FLUKE®
Calibration

RUSKA 2482

Differential Pressure Piston Gauge

Users Manual

PN 3966525
November 2010

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Introduction

This manual covers the operation and maintenance of the RUSKA 2482 Differential Pressure Piston Gauge.

How to Contact Fluke

To order accessories, receive operating assistance, or get the location of the nearest Fluke distributor or Service Center, call:

- Technical Support USA: 1-800-99-FLUKE (1-800-993-5853)
- Calibration/Repair USA: 1-888-99-FLUKE (1-888-993-5853)
- Canada: 1-800-36-FLUKE (1-800-363-5853)
- Europe: +31-402-675-200
- China: +86-400-810-3435
- Japan: +81-3-3434-0181
- Singapore: +65-738-5655
- Anywhere in the world: +1-425-446-5500

Or, visit Fluke's website at www.fluke.com.

To register your product, visit http://register.fluke.com.

To view, print, or download the latest manual supplement, visit http://us.fluke.com/usen/support/manuals.

Safety Information

The following are general safety precautions that are not related to any specific procedures and do not appear elsewhere in this publication. These are recommended precautions that personnel must understand and apply during equipment operation and maintenance to ensure safety, health, and protection of property.

Compressed Gas

Use of compressed gas can create an environment of propelled foreign matter. Pressure system safety precautions apply to all ranges of pressure. Care must be taken during testing to ensure that all pneumatic connections are properly and tightly made prior to applying pressure. Personnel must were eye protection to prevent injury.

Heavy Weights

Lifting and movement of heavy weights can create an environment of strain and impact hazards. Are must be taken during testing to ensure that weight masses are lifted in a manner that avoids over-reaching or twisting, and that the masses are not dropped. Personnel must wear reinforced safety shoes to prevent injury.

Personal Protective Equipment

Wear eye protection and reinforced safety shoes approved for the materials and tools being used.

⚠ Warning

If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Symbols Used in this Manual

In this manual, a **Warning** identifies conditions and actions that pose a hazard to the user. A **Caution** identifies conditions and actions that may damage the Differential Pressure Piston Gauge or the equipment under test.

Symbols used on the Differential Pressure Piston Gauge and in this manual are explained in Table 1.

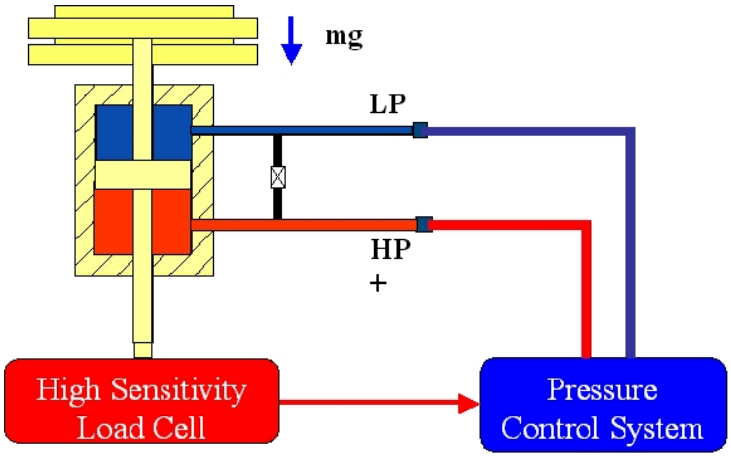
Table 1. Symbols

Symbol	Description
~	AC (Alternating Current)
⏚	Earth Ground
⚠	Important Information: refer to manual
	Do not dispose of this product as unsorted municipal waste. Go to Fluke's website for recycling information.
CE	This equipment meets the requirements of all relevant European safety directives. The equipment carries the CE mark.

General Information

The RUSKA 2482 Differential Pressure Piston Gauge is a precision standard that provides unsurpassed performance in the field of differential pressure metrology at high static line pressures. This instrument can calibrate virtually any differential pressure device used at high static line pressures. A single piston design eliminates many of the difficulties associated with dual piston differential systems.

The RUSKA 2482 is a hydraulic gauge that allows for gas calibrations through the gas/oil interface chambers. The pressure control system uses feedback from a sensitive load cell to maintain the system null condition. The RUSKA 2482 software is incorporated into WinPrompt® to provide the full range of corrections and calculations required to get the highest performance from a precision piston gauge standard. For a basic system diagram, see Figure 1.



gms02.bmp

Figure 1. Basic System Diagram

NVLAP Accredited Calibrations

Fluke is recognized by the United States Department of Commerce National Institute of Standards and Technology's National Voluntary Accreditation Program (NVLAP) for conformance with criteria set forth in NIST Handbook 150:2001 and all requirements of ISO/IEC 17025:1999.

A NVLAP accredited calibration certificate is provided standard with the RUSKA 2482.

Theory of Operation

An overview of the RUSKA 2482 system is shown in Figure 2. During the initial configuration of the system, the Balance is internally aligned and zeroed. With only the weight of the piston and associated hardware acting on the Balance, the Balance is zeroed.

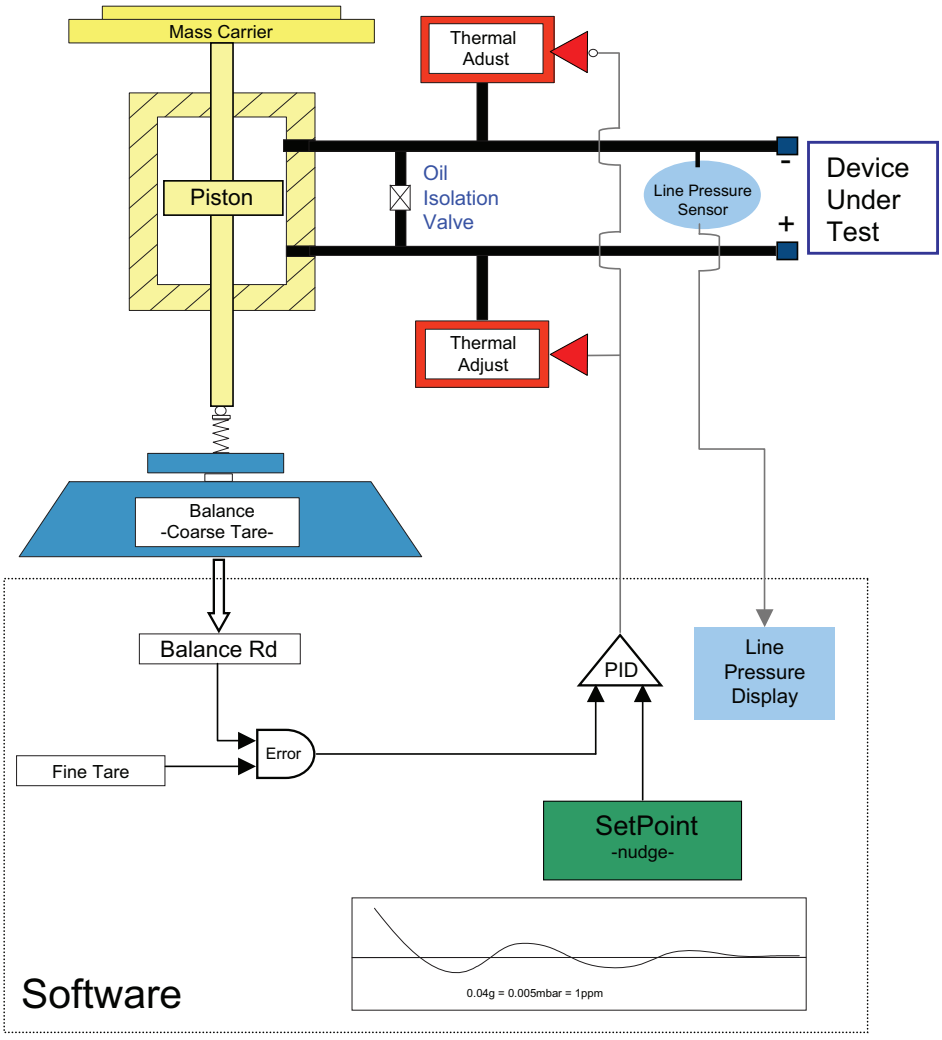


Figure 2. System Operation Overview

With the Oil Isolation Valve open, there is zero differential across the Piston. Using the hand pump a line pressure can be applied. This pressure is generated equally across the Piston when the Oil Isolation Valve is open. Changes in the line pressure may result in a small offset on the Balance. This effect is nulled by using the control program to tare the offset and establish a zero datum at the given line pressure.

If the Oil Isolation Valve is closed and the thermal compensation enabled, the control program will adjust the power to the temperature compensators to maintain a zero reading from the Balance.

When a weight is added to the Mass Carrier, a force will be transferred to the Balance. The resulting non-zero reading of the Balance will drive the controller to adjust the power of the thermal compensators. The PID controller drives a change in the differential pressure until the Balance is returned to the zero datum.

Once at the zero datum the differential pressure is determined by the weight applied and the piston area, thus giving a primary standard for differential pressure. WinPrompt® software manages the calculations for these conversions and can also be used to compensate for other environmental factors.

If a small incremental pressure change is desired, the program can thermally control the pressure to leave a small residual weight on the Balance. This residual weight is added to the applied weight. For small increments, the induced errors on the Balance will have negligible effect on the overall accuracy.

Installation

Minimum Requirements

To install the RUSKA 2482, the following are required:

- A sturdy workbench able to safely support the additional weight of the RUSKA 2482 with accessories, approximately 45 kg (100 lbs)
- PC computer with Microsoft® Windows® 2000 or XP, 400 MHz, 1.6 MB hard disk space available, 256 kb RAM available, RS-232 serial port (USB to RS-232 adapter is acceptable)
- Refer to Specifications for additional environmental, power, media, and supply gas requirements.

Unpacking

1. Carefully remove all packaged items from the shipping box and place the RUSKA 2482 on the workbench.

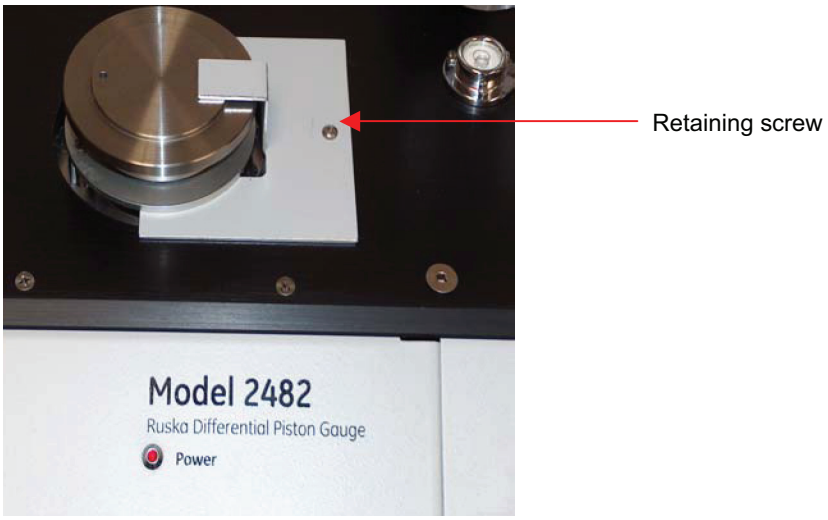
   The following items will be included with the package:

   - RUSKA 2482 main chassis
   - RUSKA 2482 User's Manual
   - WinPrompt® software Version 2R20 or later
   - Hand pump assembly and pump spindle handles
   - Two flexible hoses
   - Accessories kit
   - Power supply and power cord

2. Inspect the instrument for any shipping damage. If any damage is discovered, notify the shipping company immediately.
3. Save specialized packaging for future shipping and/or storage requirements.

