Smith Meter Inc
An FMC EnergySystems business

Prover Computers
ProvMate ™
Installation/Operation

Bulletin MN06099

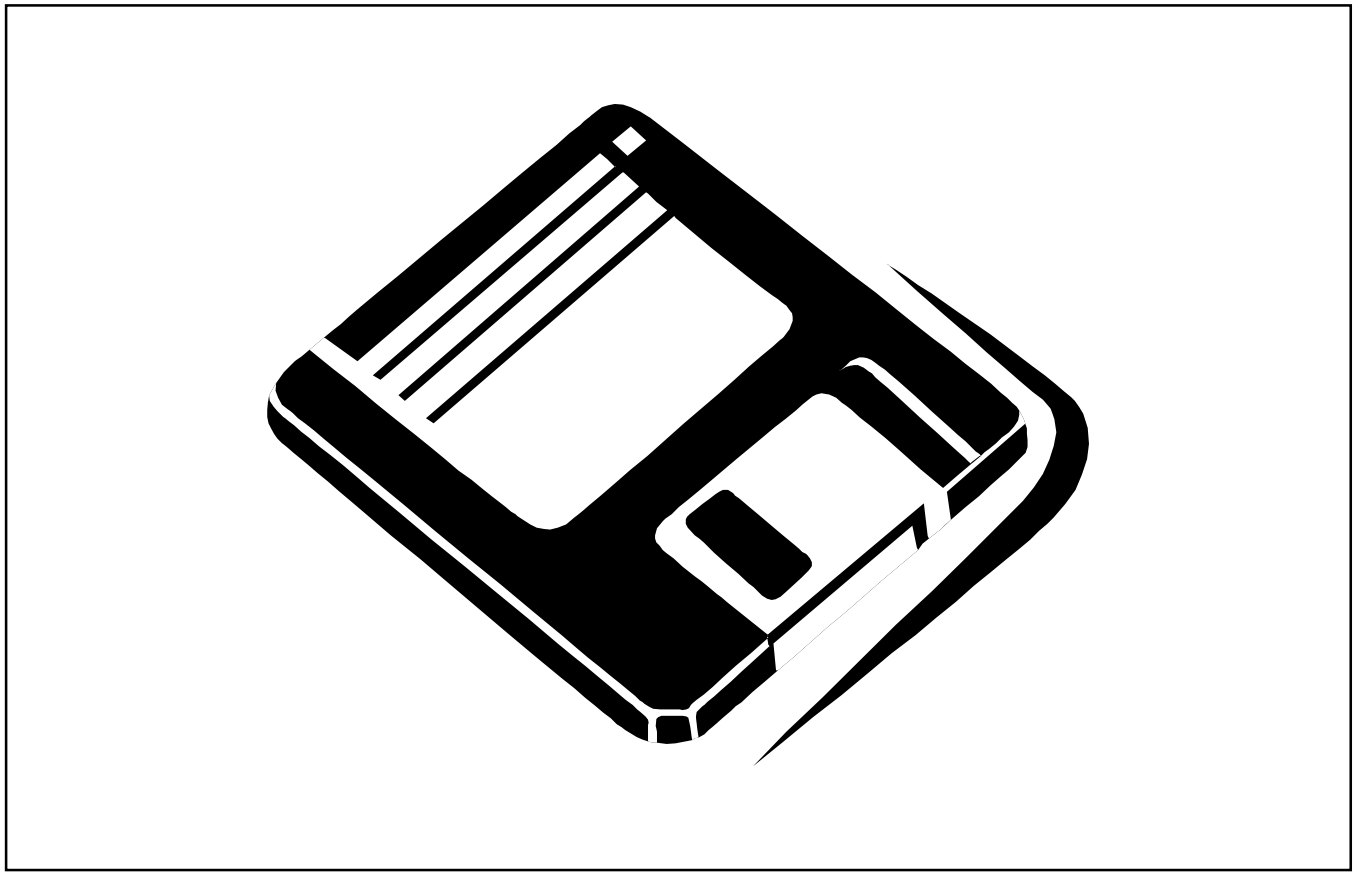

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Table of Contents

Section I - Introduction 1
- Product Description 1
- System Requirements 1
  - ProvMate Operation 1
- Program Input 2
  - Edit Fields 2
  - Esc 2
  - Enter 2
  - Up Arrow 2
  - Down Arrow 2
  - Page Down 2
  - Page Up 3
  - Left Arrow 3
  - Right Arrow 3
  - End 3
  - Home 3
  - Delete 3
  - Insert 3
  - F10 Function Key 3
  - Mouse 3
  - Selection Boxes 3

Section II - Installation 4
- Installing the Software 4
- Using UPDATE 4

Section III - The ProvMate Menus 5
- The ProvMate Menus 5
- File Menu 5
  - Open existing meter run file 5
  - Add last run to meter file 5
  - Save last run separately 5
  - Save current meter description 6
  - Load meter description 6
  - Quit 6
- Reports Menu 6
  - Print last run 6
  - View last run 6
  - Meter Info 6
- Mode Menu 6
  - Simulate 6
- Setup Menu 7
  - Prover 7
  - Communications port 7
  - Colors 7
  - Units 7
  - Send output to 8
  - Output format 8
  - Find SVP port 8
  - Example of CONSEC Prover Report in 40-Column Format 9
  - Example of CONSEC Prover Report in 80-Column Format 11
  - Example of GROUP Prover Report in 40-Column Format 12
  - Example of GROUP Prover Report in 80-Column Format 14

Table of Contents

Section IV - Modes 15
CONSEC and CONRAC Prompts 15
GROUPS 20
Computer Screen Prompts 20
MAINT 24
OBV = OPEN BYPASS VALVE 25
CBV = CLOSE BYPASS VALVE 25
SPH = SEND PISTON HOME 25
LP! = LAUNCH PISTON 25
BS? = BYPASS VALVE STATUS? 26
PS? = PISTON STATUS? 26
PP? = PROVER PROGRESS? 26
T1? = T1? 26
TS? = T2? 26
MP? = RAW PULSE COUNT? 26
N'? = GET COUNTS 26
QUICK 27
WATERDRAW 27
Section V - Establishing EIA-232 Communications 31
Establishing EIA-232 Communications 31
Steps of ProvMate - SVP Communications 31
Section VI - ProvMate Error Messages 32
ProvMate Error Messages 32
Default file needs repaired! 32
Keystroke does not do anything. 32
No last run file exists. 32
This is the last run in file. 32
This file cannot be appended. 32
No serial ports are installed on this machine!!! 32
Utility has been cancelled without success. 32
The SVP is not responding on any port. 32
Last run is too large to fully display! 32
Check cables. Prover is not responding. 32
User interrupted communications. 32
Prover Temperature too high! 32
Printer is off or disconnected. 32
ProvMate ERROR TRAP 32
The filename: XXXXXXXX.XXX cannot be found. 32
The SVP has responded on communications port #. 32
SVP Diagnostic Errors 33
Troubleshooting Operational Inter-Lock Alarm Codes 33
E-01 Diagnostic Failure 33
E-02 Bypass Valve Failed to Open 33
E-03 Piston Failed to Return 33
E-04 Bypass Valve Failed to Seal 34
E-05 Piston Seal Circuit Failure 34
E-06 First Detect Timeout 34
E-07 Second Detect Timeout 35
E-08 Piston Seal Flag Stuck 35
E-09 Piston Seal Failure 35
E-10 Counter Circuit Failure 35
E-11 Pulse/Rev Input Failure 36
E-12 Opto Power Failure 36
E-13 Meter Pulse Failure 36

Product Description

The ***Smith ProvMate*** is a software tool that simplifies setup and maintenance of the ***Smith Small Volume Provers***. It is designed to operate on MS-DOS or PC-DOS compatible computers.

System Requirements

The ProvMate will operate on MS-DOS or PC-DOS compatible computers (3.1 or higher) that have the following minimum facilities:

- 512K memory
- A hard disk is recommended
- CGA video is the minimum video standard supported.

ProvMate will also run in a DOS window under Windows 3.1 or Windows 95, and will operate with a mouse if one is available.

ProvMate supports all seven PSION proving modules and utilities, including CONSEC, CONRACK, GROUPS, MAINT, QUICK, WATERDRAW, and MANCONS. ProvMate also has a SIMULATE program. In sequence of operation, user prompts and printed reports, these modules and utilities operate identically or similar to their PSION counterparts.

This version generates reports identical to the PSION software (standard format) as well as an expanded format. Sample reports are included in this manual.

In this Overview, the term “meter run” is defined as an entire proving session on a meter that could consist of several (up to 50) individual proving trips.

As the proving run progresses, a disk image of the printed reports is created in a file. The file is entitled CRNTPRVE.CHN. This is replaced each time a meter run is made. It always contains the last actual meter run. The information in this file may be converted to a user-named file in two possible ways.

1. The disk image of the printed report may be saved as a SINGLE RUN in a file. This file holds ONLY a single meter run. CRNTPRVE.CHN is saved as a user-named file.
2. The disk image of the printed report is appended to a file containing any number of proving runs. Typically, this should be used to track the history of an individual metering unit or perhaps an entire day’s proving work.

ProvMate can maintain Meter Description Files. These files contain information specific to a given meter. The user may store meter information for use in future meter proving runs.

Cable connections from the computer to the SVP will depend on the type of connector used on the computer, it will either be a 9 pin (DB-9) or a 25 pin (DB-25) connector. The connector on the SVP is a DB-25-F, connections are as follows:

Computer	SVP
DB - 9	DB - 25 - F
Pin 5 - Ground	Pin 7 - Ground
Pin 3 - Receive	Pin 3 - Transmit
Pin 2 - Transmit	Pin 2 - Receive

Computer	SVP
DB - 25	DB - 25 - F
Pin 7 - Ground	Pin 7 - Ground
Pin 2 - Receive	Pin 3 - Transmit
Pin 3 - Transmit	Pin 2 - Receive

ProvMate Operation

ProvMate is a DOS program that is initiated by logging on to the drive to which ProvMate was installed, then typing “SVP” and “Enter” at the DOS prompt. In the Windows environment, an icon can be created to launch the program. Refer to Windows documentation for instructions on setting up icons.

