DTG Operation Manual

Introduction

Thank you for choosing the Digital Test Gauge (DTG) from Crystal Engineering Corporation.

The DTG is very much like a mechanical test gauge: Rugged, accurate, and easy to use. The difference, of course, is the greater accuracy possible with a digital display and, through an advanced design, accuracy that is specified in percent of reading over the entire operating temperature range of -10°C (14°F) to 50°C (122°F).

The large LCD was designed to be reliable and easy to see under a variety of environmental conditions. The DTG display is a full five digits (99999), so auto-ranging is not required: There's always enough display resolution for the rated accuracy.

The silicon chip pressure sensors used in all DTGs are highly repeatable over pressure and temperature. DTG sensors incorporate a permanently filled, oil isolated stainless steel diaphragm in an all-welded fitting. The only wetted materials are 316 stainless steel. Integral to the process connection is a stainless steel filter, insuring that only gases or liquids reach the sensor diaphragm.

Other features include:

- Select from up to 9 different pressure units (depending on pressure range)
- Minimum and maximum pressure detection
- Automatic shutdown after 20 minutes (shutoff can be easily disabled)
- 1500 hour battery life (continuous use) on 3 standard alkaline AA batteries

Long battery life while maintaining high performance is the result of using a RISC (Reduced Instruction Set Computer) type microprocessor. The case is electro-polished stainless steel with elastomeric seals, for weather and corrosion resistance.

And finally, the DTG is manufactured and serviced by a company that only makes pressure measuring instruments. It's the only thing we do and that's why we say:

Pressure is Our Business!

Operating Instructions

The DTG is shipped with batteries installed, so it's ready to use. Press the power button and the DTG will test all LCD segments. Continue pressing the power button for at least one second and the DTG will start normal operation. (The one second delay avoids turning on the DTG by mistake.)

The DTG always resumes operation in the mode and the units of the pressure last used, and it ***does not automatically rezero when turned on.***

All DTGs are intended for gauge pressure measurement. That is, they indicate the difference between applied pressure and ambient barometric pressure. The zero button can also be used as a tare function, meaning it can be set to read zero pressure at for any pressure up to the full scale of the gauge.

Connect the DTG to your system. Always use pipe thread tape or pipe thread sealant on the ¼″ NPT fitting. To ensure safe and accurate operation, please read the following warnings:

WARNING:

SEVERE INJURY OR DAMAGE CAN OCCUR THROUGH IMPROPER USE OF PRESSURE INSTRUMENTS. Do not exceed recommended pressure limits of tubing and fittings. Be certain all pressure connections are secured.

THIS GAUGE CAN DISPLAY ZERO PRESSURE WITH FULL SCALE PRESSURE APPLIED. Do not rely on the display indication before disconnecting - it may not be indicating true pressure. ***Never disconnect pressure instrumentation without first relieving system pressure.***

CAUTION:

NEVER INSERT ANY OBJECT (other than the 1/16″ NPT metal filter) INTO THE PROCESS CONNECTION. The sensor diaphragm is very thin and can be damaged or destroyed by solid or sharp objects. Cleaning of the sensor must be done with appropriate solvents, only.

Zero/Tare

To make sure that the DTG is performing to it's rated accuracy, the DTG should be exercised and re-zeroed whenever exposed to changes in temperature (see Specifications). It's also good practice to check zero as your final reading too, as the DTG should return to a perfect zero reading. (If it does not return to zero - check the filter - it may be blocked).

The DTG can zero (or "tare") any applied pressure within it's specified operating range. This means that even if zero pressure is displayed, the actual gas or fluid pressure connected to the DTG may be high enough to be dangerous if you were to disconnect the DTG without relieving the pressure first. ***Always check that the pressure has been equalized with ambient pressure before disconnecting the DTG!***

To zero or tare the DTG, you must press the Zero button for at least one second before it responds. This is to avoid unintentional changes to the zero/tare setting.

