FANUC CNC vertical machining center "EX1016 - Low Air Pressure" fault diagnosis

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Abstract: In this paper, the "EX1016 - low air pressure" alarm that occurs in the VDF-850 vertical machining center (FANUC-0i-Mate-MD system) produced by Dalian Dalian Machine Tool Factory causes the machine to fail to start the cycle as an example, and describes the generation of air pressure. Low working principle, troubleshooting method, modification of PMC ladder diagram, etc., and timely troubleshooting, to ensure normal teaching and production.

1. Introduction
FANUC 0i-mate-MD NC machining center "EX1016" alarm is a common fault, EX1016 alarm means: AIR ALARM CANNOT CYCLE START, this failure will cause the machine tool to fail to start the machining cycle. As a seemingly simple fault, if the cause of the fault is not clearly analyzed, it is difficult for maintenance personnel to repair it. In the following, we take vdf-850 vertical machining center (FANUC-0i-Mate-MD system) as an example to analyze the fault of low air pressure[1].

2. Material and Methods
When "EX1016-low pressure" fault occurs in the NC machining center, ALM flashes at the bottom of the machine tool screen and "ex1016-low pressure" appears at the top of the machine tool screen, and the machine tool cannot operate at this time. The fault phenomenon is shown in figure 1[2].

Figure 1. EX1016 - low air pressure alarm diagram.

How does the CNC system know that the pressure of compressed air entering the machine has not reached the specified value? Generally, the machine tool manufacturer has set up a detection device - pressure switch (model SMC-wj22l003-IS3) for the machine tool to detect the compressed air pressure entering the machine tool, and the status of the pressure switch is determined logically by PMC program. The allowable air pressure range of the machine tool is 0.4-0.6MPa, and the installation
position of the pressure switch is shown in Figure 2.

![Figure 2. Installation position of pressure switch.](image)

The circuit diagram of the pressure switch of the machine tool is shown in Figure 3. The address of the pressure switch is x9.5, when the pressure is within the allowable range of the machine tool (0.4-0.6MPa), the contact of the pressure switch is closed, and the status is "1". If the pressure is lower than 0.4MPa or higher than 0.6MPa, the contact of the pressure switch is open, and the status is "0". When the "0" state is input into PMC for processing, it is determined that it cannot meet the normal operation of the machine tool, and the error code and alarm information will be reported on the screen[3].

![Figure 3. Electrical schematic diagram and actual wiring diagram of pressure switch.](image)

FANUC0 i-Mate-MD CNC system provides real-time monitoring of PMC ladder diagram and status check and tracking of I/O interface. Therefore, we can monitor the address X9.5 of the pressure switch in real time through the PMC ladder diagram or check the status of the I/O interface, so as to quickly monitor whether the pressure switch of the machine works properly[4].

Status monitoring steps to enter I/O interface (X9.5):

Press "system" key on MDI keyboard → press PMC soft key → press " PMCDGN" soft key → press "STATUS" soft key → press x9.5 on MDI keyboard → press " SEARCH" soft key → the status of x9.5 is displayed as 1 or 0, the status of x9.5 on PMC screen is shown in Figure 4.

![Figure 4. Status of x9.5 on PMC screen.](image)

3. Results

According to the principle analyzed above and combined with the actual work, the possible faults are eliminated one by one. The specific steps of diagnosis and treatment are as follows:

(1) Check whether the air pressure gauge is ventilated and whether the pressure is within the range
of 0.4 ~ 0.6MPa.
Observe the pressure of the air pressure gauge, if the pressure is 0MPa, open the air compressor to supply air; If the pressure is lower than 0.4MPa, pull up the pressure adjusting knob of the pressure reducing valve of the air source processing device and slowly rotate it, observe the pressure gauge pointer to reach the required pressure value, and then press down the knob; If the pressure is higher than 0.6MPa, the pressure will be too high to cause impact and related parts damage, then the pressure should be lowered to below 0.6MPa; If the pressure starts in the range of 0.4 ~ 0.6MPa, and after a period of time the pressure is lower than 0.4MPa, the air path should be checked for leakage[5].

(2) Check whether the pressure switch signal X9.5 is responsive.
Enter the PMC screen of the system and observe whether the signal of X9.5 is 1. If it is 0, the corresponding circuit will be detected.
1) Use the dc file (200V-) of the multimeter to measure the voltage between the signal line 1 and 0V at the pressure switch. If it is 0V, the circuit may be broken, and a new conductor is needed to test; if it is 24V, it means there is no problem with the line.
2) Use the dc file (200V-) of the multimeter to measure the voltage between signal line 2 and 0V at the pressure switch. If it is 0V, the pressure switch may be broken, the pressure switch 1 and 2 should be short-connected with wires before testing. If it is 24V, there is no problem with the pressure switch.
3) Use the dc file (200V-) of the multimeter to measure the voltage between 0V at 3 places. If it is 0V, the 2-3 wire may be broken, and replace it with a new wire; If it is 24V, it means there is no problem with 2-3 wires.
4) Use the dc gear (200V-) of the multimeter to measure the voltage between 0V at 4 places. If it is 0V, the 3-4 terminals may be damaged. If it is 24V, then there is no problem with 3-4 terminals.
5) Use the dc file (200V-) of the multimeter to measure the voltage between 0V at 5 places. If it is 0V, the 4-5 wire may be broken. It may also be the terminal damage of the relay module adaptor board in 5 places, the general relay module adaptor board has indicator light, take down the 5 leads and observe the lights on and off, when the terminal is damaged, the terminal should be replaced and the PMC trapezoid diagram of the numerical control system should be modified. If it is 24V, it means there is no problem with the terminal of 4-5 wire and relay module adaptor plate[6].

Combined with relevant principles and using the troubleshooting method to detect the machine tool, it was found that whether the pressure switch wire X9.5 was connected or not, the indicator light of the relay module adapter board terminal (B12) was always on, as shown in figure 5, determine the terminal port is damaged. The fault handling method is: connect x9.5 wire to A12 terminal (according to the circuit diagram of machine tool and PMC program, it is found that this terminal belongs to reserved port). In this case, the signal entered into the PMC trapezoidal diagram of the CNC system changes to X9.4, and all X9.5 in the trapezoidal diagram needs to be replaced by X9.4. The modified ladder diagram is shown in figure 6. After the machine power off and restart, no alarm, troubleshooting.

![Figure 5. Relay module adapter board terminal B12 indicator light is always on.](image)
4. Conclusions
This paper takes the vdf-850 vertical machining center (fanuc-0i-mate -MD system) produced by the laboratory dalian machine tool factory as an example, because of the alarm of "ex1016-low air pressure", the machine tool could not start the cycle fault. The working principle of producing low air pressure, the method of troubleshooting and the modification method of PMC ladder diagram are analyzed in detail, and the faults are eliminated in time.

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