

**Operating manual
DC-PD-10
Pressure drop sensor**

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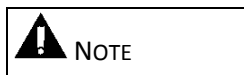
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I. STRUCTURE OF THE MANUAL / CLARIFICATION

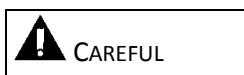
The different aspects of the users' instruction of the application are explained in detail in this description. Points of interest are marked as follows throughout the instructions.



Offers suggestions and/or advice to the operator to perform specific tasks easier



Makes the operator aware of possible problems



Indicates damage to the application or immediate adjoining equipment if the operator does not carry the procedures out cautiously



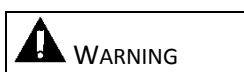
Warns the operator of the possibility of injury when the procedures are not followed carefully



Possible life threatening danger for the operator

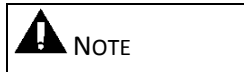
Under the operator Demaco Holland bv understands:

The person operating the machine supplied by Demaco Holland bv



The operator is responsible for the safety of an eventual assistant. The operator must ensure that no dangerous situation could arise for the assistant.

II. SAFETY AND HEALTH CONCERNS



These instructions should be read by the operator as soon as possible to enable him to become familiar with the use of the system

Because of a possibility of injury to the operator, the hazards that could appear with the use of cryogenic media are specifically referred to. The sticker depicted below is applied on the Demaco Holland bv equipment where the operator could possibly come into contact with cryogenic media. This warns the operator of the danger of freezing and it indicates the necessity to wear safety glasses and gloves with wrist protection.



Figure 1; Safety label on Demaco Holland bv products

This manual must at least be available at the supervisor of the department for inspection. We recommend that a copy be made of this manual inserted in plastic folders, or bound, and put on view at location with the control cabinet.

We also recommend to carefully read the Demaco safety instruction "Safety guidelines for working with cold media". Extensive information is provided in this manual about working with cryogenic media. A copy of the "safety instruction" is shipped with this delivery. Should you require more copies of this instruction in order to create a safe working environment for your operator(s), additional copies can be requested from Demaco Holland bv. Contact our sales department.

Operating Manual DC-PD-10 Pressure drop sensor

1 INTRODUCTION

1.1 Use of the DC-PD-10 Pressure drop sensor

The DC-PD-10 Pressure drop sensor, combined with a pressure switch, is designed to monitor the liquid nitrogen level in open and closed vessels.

The DC-PD-10 Pressure drop sensor consists of a capillary tube which is filled with gas. When this capillary tube comes in contact with liquid nitrogen the temperature falls and the gas in the capillary tube condensates. This condensation gives a pressure drop which activates a pressure switch element. The pressure switch element has a potential free contact. Depending on the gas in the capillary tube, either argon or nitrogen, the response time of the sensor will be respectively shorter or longer.

The DC-PD-10 Pressure drop interfaces:

Design pressure	12 bar(g)
Process connection	Ø 18 x 1 mm
Weight empty	appr. 1 kg
Switching	AC 250V 10 (3) A DC 24V 2 (1) A DC 220V 0,25 (0,2) A

Working area

For safe operation of the DC-PD-10 Pressure drop sensor the following points must be taken into consideration :

- Easy to access.
- Adequate space to operate and maintain the DC-DP-10 Pressure drop sensor.

Transport

In case of transport of the DC-PD-10 Pressure drop sensor the following points should be taken into consideration:

- Use a proper casing to protect the DC-PD-10 Pressure drop sensor from damage.

Mounting

- The DC-DP-10 Pressure drop sensor is designed for outside air temperature between – 20°C and + 50°C.

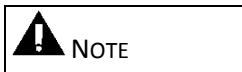
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2 INSTALLATION OF A DC-PD-10 PRESSURE DROP SENSOR



When filling a vessel which is equipped with an DC-PD-10 Pressure drop sensor with liquid nitrogen, one has to realize that the vessel first has to be cooled down from room temperature to $-196\text{ }^{\circ}\text{C}$.

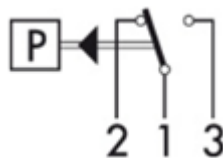
This implies that the first quantity of nitrogen will evaporate. Only after a period of time, depending on the contents of the cooling vessel, the cooling vessel will fill with liquid nitrogen. Once the surface of the liquid nitrogen has settled, a proper adjustment of the DC-PD-10 Pressure drop sensor switching point can be made.



The setting of the switching pressure of the DC-PD-10 Pressure drop sensor is factory set and should not be changed anymore.

2.1 Electrical connection

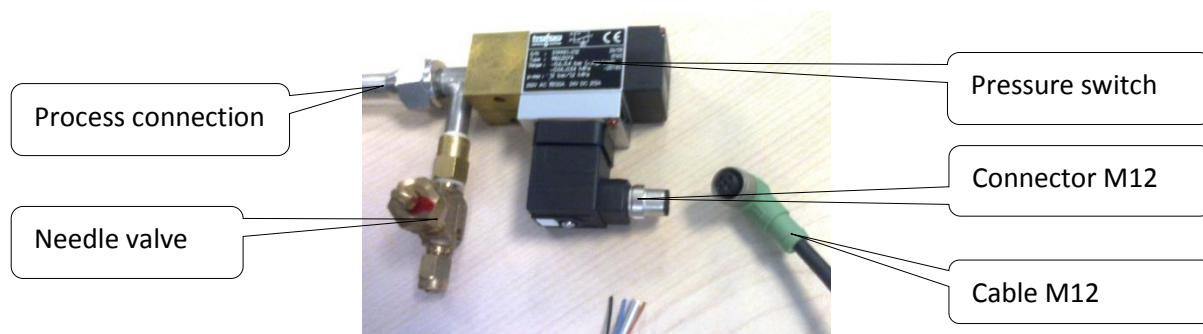
A mechanical pressure switch is mounted on top of the DC-PD-10 Pressure drop sensor. This pressure switch is equipped with a potential free switching contact.



