DANIEL INDUSTRIES, INC.
DANLOAD OPERATIONS REFERENCE MANUAL
(including DANBLEND OPERATIONS)

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1.0 INTRODUCTION

The purpose of this manual is to familiarize users with the functions of the DANLOAD system’s hardware and software, as well as to provide the terminal staff with a basic understanding of troubleshooting and meter calibration. Each section is discussed in its entirety, with a general overview of that part of the system preceding each discussion. Operations staff should review this manual before attempting to operate, troubleshoot, or calibrate any of its equipment.

In addition, this manual is written with the assumption that the operator is someone who is knowledgeable in the field of terminal operations, specifically load rack applications. This manual should be kept for quick reference when using DANLOAD equipment.

Furthermore, Appendix C of this manual contains information on the DANBLEND system’s hardware and software, which should be used in conjunction with the DANLOAD Operations Manual.

The DANLOAD system firmware, including any related documentation is furnished to the purchaser under license for use on the system for which, or in connection with which it is supplied. The purchaser may reproduce or modify any such documentation only for use on that system, and only provided all reproductions and modifications carried out by the purchaser or their agents have specifically been approved by Daniel Automation Division, Daniel Industries, Inc.. The purchaser may not make the firmware, hardware, and related documentation or the contents thereof available to third parties without the written approval of Daniel Automation Division, Daniel Industries, Incorporated.

The DANLOAD is an island based batch controller and is comprised of the following components:

1) DANMASTER
2) Explosion Proof Unit (EPU)
3) DANTROL
4) L.R. Turbine Meter
5) DANFLO Control Valve

The DANMASTER is the central control unit and houses the Meter Control Units (MCU), Central Processing Unit (CPU), Program Storage (ROM), Power Supply Unit (PSU), and I.S. barriers. The DANMASTER and EPU are both housed in Nema 7 enclosures. The DANMASTER is strictly a low voltage D.C. device. All A.C. power in the system is terminated in the EPU. The EPU houses the A.C. to D.C. power supply and thirty-two solid state relays for control of circuits such as pumps, valves, and additive injectors.
The DANTROL unit is the operator interface to the system. The DANTROL has three Liquid Crystal Displays (LCDs); two are six-character numeric displays for the preset and delivered quantities; the third is a two line, sixteen-character per line, alpha-numeric display. The DANTROL also utilizes a keypad for driver input of data. The DANTROL is a U.L. rated, intrinsically safe device. Up to six DANTROL units can be interfaced to one DANMASTER/EPU set.

The DANLOAD system can perform safe, accurate batch loading in a stand-alone environment. However, this may also be dependent on the degree with which the system is interfaced with the terminal automation system used at the terminal. This degree of independent operation is determined by the end user.

The following topics cover the design features of the DANLOAD. Each feature is described on a per riser basis:

1) Capabilities

A) Three K-factor inputs, for low, medium, and high flow rates, designed to linearize the meter accuracy curve.

B) The DANLOAD provides low flow start-up and shutdown. The system can also control an intermediate flow rate if the maximum rate is unattainable due to under pumped conditions. This provides for operation at known points along the meter curve.

C) The DANLOAD provides two levels of system security, primary and secondary.

Secondary alarms provide local indication of the alarm on the alpha-numeric display and pulse an alarm contact at one second intervals. The secondary alarms are based on the four status point inputs and can be cleared simply by correcting the status point failure.
Primary alarms also provide local indication of the problem on the display but holds the alarm contact indefinitely. The primary alarms must be reset by means of a key. Primary alarms are: no flow detected, flow rate too slow, unauthorized flow, dual pulse failure, temperature probe failure, and unable to close valve.

D) The system is easily programmed via the prompting display and keypad. Parameters such as minimum preset amount, maximum preset amount, minimum flow rate, and minimum flow rate time out period are user programmable along with K-factors, flow rates and some time durations. The DANLOAD also offers a proving routine to assist in establishing K-factors and performing meter calibration.

2) Inputs

A) Four permissive inputs per DANTROL, for status input monitoring. Inputs may include DART SYSTEM permissive, scully permissive, vapor recovery, grounding system, etc. At the minimum, we suggest monitoring the scully system.

B) Raw meter pulse input, either singularly or in a dual pulse security mode.

3) Outputs

A) One pulse per unit open collector, for whole unit output to an automation system such as the DART SYSTEM.

B) One solid-state relay pump control circuit output with programmable line pack delay and shutoff delay time periods.
C) Two solid-state relays for "digital" valve control, such as the Daniel DANFLO valve, Smith 210 or Brooks 788 Models.

D) One solid-state relay for alarm indication.

E) Four additive control solid state relay outputs for additive pacing. Each additive ratio is user programmable.

The L.R. TURBINE METER is responsible for accurate and repeatable measurement of the product. The L.R. was specifically designed for load rack applications. The meter features a unique self-cleaning ball bearing design and a patented self-cleaning hanger. The meter body is stainless steel and utilizes aluminum internals. There is also a carbon steel model. The driving force behind the design was to offer an extremely accurate and repeatable meter at a very competitive price.

The DANFLO valve performs the actual product control. The DANFLO is a spring biased, positive sealing, fail-shut valve. There are two solenoids on the DANFLO which are controlled by the DANLOAD. These two solenoids are used to control product behind the piston. The product itself is, therefore, used to actually move the piston throughout its travel.

The DANLOAD system analyzes the frequency of incoming pulses from the meter, compares this to the programmed parameters and then modulates the valve in both the low, medium, and high flow rates.
1.1 DESCRIPTION OF OPERATION

During product flow, the DANLOAD system controls the valve solenoids to achieve the preset volume and to maintain the programmed flow rates on the basis of the pulse count and the established meter K-factors. Low flow start-up and shutdown periods are monitored and controlled using the gross volume.

Additionally, the DANLOAD system computes the average valve closure period at the end of each normally terminated load. The average valve closure period is used to ensure that the product flow is halted at the preset volume.

The current load total and meter totalizers are continuously stored in non-volatile memory to guard against data loss in the event of a power failure.

Loss of line power results in immediate shutdown of the loading operations. Pulses are counted until full internal power failure occurs. When power is restored, the final counts are accessed by the system for use.

All critical calibration functions are stored in non-volatile memory so that they may be retrieved when power is restored.

When the temperature option is installed, five methods of calculating the net product flow are permitted by using one of five American Petroleum Institute (API) tables. Temperature samples are only averaged into the loading temperature when product is flowing. The DANLOAD temperature sub-system produces a true weighted average for the loaded volume in that the total number of samples is divided into the sum of all the temperatures taken. Additionally, these samples are taken on a volumetric basis instead of a timed basis.

Additive injection outputs, of which there are four, are controlled using the ratios entered by the operator during system setup. The ratios are the number of units of measure loaded per one output pulse delivered to the additive relay. Each additive has an individually programmable ratio. Additive control is achieved by cycling the additive’s relay on a 50% duty cycle each time the adjusted volume is equal to any multiple of the additive’s ratio. This calculation is performed separately for each additive installed, thus permitting different ratios for each additive relay.
The units of measure displayed are a function of the meter calibration K-factor. The meter K-factor is given as the number of pulses input into the DANLOAD system per unit of measure pumped. This factor is usually marked on the meter by the factory (typically 23.5 +/- .5 for a 4" system). The meter K-factor is entered as "XX.XXXX". The DANLOAD system permits meter K-factors from 1.0 to 99.9999. Meter factors of less than 1.0 are not permitted because there would not be sufficient pulse generation per unit of measure for the system to control valve closure properly. A meter K-factor of 10.0 or greater is recommended.

Valve control is achieved by stepping the valve, open or closed, until the desired flow rate is attained. The valve position is then adjusted every one second throughout the load, if necessary, to maintain the desired flow rate of + or - 5%. If the flow rate cannot be achieved, the DANLOAD steps down to the programmed medium flow rate, if it being used. If this rate cannot be achieved, the DANLOAD "locks-in" at the flow rate which is currently being pumped (see also Sections 5.0 and 11.0 on meter calibration). This feature results in true digital valve control and in the ability to maintain a stable flow rate even during varying pressure/demand situations. Additionally the more stable the flow, the better the results of meter repeatability.

Operator selectable minimum flow rate and time-out values are used to continually check the current flow rate against the set values. If the flow rate remains below the minimum value for a period greater than the time-out value, the alarm relay is enabled and an alarm condition is declared.

The operator also selects the time out period that is permitted after the product is authorized before pulses must be sensed. This limits the volume of product that would be permitted to flow in the event the pulser should fail. This value is also used to check for the loss of pulses during a load. A "no flow" condition causes the alarm relay to be enabled and an alarm condition is declared.

During periods when product flow is not authorized, the DANLOAD system monitors the pulser input, looking for unauthorized product flow. The operator can program a value for the allowable unauthorized flow between loads. If the unauthorized flow value is exceeded, the system enables an alarm relay and declares an alarm condition.

While normal loading is in progress, the user can stop the flow of product by pressing the "C", STOP LOAD, key. The DANLOAD system then ramps the DANFLO valve back into low flow and then stops the flow by fully closing the valve. To start flow again, the user must enter a new preset value. If the volume to load is the remainder of the original preset, the quantity may be obtained from the top numeric display.
Pressing the "D", CANCEL LOAD, key immediately closes the valve and disables the pump control relay. This may result in "line shock" if the product is flowing at a very high rate. The user must preset the unit again to restart the product flow. The "B", START LOAD, key does not restart the loading operation after either the "C", or "D", keys are pressed, without first entering a new preset value.

The "A", PRESET, "C", STOP LOAD, and "D", CANCEL LOAD, keys also cancel a preset before the "B", START LOAD, key is pressed. Additionally, when no preset or loading operation is taking place, pressing the "D" key causes the display of the totalizer value on the alpha-numeric display. Pressing the "C" key displays the current probe temperature as well as the average temperature of the last load (provided a temperature board is installed and the temperature option is selected).

The pump relay is enabled for an operator selectable delay period (line pack delay) before the control valve attempts to open and is held enabled for an operator selectable delay period (pump stop delay) after a normal load termination. The operator may use a dual pulse transmitter with the DANLOAD system and program the permitted difference between the two pulser inputs. If a difference greater than the selected value is achieved, the system terminates the loading process, enables the alarm relay, and declares an alarm condition.

The operator determines the maximum permissible preset volume. The DANLOAD system uses this value to prevent excess preset values that are sometimes used to bypass the low flow start-up and shutdown volumes. It is recommended that this parameter be set to a value less than or equal to the maximum compartment size of authorized vehicles.

The minimum permissible preset volume is also programmed by the operator. The DANLOAD system should be programmed with a large enough value to permit proper valve closure control and yet small enough to provide for load "topping off".
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2.0 PHYSICAL LAYOUT OF SYSTEM

SECTION 2
2.1 DANMASTER LAYOUT

The general card-slot assignment for the DANMASTER is as follows:

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Slot 1 - Power with Communications Board
Slot 2 - MCU #1 - #4
Slot 6 - CPU Board
Slot 7 - MUC #5
Slot 8 - ROM Board
Slot 9 - Temperature Board

**NOTE:** MCU #6 may be replaced by a temperature board, if applicable. Additionally, the CPU and 64K ROM boards are not labeled due to the fact they do not plug into a connector located in the backplane. They may be inserted anywhere between MCU #1 and MCU #6.
2.2 DANTROL LAYOUT

The physical layout of the DANTROL is as follows:

![DANTROL Layout Diagram]

**NOTE:** An alarm reset switch is located on the DANTROL box to clear alarms. The DANTROL calibration switch is located within the DANTROL housing on the ACU board.
3.0 INITIAL POWER UP OF SYSTEM

Install the DANLOAD system in accordance with this manual and any applicable codes. It is strongly recommended that a qualified field service representative from Daniel be present during initial power up of the system. The electrical contractor should also be present at this time. All wiring should be checked to insure a safe, reliable start-up. In the case of a conflict arising with the installation, the National Electric Code takes precedence. However, the electrical contractor should first contact Daniel Automation Division, Daniel Industries, Incorporated, for verification prior to installation.

As the system is powered up, the boot loader firmware loads the DANLOAD application program and performs an internal check to ensure that the program was properly loaded from the ROM board into the CPU’s random access memory. After passing this initial check, the loading application program begins execution.

The loading application program first checks areas of the battery-backed RAM to make certain that the battery-backed RAM had not been altered and that it may be written to. If the battery-backed RAM cannot be written to, the program prevents the system from initializing and running.

If the "power on" situation is the first "power on" encountered by the battery-backed RAM, or if the battery-backed RAM has not been initialized using this program revision level, the system notes that there is a need to initialize the values stored in the battery-backed RAM before permitting the use of the DANLOAD system.

The states of the ALARM RESET switch and the CALIBRATION switch are then checked. If either switch is in a position other than the normal run position, the operator is prompted with:

```
SWITCH OFF
ALARM RESET
and/or
SWITCH OFF
CALIBRATION
```

These messages are displayed until the operator takes the indicated action.
After the completion of the internal software initialization and a cursory hardware check, the DANLOAD system may prompt the operator with:

ALARM PENDING
RESET ALARM

This message indicates that when the DANLOAD system was last powered down, there was an alarm condition pending. The operator must reset the alarm before the program permits the operator to continue. This is done by turning on the ALARM RESET switch. This action should not be taken until the operator has determined that the cause of the alarm condition has been properly cleared and that the DANLOAD system may be safely operated.

After the ALARM RESET has been turned on, the operator is prompted with:

SWITCH OFF
ALARM RESET

The operator must then turn off the ALARM RESET switch. As indicated before, the DANLOAD may note that the battery-backed RAM has not been previously initialized. If this circumstance occurs, the system prompts the following:

CHECK TOTALIZERS

This indicates that the operator must press the "D", CANCEL LOAD, key which also serves as the CHECK TOTALIZER key.

The current gross totalizer which is stored in the battery-backed RAM is shown on the alpha-numeric display:

GROSS TOTAL

The message is displayed for approximately 10 seconds to allow the operator time to record this value for comparison with previous readings.
If the temperature option has been selected, the DANLOAD system automatically displays the current net totalizer value stored in the battery-backed RAM:

| NET TOTAL |

This message is also displayed for 10 seconds.

**NOTE:** While the loading application program is running, and there is no loading taking place on a DANTROL, the "D", CANCEL LOAD, key can be used at that time to display the gross and net totalizers on the alpha-numeric display.

The operator is then prompted with the following message:

| SETUP REQUIRED | VERIFY VALUES |

This indicates that the operator must turn on the calibration switch. This action permits the operator to verify that the values stored in the battery-backed RAM are correct and to allow the operator to change them if they are incorrect. For more information refer to the next section on operational setup.
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4.0 CALIBRATION: GENERAL INFORMATION

There are a few rules which the operator may find helpful to know before stepping through the CALIBRATION process.

