Installation and Operation Manual

Model T675
Delivery System Totalizer

SPONSLER, INC.
Flow Measuring Devices and Controls

IDEX CORPORATION

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1. GENERAL INFORMATION:

1.1 INSTALLATION GUIDE

1.1.1 Introduction:

The installation guidelines are specific to the **T675** Totalizer. Please refer to the individual technical data sheets for information pertaining to the turbine flowmeter, RTD temperature probe and printer. Compliance with the following basic guidelines permits the user to acquire maximum benefit of this asset.

1.1.2 Precautions:

The **T675** incorporates sophisticated electronic components and many safeguards have been designed to minimize susceptibility to static discharge and stray voltages. Every precaution for safe handling should still be observed. The most common is to eliminate static or stray voltage by grounding oneself touching a conductive discharge surface.
Welding in the proximity of the **T675** is not advised. Disconnect **ALL** cables at the **T675** prior to welding activity.
The display lens is a plastic composite and should be cleaned with a soft fabric cloth. Paper towel products or dirty leather gloves will score the lens and obscure visibility.

1.1.3 Totalizer:

The **T675** should be mounted at a convenient viewing height and angle that minimizes the reduced visibility caused by direct sunlight. Accessibility is also a prime consideration. A thin application of an Oxygen compatible lubricant on the threaded bolts of the securing knobs eliminates any corrosion opportunity. The threaded brass receptacle prevents galling. Although the **T675** has been designed to withstand the rigors of the cryogenic transport environment, placement under piping that defrosts or in the proximity of pumps that spray liquid is not recommended.

1.1.4 Interconnecting Cables:

All cables should be secured in place with proper stress relief and avoiding contact with the piping. Sufficient slack should be maintained in the cables to permit the **T675** Totalizer to be rotated forward for easy access to the rear panel connections. Additionally, a thin application of a non-conductive Oxygen compatible lubricant to the male threads of the nickel plated connectors will provide an additional moisture barrier. To minimize interference of other operating systems or low voltage events the power cable should be terminated at the battery or the most direct input source. The power input is polarity insensitive. SCI strongly recommends that power for the **T675** be direct to the source.

1.2 WARRANTY

Sponsler Co., Inc. hereafter referred to as SCI, products are warranted to be free from defects in material and workmanship under normal use and intended service for a period of 1 year from the date of shipment. Any product returned prepaid to SCI within the warranty period and found by SCI to be defective in workmanship or material, will be repaired or replaced free of charge at the sole discretion of SCI. Return shipment will be prepaid using the lowest cost means of transportation.
The warranty excludes but is not limited to products which are subjected to abuse, improper installation, altered, repaired anywhere except SCI, repaired using parts other than issued by SCI, accident or used in service other than intended or purchased.
In the event of defective product, contact Sponsler Co., Inc. (800)258-1165 to receive a Return Material Authorization (RMA) number. The RMA number should be prominently displayed on the return package. Return shipments without a RMA number are not accepted by the Shipping and Receiving department

2. FEATURES OVERVIEW:

2.1 INTRODUCTION

The **Model T675** Delivery System is a thoroughly engineered electronic totalizing system that incorporates the latest technology and provides the most comprehensive features available to the industry. The **T675** is designed to accurately compute and display in real time, pertinent flow parameters in both digital and graphic form. The displayed total of the product being delivered is continually corrected for the temperature of the product. Additional accuracy can be acquired by linearizing the turbine flowmeter input signal. The **T675** math processor permits direct reading of product totals in any desired engineering unit i.e., pounds, gallons, liters, scf etc.

This next generation system delivers the most sought after system enhancements while maintaining a user-friendly simplicity of operation. The **Model T675** configuration settings can be reprogrammed in the field with any one of three methods, the keypad, any standard Windows based PC with a **T675** communication cable or via the Flash Memory infrared communications port with an SP825 Data Cube. Programming the **T675** is simply a matter of selecting the desired operating criteria from an all-inclusive menu thus eliminating the need to scroll through an entire flow chart to enter or change select data. Display of various flow properties such as temperature and flow limits, fluid density and equivalent volume is achieved automatically with the selection of product to be measured and turbine size.

Fault detection and identification has never been easier. In addition to standard alarm icons the **T675** provides a **"Detail Screen"** that lists operating conditions such as supply voltage, internal battery voltage, signal input frequency, coil and RTD resistance, product and fluid temperature to name a few. Additionally, a **System Alarm Log** catalogs 16 events.

The **T675** Maintenance program with ICON reminders can be customized to account for the varying operating conditions that exist between installations. This feature allows the end user to extract maximum real world service intervals without sacrificing effective maintenance.

2.2 FEATURES

- Easy to program, operate and understand
- 3x5 back lit full graphics display
- Dual microprocessors for real-time graphics, display of totals, temperature, pressure, flowrate and alarms
- Password protected configuration and calibration parameters
- Temperature Compensator supports 8 individual products, LOX, LIN, LAR, CO2, CCO2, LNG, LNO2, MAPP
- 'softkeys' simplify display operation
- Selectable 2 – 10 point flowmeter linearization
- Automatic delivery system maintenance reminders based on a date and/or turbine hours of operation
- Audit trail documents Kfactor changes with date stamp, displaying the most current on the operating screen
- System alarm log simplifies fault identification
- Totalizer will withstand complete loss of power for 1 second, then save all operating data
- Restores to previous operating mode after power restoration
- Programmable Pump Control features protect the delivery system and increases service life
- Infrared and RS-232 communication ports
- IR interface with Model SP824 Portable Printer
- Easily compatible with other printers

2.3 SYSTEM OVERVIEW

When introduced to flow the turbine flowmeter generates an AC sinewave signal within the pickup coil located directly above the turbine's rotor. The signal of the pickup coil is amplified, divided, corrected and displayed by the **T675**. The displayed total is corrected for temperature by sensing the resistance of the RTD temperature probe. Delivery information consisting of total, product, temperature and temperature correction factor is transmitted via the Infrared (I.R.) or RS232 communications port. The accessory **SP825** data collection device receives and then downloads the delivery information to the **SP824** portable printer that can maintain a delivery summary of up to 60 transactions for daily invoice reference. This unique integrated system provides the end user a compact total delivery system.

2.4 THEORY OF OPERATION

The **SCI** turbine flowmeter is a volumetric measurement device that measures fluid velocity with one moving component, the rotor. The momentum of the flowing fluid engages the low mass rotor resulting in the rotor rotating at an angular velocity that is proportional to the fluid velocity. The rotor's rotation generates an AC sinewave signal in the pickup coil. **SCI** turbine flowmeters are linear devices therefore the signal output frequency is proportional to the flowrate within the designed flow range. Another benefit of a linear turbine meter is it's Kfactor, the number of pulses generated per unit volume (gallons, pounds etc.) is consistent over the entire flow range. The total number of pulses generated is directly related to the total volume. The displayed total in the desired engineering unit is acquired by dividing the total pulses by the Kfactor. Because volumetric flowmeters and product density are influenced by fluid temperature, temperature must be measured and calculated into the final summation for the displayed total to be exact. A temperature compensation algorithm accomplishes this by computing the fluid density for the measured temperature and adjusts the volumetric or mass delivery total.

Simply stated, temperature compensation adds pulses to the pulse total when the detected temperature is colder than the products reference temperature and subtracts pulses when the product temperature is warmer than the reference temperature. The rate at which the pulses are added or subtracted is determined by the measured temperature departure from the products reference temperature.

2.5 CONTROL PANEL INDICATORS

POWER INDICATOR: A Green LED illuminates when the **T675** is "On" and is extinguished when the **T675** is "Off".

SIGNAL INDICATOR: An Amber LED flashes when an input signal is present.

SYSTEM ALARM INDICATOR: A Red LED flashes indicating the presence of an Alarm or Maintenance condition.

2.6 CONTROL PANEL PUSHBUTTONS

ON/OFF PUSHBUTTON: Momentarily depressing the **On/Off** pushbutton will turn the **T675** system "On" illuminating the green LED. The system resumes operation exactly as existed at the moment of the last power "Off". In order to turn the **T675** "Off" during normal operation you must depress and hold the **On/Off** pushbutton for 3 seconds before the system will turn "Off". During the brief delay the Green **Power** LED will flash as a warning indicator. Once the display backlight extinguishes the **On/Off** pushbutton can be released.
As a safeguard, during some critical operations such as system setup, the **On/Off** pushbutton is disabled. This allows the operator to complete the setup operation (or exit setup first via the **Reset/Esc** key). Either way changes will be saved before the system powers "Off".

KEYPAD: A 16 pushbutton keypad, 10 numeric, decimal point, backspace key (←) and 4 special function keys, used for data entry during setup of the **T675**. During normal operation (**Operating** mode) the keypad is disabled with the exception of the **Setup** key.

SETUP: Changes the **T675** from the **Operating** to the **Prove** mode.

RESET (ESC): Enables escape function, will initiate system reset only in **Programming** mode when "double clicked"

CLEAR: permits deletion of an entire user entry.

ENTER: inputs data only in **Programming** mode

SOFTKEYS: 4 keys located immediately below the display whose function is defined by an on screen label directly above the key. During normal operation the Detail, Reset, Print and Alarm softkeys are depicted on screen.

DETAIL SOFTKEY: Depressing this softkey will display the **Detail** screen. Once the **Detail** screen is displayed the softkey now converts to a **Hold** softkey and retains the **Detail** screen until this softkey is released. Releasing the **Hold** softkey permits the display to return to the **Operating** screen.
Two additional softkeys are displayed while in the **Detail** screen, **Bat Test** and **Ok** softkey.

