle is not moving. Enter the simulated operating granular rate by depressing

the key labelled:  (display will flash). If 600 lbs/mile [kg/km] is

desired, enter 600 [600]. (See CONSOLE PROGRAMMING on page 14).

NOTE: The SELF TEST feature assumes a vehicle speed of 20 MPH [km/h].

INITIAL SYSTEM SET-UP

- 1) Fill tank with water only. (If positive displacement pump is used, fully open pressure relief valve, PRV).
- 2) Place KEY SWITCH vertical.
- 3) Place POWER switch to ON.
- 4) Verify that METER CAL, LIQ CAL, and GRAN CAL have been entered correctly into the Console. In SELF TEST mode enter the normal granular operating rate.
- 5) Run pump at normal operating RPM.
- 6) If centrifugal pump is used, proceed with Step 8. If positive displacement pump is used, set pressure relief valve (PRV) to 65 PSI [450 kPa].
- 7) Verify that boom valve operates and that no nozzles are plugged.
- 8) To verify maximum pressure and rate, enter 999.9 into LIQ CAL, 10 into METER CAL, 10 into GRAN CAL, and 1000 into SELF TEST. This assures that the motorized Control Valve is fully open. Verify maximum pressure and LIQ/GRAN rate. (Pressure gauge is not supplied with the DCS 300 system).

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

- 9) Adjust agitator line hand valve for desired agitation. Verify maximum pressure is still present.
- 10) To verify minimum pressure and rate, enter 0 into LIQ CAL. This assures that the motorized Control Valve is fully closed. Verify minimum pressure and LIQ/GRAN rate. If minimum pressure and rate can not be obtained, consider by-pass plumbing system in Appendix 1.
- 11) Re-enter correct METER CAL, LIQ CAL, and GRAN CAL.

INITIAL SYSTEM ROAD TEST

- 1) Drive down road at target granular rate with pre-wetting boom OFF.
- 2) With water in tank, turn on spray and place the POWER switch to ON. Increase or decrease speed slowly. The system should automatically correct to the target LIQ CAL rate.
- 3) If for any reason the system is unable to correct to the desired LIQ CAL rate, 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 SYSTEM SET-UP on page 17.
- 5) To shut off liquid flow, turn POWER switch to OFF position. This also shuts off the liquid volume totalizer.
- 6) Verify granular and liquid volume used.

PREVENTIVE MAINTENANCE

Preventive maintenance is most important to assure long life of the DCS 300 system. The following maintenance procedures should be followed on a regular basis:

- 1) Flush entire system with water after use of suspension type chemicals. Failure to clean system can result in crystallization of chemicals which may plug the Flow Meter, lines, and/or tips.
- 2) Flush and drain system before storing. **FREEZING TEMPERATURES MAY DAMAGE FLOW METER IF WATER IS NOT DRAINED.**
- 3) Remove Flow Meter at the end of each season. Clean Flow Meter turbine and inlet hub. Clean off all metal filings and wettable powders which have hardened on the plastic and metal parts. Check the inlet hub and turbine assembly for worn or damaged turbine blades and bearings. Flush Flow Meter with clear water and drain.

KEEP FROM FREEZING

- 4) Remove Console when not in use for extended periods.