After initial bootup, the system date is displayed and the user is prompted to confirm or change the date.

The system clock date is displayed and the user is asked to confirm it. If the date is correct, press “Enter.” If it needs to be changed, select “DATE needs CHANGED” by pressing the UP ARROW and highlighting the choice. Confirm the choice with “Enter.”

To change the ProvMate effective date:

1. Enter MONTH:

   06 “Enter”

A two-character response of 01 to 12 is accepted here. Any improper response will be met with a beep and endless loop until a proper response is given.

2. Enter DAY:

   27 “Enter”

A two-character response of 01 to 31 is accepted here. Any improper response will be met with a beep and endless loop until a proper response is given.

3. Enter YEAR:

   97 “Enter”

A two-character response is accepted here. Any improper response will be met with a beep and an endless loop until a proper response is given.

The altered date is displayed and the user is asked to confirm that it has been properly entered. If the date is correct, the user need only press “Enter.” If it needs to be changed, the user selects “DATE needs CHANGED.” The UP ARROW highlights the choice. A confirmation is done with “Enter.”

Steps 1 through 3 above are repeated. This date will later be compared to the data base date and issue warnings from the data base if the dates do not match.

The Main Menu will be displayed in colors chosen by the user. The background (desktop) pattern may also be selected by the user. These selections are made in the Setup Menu by choosing “Colors.”

The main menu is generated across the top of the screen. The four menu selections are as follows: File, Reports, Mode, and Setup. These selections are discussed in detail in later sections of this manual.

The version of ProvMate is displayed in the upper right-hand corner of the screen.

Program Input

There are two main user input configurations.

The first type is a prompt requested by a proving module or utility. This consists of a single user input item and is usually a prompt requesting information to continue. This type of input is found on the last line of the display. An example of this is the number of counts in the MANCONS module.

The other consists of a group of inputs presented on the screen at one time consisting of edit fields and selection boxes. A single line of context-sensitive help is displayed at the bottom of the screen. Selection box and edit field operation is discussed below.

Edit Fields

In most cases, a single line of context-sensitive HELP is displayed at the bottom of the display screen.

Esc

The “Esc” key cancels the entire input screen and moves to the next screen.

Enter

The “Enter” key moves to the next field or screen.

Up Arrow

The Up Arrow moves to the previous (or first) field when in a screen with a group of input fields. The Up Arrow moves to the next screen when in a single input field screen.

Down Arrow

The Down Arrow moves to the next (or last) field when in a screen with a group of input fields. The Down Arrow moves to the next screen when in a single input field screen.

Page Down

Page Down moves to the last field when in a screen with a group of input fields. It does nothing in a single input screen.

Page Up

Page Up moves to the beginning of the input screen when in a screen with a group of input fields. It does nothing in a single input screen.

Left Arrow

The Left Arrow moves the cursor in the field to the LEFT all the way to the beginning of the current field when in a screen with a group of input fields. The Left Arrow moves to the next screen if in a single input screen.

Right Arrow

The Right Arrow moves the cursor in the field to the RIGHT all the way to the end of the current field when in a screen with a group of input fields. The Right Arrow moves to the next screen if in a single input screen.

End

The “End” key moves the cursor to the END of the current field. It does nothing in a single input screen.

Home

The “Home” key moves the cursor to the beginning of the current field. It does nothing in a single input screen.

Delete

The “Delete” key erases the entire field and places the cursor at the beginning of the current field. It does nothing in a single input screen.

Insert

The “Insert” key deletes to the end of the field starting at the current cursor position.

F10 Function Key

F10 restores the field to the original condition upon entry into the current field (Undo).

Mouse

A mouse click in an inactive field activates that field and deactivates the prior field.

A mouse click in an active field places the cursor at the character position of the click.

A mouse click outside the input window is the same as pressing the “Esc” key.

Selection Boxes

The selection box opens with one selection preselected, usually a default or a previous selection.

Installing the Software

To install ProvMate from DOS, insert the Master Disk in a drive and log on to that drive. From Windows 3.1 or Windows 95, open the DOS window and proceed as described in the DOS instructions.

Example

First, type “A:” then press ”Enter.”

The next step is to type “install,” then press “Enter.”

Note*: An Installer/updater program has been developed and included on the disk.*

The purpose of this program is twofold. First, it provides the user with a convenient way to install the many ProvMate files. Second, it provides Smith with a way to conveniently update existing users to the most current files.

Once the “install” program has been activated, an initial Welcome screen is generated. The user presses any key (except ESC) to continue with the installation. As noted on the screen, installation may be aborted by pressing the ESC key.

The target drive designation will be chosen next. A general information screen appears with an explanation of how to choose the drive. The C: drive is the default. Drives A through G are available from a selection box. To obtain the drive selection box, press any key *except* “Enter.”

To make a selection:

UP ARROW

moves the selection up, if possible. If not possible, it moves the selection to the last button.

DOWN ARROW

moves the selection down, if possible. If not possible, it moves it to the first position in the list.

ENTER

confirms the choice and closes the selection box.

MOUSE

A mouse click makes the selection and closes the selection box in one operation.

If the mouse button is HELD and moved OUTSIDE the selection box, the selection is not made and the initial selection returns. The selection box is not closed, thereby allowing the user a last minute change of mind.

A mouse click outside the selection box is equivalent to hitting the ESC key.

If the mouse click falls in a prompt area, that area will become active.

A screen appears with instructions for the naming of the target directory.

The next prompt allows the user to agree with the name of the directory (which by default is known as PROVER, but can be changed).

A status screen appears, detailing the operation of the installer. A bar graph gives a visual indication of the amount of installation completed. After installation an informational screen appears, explaining that installation was successful and pointing out the directory name that was created.

If reinstallation is attempted, the installer will alert the user that key files will be replaced. The user is given the opportunity to cancel any file rewrites that are site specific.

Using UPDATE

The user inserts the Master Disk in a drive and logs on to that drive.

Example

First, type “A:” then press ”Enter.”

The next step is to type “update,” then press “Enter.”

Screens similar to the INSTALL procedure appear. The updater will alert the user that key files will be replaced and the user is given the opportunity to cancel any file rewrites that are site specific.

At the conclusion of the update procedure, an informational screen details what version was replaced with the current version.

The ProvMate Menus

The menu bar that appears across the top of the screen may be manipulated by the user in a variety of ways.

The LEFT AND RIGHT ARROW keys will choose a main menu selection. The chosen selection is highlighted from the rest. The double arrow (<>) at the end of the menu bar is a “parking place.”

The UP AND DOWN ARROWS select items from within a main menu grouping.

Beside each menu item, a single key equivalent or shortcut is displayed. As the user becomes familiar with the program, these single keystrokes become more intuitive. A mouse, if available, may be used to choose a main menu selection. Then an item may be selected from the menu. A simple mouse click is all that is needed.

The FUNCTION KEYS F1 through F4 will pull down the designated menu.

Each menu item is discussed below.

File Menu

Open existing meter run file

This selection allows the user to specify a previously created meter run file. The user must specify a file and extension. The extension .MTR is automatically appended to a filename in ”add last run to meter file” (see below) and the extension .MTO is automatically appended to a file saved as “save last run separately” (see below).

If the named file is not found, a DIRECTORY is automatically displayed. This directory shows all files with the file extensions .MTR and .MTO. If the directory contains more files than can fit on a single screen (in wide format), a full screen is displayed at a time before returning to the FILE prompt.

ProvMate offers full access to all DOS commands through the “open existing meter run file” menu item. To shell to DOS, simply make sure the first character typed at the prompt is a - (minus sign). For example, to get a full directory listing of the current directory, type the following:

```
Filename:-DIR *.*
```

This will shell the DIR command to DOS, which will print the directory on screen (wide format if the /W switch is used) and return to ProvMate. Any DOS command or executable file may be accessed in this way.

Any DOS command is valid. Other examples are as follows:

```
Filename:-CD .
Filename:-CD ..
Filename:-CD PROVER
```

Add last run to meter file

A filename is requested from the user. The name may be comprised of any path, filename, and extension. The extension .MTR is automatically supplied if one is not specified.

This selection appends the last run to an existing meter file (or creates one if the named file does not exist).

Save last run separately

This selection prompts the user for a filename. Any path, filename and extension may be specified. If a file extension is not chosen, the extension .MTO is automatically supplied.

A file overwrite notification is given, if appropriate. The user may choose to replace the file, select a new name, or cancel the operation.

This option allows the saving of the last run to any file in any directory.

Save current meter description

The meter specific information found in the last or current meter run will be stored in a file named by the user. If no extension is given, .MDF is automatically used. This allows a library of meter descriptions to be built over time and later used to speed data entry.

A file overwrite notification is given, if appropriate.

Load meter description

The user may specify a meter description filename. If no extension is given, .MDF is automatically used. If the file cannot be found, the current DIRECTORY of all .MDF files is displayed.

Meter specific information in the next proving run will be that from the meter description file.

Quit

After confirmation, ProvMate saves all relevant user information to a disk file entitled SVPPREFS.CHN. The program halts and returns control to DOS.

Reports Menu

Print last run

Sends the last proving run (the one contained in the disk file CRNTPRVE.CHN) to the printer. The format of this report is defined in the Setup Menu under “Output format.”

View last run

Allows on screen viewing of the meter run in the disk file named CRNTPRVE.CHN. The format of this report is defined in the Setup Menu under “Output format.”

Meter Info

Displays current meter information.

