

HEATEC TEC-NOTE

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Setting United Electric One Series Differential Pressure Switch on Heatec Thermal Fluid Heaters

WHAT THIS DOCUMENT COVERS

This document covers setting electronic differential pressure switch Model 4W3A01-K-13 made by United Electric Controls and virtually identical ones with explosion-proof housings and/or for different operating voltages. These switches are used on Heatec heaters to prevent overheating their helical coils. This document applies only to switches on the following types of heaters (**Fig. 1**):

1. Heaters with helical coils
2. Heaters that heat thermal fluid
3. Heaters that use the switch to sense differential pressure across the helical coil
4. Heaters that shut off the burner if differential pressure is too low

The switch units are 100% solid-state microprocessor-based pressure instruments with a digital display. Each unit has a *single* DP (differential pressure) switch that is user adjustable over a range of 0–200 psid. The unit is pre-calibrated so that settings made in the field are highly accurate and repeatable.



Figure 1. DP switch 4W3A01 by United Electric Controls.

HOW THE SWITCH PREVENTS OVERHEATING

The DP (differential pressure) switch is wired into a limit circuit that shuts off the burner if an abnormally low-flow of thermal fluid through the heater coil is encountered. The switch opens the circuit and shuts down the burner when differential pressure is lower than the set point at which the switch is set.

HOW DIFFERENTIAL PRESSURE RELATES TO OVERHEATING

Differential pressure is related to the flow rate of thermal fluid through the coil. And flow rate is related to coil overheating. Therefore, differential pressure is used to monitor flow rate and prevent overheating. Accordingly, each heater has a range of differential pressures *suitable* for normal operation. Differential pressures lower than that range must be avoided to prevent overheating.

THE PERILS OF OVERHEATING

Overheating the coil can have serious consequences. The importance of a suitable flow rate cannot be overstated.

⚠ WARNING

Do not operate the heater at differential pressures other than those recommended by Heatec. Insufficient flow rates cause overheating. Overheating could cause the coil to crack or rupture, allowing thermal fluid to enter the combustion chamber of the heater and cause an uncontrolled fire. The fire could cause death, serious injuries and/or property damage.

Overheating will also cause the thermal fluid to breakdown, which causes the fluid to coke and deposit residues inside the coil. Residues can build up and clog the coil thereby reducing heat transfer and leading to even further damage. Moreover, the fluid will probably have to be replaced (at a considerable cost).

CAUSES OF ABNORMAL FLOW

If your heater operates normally when the DP switch is set as recommended, its flow rate is high enough to prevent overheating the coil. However, if the DP switch shuts down your heater when set as recommended, flow may be too low and you need to find the cause (See Figure 2).

Possible causes of abnormally *low* differential pressure:

- Clogged pump strainer.

- Improper settings of one or more valves in the piping circuit.
- Excessive resistance to flow in the system being heated.
- Pump is either undersized or defective.
- Pump rotation is wrong.

Abnormally *high* differential pressure is another condition that may be encountered, but is less apt to cause overheating than *low* differential pressure. **NOTE: The switch will *not* shut down the heater due to abnormally high differential pressure.**

Possible causes of abnormally *high* differential pressure are:

- Clogged helical coil (unlikely).
- Oversized pump.
- Viscosity of thermal fluid is too high.