Over-pressure Conditions

The DTG will read pressure up to approximately 110% of the rated pressure range, at which point the display will start flashing and the readings will not be reliable. The zero function does not affect the point at which the display starts flashing to indicate over-pressure, so depending on the tare value it is possible that the display can start flashing without the maximum pressure being displayed.

For instance, if a 100 PSI DTG is zeroed when 30 PSI is being applied, it will indicate that the over-pressure condition has been reached at 80 PSI (i.e., 110% x 100 PSI – 30 PSI = 80 PSI).

Over-pressure can affect accuracy, but the effect is only temporary unless the sensor has been destroyed. See Specifications on for maximum over-pressure.

Units button

Pressing this button causes the DTG to select the next unit of pressure measurement. There are up to 9 units available. See Specifications on page 5 for the list of scales.

Peak detection

The DTG continuously records maximum and minimum applied pressure, and cannot be disabled. To view the maximum pressure value press the PEAK button. Press the PEAK button again to view the minimum recorded pressure. Pressing the PEAK button once more returns the display to the current applied pressure reading.

Resetting recorded peak values

When displaying either high or low recorded pressure, the zero button is used to reset the peak high and low values to the currently displayed pressure. This will not affect the zero or tare value. If you need to rezero the gauge, the gauge must be in normal pressure mode.

Automatic shut-off

Normally, the DTG will turn off automatically after 20 minutes of operation without a key depression. This can be defeated however, when turning the DTG on. Pressing the ON/OFF and ZERO buttons simultaneously will prevent the DTG from automatically turning off. The DTG will briefly display the words “No Auto Off” to indicate that it will not turn off.

This procedure is required each time the DTG is turned on, if you want to defeat the auto-shutoff.

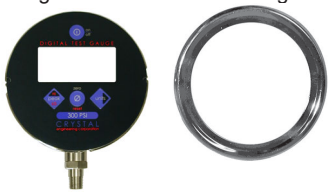
Low battery indication

A lighted battery icon is the first indication of a low battery. The DTG will continue to operate accurately while the icon is lit. When the batteries are exhausted, the letters “batt” will appear across the display and no further pressure measurements will be possible until the batteries are replaced.

Battery replacement

The DTG uses 3 AA batteries. Alkaline batteries are recommended, but not required if the gauge will only be operated in warm environments. Most alkaline batteries will operate down to –10°C or colder.

Figure 1: Remove Trim Ring



Remove the trim ring on the front of the DTG (Figure 1) by rotating it counter-clockwise. Then remove the four #6 screws from the back of the DTG as shown in Figure 2.

Carefully separate the front of the DTG from the housing. Be careful to not put stress on the cable between the sensor and the circuit cards. When replacing the batteries be sure to install them in the indicated orientation.

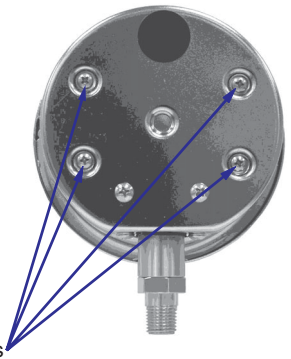


Figure 2: Four Access Screws

Other display conditions

All decimal points lit simultaneously is an indication of an internal problem or failure.

Reset

If, for some reason the unit needs to be reset, remove any battery for at least one minute, then reinstall the battery. If the reset is successful, the DTG will start operating without pressing the ON /OFF button.

Measuring Vacuum

All versions of the DTG can be used to measure moderate vacuum. When measuring pressure less than ambient barometric conditions, a minus (-) sign will appear. DTGs are not recommended for continuous use at high vacuum (pressures less than -14.5 PSI, at sea level).

Digtal Interface

The DTG can be connected to standard RS-232 computer ports. This requires an accessory cable/interface adapter and software available from Crystal Engineering.

Calibration

If adjustment is required, we recommend returning the unit to the factory.

