# TABLE OF CONTENTS

## OPERATION MANUAL

1. **Introduction** .................................................................................................................. 5
   1.1 Record of Ownership ................................................................................................. 5
   1.2 Revision Record ....................................................................................................... 5
   1.3 Translation Notice ................................................................................................... 5
   1.4 Copyright Notice ..................................................................................................... 5
   1.5 About This Manual .................................................................................................. 6
   1.6 Conventions Used in This Manual ........................................................................... 7
   1.7 Manual Danger, Warning, and Caution Statements ............................................... 8

2. **Overview** ..................................................................................................................... 9
   2.1 Who Should Use This Manual? ............................................................................... 9
   2.2 Who Can Use IPC-PC? ............................................................................................. 9

3. **Initial Setup** ................................................................................................................. 11
   3.1 How IPC-PC Interacts with the IPC Controller Network ....................................... 11
   3.2 The COM Port Setup Window ................................................................................ 11
   3.3 The Serial Port Enumerator ..................................................................................... 12
   3.4 Selecting a COM Port ............................................................................................. 13
   3.5 COM Status LEDs .................................................................................................. 13
   3.6 Serial Data Output ................................................................................................... 14
   3.7 Communication Setup Window ................................................................................ 15
   3.8 AccuFrac PC TCP Server ....................................................................................... 16
   3.9 Selecting the Engine & Transmission ..................................................................... 17

4. **The Multi-Pump Control Window** ............................................................................. 19
   4.1 Engine Throttle Control ........................................................................................... 20
   4.2 Transmission Gear Selector ..................................................................................... 20
   4.3 Transmission Lockup LED ....................................................................................... 21
   4.4 Overpressure Trip Set Point .................................................................................... 22
   4.5 Instant Idle/Neutral Button ...................................................................................... 23
   4.6 Alarm LED ................................................................................................................ 23
   4.7 Pump Zoom Button .................................................................................................. 24
   4.8 Total Radio Button ................................................................................................. 24
   4.9 Resistor Button ....................................................................................................... 24
5. The Diagnostics & Control Window .............................................................. 25
  5.1 Engine Diagnostics Display ................................................................. 26
  5.2 Throttle Controls & Tachometer ......................................................... 26
  5.3 Change Filter & Lockup LEDs ............................................................ 27
  5.4 Pressure Transducer Calibration ....................................................... 27
  5.5 Slurry Totalizer ................................................................................. 28
  5.6 The Pump Selector ............................................................................ 28
  5.7 Alarm Indicators .............................................................................. 29

6. The Hardware Calibration Window ........................................................... 31
  6.1 Navigating to the Hardware Calibration Window .................................. 32
  6.2 Throttle Setup .................................................................................... 33
  6.3 Alarm Calibration ............................................................................... 34
  6.4 Transmission Oil Pressure Calibration ............................................... 35
  6.5 Transmission Filter Switch Calibration .............................................. 35
  6.6 The Pump Setup Window ................................................................... 36
  6.7 Pump Rate Setup Window .................................................................. 37
  6.8 Plunger Setup Window ....................................................................... 38

7. Taskbar Options ................................................................................... 39
  7.1 Refresh Tab ....................................................................................... 39
  7.2 Language Tab .................................................................................... 40
  7.3 Record Tab ....................................................................................... 41
  7.4 Units Tab .......................................................................................... 41
  7.5 Totals Tab ........................................................................................ 42
  7.6 Pressures Tab ................................................................................... 42
  7.7 Shutdown Tab ................................................................................... 42

Appendix A: Serial Data Output Values ....................................................... 43
Appendix B: IPC-PC Measurement Units ..................................................... 45

TABLE OF TABLES

Table 1, Serial Data Output ......................................................................... 43
Table 2, IPC-PC Engineering Units ............................................................. 45
TABLE OF FIGURES