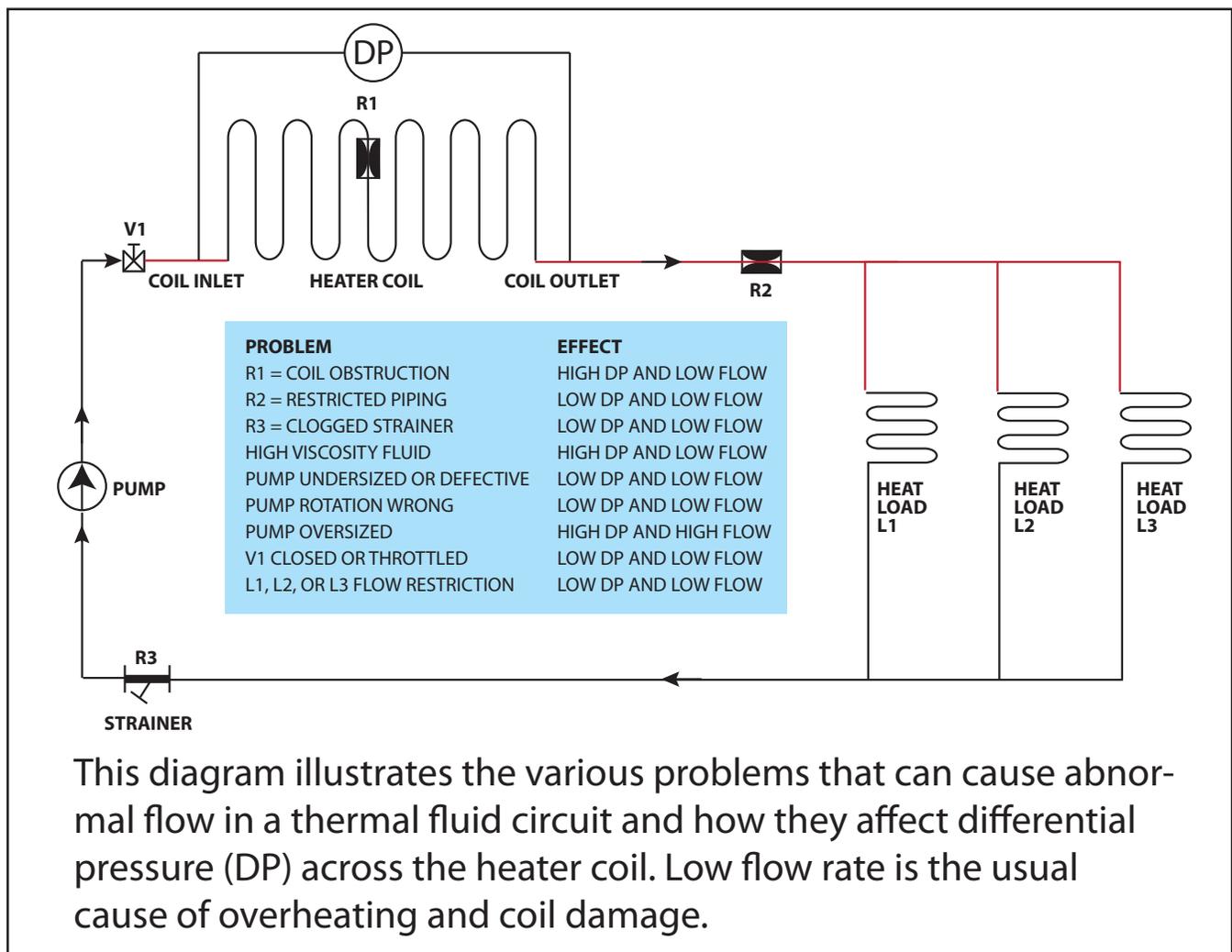


Figure 2. Effects of various problems on differential pressure.

NOTE: When the thermal fluid in the system is cold its viscosity is higher than when it is hot. Abnormally high viscosity can cause abnormally high differential pressure. But the viscosity of the fluid will decrease after it heats up and the differential pressure should return to normal.

HOW THE SWITCH WORKS

One side of the switch is piped to a connection at the *inlet* of the helical coil and senses the pressure of the thermal fluid at that point. The other side of the switch is piped to a connection at the *outlet* of the coil and senses the pressure at that point. The difference in the two pressures is the *differential pressure*.



Figure 3. DP switch 4W3A01 installed on a Heatec heater.

Note the two gauges shown in **Figure 3**. The one on the left indicates actual pressure at the coil *inlet*. The one on the right indicates pressure at its *outlet*. The difference in values of these two indications is the differential pressure, which is what the display on the switch shows. Incidentally, if the pressure at the coil *inlet* is the same as the pressure at the coil *outlet*, the display would indicate 0 (zero) differential pressure.

The switch also has a *set point* that must be manually set according to Heatec recommendations. The switch is closed while the actual differential pressure is higher than its set point. It will open and shut off the burner if operating conditions cause the differential pressure to go lower than the set point. But it will reset automatically when the differential pressure goes higher than its set

point. However, the burner will have to be restarted manually after it is shut off by the switch.

The switch also has a setting known as DB or *deadband*. Deadband affects resetting the switch after it has opened because of low differential pressure. Its setting governs how much the differential pressure must exceed the set point to reset the switch.

Consider a switch with a set point of 10 and a deadband of 01.0. If that switch opened because the differential pressure dropped to 10 or lower, the differential pressure would have to reach 11 psid to reset the switch. Or if the deadband was set to 05.0, the pressure would have to reach 15 to reset the switch.