RESET SOFTKEY: Depressing this softkey resets the **Delivery Totalizer**. This softkey is disabled during delivery unless the unit is in the **Prove Mode**.

PRINT SOFTKEY: Depressing this softkey downloads delivery information for 1 minute or until acknowledged. This key will not be displayed if the printer output has been disabled in the **T675 Settings Menu** page 2 Item 3.

ALARM SOFTKEY: Depressing this softkey will display a detailed description of all of the active alarm conditions. Once the **Alarm** screen is displayed the softkey converts to a **Hold** softkey and retains display of the **Alarm** screen. Releasing the **Hold** softkey permits the display to return to the **Operating** screen.

2.7 DISPLAY SCREENS

The **T675** has 4 primary screens; **Power Up**, **Operating**, **Detail** and **Prove**. In addition there are 3 primary menu screens, the **Initialization** Menu, **Adjustment** Menu and the **Settings** Menu.

2.7.1 POWER UP SCREEN

When the **T675** measurement system is initially turned “On”, this screen displays the self-test results, software version identification and temperature correction curves. Additionally, a configurable message can be programmed and displayed on the lower portion of the screen. The message is factory configurable and must fit within an area of 48 x 240 pixels.
For more detailed information about “**power on self-test”** consult the **SYSTEM DIAGNOSTICS** section of this manual.

2.7.2 OPERATING SCREEN

CUSTOMER'S ICON: The icon is located in the upper left corner of the display and can be customized for the end user. The icon must be digitized to fit within 24 x 24 pixels.

TIME & DATE: The current time and date as set by the system's real time clock (24-hr format). The colon separating the hours and minutes will flash once per second to indicate that the system is functioning. Note that the clock is automatically corrected for the transition between Daylight savings time and Standard time.

TEMPERATURE BARGRAPH: The temperature bargraph indicates the process temperature of the product being delivered in relation to the minimum and maximum temperature limits automatically determined by the product correction table loaded into the system when the product is selected. The product and digital temperature are displayed directly beneath the bargraph in °F, °C or °K. The temperature bargraph is updated every second. Note: if the delivery temperature is out of range, the **'Temp'** descriptor above the bargraph and red **System Alarm** LED will flash.

FLOWRATE BARGRAPH: The flowrate bargraph indicates the current flowrate of the product being delivered in relation to the minimum and maximum flowrate limits automatically determined when the turbine flowmeter size is selected in the **Setup** menu. The flowrate is digitally displayed directly beneath the bargraph in engineering units selected in the **Setup** menu. The flowrate is calculated with the K-factor entered in the **Setup** menu. The flowrate bargraph is updated every second. Note: if the delivery flowrate is out of range, the **'Rate'** descriptor and red **System Alarm** LED will flash.

ACCUMULATIVE TOTALIZER: The 'small' 9 digit totalizer. This totalizer is "slaved" to the **Delivery Totalizer** and increments in the same engineering units. The total is **"Priviledge"** password protected and can only be **Reset** by factory personnel.

KFACTOR INFORMATION: The displayed Kfactor information has a dual purpose. If the linearizer is inactive, the displayed Kfactor represents the latest Kfactor entered into the setup menu. If the linearizer is active, the Kfactor information is replaced with the word linearizer. The instantaneous calculated linearized K-factor based on flow rate is available on the **Detail Screen**.

DELIVERY TOTAL: The 6 digit delivery total represents the cumulative total since the last **Reset** action. (Refer to **RESET** softkey pg. 6) The delivery total is the total pulses generated divided by the Kfactor and corrected for temperature if compensation is activated. If the engineering unit of measure is changed the displayed delivery total will be automatically converted to the equivalent total.

Directly above the **Delivery Totalizer** the engineering units of measure and delivery conditions are displayed. If the temperature compensator is activated and the delivery temperature is within range, **'@ NBP'** for liquids or **'@ NTP'** for gases will be displayed after the engineering unit of measure. The total will be corrected at the measured temperature. If the delivery temperature is out of range, **'@ DEFAULT TEMP'** will be displayed and the delivery total will be corrected at the warmest delivery temperature for that product. If the temperature compensator function is turned "Off", **'@ NO TCF'** will be displayed and the TCF will be 1.000, (volumetric).

The delivery totalizer will discontinue counting in the event of a temperature failure unless the "**totalize during alarm**" option is selected in the **Setup** menu. If totalize during alarm is selected the totalizer will operate at the warmest temperature value (default temp) for the selected product.

PUMP ICON: The pump icon indicates the status of the delivery pump. When the pump icon is not displayed, the delivery pump is enabled. A temperature and time based pump cooldown feature can be activated by enabling the **Pump Cooldown Timer**. In the event of an intermittent non-fatal temperature error, the **Intermittent Temp Tolerance Timer** is activated. This programmable timer specifies a time period during which a temperature fault is allowed to exist without disabling the delivery pump. During this failure a thermometer icon with an upward pointing arrow and countdown timer will appear on screen indicating the number of seconds remaining before the temperature fault will disable the delivery pump unless corrected. Failure to correct the temperature fault within the specified time will cause the pump icon to be displayed, disable the delivery pump and preset the **Pump Cooldown Delay Timer** to the programmed value. When the fault is corrected and the temperature returns within range, the pump cooldown delay timer will decrement toward zero. If no further temperature errors occur, the pump cooldown delay timer reaches zero, the pump icon disappears and the delivery pump is enabled.

SYSTEM MAINTENANCE ICON: An **oil can** icon indicates that a system maintenance alarm condition exists. An abbreviated alarm message is displayed below the icon identifying the component. If more than one alarm condition exists, the alarm message(s) will be displayed in a sequential fashion. Depressing the **ALARM** softkey will display all current alarm conditions. The **System Alarm Log** in the "**675 settings menu**" maintains an alarm event history that can be accessed by **Privileged** or **User** passwords. The **System Alarm LED** indicator flashes during any alarm condition. In the event a low power condition is detected, the alarm icon converts to a **gas pump** and begins a 1 second countdown. During this low power condition, the system turns off the LCD backlight to conserve power and begins operating off the internal lithium battery. If the incoming power is restored within 1 second, the system will refresh and operate normally. If, however, sufficient power is not restored, the system will save all operating parameters and shut itself "Off".

***T675* MESSAGE:** This message indicates that the unit is in the normal **Operating** mode. When this message is replaced with '**PROVER**' the unit is operating in the **Prove** mode.

2.7.3 DETAIL SCREEN

The **Detail** screen displays hardware information and additional current operating conditions of the system. A total of 11 parameters are available for review; Input voltage, Battery voltage, P/U coil ohms, LCD Heater status, Input frequency, Kfactor, RTD ohms, T/C factor, Density, Delivery product and Temperature. The temperature displayed in digital and bargraph format.

3 **Softkeys** are displayed with the **Detail** screen:

BAT TEST SOFTKEY: Depressing this key while in the **Detail** screen instructs the system to test the **T675** backup battery. This test involves applying a 35mA load to the battery for 2 seconds, reading and storing the battery voltage. Since this test evaluates the battery's condition by applying a load, it is recommended that this test be conducted only if either **Batt** is below the **Maintenance** icon or a new battery is installed by the factory. The system automatically performs this test at the beginning of each month.

OK SOFTKEY: Depressing this key terminates the **Detail** screen and immediately returns the display to the **Operating** screen.

HOLD SOFTKEY: Depressing this key retains the **Display** screen, when released the system will automatically revert to the **Operating** screen after several seconds.

2.7.4 PROVER SCREEN

Depressing the **Setup** key located on the keypad accesses the **Prover** screen. This screen is identical to the **Operational** screen with the exception of the ***T675*** icon is replaced with the word **PROVER**. The function of the **Prove** mode is examined in detail below.

2.8 MODES OF OPERATION

The **T675** program offers 3 modes, **Operating**, **Programming** and **Prove**. Any mode that can affect the calibration of the **T675** is password protected. The T675 has a 2 tiered password level of security, **Privileged** and **User**. The **Privileged** password is maintained exclusively for Factory use and allows access to ALL menu options. The **User** password allows access to all displayed menu options except one, Initialization Option 5, Hardware test/calibrate.

2.8.1 OPERATING MODE

The **Operating** mode is the power up mode for the **T675**, all others must be accessed with a password. The **Operating** screen containing all delivery vitals is the normal display for this mode. The **Detail** screen is also accessible in this mode without a password.

2.8.2 PROGRAMMING MODE

The **Programming** mode and associated menu's allow the **T675** to be configured to the operating conditions of the application. When accessed, the first screen displayed is **675 Initialization Options** menu containing 7 options. Options 2,3 and 5 are password protected. Option 5 requires a **Privileged** password and is intended for Factory use only. The **Programming** mode is quite extensive and is explained completely beginning with the **675 Initialization Options** Menu on page 10.