Figure 1, IPC-PC Control Window ........................................................................................................... 9
Figure 2, Typical IPC Controller Network .................................................................................................. 11
Figure 3, Network Tab ............................................................................................................................ 11
Figure 4, COM Port Setup Window ........................................................................................................ 12
Figure 5, Serial Port Enumerator ........................................................................................................... 12
Figure 6, COM Port Selector .................................................................................................................. 13
Figure 7, COM Status LED .................................................................................................................... 13
Figure 8, Serial Output Control ............................................................................................................... 14
Figure 9, Communication Setup Window .............................................................................................. 15
Figure 10, Server Name Window ........................................................................................................... 16
Figure 11, Engine & Transmission Selection Screen .............................................................................. 17
Figure 12, Multi-Pump Control Window ................................................................................................ 19
Figure 13, Engine Throttle Control ....................................................................................................... 20
Figure 14, Transmission Gear Selector .................................................................................................. 20
Figure 15, Transmission Lockup LED .................................................................................................. 21
Figure 16, Number Pad .......................................................................................................................... 22
Figure 17, Overpressure Trip Controls ................................................................................................ 22
Figure 18, Instant Idle/Neutral Button ................................................................................................... 23
Figure 19, Alarm LED ............................................................................................................................ 23
Figure 20, Pump Zoom Button ................................................................................................................. 24
Figure 21, Total Radio Button ................................................................................................................. 24
Figure 22, Resistor Button ....................................................................................................................... 24
Figure 23, Diagnostics & Control Window ............................................................................................ 25
Figure 24, Engine Diagnostic Display .................................................................................................... 26
Figure 25, Throttle Controls & Tachometer ............................................................................................ 26
Figure 26, Change Filter LED .................................................................................................................. 27
Figure 27, ZERO Discharge Pressure Button ........................................................................................ 27
Figure 28, Slurry Totalizer with Reset Button ....................................................................................... 28
Figure 29, Pump Selector ........................................................................................................................ 28
Figure 30, Alarm Indicators ..................................................................................................................... 29
Figure 31, Hardware Calibration Window ............................................................................................. 31
Figure 32, System Password Window .................................................................................................... 32
Figure 33, Throttle Setup ........................................................................................................................ 33
Figure 34, Engine Alarm Calibration Window ........................................................................................ 34
Figure 35, Transmission Oil Pressure Calibration Window .................................................................... 35
Figure 36, Pump Efficiency & Gear Ratio Fields .................................................................................... 36
Figure 37, Pump Rate Setup Window ..................................................................................................... 37
Figure 38, Plunger Setup Window .......................................................................................................... 38
Figure 39, Refresh Setup Window ......................................................................................................... 39
Figure 40, Language Tab ......................................................................................................................... 40
Figure 41, Chinese Display ..................................................................................................................... 40
Figure 42, Record Tab .............................................................................................................................. 41
Figure 43, Metric Gauges .......................................................................................................................... 41
Figure 44, Totals Tab ............................................................................................................................... 42
Figure 45, Pressures Tab .......................................................................................................................... 42
Figure 46, Shutdown Tab ........................................................................................................................ 42
1. Introduction

1.1 Record of Ownership
PROPERTY OF: ____________________________________________________________

COMPANY: ______________________________________________________________

ADDRESS:  __________________________________________________________________

CITY: ____________________   STATE: ____________   ZIP CODE: __________

COUNTRY: __________________________________________________________________

1.2 Revision Record
Check each revision received and insert the revised and supplementary pages in your manual (if applicable).

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1.3 Translation Notice
This manual is written in English. If the equipment owner translates this manual using in-house personnel or a professional service, then the equipment owner acknowledges responsibility for the accuracy of the translated manual. Stewart & Stevenson assumes no responsibility for unit operation errors, damage to or improper use of equipment, improperly trained personnel, improperly maintained equipment, or failure to follow normal safety precautions outlined in this manual or in the vendor literature that may result from inaccuracies in the translated manual.

1.4 Copyright Notice
Copyrighted as an unpublished work. Stewart & Stevenson LLC reserves the right to update any portion of this publication at any time. Information provided by this manual is believed to be correct and reliable at the time of this publication. No responsibility, however, is assumed by Stewart & Stevenson LLC for its use. Ultimate responsibility for the installation, operation, and preventative (scheduled) maintenance rests upon the owner unless expressly undertaken by Stewart & Stevenson LLC.

ALL RIGHTS RESERVED. © COPYRIGHT 2013 BY STEWART & STEVENSON LLC.
1.5  About This Manual

This manual is not a textbook on electronics. Sufficient descriptive material and illustrations are included to enable the operator to understand the basic theory of operation of this equipment. The intent of this manual is to assist trained operators and maintenance personnel in the proper use of the equipment. This guide is not a substitute for properly trained personnel or common sense.