1. Numeric entries require that the ENTER key be pressed to terminate data entry.
2. Function key (A, B, C, D) entries do not require the use of the ENTER key.
3. While entering numeric data, the CLEAR key may be used at any time to return the cursor to its original position, erasing the previously entered keystrokes. A new series of keystrokes may be entered at the keypad until the ENTER key is pressed.
4. After pressing the ENTER key on numeric entries, the DANTROL momentarily displays "PLEASE WAIT".
5. The current stored value of a function key entry is displayed, right-justified, on the second line of the alpha-numeric display.
6. The current stored value of a numeric entry is displayed, left-justified, on the second line of the alpha-numeric display.
7. The current stored value of a numeric entry is displayed with each numeric prompt and may be retained by pressing the ENTER key without re-entering the data.
8. Function key entries are echoed with their corresponding text immediately after pressing the function key.
9. A numeric value preceded by a zero is interpreted as having a negative value.
10. Calibration set-up functions are identified by option number. These option numbers are required to operate the system in the selection mode.
4.1  CALIBRATION: OPERATIONAL SETUP

When the calibration switch, located in the DANTROL housing, is turned on, the DANMASTER switches to the CALIBRATION mode. While the CALIBRATION application program is being initialized, all DANTROLS associated with that DANMASTER display:

```
PLEASE WAIT
```

During the initialization process, the alarm relays are enabled for approximately three seconds. This serves as a check of the hardware "watch dog" timer.

Only one DANTROL can be configured at a time. On the DANTROL being configured, the DANLOAD system briefly displays:

```
A = YES
B = NO
```

This is strictly an informational message to let the operator know that any message followed by "Y/N" requires an "A" or "B" input. All other numeric entries require a value followed by the ENTER key.

If the system recognizes that this is the first power up of the battery-backed RAM, the system prompts for all of the calibration options (unless otherwise indicated in certain sections) beginning with Section 4.2, "SELECT LANGUAGE." If this is not the initial power up, the system automatically enters a selection mode and displays the following message:

```
ENTER SELECTION
```

To make a calibration change, select an option number and press Enter. To review or change all of the options in sequence, select 0 and press Enter. If no number is entered, the selection will default to the last option chosen.

The operator may exit CALIBRATION SET-UP at any time by turning OFF the Calibration switch.
4.2 SELECT LANGUAGE (Option #1)

The DANLOAD system displays the message:

```
SELECT LANGUAGE ?
```

The DANLOAD system offers a selection of language texts. Currently, the operator may choose either English or Spanish. Two additional language choices are reserved for future use. If an entry is made for a language not yet available, the system will default to English. All questions will be displayed in the language selected.

Enter 0 for English or 1 for Spanish.
4.3 COMMUNICATIONS PARAMETERS

4.3.1 HOST/COMMS (Option #2)

The DANLOAD system displays the message:

```
HOST/
COMMS Y/N
```

Select A (YES) if the DANMASTER is communicating with a host. Select B (NO) if the DANMASTER is a stand-alone unit.

If the answer is YES, the DANLOAD system will prompt two additional communications parameters (Dart Data Rate and Danmaster Address).

If the answer is NO, these options will not apply and will not be prompted.

4.3.2 DART DATA RATES (Option #3)

The DANLOAD system displays the message:

```
DART DATA RATE
```

The Dart data rate is the baud rate at which the DANMASTER is communicating to a host computer. The operator may select an optional baud rate by entering a value from one to four (1=1200, 2=2400, 3=4800, 4=9600).

4.3.3 DANMASTER ADDRESS (Option #4)

The DANLOAD system displays the message:

```
DANMASTER ADDR ?
```

To assure proper communication between the host and each DANMASTER, the operator must identify the DANMASTER by value (1 - 15). The sequence will not proceed until the DANMASTER has been identified.
**DANLOAD**

### 4.4 TEMPERATURE (Option #5)

The DANLOAD system displays the message:

```
TEMPERATURE
OPTION ? Y/N
```

If the operator responds with "YES", the temperature option for volume correction is installed. With net compensation now chosen, the system prompts:

```
API 6A = 1 and API 54A = 3 and API 6D = 5
API 6B = 2 API 54B = 4
```

These are displayed, alternately, every few seconds until a selection is made.

If API table 6A, 6B, or 6D is selected, the following message is displayed:

```
GRAVITY ?
```

The operator must enter the appropriate three digit value for the specific gravity of the product to be pumped. The entry is in the format of XX.X. No decimal point may be entered, however, the system assumes the decimal point one place to the left of the last digit. For example an entry of 536 is recorded as 53.6.

If table 54A or 54B is selected, the following message is displayed:

```
DENSITY ?
```

The operator must enter the appropriate six digit value for the density of the product to be pumped. The entry is in the format of XXXX.XX. Again, the decimal point is assumed. An entry of 86750 is recorded as 867.50.
Following the operator’s entry, the DANLOAD system interprets the entry and echoes the response with the decimal point in the proper location, using the appropriate prompt:

<table>
<thead>
<tr>
<th>CORRECT ? Y/N</th>
<th>or</th>
<th>CORRECT ? Y/N</th>
</tr>
</thead>
<tbody>
<tr>
<td>XX.X</td>
<td></td>
<td>XXXX.XX</td>
</tr>
</tbody>
</table>

If the operator selects "NO", the operator must re-enter the value for the appropriate gravity or density in the same manner as before. If the operator responds with "YES" the entry is accepted provided it is within the acceptable bounds of the chosen API table.
4.5 DUAL PULSE (Option #6)

The DANLOAD displays the message:

DUAL PULSE
INPUT ? Y/N

If the operator responds with "YES", the DANLOAD system performs pulse checking on the dual pulse inputs from the meter and alerts the user of any meter errors which occur.

The DANLOAD system displays the message:

MAX ERROR COUNT

The operator must then enter a value which is the maximum number of errors allowed. Dual pulse errors are generated by the detection of additional or missing pulses in either pulse stream, phase shifts, and frequency differences. Should this limit be exceeded, the system goes into an alarm condition and the alarm relay is enabled.
4.6 ADDITIVES (Option #7)

The DANLOAD system displays the message:

```
# OF ADDITIVES?
```

The value entered informs the DANLOAD of the number of additives that are to be used for that product. The operator must enter a value from zero to four. Any other entry is rejected and the prompt is displayed again. If a zero is entered, the program branches to the prompt concerning the maximum preset parameters (see Section 4.7, PRESET PARAMETERS).

If a non-zero entry is made, the operator is prompted with:

```
ADD #1 RATIO
```

The operator must then enter the value to be used for the injector. This represents the number of units measured per additive injection. This prompt is repeated for the number of additives entered.
4.7 PRESET PARAMETERS

4.7.1 MAXIMUM PRESET (Option #8)

The DANLOAD system displays the message:

```
MAXIMUM PRESET ?
```

The operator must then enter a positive numeric value which is the maximum load limit allowed per one preset operation. The value is, ideally, set to be the single largest vehicle compartment to be loaded at the riser.

4.7.2 MINIMUM PRESET (Option #9)

The DANLOAD then prompts the operator with:

```
MINIMUM PRESET ?
```

The operator enters a positive numeric value. This value limits the smallest load that may occur during any one preset operation. This value should be set to a value great enough for the DANLOAD system to gain full control of the valve while still allowing for "top-off" operations.
4.8 ALARM PARAMETERS

The DANLOAD system next prompts for several of the user programmable options for alarms. When these parameters are exceeded the system notifies the operator that an alarm condition has occurred and these instances should be investigated before proceeding. Some of these parameters not only have values but also time limits. An explanation proceeds these parameters and the operator should refer to the troubleshooting section, Section 10.0, to rectify these problems.

4.8.1 LOW FLOW ALARM (Option #15)

The DANLOAD system displays the message:

LOW FLOW ALARM

The operator enters a positive value which denotes the slowest acceptable flow rate permitted at the loading position. Flow rates, at or below this rate, causes an alarm condition to be declared, the alarm relay to be enabled and loading to be terminated.

4.8.2 TIME TO MINIMUM FLOW RATE (Option #17)

Slow flow rate conditions are permitted only for a certain period of time and the corresponding prompt is:

TIME TO MIN FLW RATE

This parameter is an operator specified time period in seconds for the flow rate to reach the minimum acceptable rate. The "MIN FLOW RATE" and "TIME TO MIN RATE" work together to ensure that the flow has not dropped to that which is below the acceptable standards (during a load). This is to prevent the user from "milking the meter".
4.8.3 NO FLOW TIME OUT (Option #18)

The DANLOAD system displays the message:

```
NO FLW TIME OUT ?
```

The operator must enter a value which indicates the period of time in seconds that is permitted for the flow to begin, following the issuance of permissive to the valve. If pulses are not sensed within this period of time or at any time during the loading sequence, the system shuts down and declares an alarm condition. This value should be set high enough to allow the valve to open and achieve the programmed low flow rate. This value and all others should be discussed during start-up after the Daniel Service Representative has had adequate time to look over all conditions which may require special consideration for your terminal.

4.8.4 UNAUTHORIZED FLOW LIMIT (Option #19)

The DANLOAD system displays the message:

```
UNAUTH FLW LIMIT
```

The operator enters a value which is the total number of units allowed while the DANTROL is in an unauthorized state before the system shuts down and declares a primary alarm condition.
4.9 PUMP DELAY PARAMETERS

4.9.1 LINE PACK DELAY (Option #20)

The DANLOAD displays the message:

```plaintext
LINE PACK DELAY ?
```

The operator must enter a positive value which indicates the period of time in seconds in which the pump runs before the valve is permitted to open. This parameter should be set to a value great enough for the line pressure to reach its maximum and to force product vapor back into liquid.

4.9.2 PUMP STOP DELAY (Option #21)

The DANLOAD system displays the message:

```plaintext
PUMP STOP DELAY ?
```

The operator must enter a positive value. The value indicates the period of time in seconds that is permitted to pass after the product has stopped flowing before the pump is disabled. At some terminals, a pump delay relay is utilized; however, if the capability does not already exist, the DANLOAD system can perform this task. Additionally, this permits the driver to move a loading arm and to begin the next load without cycling the pump off and then back on. This feature reduces the normal wear on the pump starter motor.
4.10 LOW FLOW PARAMETERS

4.10.1 LOW METER FACTOR (Option #30)

The DANLOAD system displays the message:

LOW METER FACT ?

The operator must enter a positive value. This value indicates the number of meter pulses per unit of measure that is received at the low flow rate. This is referred to as the Low Flow K Factor. This value should initially be set to the value indicated on the meter. The Low Flow K Factor has an assumed decimal point with four significant digits. Previously entered values will appear on the second line.

Following the operator entry, the DANLOAD system interprets the entry and echoes the response with the decimal point in the proper location, using the following prompt:

CORRECT ? Y/N
XX.XXXX

If the operator responds with "NO", the Low Flow K-factor is displayed again and the operator is allowed to view and change the factor.

4.10.2 LOW FLOW RATE (Option #31)

The DANLOAD system displays the message:

LOW FLOW RATE ?

The operator then enters a positive value. This value indicates the rate of flow at which the product is pumped during the start-up and shutdown periods of the load.
4.10.3 LOW FLOW START UP (Option #32)

The DANLOAD system displays the message:

```
LO-FLW START-UP ?
```

The operator must enter a positive value which indicates the volume which is initially loaded during start-up before the valve is allowed to open to its predetermined high flow rate. This feature reduces the probability of product "splash back" and static build up with some products.

4.10.4 LOW FLOW SHUTDOWN (Option #33)

The DANLOAD system displays the message:

```
LO-FLW SHUTDOWN ?
```

The operator enters a positive value which indicates the amount of product to be pumped at the low flow rate before the valve is to be closed and the loading terminated.

4.10.5 RUN LOW FLOW TEST (Option #34)

The DANLOAD system displays the message:

```
RUN LOW FLOW TEST? Y/N
```

A "NO" response causes the program to execute the sequence under Section 4.12, HIGH FLOW PARAMETERS, while a "YES" response branches the system to Section 6.1, CALIBRATION OF THE METER.
4.11 MEDIUM FLOW PARAMETERS

4.11.1 MEDIUM METER FACTOR (Option #35)

The DANLOAD system displays the message:

```
MEDIUM MTR FACT?
```

The operator enters a positive value. This value indicates the factor utilized by the system at the medium flow rate. This is referred to as the Medium Flow K Factor. During the initial calibration, this factor should be set to the value indicated on the meter.

The system then redisplays the value and prompts:

```
CORRECT ? Y/N
XX.XXXX
```

If the user responds with "No," the Medium Flow K Factor is displayed again and the operator is allowed to view and change the factor.

4.11.2 MEDIUM FLOW RATE (Option #36)

The DANLOAD system displays the message:

```
MED FLOW RATE ?
```

The operator must enter a positive value. This value indicates the rate of flow at which the product is pumped during its medium flow. Section 11.0 (CALIBRATION: AN IN-DEPTH ANALYSIS) deals with this topic in more detail. The medium flow rate serves two primary purposes. First, the medium flow rate is used to increase meter linearization. By establishing an additional proven meter factor between low and high flow rates, the measurement accuracy is increased during transitional periods (ramping from low to high and high to low). The medium meter factor is also utilized in under-pumped conditions which usually occur when two trucks load simultaneously. In this condition, the programmed high flow rate may not be obtainable. The system is designed to recognize the under-pumped condition by controlling flow at a proven flow rate (medium flow), resulting in increased accuracy.
If the high flow rate is set too high and two trucks are loading simultaneously, the system may not be able to achieve the predetermined high flow rate.

Based on statistics from several meters, this change in flow rates may require the introduction of a medium flow rate. The system recognizes the change with two trucks loading and stabilizes its flow rate to a rate which it has been calibrated. This is the overall objective for having a medium flow rate calibration.

The functionality of the medium flow rate can be eliminated by entering the same meter factor and flow rate for medium and high flow.

4.11.3 RUN MEDIUM FLOW TEST (Option #37)

The DANLOAD system displays the message:

```
RUN MEDIUM FLOW TEST ? Y/N
```

A "NO" response causes the program to execute the sequence under Section 4.12, HIGH FLOW PARAMETERS, while a "YES" response branches the system to Section 6.1, CALIBRATION OF THE METER.
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4.12 HIGH FLOW PARAMETERS

4.12.1 HIGH METER FACTOR (Option #38)

The DANLOAD system displays the message:

```
HIGH METER FACT ?
```

The operator must enter a positive value which indicates the meter factor to be utilized during the high flow rate. This is referred to as the High Flow K Factor. Again, this value should initially be set the value indicated on the meter.

