SUBJECT: COMPARISON OF MODULATING (AVT) AND SOLENOID COOLING VALVES #1-A-002 11/07/00

Pictured above is the AVT valve, positioned on the cooling cylinder, shown with the APS cover installed.

Pictured above is the AVT valve shown without the aluminum cover.

INTRODUCTION:
Control is accomplished by the measured introduction of cool plant water supply into the unit's circulating system with the simultaneous discharge of "over temp" water to the drain using a cooling control valve (CCV) activated by a control instrument.

OVERVIEW:
The **ADVANTAGE** AVT (Advanced Valve Technology) is the plastics industry's first and only modulating cooling valve, designed specifically for mold temperature control units. It is a part of an overall patent covering the SENTRA temperature control unit. Until the introduction of the **ADVANTAGE** AVT system, all suppliers of mold temperature controllers used on/off solenoid valves as the CCV.

The on/off pulsations of solenoid valves causes the "batch introduction" of a slug of cooling water into the circulating system. This slug creates a distinct temperature fluctuation impact until it is blended into the circulating stream. Refer to the chart on the opposite page for related temperature excursions.

The system pressure also fluctuates as the solenoid pulses causing a condition known as water hammer.

The **ADVANTAGE** AVT is a motor driven ball valve. The ball valve body is manufactured to **ADVANTAGE** specifications by a leading supplier of industrial valves. Using a custom machined coupling, a motor-gear train assembly is attached to the valve stem, and along with a "home switch", the valve can be controlled by 3000 "steps" per 90° of valve revolution.

AVT electronics compensates for lash inherent in all mechanical assemblies. The controller "knows" the valve's position at all times, and is programmed to self-diagnose for malfunction.

As the electronic controller "learns" the dynamics of the heat rejection requirements of the process, the modulating valve orifice is sized to continually maintain the exact cooling flow. No batch cooling slugs, no system pressure changes (water hammer), no over cooling, and no heater cycling to compensate.

The AVT is the result of 2 years of research and development by **ADVANTAGE**. Using a test fixture, we evaluated and life tested numerous designs and components. At the same time, the electronics microprocessor programming was developed to drive the valve under all expected fluid temperature and process conditions.

COMPARISON OF MODULATING VS SOLENOID VALVES IN THE COOLING PHASE

MODULATING VALVE (AVT)	SOLENOID VALVE
The orifice rotates constantly, making minute adjustments.	The valve is mechanically full open or full closed in sudden pulses.
Since the AVT is consistently 'partially' open, its rejects heat (BTU) in greater capacity than a solenoid valve of the same "pipe size".	A solenoid controls temperature by being pulsed on and off over time (i.e. on for 2 seconds, off for 10 seconds). It's typically off more than on.
The AVT is less susceptible to plugging or fouling because particles entering the valve can pass straight through. The AVT valve actually cleans itself as the ball rotates.	Solenoid valves are susceptible to fouling because particles must navigate a serpentine course through the valve body, and small diaphragm pilot holes are readily fouled.
Variation in water supply pressure or temperature (or both) are compensated for by the simple reposition of the orifice ball.	With solenoid valves, the only compensation possible is to increase/decrease the amount of time on/time off. The greater the pulsation the greater the mechanical wear, the impact of water hammer and temperature fluctuations.
Temperature control is a straight line with no cycling.	Batch introduction of cooling water "impacts" the system causing under shoot past set point, and in absence of a wide dead band, a heating function is normally activated to compensate setting up a condition known as cycling. Considerable mechanical and electrical waste occurs.
There is no water hammer concussion to create spike pressures which are the leading cause of pump seal failures	Each cooling pulse creates a sharp pressure spike which compresses the pumps seal faces increasing frictional and abrasive wear.