No liability, either express or implied, is given for any information contained herein. This manual is intended only as a guide, and not as a substitute for proper training by qualified personnel. Stewart & Stevenson LLC assumes no responsibility for improper use of equipment, improperly trained personnel, improperly maintained equipment, or failure to follow normal safety precautions outlined here or by properly trained personnel.

Use of this guide for any purpose other than for the safe and proper operation and maintenance of the equipment and all of its components constitutes misuse, and is punishable by all applicable laws.

If there is any discrepancy between information contained in this manual and the vendor literature, the vendor literature is assumed correct. Stewart & Stevenson LLC assumes no liability whatsoever for any person who fails to follow the operation and safety procedures of the original equipment manufacturers.

Please read through this guide in its entirety before attempting to operate the equipment. Stewart & Stevenson LLC assumes no liability for failure to do so.

All information in this guide is based on the latest production information available at the time of publication. Direct any questions concerning the contents or format of this guide to:

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1.6 Conventions Used in This Manual

The IPC-PC Intelligent Pump Control Manual uses the following formats:

- **Bold and Italicized Text** indicates a screen name.
- **Bold Text** indicates a button on a screen or dialog box.
- **Italicized Text** indicates a variable that must be entered by the user.
- **Courier Text** indicates commands that must be entered by the user.
- **ALL CAPITAL TEXT** indicates a file name.

---

**NOTE:** Is used to notify personnel of installation, operation, or maintenance information that is important, but not hazard related.
1.7 Manual Danger, Warning, and Caution Statements

Throughout this manual, statements may appear which emphasize important and critical information. These statements will be set off from the rest of the text, and will be formatted and defined as shown.

**DANGER!**

Indicates an imminently hazardous situation, which, if not avoided, will result in death or serious injury. This type of statement is limited to only the most extreme situations.

**WARNING**

Indicates a potentially hazardous situation, which, if not avoided, could result in death or serious injury.

**CAUTION**

Indicates a potentially hazardous situation, which, if not avoided, could result in minor or moderate injury or serious damage to equipment. It may also be used to alert against unsafe practices.

**NOTE:** Is used to notify personnel of installation, operation, or maintenance information that is important, but not hazard related.
2. Overview

Stewart & Stevenson’s IPC-PC allows fracturing pump operators to monitor and control up to twenty-four frac pumps simultaneously from a single PC interface. Mission critical process data is displayed in an easy to read analog format with data continuously compared against configurable alarm set points. The operator is alerted if any engine, transmission, or pump data from any of the (up to) twenty-four frac pumps is out of range. Real-time data acquired from multiple pumps can be multiplexed into a single data stream for transmission to external data acquisition or analysis packages.

2.1 Who Should Use This Manual?

This manual supplements the existing Intelligent Pump Control (IPC) user documentation and is intended for IPC operators who desire to add PC navigability and functionality with IPC-PC.

2.2 Who Can Use IPC-PC?

IPC-PC may be used with any IPC hardware that has firmware version 2.0 or later. IPC-PC firmware upgrades are available at no cost at:

3. Initial Setup

This section covers the details of understanding, establishing, and operating the communications network in IPC-PC. Furthermore, many key components, diagrams, and terms will be sufficiently explained in detail in order to facilitate the user in operating an IPC-PC workstation.

3.1 How IPC-PC Interacts with the IPC Controller Network

A typical Intelligent Pump Control installation is shown below in Figure 2. Multiple Frac Pumps are connected to one IPC-PC workstation.

![Figure 2, Typical IPC Controller Network](image)

3.2 The COM Port Setup Window

The **COM Port Setup** window is used to select the COM ports on the host computer through which IPC-PC will communicate with IPC. To display the window select **Network → COM Port Setup** from the IPC menu as shown in Figure 3.

![Figure 3, Network Tab](image)
The **COM Port Setup** window contains settings for up to twenty-four input serial ports and one additional port for serial output. Each of the twenty-four input ports can be connected to one IPC frac pump.

![Figure 4, COM Port Setup Window](image)

### 3.3 The Serial Port Enumerator

The **Serial Port Enumerator** shown in Figure 5 is part of the **COM Port Setup** window. The enumerator lists all COM ports installed on the host computer. The **Serial Port Enumerator** is a simple diagnostic tool that may be useful when configuring the host computer.