2.8.3 PROVE MODE

The **Prove** mode permits convenient calibration of the trailer's delivery system. This mode temporarily aborts certain safeguard features and therefore is password protected. To access this mode, depress the **SETUP** key. The system will prompt for a password, either user or privileged, to be entered. If an incorrect password is entered or the **RESET/(ESC)** key is depressed, the **T675** will revert to the **Operating** mode. The **Prove** mode allows entering, changing or viewing the Kfactor. The **Prove** mode is retained until the **T675** is either turned "Off" or no flow activity for 5minutes. The **Prove** mode has the following operational characteristics:

- The ***T675*** message is replaced with the **PROVER** message
- The **SETTINGS** password is not required to change the Kfactor
- The pump cooldown timer is disabled (pump enabled)
- The I.R. communications port is disabled
- The Totalizer can be reset regardless of flowrate

3. PROGRAMMING:

3.1 T675 INITIALIZATION OPTIONS MENU

The **T675 Initialization Options** Menu is accessed by the simple sequence of depressing and holding the **RESET** key while momentarily depressing and releasing the **On/Off** pushbutton. Options 1,2 and 3 in this menu contain all the program configuration screens to customize the **T675**.

```
*********************************************
******* 675 Initialization Options *******
*                                           *
*     1 - Set clock                         *
*     2 – Adjustment Mode                   *   Password Required
*     3 - Change system settings            *   Password Required
*     4 - I.R. system transfer              *
*     5 - Hardware test/calibrate           *   Privileged Password Required
*     6 - Restart system                    *
*     7 – I.R. Echo/Debug                   *
*     Option?                               *
*                                           *
*********************************************
```

NOTE: 1) Entry of the Password is not displayed, a ***** is displayed with each digit maintaining confidentiality.
2) Depressing the **RESET** key during data entry will return the display to the previous menu screen.
3) Any item within the **< >** borders signifies depressing that key or pushbutton.
4) ← key backspaces 1 position each time it is depressed
5) **CLEAR** key deletes entire entry

3.1.1 <1> – SET CLOCK:

Sets the **T675**'s real time clock. The clock uses a military time format, and automatically adjusts for Daylight savings. The screen will automatically advance to the next setting with each entry. NOTE: No check is conducted to insure the correct date is entered for the corresponding month. If the date entered is incorrect simply reset the clock. Depressing **RESET** anytime during the entry sequence will abort setting the clock and revert the display to the **675 Initialization options** screen.

Example: Set 1:35pm November 1, 2000,

```
*************************************************
*********** Setting real time clock ***********
*                                               *
*    Current setting: 11:54 01-Nov-00           *
*                                               *
*    Hours (0-23)?                              *
*                                               *
*************************************************
```

<13> <ENTER>

```
*************************************************
*********** Setting real time clock ***********
*                                               *
*    Current setting: 11:54 01-Nov-00           *
*                                               *
*    Minutes (0-59)?                            *
*                                               *
*************************************************
```

<35> <ENTER>

```
************************************************
*********** Setting real time clock ***********
*                                              *
*    Current setting: 11:54 01-Nov-00          *
*                                              *
*    Date (1-31)?                              *
*                                              *
************************************************
                <01> <ENTER>

************************************************
*********** Setting real time clock ***********
*                                              *
*    Current setting: 11:54 01-Nov-00          *
*                                              *
*    Month (1-12)?                             *
*                                              *
************************************************
                <11> <ENTER>

************************************************
*********** Setting real time clock ***********
*                                              *
*    Current setting: 11:54 01-Nov-00          *
*                                              *
*    Year (0-99)?                              *
*                                              *
************************************************
                <00> <ENTER>
```

To confirm that the **Current setting** is correct **<1> Set clock** and review. **<RESET>** to exit and return to the **675 Initialization options** menu.

3.1.2 <2> – ADJUSTMENT MODE:

Permits the programming of sealable Calibration and Configuration parameters. Selecting this option will cause an onscreen prompt for a password. Once the password is entered properly access is permitted. Refer to page 12 for complete **Adjustment** programming instructions.

The **Adjustment Mode** contains the programmable Calibration and Configuration parameters. These sealable parameters are password protected because they alter the calibration and/or billing accuracy. Depress the corresponding category number in the left column, entry is automatic.

```
************************************************
************* Adjustment Mode **************
*                                              *
*    1 - Calibration                           *
*    2 - Configuration                         *
*                                              *
*    Enter setting (ESC to exit)?              *
*                                              *
************************************************
```

3.1.2.1 1 – Calibration: Allows setting the following parameters. Depress the corresponding category number in the left column, entry is automatic.

```
**************************************************
****** Adjustment Mode – Calibration ******
*                                                *
*    1 – Avg. Kfactor                            *
*    2 – Linearizer                              *
*    3 – Linearizer (0=OFF, 1=ON)                *
*                                                *
*    Enter setting (ESC to exit)?                *
*                                                *
**************************************************
```

1 – Avg. K factor: Allows entry of the average Kfactor in pulses per gallon. This Kfactor is used to for all calculations when the linearizer function is turned "Off".

Example: Insert Kfactor = 148.914, **<148.914> <ENTER>**

```
**************************************************
*************     Avg. Kfactor     ************
*      *Current setting = 148.914               *
*                                               *
*      Enter setting (ESC to exit)?             *
*                                               *
**************************************************
```

2 – Linearizer: Allows the T675 to take advantage of point to point programming using the turbine flowmeter calibration sheet to enter frequency and corresponding K-factor. The table is constructed from top to bottom. The frequency data must be entered in numerical order, Point 0 being the lowest frequency and Point 9 the highest. To abbreviate the number of linearizer points enter 0 for the frequency after the last desired point. Once a frequency of zero has been entered the table is considered complete and all points below are calculated at the last valid Kfactor. Remember that the number of linearizer points can range from 2 – 10. As a convenience, **<SETUP>** key will alternate the linearizer between activated or deactivated during this function. The Initial Linearizer Screen illustration is an example of a 3 point linearizer.

Initial Linearizer Screen

```
**************************************************
*    Linearizer OFF  meter: 0000                 *
*           FREQ     K-FACTOR                    *
*    0-     10       100                         *
*    1-     100      100                         *
*    2-     1000     100                         *
*    3-     0        0                           *
*    4-     0        0                           *
*    5-     0        0                           *
*    6-     0        0                           *
*    7-     0        0                           *
*    8-     0        0                           *
*    9-     0        0                           *
*                                                *
*    Enter setting (ESC to exit)?                *
*    (SETUP toggles linearizer ON/OFF)           *
**************************************************
```

The linearizer option is versatile and allows customized programming that reflects the application. This process can be simplified by reviewing the turbine flowmeter calibration sheet in advance and determine the following: 1) the extent of flow range coverage desired, 2) the number of points to linearize, 3) where to distribute the points, such as 3 points over the entire range, 5 points confined to the lower half of the flow range etc.

Example: Using the 2" calibration sheet (page 32), program the linearizer for 10 points evenly distributed over the entire flow range (15 – 225gpm). Beginning with Point 0 - **<0>** enter the lowest frequency **<37.746><ENTER>**, the screen advances to the Kfactor request, enter the corresponding Kfactor **<148.85><ENTER>**. Repeat this process for points 1 – 9. When the table is complete depress **RESET/(ESC)** once to exit the linearizer setup menu, twice to return to the Kfactor setup menu and three times to exit to the **Operating mode**.

Linearizer Point 0 Frequency Setup Screen

```
**************************************************
*   Linearizer OFF  meter: 0000                  *
*          FREQ       K-FACTOR                   *
*   0-     10         100                        *
*   1-     100        100                        *
*   2-     1000       100                        *
*   3-     0          0                          *
*   4-     0          0                          *
*   5-     0          0                          *
*   6-     0          0                          *
*   7-     0          0                          *
*   8-     0          0                          *
*   9-     0          0                          *
*                                                *
*   0-freq?   37.746                             *
*                                                *
**************************************************
```

Linearizer Point 0 Kfactor Setup Screen

```
**************************************************
*   Linearizer OFF  meter: 0000                  *
*          FREQ       K-FACTOR                   *
*   0-     37.746     100                        *
*   1-     100        100                        *
*   2-     1000       100                        *
*   3-     0          0                          *
*   4-     0          0                          *
*   5-     0          0                          *
*   6-     0          0                          *
*   7-     0          0                          *
*   8-     0          0                          *
*   9-     0          0                          *
*                                                *
*   0-Kfactor?   148.85                          *
*                                                *
**************************************************
```

After selecting a linearizer point depressing **ENTER** will skip over the entry prompt without changing the existing value.

Linearizer Point 0 Screen

```
**************************************************
*   Linearizer OFF  meter: 0000                  *
*          FREQ       K-FACTOR                   *
*   0-     37.746     148.85                     *
*   1-     100        100                        *
*   2-     1000       100                        *
*   3-     0          0                          *
*   4-     0          0                          *
*   5-     0          0                          *
*   6-     0          0                          *
*   7-     0          0                          *
*   8-     0          0                          *
*   9-     0          0                          *
*                                                *
*   Enter setting (ESC to exit)?                 *
*   (SETUP toggles linearizer ON/OFF)            *
**************************************************
```

Completed Linearizer Screen

```
**************************************************
*   Linearizer ON   meter: 01234                 *
*          FREQ       K-FACTOR                   *
*   0-     37.746     148.85                     *
*   1-     96.122     148.44                     *
*   2-     152.563    149.23                     *
*   3-     212.368    148.48                     *
*   4-     268.338    148.73                     *
*   5-     328.613    148.74                     *
*   6-     386.612    149.28                     *
*   7-     445.852    149.41                     *
*   8-     502.946    149.18                     *
*   9-     563.061    148.80                     *
*                                                *
*   Enter setting (ESC to exit)?                 *
*   (SETUP toggles linearizer ON/OFF)            *
**************************************************
```

Once all the data has been entered the **Setup** key can be used to toggle the linearizer On and Off. The linearizer status is displayed in the upper left portion of the screen. In the **Operating mode** the word **Linearize** is displayed in place of the actual Kfactor.