Mechanical Setup

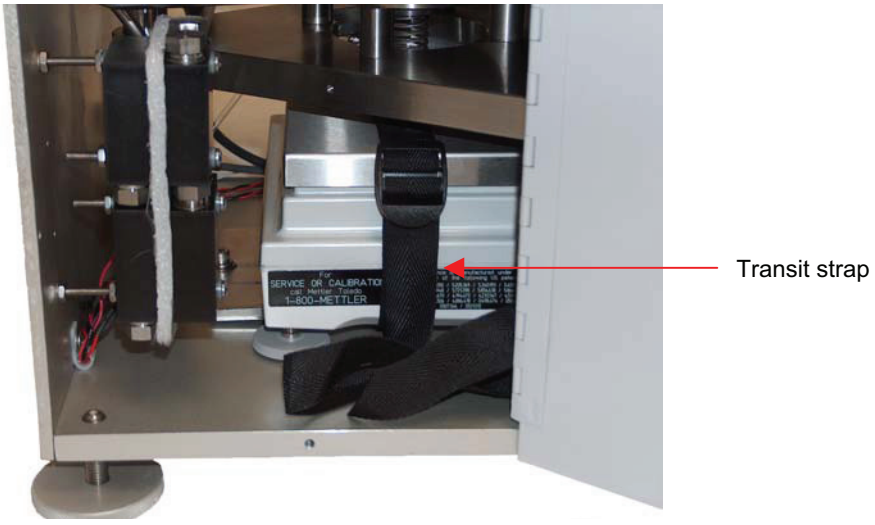
1. Remove the transit clamp and the retaining screw (see Figure 3).



gms04.eps

Figure 3. Transit Clamp with Retaining Screw

2. Remove the balance transit strap as follows (see Figure 4):
   a. Remove the three screws that secure the left panel door — two from the rear panel and one from the bottom side panel.
   b. Open the panel door.
   c. Loosen and remove the balance transit strap.
   d. Close the side panel door.
   e. Replace the three panel screws.
   f. Store the transit strap for future use.



gms05.eps

Figure 4. Transit Strap Removal

3. Adjust the leveling screws so the level vial on top of the instrument indicates the instrument is level. All four leveling screws must be in contact with the workbench.

Note

Leveling is a critical function and should be verified before each operation.

4. Position the hydraulic pump unit on the workbench approximately 25 cm (10 in) to the left of the main instrument (see Figure 5).

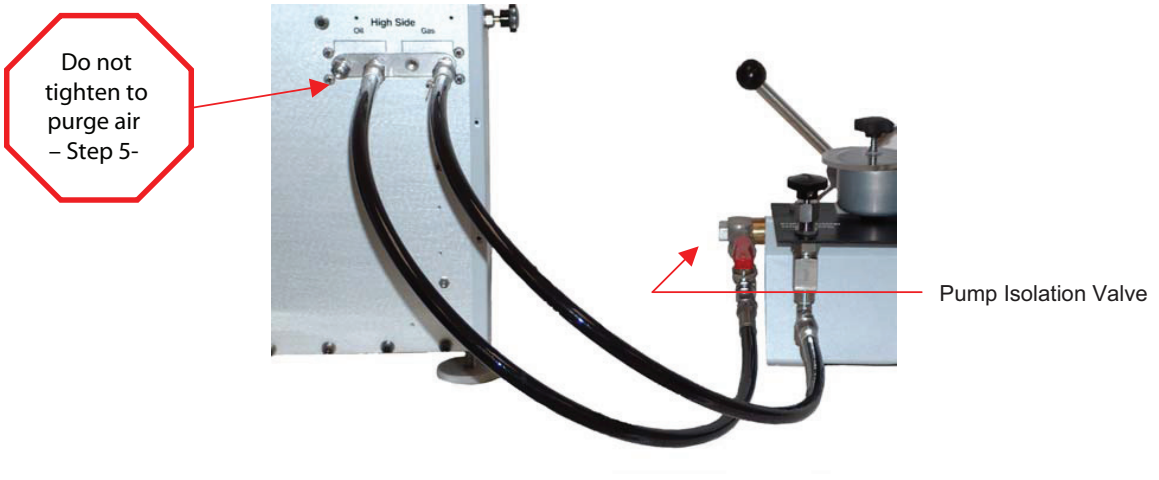


Figure 5. Plumbing Connections

Note

Figure 5 shows the gas supply connection. This connection is used in gas mode operations and does not need to be installed for initial setup and demonstration of oil mode operations. Refer to the Gas Mode Setup section.

5. Connect a flexible hose between the Pump Isolation Valve and the High Side Oil Port on the RUSKA 2482 rear panel. Do NOT tighten the rear panel fitting until air has been purged from the line (see Figure 5).
6. Connect a flexible hose between the High Side Gas Port on the RUSKA 2482 rear panel and the tee fitting located on the rear of the hydraulic pump assembly (see Figure 5).
7. Route the waste oil drain tube to a suitable container compatible with Dioctyl Sebacate Oil (DOS oil).
8. Position the hydraulic pump unit and the RUSKA 2482 close to the front of the workbench. The placement should assure that the tubing is not being stressed and the pump handles will not hit the workbench through the entire pump stroke.
9. Install the four pump spindle handles.
10. Anchor the hydraulic pump unit to the bench.

Note

Steps 11 through 14 are intended to purge air from the pump assembly and tubing. The system is shipped with DOS oil in the system. If the integrity of this system has been compromised, refer to the Maintenance section for instructions to purge air from the entire system.

11. Close the Pump Isolation Valve. Loosen the Oil Reservoir Valve and rotate the reservoir cover to the side. Fill the reservoir with fresh DOS oil to approximately two-thirds full, then rotate the cover back over the top of the reservoir (see Figure 6).

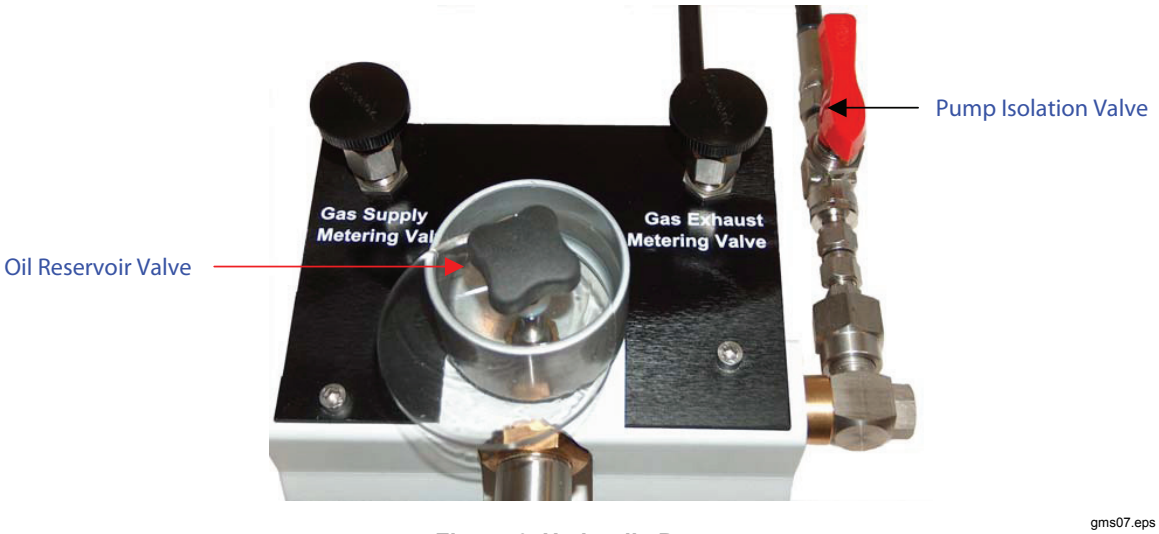


Figure 6. Hydraulic Pump

12. Rotate the pump spindle fully clockwise to purge any air from the pump housing, then rotate the spindle fully counterclockwise. Close the Oil Reservoir Valve.
13. Open the Pump Isolation Valve and rotate the pump spindle clockwise. This will force the DOS oil through the line connected to the rear of the main instrument. Continue pumping until DOS oil comes out of the loose fitting at the High Side Oil Port. Once DOS oil is coming out of this fitting then tighten the fitting.

    Once the system is sealed by tightening all fittings, the Oil Isolation Valve must be in Equalize position. While the Oil Isolation Valve is in Equalize mode, turning the pump spindle generates line pressures. While the Oil Isolation Valve is in Isolation mode, turning the pump spindle will generate Delta pressures.

Note

If the pump spindle runs out of travel before the DOS oil comes out of the line, repeat steps 12, 13, and 14.

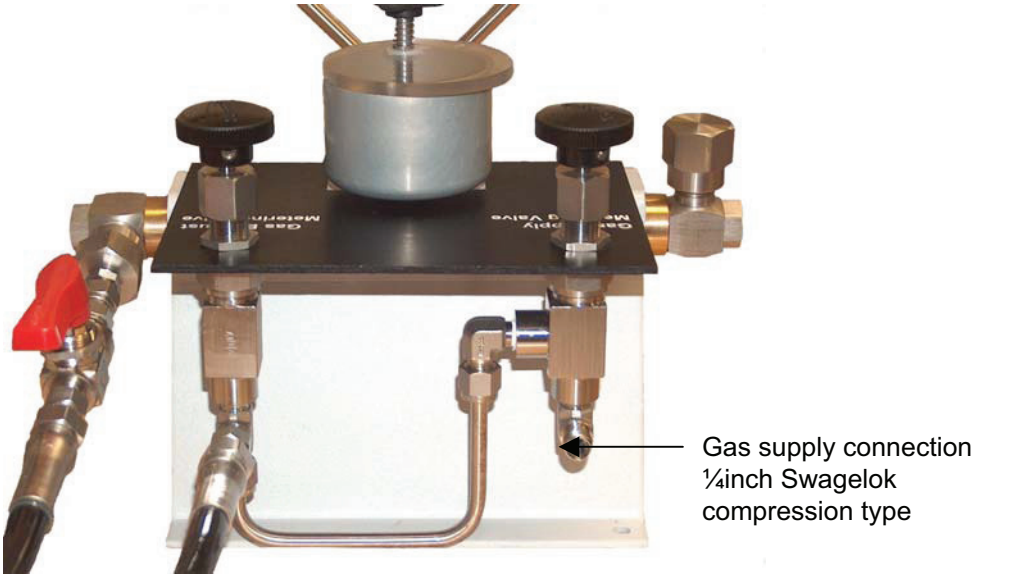
14. Once the air is purged from the high side oil line, close the Pump Isolation Valve and open the Oil Reservoir Valve. This prevents pressure building in the pump assembly when not in use.