Factory service offers benefits you won't find anywhere else. We have the facilities to provide calibration reports that include test data at a variety of temperatures utilizing NIST traceable standards. In addition, upgrades may be available to add or enhance operating features. We designed the product to last, and we support it so that you can get the most from your investment.

We recommend the DTG be recalibrated on an annual basis. However, your quality system requirements may require more or less frequent calibration depending on the environment in which it is used, and the calibration history of your DTG.

Although we prefer that you return the DTG to Crystal Engineering for calibration, ordinary recertification and/or adjustments may be performed by any qualified personnel with appropriate training and equipment. **The following instructions are ONLY intended for such qualified personnel with appropriate test equipment.** We recommend that the calibration standards used have a minimum rated accuracy of 0.025% of reading, or equivalent in terms of percent of full scale. Usually, this level of accuracy requires the use of piston (deadweight) gauges or very high performance pressure controllers, such as those manufactured by DH Instruments (www.dhinstruments.com).

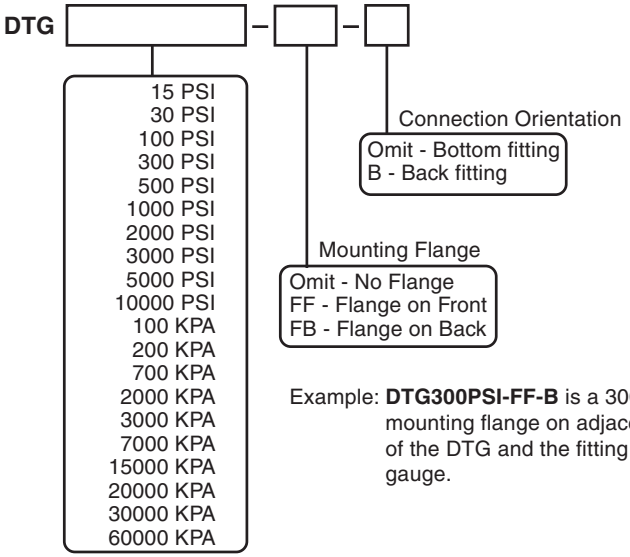
There are no internal potentiometers: The DTG contains a "span" factor which all readings are multiplied by. Normally, this is set to a value of 1.0000. However, as components age this may need to be changed to a value slightly higher or lower than 1. This adjustments is made via the keypad or the RS-232 interface. If adjustment is required, determine the span factor that results in the best fit of the data to the true pressure applied.

"Zero" the DTG, then record readings for at least two or more pressure points. Determine if the DTG needs, or would benefit from, a change in the span value.

To change the span factor, turn off the DTG, then press the ON, UNITS and PEAK buttons simultaneously. The word "cal" will briefly be displayed, followed by the actual span value. The span factor may be adjusted by pressing either the units button (to increase the value) or peak button, to decrease the value. The value changes in 0.0001 increments. Press the ZERO button to store the new value in memory.

DTG Model Numbering System

This manual applies to all models in the current DTG product line. To determine the specifications for your model you will need to determine the model number. Note: DTGs with "KPA" in the part number are limited to displaying SI (metric system) units, only.



Example: **DTG300PSI-FF-B** is a 300 PSI DTG with a mounting flange on adjacent to the front surface of the DTG and the fitting on the back of the gauge.