![Figure 5, Serial Port Enumerator](image)
3.4 Selecting a COM Port

A COM port must be selected for each frac pump to be controlled by IPC-PC. COM ports 1-48 may be chosen. After a port is selected IPC-PC immediately attempts to open the port. If the selected port is unavailable or in use by another application, the port will not open. A message will prompt the operator that the selection is invalid.

COM port setup needs to be done only once since the settings are stored and will be recalled when the IPC-PC application runs.

3.5 COM Status LEDs

If the selected port is opened successfully, the green Port Available LED will illuminate. As data is received from the IPC network the red Receiving Data LED will illuminate. It is normal for the Receiving Data LED to flash on and off as data is received.
3.6 **Serial Data Output**

Selecting a COM port on the serial output selector enables serial output. In this case the rightmost LED indicates *Transmitting Data* instead of *Receiving Data*.

The serial output port is configured at 57,600 bits per second, eight data bits, no parity bit, one stop bit, with flow control off.

The serial output data is formatted as comma-delimited ASCII text and consists of a timestamp in the form HH:MM:SS followed by packets of real-time data values for each online pump. Specific details of the data values included in the serial output can be found in Appendix A, *Serial Data Output Values*. 
3.7 Communication Setup Window

The Communication Setup window allows the operator to fundamentally change how data is transferred across the IPC-PC network. The operator can access this window by selecting the Network tab then, Communication Setup.

![Communication Setup Window]

The Hardware Layer radio select buttons allows the operator to connect to the Main Control Board (MCB) through the Gateway using a RS232 connection, or by Direct Control using a RS485 connection.

---

**CAUTION**

The E-Stop button sets the engine to instant idle/neutral. It is **NOT** an emergency stop button.

---

To the right of the Hardware Layer radio select buttons is the Enable E-Stop selector, which allows an operator to immediately set the engine to instant idle/neutral by depressing the large mushroom button located inside the data van. No action will occur if the E-Stop selector is not enabled.
3.8 AccuFrac PC TCP Server

The AccuFrac PC TCP Server tab allows the operator to connect to AccuFrac PC to receive and display Inline Pressure. To connect to the server, the operator must select Change Server Name on the AccuFrac PC TCP Client window, and input the server address into the field shown in Figure 10.

![Server Name Window]

Figure 10, Server Name Window
3.9 Selecting the Engine & Transmission

Configuring the Engine & Transmission is done at the factory. However, if new firmware is loaded on the MCB these settings will have to be configured again.

**NOTE:** Improper settings can damage the *Engine* and *Transmission* being used. Contact Stewart & Stevenson if you are unsure of these settings.

![Figure 11, Engine & Transmission Selection Screen](image-url)
4. The Multi-Pump Control Window

The Multi-Pump Control window allows the operator to control up to twenty-four pumps simultaneously. Individual controls for each pump’s engine throttle and transmission gear are provided. Displayed data includes pump discharge pressure, discharge rate, engine rpm, and transmission lockup. All data including those not displayed on the Multi-Pump Control window are monitored for alarm conditions. Any data point outside of its normal operating range generates an alarm event and illuminates the alarm indicator.

Any unused pump panel (not connected to an IPC pump) will appear dimmed. Figure 12 shows one active pump connection, while panels two through eight are dimmed.

![Multi-Pump Control Window](image)

Figure 12, Multi-Pump Control Window
4.1 Engine Throttle Control

The Engine Throttle Control is a four-way switch with small and large increment and decrement buttons. Each press of a button causes the corresponding engine’s RPMs to increment or decrement by either the small or large throttle steps as configured in IPC. The engine’s RPM set point will never exceed the high RPM limit configured in IPC.

![Figure 13, Engine Throttle Control](image)

4.2 Transmission Gear Selector

The Transmission Gear Selector is a two-way switch that increments or decrements the selected gear. Each touchscreen button causes the transmission to shift up or down by one gear. The gear that the transmission is currently in will be displayed in red, while all other gears appear white. After pressing a gearshift button, a slight delay while the transmission shifts before the indicated gear changes is normal.

![Figure 14, Transmission Gear Selector](image)
4.3 *Transmission Lockup LED*

The green *Transmission Lockup* LED will illuminate in green when the transmission is in lockup mode.

![Lockup LED](image)

**Figure 15, Transmission Lockup LED**

[CAUTION]

Operating the transmission under load for extended periods of time out of lockup (i.e., in torque converter mode) may cause excessive heat build up or damage.