3 - Linearizer on/off: Activates or deactivates the linearizer function. **<0>** = Off, **<1>** = On

Example: To activate the linearizer, **<1>**

```
**************************************************
******** Linearizer (0=OFF, 1=ON)  *******
*      *Current setting = 1                      *
*                                                *
*      Enter setting (ESC to exit)?              *
*                                                *
**************************************************
```

3.1.2.2 2 – Configuration: Allows setting the following parameters. Depress the corresponding category number in the left column, entry is automatic.

```
**************************************************
***** Adjustment Mode – Configuration ****
*                                                *
*    1 – TC On/Off                               *
*    2 – Product                                 *
*    3 – Units of Measure                        *
     4 – Digits right of decimal
*                                                *
*    Enter setting (ESC to exit)?                *
*                                                *
**************************************************
```

1 - Compensation active: Activates or deactivates the temperature compensator, **<0> = Off, <1>= On**
Note: To operate the **T675** volumetric (no temp comp) select 0.

Example: Activate temperature compensation, **<1>**

```
**************************************************
******Compensation (0=OFF, 1=ON)*******
*      *Current setting = 1                      *
*                                                *
*      Enter setting (ESC to exit)?              *
*                                                *
**************************************************
```

2 - Trailer product: Selects the product to be measured. Even if compensation is not active, the proper product is required because engineering unit of measure equivalency information is contained in the product table. Additionally, all bargraph and alarm limits for temperature are contained in this table. Depress the corresponding product number in the left column, entry is automatic.

Example: Select Liquid Nitrogen, **<2>**

```
**********************************************
************** Trailer product ***************
*      * Current setting = 2                 *
*                                            *
*      1 – LOX                               *
*      2 – LIN                               *
*      3 – LAR                               *
*      4 – LCO2                              *
*      5 – LN20                              *
*      6 – CC02                              *
*      7 – MAPP                              *
*      8 - LPG                               *
*                                            *
*      Enter setting?  (ESC to exit)         *
*                                            *
**********************************************
```

Product temperature ranges:

	Temperature								
	Low			Reference:			High		
Product	**ºK**	**ºC**	**ºF**	**ºK**	**ºC**	**ºF**	**ºK**	**ºC**	**ºF**
LOX	88.0	–185.15	–301.27	90.180	–182.970	–297.346	110.0	–163.15	–261.67
LIN	75.0	–198.15	–324.67	77.364	–195.786	–320.411	95.0	–178.15	–288.67
LAR	85.0	–188.15	–306.67	87.284	–185.866	–302.555	107.0	–166.15	–267.07
LCO2	233.1	–40.05	–40.09	256.762	–16.388	2.502	266.2	–6.93	19.53
LN2O	222.1	–51.09	–59.96	238.470	–34.680	–30.424	288.5	15.38	59.69
CCO2	233.1	–40.05	–40.09	247.317	–25.833	–14.499	266.2	–6.93	19.53
MAPP	255.3	–17.87	–.17	288.534	15.384	59.691	324.1	50.92	123.66
LPG	233.1	–40.05	–40.09	288.534	15.384	59.691	323.1	49.94	121.89

3 - Units of measure: Allows selecting the unit of measure, commonly referred to as Engineering Units, for the Ratemeter, Totalizer and Temperature displays. All displays are independent. Depress the corresponding number in the left column to select the display to be programmed, entry is automatic.

Example: Select Totalizer, **<2>**

```
************************************************************
******************** Unit of measure ********************
*                                                          *
*      1 – Ratemeter                                       *
*      2 – Totalizer                                       *
*      3 - Temperature                                     *
*                                                          *
*      Enter setting  (ESC to exit)?                       *
*                                                          *
************************************************************
```

Depress the corresponding Engineering Unit of measure number in the left column, entry is automatic.

Example: Select Liters for the Totalizer, **<2>**

Display for Options 1, 2

```
************************************************
********** Ratemeter / Totalizer **********
*       Current setting = 2                    *
*                                              *
*       1 – Gal                                *
*       2 – Ltr                                *
*       3 – Lbs                                *
*       4 – Lbs x 10                           *
*       5 – Kg                                 *
*       6 – Scf                                *
*       7 – Scf x 100                          *
*       8 – Sm3                                *
*                                              *
*       Enter setting (ESC to exit)?           *
*                                              *
************************************************
```

Display for Option 3

```
************************************************
********** Temperature **********
*       Current setting = 3                    *
*                                              *
*       1 – Kelvin                             *
*       2 – Centigrade                         *
*       3 – Fahrenheit                         *
*                                              *
*                                              *
*                                              *
*                                              *
*                                              *
*       Enter setting (ESC to exit)?           *
*                                              *
************************************************
```

Note: Changing the Engineering Unit will reset any existing delivery total

4- Digits right of decimal: Selects the number of digits to the right of the decimal point (0 – 3) in the delivery totalizer quantity. Depress the desired number, entry is automatic.

Example: Select 2 digits to right of the decimal point (DP), **<2>**

```
************************************************************
********** Digits right of decimal **********
*       * Current setting = 2                              *
*                                                          *
*       Enter setting  (ESC to exit)?                      *
*                                                          *
************************************************************
```

Note: Changing the setting will clear any existing delivery total.

3.1.3 <3> - CHANGE SYSTEM SETTINGS:

Accesses the **T675 Settings** menu which consists of 9 settings choices that constitute all operating parameters that are programmable. This option requires a password. The level of the password entered determines what settings are available for configuration of the **T675**. Once the password is entered properly, the system indicates the user's access level, **Privileged** or **User**. Refer to page 17 for complete **Settings** program instructions

3.1.3.1 675 SETTINGS MENU PAGE 1:

The system settings menu consists of 2 pages permitting the user to customize the **T675** for the application. The **On/OFF** pushbutton is disabled during the system setup. To exit the **Setup** menu depress the **RESET/ESC** key. Note that some settings discussed will be unavailable at the **User** password level and will show up as 'Spare'.

Depress the corresponding category number in the left column, entry is automatic.

```
**************************************************
********** 675 settings,  Page 1 ***********
*                                                *
*     1 – Flowmeter size                         *
*     2 – Alarm and Timer settings               *
*     3 – Serial numbers                         *
*     4 – User passcode                          *
*     5 – Maintenance                            *
*     6 – Printer output options                 *
*     7 – System alarm log                       *
*     8 – System activity                        *
*     9 – Initialize system                      *   Privileged Password Required
*     0 – Goto page 2                            *
*                                                *
*     Enter setting?  (ESC to exit)              *
*                                                *
**************************************************
```

1 - Flowmeter: Automatically programs the corresponding minimum and maximum flow range, ratemeter bar graph display limits and alarm points. Depress the corresponding number for the turbine size in left column, entry is automatic.

Example: 2" turbine - **<7>**.

```
**************************************************
**************  Flowmeter size **************
*     * Current setting = 4                      *
*                                                *
*     1 –1/2"                                    *
*     2 –5/8"                                    *
*     3 – 3/4"                                   *
*     4 – 1.0"                                   *
*     5 – 1-1/4"                                 *
*     6 – 1-1/2"                                 *
*     7 – 2.0"                                   *
*     8 – 3.0"                                   *
*     9 – 4.0"                                   *
*     Enter setting?  (ESC to exit)              *
*                                                *
**************************************************
```

Flowrate chart by turbine size:

Flowmeter Size	Min Flow (GPM)	Max Flow (GPM)
1/2”	1	10
5/8”	2	15
3/4”	3	30
1”	4	60
1 ¼”	6	90
1 ½”	8	130
2”	15	225
3”	40	650
4”	75	1250

2 –Alarm, timer settings: Permits setting the following parameters. Depress the corresponding category number in the left column, entry is automatic.

```
*************************************************************
**************** Alarm & timer settings ****************
*                                                           *
*     1 – Totalize during alarm (0=NO, 1=YES)               *
*     2 – Pump cooldown timer (0=OFF, 1=ON)                 *
*     3 – Pump cooldown delay (sec)                         *
*     4 – Intermittent temp. tolerance (sec)                *
*                                                           *
*     Enter setting  (ESC to exit)?                         *
*                                                           *
*************************************************************
```

1 - Totalize during alarm: Allows the programmer to select whether or not the system will count during a temperature alarm condition. **<0> = no totalize, <1>= totalize**. If a FATAL temperature probe error exists such as a short or open RTD probe or cable (resistance <10 or >200Ω), the system will totalize regardless of this setting and will state above the large delivery totalizer “@ default temp”.

Example: Allow totalizer to count during alarm, **<1>**

```
************************************************
*  Totalize during alarm (0=NO, 1=YES)  *
*      *Current setting = 1                *
*                                          *
*      Enter setting (ESC to exit)?        *
*                                          *
************************************************
```

2 - Pump cooldown timer: Selects whether the cooldown timer is active or disabled. **<0> = timer disabled,** pump always enabled, no pump cooldown required, **<1> = timer active,** pump enabled after preset cooldown period as set in 3 – Pump cooldown delay.

Example: Enable the pump cooldown timer, **<1>**

```
************************************************
* Pump cooldown timer (0=OFF, 1=ON) *
*      *Current setting = 1                *
*                                          *
*      Enter setting (ESC to exit)?        *
*                                          *
************************************************
```

3 - Pump cooldown delay: Entered value determines the elapsed time after the temperature is within liquid product range before the pump is enabled, commonly referred to as "pump cooldown". The programmed delay range is 0 to 32000 seconds. Except on initial power up, a fatal temperature error will override the cooldown delay and the pump is enabled after the Intermittent temp tolerance timer counts down. Typical delays are O2, N2 = 10min (600sec), Ar = 15min. (900sec).

