ENGINEERING TOMORROW

Thermostat - Handling Guideline

Introduction

The thermostat from Appliance Controls is an electro-mechanical thermostat designed for household and light commercial cold appliances. Despite the robust construction, thermostat mechanics can be affected or damaged by incorrect handling. This guideline specifies how the thermostat must be handled at the customers' manufacturing plant.

Packing

Visual check of packing

Thermostats are supplied packed in cardboard boxes. These must be visually inspected for any damage before unpacking.

Thermostat unpacking

Boxes must be opened carefully. Special care must be taken when using a bladed instrument, not only to the operator but also to avoid any cuts/nicks/scratches to the thermostat housing and capillary. Dumping of the thermostats from the boxes must be avoided. Danfoss Appliance Controls considers any thermostat to have fallen from height to be a reject. Any sudden impact can cause a loss of function or change to factory settings.

Capillary tube handling

In general the capillary tube has a very good formability, but a few basic rules must be followed to avoid affecting the thermostat function. Multiple bends at one spot can lead to breakage and leakage. To ensure the best function, it is important to ensure that the sensor (capillary tube end) makes good contact with the evaporator; or, in room thermostat applications, with the airflow. The sensor must always be placed colder than the remaining section of the capillary tube and the thermostat itself.

Capillary tube handling/de-coiling

The thermostat capillary can be de-coiled using a gloved finger or preferably a smooth pin or bobbin tool which has a low friction surface. Holding the thermostat body in one hand, insert the pin into the capillary coil using the other hand, and pull out the capillary smoothly. Take care not to stress the capillary exit from the thermostat body.

Direct mounting of the capillary tube and sensor

When mounting the thermostat in the appliance the capillary tube can be bent to a minimum radius of 4 mm (R4). When direct mounting, the capillary must not be deformed or flattened anywhere along its length. This can lead to restrictions in the media flow or to a break and subsequently leakage. Flattening of the capillary tube will cause a change in temperature response or loss of function.
The thermostat sensor needs to have a good contact with the evaporator (thermal conductivity) to sense the temperature correctly.

Indirect mounting of the capillary tube (foamed inner liner)

The tube guide for inserting the capillary tube must have the proper diameter to enable an easy insertion. Design of the tube path has to respect requirement of easy insertion as well as the capillary tube mechanical properties.

Air sensor mounting

An air sensor is designed to be placed in the flow of cold air and sense its temperature. Placement position has to be secured very precisely when designing the appliance. Placement of the air sensor influences the thermostats temperature response. The air sensor shall not be deformed at mounting. An air sensor type thermostat cannot be uncoiled.

Terminals (connection tabs)

Electrical connections to the thermostat are made using blade type receptacles - Faston or similar.
According to IEC 60730-1 the maximum allowed forces are:

	4.8x0.8 mm terminals	6.3x0.8 mm terminals
Maximum insertion (push) force	60 N	80 N
Maximum withdrawal (pull) force	50 N	70 N

These forces are considered as pure axial forces. Any perpendicular force or torque to the terminal must be avoided at any time - during or after assembly. Danfoss Appliance Controls recommends to use original accessories in order to avoid excessive forces during the thermostat assembly.

Thermostat adjustment

The thermostats are manufactured according to strict specifications. Adjustment of the factory settings must be avoided. Change of single screw settings can change all temperatures and even compromise the thermostat function. If you would like to change the setting of the specifications, please contact Danfoss Appliance Controls.

Thermostat body

The thermostat body must not be exposed to condensate or defrost water, but must be placed in a dry and non dusty location. No excessive forces must be applied to the cover plate, contact housing, thermostat body or spindle. None of the thermostats' moving parts shall be obstructed or prevented from its natural movement.
All these actions can cause a change in the temperature adjustment, a partial or total loss of function.

Thermostat mounting

Irrespective of which type of mounting the customer chooses, a certain free space around the thermostat must be observed. Any forces (e.g. from wire harnesses, Faston receptacles, plastic housing or other components) needs to be avoided.
There are 3 possible ways how to assemble the thermostat into the appliance or appliance lamp housing.