Mode Menu

This menu offers a selection of the various proving modes and utilities. They are identical to the PSION. The options are as follows:

- Consec - Consecutive Proving
- Conrac - High Speed Consecutive Proving
- Groups - Group Proving
- Maint - Maintenance Mode
- Quick - Prover Exerciser
- Waterdraw - Calibrate Prover
- Mancons - Proving Calculator used with any type of prover

For more information about modes, refer to Section IV of this manual.

Simulate

ProvMate has a simulation facility for the proving modes of CONSEC, CONRACK, and GROUPS. The simulation mode exercises the same functions as a real linkup with an SVP. SVP error codes may be generated during a simulated prove by Function Keys 1 through 12. The error generated is equivalent to the function key number (F4, for example, generates an error code of E04, or “BYPASS VALVE FAILED TO SEAL”).

The SVP command responses are simulated. The numerical values of the responses for T1, flow rate, and pulses are derived as follows.

Flow rate is based on the input “FLOW RATE/HR:”. If a zero or “Enter” is entered in response, then 10000 is used.

The meter pulse factor is entered at the prompt “K-FACTOR/Unit VOL:”. If no response is given (0, “Enter”) then the “Nominal Pulses per Totalizer Unit” value is used.

The number of pulses for each run is a randomized number based on the product of Prover Volume and K-FACTOR/Unit VOL:”.

After entering the chosen proving mode, all prompts and calculations are identical to an actual run.

Setup Menu

Prover

This selection sets the prover volume, etc. The exact prompts are determined by the selected units as indicated below.

Prover Inside Diameter in INCHES:
Prover Wall Thickness in INCHES:
Prover Volume:

An example of the required information is shown on the last line of the display.

Communications port

This menu allows the user to select the comm port to which the SVP is to be connected, and selects the operating parameters for the comm port.

Serial port used:	port 1	
	port 2	
Baud rate:	110	
	150	
	300	
	600	
	1200	(default)
	2400	
	4800	
	9600	
Parity	none	(default)
	odd	
	even	
Stop bits:	one	
	two	
Word length:	7 bits	
	8 bits	(default)
Buffer length:	0	(default)
	256	
	512	
	1024	
Retry rate:	100	
	500	
	1000	
	5000	(default)
	10000	

The “retry rate” controls the number of times ProvMate attempts communications with the SVP before it declares a broken cable. A communications check is done before each command is sent to the SVP. Because of the mismatched response times of the SVP and host system, a number of tries must be made.

Colors

This menu allows the user to choose the colors of the ProvMate display. The colors are selected using the Up, Down, Left, and Right arrows.

The default color selections are as follows:

Primary text - light green
Primary background - gray
Highlighted text - yellow
Highlighted background - brown
Desktop - second selection from the right (no pattern)

Certain color combinations may cause the test display (at the bottom of the color selection screen) to flash. If the test display is flashing, the actual display will flash, as well. Since a flashing display is virtually illegible, it is necessary to correct this condition before attempting the operate the ProvMate. Simply revert to the default color selections, then choose new combinations. ESC exits the screen and returns to the main screen.

Units

This menu allows the user to select English or Metric units.

If English is selected, all prompts and outputs are in inches, PSI, and Fahrenheit. Metric causes the prompts to be in millimeters, KG/M and Centigrade. In both cases, volume is in engineering units.

The next selection is for reference temperature.

Send output to...

This setup option allows the user to select whether the prove run is printed concurrent to the run or is only stored to disk and displayed on screen.

If either of the Printer Options are selected, ProvMate checks for proper printer operation before each meter run and requests user confirmation.

Output format

This setup option allows the user to specify the standard 40-column format or the expanded 80-column format of the report.

Find SVP port

This utility is provided for ease of setup of the system. It performs several functions as detailed below. The SVP must be connected and powered up to operate this utility.

“Find SVP port” checks for the number of active serial ports and displays the number of ports on the screen.

This option also issues a command to the SVP and waits for a response at each port. It does this 1000 times, thereby allowing time to connect and check cables.

If a port is found, the ProvMate sets the default specs to SVP defaults and sets the active port.

Note: *Any other connected serial devices (mouse, trackball, etc.) will probably not operate properly after using this function. A system reboot will be necessary.*

Example of CONSEC Prover Report in 40-Column Format

```
consec



DATE:11/25/97
ProvMate REV:W.5

CUSTOMER:SMITH METER INC
LOCATION:ERIE PA
METER    :TEST 1

OPENING
METER READING:14526

PRODUCT:KERO
STANDARD GRAVITY: 39.6

REF TEMP       : 60 F
PROVER I.D.    :12.75
WALL THICKNESS:0.625
NOM.PROVER VOL:14.9449

FLOW RATES:
9999.55 UNITS/HR.
166.66 UNITS/MIN.

EQUILIBRIUM PRESSURE =
0 PSIG
OBSERVED GRAVITY  40 @ 65F

RUN               PULSES
1                 2240.43
2                 2240.66
REPEATABILITY CRITERIA
SATISFIED FOR RUNS
# 1 THRU # 2

TOTAL FOR LAST 2 RUNS =
4481.09
AVERAGE = 2240.55

AVG.S FOR CALCULATION
COUNTS: 2240.55

PROVER TEMP : 65
PROVER PRESS: 15
METER TEMP  : 60
METER PRESS : 10

2240.66
--------- -1 X 100% = 0.0103%
2240.43

% REPEATABILITY: 0.0103

NOMINAL PROVER VOL:14.9449
CORRECTED PROVER VOL.@ 60 F:14.9449
CTSP: 1.00006
CPSP: 1.00001
```

```
CTLP: 0.99758
CPLP: 1.00008
CCFP: 0.99773
VOLUME AT PROVING COND:
14.9110

AVG. COUNT: 2240.55
CTLM: 1.0000
CPLM: 1.0001
CCFM: 1.0001
COUNT AT PROVE: 2240.77

COUNT AT PROVE  2240.77
DIVIDED BY
VOL. AT PROVE  14.9110
YIELDS K FACTOR: 150.28
TOTALIZER FACTOR 150
DIVIDED BY
K FACTOR  150.28
YIELDS METER FACTOR: 0.9981

CLOSING METER READING:

PREVIOUS METER FACTOR:


---------------------------------------

OPERATORS SIGNATURE:


---------------------------------------

WITNESS SIGNATURE:


---------------------------------------
```

Example of CONSEC Prover Report in 80-Column Format

```
\bgn\
                  ****************************************
                  *                                      *
                  *              PROVER REPORT           *
                  *                                      *
                  ****************************************

                                                                    11/25/97
CUSTOMER          :SMITH METER INC
LOCATION          :ERIE PA
METER             :TEST 1
PRODUCT           :KERO
STANDARD GRAVITY  : 39.6
REF TEMP          : 60 F
NOM.PROVER VOL    :14.9449
METER K FACTOR    : 150.28
PROVE COMPLETED   :11/25/97

-------------------------------------------------------------------------------
  RUN          METER        METER     PROVER     METER     PROVER      FLOW
               PULSES       TEMP      TEMP       PRESS     PRESS       RATE
                            (F)       (F)        (PSI)     (PSI)     UNITS/HR
-------------------------------------------------------------------------------
   1         2240.43       60        65         10        15        9999.55
   2         2240.66       60        65         10        15        9999.55
-------------------------------------------------------------------------------
 *AVG        2240.55       60        65         10        15        9999.55
-------------------------------------------------------------------------------
                           PROVE WITHIN LIMIT
             % REPEATABILITY: 0.0103       METER FACTOR: 0.9981

CORRECTED PROVER VOL.@ 60 F:14.9449

                           CORRECTION FACTORS
                CTSP: 1.00006                    CTLM: 1.0000
                CPSP: 1.00001                    CPLM: 1.0001
                CTLP: 0.99758                    CCFM: 1.0001
                CPLP: 1.00008
                CCFP: 0.99773


SIGNATURE_____________________________________
*******************************************************************************
*AVG: AVERAGE OF LAST 2 RUNS
```

Example of GROUP Prover Report in 40-Column Format

```
groups



DATE:11/25/97
ProvMate REV:W.5

CUSTOMER:SMITH METER INC
LOCATION:ERIE PA
METER    :TEST 1

OPENING
METER READING:14526

PRODUCT:KERO
STANDARD GRAVITY: 40.0

REF TEMP       : 60 F
PROVER I.D.    :12.75
WALL THICKNESS:0.625
NOM.PROVER VOL:14.9449

FLOW RATES:
9999.55 UNITS/HR.
166.66 UNITS/MIN.

EQUILIBRIUM PRESSURE =
0 PSIG
OBSERVED GRAVITY  40 @ 60F
RUN                 PULSES
1 / 1              2240.43
2 / 1              2240.66

TOTAL  : 4481.09
AVERAGE: 2240.55

RUN                 PULSES
1 / 2              2241.33
2 / 2              2241.22

TOTAL  : 4482.55
AVERAGE: 2241.28

RUN                 PULSES
1 / 3              2240.88
2 / 3              2241.11

TOTAL  : 4481.99
AVERAGE: 2241.00

RUN                 PULSES
1 / 4              2241.44
2 / 4              2241.11

TOTAL  : 4482.55
AVERAGE: 2241.28

RUN                 PULSES
1 / 5              2241.33
```

```
2 / 5              2240.43

TOTAL   : 4481.76
AVERAGE: 2240.88

GRAND AVERAGE: 2240.99

AVERAGES:
COUNT: 2240.99

PROVER TEMP : 65
PROVER PRESS: 15
METER TEMP  : 60
METER PRESS : 10

2241.28
--------- -1 X 100% = 0.0326%
2240.55

% REPEATABILITY: 0.0326

NOMINAL PROVER VOL:14.9449
CORRECTED PROVER VOL.@ 60 F:14.9449
CTSP: 1.00006
CPSP: 1.00001
CTLP: 0.99757
CPLP: 1.00008
CCFP: 0.99772
VOLUME AT PROVING COND:
14.9108

AVG. COUNT: 2240.99
CTLM: 1.0000
CPLM: 1.0001
CCFM: 1.0001
COUNT AT PROVE: 2241.22

COUNT AT PROVE  2241.22
DIVIDED BY
VOL. AT PROVE  14.9108
YIELDS K FACTOR: 150.31
TOTALIZER FACTOR 150
DIVIDED BY
K FACTOR  150.31
YIELDS METER FACTOR: 0.9979

CLOSING METER READING:

PREVIOUS METER FACTOR:


---------------------------------------

OPERATORS SIGNATURE:


---------------------------------------

WITNESS SIGNATURE:
```