Increasing the deadband is sometimes necessary to prevent the switch from frequently recycling on and off. But this is only needed in systems where the normal differential pressures remain close to set point. We recommend a deadband setting of 01.0, which should be adequate for most Heatec heaters.

THE SWITCH SETTINGS

The switch on all new heaters is normally set at the Heatec factory before the heater is shipped. It should *not* need to be reset. *However, as a precaution be sure to check its settings after the heater is installed, but before its initial startup.* And if you ever replace the original switch with a new one you will need to program it before you start the heater.

Normally **SP1** (set point), **DB1** (deadband) and **SW1** (switch 1) are the only settings subject to change from the factory default settings. The following procedure will guide you in checking those settings and changing them if necessary.

Use the two push buttons on the switch (**Fig. 1**) to display the various settings and make any changes needed to match those prescribed by Heatec.

1. Press left and right buttons (both) simultaneously. **SW1** will show on display.

2. Press right button to select switch mode. Press left button several times until the alternating words **OPEN** and **FALL** flash on display.
3. Press right button. **SP1** (setpoint) will show on display. Press right button to see set point value. Use right and left buttons to change value to recommended set point value shown in **Figure 5**.
4. Press right button. **DB1** will appear on display. Press right button to see deadband value. Use right and left buttons to change the value to the one for **DB1** as shown in **Figure 4**.
5. Press right button. **SW1** will appear on the display. Press both buttons simultaneously. The alternating words **SAVE** and **CHNG** will flash on the display. Press right button. The word **NO** will appear on the display. Press left button. The word **YES** will appear on the display. Press both buttons simultaneously to save the settings.
6. The switch is now in normal operating mode and will react to the actual differential pressure. If the differential pressure is *higher* than the set point, the display will show the value of the actual differential pressure. If the differential pressure is *lower* than the set point, the words on the display will alternate between **SW1** and the value of the actual differential pressure.

Figure 4. Switch settings	
PARAMETER	SETTING
SW1	OPEN/FALL
SP1 (SET POINT)	(SEE FIGURE 5)
DB1	01.0
OFST	00.0
CLR MAX/MIN	(NA)
SPAN	00.0
LCH1	OFF
PLUG PORT	OFF
DELAY	OFF
SAVE CHNG	YES

Figure 5. Set points for HC and HCS heaters			
HEATER	SP1	HEATER	SP1
HCS-70	10.5		
HCS-100	15.4	HC-120	15.4
HCS-175	17.8	HC-200	17.8
HCS-250	5.7	HC-300	5.7
HCS-350	14.6	HC-400	14.6
Set points for other heaters are discussed below.			

SET POINTS FOR OTHER HEATERS

Other Heatec heaters are used in a wide variety of operating conditions, and must be customized for each application. Consequently, set points for their switches must be calculated for each heater based on customer input.

Recommended settings for their DP switches are usually shown on P&ID drawings furnished with the heater. NOTE: When both low and high differential pressure set points are shown, use only the low set point and disregard the *high* set point. UE switch Model 4W3A01-K-13 does not have a switch for *high* differential pressure.

If P&ID drawings showing the DP set points are not available, call the Engineering Department at Heatec to obtain the recommended settings.

If actual operating conditions are different from those expected, the heater may not run when recommended settings are used. Or it might run, but without adequate flow protection. In either case call the Engineering Department at Heatec to obtain a suitable remedy.

OTHER SWITCH SETTINGS

All other switch settings shown in **Figure 4** should be checked just to make sure they are correct. Please use the flowchart from the UE manual as a guide for using the buttons to check settings. We have reproduced it on the last page for your convenience.

ADDITIONAL INFORMATION

Each switch comes with a manual entitled Installation and Maintenance Instructions IM_ONE-02. A printed

card that contains a Quick Start Programming Guide is also provided. Heatec sends these with each new heater. Please refer to these documents if you need help in checking the settings. If you do not have the manual you can obtain a copy on the internet at http://www.ueonline.com/techinfo/im_one.pdf. The United Electric tech support phone is 617-923-6977.

United Electric can help you understand how to operate the switch, but cannot tell you what settings to use. The settings are only available from Heatec.