Mounting with nut (central mounting)

The thermostats are offered with M10x0.75 thread (connector) for mounting with a nut. Please see figure 1.

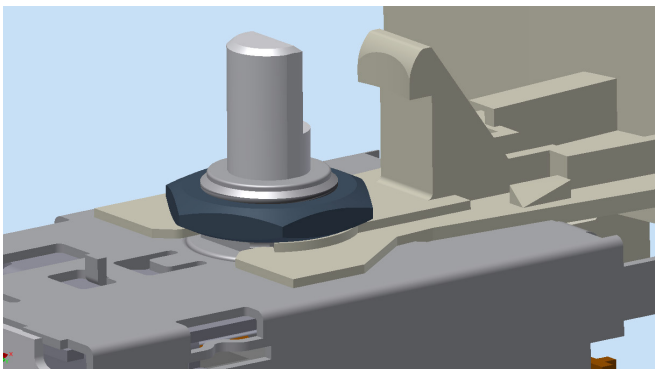

Figure 1: *Thermostat mounting with nut*
Maximum allowed force applied for mounting of nut is 300 Ncm.

Mounting with bracket / mounting plate

Thermostats are available with a bracket mounted to allow mounting to a plate or similar. The brackets are available from Danfoss in the following versions;
height 9.0 mm / hole pitch 56 mm, height 5.5 mm / hole pitch 56 mm or height 5.5 mm / hole pitch 68 mm.
All brackets have M4 x 6 holes for fixings. The bracket may also be supplied separately for mounting with the M10 nut. Please see figures 2 and 3.

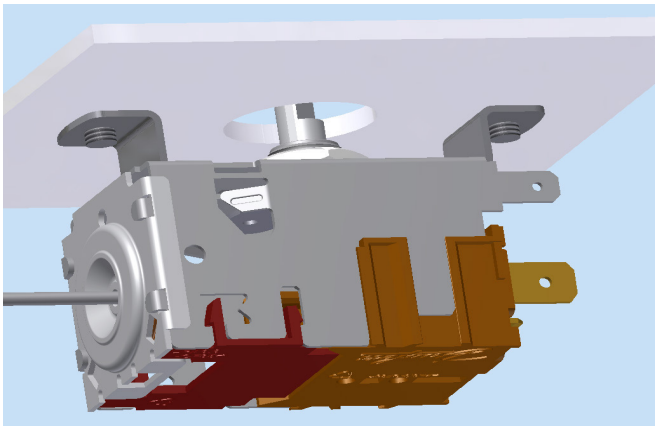

Figure 2*: Thermostat mounting with bracket / mounting plate*

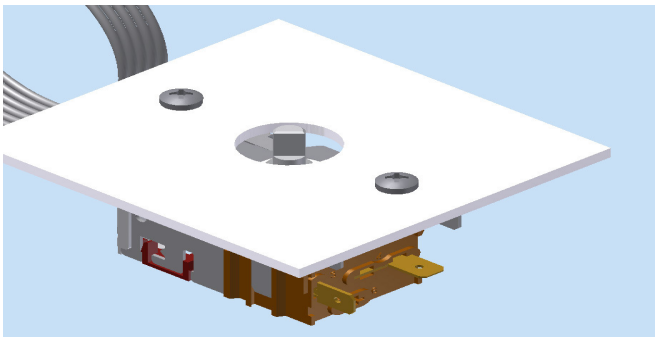

Figure 3: *Thermostat mounting with bracket / mounting plate*

Snap-fit mounting

If the snap-fit mounting is used it must be designed so that it snaps the thermostat only in the rigid areas near the thermostat edges. Snap-fit must not cause a deformation of the parts or obstruct the thermostat's moving parts. Please see figures 4 and 5.