If the operator responds with "NO", the High Flow K-Factor is displayed again and the operator is allowed to view and change the factor.

The system redisplays the value and prompts:

```
CORRECT ? Y/N
XX.XXXX
```

4.12.2 HIGH FLOW RATE (Option #39)

The DANLOAD system displays the message:

```
HIGH FLOW RATE ?
```

This value indicates the rate at which the product is to be pumped during its high flow operation. This value should be set such that the rate of flow is attainable, even under adverse conditions. Though a medium flow rate is installed, the operator should not assume this rate can be set to the maximum rate which the pump is capable of. REMEMBER, safety always takes the highest precedence.
4.12.3 RUN HIGH FLOW TEST (Option #40)

The DANLOAD system displays the message:

```
RUN HIGH FLOW TEST ? Y/N
```

A "NO" response causes the program to execute the sequence under Section 4.12, HIGH FLOW PARAMETERS, while a "YES" response branches the system to Section 6.1, CALIBRATION OF THE METER.
4.13 STATUS POINTS

Each DANMASTER MCU is equipped with four hardware interfaces which monitor on/off status of external equipment. Each interface must be assigned a status point type. There are 17 status point types, 13 of which are preassigned by the DANMASTER. Four types are available for assignment by a host. The status point types are identified by numeric values as follows:

0 = no status point input type
1 = swing arm input
2 = host permissive
3 = safety system
4 = ground system
5 = permissive side one
6 = permissive side two
7 = safety system side one
8 = safety system side two
9 = ground system side one
10 = ground system side two
11 and 12 = not allowed for use
13-16 = reserved for host computer

To assign a status point type to the hardware interface, the operator must identify the type by value and indicate "Yes" or "No" if the contact switch at the interface is opened or closed.
4.13.1 STATUS POINT 1 - TYPE (Option #70)

The DANLOAD system displays the message:

```
ST. PT. 1 TYPE
```

To select a status point type, the operator must enter a numeric value from the list of types described in Section 4.13.

4.13.2 STATUS POINT 1 - INVERT (Option #71)

The DANLOAD system displays the message:

```
ST. PT. 1 INVERT Y/N
```

At times it is necessary to invert a status point. A status point input is normally closed if it is in a true condition. If inverted, an open status point is in a true condition. To invert a status point, the operator must select "Yes".
4.13.3 STATUS POINT 2 - TYPE (Option #72)

The DANLOAD system displays the message:

```
ST. PT. 2 TYPE
```

To select a status point type, the operator must enter a numeric value from the list of types described in Section 4.13.

4.13.4 STATUS POINT 2 - INVERT (Option #73)

The DANLOAD system displays the message:

```
ST. PT. 2 INVERT Y/N
```

At times it is necessary to invert a status point. A status point input is normally closed if it is in a true condition. If inverted, an open status point is in a true condition. To invert a status point, the operator must select "Yes".

4.13.5 STATUS POINT 3 - TYPE (Option #74)

The DANLOAD system displays the message:

```
ST. PT. 3 TYPE
```

To select a status point type, the operator must enter a numeric value from the list of types described in Section 4.13.
4.13.6 STATUS POINT 3 - INVERT (Option #75)

The DANLOAD system displays the message:

```
ST. PT. 3 INVERT Y/N
```

At times it is necessary to invert a status point. A status point input is normally closed if it is in a true condition. If inverted, an open status point is in a true condition. To invert a status point, the operator must select "Yes".

4.13.7 STATUS POINT 4 - TYPE (Option #76)

The DANLOAD system displays the message:

```
ST. PT. 4 TYPE
```

To select a status point type, the operator must enter a numeric value from the list of types described in Section 4.13.

4.13.8 STATUS POINT 4 - INVERT (Option #77)

The DANLOAD system displays the message:

```
ST. PT. 4 INVERT Y/N
```

At times it is necessary to invert a status point. A status point input is normally closed if it is in a true condition. If inverted, an open status point is in a true condition. To invert a status point, the operator must select "Yes".
4.14 ALTERNATIVE CALIBRATION SEQUENCING OPTIONS

4.14.1 INITIATE COMPLETE CALIBRATION SEQUENCE

To review or change all of the calibration options in sequence, select 0 and press Enter. The system will start at the first option and continue to the end.

4.14.2 RESUME SEQUENCING (Option #95)

To resume sequencing or to view or change a particular section, enter the option number you want to start with and complete the response. When the DANLOAD system returns to the "Enter Selection" prompt, enter #95. The system will display the next question in the sequence and proceed through to the end.

This section concludes the calibration set-up sequence.
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5.0 EXITING SETUP/CALIBRATION

To return to a specific setup option, enter the option value and press Enter when the following prompt appears:

ENTER SELECTION

To repeat the entire sequence, select "0" and press Enter.

The operator may exit SETUP/CALIBRATION at any time by turning off the CALIBRATION switch.

Once calibration is switched off, the DANLOAD system returns to normal operation. (Refer to Section 7.0, GENERAL USER PROCEDURES.)
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6.0 CALIBRATION OVERVIEW

The DANLOAD system is easily field calibrated. The CALIBRATION mode is entered, as described in Section 4.0, OPERATIONAL SETUP. To calculate the correction factor, or K-factor, for a meter, a preset volume is manually entered into the system and product is loaded into or through a proving device. The actual volume observed by the prover is then entered into the DANTROL. The internal microcomputer calculates the correct meter K-factor. Although in depth analysis is given in Section 11.0, it is only necessary to know that the new K-factor is derived based on the following formula:

\[
\text{NEW FACTOR} = \frac{\text{METERED VOLUME}}{\text{OBSERVED VOLUME}} \times \text{OLD FACTOR}
\]

Calibration should be performed at two flow rates at the minimum. For the best possible results, all three flow rates should be calibrated. The low flow start-up, shutdown, as well as low, medium, and high flow rates are operator programmable.
6.1  CALIBRATION OF THE METER

If, during the process of calibration, the RUN TEST option is selected on any flow rate, the system displays the message:

```
ENTER PRESET VOLUME
```

The operator must then enter a positive value which is greater than or equal to the minimum load size and less than or equal to the maximum load size. Further, API recommends this value be one and one-half times greater than the flow rate being calibrated. The volumetric device being used for calibration should be one and one-half times greater than the high flow rate. This is also dependent on the type of measuring device being used by the terminal. If questions arise, NBS or State Weights and Measures shall take precedence.

The following messages may occur:

If the operator enters a value greater than the maximum load size, the DANLOAD system displays:

```
LIMIT EXCEEDED
TRY AGAIN
```

The operator is then allowed to enter a new value.

If the operator enters a new value that is less than the minimum load limit, the system displays the message:

```
LOAD TOO SMALL
TRY AGAIN
```

The operator is again allowed to enter a new value.

If the operator enters a zero or presses the enter key, the system returns to the RUN TEST prompt in CALIBRATION.
If the operator enters an acceptable value, the DANLOAD system prompts the operator to:

PRESS START
WHEN READY

A response of "B", START, begins product flow if all safety circuits are satisfied (see Section 8.2, SECONDARY ALARMS). Any other function key response causes the system to display the RUN TEST prompt again. Additionally, after a preset volume is entered, the entered volume is displayed on the top numeric display, indicating the volume remaining to be loaded, and the bottom display is zeroed, indicating the volume loaded displayed to the nearest .1 gal. During the loading of product, these two displays are updated every second, giving the operator a current reading of the volumes loaded and remaining to be loaded. When the operator presses the "B", START, key, and has completed all of the safety circuits, the loading process begins, and the system displays the following:

LOAD IN PROGRESS

This message is displayed during the entire loading cycle or until the operator presses the STOP or CANCEL keys. Pressing either one of these keys causes the flow of product to terminate. The STOP key causes the valve to be staged down to the low flow rate before shutting off entirely. The CANCEL key causes the removal of the valve permissive entirely and may result in "line shock" if the system is flowing at a high flow rate at the time.

In the event that a safety circuit is lost or an alarm occurs during a load, product flow is terminated, and the operator may resume loading as described in Section 8.0, PRODUCT SECURITY. At the normal termination of product flow, the DANTROL displays the following:

VOLUME LOADED

The amount of product which the meter recorded during the run is displayed to the nearest .01 gal. until the operator presses one of the four function keys.
Any function key pressed causes the system to prompts for:

**MEASURED VOLUME**

This volume is the actual gross volume measured to the nearest .01 gal. in the proving device. The value entered requires one of the two be input, gross or net, and should remain in either gross or net throughout the proving of the meter. It is recommended that these values remain in gross, and all variables be considered separately on your calibration data sheet. Again, this section only deals with the operator input of information. For an in depth analysis on calibration, please refer to Section 11.0.

The system displays:

**CORRECT ? Y/N**

**XXX.XX**

If the operator selects "NO", the measured volume is displayed again and the operator may make changes as needed. If the operator presses "YES", the system proceeds to calculate a factor. If the system cannot compute a factor based on the information provided the following message is displayed:

**UNABLE TO COMPUTE FACTOR**
If the system can compute a factor, a warning message is displayed for a few seconds to indicate the factor about to be displayed is only a recommendation:

**FOLLOWING IS A SUGGESTED FACTOR**

Next, the system displays the factor:

**FACTOR OK? Y/N**

XX.XXXX

If the operator selects "YES", the system proceeds to the "RUN FLOW TEST" prompt. If the operator selects "NO", the system displays:

**WISH TO ENTER A NEW FACTOR? Y/N**

If the operator enters "NO", the system returns to the "RUN FLOW TEST" prompt. If "YES" is entered, the system prompts for:

**METER FACT? XXXXXX**

After the meter factor is entered the system displays:

**CORRECT ? Y/N**

XX.XXXX

If a "NO" response is entered the meter factor is displayed again and the user may make changes as needed. A "YES" response causes the system to proceed to the "RUN FLOW TEST" prompt.
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7.0 GENERAL USER PROCEDURES

When the user approaches a DANTROL, the following message is on the DANTROL alphanumeric display:

PRESET READY

This indicates that the DANLOAD system is ready for the next preset operation. The user only needs to press the "A", PRESET, key to be able to enter the preset volume to load. In the event that "PRESET READY" is not displayed, but an alarm message is displayed, the user should first notify the terminal staff to diagnose the fault. After pressing the "A", PRESET, key, the system prompts the user to:

ENTER PRESET VOLUME

The user enters a preset value which is either less than or equal to the maximum load size or greater than or equal to the minimum load size selected in the program. Ideally, this is the amount of the compartment to be loaded. A load size too small or too large is indicated as shown previously, and the user is allowed to re-enter that preset volume. Additionally, after a preset volume is entered, the entered volume is displayed on the top numeric display, indicating the volume remaining to be loaded, and the bottom display is zeroed, indicating the volume currently loaded. During the loading of the product, these two displays are updated approximately every second, giving the user a current reading of the volumes loaded and remaining to be loaded.

If the user has chosen an acceptable value, the system next displays the message:

PRESS START WHEN READY

Pressing the "B", START, key, begins the product flowing. Any other function key response causes the system to display the "PRESET READY" prompt again.
The system makes checks of all safety circuits, if applicable, and allows loading to proceed. If any of the safety checks fail the system displays:

**SAFETY CIRCUIT NOT MADE**

---

**NOTE:** Not all terminals utilize the safety circuit inputs provided by the DANLOAD system. Terminal personnel should familiarize themselves with the applicable safety features of their system at the time of installation. Any failures which may occur should be diagnosed using Section 10.0 of this manual. Continual faults are very often the results of incorrect values entered in the system. During start-up of your system, please notify Daniel Industries of any quirks or unique features of your system. All documentation is placed on file at Daniel so as to allow for easier phone diagnostics.

---

When the user presses the "B", START, key and has satisfied all safety circuits, the loading process begins and the display reads:

**LOAD IN PROGRESS**
The message is displayed during the entire loading process or until the user presses the "C", STOP, or "D", CANCEL, key. Pressing either of these two keys causes the load to be terminated and requires the user to re-enter the amount to be loaded as before.

If the user loses a safety circuit during the load, the following message is displayed:

```
SAFETY CIRCUIT
NOT MADE
```

This message does not require the user to re-enter any values but, instead, stops loading until the appropriate measures are taken to correct the safety circuit. After the correction is made, the system once again displays the message "PRESS START WHEN READY".

At the normal termination of the load, the system displays the following message:

```
PRESET READY
```

At any time the DANTROL is displaying the PRESET READY message, the user may access the meter totalizers by pressing the "D", CANCEL, key. The meters gross totalizer is displayed for approximately ten seconds, followed by the meters net totalizer, (provided the temperature option has been selected and is installed). The displays appear in the following manner:

```
GROSS TOTAL and NET TOTAL
```
8.0 PRODUCT SECURITY

The DANLOAD system has been designed to provide accurate measurement, convenient use and, most importantly, safe operation. Because safety has been a prime objective from the beginning, the user will find that the DANLOAD system requires a little knowledge of the system to perform safe loading operation.

All the potentially hazardous conditions are called to the attention of the user as either primary or secondary alarms. The primary alarms terminate the loading process and prohibit further loading until the condition is cleared and the alarm is reset by the terminal operations staff. Secondary alarms can be cleared and reset by the driver and loading is allowed to continue without intervention of terminal staff.
8.1 PRIMARY ALARMS

Primary alarms may occur at any time during the operation of the DANLOAD system. When a primary alarm occurs, all loading in progress at the affected DANTROL is halted, the alarm relay is enabled and an alarm message is displayed to the user. The alarm relay should be connected to a visible or audible warning device and should be connected accordingly to serve as a hazard warning.

If a primary alarm occurs, an operator must clear the alarm condition indicated by the alarm message, reset the alarm by switching the ALARM RESET switch on, and wait for the system to display the following:

```
SWITCH OFF
ALARM RESET
```

After the operator has cleared the alarm, the display returns to:

```
PRESET READY
```

At this point the user may re-initiate loading.

There are seven standard primary alarm conditions which may occur. The first primary alarm is concerned with the loss of a pulse stream while loading is in progress. When no meter pulses are received within the operator programmed period of time during an authorized load, an alarm condition is declared. This can occur if:

1. The valve is stuck in the closed position and will not open.
2. The meter wiring is defective.
3. The meter is damaged by foreign matter in the product line.
4. The meter pick-off or pre-amp is defective.
5. The MCU board is defective.
DANLOAD

6. There is a deliberate attempt to steal product by disabling the meter. In the event that this primary alarm is encountered, the following message is displayed:

```
TIMED OUT
NO FLOW DETECTED
```

Another of the primary alarms happens when the operator programmed minimum flow rate is not maintained for the programmed period of time. This alarm can occur if:

1. The valve is stuck in a near closed position and will not open further.
2. The product line pressure is too low to provide the required flow rate.
3. There is an obstruction in the product line.
4. The meter has been damaged during product flow.
5. The operator has not provided an adequate time period for the valve to open to the minimum flow rate.