Note

When the system is free of air and closed, and the Oil Isolation Valve is in Equalize mode, a one-half turn of the pump handle will generate system line pressure.

Gas Mode Setup

The setup for gas mode operation does require the entire oil mode setup to be completed as detailed in the Mechanical Setup section. A regulated gas supply needs to be connected as shown.



gms08.eps

Figure 7. Back of Hydraulic Pump

Electrical Setup

1. Insert the power adapter plug into the power receptacle on the rear panel of the instrument (see Figure 5).

gms09.bmp

Figure 8. Power Connection

2. Plug the power adapter cord into a suitable wall outlet. The power lamp on the front panel of the RUSKA 2482 will turn on.
3. Connect the RS-232 communication cable between the instrument and the PC computer. The cable provided is a straight through cable (Pin 1 to 1, 2 to 2, … 9 to 9). If a USB to RS-232 adapter is used, the associated drivers must be installed on the PC.

Software Setup

This section covers the installation of software and the verification that communications with the RUSKA 2482 is established. Refer to the Software section to learn more about software function and application.

WinPrompt®, Revision 3R00 and later, has the RUSKA 2482 driver included.

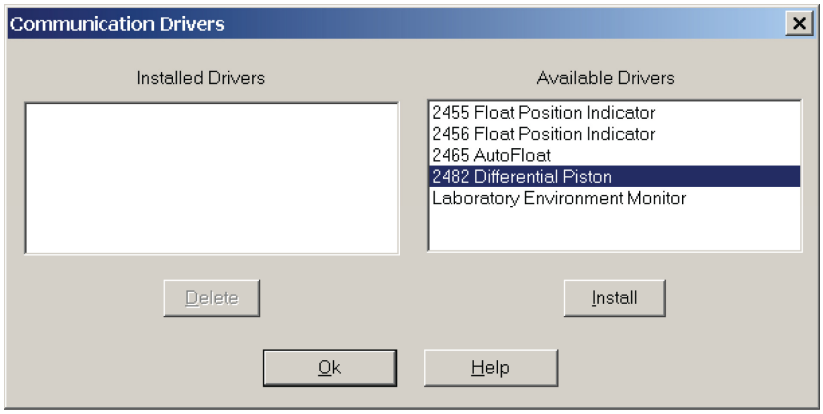
Installation

Insert the WinPrompt® CD (Version 3R00 or later) into the computer. If Autorun does not begin the installation then manually activate the *setup.exe* program on the CD.

Refer to the WinPrompt® manual for more details.

Since WinPrompt® supports many Piston Gauge products, the RUSKA 2482 Differential Pressure Piston Gauge Driver needs to be activated (Figure 9).

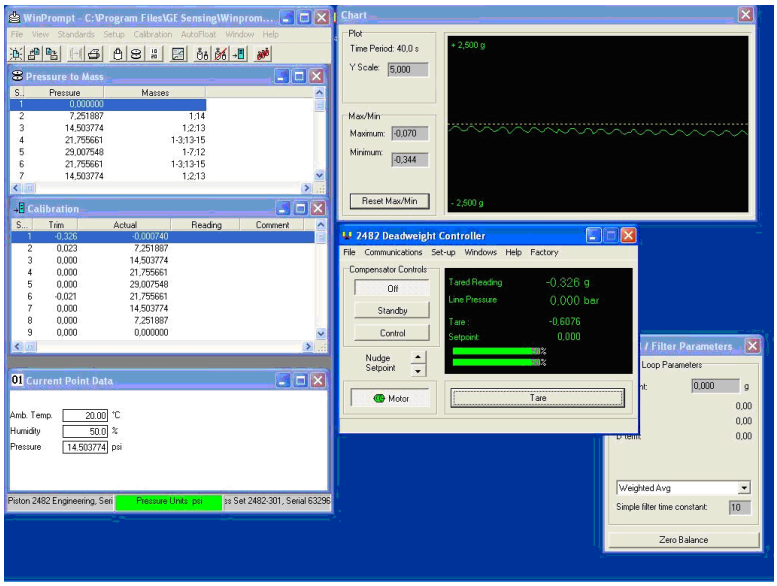
WinPrompt® MAIN: SETUP|DRIVER



gms32.bmp

Figure 9. RUSKA 2482 - Drivers Selection

Once the Driver is selected the RUSKA 2482 software window will activate (Figure 10).



gms11.bmp

Figure 10. Software Window - Typical Setup

Note

If the LEM will be used with the RUSKA 2482, it is recommended that the RUSKA 2482 Driver installation and verification be completed before installing the LEM Driver. This will simplify the resolution of any configuration issues that may arise.

Note

The RUSKA 2482 Window can function as a Stand-Alone program without ***WinPrompt®****. Simply close* ***Winprompt®*** *and activate the DP2482.exe from the File Manager. The DP2482.exe program is installed in the same directory structure created for* ***WinPrompt®.***

When communication is established between WinPrompt® and the RUSKA 2482, the status bar in WinPrompt® will turn green and the grams reading in the RUSKA 2482 window will update. The status bar is located on the bottom and center of the WinPrompt® window (see Figure 10).

Troubleshooting Communication Setup

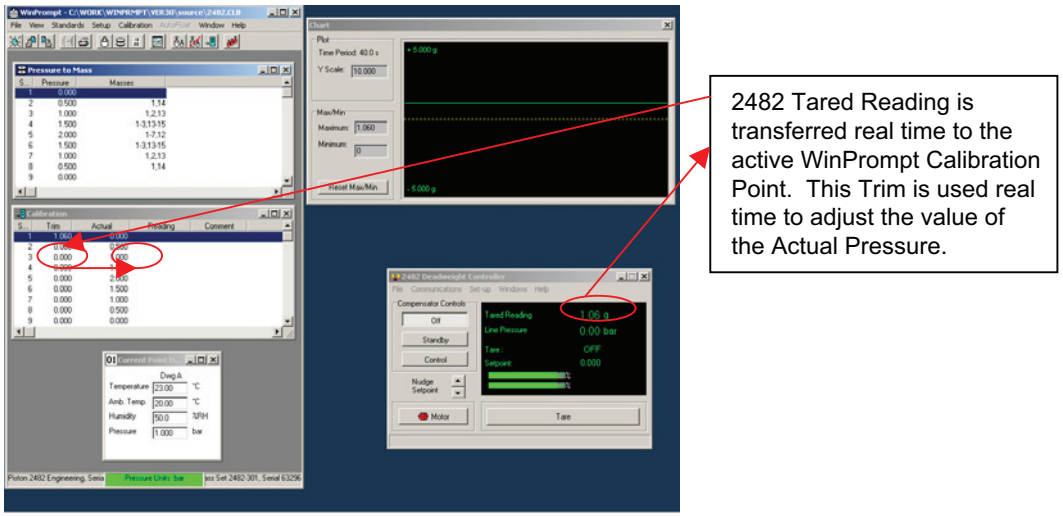
1. Verify the following in the RUSKA 2482 communications window:
   a. Port menu: select Com Port being used
   b. Address: Type **41**
2. Verify the serial cable is a straight through cable.
3. Verify that the power is applied to the RUSKA 2482 instrument. The LED on the RUSKA 2482 instrument will turn on when power is applied.

WinPrompt® Software

WinPrompt® performs pressure-to-mass and mass-to-pressure calculations for the RUSKA 2482 Differential Pressure Piston Gauge. It provides the operator with the pressure being generated by a required mass load while correcting for environmental influences.

The RUSKA 2482 can be used without WinPrompt® by selecting the *DP2482.exe* directly from the directory in which WinPrompt® was installed.

Figure 11 shows a typical setup of WinPrompt® for a RUSKA 2482 calibration. The Setup of WinPrompt® is described in the WinPrompt® manual. As an overview, the user will set up several files and configure how WinPrompt® receives information. Most of this setup is performed rather infrequently, and is typically required only when a procedure is edited, a piston and mass set is being used for the first time, or when a piston or mass set has been recalibrated. The environmental conditions for humidity, barometric pressure, and ambient Temperature can be entered manually or the values can be acquired from a RUSKA 2456-LEM Laboratory Environment Monitor.



gms12.eps

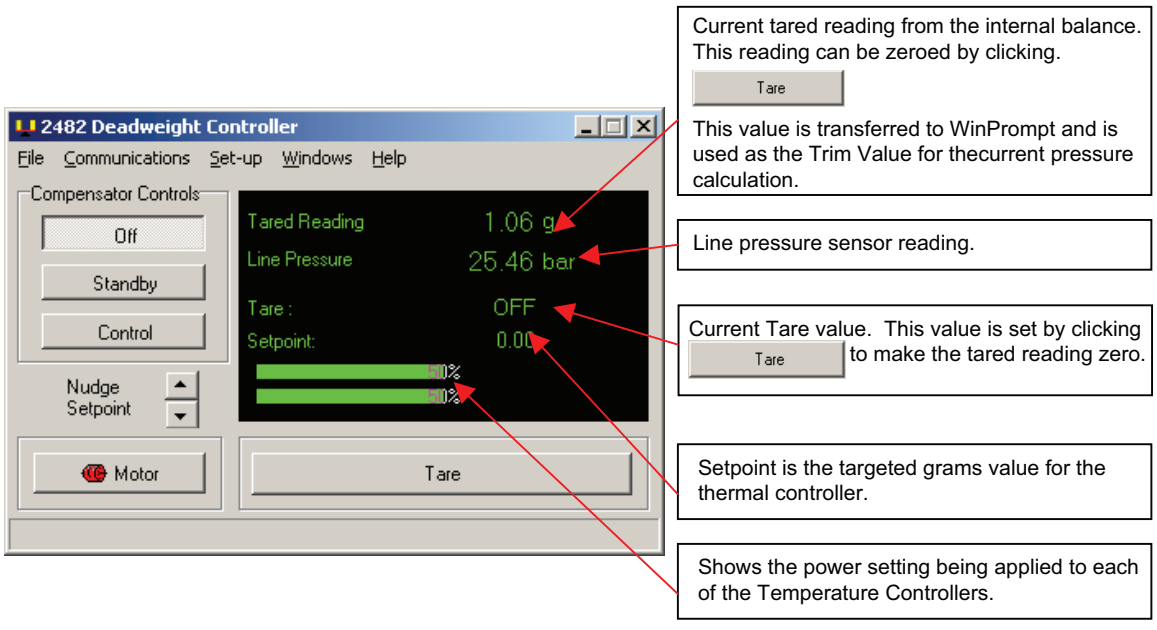
Figure 11. RUSKA 2482 - WinPrompt® - Typical Setup

A typical setup for the RUSKA 2482 is shown in Figure 11. Above left is the WinPrompt® window; above right is the chart window, and below right is the RUSKA 2482 deadweight controller window

RUSKA 2482 Software

The RUSKA 2482 Deadweight Controller window is the primary operation window of the RUSKA 2482 software. It shows the current state and provides buttons for the major operations of the RUSKA 2482. It also provides for setup, calibration, and opening of all other windows available in the RUSKA 2482.