Example: 10minutes **<600> <ENTER>**

```
************************************************
******** Pump cooldown delay  (sec) *****
*      *Current setting = 600                  *
*                                              *
*      Enter setting (ESC to exit)?            *
*                                              *
************************************************
```

4 – Intermittent temp. tolerance: Entered value establishes the number of consecutive seconds a temperature error must exist before the delivery pump is disabled for a non fatal temperature fault. The tolerance range is selectable between 0 and 32000 seconds. The factory default is 10 seconds.

Example: <10> <ENTER>

```
************************************************
***Intermittent temp. tolerance   (sec) ***
*      *Current setting = 10                   *
*                                              *
*      Enter setting (ESC to exit)?            *
*                                              *
************************************************
```

3 –Serial numbers: Permits recording serial numbers for the following menu items. **Options 4 & 5** are displayed as "Spare" with the **User** access level. Depress the corresponding number in left column to access that menu item.

```
************************************************
************  Serial numbers   ************
*                                              *
*      1 – Flowmeter                           *
*      2 – Plant                               *
*      3 – Trailer                             *
*      4 – 675 S/N                             *
*      5 – 675 manufacture date                *
*                                              *
*      Enter setting (ESC to exit)?            *
*                                              *
************************************************
```

1 – Flowmeter: Enters the assigned serial number into memory.

Example: S/N12345; **<01234> <ENTER>**

```
************************************************
***************  Flowmeter  ******************
*      *Current setting = 01234                *
*                                              *
*      Enter setting (ESC to exit)?            *
*                                              *
************************************************
```

2 – Plant: Enters the Plant Location Code into memory.

Example: Plant 1111; **<1111> <ENTER>**

```
**************************************************
****************** Plant ********************
*     *Current setting = 1111                    *
*                                                *
*     Enter setting (ESC to exit)?               *
*                                                *
**************************************************
```

3 – Trailer: Enters the trailer number into memory.

Example: Trailer 2222; **<2222> <ENTER>**

```
**************************************************
****************** Trailer ********************
*     *Current setting = 2222                    *
*                                                *
*     Enter setting (ESC to exit)?               *
*                                                *
**************************************************
```

4 – 675 S/N: Enters the assigned **T675** S/N into memory. **Privileged Only**.

Example: S/N56789; **<56789> <ENTER>**

```
**************************************************
****************** ~675 S/N ******************
*     *Current setting = 56789                   *
*                                                *
*     Enter setting (ESC to exit)?               *
*                                                *
**************************************************
```

5 - 675 manufacture date: Enters the **T675** date of manufacture into memory, DDMMYY. **Privileged Only.**

Example: October 25, 2001; **<251001> <ENTER>**

```
**************************************************
********* ~675 manufacture date  *********
*     *Current setting = 251001                  *
*                                                *
*     Enter setting (ESC to exit)?               *
*                                                *
**************************************************
```

4 – User passcode: Allows changing the **User** password from the factory default setting (675). The password can contain 1 –16 digits. This password allows access to all the **System settings** except as indicated by **Privileged**.

Example: 0000; **<0000> <ENTER>**

```
**************************************************
************** User passcode****************
*     *Current setting = 0000                    *
*                                                *
*     Enter setting (ESC to exit)?               *
*                                                *
**************************************************
```

5 - Maintenance: Allows setting both the system and turbine maintenance parameters, such as scheduling future maintenance dates, establishing accumulated hours of operation between maintenance activities and resetting both sets of accumulated hours of operation. Depress the corresponding maintenance number in left column to access the menu item.

```
*************************************************************
********************  Maintenance ***********************
*                                                           *
*     1 – System maintenance due  DDMMYY                    *
*     2 – System maintenance just performed                 *
*     3 – Turbines hrs until maintenance                    *
*     4 – Turbine maintenance just performed                *
*                                                           *
*     Enter setting  (ESC to exit)?                         *
*                                                           *
*************************************************************
```

1 – System maintenance due DDMMYY: Entry specifies the maintenance date when the **Maintenance icon** reminder for system maintenance is displayed.

Example: March 14, 2002; **<140302> <ENTER>**

```
*************************************************************
********* System maintenance due DDMMYY ********
*     Current setting = 140302                              *
*                                                           *
*     Enter setting (ESC to exit)?                          *
*                                                           *
*************************************************************
```

2 – System maintenance just performed: Functions as a maintenance record. **<1>** enters today's date into the **System Activity** register for **Last System PM**, **<0>** retains the last entry date.

Example: Record today's date as the maintenance date, **<1>**

```
*************************************************************
******** System maintenance just performed  *******
*                                                           *
*                                                           *
*     ARE YOU SURE, 1 = yes    0 = no ?                     *
*                                                           *
*************************************************************
```

3 – Turbine hrs until maintenance: Entry establishes the hours of turbine operation for the maintenance cycle.

Example: 1000 hours; **<1000> <ENTER>**

```
*************************************************************
************  Turbine hrs until maintenance  ************
*     Current setting = 1000                                *
*                                                           *
*     Enter setting (ESC to exit)?                          *
*                                                           *
*************************************************************
```

4 – Turbine maintenance just performed: Functions as a maintenance record. **<1>** enters today's date into the **System Activity** register for **Last Turbine PM**, **<0>** retains the last entry date.

Example: Record today's date as the maintenance date, **<1>**

```
************************************************************
******* Turbine maintenance just performed *******
*                                                          *
*                                                          *
*     ARE YOU SURE, 1 = yes    0 = no ?                    *
*                                                          *
************************************************************
```

6 – Printer Output Options: Allows selection of a specific printer output format or disabling the printer output. Depress the corresponding number in left column to access that menu item. Any selection automatically disables the remaining menu items. If the printer output has been disabled the **Print** softkey will not be displayed.

Example: Disable printer output, **<1>**, items 2 – 5 are disabled.

Enable OBC, **<5>**, items 1 – 4 are disabled.

Note: Delivery information is available to the printer for 5 minutes after flow discontinues.

```
************************************************
********* Printer Output Options *********
*     Current setting = 1                      *
*                                              *
*     1 – Disabled                             *
*     2 – SP824                                *
*     3 – SP834                                *
*     4 – Predefined with titles               *
*     5 – Predefined w/o titles                *
      6 – OBC
*     7 – ALC telxon                           *

*     Enter setting (ESC to exit)?             *
*                                              *
************************************************
```

7 - System alarm log: Displays a chronological log of 16 system alarms divided into 2 groups of 10 events, **Alarm Log** page 1(newest) and **Alarm Log** page 2 (oldest). Each entry contains the date, time description of the failure and value. Note: If the current alarm is the same as the previous alarm in the table it will be classified as a continuation of the previous alarm and will not be added to the table as a separate event. This is to prevent the same alarm condition from overflowing the table. The **Alarm Log** page 1 contains the most recent events listed top to bottom. After more than 10 events the oldest listing on page 1 will transfer to the **Alarm Log** page 2 The **Empty** designation indicates that less than 10 events have been registered on that page.

```
************************************************************
******************  Alarm Log pg. 1  *****************
*                                                          *
*     21-Mar-00 18:48 –Coil open                           *
*     08-Sept-99 17:20 –RTD short                          *
*     12-May-99 16:16 –Low power                           *
*     16-Feb-99 10:51 –Tloop short                         *
*     13-Oct-98 06:35 –Coil open                           *
*     11-Jul-98 14:25 –Tloop open                          *
*     15-Apr-98 09:42 –Low batt                            *
*     03-Feb-98 07:33 –RTD open                            *
*     31-Jan-98 01:15 –Coil short                          *
*     11-Nov-97 20:30 –Low power                           *
*                                                          *
*     Press any key to continue                            *
************************************************************
```

```
************************************************************
******************  Alarm Log pg. 2  *****************
*                                                          *
*     25-Jun-97 13:45 –RTD short                           *
*     16-Feb-97 10:15 –Coil open                           *
*     Empty                                                *
*     Empty                                                *
*     Empty                                                *
*     Empty                                                *
*     Empty                                                *
*     Empty                                                *
*     Empty                                                *
*     Empty                                                *
*                                                          *
*     Press any key to continue                            *
************************************************************
```

The following table details the available alarm parameters that are logged and their respective limits:

System alarm	Alarm cause
Low Power	Low input power below 8.75v
Low batt	Backup battery voltage below 8.5v
Coil short	Pickup coil resistance below 250 ohms
Coil open	Pickup coil resistance above 2500 ohms
RTD short	RTD probe resistance below 10 ohms (x10 for 1K RTD)
RTD open	RTD probe resistance above 200 ohms (x10 for 1K RTD)
Tloop Short	Temperature loop current is above 35mA.
Tloop open	Temperature loop current is below 4.0mA
Ploop Short	Pressure loop current is above 35mA.
Ploop open	Pressure loop current is below 4.0mA

8 - System activity: Permits review of the following operating and maintenance items:

```
************************************************
************** System activity **************
*                                              *
*     Turbine hrs       : 10.9                 *
*     System hours      : 25.6                 *
*     Power cycles      : 55                   *
*     Backup Batt sec   : 125                  *
*                                              *
*     Last System PM    : 25-Oct-00            *
*     Last Turbine PM   : 18-Sept-99           *
*                                              *
*                                              *
*     Press any key to continue                *
*                                              *
************************************************
```

- **Turbine hrs** – Total hours of operation, accumulates only during flow
- **System hours** – Total hours that the **T675** has been “On”
- **Power cycles** - Number of times the system has been turned “On”
- **Backup Batt sec** – Total seconds that the battery has been the **T675** operating power source
- **Last System PM** - The date when the **System maintenance just performed** last had a **<1>** entry
- **Last Turbine PM** – The date when the **Turbine maintenance just performed** last had a **<1>** entry

9 - Initialize system: This **PRIVILEGED** function allows resetting and initializing the following items:

1 – Grand totalizer: Resets the accumulative totalizer. **<1>** automatically resets and **<0>** retains present total.