Lockup is typically achieved at speeds above 1500 RPM.
4.4 Overpressure Trip Set Point

IPC commands the engine to idle and the transmission to go to neutral whenever the discharge pressure exceeds the Overpressure Trip Set Point. The Overpressure Trip Set Point for each pump is displayed near the top of each pump panel. To enter a new set point, click the SET button and a number pad for a new set point will appear shown in Figure 16.

![Number Pad Image]

Figure 16, Number Pad

The overpressure bar graph is displayed to the right of the set point. This graph indicates the current discharge pressure of the pump as a percentage of the trip pressure. If the graph moves all the way to the top, the pump will trip.

![Trip Controls Image]

Figure 17, Overpressure Trip Controls
4.5  *Instant Idle/Neutral Button*

An *Instant Idle/Neutral* button is located at the bottom of each pump panel. Pressing the *Instant Idle/Neutral* button causes the corresponding pump’s throttle to go to idle and the transmission to go to neutral without affecting any of the other pumps.

The *Instant Idle/Neutral* button must first be enabled by moving the nearby toggle switches to the “Up” position. When enabled, the *Instant Idle/Neutral* button changes from gray to red.

![Instant Idle/Neutral Button](image)

*Figure 18, Instant Idle/Neutral Button*

4.6  *Alarm LED*

An *Alarm* LED is associated with each pump. The red alarm LED will illuminate if any of the operating parameters are outside of their normal operating ranges as configured in IPC. The *Alarm* LED will also illuminate if a diagnostic fault code is received from the engine’s electronic control module (ECM). If an alarm becomes active, as indicated by the *Alarm* LED, the source of the alarm may be located by navigating to the *Diagnostics & Control* window with the *Pump Zoom* Button. The *Pump Zoom* button is described in section 4.7, *Pump Zoom Button*.

![Alarm LED](image)

*Figure 19, Alarm LED*
4.7 **Pump Zoom Button**

Each pump panel contains a Pump Zoom button. Clicking the Pump Zoom button will display the Diagnostics & Control window as described in the next section.

![Figure 20, Pump Zoom Button](image)

4.8 **Total Radio Button**

The Total Radio button allows the operator to total the rate, HHP, and volume for all pumps the operator chooses to select. The totals for each pump can be viewed at the bottom of the Multi-Pump Control window.

![Figure 21, Total Radio Button](image)

4.9 **Resistor Button**

The Resistor button found on each pump panel of the Multi-Pump Control window takes the operator to the Hardware Calibration window for the corresponding pump selected. The Hardware Calibration Window which will be discussed in Section 6 allows the operator to calibrate various aspects of the engine, transmission, and pump.

![Figure 22, Resistor Button](image)
5. The Diagnostics & Control Window

The *Diagnostics & Control* window is an in-depth display of the frac pump’s operation shown below in Figure 23.

It is organized into three main sections:

- Engine
- Transmission
- Pump

Each section contains a wealth of diagnostic data that the operator can use to monitor the engine, pump, and transmission.

---

**Figure 23, Diagnostics & Control Window**
5.1 Engine Diagnostics Display

The Engine Diagnostics display translates diagnostic fault codes generated by the engine’s ECM. Messages are retained in the scrollable list box until the CLEAR button is pressed or the IPC-PC application is shut down.

Broadcast fault codes conforming to either the J1587 or J1939 standard can be displayed on IPC-PC. Currently, IPC and IPC-PC can display fault codes generated by Detroit Diesel ECMs only.

![Engine Diagnostic Display](image1)

Figure 24, Engine Diagnostic Display

5.2 Throttle Controls & Tachometer

The Throttle Controls & Tachometer on the Diagnostics & Control window look and operate the same as those on the Multi-Pump Control window, with the exception that the throttle control has a slightly different shape.

![Throttle Controls & Tachometer](image2)

Figure 25, Throttle Controls & Tachometer
5.3 Change Filter & Lockup LEDs

A lockup indicator LED is displayed in the transmission section of the Diagnostics & Control window along with an additional LED labeled CHANGE FILTER. The red change filter LED illuminates when IPC receives a blocked filter signal from the transmission filter transducer.

![Figure 26, Change Filter LED](image)

5.4 Pressure Transducer Calibration

The pump discharge pressure can be calibrated (zeroed) from IPC-PC by clicking the ZERO discharge pressure button. This causes the current signal level from the discharge pressure transducer to represent zero within IPC. This is an IPC hardware calibration and will be retained in non-volatile memory.