Example of GROUP Prover Report in 80-Column Format

```
\bgn\
                  ****************************************
                  *                                      *
                  *             PROVER REPORT            *
                  *                                      *
                  ****************************************

                                                                      11/25/97
CUSTOMER          :SMITH METER INC
LOCATION          :ERIE PA
METER             :TEST 1
PRODUCT           :KERO
STANDARD GRAVITY  : 40.0
REF TEMP          : 60 F
NOM.PROVER VOL    :14.9449
METER K FACTOR    : 150.31
PROVE COMPLETED   :11/25/97

-------------------------------------------------------------------------------
  AVG          METER        METER     PROVER     METER     PROVER     FLOW
               PULSES       TEMP      TEMP       PRESS     PRESS      RATE
                            (F)       (F)        (PSI)     (PSI)    UNITS/HR
-------------------------------------------------------------------------------
 GRP 1       2240.55       60        65         10        15        9999.55
 GRP 2       2241.28       60        65         10        15        9999.55
 GRP 3       2241.00       60        65         10        15        9999.55
 GRP 4       2241.28       60        65         10        15        9999.55
 GRP 5       2240.88       60        65         10        15        9999.55

-------------------------------------------------------------------------------
GRAND AVG    2240.99       60        65         10        15        9999.55
-------------------------------------------------------------------------------
                              PROVE COMPLETED

             % REPEATABILITY: 0.0326       METER FACTOR: 0.9979

CORRECTED PROVER VOL.@ 60 F:14.9449

                           CORRECTION FACTORS
                CTSP: 1.00006                    CTLM: 1.0000
                CPSP: 1.00001                    CPLM: 1.0001
                CTLP: 0.99757                    CCFM: 1.0001
                CPLP: 1.00008
                CCFP: 0.99772


SIGNATURE_____________________________________
********************************************************************************
```

CONSEC and CONRAC Prompts

The following pages contain displays of the prompts that will be displayed on the computer screen during the performance of the proving program entitled CONSEC. CONSEC and CONRAC are identical in operation, except that CONSEC will perform an initialization sequence to determine flow rates prior to running prover cycles, and CONRAC does not. CONSEC would be used in situations that require the flow rate information to be displayed prior to the start of the proving runs. CONRAC is a high speed version of CONSEC. All CONRAC calculations are performed after the proving cycles have been completed. CONRAC is used if maximum prover speed is required, as in load rack proving where run time is limited. CONSEC and CONRAC perform repeatability tests on consecutive runs with an adjustable repeatability tolerance. Use these programs on turbine meters and PD meters with dummy calibrators.

In general, if units such as PSIG or °F are in the prompt, DO NOT enter units in the reply. For example, enter figures only as in 30. PSIG is understood.

```
New Prover?
NO
YES
CANCEL
```

Select YES if the dimensions of the SVP in use have not been entered before or if a value is changing. This change is required, for example, when changing from meter upstream to meter downstream proving. If YES is selected, the following prompt will appear:

```
display units as:
English
Metric
```

Select the system of measurement in which the units are to be displayed.

English unit conventions are as follows: temperature in degrees F (Fahrenheit); pressure in PSIG (pounds per square inch gauge); volume in GAL (gallons) or BBL (barrels); and dimensions in IN (inches).

Metric unit conventions are as follows: temperature in degrees C (Celsius); pressure in KPas (kilopascals); volume in L (liters) or m^3 (cubic meters); and dimensions in MM (millimeters).

```
REF. Temp (deg F): 60
      [or]
REF. Temp (deg C): 15
```

Either accept the default reference temperature, or specify a new temperature. The default reference temperature is 60°F (15°C) when a new prover selection is made. The operator can select a new base temperature that will be used for the temperature compensation calculations.

```
Prover Inside Diameter in INCHES:
```

Enter prover inside diameter in decimal inches 12.75 (millimeters as in 324.10).

SVP1 ID = 12.75 inches;
SVP2 ID = 18.50 inches;
SVP4 ID = 26.00 inches.

```
Prover Wall Thickness in INCHES:
```

Enter prover wall thickness in decimal inches 0.625 (millimeters as in 15.875).

SVP1 W.T. = 0.625 inches;
SVP2 W.T. = 0.750 inches;
SVP4 W.T. = 1.000 inches.

```
Prover Volume:
```

Enter prover certified volume in engineering units as determined by the “WATERDRAW METHOD.” Example: 14.9949 gal. (56.7619 Liters; 0.0567619m^3).

```
Customer:...
```

Enter customer name. The maximum line width is 40 characters.

```
Location:
```

Enter the city, state, and site of the prove operation. The maximum line width is 40 characters.

```
Meter Identification:
```

Enter the name of the meter being proved. This may be any combination of letters and numbers of 26 characters or less.

```
Opening Meter Reading:
```

Enter the figures shown on the non-resettable totalizer (if used) prior to initiating the prove operation.

```
Meter Compensation:
TEMPERATURE COMPENSATED
PRESSURE COMPENSATED
PRESSURE TEMP COMPENSATED
DENSITY COMPENSATED
NOT COMPENSATED
```

The selection you choose indicates to the computer whether the meter signal is gross or if the pulses are already adjusted to a reference temperature, reference pressure, both pressure and temperature, or to a reference density. This determines whether the meter pulses at prove are adjusted by calculation or whether 1.0000 is to be used.

As an example, if the meter signal is coming from the stack above an A.T.C., use the “Temperature Compensated” option to indicate that temperature adjustments are being made by the equipment outside the SVP.

```
Product Name:
CRUDE OILS
GASOLINE/NAPTHANES
JET FUEL/KEROSENES
DIESEL/HEATING
LUBE OILS
TRANSITIONAL PRODUCT
OTHER PRODUCT
```

Select the appropriate classification for the product being proved.

If the product does not fall into one of the previous six groups, it is not covered by the preprogrammed computer equations. Selecting “Other Product” will result in the following series of prompts.

```
Observed Gravity:
```

Enter the product gravity with no units. Since this is a display value only, it is permissible to use API, relative density, or specific gravity.

```
Observation Temp. in Degrees F:
            [or]
Observation Temp. in Degrees C:
```

Enter the product temperature at the time the gravity information was observed. Enter the base temperature if the gravity data is already at standard conditions.

Standard Gravity:

Enter the standard gravity of the product with no units. This standard value must be entered because the preprogrammed computer equations do not cover "Other Products."

Note: *The "Observed Gravity," "Observation Temp. in Degrees," and "Standard Gravity" prompts will be seen only if "Other Product" is selected.*

Observed API:

When not working with "Other Products," enter the API gravity of the product to be proved as determined by laboratory, densitometer, or hydrometer.

API Observation Temp In Degrees F
[or]
API Observation Temp In Degrees C

Enter the temperature at which this API density was observed. If using lab data, the temperature will normally be 60° F. If using a hydrometer, use the temperature indicated on the hydrometer bulb.

Equilibrium Press. in PSIG:
[or]
Equilibrium Press in kPag:

A "0" entry is selected if the product to be proved has a vapor pressure at or below atmospheric pressure.

Hydrometer Used?:

Entering "Yes" to this prompt will cause the computer to correct the density from observed temperature to 60°F, including the correction for the glass bulb of the hydrometer. Enter "No" if lab or densitometer gravity was entered.

Note: *This prompt will not be used with "Other Products."*

Nominal Pulses Per Totalizer Unit:

Enter the number of pulses per engineering unit supplied by the meter transmitter. For example, when proving a LACT unit with a transmitter which provides 8400 pulses per revolution, enter 8400 as the nominal pulses per totalizer unit and calculations will yield a multiplier to meter registration. When proving a meter which produces a nominal 8400 pulses per totalizer unit, but the electronic totalizer is set at 10,000 pulses per unit, then enter 10,000 as the nominal pulses per unit.

Maximum number of proving trips
is now at [#]
OK
CHANGE
CANCEL

Enter the maximum number of proving runs from which to collect meter repeatability while checking the spread from maximum to minimum for repeatability. The maximum number of total proving runs is 50.

PROVING TRIPS: [#]

This prompt appears only if CHANGE is selected for the above entry. In this case, enter the total number of runs to be completed in verifying the meter repeatability against a smaller number of 3 consecutive "good" runs. Note that if the number of proving runs to be completed is changed to 10, for example, the program will display the following prompt:

Maximum Number of Proving Trips
is now at 10
OK
CHANGE
CANCEL

where "10" is the new entry for total number of runs. If the total number of runs entered is correct, select OK.

```
Repeatability is based on
[#] good runs
OK
CHANGE
CANCEL
```

Assuming no changes to the total number of runs is to be made, this entry would allow the computer to execute continuous proving runs (up to a maximum of 10 total runs) while comparing the last three runs for the required repeatability on a rolling basis. For example, runs 2 through 4 may meet the repeatability requirement, in which case the program will terminate the proving process. In the event that the required repeatability cannot be achieved within the specified limit, the program prints the accumulated repeatability of the last three runs and stops processing. If CHANGE is entered for this prompt, the computer will display the prompt:

```
GOOD RUNS:[#]
```

Enter the number of runs that the prover must execute consecutively in order to achieve the requested meter repeatability, if other than 3. If the number is changed to 7, for example, the following prompt will appear.

```
Repeatability is based
on 7 good runs
OK
CHANGE
CANCEL
```

Here, “7” is the new number of consecutive trips required for a good prove.

```
Repeatability check is at [#]
OK
CHANGE
CANCEL
```

The percentage spread from maximum pulse count to minimum pulse count is shown. To accept this percentage, select OK. To be prompted for a new percentage, select CHANGE. To exit from PROVE mode and return to the main menu, select CANCEL.

```
NEW %:
```

Enter the new desired percentage repeatability value. Do not enter the percent sign (%).