In the event this alarm is encountered, the following message is displayed:

```
FLOW RATE TOO SLOW
```

Another primary alarm occurs when a number of meter pulses are recorded during an unauthorized load condition. If this quantity exceeds the operator selected unauthorized flow limit, the following message appears:

```
ILLEGAL FLOW EXCEEDS LIMITS
```

A primary alarm condition also occurs when the DANLOAD system continues to sense pulses after the valve permissive has been removed at the termination of the load. The sensed pulses must exceed the operator programmed unauthorized flow quantity or continue for longer than ten seconds.
This alarm may occur if:

1. The valve is stuck in the open position.
2. The valve is very sluggish.
3. The valve has been recently installed and has air trapped behind the piston.

In this event, the system displays the following message:

UNABLE TO CLOSE VALVE

In the event the operator has selected the dual pulse option, a primary alarm is registered when the error count between the two pulse streams exceeds the operator programmed maximum. This alarm occurs if:

1. One of the two pulsers fail.
2. One of the two pre-amps has failed.
3. The meter wiring is defective.
4. The pulse streams are out of phase.
5. The MCU board is defective.
6. The meter is damaged by foreign material in the line.

In the event this alarm is encountered, the following message is displayed:

PULSE TX FAILURE
If the operator has selected the temperature option, a primary alarm can occur when a temperature probe failure has been sensed. Some causes of this alarm are:

1. The temperature board is not connected to the DANMASTER ribbon cable.
2. The address switch on the temperature board is not set properly.
3. The temperature probe is defective.
4. The wiring to the probe is defective.
5. The wrong size temperature element is being used.
6. The temperature board has failed.

In the event that this alarm is encountered, the following message is displayed:

TEMPERATURE PROBE FAILURE
8.2 SECONDARY ALARMS

Secondary alarms may occur either during a load or at the moment the user attempts to begin a load. When a secondary alarm occurs, loading is halted, the alarm relay is enabled, and an alarm message is displayed on the DANTROL. If a secondary alarm occurs during a load, the operator must clear the alarm condition indicated on the DANTROL and wait for the DANLOAD system to display the following message:

PRESS START
WHEN READY

This allows loading to continue from the point at which loading was halted.

The following secondary alarm messages are displayed if any of the three safety circuit inputs are not completed:

<table>
<thead>
<tr>
<th>SAFETY CIRCUIT</th>
<th>1 NOT MADE</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAFETY CIRCUIT</td>
<td>2 NOT MADE</td>
</tr>
<tr>
<td>SAFETY CIRCUIT</td>
<td>3 NOT MADE</td>
</tr>
<tr>
<td>SAFETY CIRCUIT</td>
<td>4 NOT MADE</td>
</tr>
</tbody>
</table>
NOTE: These messages are not always standard for each terminal and terminal personnel should familiarize themselves with which safety circuits they are utilizing. During start up, Daniel Industries will also record the use of safety circuits to allow for easier phone diagnostics. Customized messages may be utilized, if ordered, and may ease troubleshooting for terminal personnel.

Some examples of customized safety circuit messages are:

| SCULLY NOT CONNECTED | or | VAPOR RECOVERY NOT MADE |

It is highly recommended that each of these status points be dedicated to a particular link in the permissive circuit. For example, DART permissive, scully device, deadman switch, etc. When all of these devices are connected in series through one status point, it makes it difficult for the user to determine which of these devices have caused the failure. It is strongly recommended that, at the very least, the scully dry contact be wired into safety circuit one (1).
NOTE: The use of safety circuits and messaging is simple. If a condition at the rack exists where the driver has forgotten something, the display informs the driver of any failed safety checks. At the same time, it does not lock the user out as in a FLOW TIME OUT primary alarm condition which requires terminal staff to come out and reset the alarm switch with a key. If the driver has simply forgotten to connect the scully, it is not considered as a condition which requires terminal staff intervention; but, rather, a driver mistake which needed minor corrections. It is, thus, preferable to handle this as a secondary alarm and avoid a lengthy shutdown and operator inconvenience. It is important to realize that these secondary alarm status points are intended to be used as a means to help the user identify problem areas; not for actual "permissive" control.
### 9.0 GENERAL HARDWARE SETUP

The DANLOAD system hardware switches should be set up as follows:

<table>
<thead>
<tr>
<th>BOARD NUMBER</th>
<th>BOARD NAME</th>
<th>SWITCH</th>
<th>SWITCH SETTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-3-1500-064</td>
<td>CPU</td>
<td>N/A</td>
<td>NOT APPLICABLE</td>
</tr>
<tr>
<td>2-3-1500-034</td>
<td>64K ROM</td>
<td>S1</td>
<td>SET 1 = OFF</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2 = ON</td>
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<td>3 = ON</td>
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<td>4 = OFF</td>
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<td>5 = ON</td>
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<td>6 = ON</td>
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<td>7 = ON</td>
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<td></td>
<td></td>
<td></td>
<td>8 = ON</td>
</tr>
<tr>
<td>2-3-1500-065</td>
<td>POWER WITH COMMUNICATIONS</td>
<td>S1</td>
<td>SET 1 = ON</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2 = ON</td>
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<td>3 = ON</td>
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<td>6 = ON</td>
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<td>7 = OFF</td>
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<td></td>
<td></td>
<td></td>
<td>8 = ON</td>
</tr>
<tr>
<td>2-3-1500-029</td>
<td>TEMPERATURE</td>
<td>S1</td>
<td>SET 1 = ON</td>
</tr>
<tr>
<td>2-3-1500-075</td>
<td></td>
<td></td>
<td>2 = OFF</td>
</tr>
<tr>
<td>2-3-1500-033</td>
<td>METER CONTROL</td>
<td>S1</td>
<td>SET 1 = ON</td>
</tr>
<tr>
<td></td>
<td>UNIT # 1</td>
<td></td>
<td>2 = OFF</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3 = ON</td>
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<td>4 = OFF</td>
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<td>5 = ON</td>
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<td>7 = ON</td>
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<td>8 = ON</td>
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<tr>
<td>BOARD NUMBER</td>
<td>BOARD NAME</td>
<td>SWITCH</td>
<td>SWITCH SETTING</td>
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<td>---------------</td>
</tr>
<tr>
<td>2-3-1500-033</td>
<td>METER CONTROL</td>
<td>S1</td>
<td>SET 1 = ON</td>
</tr>
<tr>
<td>UNIT # 2</td>
<td></td>
<td></td>
<td>2 = OFF</td>
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<tr>
<td></td>
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<td>3 = ON</td>
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<td>4 = OFF</td>
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<td>5 = ON</td>
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<td>6 = ON</td>
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<td>8 = OFF</td>
</tr>
<tr>
<td>2-3-1500-033</td>
<td>METER CONTROL</td>
<td>S1</td>
<td>SET 1 = ON</td>
</tr>
<tr>
<td>UNIT # 3</td>
<td></td>
<td></td>
<td>2 = OFF</td>
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<td>3 = ON</td>
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<td>6 = ON</td>
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<td>8 = ON</td>
</tr>
<tr>
<td>2-3-1500-033</td>
<td>METER CONTROL</td>
<td>S1</td>
<td>SET 1 = ON</td>
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<tr>
<td>UNIT # 4</td>
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<td>8 = OFF</td>
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<tr>
<td>2-3-1500-033</td>
<td>METER CONTROL</td>
<td>S1</td>
<td>SET 1 = ON</td>
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<tr>
<td>UNIT # 5</td>
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<td>2 = OFF</td>
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<td>8 = ON</td>
</tr>
<tr>
<td>2-3-1500-033</td>
<td>METER CONTROL</td>
<td>S1</td>
<td>SET 1 = ON</td>
</tr>
<tr>
<td>UNIT # 6</td>
<td></td>
<td></td>
<td>2 = OFF</td>
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<td>3 = ON</td>
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<td>4 = OFF</td>
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<td></td>
<td></td>
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<td>8 = OFF</td>
</tr>
<tr>
<td>BOARD NUMBER</td>
<td>BOARD NAME</td>
<td>SWITCH</td>
<td>SWITCH SETTING</td>
</tr>
<tr>
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<td>------------</td>
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<td>----------------</td>
</tr>
<tr>
<td>2-3-1500-024</td>
<td>ALPHA-NUMERIC ACU 1 CONNECTED</td>
<td>LK1</td>
<td>SET 1 = ON, 2 = OFF, 3 = OFF, 4 = OFF, 5 = OFF, 6 = OFF, 7 = OFF, 8 = OFF</td>
</tr>
<tr>
<td>2-3-1500-025</td>
<td>2-3-1500-025 MCU 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-3-1500-025</td>
<td>ACU BOARD</td>
<td>LK1</td>
<td>SET 1 = OFF, 2 = ON, 3 = OFF, 4 = OFF, 5 = OFF, 6 = OFF, 7 = OFF, 8 = OFF</td>
</tr>
<tr>
<td>2-3-1500-025</td>
<td>ACU 2 CONNECTED</td>
<td>LK1</td>
<td>SET 1 = ON, 2 = ON, 3 = OFF, 4 = OFF, 5 = OFF, 6 = OFF, 7 = OFF, 8 = OFF</td>
</tr>
<tr>
<td>2-3-1500-025</td>
<td>MCU 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-3-1500-025</td>
<td>ACU 3 CONNECTED</td>
<td>LK1</td>
<td>SET 1 = OFF, 2 = OFF, 3 = ON, 4 = OFF, 5 = OFF, 6 = OFF, 7 = OFF, 8 = OFF</td>
</tr>
<tr>
<td>2-3-1500-025</td>
<td>MCU 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-3-1500-025</td>
<td>ACU 4 CONNECTED</td>
<td>LK1</td>
<td>SET 1 = ON, 2 = OFF, 3 = ON, 4 = OFF, 5 = OFF, 6 = OFF, 7 = OFF, 8 = OFF</td>
</tr>
<tr>
<td>2-3-1500-025</td>
<td>MCU 4</td>
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<td></td>
</tr>
<tr>
<td>2-3-1500-025</td>
<td>ACU 5 CONNECTED</td>
<td>LK1</td>
<td>SET 1 = ON, 2 = OFF, 3 = ON, 4 = OFF, 5 = OFF, 6 = OFF, 7 = OFF, 8 = OFF</td>
</tr>
<tr>
<td>2-3-1500-025</td>
<td>MCU 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BOARD NUMBER</td>
<td>BOARD NAME</td>
<td>SWITCH</td>
<td>SWITCH SETTING</td>
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<td>----------------</td>
</tr>
<tr>
<td>2-3-1500-025</td>
<td>ACU 6 CONNECTED</td>
<td>LK1</td>
<td>SET 1 = OFF</td>
</tr>
<tr>
<td></td>
<td>MCU 6</td>
<td></td>
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<td>3 = ON</td>
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<td>8 = OFF</td>
</tr>
</tbody>
</table>
10.0 TROUBLESHOOTING GUIDE

This troubleshooting guide is written with the expectation that terminal personnel performing the tasks be qualified in areas of terminal operations. Daniel Industries offers a training course on the DANLOAD system operation and equipment. Those who wish to be provided this training please contact:

Daniel Automation Field Service Manager  
Daniel Industries, Incorporated  
Tel: (713) 890-0083  
Fax: (713) 890-1208

Should you encounter any problems with the DANLOAD system installed at your terminal which cannot be solved with the help of the following guide, please contact field service at Daniel Automation as soon as possible:

Daniel Automation Field Service  
Daniel Industries, Incorporated  
Tel: (713) 890-0083  
Fax: (713) 890-1208  
After Hours: (713) 464-5715
10.1 OVERVIEW

Before troubleshooting any problem, recognition of the problem is of extreme importance. The following diagram is provided to familiarize terminal personnel with the components of the DANLOAD system.

<table>
<thead>
<tr>
<th>EPU</th>
<th>PSU</th>
<th>CPU</th>
<th>MCU # 1</th>
<th>ACU # 1–6</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>ROM</td>
<td>MCU # 2</td>
<td>PUMP</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>MCU # 3</td>
<td>METER</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>MCU # 4</td>
<td>VALVE</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>MCU # 5</td>
<td>ADDITIVES</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>MCU # 6</td>
<td>ALARMS</td>
</tr>
</tbody>
</table>

The first three blocks control the entire system. Failure of these components are easily recognizable in that the DANLOAD system is affected as a whole. Block four contains only the MCU boards. Each MCU board controls only one riser and the lights on each MCU can give a good indication as to what is happening to your system, electronically. Block five represents the parts external to the DANMASTER and EPU.

A typical load is run as follows: First the driver is required to hook up all the safety devices as well as any other permissive requirements. Next, the driver uses the keypad to enter a preset volume and to begin the load.

The CPU then sends the information to the MCU, which through the solid-state relays, energizes the necessary pump and valves. As product begins to flow, the meter sends an electrical signal through the pre-amp to the MCU. This information is then transmitted back to the CPU. The CPU determines rate of flow, pump delays, and which meter factor to use based on rate of flow, etc., (as programmed in). The CPU instructs the MCU which sequence of events to perform next.