Specifications

Pressure Ranges vs. Resolution

Full Scale (PSIG)	Maximum Pressure (PSIG)	**Full Scale (kpa)**	Maximum Pressure (kpa)	**Resolution/Scale**
15	100	**100**	700	0.001 PSI; 0.01″$H_2$0; 0.001″Hg; 0.01 kpa; 0.01 mmHg; 1 mm$H_2$0; 0.0001 bar; 0.1 mbar; 0.0001 kg/cm^2
30	100	**200**	700	0.001 PSI; 0.01″$H_2$0; 0.001″Hg; 0.01 kpa; 0.1 mmHg; 1 mm$H_2$0; 0.0001 bar; 0.1 mbar; 0.0001 kg/cm^2
100	200	**700**	1400	0.01 PSI; 0.1″$H_2$0; 0.01″Hg; 0.01 kpa; 0.1 mmHg; 1 mm$H_2$0; 0.0001 bar; 0.1 mbar; 0.0001 kg/cm^2
300	600	**2000**	4200	0.01 PSI; 0.1″$H_2$0; 0.01″Hg; 0.1 kpa; 1 mmHg; 0.001 bar; 1 mbar; 0.001 kg/cm^2
500	1000	**3000**	7000	0.01 PSI; 1″$H_2$0; 0.1″Hg; 0.1 kpa; 1 mmHg; 0.001 bar; 1 mbar; 0.001 kg/cm^2
1000	2000	**7000**	14000	0.1 PSI; 0.1″Hg; 0.1 kpa; 0.001 bar; 0.001 kg/cm^2
2000	4500	**15000**	35000	0.1 PSI; 0.1″Hg; 1 kpa; 0.01 bar; 0.01 kg/cm^2
3000	4500	**20000**	35000	0.1 PSI; 0.1″Hg; 1 kpa; 0.01 bar; 0.01 kg/cm^2
5000	7500	**30000**	45000	0.1 PSI; 1″Hg; 1 kpa; 0.01 bar; 0.01 kg/cm^2
10000	15000	**60000**	100000	1 PSI; 1 kpa; 0.01 bar; 0.01 kg/cm^2

SI (metric) Versions

"SI" is the French acronym for the International System of Units. DTGs with "KPA" in the part number are intended for markets where ***only*** SI units are permitted. Therefore, these models only have kpa, Bar and/or mBar available.

Accuracy

20 to 100% of Full Scale: ± 0.1% of reading

0 to 20% of Full Scale: ± 0.02% of Full Scale

*0 to -14.5 PSIG: ±2% of Full Scale (where F.S. = 14.5 PSI)

Note: Accuracy specifications are for one year, and include all effects of linearity, hysteresis, repeatability, and temperature within the specified operating temperature range. The gauge must be exercised and re-zeroed whenever exposed to significant changes in environmental conditions to achieve these specifications. To exercise the gauge, cycle the gauge between zero and the pressure of interest. A properly exercised gauge will return to a perfect zero reading.

Exposure to environmental extremes of temperature, shock and/or vibration may warrant a more frequent recertification period.

*Not specified for 2000 PSI (7000 kpa) models and higher, though all models can be safely connected to vacuum.

Temperature

Operating & Compensated Range:	-10°C to 50°C (14°F to 122°F)
Storage Range:	-20°C to +70°C (-4°F to +158°F)

Humidity

Temperature Range	Humidity
-10 to 10°C	Uncontrolled
10 to 30°C	0 to 95% Relative
30 to 40°C	0 to 75% Relative
40 to 50°C	0 to 45% Relative

Media Compatibility

Liquids and gases compatible 316 Stainless Steel

Pressure Conversions

1 PSI = 27.6806 inches of water column (water at 4°C [39.2°F])
2.03602 inches of mercury (mercury at 0°C [32°F])
6.8948 kilopascals
51.7149 millimeters of mercury (mercury at 0°C [32°F])
703.087 millimeters of water column (water at 4°C [39.2°F])
0.068948 bar
68.948 millibar
0.070307 kilograms per square centimeter

Note: Other conversions may have been specified at time of order. Refer to your certificate of calibration for details.

Power

Batteries: 3 x AA, alkaline recommended

Battery Life: 1500 hours continuous operation

Low Battery Indicator: Battery Icon

Dead Battery Indication: “batt”

Connection

Pressure Fitting: ¼″ male NPT with integral $^{1}/_{16}$″ NPT stainless steel filter.

Enclosure

Dimensions: See Below

Weight: 635g (22oz.), including batteries.

Accessories

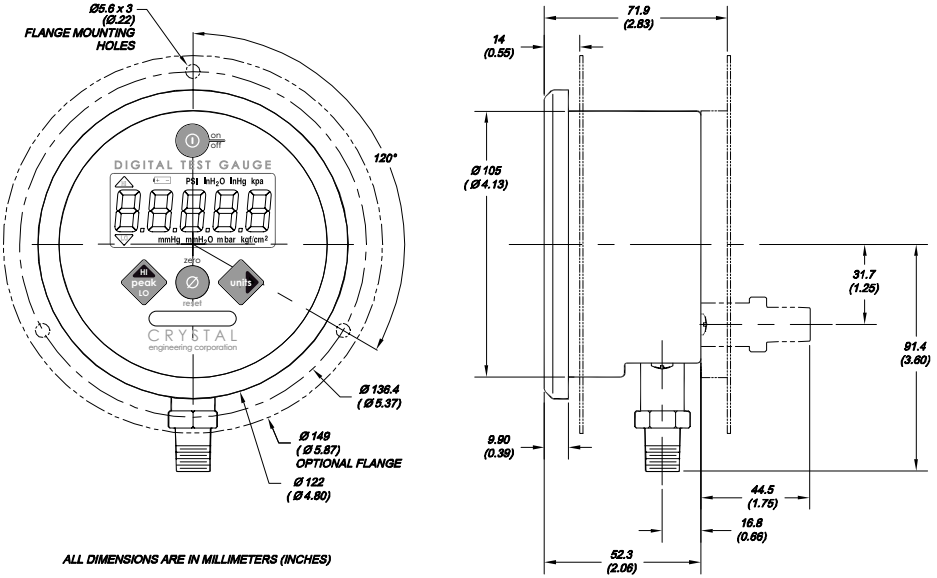
RS-232 interface adapter kit (PN: 2746)

Duplex (Pressure & Vacuum) Handpump: -13.7 to 500 PSI (PN: 1919)

Hydraulic Handpump: 0 to 5000 PSI (PN: 2820)

Replacement parts

The only user-replaceable parts are the batteries and the $^{1}/_{16}$″ NPT stainless steel filter.



Warranty

Crystal Engineering Corporation warrants the Digital Test Gauge to be free from defects in material and workmanship under normal use and service for one (1) year from date of purchase to the original purchaser. It does not apply to batteries or when the product has been misused, altered or damaged by accident or abnormal conditions of operation.

For in (or out) of warranty service, we can be reached at:

Phone ..... (805) 595-5477

Toll-Free ..... (800) 444-1850

Fax ..... (805) 595-5466

Email ..... service@crystalengineering.net

Web ..... www.crystalengineering.net

If calling, have ready the model number, serial number, date of purchase and reason for return. You will receive instructions for returning the device to Crystal Engineering.

Crystal Engineering will, at our option, repair or replace the defective device free of charge and the device will be returned, transportation prepaid. However, if we determine the failure was caused by misuse, alteration, accident or abnormal condition of operation, you will be billed for the repair.

CRYSTAL ENGINEERING CORPORATION MAKES NO WARRANTY OTHER THAN THE LIMITED WARRANTY STATED ABOVE. ALL WARRANTIES, INCLUDING IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE, ARE LIMITED TO A PERIOD OF ONE (1) YEAR FROM THE DATE OF PURCHASE. CRYSTAL ENGINEERING SHALL NOT BE LIABLE FOR ANY SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES, WHETHER IN CONTRACT, TORT OR OTHERWISE.

Note (USA only): Some states do not allow limitations of implied warranties or the exclusion of incidental or consequential damages, so the above limitations or exclusions may not apply to you. This warranty gives you specific legal rights and you may have other rights which vary from state to state.

708 Fiero Lane, Suite 9

San Luis Obispo, CA 93401-8701

PN: 2646 REV B, 8/2002

Firmware Release 1.05

PRESSURE *is Our* BUSINESS™