APPENDIX 1

ALTERNATE BY-PASS LINE PLUMBING SYSTEM

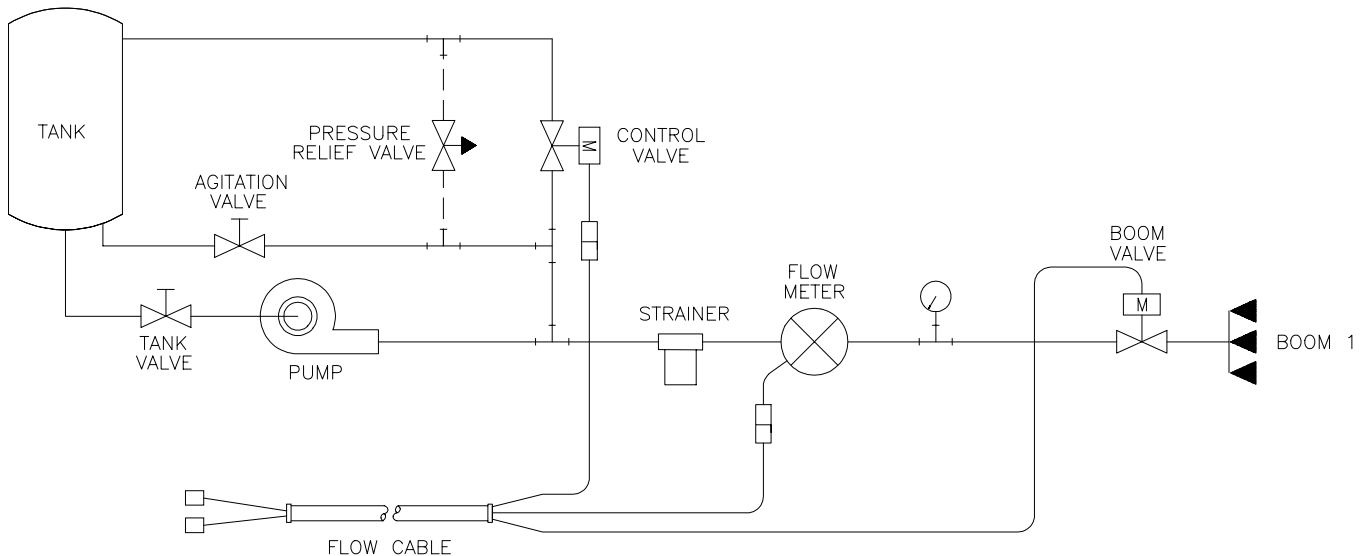


FIGURE 5

INITIAL SYSTEM SET-UP

Install Polarity Reversal Jumper in motorized Control Valve Cable (Raven Part # 115-0159-415). Plumb the system as shown in Figure 5. Adjust as follows:

- 1) Fill tank with water only.
- 2) Place KEY SWITCH to vertical.
- 3) Place POWER switch to ON.
- 4) Verify that METER CAL, LIQ CAL, and GRAN CAL have been entered correctly into the Console. In SELF TEST mode enter the normal granular operating rate.
- 5) With pump not running, fully open main line hand valve, fully open by-pass #1 hand valve, and completely close agitator line hand valve. If positive displacement pump is used, fully open pressure relief valve, PRV.
- 6) Run pump at normal operating RPM.
- 7) If centrifugal pump is used, proceed with Step 8. If positive displacement pump is used, proceed as follows:
 - a) Place KEY SWITCH horizontal (OFF).
 - b) Close by-pass #1 hand valve.
 - c) Set PRV to 65 psi [450 kPa].
 - d) Open by-pass #1 hand valve.
 - e) Place KEY SWITCH vertical (ON).

- 8) Verify that the boom valve operates and that no nozzles are plugged.
- 9) To assure motorized Control Valve is fully closed, enter 999.9 into LIQ CAL, 10 into METER CAL, 10 into GRAN CAL, and 1000 into SELF TEST.
- 10) Adjust agitator line hand valve for desired agitation.
- 11) Close the main line hand valve, if necessary, to set the desired maximum operating pressure. Maximum pressure should be approximately 10 psi [70 kPa] above normal pre-wetting pressure.
EXAMPLE: If normal pre-wetting pressure is 30 psi [210kPa], set maximum pressure at approximately 40 psi [280 kPa].
- 12) To assure motorized Control Valve is fully open, enter 0 into METER CAL.
- 13) Close by-pass #1 hand valve to set the desired minimum operating pressure. Minimum pressure should be approximately one half the normal pre-wetting pressure.
EXAMPLE: if normal spraying pressure is 30 psi [210kPa], set minimum pressure at approximately 15 psi [105 kPa].
- 14) Verify maximum and minimum pressures and LIQ/GRAN rate by repeating Steps 11 and 13.

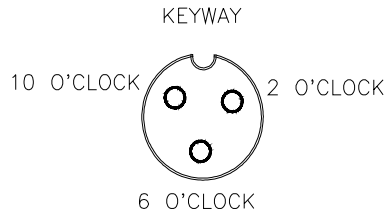
INITIAL SYSTEM ROAD TEST

- 1) Drive down road at target granular rate with pre-wetting OFF.
- 2) Turn on spray and place the POWER switch to ON. Increase or decrease speed slowly. The system should automatically correct to the target LIQ CAL rate.
- 3) If for any reason the system is unable to correct to the desired LIQ CAL rate, 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 SYSTEM SET-UP.
- 5) Verify granular and liquid volume used.

APPENDIX 2

PROCEDURE TO TEST FLOW METER/ENCODER 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 
- 2) Depress key labelled 
- 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 Meter or Encoder.

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

APPENDIX 3

FLOW METER MAINTENANCE AND ADJUSTMENT PROCEDURE



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

NH₃ 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 4

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 it into a calibrated 5 gallon [19 liter] container.
- 5) Switch ON appropriate boom switch (for the hose that was just placed into the 5 gallon container) and the 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 calibration number stamped on the tag of the 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]

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

ENGLISH UNITS:

$$= \frac{720 \times 260}{250} = 749$$

METRIC UNITS:

$$= \frac{[190] \times [984]}{[946]} = [198]$$

Corrected METER CAL = 749 [198]

- 9) Enter corrected METER CAL before resuming application.