![Figure 27, ZERO Discharge Pressure Button](image)
5.5 **Slurry Totalizer**

IPC maintains a running total of the amount of slurry pumped. This value is displayed on IPC-PC and can be reset by clicking the totalizer **RESET** button.

![Figure 28, Slurry Totalizer with Reset Button](image)

5.6 **The Pump Selector**

The **Pump Selector** shown in Figure 29 indicates which pump is currently displayed on the pump diagnostics window. The selector also allows the operator to choose which pump is displayed by clicking the up or down arrows. The currently selected pump is also indicated on the title bar of the **Diagnostics & Control** window.

The pump selector may be dragged with the mouse anywhere within the **Diagnostics & Control** window.

![Figure 29, Pump Selector](image)
5.7 **Alarm Indicators**

The normal operating ranges for all data points are independently configurable from within IPC. Each of the digital numeric fields indicates when its value is not within normal operating range by changing color from green to red. When any digital display is out of range (colored red), or if any engine diagnostic fault codes are displayed, the **Alarm** LED on the multi-pump control window will illuminate.

![Figure 30, Alarm Indicators](image)
6. The Hardware Calibration Window

The *Hardware Calibration* window allows the operator to calibrate various aspects of the engine, transmission, and pump. This section will cover different aspects concerning calibration and the steps the operator required to properly modify these settings.

![Figure 31, Hardware Calibration Window](image-url)
6.1 Navigating to the Hardware Calibration Window

The first step in navigating to the Hardware Calibration window is clicking the Resistor Button (shown in Figure 22) corresponding to the desired pump located on the Multi-Pump Control window. The operator will then be prompted for a password (shown in Figure 32) which can be entered using a digital key pad by depressing the left mouse button over the password field.

Figure 32, System Password Window
6.2 Throttle Setup

The operator can navigate to the Throttle Setup screen by clicking:
Resistor button → Engine tab → Throttle.

From here, the operator can modify the throttle step size, scale, and RPM range.

The Throttle Step Size changes the RPM increments when depressing the larger and smaller throttle step buttons. They are defaulted at 10 and 100 RPMs.

**NOTE:** The offset and gain are calibrated at the factory. Contact Stewart & Stevenson if these settings need to be changed.

After configuring the throttle steps, offset, and gain, it is necessary to calibrate the RPM range. The low limit RPM range is defaulted at 600 RPMs however, it is up to the operators discretion as to what these values should ultimately be set to. It should be noted, that the engine will not fall below its idling speed even with the low limit range set to zero. The same holds true for the high limit range.

**NOTE:** The operator must click “set” to store new values.

![Figure 33, Throttle Setup](image-url)
6.3 **Alarm Calibration**

When calibrating the alarms, the operator should follow the same procedure as detailed in section 5.2 for configuring the low limit and high limit RPM range. When an alarm is tripped the corresponding display on *Diagnostics & Control* window will turn red and the *Alarm* LED will illuminate.

![Figure 34, Engine Alarm Calibration Window](image-url)
6.4 Transmission Oil Pressure Calibration

Calibrating the Transmission Oil Pressure is a six step process:

1. Enter the desired PSI into the Min-Scale Reading field.
2. Press the Calibrate Min-Scale Reading button.
3. Enter the desired PSI in the Max-Scale Reading field.
4. Press the Calibrate Max-Scale Reading button.
5. Press the Auto-Scale button.
6. Press the Set button to save your changes.

NOTE: There are four other screens (Transmission Oil Temperature, Pump Discharge Pressure, Pump Oil Temperature, and Pump Oil Pressure) that have the same layout and procedure as the Transmission Oil Pressure screen. Therefore, only the Transmission Oil Pressure screen will be covered in detail.

6.5 Transmission Filter Switch Calibration

Average Counts is the only setting available for calibration on the Transmission Filter Switch Screen. Average Counts is defaulted to five which is the recommended setting for this particular application.
6.6 **The Pump Setup Window**

The *Pump Setup* window allows the operator to set the pump efficiency factor and the pump gear ratio. The pump gear ratio should be a value that reflects the manufacturer’s specifications for the specified pump.

The pump efficiency factor is simply used to correct theoretical displacement and is measured in percentages. Therefore, a rating of “1.00” is equal to one hundred percent efficiency and a rating of “0.50” is equal to fifty percent efficiency. As a pump wears the efficiency tends to decrease and it is up to the operator to compensate for this.