WHAT TO DO IF THE DP SWITCH SHUTS THE HEATER DOWN

In some instances the recommended settings for the DP switch may prevent the burner from operating. This usually indicates that flow through the

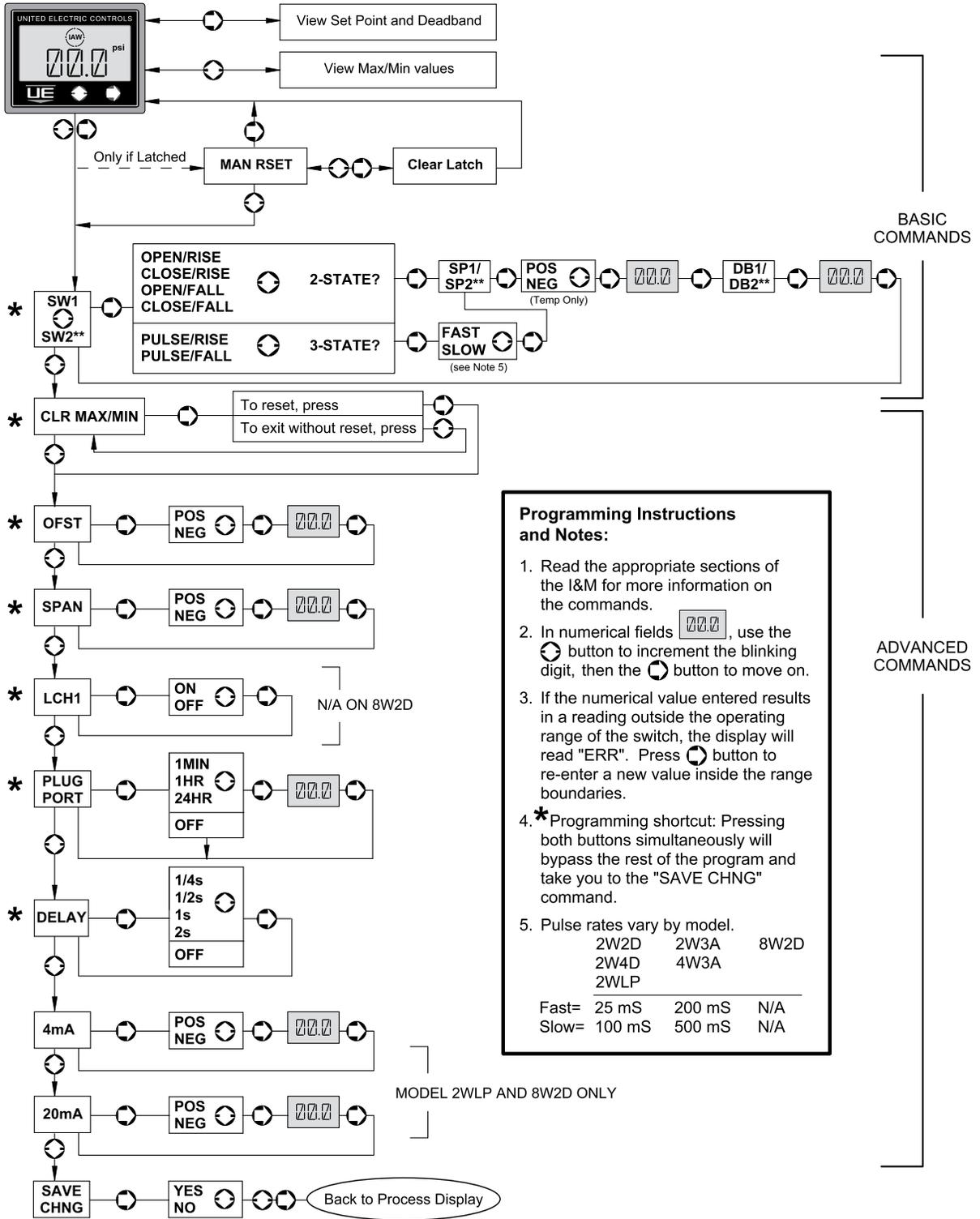
coil is not adequate. Make sure the problem is not low flow as a result of one of the causes mentioned earlier and illustrated in **Figure 2**.

You should not arbitrarily change the recommended settings of the switch in order to make the heater operate. Contact Heatec engineering so a qualified engineer can review design parameters for the heater and recommend a suitable remedy.

In some cases the thermal fluid piping system must be modified to achieve the minimum recommended flow through the heater coil. In other cases new settings for the DP switch may be possible without jeopardizing coil protection.

PROGRAMMING FLOWCHART

PROCESS DISPLAY



* PRESS BOTH BUTTONS TO SKIP TO "SAVE CHNG" COMMAND

**8W2D ONLY