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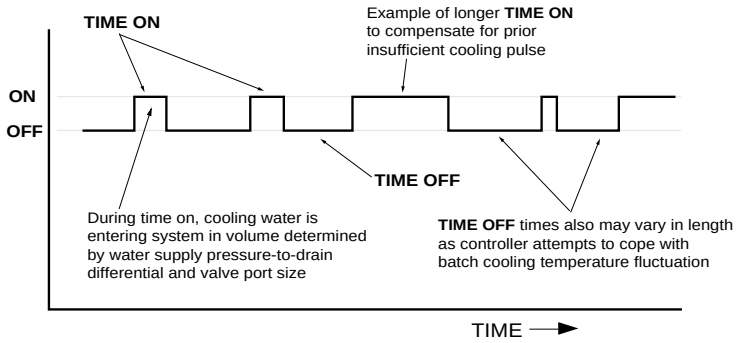
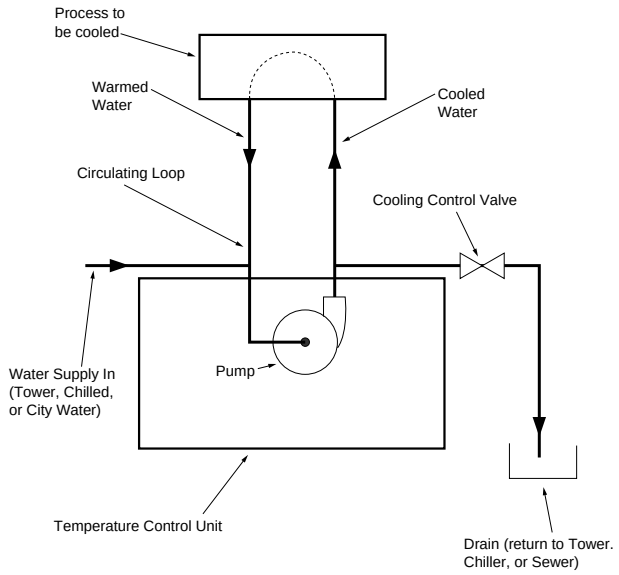
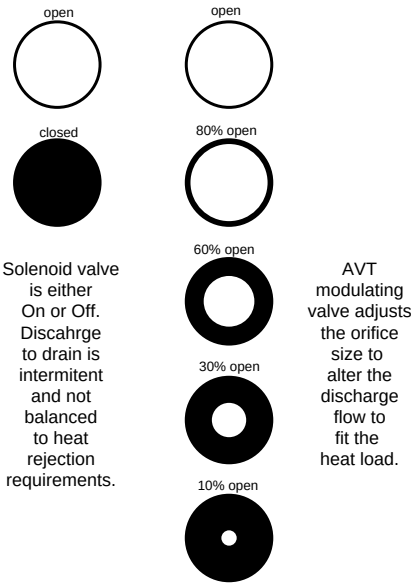
SOLENOID VALVE 'TIME ON/OFF' PROFILE



SIMPLIFIED PROCESS FLOW CIRCUIT

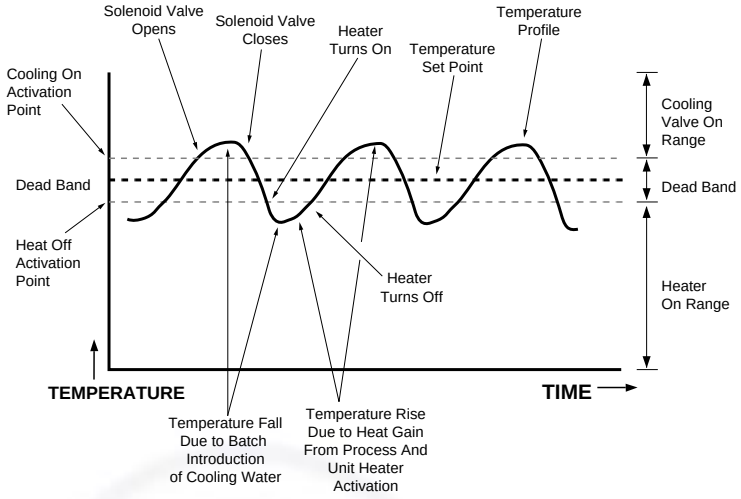


MODULATING VS SOLENOID VALVE ORIFICE SIZE



VARIABLES WHICH INFLUENCE TEMPERATURE CONTROL STABILITY

TEMPERATURE PROFILE WITH ON/OFF SOLENOID



In the solenoid valve system, ALL of these factors, acting simultaneously, influence temperature stabilization:

1. Water supply temperature
2. Water supply pressure
3. Unit set point temperature
4. Width of dead band
5. Size of solenoid valve
6. Length of valve time on/off
7. Repeatability of valve mechanical response to electrical signals
8. Size of process being cooled
9. Flow rate of unit pump system
10. Heat rejection load of the process

THE ADVANTAGE MODULATING VALVE (AVT) ACCOMMODATES ALL VARIABLES WITH MINUTE ORIFICE ADJUSTMENTS YIELDING STRAIGHT LINE CONTROL.

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