Example: Reset the totalizer, **<1>**

```
************************************************************
**************** Reset Grand totalizer ****************
*                                                          *
*                                                          *
*      ARE YOU SURE, 1 = yes    0 = no ?                   *
*                                                          *
************************************************************
```

2 – Alarm log: Clears the stored **System alarm log**. **<1>** clears the log, **<0>** retains the log.

Example: Clear the alarm log, **<1>**

```
************************************************************
****************** Reset Alarm log  ********************
*                                                          *
*                                                          *
*      ARE YOU SURE, 1 = yes    0 = no ?                   *
*                                                          *
************************************************************
```

3 – System hrs: Resets the **T675** hours of operation and power cycles (On/Off). **<1>** resets the accumulated hours of operation to zero, **<0>** retains the values listed in **View System Activities, 675 settings, Page 1.**

Example: Reset the accumulated hours of operation, **<1>**

```
************************************************************
****************** Reset System hrs  *******************
*                                                          *
*                                                          *
*      ARE YOU SURE, 1 = yes    0 = no ?                   *
*                                                          *
************************************************************
```

4 – Backup battery timer: Resets the seconds of battery operation. **<1>** resets the accumulated seconds of battery operation to zero, **<0>** retains the battery seconds listed in **View System Activities, 675 settings, Page 1.**

Example: Reset battery timer, **<1>**

```
************************************************************
************** Reset Backup battery timer **************
*                                                          *
*                                                          *
*      ARE YOU SURE, 1 = yes    0 = no ?                   *
*                                                          *
************************************************************
```

0 – Go to page 2: Advances to **675 Settings, Page 2** menu.

3.1.3.2 675 SETTINGS MENU PAGE 2

```
************************************************
*********  675 settings,  Page 2 **********
*                                              *
*      1 – View Audit Trail                    *
*      2 – Spare                               *
*      3 – Spare                               *
*      4 – Spare                               *
*      5 – Spare                               *
*      7 – Spare                               *
*      7 – Spare                               *
*      8 – Spare                               *
*      9 – Spare                               *
*      0 – Return to page 1                    *
*                                              *
*      Enter setting (ESC to exit)?            *
*                                              *
************************************************
```

1 – <u>View Audit Trail:</u> Depress the corresponding category number in the left column, entry is automatic.

Note: The Audit trail can also be accessed during initial **Power On** by depressing and holding ← while momentarily depressing and releasing the **On/Off** pushbutton.

```
*************************************************************
********************  View audit trail  ********************
*                                                           *
*     1 – Calibration event log                             *
*     2 – Configuration event log                           *
*     3 – Event counters                                    *
*     4 – Print Audit Trail log                             *
*                                                           *
*     Enter setting  (ESC to exit)?                         *
*                                        *PRINT*            *
*************************************************************
```

1 –Calibration event log: Allows viewing the changes for the sealable calibration parameters in chronological order beginning with the most recent. The last 30 Kfactor or linearizer changes are recorded. When full, the audit trail shifts the oldest date and time stamp off screen. Changes made within the linearizer table or the linearizer status are recorded as a single entry to the audit trail.

```
*************************************************************
*************  Calibration event log Page 1 ************
*                                                           *
*     006 01Nov00 16:33 –New factor = 148.914               *
*     005 02Nov99 19:34 –New factor = 149.345               *
*     004 04May99 14:25 –Lin. OFF                           *
*     003 15Mar99 10:45 –Lin. table                         *
*     002 23Jan99 17:42 –Lin. ON                            *
*     001 15Oct98 14:52 –New factor = 150.115               *
*     Empty                                                 *
*     Empty                                                 *
*     Empty                                                 *
*     Empty                                                 *
*                                                           *
*     Press any key to continue                             *
*                                                           *
*************************************************************
```

Each page of the audit trail calibration event log contains 10 entries. The minimum log capacity is 30 events. The number of pages required to document this depends on the number of multiple changes that occur per event. Any unused entry is displayed as Empty. Multiple changes executed during the same **Adjustment mode** entry will be recorded as a single event and increment the calibration counter 1.

2 – Configuration event log: Allows viewing the changes for the sealable configuration parameters in chronological order beginning with the most recent. The last 40 product, digits to right of decimal or unit of measure changes, or temperature compensation enable/disable cycles are recorded. When full, the audit trail shifts the oldest date and time stamp off screen.

```
************************************************************
********** Configuration event log Page 1**********
*                                                          *
*     005 20Sept00 1951 –DP = 2                            *
*     004 09Jun00 20:34 –Temp comp On                      *
*     003 05Feb00 11:36 –Product change - Lox              *
*                        E.U. change – gal                 *
*     002 18Aug99 09:45 –E.U. change – lbs.                *
*     001 31Mar99 10:18 –Temp comp Off                     *
*     Empty                                                *
*     Empty                                                *
*     Empty                                                *
*     Empty                                                *
*                                                          *
*     Press any key to continue                            *
*                                                          *
************************************************************
```

Each page of the audit trail configuration event log contains 10 entries. The minimum log capacity is 40 events. The number of pages required to document this depends on the number of multiple changes that occur per event. Any unused entry is displayed as Empty. Multiple changes executed during the same **Adjustment mode** entry will be recorded as a single event and increment the configuration counter 1.

3 –Event counters: Indicates the total number of changes that have occurred since the initialization of the **T675** system. Both counters rollover after 999.

```
************************************************************
**************  Audit trail event counters  *************
*                                                          *
*     Calibration counter - 006                            *
*     Configuration counter - 005                          *
*                                                          *
*     Press any key to continue                            *
*                                                          *
************************************************************
```

Note: Entry into the **Adjustment mode** without making any changes does not increment the audit trail event counters. Multiple changes executed during the same **Adjustment mode** entry will be recorded as a single event.

4 – Print audit trail logs: Downloads the complete audit trail summary to a printer. The format is the same as the displayed summary. There are 2 methods: direct to a printer via the RS232 port or infrared transfer via the **SP825** Data Cube.

RS232 Transfer Method:

Example: Print audit trail **<4>** or **<Print>**. Dots will sequence across the screen left to right to confirm transfer activity

Infrared Transfer Method:

Example: Print audit trail, place **SP825** in alignment bracket and **<Print>**. A series of beeps will occur then dots sequence across the screen left to right. Completion of the data transfer is confirmed by a final loud elongated beep. Insert and leave the **SP825** Data Cube in the **SP824** Printer saddle and depress Red **SP824** Print pushbutton.

Typical printed audit trail format:

Audit Trail
T675 S/N56789
14:4514 Mar 01
Trailer 2222
Flowmeter 01234
Calibration Event Log
006 01Nov00 16:33 –New factor = 148.914
005 02Nov99 19:34 –New factor = 149.345
004 04May99 14:25 –Lin. OFF
003 15Mar99 10:45 –Lin. table
002 23Jan99 17:42 –Lin. ON
001 15Oct98 14:52 –New factor = 150.115

Configuration Event Log
005 20Sept00 1951 –DP = 2
004 09Jun00 20:34 –Temp comp On
003 05Feb00 11:36 –Product change - Lox
E.U. change – gal
002 18Aug99 09:45 –E.U. change – lbs.
001 31Mar99 10:18 –Temp comp Off

Event Counters
Calibration counter 006
Configuration counter 005

Note: Default settings for T675 S/N, Trailer and Flowmeter are 0000.

2 – 9 Spare: Available for future expansion, **0 – Return to page 1:** Returns to **675 Settings, Page1** menu.

3.1.4 <4> - I.R. SYSTEM TRANSFER: Activates the system's InfraRed communications port. Once activated, data and system programs can be transferred between the **T675** and an IBM-PC. **** I.R. communication activated **** is displayed and an audible tone occurs every second. Depressing the **RESET** key exits this function and reverts to the **675 Initialization options** screen.

3.1.5 <5> - HARDWARE TEST/CALIBRATE: This function is **PRIVILEGED** password protected. Factory calibration of the A/D converter channels, cold starting a virgin system and running system diagnostics are performed in this function. A complete instruction sequence is contained in the Technical Addendum page 1.

3.1.6 <6> - RESTART SYSTEM: Initiates system hardware reset. ***System Reset in Progress*** will be displayed prior to the automatic return of the system to the **Operating** mode.

3.1.7 <7> – I.R. ECHO/DEBUG: Factory technician's aid to confirm data transfer functions. ** Echo Test Activated ** will be displayed. Depressing the **Reset** key exits this function and reverts to the **675 Initialization options** screen.

4. FIELD OPERATION

4.1 INITIAL POWER ON:

Depress **Power** pushbutton, the green **Power** indicator illuminates, depress **Hold** softkey to review diagnostic data or **OK** softkey to advance to the **Operating** screen.
A quick diagnostic check is performed when the system is initially turned On. This Power On Self Test (POST) checks the system hardware, reports any failure and displays the current software version and the product temperature curves.