The Current Status window (see Figure 12) shows the following items:



gms13.eps

Figure 12. RUSKA 2482 Deadweight Controller - Current Status Window

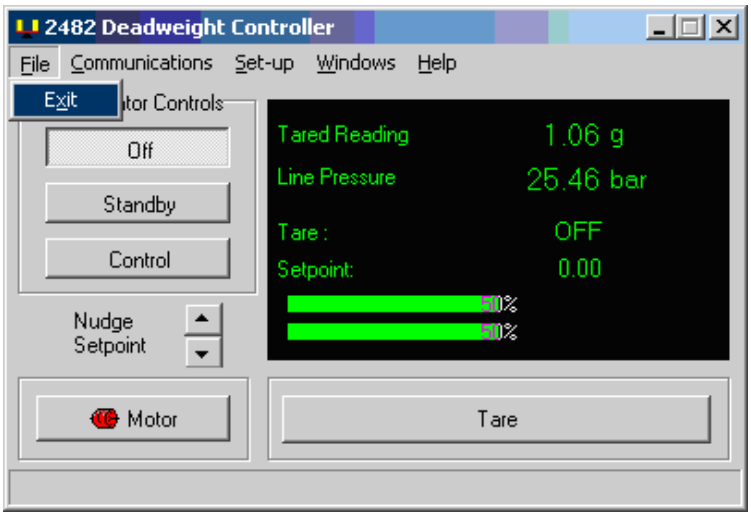
The Compensator control loop is turned on and off by these buttons:

Button	Action
Off	**Off**
	No compensation, no heating nor cooling is done.
Standby	**Standby**
	The temperature controllers are being biased to defined presets. The heating is constant and not affected by the Tared Reading. This mode provides increased control distance in one direction by biasing. Temperature should be allowed to stabilize in this mode before attempting Control mode.
Control	**Control**
	Temperature controllers are actively controlling in order to bring the Tared Reading to Setpoint.
▲ ▼	**Nudge Setpoint**
	Adjusts the setpoint in small increments
Motor	**Motor**
	Turns motor on (green) and off (red).
Tare	**Tare**
	Zeros the Tared Reading by changing the tare value. This is used to remove offsets in the Tared Reading while the piston is equalized.

Menu Commands

Menu: File | Exit

When running as a standalone program, File → Exit closes the application. A warning will appear if attempting to exit while the controller is running.

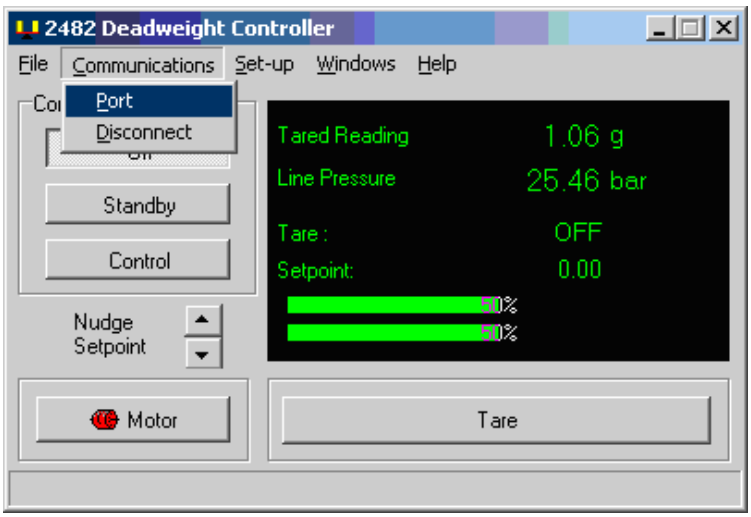


gms14.bmp

Figure 13. File Menu

Menu: Communications | Port

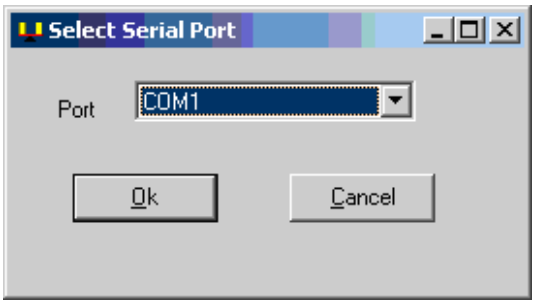
Allows selection of the communication port to which the RUSKA 2482 is connected. The RUSKA 2482 requires RS-232 serial port communications. RUSKA serial port may be directly connected to the PC or connected to the USB port using the RS-232/USB converter cable. The Comm Port selection dialog will be displayed.



gms15.bmp

Figure 14. Communications Menu

Click the drop-down arrow next to the current selection to see the available communication ports. If the port is not listed it is not installed correctly in Microsoft® Windows or is not connected to the USB port. Select the correct port and then press Ok.



gms16.bmp

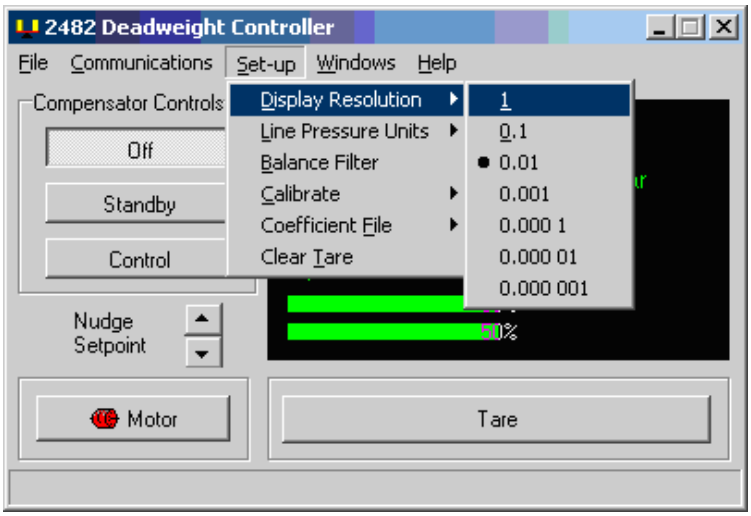
Figure 15. Comm Port Selection

Menu: Communications | Disconnect | Connect

Clicking this menu item will disconnect and connect the communications port. This will reset the communications port and re-establish communications.

Menu: Set-up | Display Resolution

Selects the number of decimal places shown in the Main window for the Tared Reading.

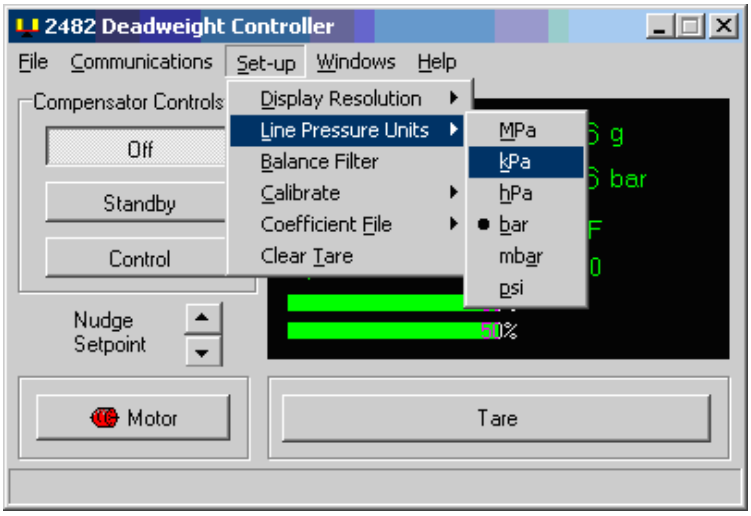


gms17.bmp

Figure 16. Display Resolution Selection

Menu: Set-up | Line Pressure Units

Selects the units for the Line Pressure displayed in the Main window.

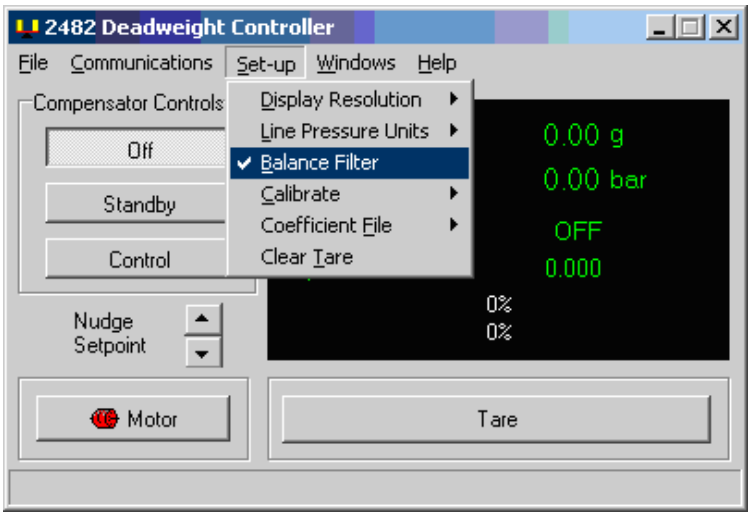


gms18.bmp

Figure 17. Line Pressure Units Selection

Menu: Set-up | Balance Filter

Select the Balance Filter to turn on and off. If a check mark appears in the Menu beside Balance Filter, then the filter is enabled. The type and amount of filtering is set in Windows | Control + Filter window.

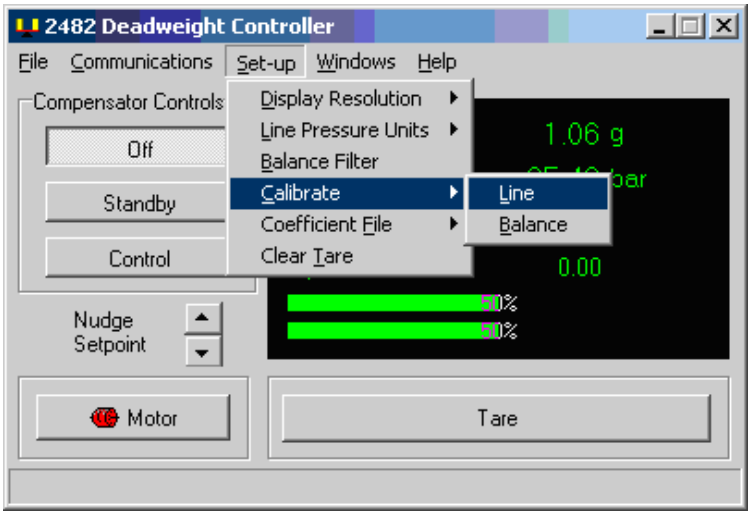


gms19.bmp

Figure 18. Balance Filter Selection

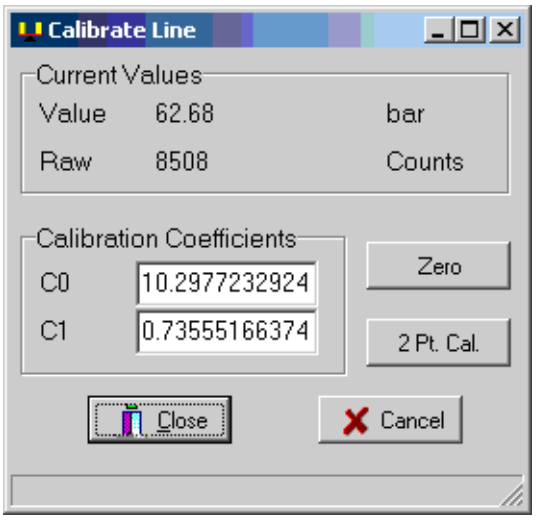
Menu: Set-up | Calibrate | Line

Displays the dialog for calibration of the line pressure transducer.