![Figure 36, Pump Efficiency & Gear Ratio Fields](image)

---

Page 36
6.7 **Pump Rate Setup Window**

A *K-Factor* is used to convert a frequency into an engineering unit. If the operator knows the *K-Factor*, input it directly into the *K-Factor* field.

If the *K-Factor* is unknown the operator can complete the following steps:

1. Enter the desired current value.
2. Click the **Get Frequency** button.
3. Click the **Auto-Scale** button.
4. Press **Set** to store your changes.

![Figure 37, Pump Rate Setup Window](image-url)
6.8 **Plunger Setup Window**

The *Plunger Setup* window asks the operator for the *number of plungers*, the *plunger size* (diameter), and the *plunger stroke* (length). All of this data except for the *number of plungers* can be derived from the manufacturer's specifications and should be entered in the fields below in Figure 38.

![Figure 38, Plunger Setup Window](image-url)
7. Taskbar Options

Several options are available from the taskbar to customize the IPC-PC system.

7.1 Refresh Tab

The speed at which the IPC-PC windows are updated can be adjusted to reduce CPU utilization when running IPC-PC on lower-performance computers. The default refresh period of one second is recommended for most cases.

<table>
<thead>
<tr>
<th>Refresh</th>
<th>Language</th>
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<td>✔ 1 second</td>
</tr>
<tr>
<td>2 seconds</td>
<td>4 seconds</td>
</tr>
</tbody>
</table>

Figure 39, Refresh Tab
7.2 Language Tab

The display language used on the application windows can be selected from the Language menu item. Currently the English and Chinese languages are supported.

![Language Tab](image)

![Chinese Display](image)
7.3 Record Tab

The Record tab allows the operator to start, stop, and pause data being gathered and recorded by IPC-PC to a CVS file for later analysis. The pump number, date, and time are all recorded in millisecond time intervals.

![Record Tab](image)

Figure 42, Record Tab

7.4 Units Tab

The Units tab allows the operator to choose whether the Metric System or English System of units is displayed on all gauges.

![Metric Gauges](image)

Figure 43, Metric Gauges
7.5 **Totals Tab**

By selecting **Reset Discharge Totals** under the **Totals** tab the operator has the ability to reset the discharge total on all active pumps to zero.

![Totals Tab](Figure 44, Totals Tab)

7.6 **Pressures Tab**

The **Pressures** tab is similar to the **Totals** tab. It has one drop down sub menu called, **Zero Discharge Pressures**. It allows the operator to zero the discharge pressure on all active pumps.

![Pressures Tab](Figure 45, Pressures Tab)

7.7 **Shutdown Tab**

The **Shutdown** tab allows the operator to set all active pumps to idle/neutral.

![Shutdown Tab](Figure 46, Shutdown Tab)
Appendix A: Serial Data Output Values

The serial output data is formatted as comma-delimited ASCII text and consists of a timestamp in the form HH:MM:SS, followed by packets of real-time data for each online pump and ending with a carriage return/line feed. Table 1 is an example of the data output when two pumps are online.

Table 1, Serial Data Output

<table>
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Appendix B: IPC-PC Measurement Units

IPC-PC can scale the process data to both the English and Metric measurement systems. This scaling is reflected in the values displayed on the screen as well as the values of the serial output data. Table 2 lists the units of measurement used for each data point.

**Table 2, IPC-PC Engineering Units**

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<td>Engine Fuel Pressure</td>
<td>PSI</td>
<td>kPa</td>
</tr>
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<td>°C</td>
</tr>
<tr>
<td>Engine Fuel Temperature</td>
<td>°F</td>
<td>°C</td>
</tr>
<tr>
<td>Engine Coolant Temperature</td>
<td>°F</td>
<td>°C</td>
</tr>
<tr>
<td>Transmission Oil Pressure</td>
<td>PSI</td>
<td>kPa</td>
</tr>
<tr>
<td>Transmission Oil Temperature</td>
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<td>°C</td>
</tr>
<tr>
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<td>PSI</td>
<td>MPa</td>
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<td>kPa</td>
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<td>°C</td>
</tr>
<tr>
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<td>RPM</td>
<td>RPM</td>
</tr>
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<td>m³ / min</td>
</tr>
<tr>
<td>Pump Slurry Total</td>
<td>BBL</td>
<td>m³</td>
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