At this point, the prover is initialized. The following message will be displayed:

```
[#] UNITS/MIN.
[#] UNITS/HR.
```

Press any key to exit this screen and proceed with the proving process.

The prover operates under the control of the laptop computer until either the proving requirements are met or the maximum number of runs has been made. After proving is completed, the following message will be displayed:

```
PROVER VOL. @ [#] F:[#]
OK
CHANGE
```

The prover volume stored in the computer’s memory is [#]. If the value is correct, select OK. To indicate a new value, select CHANGE.

```
Prover Volume:
```

This prompt appears only when a change in prover volume is requested. Type the desired prover volume after the colon.

```
PROVER TEMPERATURE: [#]
```

The current prover temperature in use appears here. When performing more than one prove, the previous value entered will be shown here. Press ENTER to accept the value as shown, or type in a new prover temperature and then press ENTER.

PROVER PRESSURE: [#]

The current prover pressure in use appears here. Press ENTER to accept the value as shown, or type in a new prover pressure and then press ENTER. The input is understood to be in PSIG or kPag.

METER TEMPERATURE:

The current meter temperature in use appears here. Press ENTER to accept the value as shown, or type in a new meter temperature and then press ENTER. The input is understood to be in °F or °C.

METER PRESSURE:

The current meter pressure in use appears here. Press ENTER to accept the value as shown, or type in a new meter pressure and then press ENTER. The input is understood to be in PSIG or kPag.

If “Other Products” was selected, the following additional prompts will be displayed.

PROVER TEMP=[#] ENTER CTLP=[#]

Enter the value of CTLP found in the appropriate API table under the displayed temperature.

ENTER COMPRESSIBILITY FACTOR:[#]

Enter the value of “F” (compressibility factor) as a decimal. The program does not make the change from table value to decimal form. For example, if the value found in the API table is 0.050, the computer operator would enter 0.0000050.

.050 API = Entry as 0.0000050

Note: *This prompt will appear only if “Other Products” is selected.*

METER TEMP=[#] ENTER CTLM=[#]

This prompt is governed by the same procedures and rules as CTLP.

ENTER COMPRESSIBILITY FACTOR:[#]

This prompt is governed by the same procedures and rules as compressibility (F) for the prover.

Note: *This prompt will appear only if “Other Products” is selected.*

Generate a Composite Meter Factor?
YES
NO

If the practice is to use a standard pressure correction within the meter factor, select YES.

OPERATING PRESSURE:

If the response to the above prompt was YES, this prompt appears to obtain the pressure value to be used for a normal product delivery. Enter the normal operating pressure in PSIG.

Note: *This prompt will only appear if you wish to generate a composite factor.*

CLOSING METER READING:

Enter the figures shown on the non-resettable totalizer (if used) after completion of the prove operation.

At this point, information about the last run will be displayed on the screen. Use the UP or DOWN arrows to scroll through the data. The ESC key will display the following prompt:

```
Change Inputs?
NO
YES
```

Selecting YES will display the following screen:

```
New Prover?
NO
YES
CANCEL
```

Select YES to prove this meter or any other meter for the current customer and location. The prove routine will return to the prompt for meter identification and proceed from there. Select NO to exit the program.

GROUPS

The program collects groups of runs and calculates the repeatability between groups. Because of the number of runs collected, there is no repeatability tolerance entered by the operator for the computer to check against. It is recommended that this program be utilized on any meter where the transmitter of the meter is subject to cyclic pulse generation, such as PD meters with clutch calibrators or ATC Temperature Compensators.

In general, if units such as psig (kPag) or °F (°C) are in the prompt, DO NOT enter units in your reply. For example, enter figures only as “30”; psig (or kPag) is understood.

Computer Screen Prompts

```
New Prover?
NO
YES
CANCEL
```

Enter YES if the dimensions of the SVP in use have not been entered before or if a value is changing. This change is required, for example, when changing from meter upstream to meter downstream for proving.

```
display units as:
english
metric
```

Select either English or metric units of measure.

```
REF. TEMP (deg F): [#]
or
REF. TEMP (deg C): [#]
```

Enter the base temperature for compensation calculations.

```
Prover Inside Diameter in INCHES:
[or]
Prover Inside Diameter in MM:
```

Note: *Display reflects units selected by the operator in the previous menu.*

Enter prover inside diameter in decimal inches. Example: 12.75 (millimeters as in 323.85).

SVP1 I.D. = 12.75 inches (323.85 mm);
SVP2 I.D. = 18.50 inches (469.90 mm);
SVP4 I.D. = 26.00 inches (660.40 mm).

```
Prover Wall Thickness in INCHES:
[or]
Prover Wall Thickness in MM:
```

Enter prover wall thickness in decimal inches 0.625 (millimeters as in 15.875).

SVP1 W.T. = 0.625 inches (15.875 mm);
SVP2 W.T. = 0.750 inches (19.050 mm);
SVP4 W.T. = 1.000 inches (25.400 mm).

Nominal Prover Volume:

Enter prover certified volume in engineering units as determined by the "WATERDRAW METHOD." Example: 14.9949 gal. (0.0567619 M^3 or 56.7619 liters).

Customer:

Enter the customer's name. The maximum line width is 24 characters.

Location:

Enter the city and/or state of the site of the prove operation. The maximum line width is 24 characters.

Meter Identification:

Enter the name of the meter being proved. This may be any combination of letters and numbers of 24 characters or less.

Note: *In any menu that allows both alpha and numeric characters to be entered, the alpha characters are entered directly. To enter numeric characters, the SHIFT key must be depressed while pressing the numeric character.*

Opening Meter Reading:

Enter the figures shown on the non-resettable totalizer (if used) prior to initiating the prove operation.

Note: *On menus that expect numeric characters, the computer will automatically apply the SHIFT key.*

Meter Compensation:
TEMPERATURE COMPENSATED
PRESSURE COMPENSATED
PRESSURE AND TEMP COMPENSATED
DENSITY COMPENSATED
NOT COMPENSATED

This input tells the computer whether the meter signal is gross or if the pulses are already adjusted to a reference temperature, reference pressure, both reference temperature and pressure, or to a reference density. This determines whether the meter pulses at prove are adjusted by calculation or whether a 1.0000 is to be used.

As an example, if the meter signal is coming from the stack above an ATC, select TEMPERATURE to indicate that temperature adjustments are being made by the equipment outside the SVP.

Product Type:
CRUDE OILS
GASOLINE/NAPTHANES
JET FUEL/KEROSENES
DIESEL/HEATING
LUBE OILS
TRANSITIONAL PRODUCT
OTHER PRODUCT

Select the classification of the product being proved.

If the product does not fall into one of the previous six groups, it is not covered by the preprogrammed computer equations. Selecting "Other Product" will result in the following series of prompts.

Observed Gravity:

Enter the product gravity with no units. Since this is a display value only, it is permissible to use API, relative density, or specific gravity.

Observation Temp. in Degrees F:
[or]
Observation Temp. in Degrees C:

Enter the product temperature at the time the gravity information was observed. Enter the base temperature if the gravity data is already at standard conditions.

Standard Gravity:

Enter the standard gravity of the product with no units. This standard value must be entered because the preprogrammed computer equations do not cover “Other Products.”

Note: *The “Observed Gravity,” “Observation Temp. in Degrees,” and “Standard Gravity” prompts will be seen only if “Other Product” is selected.*

Observed API:

When not working with “Other Products,” enter the API gravity of the product to be proved as determined by laboratory, densitometer, or hydrometer.

API Observation Temp In Degrees F
[or]
API Observation Temp In Degrees C

Enter the temperature at which this API density was observed. If using lab data, the temperature will normally be 60° F. If using a hydrometer, use the temperature indicated on the hydrometer bulb.

Equilibrium Press. in PSIG:
[or]
Equilibrium Press in kPag:

A “0” entry is selected if the product to be proved has a vapor pressure at or below atmospheric pressure.

Hydrometer Used?
YES
NO

Selecting YES to this prompt will cause the computer to correct the density from observed temperature to 60°F, including the correction for the glass bulb of the hydrometer. Select NO if lab or densitometer gravity was entered.

Note: *This prompt will not be used with “Other Products.”*

Nominal Pulses Per Totalizer Unit:

Enter the number of pulses per engineering unit supplied by the meter transmitter. For example, when proving a LACT unit with a transmitter which provides 8400 pulses per revolution, enter 8400 as the nominal pulses per totalizer unit and calculations will yield a multiplier to meter registration. When proving a meter which produces a nominal 8400 pulses per totalizer unit, but the electronic totalizer is set at 10,000 pulses per unit, then enter 10,000 as the nominal pulses per unit.

Number of proving groups
is now at [#]
OK
CHANGE
CANCEL

Enter the total number of times the consecutive run data is to be collected while checking the repeatability spread from maximum to minimum. The total number of groups permissible is 5. If CHANGE is selected, the following prompt will appear.

PROVING GROUPS: [#]

Enter a new value between 1 and 5.

Number of proving groups
is now at [#]
OK
CHANGE
CANCEL

This prompt displays the new entry for the total number of proving groups. If the total number of groups selected is correct, choose OK.