gms20.bmp

Figure 19. Calibration Selection



gms21.bmp

Figure 20. Calibrate Line Pressure

To zero the Line sensor: Set-up → Calibrate → Line

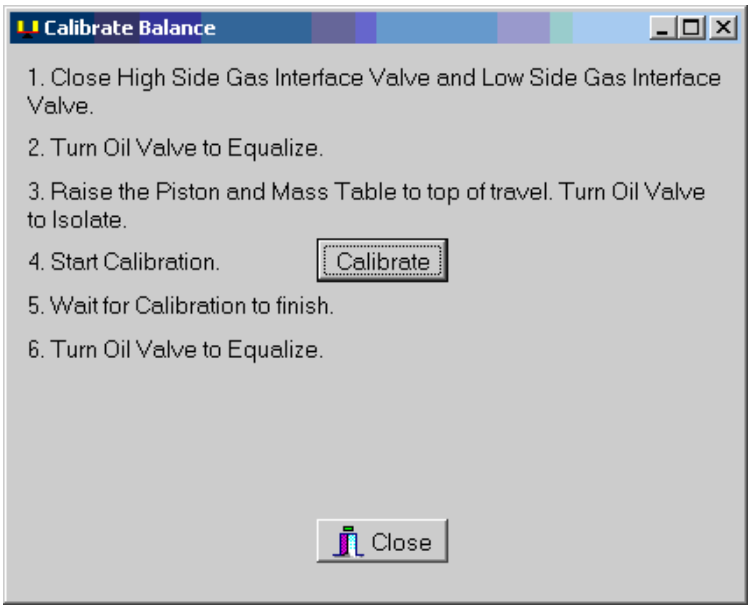
1. Click Zero.
2. Release pressure from the line sensor or apply a known low pressure.
3. Enter the Actual pressure.
4. Click Accept. The C0 coefficient will be adjusted to give the correct pressure reading.
5. Click Close.

To calibrate the line sensor: Set-up → Calibrate → Line

1. Click 2 Pt. Cal.
2. Apply the first known pressure.
3. Enter the Actual pressure.
4. Click Accept. The dialog for the second point will be displayed.
5. Apply the second known pressure.
6. Enter the Actual pressure.
7. Click Accept. C0 and C1 will be adjusted to calibrate the line pressure sensor.
8. Click Close.

Menu: Set-up | Calibrate | Balance

This shows the step-by-step procedure necessary to calibrate the internal balance.

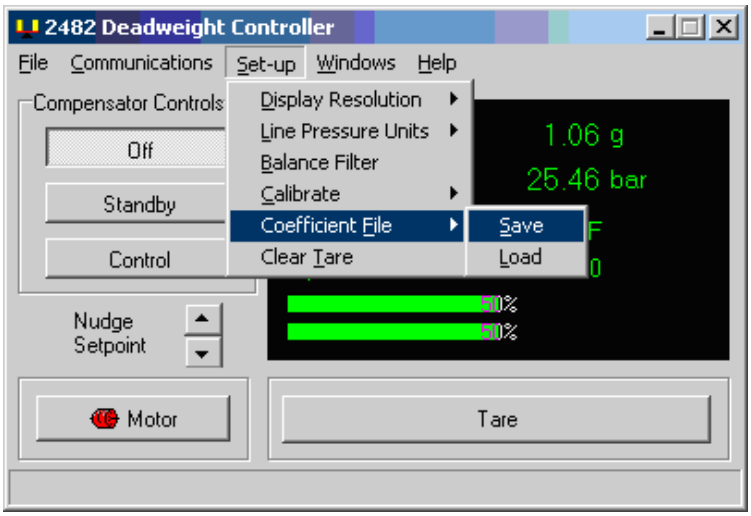


gms22.bmp

Figure 21. Calibrate Internal Balance

Menu: Set-up | Coefficient File | Save

The Coefficient File options allow the user to Save and Load all of the calibration and setup of the RUSKA 2482 software. Selecting Save will write the coefficients to a user selected filename. Selecting Load will retrieve the coefficients from a user selected file. The loaded coefficients will be written to the non-volatile memory in the RUSKA 2482 instrument.



gms23.bmp

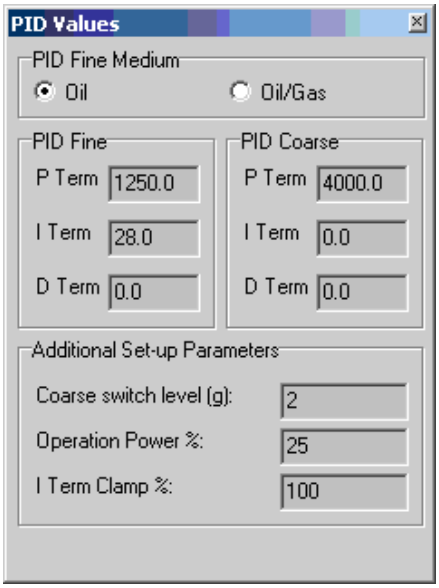
Figure 22. Saving/Loading Coefficient Files

Menu: Set-up | Clear Tare

The Clear Tare option will remove the effect of taring the balance. The tare value will be set to zero and the Tared Value will show the reading directly from the Balance.

Menu: Windows | PID Values

Displays the selected medium and the current control coefficients.



gms24.bmp

Figure 23. PID Values with Control Coefficients

PID Fine Medium

This selects one of two sets of coefficients, the first for Oil calibrations, and the second for Oil/Gas calibrations. This affects the Fine Coefficients only.

PID Fine/Coarse

These are coefficients for the instrument controller. There are two sets of Fine coefficients, one for Oil calibrations, and a second for Oil/Gas calibrations. The Coarse coefficients are used for both calibration types. These coefficients are set at the factory and normally are not changed.

Additional Setup Parameters

These can be edited and are written to instrument memory as each value is changed.

Coarse switch level (g)

This defines the Tared reading at which the switch from Fine to Coarse, and from Coarse to Fine, coefficients is made. It is entered as an absolute value, and is used as a positive and a negative limit.

Operation Power %

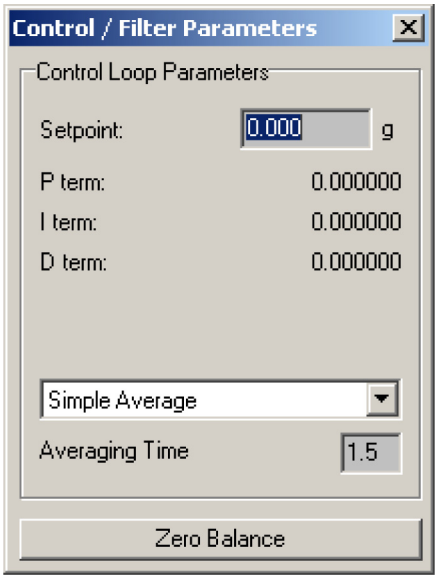
This sets the level for biasing the temperature controllers for Standby mode. Typical settings 25 % – 30 % for extended calibration; 30 % – 50 % otherwise.

I Term Clamp %

This is used to limit the I term to a reasonable value.

Menu: Windows | Control + Filter

Displays the current setpoint, control terms, and the filtering method. Setpoint is the same as in the main window but also allows entering a new value. This also is affected by the nudge buttons on the main window. The control terms is used during tuning and shows the contribution of each term to the control output.



gms25.bmp

Figure 24. Control/Filter Status

The filter type and time constant may be changed for additional filtering of the Balance Reading.

Note

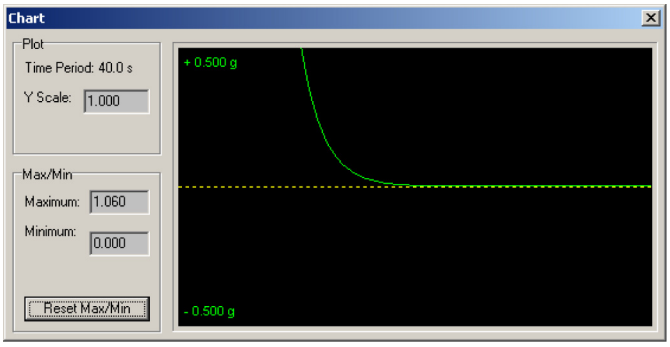
Setup | Balance Filter must be checked for the filter to be used.

The filter time constant has the units of seconds and can be entered in 0.1 increments. Most system noise will occur at piston rotation speed, which is approximately 0.5 Hz (2 seconds). Best results are achieved when the Averaging Time is set for 0 to 0.5 seconds or adjusted to the motor period. Setting the Averaging Time equal to approximately 2.1 will remove most Filter aliasing and rotational noise.

The Zero Balance button can be used to zero the internal balance.

Menu: Windows | Chart

Displays a graph of the balance reading.



gms26.bmp

Figure 25. Tared Reading Graph

Y Scale defines the total vertical scale in grams, with half of the range above zero, and half below the zero point. Change this value to zoom the graph in or out.

Maximum is the highest Tared Reading since Reset Max/Min was clicked.

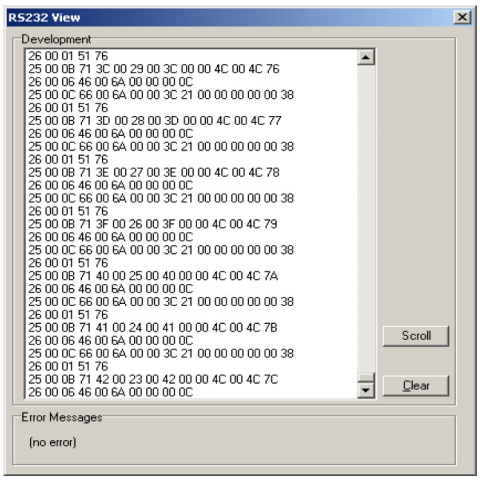
Minimum is the lowest Tared Reading since Reset Max/Min was clicked.

Clicking 

will set the maximum and minimum to the current Tared Value.

Menu: Windows | RS-232 Viewer

This window is useful in solving communication problems. When the instrument is operating normally, this window can be closed.



gms27.bmp

Figure 26. RS-232 View

Development

Displays, in a hexadecimal format, the serial communication strings that have been transmitted and received. A line that begins with a “26” is a transmission to the instrument, while a line that begins with a “25” is a response received from the instrument. The newest lines are added to the bottom of the box.

Scroll

Pressing this button toggles a setting that will either stop or start the scrolling of the communication strings. Stopping the scrolling, allows manual scrolling of the box to view specific data.

Clear

Erases existing strings from display.