The first section of this troubleshooting guide deals, almost exclusively, with electronic problems, while the latter section deals with other possible system failures. In order to eliminate unnecessary downtime, please troubleshoot and replace all defective boards with boards from your spares kit. If no spares are present, consideration should be given to purchasing those spares necessary to maintain system operation.
NOTE: First, and foremost, look for activity of the red and green indicator lights on each MCU. Remember, when looking at the MCU board lights, that the red light is transmitting information out to the DANTROL and the green light is receiving information in from the DANTROL.
### 10.2 DANMASTER FAULTS

<table>
<thead>
<tr>
<th>SYMPTOM</th>
<th>PROBABLE CAUSE</th>
<th>CORRECTIVE ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>All MCU lights blink in unison</td>
<td>momentary power interruption</td>
<td>1) recycle power</td>
</tr>
<tr>
<td></td>
<td>DANLOAD program has malfunctioned</td>
<td>1) replace CPU board 2) replace ROM board</td>
</tr>
<tr>
<td>Lights on all MCU’s solid or not on within 30 seconds after power up</td>
<td>failure during program download</td>
<td>1) recycle power 2) check +12 VDC on MCU terminals 1&amp;2 3) check CPU reset switch for free movement 4) replace CPU board 5) replace ROM board</td>
</tr>
<tr>
<td>Red light on MCU blinks twice or more</td>
<td>communication has failed between MCU and ACU board</td>
<td>1) check switch settings 2) replace ACU board 3) disconnect keypad/display to determine if it is loading communications down 4) check intrinsic safety barriers, if applicable</td>
</tr>
<tr>
<td>Green light on MCU blinks twice</td>
<td>communication has failed between ACU and MCU</td>
<td>1) check switch settings 2) replace MCU board</td>
</tr>
<tr>
<td>Red or green light on MCU is out</td>
<td>defective wiring or board</td>
<td>1) check all wiring 2) if red light is out, replace MCU 3) if green light is out, replace ACU</td>
</tr>
<tr>
<td>DANTROL Displays ACU RESET or DEVICE OFFLINE</td>
<td>communications failure</td>
<td>1) check lights and troubleshoot as before</td>
</tr>
</tbody>
</table>
# 10.3 PRESET ALARMS

<table>
<thead>
<tr>
<th>SYMPTOM</th>
<th>PROBABLE CAUSE</th>
<th>CORRECTIVE ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature probe failure</td>
<td>temperatures have failed</td>
<td>1) check resistance of probes/digital meter</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2) check switch setting on temperature board</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3) temperature option selected and should not have been</td>
</tr>
<tr>
<td>Pulse &quot;TX&quot; failure</td>
<td>dual pulse has failed</td>
<td>1) pick-off coil loose or dirty</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2) pre-amp is defective</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3) MCU defective</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4) max error count set to low</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5) pulsers wired in out of phase</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6) dual pulse selected program &amp; should not have been</td>
</tr>
<tr>
<td>Illegal flow exceeds limit</td>
<td>meter has turned during unauthorized condition</td>
<td>1) air trapped in line</td>
</tr>
<tr>
<td>Flow rate too slow</td>
<td>DANLOAD unable to achieve minimum flow rate</td>
<td>2) valve open (refer to Section 10.4)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3) check to see if pump is coming on</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4) valve not opening fast enough (refer to Section 10.4)</td>
</tr>
<tr>
<td>Timed out no flow detected</td>
<td>meter has failed to receive pulses within specified time period</td>
<td>1) pickoff coil defective</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2) pre-amp defective</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3) MCU defective</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4) valve not opening (Section 10.4)</td>
</tr>
<tr>
<td>SYMPTOM</td>
<td>PROBABLE CAUSE</td>
<td>CORRECTIVE ACTION</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>-----------------------------------------------------</td>
<td>--------------------------------------------------------</td>
</tr>
<tr>
<td>Unable to close valve</td>
<td>valve has failed to close</td>
<td>1) refer to Section 10.4</td>
</tr>
<tr>
<td>Unable to enter calibration</td>
<td>loading is taking place on another DANTROL</td>
<td>1) wait until loading is completed</td>
</tr>
<tr>
<td>Unable to compute factor</td>
<td>information entered into system is invalid</td>
<td>1) continue with calibration or enter calculated factor</td>
</tr>
<tr>
<td>Status point 1, 2, or 3 not made</td>
<td>system has failed to recognize input</td>
<td>1) driver failed to complete safety circuits</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2) MCU defective</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3) check device wired to status point</td>
</tr>
</tbody>
</table>
# 10.4 Valve Or System Faults

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Probable Cause</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valve will not open (no inlet pressure)</td>
<td>1) pump not on or cavitated</td>
<td>1) check drybreak on truck</td>
</tr>
<tr>
<td></td>
<td>2) in-line block valve closed</td>
<td>2) check internal valve on truck</td>
</tr>
<tr>
<td></td>
<td>3) strainer plugged</td>
<td>3) check strainer</td>
</tr>
<tr>
<td></td>
<td>4) restriction in upstream line</td>
<td>4) check pump for cavitation</td>
</tr>
<tr>
<td>Valve will not open (pressure on inlet)</td>
<td>insufficient down-stream pressure</td>
<td>1) check power, wiring, coils on solenoids</td>
</tr>
<tr>
<td></td>
<td>solenoids inoperative</td>
<td>2) check poppet valves for damage</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3) replace MCU board</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4) replace solid-state relay board</td>
</tr>
<tr>
<td>Valve opens slowly</td>
<td>inlet pressure too low</td>
<td>1) check strainers</td>
</tr>
<tr>
<td>normally open</td>
<td>normally open</td>
<td>2) check pumps</td>
</tr>
<tr>
<td>solenoid not sealing</td>
<td>solenoid not sealing</td>
<td>1) disassemble solenoids and inspect poppet</td>
</tr>
<tr>
<td>or normally closed, not fully open</td>
<td></td>
<td>2) replace assemblies, if needed</td>
</tr>
<tr>
<td>Valve opens fully from start</td>
<td>calibration value incorrect</td>
<td>1) check low flow start value</td>
</tr>
<tr>
<td>Valve is open without starting</td>
<td>solenoids energized or defective</td>
<td>1) check for power on solenoids</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2) inspect poppet assy</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3) replace MCU</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4) replace solid-state relay board</td>
</tr>
<tr>
<td>SYMPTOM</td>
<td>PROBABLE CAUSE</td>
<td>CORRECTIVE ACTION</td>
</tr>
<tr>
<td>--------------------------------------------------------------</td>
<td>---------------------------------------------</td>
<td>------------------------------------------</td>
</tr>
<tr>
<td>Valve cannot attain high flow rate (solenoids click constantly)</td>
<td>valve is not seated internally</td>
<td>1) remove valve from line and rebuild</td>
</tr>
<tr>
<td></td>
<td>calibration limits set out of tolerance</td>
<td>1) high flow rate set over maximum pump capability</td>
</tr>
<tr>
<td></td>
<td>restrictions in line</td>
<td>1) check strainers</td>
</tr>
<tr>
<td></td>
<td>poppet assy. on upstream solenoid not seated;</td>
<td>2) ensure pump still on</td>
</tr>
<tr>
<td></td>
<td>calibration out of tolerance</td>
<td>1) inspect and replace solenoid (if necessary)</td>
</tr>
<tr>
<td></td>
<td>solenoids inoperative</td>
<td>2) CPU defective</td>
</tr>
<tr>
<td></td>
<td>downstream solenoid not seated or</td>
<td>1) check power/solenoids</td>
</tr>
<tr>
<td></td>
<td>upstream solenoid not full open</td>
<td>2) disassemble &amp; inspect poppet assemblies</td>
</tr>
<tr>
<td></td>
<td>valve defective</td>
<td>3) replace MCU</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4) replace solid-state relays</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1) remove and rebuild valve</td>
</tr>
</tbody>
</table>

---

**SECTION 10**
11.0 CALIBRATION: AN IN DEPTH ANALYSIS

The following section provides an in depth analysis of meter calibration through the utilization of three meter factors. It is intended for those individuals who are knowledgeable in terminal operations, specifically: flow control, flow measurement and proving.

11.1 SCOPE

This document provides a suggested method of calibration of the Daniel Automation DANLOAD system. The procedure assumes the calibration is done by competent individuals who are knowledgeable in the terminal operations listed above.

The procedure, specifically, omits safety and environmental considerations. Both items are of paramount importance. Calibration and proving must be accomplished in accordance with the current rules, practices and procedures dictated by the terminal manager.

Calibration and proving must be accomplished in accordance with all applicable laws, regulations, codes and standards. In case of conflict, this procedure shall be subservient.
11.2 GENERAL INFORMATION

A good understanding of the functional operation of the system is helpful during calibration. General information is listed in this section. More concise and detailed data is contained in the Section 4.0, CALIBRATION:GENERAL INFORMATION.

The DANLOAD system is, basically, a computer based flow rate monitor and flow totalizer. The computer runs on a real-time multi-tasking operating system. The computer acquires flow data from the flow meter, reviews the flow data and sends signals to the control valve. Although the control valve is the actual flow modulating member, the computer is the primary controlling device.

The computer accomplishes other calculations and functions that are not directly related to this discussion. If the computer senses a condition that is in violation of the safety or security parameters, the computer stops all flow and provides a text message on the display regarding the improper condition.

The DANLOAD system controls the flow during the complete loading cycle. In the most frequent application, the initial portion of the load is accomplished at the low flow rate. After the initial quantity has been loaded, the system then utilizes a high flow rate. The last portion of the load is completed at the low flow rate. A typical loading sequence is illustrated in Figure 1. The initial low flow rate quantity and the final low flow quantity are programmable. The low flow rate, initial and final quantities, are independent constants that do not vary with the total load quantity delivered. These values must conform to the values dictated by the terminal. The low flow rate and high flow rate are programmable and must also conform to the values dictated by the terminal.

The DANLOAD system controls the rate of flow to within plus or minus five percent of the assigned (programmed) flow rate. Further, when two factors are used, the computer determines the midpoint between the high flow rate and the low flow rate. When the flow rate is greater than the midpoint, the computer utilizes the high flow K factor in all calculations. When the flow rate is less than the midpoint, the computer utilizes the low flow rate meter K factor in all calculations. Figure 2 illustrates the utilization of the two factors.

For example, a 150 GPM low flow rate and a 750 GPM high flow rate have a midpoint at 450 GPM. When the flow rate is equal to or less than 450 GPM, the computer utilizes the low flow meter K factor. If the flow rate is greater than 450 GPM, the computer utilizes the high flow meter K factor.
In some applications, the pumping system may not be able to consistently achieve the high flow rate. A typical low pumping capacity loading cycle is shown in Figure 3.

The DANLOAD system has the ability to compensate for limited capacity pumps or other foreseeable flow rate limiting events. When the pumping system is unable to produce and maintain the assigned high flow rate, the computer senses the unusual condition and initiates remedial action. The DANLOAD system immediately stops attempts to achieve the high flow rate and begins to control a lesser, medium flow rate.

The magnitude of the medium flow rate must be determined by the terminal. The determination should include theoretical evaluation, as well as field test. A practical experiment can be conducted in the worst operating condition, usually multiple risers in simultaneous operation.
Experiment:

1. Reprogram the preset on both risers to specify both medium and high flow rates much higher than the system ability, perhaps 1500 GPM.

2. Load from both risers, starting simultaneously.

3. After the low flow rate quantity has been delivered, observe the delivered quantity register. Observe and record an initial value and time for one minute. At the end of one minute, observe and record the final value.

4. The system flow rate is equal to the difference between final and initial values.

To provide precise flow rate control, the medium flow rate must be less than the observed system flow rate. The medium flow rate actually utilized should be approximately 90% of the observed flow rate. Further, the medium flow rate actually utilized should not be greater than 85% of the high flow rate.

Example A:

High flow rate (single riser): 700 GPM
Observed flow rate (dual riser): 550 GPM

\[
\begin{align*}
550 \times 0.90 &= 495 \\
700 \times 0.85 &= 595
\end{align*}
\]

Use 500 GPM for medium flow rate. 500 GPM is approximately 90% of the observed flow rate. 500 GPM is less than 85% of the 700 GPM high flow rate.
A medium flow rate K factor is associated with the medium flow rate. The computer determines the midpoint between the low flow rate and the medium flow rate. The computer also determines the midpoint between the medium flow rate and the high flow rate. When the flow rate is equal to or less than the low/medium midpoint, the system utilizes the low flow K factor in all calculations. When the flow rate is greater than the low/medium midpoint, but equal to or less than the medium/high midpoint, the computer utilizes the medium meter K factor in all calculations. When the flow rate is greater than the medium/high midpoint, the computer uses the high flow meter K factor in all calculations.

Figure 4 illustrates the use of the low flow and medium flow K factors in a loading cycle with limited capacity. Figure 5 illustrates the use of the low flow, medium flow, and high flow meter K factors in a normal loading cycle. Figure 6 illustrates the relationship between nominal flow rates, flow rate tolerance bands and K factor division lines.
Procedure:

1. Fully initialize the DANLOAD system and its associated DANTROLs, if they have not been initialized. This procedure is self-explanatory, however, if the operator needs help, a description is provided in previous sections of this manual.

2. To begin the setup and calibration set the Mode Selection Switch inside the DANTROL to the "Setup/Calibration Mode".

3. Enter or accept a low flow rate meter K factor to the nearest ten-thousandth. Enter all six digits. The display shows the proper decimal point placement (XX.XXXX). Initially, enter the factor that is supplied by the maker of the meter or the pulse transmitter.

4. Enter or accept a low flow rate to be used for the product to be associated with the preset in use. The selected flow rate must conform to the operating company’s policy and product safety considerations.

5. Enter or accept a low flow rate start-up quantity as required by the operating company’s policy and product safety considerations.

6. Enter or accept a low flow rate shutdown quantity of at least 50 gallons. However, 70 gallons or more is recommended to insure the DANLOAD system can gain full control of the valve at the low flow rate before encountering the predicted valve closure period.

7. If the medium and high flow rate meter K factors and flow rates were entered during initialization of the DANLOAD system, proceed to calibrate the meter at the low flow rate. To begin to calibrate the meter, answer "YES" to the "RUN LOW FLOW TEST" prompt.

8. Complete all safety interlocks.

9. Enter the quantity to be used for the calibration load at the "ENTER PRESET VOLUME" prompt. The quantity must be at least two hundred gallons or the DANLOAD does not attempt to compute a low flow rate meter K factor.

10. When ready, press the "B", START, key on the DANTROL.
11. At the normal termination of the calibration load, the DANLOAD system displays the amount of the metered load on the DANTROL to the nearest one-hundredth. The display remains until the operator presses any one of the four function keys.

12. Enter the amount loaded, as indicated by the proving vessel at the "MEASURED VOLUME" prompt. This amount must be entered to the nearest one-hundredth. The DANLOAD system displays the entered amount with the decimal point in place for confirmation purposes. For example, a prover volume of 1000.5 is entered as 100050. The quantity 1000.50 is displayed.

13. The DANLOAD system computes a low flow rate meter K factor based on the flow rate registers, and the amount entered by the operator as the measured volume using the following formula:

\[
\frac{\text{Total Pulses Rec'd}}{\text{Measured Volume}} = \text{New Factor}
\]

\[
\text{Metered Volume} = \frac{\text{Total Pulses Rec'd}}{\text{Old Factor}}
\]

**NOTE:** A warning is displayed indicating that the meter K factor that is about to be displayed is only a recommendation. This is necessary because the DANLOAD system does not have the ability to perform interpolation. It cannot be permitted to remember previous calibration loads and use this information to average the K factors. As a result, the computer meter K factor may tend to "jump" about a central point. The operator is able to spot this trend and, using interpolation, be able to select a meter K factor for use by the DANLOAD system.
14. The computed low flow rate meter K factor is displayed and the operator is prompted to accept or reject the computed factor. If the operator answers "YES" to the "FACTOR OK" prompt, the computer factor is recorded in non-volatile memory for future use. Otherwise, the computed factor is discarded and the operator is asked if a new, manually computed low flow rate meter K factor should be entered. If the operator answers "NO" to the "ENTER NEW FACTOR" prompt, the old low flow rate meter K factor is retained. However, if the operator answers "YES", the DANLOAD system allows the operator to enter a new low flow rate meter K factor. The new factor is recorded in non-volatile memory for future use and the old factor is discarded.