Number of runs per group is [#]
OK
CHANGE
CANCEL

Enter the number of consecutive trips to be completed per group of proving runs. The maximum permissible number of runs per group is 10. If CHANGE is selected, the following prompt will appear:

```
PROVING RUNS: [#]
```

Enter the new value between 1 and 10. This prompt appears only if CHANGE is selected for the above entry. In this case, enter the total number of runs to be completed in verifying the meter repeatability against a smaller number of 3 consecutive "good" runs. Note that if the number of proving runs to be completed is changed to 10, for example, the program will display the following prompt:

```
Number of proving trips
is now at 10
OK
CHANGE
CANCEL
```

where "10" is the new entry for total number of runs. If the total number of runs entered is correct, select OK.

The prover begins its initialization sequence. The following message will appear:

```
[#] UNITS/MIN.
[#] UNITS/HR.
```

Press any key to proceed with the proving process. After completion, the following menu will be displayed.

```
Prover Volume @ [#] F:[#]
OK
CHANGE
```

The prover volume stored in the computer's memory is [#]. If the value is correct, select OK. To indicate a new value, select CHANGE.

```
Prover Volume:
```

This prompt appears only when a change in prover volume is requested. Type the desired prover volume after the colon.

```
PROVER TEMPERATURE: [#]
```

The current prover temperature in use appears here. When performing more than one prove, the previous value entered will be shown here. Press ENTER to accept the value as shown, or type in a new prover temperature and then press ENTER.

```
PROVER PRESSURE: [#]
```

The current prover pressure in use appears here. Press ENTER to accept the value as shown, or type in a new prover pressure and then press ENTER. The input is understood to be in PSIG or kPag.

```
METER TEMPERATURE:
```

The current meter temperature in use appears here. Press ENTER to accept the value as shown, or type in a new meter temperature and then press ENTER. The input is understood to be in °F or °C.

```
METER PRESSURE:
```

The current meter pressure in use appears here. Press ENTER to accept the value as shown, or type in a new meter pressure and then press ENTER. The input is understood to be in PSIG or kPag.

If “Other Products” was selected, the following additional prompts will be displayed.

```
PROVER TEMP=[#] ENTER CTLP=[#]
```

Enter the value of CTLP found in the appropriate API table under the displayed temperature.

```
ENTER COMPRESSIBILITY FACTOR:[#]
```

Enter the value of “F” (compressibility factor) as a decimal. The program does not make the change from table value to decimal form. For example, if the value found in the API table is 0.050, the computer operator would enter 0.0000050.

.050 API = Enter as 0.0000050

Note: *This prompt will appear only if “Other Products” is selected.*

```
METER TEMP=[#] ENTER CTLM=[#]
```

This prompt is governed by the same procedures and rules as CTLP.

```
ENTER COMPRESSIBILITY FACTOR:[#]
```

This prompt is governed by the same procedures and rules as compressibility (F) for the prover.

Note: *This prompt will appear only if “Other Products” is selected.*

```
Generate a Composite Meter Factor?
YES
NO
```

If the practice is to use a standard pressure correction within the meter factor, select YES.

```
OPERATING PRESSURE:
```

If the response to the above prompt was YES, this prompt appears to obtain the pressure value to be used for a normal product delivery. Enter the normal operating pressure in PSIG.

Note: *This prompt will only appear if you wish to generate a composite factor.*

```
CLOSING METER READING:
```

Enter the figures shown on the non-resettable totalizer (if used) after completion of the prove operation.

```
New Prover?
NO
YES
CANCEL
```

Select YES to prove this meter or any other meter for the current customer and location. The prove routine will return to the prompt for meter identification and proceed from there. Select NO to exit the program.

MAINT

The following pages contain instructions for using the Small Volume Prover maintenance program. The MAINT program is used for testing of the prover I/O, solenoids/hydraulics, proximity switch, communications, internal counters, pressure switch, and home detector switch.

Upon calling on the maintenance program from the pulldown mode menu, a menu of operations options will be displayed for reference. The menu looks like this:

```
WARNING!!! Program makes no
checks.
          BE CAREFUL!!!
```

OBV	Open bypass valve
CBV	Close bypass valve
SPH	Send piston home
LP!	Launch piston
BS?	Bypass valve status?
PS?	Piston status?
PP?	Prover progress
T1?	T1?
T2?	T2?
MP?	Raw pulse count
N'?	Get counts
*	Done

The use of and cautions associated with each menu item are illustrated in the following pages.

Caution: It is recommended that only qualified personnel who are familiar with the operating sequence of the prover use the maintenance program. Improper sequencing of the prover could result in serious damage to the prover.

Turn the switch on the motor starter box to "HAND." This will turn on the hydraulics and make power available to move the various hydraulic pistons. It is permissible to leave the hydraulics off to check the action of various solenoid valves. An audible noise can be heard as the solenoids click on the "SEND PISTON HOME" and "CLOSE BYPASS VALVE" requests, assuming that all computer and electrical equipment is functioning properly.

OBV = OPEN BYPASS VALVE

This instruction sends the message "OBV" to the prover and causes the computer to shut off the power to the solenoid controlling the bypass valve. If hydraulic power is available at this time, the shuttle valve will return to the shelf position and the bypass valve will be pushed open by hydraulic and stream pressure. If the computer's explosion-proof housing is open, notice the second LED down from the top, labeled DS-2, is turned off at this time.

CBV = CLOSE BYPASS VALVE

This instruction sends the message "CBV" to the prover and causes the computer to turn on the power to the solenoid controlling the bypass valve. If hydraulic power is available at this time, the shuttle will shift to the powered position and cause the bypass valve to be closed. If the computer's explosion-proof housing is open, notice that the second LED down from the top, labeled DS-2, is turned on indicating that the solid state relay labeled SR2 is energized and 115 VAC is applied to the solenoid valve.

SPH = SEND PISTON HOME

Warning: Verify that the bypass valve is in the open position before issuing this command. (If the bypass valve is in the closed position, all product flow is diverted through the prover. Attempting to retract the piston to the home position will cause the piston to be retracted against product flow.)

This instruction sends the message "SPH" to the prover and causes the computer to energize the return piston solenoid closing the dump valve on the main hydraulic piston return to sump. Energizing the solenoid causes the shuttle valve for piston return to shift, introducing pump pressure to the main hydraulic piston line. Since the dump valve is closed, the pressure builds until sufficient pressure is attained to force the piston to the home position. This command causes the first LED from the top labeled DS-1 (in the computer box) to turn on.

LP! = LAUNCH PISTON

This instruction sends the message "LP!" to the prover and causes the computer to de-energize the return piston solenoid, releasing the stored pressure to the dump valve. This allows the dump valve to modulate the hydraulic pressure to the pressure required to maintain a main piston speed based on flow rate only. At the same time, flow from the hydraulic pump to the main actuator is stopped. This command will turn off the top LED (in the computer box), DS-1.

BS? = BYPASS VALVE STATUS?

This instruction sends the message “BS?” to the prover and causes the computer to determine the bypass valve position based on the following two signal inputs:

1. A differential pressure switch which closes when a Delta Pressure is seen between the seal cavity of the bypass valve and the pipeline pressure.

2. A proximity switch which closes when the bypass valve piston is fully extended.

If the Delta Pressure Switch is closed and the Proximity Switch is open, then the bypass is closed and sealed.

If the Delta Pressure Switch is open and the Proximity Switch is closed, then the bypass is fully open.

If the Delta Pressure Switch is open and the Proximity Switch is open, then the bypass is in travel and in an unknown position.

If the Delta Pressure Switch is closed and the Proximity Switch is closed, then the bypass position is unknown because of a fault (possibly one of the mentioned switches).

Possible messages to the PC are:

OPN = OPEN POSITION
CLS = CLOSED POSITION
??? = BYPASS IN TRAVEL OR A FAULT CONDITION

PS? = PISTON STATUS?

This instruction sends the message “PS?” to the prover and causes the computer to determine the position of the piston based on home signal input.

If the piston is in the home position, the home detector switch is activated.

Possible messages to the PC are:

HOM = PISTON IN THE HOME POSITION
??? = PISTON ANYWHERE BUT HOME

PP? = PROVER PROGRESS?

This instruction sends the message “PP?” to the prover and causes the computer to report the status of the last prove requested.

Possible messages to the PC are:

PIP = PROVE IN PROGRESS NO ERRORS
THRU = PROVER COMPLETE NO ERRORS
E01 = COUNTER DIAGNOSTIC ERROR
E02 = BYPASS VALVE FAILED TO OPEN
E03 = PISTON FAILED TO RETURN
E04 = BYPASS VALVE FAILED TO SEAL
E05 = PISTON SEAL CIRCUIT FAILED
E06 = FIRST DETECT SWITCH TIME-OUT
E07 = SECOND DETECT SWITCH TIME-OUT
E08 = PISTON SEAL FLAG STUCK
E09 = PISTON SEAL FAILURE
E10 = COUNTER CIRCUIT FAILURE
E11 = PULSE PER REV INPUT FAILURE
E12 = OPTO DETECTOR POWER FAILURE
E13 = METER PULSE FAILURE

T1? = T1?

This instruction sends the message “T1?” to the prover and causes the computer to send the latest T1 figure. T1 (Timer 1) is the number of clock pulses counted between meter pulses of the prove.

TS? = T2?

This instruction sends the message “T2?” to the prover and causes the computer to send the latest T2 figure. T2 (Timer 2) is the number of clock pulses counted between the first and second detector switches.

MP? = RAW PULSE COUNT?

This instruction sends the message “MP?” to the prover and causes the computer to send the latest meter pulse raw count.

N’? = GET COUNTS

This instruction sends the message “N?” to the prover and causes the computer to send the latest N’ figure. N’ is calculated from the ratio of (T2/T1) $\times$ meter pulses.