Operation

Power On Sequence

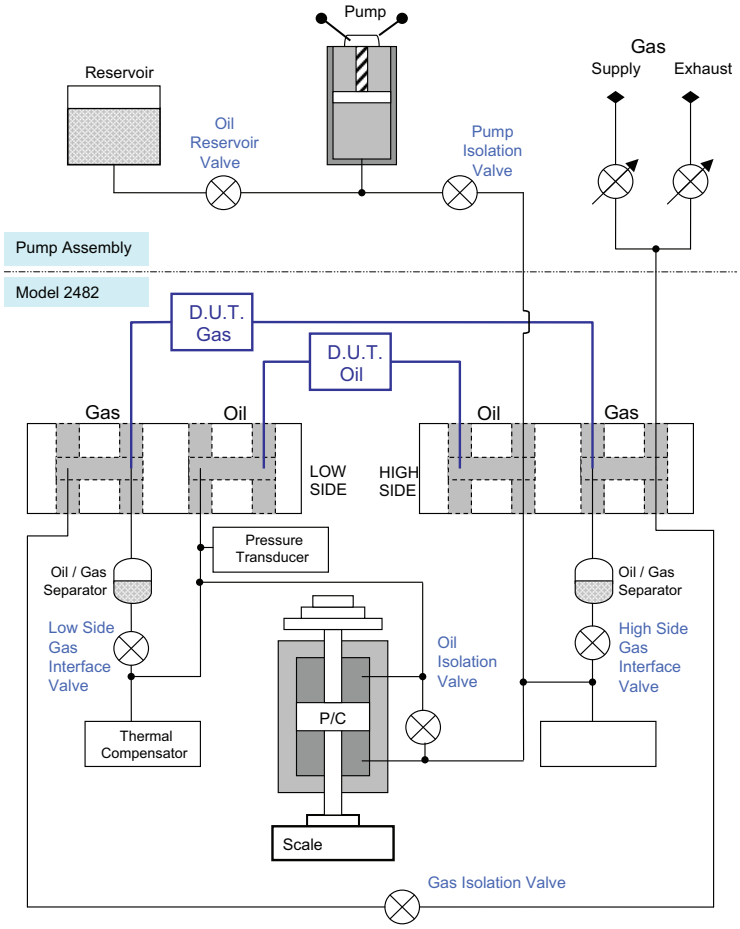
The Internal Balance will perform an automatic internal zero when power is initially applied. When performing a zero, the internal balance will null the mass load applied to the balance. The value of the Tared Reading as displayed by the RUSKA 2482 software, is influenced by the starting condition of the Balance.

An internal zeroing of the Balance can be executed by pressing Zero Balance, found in the **Windows | Control + Filter** screen.

An internal zeroing of the Balance is performed as a part of the Balance alignment, **Set-up | Calibrate | Balance**. After a balance calibration, the Tared value is cleared (**Set-up | Clear Tare**) and with the motor turned on, then the Tared Reading will be equivalent to the total mass of the piston and mass table (~935 grams).

Since the Balance is used as a reference device, the ~935 grams can be zeroed by pressing Zero Balance. This will remove the large offset from the Tared value of the RUSKA 2482 software.

To insure a proper starting condition for the system, it is recommended that the Balance Calibration be performed after a power cycle.



gms28.eps

Figure 27. System Piping Diagram

Differential Measurements Using Dioctyl Sebacate (DOS) Oil

This Section applies when the Test Instrument is tested using DOS hydraulic fluid and is connected to the Oil test ports of the **RUSKA 2482**.

PID Selection

Verify that the Oil PID option is selected (see Figure 23).

Connecting the Device Under Test (DUT)

Close the **High Side Gas Interface Valve** and **Low Side Gas Interface Valve**. The Gas system is not required. Close the **Gas Supply Metering Valve** and open the **Gas Exhaust Metering Valve** to de-energize the Gas system.

Set the **Oil Isolation Valve** to Equalize, open the **Pump Isolation Valve**, and open the **Oil Reservoir Valve**. The system should be at ambient pressure.

Connect the high pressure test port of the DUT to the HIGH SIDE OIL port of the RUSKA 2482. Connect the low pressure test port of the DUT to the LOW SIDE OIL port. When making these connections remove only one fitting at a time. This will minimize the oil loss while making these connections. If both fittings must be removed at the same time then close the **Oil Isolation Valve**. This will minimize the loss of the DOS oil by not allowing a flow to be established through the manifold.

⚠ Warning

All tubing and fitting used to connect the Device Under Test to the RUSKA 2482 must be rated for safe operation to at least 2975 psi (205 bar).

Purge the air from the interconnect tubing. Put the **Oil Isolation Valve** in Equalize mode. Open a fitting at the highest elevation where air would be trapped or use the purge valves built into many differential transducers. Cycle the pump to drive oil into the system until oil begins to flow through the loose fitting. Tighten all fittings.

If the air has been purged, the turning of the pump handle less than 1/2 turn will result in a Line Pressure increase. If the pressure does not respond appropriately, then attempt to further purge the air from the system. Cycling of the Line pressure will force the air into saturation. Turning on the Motor will help work the air out of the system.

If the **RUSKA 2482** had a major loss of oil, then refer to the Maintenance section for techniques to fill the system.

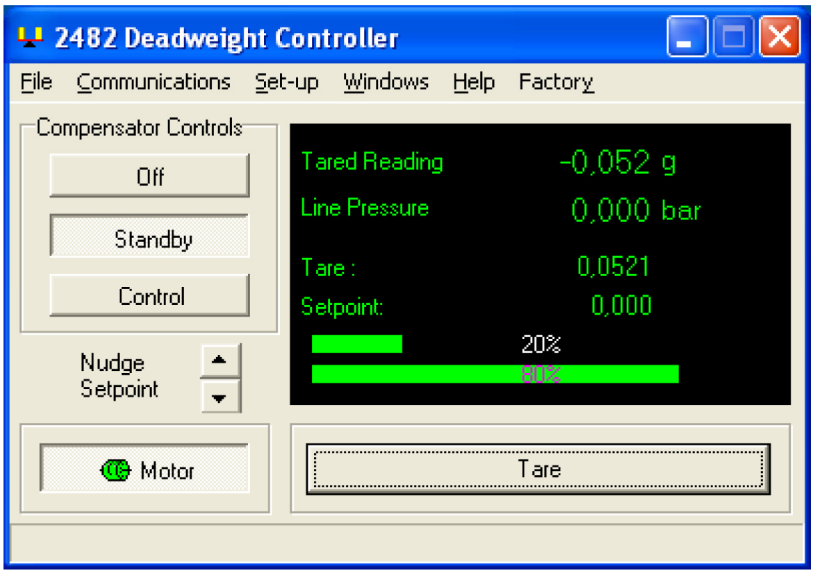
Generate Differential Pressures — Hydraulic

1. Select 

to activate the motor rotation. Light will turn green as seen in Figure 28.

2. Select 

to activate the pressure control bias to increase control capacity. This will allow the system to stabilize at the pre set bias, refer to the Software section (Windows | PID Value-Operation Power %). This will take about 15 minutes prior to a calibration sequence to provide the maximum control capacity for the system. This step may be unnecessary for short calibration cycles.



gms29.bmp

Figure 28. Activating the Pressure Control Bias

3. With **Oil Reservoir Valve** closed, and the **Oil Isolation Valve** in Equalize, rotate the hand pump clockwise to generate the desired line pressure. If barometric line pressure is desired then do not rotate the hand pump.
4. When the thermal effect caused by the line pressure change has subsided and the Tared Reading in the Deadweight Controller screen has stabilized, then press Tare. The Tared Reading should be zero. Zero Differential pressure is now applied to the test item.
5. Set the **Oil Isolation Valve** to Isolate, apply weights corresponding to the desired differential pressure, and press Control. When the control system regulates the differential pressure for a Tared Reading of zero, then the desired differential pressure is applied to the DUT.

⚠ Caution

Turning the hand pump can generate large differential pressures when the Oil Isolation Valve is in the Isolate position.

Note

If the desired differential pressure requires an increment smaller than that available in the mass set, then use the ▲▼ *to adjust the Setpoint value. The desired differential pressure is achieved when the Tared reading stabilizes to the Setpoint value. When finished with this pressure point, in order to obtain the next nominal differential pressure, use* ▲▼ *to zero setpoint.*

6. Apply the weights for the next differential point and wait for the Tared Reading to stabilize.
7. When all differential observations are complete, select Off or Standby, remove all the weights, and turn the **Oil Isolation Valve** to Equalize. Zero differential pressure is now applied to the DUT.
8. Repeat steps 1 through 7 for each line pressure measurement.
9. When all measurements are complete, turn the **Oil Isolation Valve** to Equalize, reduce the line pressure to ambient, select Motor to deactivate the motor rotation, and select Off.

Techniques for Extended Calibrations

The procedure outlined in Generating Differential Pressures — Hydraulic, relies on the Thermal Compensation circuit to control the differential pressure change from one differential pressure to the next. During an extended calibration series the capacity of the controller may be exceeded. This will be indicated by the inability of the control system to establish or maintain the desired differential pressure. When the bar graphs in the DeadWeight Controller screen are at their limits (the top bar greater than 80% and the bottom bar is less than 20%) and the differential pressure does not come closer to the desired level after several minutes, then the controller capacity has likely been exceeded.

Option 1

To recover the control capacity press Standby, remove all weights, turn the **Oil Isolation Valve** to Equalize, and wait about 20 minutes before generating further differential pressures. It is not necessary to remove the line pressure for control capacity recovery.

Option 2

The control capacity can also be conserved by using the Hand Pump to bring the differential pressure closer to the zero indication. Before changing the masses to obtain a new differential pressure, place the controller into Standby, then use the hand pump to get close to the next Differential pressure. Place the controller back into Control.

Differential Measurements Using Compressed Gas

This Section applies when the Test Instrument is tested with compressed gas and is connected to the GAS test ports of the **RUSKA 2482**. Refer to the specifications for the requirements for the quality of compressed gas.

PID selection

Verify that the Oil/Gas PID option is selected (see the Software section, Figure 4-13, PID Values with Control Coefficients).

Verify Gas Supply Connection

Verify the proper installation of the gas supply system (see the Installation section).

Using the Oil/Gas Interfaces

The oil to gas interface windows allow the maintenance of the oil levels in the system. The oil level can be manipulated with the hand pump.

To equalize the fluid levels in the oil/gas interfaces:

1. Equalize the system; Put the **Oil Isolation Valve** and **Gas Isolation Valve** in Equalize mode.
2. Open the **Low** or **High Gas Interface Valve**.
3. Use the Hand pump to push/pull oil from the site glass until the fluid level is near the middle of the window.
4. Close the **Gas Interface Valve** and repeat these steps for the other side.

If the system is left in Equalize mode: **Low/High Gas Interface Valves** open and the **Oil and Gas Isolation Valves** open then the system will eventually equalize. But this will take a long time since the only driving force is the Head height between the two interface windows.

Note

*The Operation section details the valve sequencing required to generate line and differential pressures. The **Low/High Gas Interface Valves**, located on the sides of the RUSKA 2482 chassis, will be open during the following Gas Mode operations. The **Oil and Gas Isolation Valves** on the front panel will be in the four possible states listed in the table below.*

Table 2. Oil and Gas Isolation Valves - States

State	Oil Isolation Valve	Gas Isolation Valve
Equalize/ZeroΔP	Equalize	Equalize
! Caution — Avoid !	Equalize	Isolate
Transition	Isolate	Equalize
Operate	Isolate	Isolate

Use the **Transition** state to change between the Equalize/ZeroΔP and Operate states. Avoid the condition where the **Oil Isolation Valve** is in Equalize and the **Gas Isolation Valve** is in Isolate. In this mode a differential Gas pressure may push Oil out of the RUSKA 2482.