15. The DANLOAD system then prompts the operator with "RUN LOW FLOW TEST" again. The operator may answer "YES" and repeat the steps above. After arriving at a low flow rate meter K factor, additional loads using the factor should be made to ensure the new factor is correct and to check repeatability of the meter. By answering "NO", the operator may begin calibrating the meter at the medium flow rate.

16. Choose a medium flow rate to be used for the product associated with the DANTROL in use. This flow rate should be in accordance with the terminal instructions.

NOTE: The high flow rate must be high enough to avoid interference between the medium flow rate meter K factor and the high flow rate meter K factor during the calibration of the meter at the medium flow rate. Thus, it is recommended that the high flow rate be set to a value 50% greater than medium flow rate for the medium flow rate meter calibration loads only.
NOTE: The DANLOAD system attempts to control the high flow rate within ± 5% of the entered high flow rate. The medium flow rate is controlled to within ± 5% of its assigned rate. Thus, if the medium flow rate is set to a value within 10% of the high flow rate, the DANLOAD system is unable to make full use of the medium flow rate meter K factor. Since the medium flow rate is determined by the mechanical system’s capability, the high flow rate should be changed. It can be either reduced and the medium flow rate eliminated, or if the pump can provide more flow during single riser loading, the high flow rate may be increased.

NOTE: If the product associated with the riser being calibrated has adequate pumping facilities, the medium flow rate may be set to the same value as the high flow rate. This action disables the use of the medium flow rate. This also speeds the calibration process. It has little impact on the accuracy of the meter because a medium flow rate is only encountered very briefly during the transitional period when opening the valve to the high flow rate or closing the valve back down to the low flow rate.
17. Enter or accept a medium flow rate meter K factor to the nearest ten-thousandth. Initially, enter the factor that is supplied by the maker of the meter or pulse transmitter. Enter all six digits. The display shows the proper decimal position (XX.XXXX).

18. Enter or accept a medium flow rate as chosen in Step 17 above.

19. The operator may proceed to calibrate the meter at the medium flow rate by answering "YES" at the "RUN MEDIUM FLOW RATE TEST" prompt.

20. Complete all safety interlocks.

21. Enter the quantity to be used for the calibration load at the "ENTER PRESET VOLUME" prompt. This quantity must be greater than or equal to the low flow start-up quantity, and the low flow shutdown quantity, plus two hundred gallons, or the DANLOAD system does not attempt to calculate a meter K factor.

22. At the normal termination of the load, the DANLOAD system displays the amount of the metered load on the DANTROL to the nearest one-hundredth gallon. This display remains until the operator presses any one of the four function keys.

23. Enter the amount loaded as indicated by the proving vessel at the "MEASURED VOLUME" prompt. This amount must be entered to the nearest one-hundredth. The DANLOAD system displays this amount with the decimal point in place for confirmation purposes. For example, a prover volume of 1000.5 is entered as 100050. The quantity 1000.50 is then displayed. The following formulas are utilized to determine a medium flow rate meter factor:

NOTE: Remember the medium flow rate is currently being calibrated; thus, the low flow rate is monitored but not used for calculations.
Low Flow Rate Pulses

\[
\text{Adjusted Prover Volume} = \frac{\text{Low Flow Rate Pulses}}{\text{Low Flow K Factor}}
\]

Medium Flow Pulses

\[
\text{New Medium K Factor} = \frac{\text{Medium Flow Pulses}}{\text{Adjusted Prover Volume}}
\]

24. The DANLOAD system computes a medium flow rate meter K factor based on the flow rate registers; the amount entered by the operator as the measured volume and the low flow rate meter K factor.

25. The computed medium flow rate K factor is displayed, and the operator is prompted to accept or reject the computed factor. If the operator answers "YES" to the "FACTOR OK" prompt, the computer factor is recorded in non-volatile memory for future use. Otherwise, the computer factor is discarded, and the operator is asked if a new, manually computed medium flow rate meter K factor should be entered. If the operator answers "NO" to the "WISH TO ENTER NEW FACTOR" prompt, the old medium meter K factor is retained. However, if the operator answers "YES", the system allows the operator to enter a new medium flow rate meter K factor. The new factor is recorded in non-volatile memory for future use and the old factor is discarded.

26. The DANLOAD system then prompts the operator with "RUN MEDIUM FLOW TEST" again. The operator may answer "YES" and repeat the steps above. After arriving at the medium flow rate meter K factor, additional loads using the factor should be made to ensure that the new factor is correct and to check for meter repeatability. By answering "NO", the operator may begin calibrating the meter at the high flow rate.

27. Enter or accept a high flow rate meter K factor to the nearest ten-thousandth. Initially, enter the factor that is supplied by the maker of the meter or pulse transmitter. Enter all six digits. The display shows the proper decimal point position (XX.XXXX).

28. Enter or accept a high flow rate to be used for the product associated with the DANTROL in use. Special attention is required because the high assigned rate may have adjusted to an artificially high value.

29. The operator may proceed to calibrate the meter at the high flow rate by answering "YES" to the "RUN HIGH FLOW TEST" prompt.
30. Complete all safety interlocks.

31. Enter the quantity to be used for the calibration load at the "ENTER PRESET VOLUME" prompt. This quantity must be greater than or equal to the low flow start-up quantity plus the low flow shutdown quantity, plus two hundred gallons or the DANLOAD system does not attempt to compute a meter K factor.

32. At the normal termination of the load, the DANLOAD system displays the amount of the metered load on the DANTROL to the nearest one-hundredth. This display remains until the operator presses any one of the four function keys.

33. Enter the amount loaded as indicated by the proving vessel at the "MEASURED VOLUME" prompt. This amount must be to the nearest one-hundredth. The DANLOAD system displays the entered amount with the decimal point in place for confirmation purposes. For example, a prover volume of 1000.5 is entered as 100050. The display shows 1000.50.

34. The DANLOAD system computes a high flow rate meter K factor based on the flow rate registers, the amount entered by the operator as the measured volume, the low flow rate meter K factor, and the medium flow rate meter K factor using the following algorithms:

\[
\text{Adjusted Volume} = \frac{\text{Measured Volume}}{\text{Volume}} - \left(\frac{\text{Low Flow Pulses}}{\text{Low Flow Factor}} + \frac{\text{Medium Pulses}}{\text{Medium Factor}}\right)
\]

New High K Factor = \frac{\text{High Flow Pulses}}{\text{Adjusted Volume}}

35. The computed high flow rate meter K factor is displayed and the operator is prompted to accept or reject the new factor. If the operator answers "YES" to the "FACTOR OK" prompt, the computed factor is recorded in non-volatile memory for future use. Otherwise, the computed factor is discarded, and the operator is asked if a new manually computed high flow rate meter K factor should be entered. If the operator answers "NO" to the "WISH TO ENTER NEW FACTOR" prompt, the old high flow rate meter K factor is retained. However, if the operator answers "YES", the DANLOAD system allows the operator to enter a new high flow rate meter K factor. This new factor is recorded in non-volatile memory for future use and the old factor is discarded.
The DANLOAD system again prompts the operator with "RUN HIGH FLOW TEST". The operator may answer "YES" and repeat the steps above. By entering "NO", the operator may repeat the entire calibration process or return to the "Loading Mode".

NOTE: The calibration process may be aborted by switching the Mode Selection Switch to the "Loading Mode". However, this switch is ignored by the DANLOAD system from the time the operator selects to perform a test load until the "RUN ____ FLOW TEST" prompt is displayed again.
11.3 MANUAL CALCULATIONS

The DANLOAD system has the ability to calculate the flow meter K factors. It is not only easier to allow the computer to calculate a corrected K factor, but also more accurate for the computer to accomplish the calculation.

The computer only calculates meter K factors based on the data from the most recent test. The computer does not have the ability to average meter K factors nor the ability to interpolate. Most importantly, the computer does not have the ability to reject erroneous information. For further explanation, please refer to Section 11.4, UNCERTAINTIES.

At the completion of each test run, the computer should be asked to compute a meter K factor. A log of the computer calculated meter K factors allows for manual averaging or interpolation. Meter K factors can be calculated manually. The manual calculation can be used to verify the computer calculation. Or the manual calculation may be used if the computer calculation is lost or rendered inappropriate because of inadvertent keypad operation. A flow meter K factor is the ratio of pulses to the actual unit volume.

Unfortunately, determination of the ratio requires some trial and error. The classic form of calculation is:

\[
\text{New K Factor} = \text{Old Meter K Factor} \times \left( \frac{\text{Meter Indicated Volume}}{\text{Prover Volume}} \right)
\]

This classic equation is valid for tests conducted in the low flow calibration mode only. This equation is not directly applicable to calibration at the medium or high flow rates. During the medium flow calibration tests, the initial and final portion of the loads are accomplished at the low flow rate. During those two periods of low flow, the computer utilizes the low flow rate meter K factor. Please refer to Figure 5. The low flow rate meter K factor was previously established with reasonable accuracy. The low flow rate quantities are small in comparison to the medium flow rate quantity. Therefore, it is proper to assume that volumetric errors are attributable to the trial medium flow rate meter K factor and to the volume delivered at the medium flow rate. The exact quantity of the fluid delivered at the low flow rate is not known with great precision. However, it is sufficient to assume that the low flow rate volume is exactly equal to the sum of the low flow start-up and the low flow shutdown quantities.
Then the new meter K factor can be calculated as follows:

A. Determine the gross error. Subtract the flow meter indicated volume from the corrected prover volume. Please observe that if the flow meter indicated volume is greater than the corrected prover volume, the error is negative. Obviously, the error would be positive if the corrected prover volume is greater than the indicated flow meter volume.

\[
\text{Error} = \text{Corrected Prover Volume} - \text{Indicated Flow Meter Volume}
\]

B. Determine the adjusted volume. First add the start-up volume to the shutdown volume. Next, subtract that total from the corrected prover volume.

\[
\text{Adjusted Volume} = \text{Corrected Volume} - (\text{Start-up} + \text{Shutdown Volume})
\]

C. Determine the error ratio. Divide the error by the adjusted volume. Please note that the error ratio has the same sign (+) as the error.

\[
\text{Error Ratio} = \frac{\text{Error}}{\text{Adjusted Volume}}
\]

D. Determine the correction factor. Subtract the error ratio from one (1). Please observe, the result is greater than one (1) if the error was negative.

\[
\text{Correction Factor} = 1 - \text{Error}
\]

E. Calculate the new meter K factor. Multiply the correction factor by the old meter K factor.

\[
\text{New Meter K Factor} = \text{Old Meter K Factor} \times \text{Correction Factor}
\]

In the analysis of the medium flow calibration manual calculations, some assumptions are made. The same analysis is correct for the high flow calibrations done manually; if the medium flow rate meter K factor is determined prior to high flow rate calibration.

Therefore, if the calibration is conducted in the low, medium, high sequence, the calculation method developed for the medium flow rate calibration is applicable to high flow rate calibration.
The individual steps in the calculation can be included in a single equation as follows:

11.4 UNCERTAINTIES

Reference Documents

I. Manual of Petroleum Measurement Standards:
   Chapter 4 - Proving Systems
   Chapter 5 - Metering Systems
   Chapter 13 - Application of Statistical Methods

II. Specifications and Tolerances for Reference Standards and Field
    Standard Weights and Measures
    Specifications and Tolerances for Metal Volumetric Provers
    National Bureau of Standards Handbook 105-3
    National Bureau of Standards

III. Measurement Uncertainty for Fluid Flow in Closed Conduits
    ANSI/ASME MFC - 2M
    American Society of Mechanical Engineers

The reference documents listed above provide methods for the analysis of data and the estimate of error. The reference material goes far beyond the scope of this document. However, the statistical nature of flow measurements should be recognized. Some of the major sources of variation are listed below:

A. Observer error is impossible to quantify. However, observer error is random in nature. Therefore, in a reasonably small number of tests, it is highly probable that observer error would not be repetitive. Hence, a significant observer error would be recognized as errant and the information would be discarded from the data set.

B. It is impossible to observe tank level indications between the least graduations. It is possible to estimate the midpoint between the graduations and utilize the value. However, it is rational to utilize the least estimated reading as the maximum error. The variation could be expressed as the ratio of $1/2$ the graduation reading to the nominal prover volume.
For example, a 1320 gallon tank prover with neck gauge graduation of 25 cubic inches would produce readings no more accurate than 12-1/2 cubic inches. Hence, the error would be:

\[
\text{Reading Error} = \frac{12 - 1/2}{231} = \frac{1320}{0.000041} = \pm 0.0041 \%
\]

The gross reading error is \(\pm 0.054\) gallons.

C. Errors in temperature measurement can be minimized by proper selection and application of equipment. A large quantity of literature is available on the subject. Reading error is additive to the indication error. It is reasonable to estimate the least estimated reading as 1/2 of the graduation increment. For a 1320 gallon steel prover equipped with a thermometer with 1/2 degree Fahrenheit graduations, the gross error would be:

\[
\text{Gross Temperature Error} = \frac{1320 \times 1.86 \times 0.25}{100,000} = \pm 0.006 \text{ Gallons}
\]

\[
\text{Gross Temperature Error} = \pm 0.005 \%
\]

Hence, in the system described above, a variation as large as \(\pm 0.05\) gallons could be experienced.

Multiple tests and averaging of data tends to improve the information. Additional statistical calculations and methods can smooth the data and provide an analysis that minimizes the least reading error.