QUICK

The Quick program was designed to exercise the prover prior to an actual proving run. The function of the program is to cycle the prover on a continuous basis. One use of the QUICK program would be to provide the operator with an opportunity to bleed the prover of any entrained air. The program can also be utilized to allow the prover temperature to become stabilized. Quick does not perform any meter factor calculations. It will print the following data as it is being executed: N', T1, T2, units/min, units/hr, and N values. The program will run continuously unless it is interrupted by the operator.

Upon entering the program, the following prompt will appear:

```
Set quick prove mode for:
Continuous operation
Specified number of runs
```

Selecting "Continuous operation" will generate the following prompt:

```
Prover Volume: [#]
```

After the volume is entered and the ENTER key pressed, the computer will establish communications with the prover and begin to cycle the prove.

Selecting "Specified number of runs" will generate the following prompt:

```
Number of Quick Proves: [#]
```

After the number of quick proves is entered and the ENTER key pressed, the computer will establish communications with the prover and begin to cycle the prove.

The program can be suspended at any time by holding down the spacebar for a few seconds. Suspending the program will generate the following prompt:

```
Quick has been suspended.
END
CONTINUE
```

Select END to terminate the program and return to the main menu. Select CONTINUE to resume prove operations.

WATERDRAW

The purpose of this procedure is to provide a method for determining an SVP's volume, corrected to standard conditions, using a calibration method commonly referred to as "waterdraw." The procedure applies to Smith Meter Inc.'s factory calibrations and/or field calibrations to be conducted by the SVP user.

The test measure neck reading and water temperature are entered into the laptop computer. The computer then applies the required correction factors per API Chapter 12, Section 2, and computes the SVP corrected base volume at standard conditions. If another cycle is necessary, the diverter valve manifold is changed, allowing the piston to return to the starting position for another cycle to begin.

The calibrating procedure should be repeated until satisfactory repeatability is achieved. The corrected volume for the consecutive trips in any given direction shall agree within 0.02% (+/- 0.01% of the average).

Before initializing the Waterdraw program, select "Units" from the Setup menu at the right of the screen. Indicate whether measurements at to be in English or the metric system.

```
Pause at Detect Switch?
YES
NO
```

Select whether the prover is to halt at a detect switch. Pausing at the detect switch is required by some Weights and Measures agencies.

Customer:

Enter the customer name. The maximum line width is 24 characters.

Job Number:

Enter the job number of the prover/system.

Location:

Enter the city and state of the site of the waterdraw.

Prover nominal size:

Enter a nominal description of the prover, as in 15 gallons.

Prover Inside Diameter in inches:
[or]
Prover Inside Diameter in mm:

Enter the inside diameter in decimal inches, as in 12.75, or in millimeters.

Prover Wall Thickness in inches:
[or]
Prover Wall Thickness in mm:

Enter the prover wall thickness in decimal inches, as in 0.625, or in millimeters.

Size	Wall Thk.	I.D.
SVP1	0.625	12.75
SVP2/2E	0.750	18.50
SVP4	1.000	26.00

Note that the software is set up for carbon steel.

Prover Serial Number:

Enter the serial number of the prover being waterdrawn. This information can be found on the prover nameplate.

REF. TEMP (deg F): [#]
[or]
REF. TEMP (deg C): [#]

Enter the reference temperature, then press ENTER.

Test Measure Serial Number:

Enter the serial number of the certified measure used in the waterdraw.

Note: This program uses only one measure for a waterdraw on a Small Volume Prover.

Gallon Volume of Test Measure:
[or}
Liter Volume of Test Measure:

Enter the certified volume of the test measure in U.S. gallons or liters.

```
In3. Volume of Measure:
[or]
Cm^3 Volume of Measure:
```

Enter the certified volume of the test measure in cubic inches, as in 3465.02, or cubic centimeters. (Refer to the calibration certificate.)

```
Prover Pressure in PSIG:
[or]
Prover Pressure in kPag:
```

Enter the prover pressure as indicated.

```
Prover Temperature in Deg. F:
[or]
Prover Temperature in Deg. C:
```

Enter the prover temperature collected at the beginning of the draw.

```
SWITCH MOTOR
CONTROL TO HAND
PRESS ANY KEY
TO CONTINUE
```

This prompt indicates that the system is waiting for the operator to turn on the SVP hydraulic pump motor. Press ENTER to activate both solenoid valves to proceed with the waterdraw.

```
SWITCH FLOW TO
PRVR OUTLET FLANGE
PRESS ANY KEY
TO CONTINUE
```

This message prompts the operator to change the direction of the flow into the prover and return the piston to the home position.

```
NECK READING
```

This prompt appears at the bottom of the screen. It indicates that one pass of the piston is complete and the certified measure contains the water displace between switches. Read the point of intersection of the bottom of the meniscus and the scale. Enter a negative figure as -17.5. There is no sign change capability in the computer. A volume factor per increment of scale must be applied if not directly related to volume units. (See calibration certificate.)

```
TEMPERATURE OF CAN IN DEG. F
[or]
TEMPERATURE OF CAN IN DEG. C
```

This prompt appears at the bottom of the screen. Enter the temperature of the can. Degrees Fahrenheit or Celcius are assumed by the program, so enter only the appropriate digits.

```
Prover Pressure in PSIG: [#]
or
Prover Pressure in kPag: [#]
```

Enter the appropriate PSIG or kPAG pressure reading.

```
Prover Temperature in Deg. F: [#]
[or]
Prover Temperature in Deg. C: [#]
```

Enter the appropriate Fahrenheit or Celcius prover temperature reading.

```
RUN ANOTHER PROVER?
YES
NO
```

Select YES to run another prover with this can. The program will run through the entire waterdraw sequence again. If NO is selected, the following prompt will appear:

```
SWITCH MOTOR
CONTROL TO AUTO
PRESS ANY KEY
TO CONTINUE
```

Press any key to exit the program and return to the main ProvMate menu.

Note: *The power to the prover must be removed after the completion of Waterdraw. This is required to reset the onboard computer to the normal run mode.*

Establishing EIA-232 Communications

Three-wire communication is supported by ProvMate. Tx (transmit), Rx (receive) and Signal Ground are needed for SVP-host communications. All other pins and signals are ignored.

Steps of ProvMate - SVP Communications

1. An errant command is sent to the SVP (GWB by tradition).

2. The first character of the response is read. Only one character is read to prevent a “hang up” at the port. The correct SVP response is ERR.

3. If an “E” is not detected at the port, step 1 is retried. This happens after a user selectable number of times, usually 5000.

4. If, after the specified number of times, an “E” is not detected, ProvMate declares a communications error and notifies the user. The user must dismiss the warning with an “Enter” before a retry is made by ProvMate. If in the middle of a prove, communications may be able to be restored and normal operations continued. This is far from certain because of a number of variables.

5. If an “E” is detected, ProvMate then sends the next command to the SVP and assumes all is well.

6. The port is then read for a response. The program parks at the port and waits. This is necessary because the three-wire communications (no handshake) can cause a program “hang up” to occur. A warm boot is the only recourse.

ProvMate Error Messages

Default file needs repaired!

The file PREFS.CHN does not check. ProvMate reverts to standard defaults and colors.

Keystroke does not do anything.

The user presses a key that has no menu item attached to it.

No last run file exists.

The user asks to view/print last run and the file CRNTPRVE.CHN has been deleted.

This is the last run in file.

The user pressed END KEY when viewing the last run in a meter file.

This file cannot be appended.

An attempt was made to add the current run to a file that was saved as a single run file.

No serial ports are installed on this machine!!!

Using the “find SVP” utility, ProvMate cannot detect any installed serial ports.

Utility has been cancelled without success.

The “find SVP” has been canceled by the user (key F1).

The SVP is not responding on any port.

The “find SVP” cycled through and could not find the SVP.

Last run is too large to fully display!

A last run file is too big to show. This happens if the file is greater than 48K.

Check cables. Prover is not responding.

During communications, the SVP has not responded properly.

User interrupted communications.

A key was pressed during proving. Please keep hands off keyboard when proving.

DOES NOT COMPUTE!

Convergence routines failed.

BYPASS VALVE IS NOT CONFIRMED OPEN!

An SPH was requested in maint mode and the BYPASS was closed or position could not be confirmed open.

Prover Temperature too high!

Waterdraw temperatures could not be used in calculations.

Printer is off or disconnected.

The printer is out of paper.
The printer is off-line or not selected.

ProvMate ERROR TRAP

This is a real problem if occurs. Notify programmer.

The filename: XXXXXXXX.XXX cannot be found.

An open or load file could not be found.

The SVP has responded on communications port

The SVP was found using the “find SVP” utility.

SVP Diagnostic Errors

E01	DIAGNOSTICS FAILURE
E02	BYPASS VALVE FAILED TO OPEN
E03	PISTON FAILED TO RETURN
E04	BYPASS VALVE FAILED TO SEAL
E05	PISTON SEAL CIRCUIT FAILED
E06	FIRST DETECT SWITCH TIME-OUT
E07	SECOND DETECT SWITCH TIME-OUT
E08	PISTON SEAL FLAG STUCK
E09	PISTON SEAL FAILURE
E10	COUNTER CIRCUIT FAILURE
E12	OPTO DETECTOR POWER FAILURE
E13	METER PULSE FAILURE

Troubleshooting Operational Inter-Lock Alarm Codes

E-01 Diagnostic Failure

1. Replace computer board.

E-02 Bypass Valve Failed to Open

1. Check the mechanical switch on the bypass actuator. With the bypass closed, the switch should be open and 4-5 Vdc should be present. With the bypass open, the switch should be closed. If 0 Vdc is always present, go to Step 2. If the switch changes states, go to Step 3.