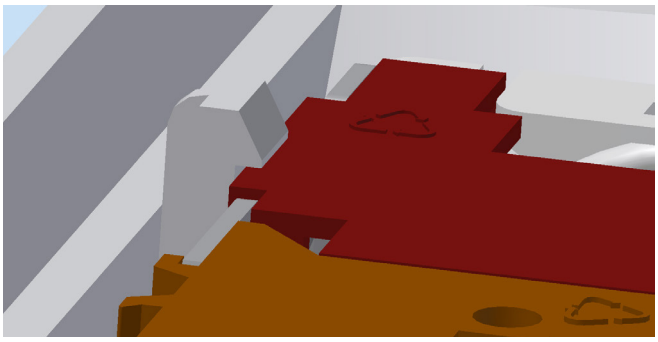

Figure 4: *Thermostat mounting with snap-fit*

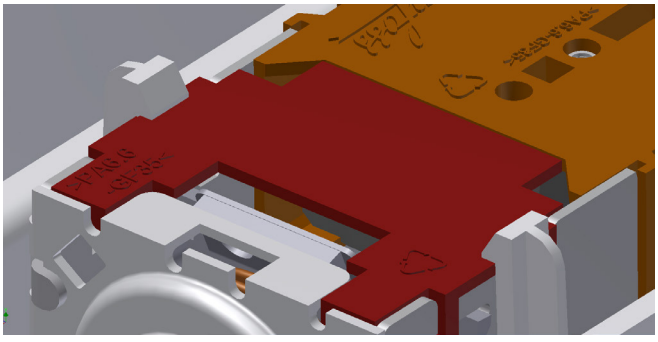

Figure 5: *Thermostat mounting with snap-fit*

Thermostat demounting

In case of demounting you have to take special care. The thermostat must not be damaged whilst demounting and the capillary tube must be properly coiled, packed and secured.

Thermostat function testing at customer's facility

Necessary tools

In order to make a proper function test, the following equipment is required:

Control bath

- Best used with alcohol or another acceptable media (e.g. silicon oil) with maximum 20% of water content in the liquid
- The temperature sensor in the control bath must have a maximum time constant (t) 10s and the bath must be agitated at all times

Barometer

- Must provide pressure in absolute pressure
- Must be calibrated according to mercury and altitude, please see below table;

Altitude from sea level [m]	Barometric pressure [mmHg]
0	760
500	717
1000	675
1500	636
2000	599
2500	563
3000	529

How to test

- Remove thermostats carefully from their packaging. All electromechanical thermostats can be affected by rough handling
- Straighten the capillary tubes so that that a minimum of 160 mm of capillary tube can be immersed into the control bath
- Turn the thermostat spindle into the adjusting position
- Place the capillary in the control bath and ensure that enough sensor length (min.160 mm) is submerged in the liquid
- Ensure correct electrical connection and confirm that all main contacts (3-4) are cut in (closed)
- Start cooling of the bath with gradient 2.0 °C/min and let the temperature decrease until the nominal cut-out value of +2 °C is reached, and then change gradient to 0.5 °C/min until all thermostats have cut-out
- Register values of cut-out temperature for all thermostats
- Start heating up with gradient 2.0 °C/min and let the temperature increase until the nominal cut-in value of -2 °C is reached, and then change gradient to 0.5 °C/min until all thermostats have cut-in
- Register the cut-in temperature for all thermostats
- For measurement of signal temperatures (contact 3-6 if applies):
    1. Start heating up with gradient 2.0 °C/min and let the temperature increase until the nominal signal cut-in value of -3.0 °C is reached, and then change gradient to 0.5 °C/min until all thermostats have cut in the signal contact
    2. Register the signal cut-in temperature for all thermostats
- If your current barometric pressure is different from the one specified according to the Danfoss dimension sketch the measured temperature values have to be corrected – for details please refer to the Barometric Pressure Information, literature number DKAP.ED.100.A2.02

The 077B….EBD, 077B….L EBD can be applied on systems with R290 and R600a as the working fluid.
For countries where safety standards are not an indispensable part of the safety system Danfoss recommend the installer to get a third party approval of the system containing flammable refrigerant.

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