D. Meter accuracy is frequently determined by comparing the gross meter indication to the corrected gross volume measured in the volumetric prover. This classic method is, universally, accepted. However, on some occasions, extremes in the environment may cause difficulties. Measuring a cool product on a warm day may cause some discrepancies. The product flowing through the meter enters the volumetric prover.
The long residence time in the prover and the large surface area of the prover may allow the product to increase in temperature. If the fluid temperature, measured at the meter, displays a significant deviation from the fluid temperature, measured in the volumetric prover, corrections should be considered. Assume that during the load of unleaded gasoline (API 60), the temperature at the meter is 75 degrees F. At the completion of the load, the temperature measured in a 1320 gallon prover is 76 degrees F. The increase in temperature (1 degree F) would cause the product to expand. Since this product has a coefficient of expansion of 0.0006 per degree, the amount of expansion can be calculated.

\[
\text{Expansion} = 1320 \times 0.0006 \times 1 = 0.792 \text{ gallons}
\]

Hence, the corrected gross prover volume should be modified by subtracting 0.79 from the measurement.
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DIAGRAMS

DK-30148 - DANMASTER MCU WIRING (6 pages)

FIG 8A - EXPLOSION PROOF UNIT FIELD CONNECTIONS

AK-30593 - EXPLOSION PROOF UNIT WIRING

AK-30594 - EXPLOSION PROOF UNIT WIRING

TEMPERATURE BOARD
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NOTED:

1. The equipment represented on this drawing must be installed and wired according to the applicable specification in the panel terminal automation equipment installation specification (ES-UP02-X).

2. One end of each shielded cable's shield must be connected to ground. The other end of that shield must be carefully trimmed and insulated to prevent it from making contact with any circuit.

DANMASTER

METER CONTROL UNIT TERMINAL STRIP

I.S. BARRIER

NON-HAZARDOUS AREA

HAZARDOUS AREA

DANTROL

** GROUND

- 0
- 1
- 11-15 VAC
- 91-3
- 92
- 93
- 94
- 0

DANMASTER GROUND BUS

EARTH GROUND ROD
FIELD CONNECTIONS

AC WIRING  TB  RELAY  TB  AC WIRING  TB  RELAY  TB

METER 1
PUMP 1  K  1  65  31  K
VALVE 2  K  1  66  29  K
Solenoid 1 3  K  67  30  K
VALVE 4  K  7  68  33  K
Solenoid 2 8  K
Additive 1 9  K  69  NOT USED

METER 2
PUMP 1  K  7  70  31  K
VALVE 2  K  11  71  29  K
Solenoid 1 12  K
VALVE 13  K
Solenoid 2 14  K
Additive 1 15  K  72  NOT USED

METER 3
PUMP 16  K  73  31  K
VALVE 17  K  20  74  26  K
Solenoid 1 21  K
VALVE 22  K
Solenoid 2 23  K
Additive 1 24  K  75  NOT USED

METER 4
PUMP 25  K  76  31  K
Additive 1 26  K  77  33  K
Load Rack Alarm 27  K
Alarm 28  K  78  NOT USED

METER 5
PUMP 29  K  79  31  K
Additive 1 30  K

METER 6
PUMP 31  K  80  NOT USED

TYPICAL SAMPLE DRAWING
EXPLOSION PROOF UNIT (E.P.U.) WIRING

ECO 7251  AK-30594 REV-B

CONNECT TO GOOD SAFETY GND.
TEMP. BOARD

CONSISTS OF 2 TWISTED PAIR INDIVIDUALLY SHIELDED CABLES

P1

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35

SRC+
RTD+
RTD-
SRC-

ETC.

PROBE #1

PROBE #2

TEMP PROBE

P1-1
P1-2
P1-3
P1-4

SHIELDS - GND TO A COMMON GND.

* POWER SUPPLIED THRU RIBBON CABLE

* NO SPLICES ALLOWED

GND TO PWR COM BD.
DANLOAD

APPENDIX B

MISCELLANEOUS LITERATURE

TERMINAL:_________________________ LOADSPOT #:________________
LOCATION:_________________________ PRODUCT:___________________
CUSTOMER CONTACT:_________________ METER SERIAL #:____________
TELEPHONE #:______________________ PROM VERSION #:____________
METER MOUNT-VERTICAL/HORIZONTAL:__________________________________
DANMASTER:________________________ DANTROL:_____________________

CALIBRATION PARAMETERS

Select language:_________________________
Host Comms? Y/N:_________________________
Host Data Rate:___________________________
DANMASTER Address:_____________________
Temperature Option:_____________________
API Table:_______________________________
Gravity:_________________________________
Density:_________________________________
Dual Pulse Input:________________________
Max Error Count:_________________________
# of Additives:___________________________
Add #1 Ratio:____________________________
Add #2 Ratio:____________________________
Add #3 Ratio:____________________________
Add #4 Ratio:____________________________
Maximum Preset:_________________________
Minimum Preset:_________________________
Min Flow Rate:___________________________
Time to Minimum Rate:___________________
No Flow Time Out:_______________________
Unauthorized Flow Limit:_______________

________________________________________

APPENDIX B 95
### DANLOAD

Line Pack Delay: __________________________
Pump Stop Delay: __________________________
Low Meter Factor: __________________________
Low Flow Rate: _____________________________
Low Flow Start-up: _________________________
Low Flow Shut Down: _______________________  
Medium Meter Factor: _______________________
Medium Flow Rate: _________________________  
High Meter Factor: _________________________
High Flow Rate: ___________________________

### SPARE PARTS LISTING

The following list includes those items that will ensure complete coverage of your DANLOAD System. Please consult your field service representative for assistance in determining those items applicable to your specific system.

<table>
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<tr>
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<th>QTY.</th>
<th>NUMBER</th>
<th>DESCRIPTION</th>
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<td>C-MOS Card Numeric Dual Display PCA</td>
<td>DANTROL</td>
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<td>3-1500-024</td>
<td>C-MOS Card Alpha-Numeric Single Display</td>
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</tr>
<tr>
<td>3</td>
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<td>3-1500-025</td>
<td>ACU PCA</td>
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<td>1</td>
<td>3-1500-030</td>
<td>DANMASTER CPU PCA</td>
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<td>3-1500-032</td>
<td>Power w/Communication PCA</td>
<td>DANMASTER</td>
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<td>6</td>
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<td>3-1500-034</td>
<td>64K ROM PCA</td>
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<td>7</td>
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<td>3-1500-033</td>
<td>Meter Control PCA</td>
<td>DANMASTER</td>
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<tr>
<td>8</td>
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<td>3-1500-043</td>
<td>DANMASTER Power Supply 110V PCA</td>
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<td>9</td>
<td>1</td>
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<td>DANMASTER Relay w/16 Relays PCA</td>
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<tr>
<td>10</td>
<td>1</td>
<td>6-7000-208</td>
<td>D.C. Resistive Barrier U.L. Approved</td>
<td>ISBU</td>
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<td>1818-A Preamp</td>
<td>Turbine Meter</td>
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<td>12</td>
<td>1</td>
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<td>Danflo Assembly 4” 150# RF STD Trim Dual Solenoid (prewired)</td>
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<td>4&quot; LR Meter 150# RF</td>
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<td></td>
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<td></td>
<td>ANSI FL 304SS</td>
</tr>
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<td>3</td>
<td>6-7000-676</td>
<td>14 3 6-7000-676</td>
<td>I.C. 16 pin</td>
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<tr>
<td>15</td>
<td>5</td>
<td>6-7000-721</td>
<td>15 5 6-7000-721</td>
<td>I.C. 6 pin Coupler</td>
</tr>
<tr>
<td>16</td>
<td>3</td>
<td>6-7000-639</td>
<td>16 3 6-7000-639</td>
<td>I.C. 16 pin Hex</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Contact Bounce</td>
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<td>Eliminator</td>
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<td>17</td>
<td>2</td>
<td>6-7000-710</td>
<td>17 2 6-7000-710</td>
<td>O-Power RAM</td>
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<tr>
<td>18</td>
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<td>I.C. 20 pin</td>
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<td></td>
<td></td>
<td>Transceiver</td>
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<td></td>
<td>Spare Solenoids</td>
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<td>20</td>
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<td></td>
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<td>Fuse, 3AG SB 3A</td>
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<td>21</td>
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<td>Fuse, 3AG SB 5A</td>
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<td>22</td>
<td></td>
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<td>Fuse, 3AG SB 15A</td>
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1.0 INTRODUCTION

Since the DANBLEND system is based on the DANLOAD system this manual only serves to define the differences in the two products. This manual is to be used in conjunction with the DANLOAD Operations Manual.

The DANBLEND system is an island based batched blend controller. It can be used to blend products from a four to fifty percent component ratio and can also be used for straight product delivery of the main component.

1.1 DESCRIPTION OF OPERATION

The DANBLEND hardware differs from the DANLOAD hardware in that there are two meters which are interfaced to one DANTROL. The primary blend meter, meter "A", is normally the meter associated with the product which has the highest percentage of the blend. The secondary blend meter, meter "B", is the meter of the product which has the lower percentage of the blend.

The DANBLEND allows for three K factors (low, medium, and high), low flow startup and shutdown, primary and secondary alarms, and three status inputs.

The DANBLEND also has four additive injection outputs. Their ratios are based on the primary blend meter’s pulse count.

Proportional blending occurs during the entire loading process with the important exception that the "secondary component" increases delivery rate during its shutdown so that its complete volume will be delivered, allowing for a "clean line" shutdown of the primary product.
2.0 PHYSICAL LAYOUT OF SYSTEM

Please refer to the DANLOAD Operations Manual.

2.1 DANMASTER LAYOUT

The DANMASTER layout is the same as in the DANLOAD system except that the DANBLEND can support up to three two-component blends.

2.2 DANTROL LAYOUT

The DANTROL layout is the same as described in the DANLOAD Operations Manual.
3.0 INITIAL POWER UP OF SYSTEM

The initial power up of the system is the same as described in the DANLOAD manual however when the "D" key is pressed after the "CHECK TOTALIZERS" prompt, the gross and net totalizers are automatically displayed for both component meters. The primary meter is displayed first:

```
GROSS TOTAL   then   NET TOTAL
METER A       METER A
```

The message is displayed for approximately 10 seconds to allow the operator time to record the value for comparison with previous readings.

Next, the system automatically displays the current gross totalizer for the secondary meter:

```
GROSS TOTAL   then   NET TOTAL
METER B       METER B
```

This message is also displayed for 10 seconds.

NOTE: While the loading application program is running, and there is no loading taking place on a DANTROL, the "D", CANCEL LOAD, key can be used at that time to display the gross totalizers for both meters on the alphanumeric display.

NOTE: The "C" key displays Vol A and Vol B blend percentage of the last load.
4.0 OPERATIONAL SETUP

Follow the procedures outlined in the DANLOAD Operations Manual under OPERATIONAL SETUP.

If the system recognizes that this is the first power up of the battery-backed RAM, the system prompts for all of the calibration options (unless otherwise indicated) beginning with Section 4.2 (SELECT LANGUAGE).

4.1 GENERAL INFORMATION

This section is the same as in the DANLOAD Operations Manual.

4.2 SELECT LANGUAGE (Option #1)

This section is the same as in the DANLOAD Operations Manual.

4.3 COMMUNICATIONS PARAMETERS (Option #2)

This section is the same as in the DANLOAD Operations Manual.

4.4 DART DATA RATES (Option #3)

This section is the same as in the DANLOAD Operations Manual.

4.5 DANMASTER ADDRESS (Option #4)

This section is the same as in the DANLOAD Operations Manual.

4.6 TEMPERATURE (Option #5)

This section is the same as in the DANLOAD Operations Manual except that the TEMPERATURE OPTION prompt is displayed twice, once for meter A and once for meter B.

4.7 DUAL PULSE (Option #6)

This section is the same as in the DANLOAD Operations Manual.
4.8 ADDITIVES (Option #7)

The section is the same as in the DANLOAD Operations Manual except that each prompt will be displayed twice, once for meter A and once for meter B.

4.9 PRESET PARAMETERS

4.9.1 MAXIMUM PRESET (Option #8)

This section is the same as in the DANLOAD Operations Manual except that the maximum preset value also represents the total blended product amount.

4.9.2 MINIMUM PRESET (Option #9)

This section is the same as in the DANLOAD Operations Manual except that the minimum preset value also represents the blended product amount.

4.9.3 SECONDARY COMPONENT (Option #10)

The DANBLEND system prompts for the percentage of the secondary component of the blend:

COMPONENT B%

The operator must enter either a percentage number between four and fifty or enter zero. The percentage number must be entered in four digits. The decimal point is understood. For example, an entry of 4000 is recorded as 40%

A zero entry indicates to the system that this DANTROL is going to be used to deliver straight product from the primary meter. A non-zero entry indicates to the system that the DANTROL is going to be used to deliver a blend using both meters A and B.

4.9.4 VALVE CONTROL (Option #11)

If a blend has been requested, the system will prompt:

CONTROL VALVE (A/B) ?
Enter A or B to designate which of the two meters controls the component percentage.

4.9.5 CLEAN LINE END (Option #12)

If a blend has been requested, the system will prompt:

```
CLEAN LINE END (A/B) ?
```

Enter A or B to determine which product will be used to clean the line out at load termination.

4.10 ALARM PARAMETERS

The alarm parameters are the same as the DANLOAD system except for the following differences:

4.10.1 LOW FLOW ALARM RATE/Meter A (Option #15)

The low flow alarm rate is requested for both meters. The system prompts the following message for meter A:

```
LOW FLOW RATE A ?
```

4.10.2 LOW FLOW ALARM RATE/Meter B (Option #16)

The system prompts the following message for meter B:

```
LOW FLOW RATE B ?
```

4.10.3 TIME TO MINIMUM FLOW RATE (Option #17)

This section is the same as in the DANLOAD Operations Manual. The flow rate entered will be applied to both meters.
4.10.4 NO FLOW TIME OUT (Option #18)

This section is the same as in the DANLOAD Operations Manual. The time out entered will apply to both meters.

4.10.5 UNAUTHORIZED FLOW LIMIT (Option #19)

This section is the same as in the DANLOAD Operations Manual. The unauthorized flow limit will apply to each meter.

4.11 PUMP DELAY PARAMETERS (Options #20-21)

This section is the same as in the DANLOAD Operations Manual.

4.12 LOW FLOW PARAMETERS (Options #30-34 for Meter A) (Options #50-54 for Meter B)

This section is the same as in the DANLOAD Operations Manual. It is displayed twice, once for meter A and once for meter B. Both meters must be set at the same rates.

4.13 MEDIUM FLOW PARAMETERS (Options #35-37 for Meter A) (Options #55-57 for Meter B)

This section is the same as in the DANLOAD Operations Manual. It is displayed twice, once for meter A and once for meter B. Meter A"s rate must be the appropriate blend percentage for its component, and it must compliment B.

4.14 HIGH FLOW PARAMETERS (Options #38-40 for Meter A) (Options #58-60 for Meter B)

This section is the same as in the DANLOAD Operations Manual. It is displayed twice, once for meter A and once for meter B. Both rates must be set the same.

After meter A has completed its sequence, the DANBLEND system will return to 4.12 LOW FLOW PARAMETERS and prompt for Meter B.