Connecting the Device Under Test (DUT)

Since this is a true oil/gas interface, care is required to insure that oil is not allowed to migrate into the DUT. This is done by keeping positive pressure on the oil. If vent ports are required on the lines between the **RUSKA 2482** and the test unit, then place these vent valves near the **RUSKA 2482**.

1. Turn the Oil Isolation Valve and Gas Isolation Valve to Equalize.
2. Close the High Side Gas Interface Valve and Low Side Gas Interface Valve.
3. Ensure the hydraulic system is at ambient pressure:
   a. Open the Pump Isolation Valve.
   b. Open the Oil Reservoir Valve.
4. Ensure the pneumatic system is at ambient pressure:

5. Close the **Oil Reservoir Valve**. If the **Pump Isolation Valve** is closed then the pump will not be used to recharge the oil side during operation.
   a. Open the High Side Gas Interface Valve.
   b. Open the Low Side Gas Interface Valve.
6. Connect the DUT high pressure test port to the High Side Gas Port of the **RUSKA 2482**.
7. Connect the DUT low pressure test port to the Low Side Gas Port of the **RUSKA 2482**.

⚠ Warning

All tubing and fittings used to connect the DUT to the RUSKA 2482 must be rated for safer operation to at least 2975 psi (205 bar).

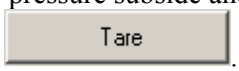
⚠ Caution

The High Side Oil Port and Low Side Oil Port of the RUSKA 2482 are not used in this test and must be capped or plugged.

Generate Differential Pressures — Gas

1. Verify the High Side Oil Port and Low Side Oil Port are capped or plugged.
2. Select 

to activate the motor rotation.
3. Select 

to activate the pressure control bias to increase control capacity. This will allow the system to stabilize at the pre set bias, refer to the Software section (Windows | PIDValue — Operation Power %). This will take approximately 15 minutes prior to a calibration sequence to provide the maximum control capacity for the system. This may be unnecessary for short calibration cycles.
4. Close the **Gas Exhaust Metering Valve**. For barometric line pressure do not open the **Gas Supply Metering Valve**. Otherwise, carefully open the **Gas Supply Metering Valve** to produce the desired line pressure.
5. When the thermal effects caused by the change in the line pressure subside and the Tared Reading in the Control Screen is stable, then select 

. The Tare status should display a numeric value. If the Tared Reading is zero then zero differential pressure is applied to the test instrument.
6. Set the **Oil Isolation Valve** to Isolate. Set the **Gas Isolation Valve** to Isolate. Apply weights corresponding to the desired differential pressure.
7. Operate the **Gas Exhaust Metering Valve** and the **Gas Supply Metering Valve** to produce the desired differential pressure to within 3 grams as indicated by the Tared Reading in the controller screen, then select 

. When the control system regulates the differential pressure for a Tared Reading of zero, the desired differential pressure is applied to the test instrument.

Note

If the desired differential pressure requires an increment smaller than that available in the mass set then use the  *function to adjust the setpoint value. The desired differential pressure is achieved when the Tared reading stabilizes to the setpoint value. When finished with this pressure point, use the*  *function to zero the setpoint in order to obtain the next nominal differential pressure.*

8. Apply the weights for the next differential pressure and wait for a stabilized Tared reading.
9. When all the differential observations are complete:
   a. Select  .
   b. Remove all the weights.
   c. Set the **Gas Isolation Valve** to Equalize.
   d. Set the **Oil Isolation Valve** to Equalize.

   Zero differential pressure is now applied to the test instrument.
10. Repeat steps 2 through 9 for each line pressure measurement series.
11. When all measurements are complete, reduce the line pressure to ambient by carefully opening the **Gas Exhaust Metering Valve**. Turn off the motor by pressing  .

Techniques for Extended Calibrations

During an extended calibration series the capacity of the controller may be exceeded. This will be indicated by the inability of the control system to establish or maintain the desired differential pressure. When the bar graphs in the Deadweight Controller screen are at their limits (the top bar greater than 80% and the bottom bar is less than 20%) and the differential pressure does not come closer to the desired level after several minutes then the controller capacity has likely been exceeded.

To recover the control capacity:

1. Press  .
2. Remove all weights.
3. Turn the **Gas Isolation Valve** to Equalize, then turn the **Oil Isolation Valve** to Equalize.
4. Wait about 20 minutes before generating further differential pressures. It is not necessary to remove the line pressure for control capacity recovery.
5. Repeat steps 2 through 9 in the Generating Differential Gas Pressure section.

Head Height

Since the RUSKA 2482 is a differential unit with the same media on both ports the issue of head height is negligible in most applications.

In Gas mode operations:

During the Stabilization period after a line pressure adjustment but before zeroing the RUSKA 2482 and Device Under Test, the oil levels in the sight glasses will move towards the same height while the **Oil Isolation Valve** is in Equalize mode.

If the oil levels in the two sight glasses are not identical when the zero is performed but the oil levels remain constant during the calibration series, then the head height does not matter as it is incorporated in the zero setting.

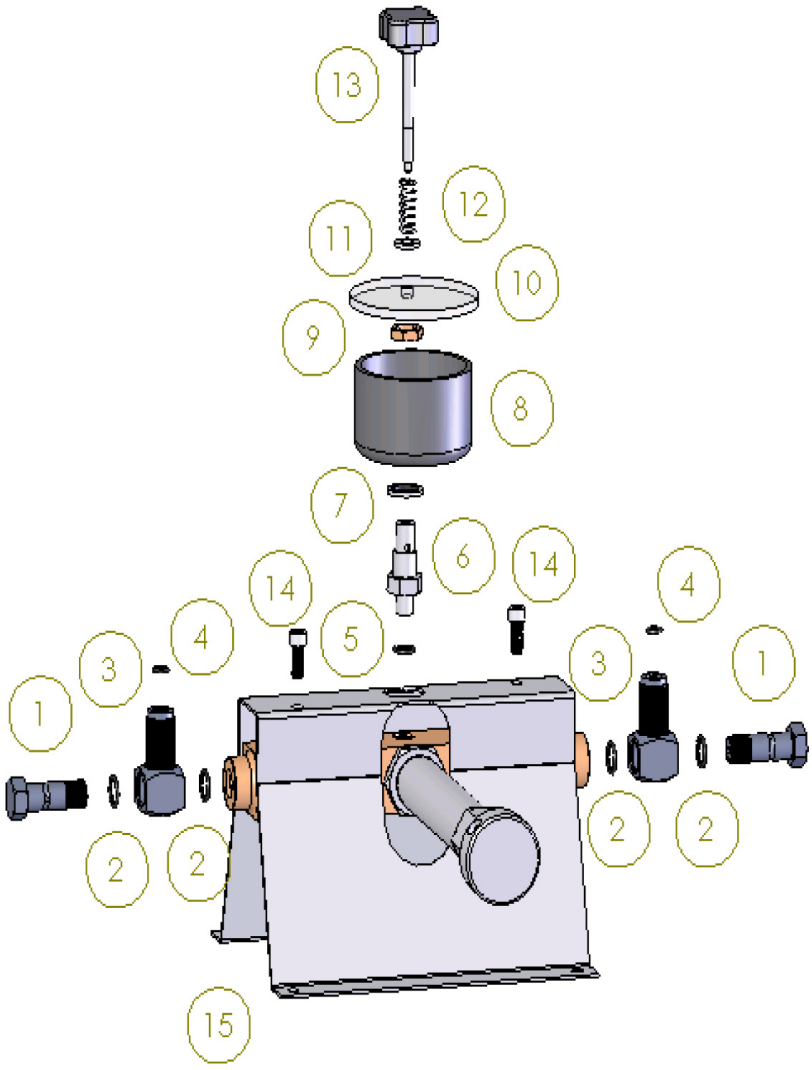
The only hydraulic head pressure that contributes to the test instrument error is the change in the height offset between the two sight glasses during a calibration run between zeroings. This change in hydraulic head pressure results from the leakage from the High Pressure Port to the Low Pressure Port during large differential pressure runs. Given the relatively small volumetric leakage of the RUSKA 2482 piston compared to the large displacement volume of the sight glass, the impact on oil head errors will be insignificant in most applications.

Maintenance

Pump

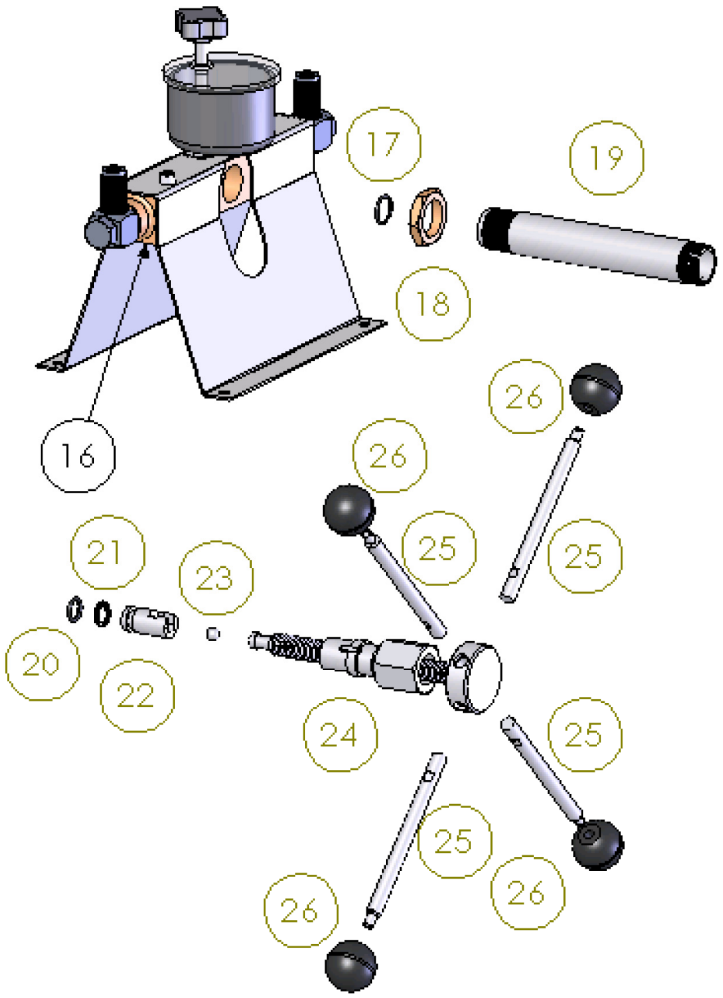
The figures in this section detail the components of each assembly together with the relevant part numbers. Where “ASSY” appears as a part number, this component is associated with other components in an assembly for replacement purposes.