2. Refer to the field wiring diagram. Check from the top of the barrier to ground. If 4-5 Vdc is present, the barrier is bad. If 0 Vdc is present, the computer or the ribbon cable is bad.

3. Check the differential pressure switch that detects a bypass seal. With the bypass open, the switch should be open and 120 Vac should be present. With the bypass closed, the switch should be closed.

4. If the problem is not in the switches, use the maintenance program to check the mechanical operation of the bypass. The bypass may have a mechanical or hydraulic problem.

5. If the bypass valve is functioning properly, the computer, ribbon cable, or bypass intrinsic-safe barrier may be defective.

E-03 Piston Failed to Return

1. Remove the instrument package cover. Inspect the carriage flag. If it is damaged, replace the flag. If the piston is between the first detect switch and the home switch, the prover will not function properly. Load the maintenance program, launch the piston, and close the bypass. The flow will carry the piston to the idle position. After the piston is in the idle position, open the bypass. Initiate a prove cycle. If the piston jams just before reaching the home position, there is a mechanical problem and the prover must be disassembled. If the piston travels all the way home and the alarm reoccurs, the first detect switch may be shorted or the flag may have an alignment problem. The flag must be on center and aligned as close to the bottom of the switch as possible. If the flag alignment is good, refer to the field wiring drawing. Voltage at the intrinsic-safe barrier should be 0.5 Vdc or less. Place a metal object in the switch. The voltage at the barrier should be 11-12 Vdc. If not, disconnect the switch. If 11-12 Vdc is now at the barrier, the switch is bad and needs to be replaced. If the piston never comes close to reaching the home position, go to Step 2.

2. Initiate a prove cycle. The piston must return home within 35 seconds or a time-out will occur. If the piston does not move at all, go to Step 3. If the piston moves very slowly, go to Step 4.

3. Check the hydraulic unit. Make sure the pump is running and producing the correct operating pressures. Open the computer box. Check DS-1. If it is lit, 120 Vac should be present at TB2-1. If DS-1 is not lit, the relay socket may need to be cleaned. The relay, computer board, or ribbon cable may be defective. If these conditions are good, go to Step 5.

4. If the piston returns home but is moving very slowly, it is an hydraulic problem. Close the ball valve on the return line for the pressure balance valve. Send the piston home. If the piston travels home within 35 seconds, the pressure balance valve is defective and should be rebuilt. If the piston still travels slowly, go to Step 6.

5. If the piston will not move at all and the conditions in Step 3 are met, an hydraulic problem exists. Three main areas that can cause this problem are 1) the return solenoid; 2) the directional control valve pilot-operated B port blocked; or 3) the inline check valve. The purpose of the inline check valve is to allow time for the PBV to close by applying pressure to the top of the PBV piston before applying pressure to the bottom of the piston.

6. The main actuator may be defective. Consult Smith Meter Inc. for the proper rebuilding instructions.

7. If the piston travels home and the piston launches when the by-pass valve is signaled to close, this is caused by a dirty or defective P-port.

E-04 Bypass Valve Failed to Seal

1. Check the bypass seal sense line for air. This can be done at the differential pressure switch.

2. Check the differential pressure switch that detects a bypass seal. With the bypass open, the switch should be open and 120 Vac should be present. With the bypass closed, the switch should be closed.

3. Check the seal on the bypass piston. This can be done with a pressure gauge 500 psi or better above system pressure. Fit the gauge to the high pressure side of the differential pressure switch. Use the maintenance program to close the bypass. If seal pressure is obtained and does not bleed off, the bypass is good. If not, refer to the maintenance section on how to replace the bypass piston.

4. Check the mechanical switch on the bypass actuator. With the bypass closed, the switch should be open and 4-5 Vdc should be present. With the bypass open, the switch should be closed. If this condition is not true, adjust the switch.

5. Check DS-7 on the interface board. It should be lit. If it is not, SR-7 may be defective. This can be easily checked by swapping SR-7 and SR-8. If the problem still exists, change the ribbon cable or the computer board.

6. Check the hydraulic operation of the bypass. Refer to the operation pre-prove state hydraulic schematic for a good understanding of the bypass operation. When the cylinder is moving, the flow of the hydraulic oil can be heard. If the cylinder does not move, DS-2 should be lit and TB2-3 will have 120 Vac activating the close bypass solenoid. If DS-2 does not light when the bypass is signaled to close, the relay, computer board, or ribbon cable may be defective. If it does light but the cylinder will not move, it is a hydraulic problem. There are two main items that can cause this problem: 1) the close solenoid or 2) the directional control valve.

E-05 Piston Seal Circuit Failure

This alarm will occur if the computer board is defective.

E-06 First Detect Timeout

1. Check for flow through the SVP.

2. Check the ball valve on the return for the pressure balance valve. Make sure it is open.

3. Check the first detect. It may be shorted or open. Refer to the field wiring diagram. The voltage at the intrinsic-safe barrier should be 0.5 Vdc or less. Place an object such as a credit card in the switch, to prevent light from passing through the barrier. The voltage at the barrier should be 11-12 Vdc. If not, disconnect the switch. If 11-12 Vdc is now at the barrier, the switch is bad. If no voltage is present, go to Step 4.

4. Check from the top of the barrier to ground. If 11-12 Vdc is present, the barrier is bad. If 0 Vdc is present, the computer or ribbon cable is bad.

5. The piston may not have been released hydraulically. This can be caused by the directional control valve pilot-operated B-port block or the return solenoid.

6. The spring may be defective and may need to be replaced. If the piston has launched and stopped before the first detect, the spring may have lost its ability to push the piston into the flow stream.

Note: *This will typically be a problem at lower flow rates.*

E-07 Second Detect Timeout

1. Check the flow. It may have stopped.

2. Check the second detect. It may be shorted or open. Refer to the field wiring drawing. Voltage at the intrinsic-safe barrier should be 0.5 Vdc or less. Place an object such as a credit card in the switch to break the infrared light beam. The voltage at the barrier should be 11-12 Vdc. If not, disconnect the switch. If 11-12 Vdc is now at the barrier, the switch is bad. If no voltage is present, go to Step 3.

3. Check from the top of the barrier to ground. If 11-12 Vdc is present, the barrier is bad. If 0 Vdc is present, the computer or the ribbon cable is bad.

E-08 Piston Seal Flag Stuck

1. Remove the instrument cover with the piston out of the bore. The flag should not be rotated. If the flag is rotated, check the flag and see if it rotates freely. If not, remove the flag and magnet assembly and clean.

2. If the flag rotates freely, remove the bleed plug on the differential pressure switch and bleed off the pressure. If the flag returns to its normal relaxed state, the instrument rod is plugged. Apply pressure to the bleed port with the piston out of the bore. This may flush the line. If not, the prover needs to be disassembled and this port needs to be cleaned.

E-09 Piston Seal Failure

1. Remove the instrument package cover. Remove the bleed plug from the differential pressure switch and bleed air.

2. Initiate a prove and watch the piston seal flag. If the flag is not rotating, the problem is with the seal circuit.

3. If the flag is rotating and remaining rotated through the whole prover cycle, the problem is electronic. The dynamic seal detect switch may be shorted or open or the flag may not be breaking the infrared light beam. Refer to the field wiring drawing. The voltage at the intrinsic-safe barrier should be 0.5 Vdc or less. Place an object such as a credit card in the switch to break the infrared light beam. The voltage at the barrier should be 11-12 Vdc. If not, disconnect the switch. If 11-12 Vdc is now at the barrier, the switch is bad. If no voltage is present, go to Step 4.

4. Check from the top of the barrier to ground. If 11-12 Vdc is present, the barrier is bad. If 0 Vdc is present, the computer or the ribbon cable may be defective.

E-10 Counter Circuit Failure

1. Check the first detect and the second detect switches for failure. Refer to the field wiring diagram. The voltage at the intrinsic-safe barrier should be 0.5 Vdc or less. Place an object such as a credit card in the switch to break the infrared light beam. The voltage at the barrier should be 11-12 Vdc. If not, disconnect the switch. If 11-12 Vdc is now at the barrier, the switch is bad. If no voltage is present, go to Step 2.

2. Check the voltage from the top of the barrier to ground. If 11-12 Vdc is present, the barrier is bad. If 0 Vdc is present, the computer or the ribbon cable may be defective.

3. If the detector switches check good, change the computer board.

E-11 Pulse/Rev Input Failure

1. If this error occurs and the pulse/rev input is not being used, take the prove display off “P”. The alarm should go away.

2. When using the pulse/rev, if this alarm is occurring, check the transmitter p/r output. If the transmitter is good, check the field wiring. If all wiring is correct, the computer or the ribbon cable may be the problem.

E-12 Opto Power Failure

1. Check the opto power coming from the first intrinsic-safe barrier on the right. The voltage should be 6-8 Vdc. If the voltage is 11-12 Vdc, the LED circuit is open. Refer to the field wiring drawing. Check the voltage at Terminals 1 and 6. If 0 Vdc is present, the wiring to the instrument package is defective. If 12 Vdc is present, a switch has failed. To determine the defective switch, measure the voltage across each LED. The one with 12 Vdc across the LED is defective.

2. If 0 Vdc is present at all switches, use an object such as a credit card to break the infrared light beam and measure the voltage at the barrier that coincides with the switch. If one reads 0 Vdc all the time, the barrier may be bad. Check from the top barrier to ground. If 12 Vdc is present, the barrier is defective. If 0 Vdc is present, the computer or the ribbon cable is bad.

E-13 Meter Pulse Failure

1. Check the flow through the line. It may have stopped.

2. Check the transmitter. It may be defective.

3. If everything checks good, the computer or ribbon cable may be defective.

The specifications contained herein are subject to change without notice and any user of said specifications should verify from the manufacturer that the specifications are currently in effect. Otherwise, the manufacturer assumes no responsibility for the use of specifications which may have been changed and are no longer in effect.

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