4.15 STATUS POINTS (Options #70-77)

This section is the same as in the DANLOAD Operations Manual.
5.0 CALIBRATION OVERVIEW

The calibration procedures are the same as described in the DANLOAD Manual except for the following:

1. The calibration procedure for low, medium, and high flow is first done for meter A and then repeated in its entirety for meter B.

2. Each prompt has the meter name following the message. For example, for meter A:

   LO METER FACT A ?

   The prompt for meter B is:

   LO METER FACT B ?

3. The flow factors for meter A have two digits preceding the decimal point and four following as for a DANLOAD meter. For meter B, however, there are three digits preceding the decimal point and only three following. The display to check the flow factor for the secondary meter appears as:

   CORRECT ? Y/N
   XXX.XXX

4. During calibration, all measurements for both meters are carried out to one hundredth of a unit.
5.1 CALIBRATION OF THE METERS

Calibration of the meters is the same as described in the D.O.M. except that:

1. Low flow rates for A and B are set to the corresponding percentage of the total low flow, but only for the actual calibration. They are then set to the desired total low flow. If the desired low flow rate is 150 gpm and the blend percentage is 40% during calibration of the meters, the low flow rate for A will be set at 90, which is 60% of 150, and B will be set to 60, which is 40% of 150. Both values will then be reset to 150 following meter proving.

2. Medium flow rates will be set to the corresponding percentage of the total desired high flow and will remain. In other words, if the desired high flow rate is 600 gpm and the blend percentage is 40%, then the medium flow rate for A will be set to 360, which is 60% of 600, and B will be set to 240, which is 40% of 600. Actually, this latter value would be 250 gpm in the preceding example, because the program will not accept a value less than 100 gpm difference between low and high.

3. Both high flow rates will be set to the same amount, or the desired high rate. The A meter will be calibrated at this rate, while the derived meter factor for B’s medium flow will also be used as its high meter factor. In other words, if the total high flow rate desired is 600 gpm, both A and B high flow rates will be set at 600.

6.0 EXITING SETUP/CALIBRATION

This procedure is the same as in the DANLOAD Operations Manual.
7.0 GENERAL USER PROCEDURES

When the user approaches a DANTROL, the following message is on the DANTROL alphanumeric display:

DANBLEND
READY

This indicates that the DANBLEND system is ready for the next preset operation. In the event that "PRESET READY" is not displayed, but an alarm message is displayed, the user should first notify the terminal staff to diagnose the fault.

The user presses the "A", PRESET, key and the system prompts the user for:

BLEND ? Y/N

The system next displays the following:

ENTER PRESET VOLUME

If the user selects "YES" to the "BLEND" prompt or if the blend status is made, the preset volume entered is the total volume to load of the blended product. If the user selects "NO" to the "BLEND" prompt, only the primary meter is used and the preset volume entered is only for the straight primary product. **It is not possible to load the secondary product alone as this will contaminate the "clean line" features of the DANBLEND.**

The user must enter a value which is either less than or equal to the maximum load size or greater than or equal to the minimum load size selected in the program. Ideally, this is the amount of the compartment to be loaded.
If the user enters a value too small, the system displays the message:

```
UNABLE TO COMPUTE BLEND
```

Additionally, after a preset volume is entered, the entered volume is displayed on the top numeric display, indicating the volume remaining to be loaded, and the bottom display is zeroed, indicating the volume currently loaded. During the loading of the product, these two displays are updated continuously, giving the user a current reading of the volumes loaded and remaining to be loaded.

If the user has chosen an acceptable value, the system next displays the message:

```
PRESS START WHEN READY
```

Pressing the "B", START, key, begins the product flowing. Any other function key response causes the system to display the "PRESET READY" prompt again.

The system makes checks of all safety circuits, if applicable, and allows loading to proceed. If any of the safety checks fail the system displays:

```
SAFETY SYSTEMS NOT CONNECTED
```
NOTE: Not all terminals utilize the safety circuit inputs provided by the DANLOAD system. Terminal personnel should familiarize themselves with the applicable safety features of their system at the time of installation. Any failures which may occur should be diagnosed using Section 10.0 of the DANLOAD Operations Manual. Continual faults are very often the results of incorrect values entered in the system. During startup of your system, please notify Daniel Industries of any quirks or unique features of your system. All documentation is placed on file at Daniel so as to allow for easier phone diagnostics.

When the user presses the "B", START, key and has satisfied all safety circuits, the loading process begins and the display reads:

BLEND IN PROGRESS

NOTE: When a blend load is selected the fourth additive output on the MCU board for the secondary meter goes low. If a straight load is in progress the additive output stays high. This can be used for appropriate indicator lights.

The message is displayed during the entire loading process or until the user presses the "C", STOP, or "D", CANCEL, key. Pressing either of these two keys causes the load to be terminated and requires the user to re-enter the amount to be loaded as before.
If the user loses a safety circuit during the load, the following message is displayed:

```
SAFETY SYSTEMS
NOT CONNECTED
```

This message does not require the user to re-enter any values but, instead, stops loading until the appropriate measures are taken to correct the safety circuit. After the correction is made, the system once again displays the message "PRESS START WHEN READY".

At the normal termination of the load, the system displays the following message:

```
DANBLEND
READY
```

At any time the DANTROL is displaying the "DANBLEND READY" message, the user may access the meter totalizers by pressing the "D", CANCEL, key. The primary meter’s gross totalizer is displayed for approximately ten seconds, followed by the secondary meter’s gross totalizer for ten seconds. The displays appear in the following manner:

```
GROSS TOTAL
METER A

GROSS TOTAL
METER B

NET TOTAL
METER A

NET TOTAL
METER B
```

If the DANTROL is displaying the "DANBLEND READY" prompt and the user presses the "C", STOP, key, the system displays the details of the last load. If the last load was a blend load the displays appear as follows each remaining on the DANTROL display for ten seconds:

```
AMT A LAST LOAD
XXXXXX.X

AMT B LAST LOAD
XXXXX.XX

BLEND %
XX.XX
```
8.0 PRODUCT SECURITY

Please refer to the DANLOAD Operations Manual for this section.

8.1 PRIMARY ALARMS

The primary alarm section is the same as described in the DANLOAD manual except for the following items:

1. Blend failure due to A/B (?)

2. After the operator has cleared an alarm, the display returns to:

   DANBLEND
   READY

3. There are only four standard primary alarm conditions instead of six as there is no dual pulse or temperature option. The two alarms not supported are "PULSE TX FAILURE" and "TEMPERATURE PROBE FAILURE".

8.2 SECONDARY ALARMS

This section is exactly as described in the DANLOAD manual.
9.0 GENERAL HARDWARE SETUP

This section is as described in the DANLOAD manual with the following exceptions:

1. There are only three ACU boards maximum to one DANBLEND.

2. The ACU board is only connected to the primary meter’s MCU board. (i.e. MCUs 1, 3, and 5)
10.0 TROUBLESHOOTING GUIDE

This troubleshooting guide is written with the expectation that terminal personnel performing the tasks be qualified in areas of terminal operations. Daniel Industries offers a training course on the DANBLEND system operation and equipment. Those who wish to be provided this training please contact:

Daniel Automation Field Service Manager
Daniel Industries, Incorporated
Tel: (713) 890-0083
Fax: (713) 890-1208

Should you encounter any problems with the DANBLEND system installed at your terminal which cannot be solved with the help of the following guide, please contact field service at Daniel Automation as soon as possible:

Daniel Automation Field Service
Daniel Industries, Incorporated
Tel: (713) 890-0083
Fax: (713) 890-1208
After Hours: (713) 464-5715
10.1 OVERVIEW

Please follow the troubleshooting procedures as outlined in the DANLOAD manual.

The overview section has only one difference for DANBLEND in that it can only be connected to a maximum of three ACUs.

10.2 DANMASTER FAULTS

Please refer to the DANLOAD Operations Manual for this section.

One difference in this section is that the red and green lights on the MCU boards for the secondary meter remain lit but do not flash as they are not connected to a DANTROL.

10.3 PRESET ALARMS

Please refer to the DANLOAD Operations Manual for this section.

10.4 VALVE OR SYSTEM FAULTS

Please refer to the DANLOAD Operations Manual for this section.
11.0 CALIBRATION: AN IN DEPTH ANALYSIS

Please refer to the DANLOAD Operations Manual for this entire section. Please also note the modifications added in Section 5.0 of this manual, CALIBRATION OF METER.

12.0 DIAGRAMS

BK-30596 - GENERIC DANBLEND WIRING (3 pages)
1 - Connect shield drain wires with stake-on ring to ground posts at bottom of card cage.

2 - MCU's 1-6 term 832 is open collector output. Jump all 832's to each other. Connect MCU 01-82 to term 109 in EPU.

NOTES
13.0  MISC. LITERATURE

TERMINAL:_______________________  LOCATION:_______________________

CUSTOMER CONTACT:_____________  TELEPHONE #:___________________

LOADSPOT #:____________________  BLEND PRODUCT:__________________

PRIMARY PRODUCT:_______________  SECONDARY PRODUCT:____________

METER A SERIAL #:_______________  METER B SERIAL #:______________

METER MOUNT-VERTICAL/HORIZONTAL:_________________________________

PROM VERSION #:________________

DANBLEND:_____________________  DANTROL:_______________________
14.0 CALIBRATION PARAMETERS

Select language: _________________________________
Component B %: ________________________________
Host Comms: __________________________________
Temp A Option: ________________________________
API Table code: ________________________________
Gravity: _______________________________________
Temp B Option: ________________________________
API Table code: ________________________________
Gravity: _______________________________________
Dual Pulse: ____________________________________
Max error count: ________________________________
# of Additives A: ________________________________
  Add # 1: _________________________________
  Add # 2: _________________________________
  Add # 3: ___________________________
  Add # 4: ____________________________
# of Additives B: _______________________________
  Add # 1: ________________________________
  Add # 2: ________________________________
  Add # 3: ________________________________
  Add # 4: ________________________________
Max Preset: __________________________________
Min Preset: __________________________________
Control Valve (A/B)?: ___________________________
Clean line end (A/B)?: ___________________________
Min Flow rate A?: ______________________________
Min Flow rate B?: ______________________________
Time to Minimum Rate: __________________________
No Flow Time Out: ______________________________
Unauthorized Flow Limit: ________________________
Line Pack Delay: ________________________________
Pump Stop Delay: _______________________________
Meter A Low Meter Factor: ______________________
Meter A Low Flow Rate: ________________________
Meter A Low Flow Startup: ______________________
Meter A Low Flow Shut Down: ____________________
Meter A Medium Meter Factor: ____________________
Meter A Medium Flow Rate: ______________________
Meter A High Meter Factor:_______________________
Meter A High Flow Rate:________________________

Meter B Low Meter Factor:_______________________
Meter B Low Flow Rate:__________________________
Meter B Low Flow Startup:_______________________
Meter B Low Flow Shut Down:______________________
Meter B Medium Meter Factor:_____________________
Meter B Medium Flow Rate:_______________________
Meter B High Meter Factor:_______________________
Meter B High Flow Rate:__________________________

St Pt 1 Type:____________________________________
Invert Status point 1? (Y/N):____________________
St Pt 2 Type:____________________________________
Invert Status point 2? (Y/N):____________________
St Pt 3 Type:____________________________________
Invert Status point 3? (Y/N):____________________
St Pt 4 Type:____________________________________
Invert Status point 4? (Y/N):____________________
WARRANTY CLAIM REQUIREMENTS

To make a warranty claim, you, the Purchaser, must:

1. Provide Daniel with proof of the Date of Purchase and proof of the Date of Shipment of the product in question.

2. Return the product to Daniel within twelve (12) months of the date of original shipment of the product, or within eighteen (18) months of the date of original shipment of the product to destinations outside of the United States. The Purchaser must prepay any shipping charges. In addition, the Purchaser is responsible for insuring any product shipped for return, and assumes the risk of loss of the product during shipment.

3. To obtain Warranty service or to locate the nearest Daniel office, sales, or service center call (281) 897-2900, Fax (281) 897-2901, or contact:

   Daniel Measurement Services
   19203 Hempstead Highway
   Houston, Texas 77065

   When contacting Daniel for product service, the purchaser is asked to provide information as indicated on the following "Customer Problem Report".

   Daniel Measurement Services offers both on call and contract maintenance service designed to afford single source responsibility for all its products.

   Daniel Industries, Inc. reserves the right to make changes at any time to any product to improve its design and to insure the best available product.
DANIEL INDUSTRIES, INC.
CUSTOMER PROBLEM REPORT

FOR FASTEST SERVICE, COMPLETE THIS FORM, AND RETURN IT ALONG WITH THE AFFECTED EQUIPMENT TO CUSTOMER SERVICE AT THE ADDRESS INDICATED BELOW.

COMPANY NAME:____________________________________________________________________________

TECHNICAL CONTACT:_________________________________ PHONE:______________________________

REPAIR P. O. #:_____________________________ IF WARRANTY, UNIT S/N: _________________________

INVOICE ADDRESS:____________________________________________________________________________

______________________________________________________________________________________________

______________________________________________________________________________________________

SHIPPING ADDRESS:____________________________________________________________________________

______________________________________________________________________________________________

______________________________________________________________________________________________

RETURN SHIPPING METHOD:________________________________________________________________________

EQUIPMENT MODEL #:____________________ S/N:__________________FAILURE DATE:______________

DESCRIPTION OF PROBLEM:_____________________________________________________________________

______________________________________________________________________________________________

______________________________________________________________________________________________

WHAT WAS HAPPENING AT TIME OF FAILURE? ______________________________________________________

______________________________________________________________________________________________

______________________________________________________________________________________________

ADDITIONAL COMMENTS:________________________________________________________________________

______________________________________________________________________________________________

______________________________________________________________________________________________

REPORT PREPARED BY:________________________________ TITLE:_______________________________

IF YOU REQUIRE TECHNICAL ASSISTANCE, PLEASE FAX OR WRITE THE MAIN CUSTOMER SERVICE DEPARTMENT AT:

DANIEL MEASUREMENT SERVICES
ATTN: CUSTOMER SERVICE
19203 HEMPSTEAD HIGHWAY
HOUSTON, TEXAS 77065

PHONE: (281) 897-2900
FAX: (281) 897-2901
The sales and service offices of Daniel Industries, Inc. are located throughout the United States and in major countries overseas. Please contact Daniel Measurement Services at 19203 Hempstead Highway, Houston, Texas 77065, or phone (281) 897-2900 for the location of the sales or service office nearest you. Daniel Measurement Services offers both on-call and contract maintenance service designed to provide single-source responsibility for all Daniel Measurement and Control products.

Daniel Measurement and Control reserves the right to make changes to any of its products or services at any time without prior notification in order to improve that product or service and to supply the best product or service possible.