Before beginning any maintenance, remove any instruments that may be mounted to the test pump, and drain the fluid from the system.



gms30.bmp

Figure 29. Reservoir and Test Port Assemblies



gms31.bmp

Figure 30. Screw Press Assembly

Table 3. Reservoir/Test Port Assemblies and Screw Press Assembly - Parts List

ITEM	DESCRIPTION	PART
1	Banjo Bolt	P101230
2	O Ring	P103614
3	Banjo Test Port	P101226
4	O Ring	P103606
5	O Ring	54-703-12
6	Valve Body	SDW5790
7	Bonded Seal	P109740
8	Reservoir	P103647
9	Locknut	P101206
10	Reservoir Cover	P101263
11	Nylon Washer	91-382

ITEM	DESCRIPTION	PART
12	Spring	S421-202-41
13	Valve Stem Assembly	PPA9118
14	Screw	70-174-2101
15	Pump Stand	P101224
16	Manifold	P101225
17	O Ring	54-703-16
18	Locknut	P101023
19	Barrel	P103932
20	O Ring	54-703-111
21	Back-Up Ring	P104708
22	Rambler	P103904
23	Ball	P101022
24	Lead Screw Assembly	PPA9119
25	Spoke	P109314
26	Knob	P101021

Screw Press Seals

1. Turn the screw press out so that there is a distance of at least 1 in/2.5 cm between the large union nut at the end of the barrel and the capstan hub.
2. Unscrew the union nut and withdraw the lead screw assembly (24) from the barrel, taking care not to drop the rambler (22).
3. Inspect the seals for signs of wear or damage. Replace as necessary.
4. The white anti-extrusion ring (21) is a PTFE spiral and can be removed by unwinding it from the rambler.
5. Do not use a sharp tool that will scratch the surfaces of the rambler when removing the rambler seal. This can cause the seal to leak when reassembled.
6. Ease the replacement rambler seal over the front of the rambler and into the groove.
7. Wind the new anti-extrusion ring into the groove in the rambler behind the rambler seal.
8. If the rambler is separated from the lead screw, ensure that the ball (23) is correctly fitted before reassembly.
9. Verify that the rambler assembly is correctly located on the end of the lead screw assembly. Carefully introduce the rambler into the open end of the barrel, making sure that it does not tilt when entering the barrel.
10. Push the lead screw assembly fully into the barrel, ensuring that the key in the nut locates correctly in the slot in the barrel.
11. Re-tighten the barrel union nut.

Note

If the lead screw assembly (24) shows signs of excessive wear, the associated components will also need to be replaced. The screw press assembly is available as a spare part.

Complete Disassembly

1. Remove the screw press assembly as described above.
2. Unscrew and remove valve stem (13), taking care not to lose spring (12) and nylon washer (11).
3. Remove reservoir cover (10).
4. Unscrew locknut (9), and remove reservoir (8).
5. Unscrew body valve (6), taking care not to lose bonded seal (7) or o-ring (5).
6. Remove banjo bolts (1) together with banjo test ports (3), taking care not to lose o-rings (2).
7. Disconnect the stand (15) from the bench. Remove screws (14). Tilt manifold/barrel assembly downward and pass it out of the bottom of the stand.
8. Loosen the locknut (18) approximately ½ turn to remove the barrel (19). Unscrew the barrel (19) from the manifold (16).
9. Verify the barrel seal (17) is correctly located in the counter-bore in the front of the barrel before re-fitting barrel. Screw the barrel fully into the test station and secure with the locknut.
10. Inspect all seals for wear or damage. Replace as necessary.

Note

If the rambler shows signs of wear, the main bore will be worn also. When the bore is worn or scratched, it will not seal correctly and may leak under pressure.

Reassembly is the reverse of the above. Ensure that all seals and sealing surfaces are clean and undamaged.

Full System Purge of Air

When the system is free of air and closed, rotate the pump one-half turn to generate system line pressure.

Open only one port at a time to prevent loss of oil. An Oil loss can create a flow path through the system. If multiple ports must be opened at the same time, use the Isolation Valves to isolate the system parts to prevent flow paths through the system.

Use these basic steps to purge air from the hydraulic system:

1. Remove all pressure from the system.
2. Verify that the Pump and Reservoir are connected to the High Pressure Port.
3. Remove all test instruments.
4. Set the **Oil Isolation Valve** and **Gas Isolation Valve** to Equalize Mode.
5. Close the **Low Side Gas Interface Valve** and **High Side Gas Interface Valve** located on the side of the RUSKA 2482.

Additional connections:

Tubing MUST be rated for full line pressure. The purpose of this tubing and valve is to be a high point in the system for forcing out the air while filling the system with oil. The tubing also allows oil that is lost to be easily directed to an open contained.

1. Connect tubing to the Low Side Oil Port.
2. Connect a *shut off valve* to the end of the tubing.

Major Purge Process

1. Close the Pump Isolation Valve.
2. Open the *shut off valve*.
3. Rotate the Pump to force oil through the instrument until no bubbles are noted at the low port *shut off valve*.
4. Close the low port *shut off valve*.
5. Open the Oil Reservoir Valve and refill the Pump.
6. With the Oil Reserve Valve open, lift the weight loading table and hold it at the top of travel.
7. Set the Oil Isolation Valve to isolate.
8. Open the low port *shut off valve*.
9. Push down on the weight table and hold it at the bottom of travel.

⚠ Caution

Do not allow the weight table to return to a normal position while the low port *shut off valve* is open!

10. Close the low port *shut off valve*.
11. Set to **Oil Isolation Valve** to Equalize.
12. Close the Pump Isolation Valve.
13. Open the low port *shut off valve*.
14. Rotate the Pump to force oil through the instrument until no bubbles are notes at the low port *shut off valve*.

Repeat Major Purge Process Steps 4 through 14 until no bubbles are noted at the low port *shut off valve*.

Minor Purge Process

The Major Purge Process may not remove all the trapped air. The remainder of the trapped air may be removed by the following steps:

1. Close the low port shut off valve.
2. Set the **Oil Isolation Valve** to Equalize.
3. Use the Pump to pressurize the system to full line pressure.
4. Close the **Pump Isolation Valve** and refill the Pump.
5. Allow the system to remain pressurized about 2 hours to allow the gas to dissolve into the oil.
6. Pressurize the Pump and open the **Pump Isolation Valve**. The system should still be at full line pressure.

7. SLOWLY open the low port *shut off valve* while rotating the hand pump to maintain pressure near full line pressure.
8. As the Pump nears the end of stroke, allow the system to decrease to ambient pressure.

15. Close the low port *shut off valve* and open the **Pump Isolation Valve**.

Repeat these steps as needed to remove additional air from the system.

Balance Removal/Installation

If the Balance must be removed for maintenance, then remove the main cover only. Do not remove the screws connecting together the Top Plate, Back Plate and Bottom plates. Only remove the screws connecting the main cover to the other plates.

1. Disconnect power.
2. Remove pressure from the system.
3. Remove the power and Communications cables from the Balance.
4. Put the **Oil Isolation Valve** to Equalize.

Note

System ports must be sealed to prevent oil loss.

5. Raise the Piston and put the **Oil Isolation Valve** to Isolate Mode. This will keep the Piston Spring clear of the Balance.
6. Remove the screws from the front and rear of the Balance mounting plate.
7. Slide the Balance and Mounting Plate out the front of the instrument.

Install the Balance by reversing the steps.

Leveling the Balance

Leveling the Balance is critical when installing the Balance. Be sure that the Mounting Plate holding screws are secure. Once the Balance is in place AND before the final Mounting Screws are fixed to secure the mounting plate:

- Verify that the system is level according to the System Level Vial.
- Level the Balance using the two disk level feet and the front single point set screw.

Note

Do not use the front Adjustable Pin Feet found on the Balance.

Masses

Should the masses be contaminated, they may be cleaned using either a mild solvent such as high grain alcohol or soap and water; however, the masses must be dried thoroughly. Masses should be handled with care during all operations to ensure that wear and damage do not impact the mass calibrations and, subsequently, the system accuracy.

Specifications

Differential Pressure Range

- 0 to 29 psi (0 to 200 kPa)

Line Pressure Range

- 0 to 2900 psi (0 to 200 bar)

Accuracy

- 40 ppm of reading +0.009 kPa

Accuracy is defined as the expended uncertainty in pressure determined using the method described in ISO "Guide to the Expression of Uncertainty in Measurement," and represents an approximate 95% level of confidence. The accuracy capability of 40 ppm of reading plus 0.009 kPa, combined root-sum-of-squares, is applicable with corrections for actual mass values and when reference conditions.

Differential Pressure Reproducibility

- Differential Pressure Reproducibility: +/-4.5 Pa[1]

Refer to the Calibration Report for Pressure Uncertainty.

Piston and Cylinder

- Thermal Coefficient (piston + cylinder): $9.2 \times 10^{-6} °C^{-1}$
- Piston & cylinder material: tungsten carbide

Electrical Power Requirements

- 12v DC 5A max 
- Universal power supply included — 120/240 VAC 50/60 Hz

Operating Conditions

- 64 °F to 92 °F (18 °C to 28 °C)
- 20% RH to 75% RH, non-condensing

Storage Conditions

- 32 °F to 122 °F (0 °C to 50 °C)
- 0% RH to 90% RH, non-condensing

Instrument Conditions

- 18 in x 15 in x 18 in (48 cm x 38 cm x 48 cm)

Instrument Weight

- Approximately 88 lb (40 kg)

Operating Medium

- Internal operation medium: Dioctyl sebacate (DOS)
- Test item operating fluid: Dioctyl sebacate (DOS) or clean dry gas

Packaging

Contact the Fluke Customer Care before returning the instrument. A Return Merchandise Authorization (RMA) is required prior to shipment. Additional instructions may be available for best packaging practices.

Fluke Calibration
10311 Westpark Drive
Houston, Texas 77042-5312
USA

custcarehouston@ge.com
T: 713 975 0547
F: 502 479 6886

Have the following information available when contacting Fluke Customer Care:

- Part number
- Serial number of the instrument
- Your Purchase Order Number (if available)
- The billing and shipping addresses
- Buyer's name and telephone number
- Invoice with Value for Customs (International)
- Declaration by Foreign Shipper on customer's letterhead (international shipments)

Disconnecting the System

1. Remove all electrical power.
2. Remove all pressure connections. Follow proper technique to prevent loss of oil.
3. Verify that line pressure is removed.
4. Verify that all ports are sealed to minimize oil loss.

Installation of Clamps

Install the Balance Strap and Transit Clamp as shown in the Installation section.

Cleaning

Remove as much oil trapped in the Oil Catch pan and drain hoses as possible before shipment. With the side panel doors open, use a clean paper towel to absorb any residual oil in the Oil Catch pan.

Packaging for Shipment

The instrument will ship with oil in the system. Minimal oil will be lost if the instrument is shipped with line pressure near zero.

1. With zero line pressure, put the **Oil Isolation Valve** into Isolation Mode. This will minimize the piston motion during shipment.
2. Secure absorbent paper towels to the end of the drain hose or drain fitting with a rubber band or tape to absorb any residual oil that may drip during shipment.
3. Enclose the instrument in a layer of plastic to prevent any contamination of the instrument during shipment.

The instrument must be packaged appropriately for protection against the selected method of transport.

Optional Shipping Method

Fluke offers custom designed shipping cases for the RUSKA 2482 instrument and accessory. The cases are designed to ship the instrument easily and safely. The following two cases are offered:

2482-106 Shipping case for RUSKA 2482 instrument

2482-107 Shipping case for RUSKA 2482 accessory

Final Instructions

Include in the shipment:

- Statement of the problem or service required.
- The name and contact information of a knowledgeable technical person for consultation
- Part number
- Serial number of the instrument
- Return shipping address
- Purchase Order number
- RMA – assigned by Fluke Customer Care