P.O.S.T. display:
LCD Firmware RLC153-V1.01 Tested OK
675 Firmware RLC152-V1.05 Tested OK
LCD runtime 675LRT-V1.00
675 Executive 675TC01-VO1.05
Product file: OPT-6A.E85

Once the **Operating** screen is displayed the red **System Alarm** indicator flashes. Unless the Maintenance icon (oil can) is displayed in the lower right corner there isn't a hardware problem but rather a conditions problem which at this point of operation is normal. The Disabled Pump icon is present and the TEMP and RATE designators should be flashing above their respective bargraphs. The delivery totalizer will display the total accumulated since the last **Reset** activity. Depress the **Alarm** softkey to access the **Alarm** screen, "Flowrate out of range" and "Temperature out of range" will be displayed.

4.2 COOLDOWN PROCEDURE:

In accordance with code for cryogenic liquid measurement devices, cooldown is required to minimize flashing and maintain a liquid state at the turbine. A benefit of this requirement is the extended service life of the pump seal. Open the appropriate valves to begin the cooldown process. As the liquid circulates and the temperature probe achieves a cryogenic temperature within the product range, the TEMP designator discontinues flashing, the temperature bargraph indicates temperature as a function of range and the timer below the Pump Disabled icon begins counting down from the preset time interval. Once the timer elapses the Pump Disabled icon disappears and the delivery system is enabled.

4.3 RESETTING THE TOTALIZER:

Prior to engaging the pump and transferring liquid through the turbine flowmeter depress the **RESET** softkey to clear the delivery totalizer. It is important to perform this function prior to delivery because the Reset function is disabled while flow is present in the turbine. The delivery system is now ready to transfer liquid at a flowrate consistent with the equipment's design. The RATE designator discontinues flashing and the flowrate bargraph indicates flow as a function of range.

4.4 DELIVERY VARIABLES:

All process variables are real time therefore, the delivery total is displayed in real time, no waiting for an updated total. The **Operating** screen displays 9 delivery variables and the **Detail** screen 8 additional. Remember, to access the **Detail** screen depress and hold the **Detail** softkey. Releasing this softkey returns the display to the **Operating** screen in 5 seconds while depressing the **OK** softkey immediately returns to the **Operating** screen.

Operating Screen	Detail Screen
Engineering Units	Input Voltage
Delivery Total	Battery Voltage
Accumulated Total	Pickup Coil Resistance
Kfactor	Signal Input frequency
Delivery Flowrate	RTD temperature probe resistance
Delivery Product	Temperature Correction Factor
Product Temperature	Product Density
Date	Product Temperature Range
Time	

Only when the delivery is completed, a no flow condition, is delivery information available via the I.R. port or RS232 connector to print a ticket. Depress **Print** softkey.

4.5 FIELD CALIBRATION:

Field calibration to adjust a Kfactor that shifted due to the influences of the installation is only practical when the **T675** is programmed to use the Average Kfactor for calculating the delivery total.

4.5.1 Methods: There are numerous calibration procedures that are widely practiced. This discussion will be confined to 2; a calibration prover and the weigh scale. The meteorologically preferred method is the prover due to superior accuracy. The scale offers an approximation and should be conducted with large volumes to minimize the error introduced by the magnitude of the scale graduations. Another consideration when using a scale is to place the receiving vessel on the scale. For either method the **T675** should be placed in the **Prove** mode. Depress the **Setup** key, enter your password when prompted and depress **Enter**. The **Prove** mode format is a calibration convenience allowing repeated access to adjust the Kfactor and overrides the cooldown timer and flow inhibit of the reset and Kfactor function.

4.5.2 Calculating a new Kfactor: Calculating the new Kfactor is the same regardless of the calibration method employed. Although the SP1200 Flow Calibration Prover calculates the new Kfactor not all competitive systems offer this convenience. A simple formula calculates the new Kfactor. Note: Always insure that the engineering units of both the **T675** and the calibration method are the same by using the appropriate liquid equivalencies.

$$\text{New Kfactor} = \frac{\text{T675 total x present Kfactor}}{\text{Calibration total}}$$

Example: Calibration total = 50,000 lbs., T675 total = 45,000 lbs., present Kfactor = 150

$$\text{New Kfactor} = \frac{\text{T675 total (}\mathbf{45{,}000}\text{) x present Kfactor (}\mathbf{150}\text{)}}{\text{Calibration total (}\mathbf{50{,}000}\text{)}}$$

$$= 135$$

Example: Calibration total = 50,000 lbs. LOX, T675 total = 3873 gals, present Kfactor = 150

Convert 50,000 lbs. LOX to gallons:

$$\frac{50{,}000}{11.62} = 4303 \text{ gallons}$$

$$\text{New Kfactor} = \frac{\text{T675 total (}\mathbf{3873}\text{)x present Kfactor (}\mathbf{150}\text{)}}{\text{Calibration total (}\mathbf{4303}\text{)}}$$

$$= 135.01$$

4.5.3 Installing a new Kfactor: Depress **Setup** and if not already in **Prove** mode enter your password. Select Avg. factor by depressing 1.

Example: A new Kfactor is calculated to be 135.01.

<135.01> <ENTER>

Depress **<RESET>** to return to the **Prover** screen

To exit the **Prove** mode depress and hold the **<ON/OFF>** pushbutton until the **T675** is Off, then turn the unit back On.

5. TECHNICAL INFORMATION

5.1 SPECIFICATIONS:

5.1.1 HARDWARE:

INPUT AMPLIFIER:	Frequency range: 0 Hz to 2,500 Hz
Sensitivity	15millivolts RMS @ 10Hz (min) 100millivolts RMS @ 500Hz (min) 400millivolts RMS @ 2,500Hz (min)
Impedance	Approximately 10kΩ
Noise immunity	High frequency roll-off, fco @ 2,500Hz
P/U coil failure detection	Internal circuit provides 500µA excitation to read coil resistance, 3250Ω full scale
SENSOR INPUTS:	One RTD and one 4-20mA current loop or two 4-20mA current loops
RTD Sensor	Platinum RTD temperature probe, 100Ω or 1000Ω, 2 or 4 wire 8mA constant current sensor excitation, 200Ω full scale, ratio-metric & chopper stabilized to eliminate drift
Current Loop Sensor	Two independent current limited channels Loop excitation boosted to 16-17v regardless of power supply
Power Sensors	Constant monitoring of main input power, backup battery and loop voltage
OUTPUTS:	
Pump Control	One general purpose Form-C 2A relay
Alarm	One general purpose Form-C 2A relay
Communications	One each RS232 and Infrared ports
LED INDICATORS:	Front panel Power, Signal and Alarm
KEYPAD:	16 button keypad, 4 “softkeys”, ON/OFF button Sealed, oil resistant, tactile feedback, 1M + operations (mcbf)
DISPLAY:	240x128 full graphic, CCFL backlight sunlight viewable Automatic LCD bias control, Self-regulating non-sweating temperature activated heater that is operational whenever power is available (even when totalizer is OFF) Max warm-up time 0sec @0°C. (heater not previously running) Max warm-up time 20sec @-20°C. (heater not previously running)
POWER:	
External	9 to 26 VDC, polarity insensitive .6A LCD heater OFF, 1.6A max with LCD heater ON Built in transient protection with internal self-resetting fuse
Internal	Rechargeable Lithium power pack, capable of repeatedly operating system for 10 sec with loss of main power. Typical service life: 2-4 years
ENVIRONMENTAL:	Operating temperature –40°C to +50°C Relative humidity 5 - 95% (non-condensing) Sealed enclosure. Shock test vibration rated to xx G's
PHYSICAL:	Size: 9.75"L x 7.50"H x 3.75"W Weight:3.5lbs

INPUTS/OUTPUTS:

Inputs	Power Signal Temperature Pressure
Outputs	Pump control 4-20mA Rate indication RS-232

SYSTEM MISCELLANEOUS: Dual 8 MHz CPU's, 1M Flash/64k RAM memory, watchdog timer, 8 channel 12 bit hi-speed ADC, Real time clock with daylight savings feature
Chopper stabilized amplifiers, Buffered serial port, FIFO CPU communication

5.1.2 SOFTWARE:

System Integrity: Built-in diagnostics for all hardware
Power-on self test
Constant system monitoring of all inputs and sensors

Sensor Resolution: RTD - .04Ω (approx.)
Current Loop - .006mA (approx.)

Math Processing: Internal floating point package, 15 digits of precision
All calculations carried out in FP for max precision.

Overall Error: .0001% max (excluding temperature/pressure probe uncertainty)

Power Management: CPU extinguishes backlight when operating on internal battery
Automatic shutdown after 10 second power loss

5.2 SPARE PARTS:

The **T675** Totalizer is a factory sealed unit that does not have any field replaceable components. The recommended spare parts inventory requires minimal investment. An assortment of miscellaneous hardware items and cable assemblies with part numbers are listed below for your convenience.

QTY	Description	Part Number
2	Base Swivel Knob with 3/8-16 stud	61125K36
5	Knob bushing	90130A031
5	Knob serrated locking metal washer	93501A031
1	Signal cable	S-2F-WS4.5T8/5653-26
1	Temperature probe cable	R-3F-WS4.6T8-26
1	Power cable	P-SP-WK4.2T8-26
1	Pressure/4-20 cable	I-SP-WWAKW4.5T8-26
1	Pump cutout cable	PCO-SP-WK4.6T8-26
1	RS232 communication cable	RS232-WASW4.5T8-26

SPONSLER CO., INC.
2363 SANDIFER BLVD.
WESTMINSTER, SC 29693
USA

WORK ORDER #:LUCITE
CALIBRATION #: 2
FLUID: WATER

TEST STAND NO.: 3
CALIBRATED BY: SWR
DATE: 20-NOV-97

SERIAL NO.: KENDEMO
HOUSING MATERIAL: LUCITE
ROTOR MATERIAL: NICKEL
BEARINGS: CRYO
COIL NO.:PC13-74G 1EA.