The DC-PD-10 Pressure drop sensor is equipped with a connector (M12) and a cable (M12).

Wiring: brown => 1, white => 2 and blue => 3.

Further connection of the DC-PD-10 Pressure drop sensor differs per application and has been factory set or will have to be realized by the user. Remove the female electrical connector. Connect a three core cable to the contacts. Refit the female electrical connector to the DC-PD-10 Pressure drop sensor.

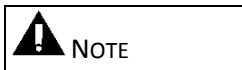


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2.2 Mechanical connection

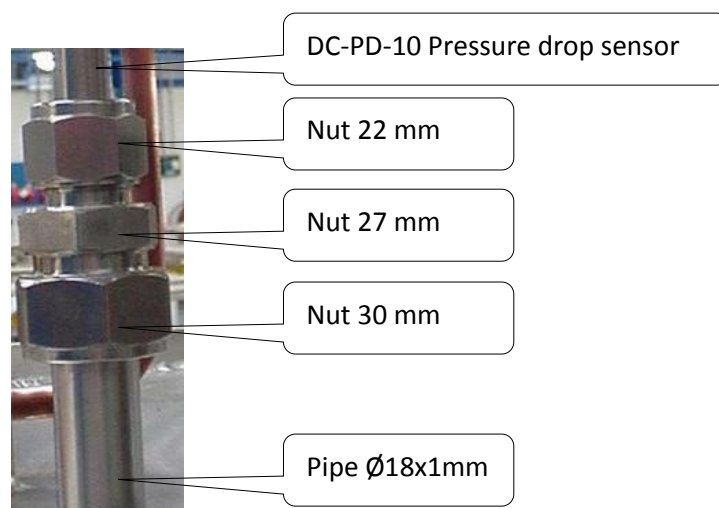
The measuring tube of the DC-PD-10 Pressure drop sensor should be vertically installed.
The setting of the DC-PD-10 Pressure drop sensor is described in the next chapter.

3 SETTING OF THE LEVEL



To adjust the DC-PD-10 Pressure drop sensor, it is necessary that liquid nitrogen is present.

When the lower end of the DC-PD-10 Pressure drop sensor is inserted about 10 mm in the liquid nitrogen, the pressure in the DC-PD-10 Pressure drop sensor drops. As a result, the potential free contact of the DC-PD-10 Pressure drop sensor will be activated. When the liquid nitrogen level drops, the pressure in the DC-PD-10 Pressure drop sensor will increase again, and the potential free contact switches back. Use the following procedure for setting the switching level of the DC-PD-1- Pressure drop sensor in a cooling vessel:



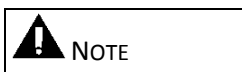
- Fit the reducing union on the piping $\varnothing 18 \times 1$ mm which is fitted in the cooling vessel and tighten the nut 30 mm.
- Loosen the nut 22 mm one or two turns and insert the DC-PD-10 Pressure drop sensor in the reducing union. Make sure the ferrule is present.
- Lift the DC-PD-10 Pressure drop sensor up to a level that the $\varnothing 12$ mm section is only just inserted in the reducing union.

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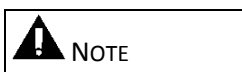
Do not use any tools when fitting the DC-PD-10 Pressure drop sensor. Over tightening the DC-PD-10 Pressure drop sensor can lead to damage.

- Tighten the reducing union hand tight, so that the DC-PD-10 Pressure drop sensor can be moved by hand.
- Connect a resistance meter to the two switching wires that come from the DC-PD-10 Pressure drop sensor.
- Fill the cooling vessel in which the DC-PD-10 Pressure drop sensor must be installed, with liquid nitrogen.



The surface of the liquid nitrogen must be smooth and should not be turbulent. Wait if necessary until the turbulence has settled.

- Fill the liquid nitrogen up to the level at which one wants the filling valve to shut off.



Liquid nitrogen evaporates. Maintain the correct nitrogen level by refilling.

- Slowly slide the DC-PD-10 Pressure drop sensor downwards. Watch the resistance meter. As soon as the resistance changes, the DC-PD-10 Pressure drop sensor is set at this level. Do this manually, however this time with more force, so that the DC-PD-10 Pressure drop sensor no longer moves.
- Check, by letting the liquid nitrogen evaporate until the DC-PD-10 Pressure drop sensor switches, and subsequently filling again, whether the DC-PD-10 Pressure drop sensor switches at the required level.
- If it does not, repeat the above steps until the desired level of liquid nitrogen has been set.

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4 MAINTENANCE



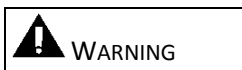
During some parts of this maintenance check the system must be operational. Therefore all safety requirements noted in this manual must be met.

Fully check the system at least once every six months by operating the equipment and checking the following:

1. Check all electrical connections. Connections that show signs of chafing, bare wires or other signs of wear must be replaced.
2. Report and repair any malfunction.
3. Clean the DC-PD-10 Pressure drop sensor housing periodically using a cloth.

5 STORAGE OF THE DC-PD-10 PRESSURE DROP SENSOR

Store the DC-PD-10 Pressure drop sensor dry and in packaging. Prevent water and other pollutants from entering. Minimum storage temperature is 5°C. Maximum storage humidity is 70%.



Be sure that the sealing lacquer on the needle valve is undamaged during unpacking.