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# INSTALLATION AND OPERATING MANUAL

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Pressure Gauges

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BADOTHERM

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## 1. Introduction

This safety and installation guide contains important safety and handling information for Badotherm pressure gauges to be used to measure pressure in hazardous areas of industrial applications.

PED (European pressure equipment directive) classification.

- Instrument type: Pressure accessory without safety function
- Media: Liquid or gaseous, group 1 (dangerous)
- Maximum permissible pressure PS, see product label
- Volume: <0,1L

The media must not be harmful to any of the wetted parts of the pressure gauge over the entire operating range of the pressure gauge



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*CAUTION: Read this installation guide carefully before unpacking the pressure gauge. Improper handling can cause damage to the pressure gauge. This IOM should be provided to the end user.*

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- This IOM should be provided to the end user.
- The contents of this IOM are subject to change without prior notice.
- All rights reserved. No part of this IOM may be reproduced in any form without Badotherm written permission.
- Badotherm makes no warranty of any kind with regard to this IOM, including, but not limited to, implied warranty of merchantability and fitness for a particular purpose.
- If any question arises or errors are found, or if any information is found to be missing from this IOM, please inform the nearest Badotherm sales office.
- The specifications covered by this IOM are limited to those for the standard type under the specified model number break-down and do not cover custom-made instruments.
- Please note that changes in the specifications, construction, or component parts of the instrument may not immediately be reflected in this IOM at the time of change, provided that postponement of revisions will not cause difficulty to the user from a functional or performance standpoint.
- Badotherm assumes no responsibility for this product except as stated in the warranty.
- If the customer or any third party is harmed by the use of this product, Badotherm assumes no responsibility for any such harm owing to any defects in the product which were not predictable, or for any indirect damages.
- The following safety symbols are used in this IOM:



Read IOM: ensure to read the manual before starting the mounting and operation.



Warning / Caution: Indicates potential hazard that could lead to (fatal) injuries or serious damage to the pressure gauge.



Information: Attention for information that is essential for a proper functioning of the pressure gauge.



Important: Extra attention should be given for proper use of the pressure gauge.

## 1.1 Specifications

### Pressure limitations

Pressure gauges suitable for maximum steady working pressure 75% of the maximum scale value.

Steady:	0,75 x full scale value
Fluctuating:	0,67 x full scale value
Short time:	1x full scale value

Pressure gauges suitable for maximum steady working pressure 100% of the maximum scale value.

Steady:	full scale value
Fluctuating:	0,9 x full scale value
Short time:	1,3x full scale value

### Temperature effect

The pressure gauge will deviate from calibrated values due to ambient temperature differences. (this is applicable when the pressure gauge has the same temperature as the ambient temperature) The maximum deviation relative to the calibration temperature of 20°C is  $\pm 0,4\%/10K$  of full-scale value.

### Case ingress protection (per IEC/EN 60529)

- IP44: BDT 1 series
- IP65: standard for all 50, 63, 80, 100, 125, 160mm gauges
- IP66: Optional for case diameters 100mm and 160mm
- IP67: Optional for case diameters 100mm and 160mm

### Design and function

- The pressure gauges are available in nominal sizes 40mm, 50mm, 63mm, 80mm, 100mm, 125mm and 160mm.
- The pressure gauge is an instrument with a Bourdon tube as sensing element.
- All pressure gauge characteristics are according EN837-1
- Pressure gauges of type BDT18 are open front pressure gauges. These gauges are available up to and including safety level "S2". Pressure gauges of type BDT20 are solid front pressure gauges designed for maximum protection, safety level "S3". (see EN837-2 table 2 for the criteria for selection of pressure gauges with Bourdon tube)

## 1.2 Safe use of this product

For safety of the operator, instrument and process installation please be sure to follow the manual's safety instruction. When not followed correctly Badotherm cannot guarantee proper and safe functioning of the pressure gauge.

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### **Points of attention**

- Before installation, commissioning and operation, check the measuring range, specific measuring conditions and design to ensure you selected the appropriate pressure gauge.
  - Check if the wetted parts of the pressure gauge are compatible with the medium.
  - During operation media is not allowed to change state. Also unstable media is not allowed to be used.
  - Check all load limits in terms of pressure, temperature, vibration etc. to see if the gauge is appropriate.
  - The pressure gauge may only be installed by an engineer or technician who is trained and has the required technical skill level and proper knowledge on pressure gauges.
  - When installing in high ambient temperature environments and process temperatures make sure not to burn yourself by touching the instruments, flanges and connections.
  - When materials are used with a mass percentage of at least 7,5% titanium, magnesium or zirconium the operator must take protective measures to avoid mechanically generated sparks.
  - As stated in 3.2 the pressure gauges must be grounded to avoid electrostatic charging. When the pressure gauge contains non-conductive parts or surfaces (like acrylic window, coatings etc.) the operator must take protective measures to prevent electrostatic charging.
  - When using tag plates, these also must be grounded.
  - Gaseous media can increase temperature rapidly due to compression. When this is the case, you may need to reduce the maximum pressure difference ( $\Delta P$ ) or reduce the maximum permissible medium temperature.
  - Never loosen the pressure gauge when the process is in operation. This can lead to serious injuries due to a sudden release of pressure or process fluid.
  - When draining the instrument take necessary precautions to prevent inhalation or contact with harmful vapours or toxic process fluids.
  - Make sure the process line is cleared by the process operator before working on the installation.
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*Because the gauges are calibrated in the factory the wetted parts of the pressure gauges can be contaminated with small residual amounts of water, oil or alcohol. When increased technical cleanliness is required the suitability of the pressure gauge for this type of application must be checked before commissioning.*

*When using liquid media that can solidify during operation, it must be checked that the solidification goes without volume change. The volume change will damage the pressure gauges sensing element.*



*When the ambient temperature is below freezing point of water, Badotherm recommends using liquid filled pressure gauges. The liquid ensures visibility because it prevents condensation in the case (on the window). It also prevents the condensation in the case from freezing so functioning of the internals will not be affected.*

**Permissible ambient temperature**

Unfilled: -40 ... +60°C

Glycerin filled: -20 ... +60°C

Silicone oil filling: -40 ... +60°C

**Permissible medium temperature**

≤ 90 °C (with case filling)

≤ 200 °C (unfilled)

*The medium temperatures only apply to the pressure gauge. Beware that you also take into account the ignition temperature of surrounding gases, vapors and dusts in ATEX environments.*

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## 1.3 ATEX Pressure Gauges

### 1.3.1 General information on ATEX pressure gauges

ATEX pressure gauges do not have a heat source it selves. Besides the medium temperature you also have to take a possible radiation source, like solar radiation, into account for surface temperatures of the pressure gauge.

#### ATEX – potentially explosive gas atmosphere



Required temperature class Ignition temperature of gas or vapour	Maximum permissible surface temperature	
	Unfilled pressure gauges	Filled pressure gauges
T6 ( $T > +85^{\circ}\text{C}$ )	+65°C	+65°C
T5 ( $T > +100^{\circ}\text{C}$ )	+80°C	+80°C
T4 ( $T > +135^{\circ}\text{C}$ )	+105°C	+90°C
T3 ( $T > +200^{\circ}\text{C}$ )	+160°C	+90°C
T2 ( $T > 300^{\circ}\text{C}$ )	+200°C	+90°C
T1 ( $T > 450^{\circ}\text{C}$ )	+200°C	+90°C

#### ATEX – potentially hazardous dust atmosphere

Ignition temperature of dust	Maximum permissible surface temperature of the pressure gauge
Dust cloud: $T_{\text{cloud}}$	$< 2/3 \times T_{\text{cloud}}$
Dust layer: $T_{\text{layer}}$	$< T_{\text{layer}} - 75\text{K}$ – [reduction depending on the layer thickness]

The permissible maximum medium temperature may never exceed the lowest determined temperature value. (this is also applicable in case of malfunctions)

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*The ATEX pressure gauge may not be used in potentially hybrid explosive areas. (areas where potentially explosive gas atmospheres are mixed with potentially hazardous dust atmospheres)*



#### ATEX – cleaning

*Cleaning of the ATEX pressure gauge must be done with a moist cloth to prevent electrostatic charge.*

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## 1.4 Warranty

- The warranty shall cover the agreed period of warranty. Problems occurring during the warranty period shall basically be repaired conform the agreed conditions.
- If any problem is experienced with the application, Badotherm's affiliate from where the application is purchased, should be contacted
- When contacting Badotherm please share full details of the product such as serial number, type of pressure gauge, date of purchase and include as much as process data as available for a fast communication.
- The purchaser shall bear the responsibility for repair costs, even during the warranty period, if the malfunction is due to:
  - Improper and/or inadequate maintenance by the purchaser.
  - Malfunction or damage due to a failure to handle, use, or store the instrument in accordance with the design specifications.
  - Use of the product in question in a location not conforming to the standards specified by Badotherm, or due to improper maintenance of the installation location.
  - Failure or damage due to modification or repair by any party except Badotherm or an approved representative of Badotherm.
  - Malfunction or damage from improper relocation of the product in question after delivery.
  - Reason of force majeure such as fires, earthquakes, storms/floods, thunder/lightening, or other natural disasters, or disturbances, riots, warfare, or radioactive contamination.

## 2 Handling and preparation

### 2.1 Storage

Storage of the pressure gauge should be in its original packing. The storage area should be selected in line with below conditions:

- Not exposed to rain or water leaks.
- Minimal vibrations and shocks
- Ambient temperature -40°C... 70°C
- Relative humidity 0%...100% R.H. (@40°C)
- Preferred environment 25°C at 65% R.H.

### 2.2 Unpacking the Pressure gauge

Check the pressure gauge for any damage that may have been caused by transport. If transport damage is found, report this immediately.



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**CAUTION!** *Damage to pressure gauges will occur due to improper transport. Please observe all symbols on the packaging.*

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- To protect the measuring system from mechanical damage leave it in the factory packing until reaching the installation site.
- Keep packaging to get maximum protection in case of sending for repair.



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**INFORMATIVE:** *When the gauges are filled with a filling fluid, shaking and shocks can form bubbles in the filling fluid. These bubbles will not have any effect on the pressure gauge functioning.*

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## 2.3 Tagging

All pressure gauges are marked with a serial number stamped into the dial. The first 4 numbers represent the manufacturing date (YYWW). The rest of the numbers are a unique following number. All information about the gauge is stored in the factory related to this serial number. Also optional calibration certificates are related to this serial number.



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**INFORMATIVE:** When contacting Badotherm regional centres send the pressure gauge type / case diameter / pressure range and serial number along in the correspondence for a fast response and action plan.

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## 3 Installation

### 3.1 Precautions

Only qualified persons authorised by the plant manager are permitted to install, maintain and service the pressure gauge. Before installation check the process specifications with product specifications.



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- The pressure gauge sealing must be checked for leak tightness.
  - Pressurized media has a high energy level. This energy will escape in the event of a pressure gauge failure. The possibilities for physical injuries and/or property damage exists.
  - When pressurizing the pressure gauge in combination with a poor sealing media can escape. This can result in dangerous situations.
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### 3.2 Mechanical Connection

The pressure gauge must be grounded via the process connection. When the connection sealing is an isolator, other measures of grounding must be applied. Make sure that the grounding must also be reinstalled at gauge replacement.



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*Please read EN 837-2 "Selection and installation recommendations for pressure gauges".*

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#### 3.2.1 Connection torque

The torque depends on the type of sealing. Read EN 837-2 for suitable sealing material when sealing is made in the threads. Parallel threads can be sealed with flat gaskets or profile sealings on the sealing face of the connection.



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*WARNING: Do not use excessive torque to orientate the pressure gauge for readability purposes. This is also applicable for applying too less torque. When using a gauge with a blow-out device or a full blow-out back, do not block the gauge by debris or dirt.*

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#### 3.2.2 Gasket installation

The gasket should be applicable for the maximum required pressure and process conditions.



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*WARNING: Failure to follow these safety instructions could result in injury or other damage. Badotherm refutes all responsibility for any direct or indirect damage to property or persons resulting from failure to follow the instruction in this guide.*

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#### 3.2.3 Installation-point requirements

The pressure gauge must be installed to a stable line. If this is not possible (in case a flexible capillary to avoid vibrations) a bracket must be used to support the pressure gauge. When vibrations cannot be avoided by building a suitable installation (isolating the source), the pressure gauges should be liquid filled. The pressure gauge should be protected against ambient temperature shocks and coarse dirt.

### 3.3 Mounting the pressure gauge

- The nominal positions the pressure gauge must be mounted is according EN-837-1 / 9.6.7 figure 9.
- Process connection on the pressure gauge can be a lower mount or a back mount. (mounting possibilities EN837-1 / 7.4 table 9)
- Some pressure gauges are equipped with a vent-plug to vent the inside of the case to atmospheric pressure. Low range pressure gauges will have a big reading error when not vented.
- Avoid additional heating of the pressure gauge by not installing the gauge where the gauge will be exposed to direct solar irradiation.
- Ensure that pressure gauges with a blow-out device or full blow-out back will have a minimum clearance of 20mm from each object.
- A blow-out device or full blow-out back will direct all released energy during a failure from the back of the gauge in a backward direction. Ensure that the area behind the pressure gauge is never defined as safe area.
- Ensure the gauge can be safely vented and/or replaced in case of a failure.
- If possible do not mount the gauge directly on a vibrating application.  
The following values may not be exceeded: Frequency range <150Hz acceleration <0,5g.
- Liquid filled gauges must have at least have a liquid level of 75% of the case diameter. Check this regularly and refill when necessary.
- Pressure gauges can be damaged by pressure surges. Open the shut-off valves slowly.
- Pressure gauge cases are intended to protect the internals of the pressure gauge. The cases may not be subjected to external loading. (e.g. mounting the pressure gauge by turning the case, using the pressure gauge as a support for other objects, using the gauge as a climbing aid etc.)

### 3.4 Faults

It can happen that the pressure gauge fails. Below is a list of possible faults with the to be taken measures.



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*WARNING: The measures must be performed by skilled personnel. For unskilled personnel there is a high chance on physical injuries and/or damage to properties and environment.*

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*If you cannot eliminate the faults by the measures below, take the pressure gauge out of operation immediately and contact the manufacturer.*

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- **After depressurisation the pointer remains just above zero.**

*This can be caused by friction in the movement. By tapping lightly on the case, the pointer shall go to zero. When this doesn't help the pressure gauge was either overloaded or there is material fatigue of the pressure sensing element. **The pressure gauge must be replaced.***

- **Pressure gauge is outside the accuracy class**

*This normally happens when the pressure gauge was operated outside the permissible performance limits. The pressure gauges are subjected to aging tests in the factory to simulate extreme performance. Only when the gauge is operated more extreme than these tests the gauge will fail. **The solution is to analyse the operating parameters of the application and replace the pressure gauge.***

- **The pressure gauge remains outside the zero tolerance after installation at atmospheric pressure**

*This is in most of the cases caused by transport damage. The pressure gauge was subjected to a non-permissible shock. **In this case you must replace the pressure gauge.***

*The second cause is a mounting error. The pressure gauge is mounted in another position than the nominal position. The nominal position can be found in EN-837-1 / 9.6.7 figure 9. **Please remount the pressure gauge in the right position.***

- **The pointer does not change reading despite pressure changes**

*This can be caused by a blocked movement, a defective pressure sensing element or a blocked pressure port. **Please replace the pressure gauge.***

- **Damage on window, case, connection etc.**

*These faults are due to improper handling. **Please replace the pressure gauge.***

- **Vibration of the pointer**

*There are vibrations in the application. This can be a vibrating application or an oscillating pressure. **Please use a pressure gauge with case filling.***

## 4 Maintenance / Cleaning / Dismounting, return and disposal

### 4.1 Maintenance

Pressure gauges are free of maintenance when used and installed correctly. However, it is advised to perform checks on a regular basis to ensure the measurement accuracy is in line with the expectations and trends are OK. For this the pressure gauge must be disconnected from the process to check on a pressure gauge testing device. The checks and repairs must be performed either by the manufacturer or appropriately qualified skilled personnel.

### 4.2 Cleaning

The pressure gauge must be cleaned using a moist cloth. (never use a dry cloth in ATEX environments) Please also wash and clean the pressure gauge after dismounting when you want to send the gauge back to the manufacturer. This is to ensure protection of personnel and the environment from exposure to residual media.

### 4.3 Dismounting, return and disposal

#### **Dismounting**

Only dismount the pressure gauge once the system has been depressurized. If there is a vent valve available, close that valve. Beware: if you dismount a pressure gauge on a active process by just closing a vent valve, pressurized media will escape from the pressure gauge.

#### **Return**

Return the pressure gauge in its original packaging or a suitable transport packaging to the manufacturer.



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#### **CAUTION:**

*All pressure gauges returned to the manufacturer must be free of any kind of hazardous substances (solutions, acids, bases etc.) The gauge must be cleaned. It is difficult to get all media removed from the internals of the pressure gauge. When the pressure gauge is used to measure a pressure of a hazardous substance or you do not know if the substance is hazardous you must inform the manufacturer by including the MSDS (Material Safety Data Sheet) of the substance. This is a legal responsibility of the owner of the pressure gauge.*

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#### **Disposal**

An incorrect disposal of the pressure gauge, its components and packaging materials can put the environment at risk. Dispose in an environmentally compatible way in accordance with the country-specific waste disposal regulation.