MODEL NO.:SP2-CB-NL-B-

PT	WEIGHT LBS.	VOL.GALLONS SP.GR.1.000	(TRUE) SP.GR.	TEMP. DEG.FAR	TRUE VOL GALLONS	RATE GPM	TIME SECONDS	TOTAL PULSES	APPROX. FREQ.HZ	"K" GAL
1	200.0	23.9926	0.9986	67.0	24.0328	227.0457	6.351	3576	563.061	148.80
2			0.9984	67.4	24.0309	202.2805	7.128	3585	502.946	148.18
3			0.9985	65.6	24.0286	179.0509	8.052	3590	445.852	149.41
4			0.9985	65.7	24.0289	155.3929	9.278	3587	386.613	149.28
5			0.9985	65.7	24.0291	132.5622	10.876	3574	328.613	148.74
6			0.9985	65.9	24.0294	108.2488	13.319	3574	268.338	148.73
7			0.9985	65.9	24.0296	85.8149	16.801	3568	212.368	148.48
8			0.9984	66.1	24.0300	61.3401	23.505	3568	152.563	149.23
9			0.9984	66.1	24.0302	38.8534	37.109	3567	96.122	148.44
10			0.9984	66.2	24.0304	15.2147	94.765	3577	37.746	148.85

MEAN TOTAL PULSES (PER WEIGHT USED): 3578.400
SENSING ELEMENT CONSTANT (MEAN "K"): 148.914

REMARKS:

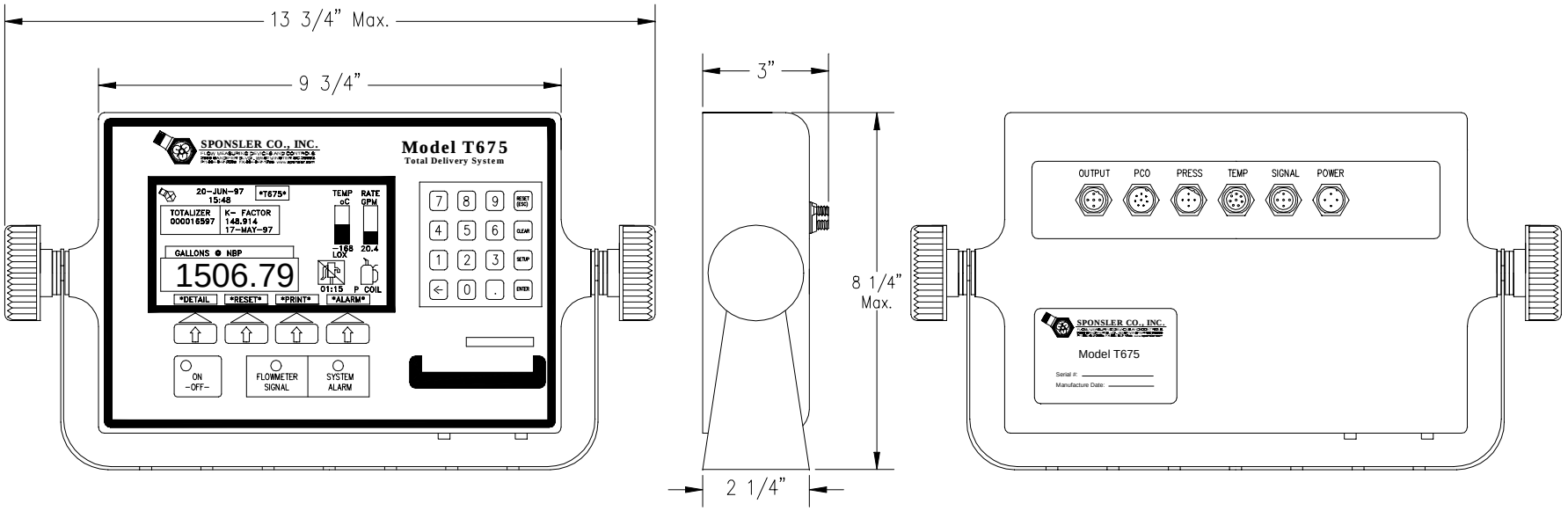
SPONSLER COMPANY INC. HEREBY CERTIFIES THAT THE ABOVE MENTIONED ITEM HAS BEEN CALIBRATED WITH EQUIPMENT WHICH HAS AN ACCURACY OF +/- 0.15% AND IS TRACEABLE TO THE NATIONAL INSTITUTE OF STANDARDS AND TECH. PER MIL-STD-45662A THROUGH TEST NUMBERS SC721201-22,30,33,34,37-39M;SC721122-17M;SC781120-4M;SC80606171M; SC730808-7M;SC720107-25M;SC721101-13M,31M,54M,57M;SC730322-3M; AND SC730122-14M,18M. ALSO THROUGH NIST CERTIFICATE NUMBERS:731/243669;807675;86707942;711/254789;254366,67;251971;253652;AND WWV. SPECIFIC GRAVITY REFERENCED AT 39.2 DEGREES FAHRENHEIT.
* RUNS NOT INCLUDED IN MEAN PULSES OR SENSING ELEMENT CONSTANT.

CALIBRATED BY: _____

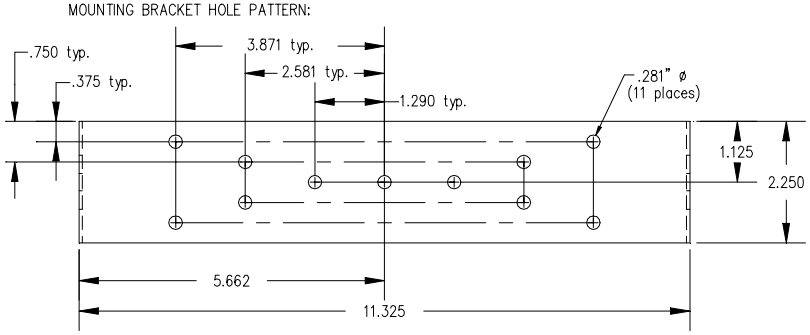
CERTIFIED BY: CRL
DATE: 20-NOV-97

SCI EQUIPMENT #: IE003
LAST CALIBRATION: 10/97
NEXT CALIBRATION: 4/98

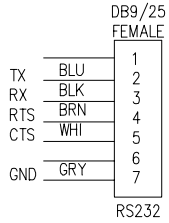
5.4.1 FRONT, REAR, SIDE VIEW AND MOUNTING BRACKET DIMENSIONS:



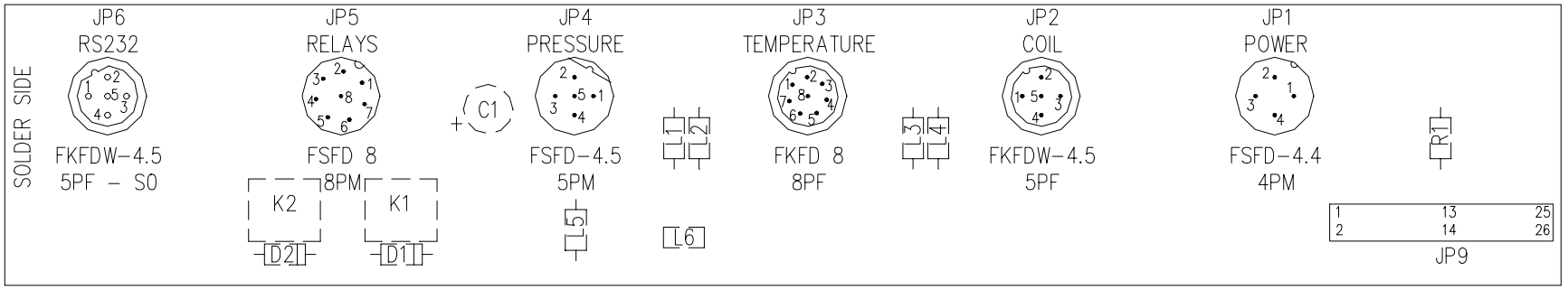
MOUNTING BRACKET HOLE PATTERN:



5.4.2 CABLE AND CONNECTOR ASSIGNMENTS:



PIN	WASW 4.5T-8	WKC6T-8	WWAKW 4.5T-8	WSC6T-8	WS 4.5T-8/S653	WK 4.2T-8	PIN
1	BRN-CTS	BRN-PUMP N/C	BRN-PCL + IN	BRN-RTD S - IN	BRN-COIL +	BRN-L1	1
2	WHI-RTS	WHI-PUMP C	WHI-PCL - IN	WHI-RTD EXC - OUT	WHI-COIL -	-----	2
3	BLU-RX	BLU-PUMP N/O	BLU-GND	BLU-RTD EXC + OUT	BLU-VCC	BLU-L2	3
4	BLK-TX	BLK-ALARM N/C	BLK-R4-20 - OUT	BLK-RTD S + IN	-----	-----	4
5	GRY-GND	GRY-ALARM C	GRY-R4-20 + OUT	GRY-TCL - IN	GRY-GND		5
6		PNK-ALARM N/O		PNK-TCL + IN			6
7		-----		-----	VCC → IF R1 INSTALLED		7
8		-----		-----	GND → IF JUMPER INSTALLED		8



5.4.3 DELIVERY COMPONENTS INTERCONNECT WIRING: